



Parks, Recreation, & Culture

Invitation to Tender No. 2023-PRC-06

Arts and Heritage Hub

For further information:
Contact: Chris Barfoot
cbarfoot@ladysmith.ca
250.245.6421

Tender Issue Date:	Thursday, June 29, 2023
Site Visit:	10:00 a.m., Friday, August 11, 2023
Tender Closing:	2:00 p.m., Thursday, August 24
Tender Opening:	2:15 p.m., Thursday, August 24, Ladysmith City Hall

TOWN OF LADYSMITH
INVITATION TO TENDER

1. Introduction

The Town of Ladysmith (the "Town") invites Tenders from qualified and experienced contractors for the construction of the Arts Studio in the Art and Heritage Hub (701 Oyster Bay Dr), in accordance with the Tender Specifications below and Appendices A-H.

2. Tender Submission

Tenders delivered by courier, mail, or in person to the following location:

Attention:
Matt O'Halloran, Manager of Corporate Services
Town of Ladysmith
410 Esplanade
PO BOX 220
Ladysmith, BC V9G 1A2

will be accepted until 2:00 p.m. PST, Thursday, August 24, 2023

3. Form of Tender

Tenders must be completed using the Form of Tender, Tender Specifications and any applicable schedules and addenda as supplied.

4. Tender Opening

Tenders received by the Tender Closing Date and Time noted above at the Tender closing location will be opened in public at the City Hall, at 410 Esplanade, Ladysmith at 2:15 p.m. PST on Thursday, August 24, 2023.

5. Late Submissions

Tenders received after the Closing Date and Time will be returned unopened to the Tenderer.

6. The lowest or any tender will not necessarily be accepted.

Please review the Instructions and Conditions to Tenderers.

**Arts and Heritage Hub
Ladysmith, BC**

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PART I

Instructions and Conditions to Tenderers

INSTRUCTIONS AND CONDITIONS TO TENDERERS

1.0 DEFINITIONS

- 1.1 In the Tender Documents the following words have the following meanings, unless the context otherwise requires:

"Contract" means an agreement for the performance of the Work to be executed by the Town and the Tenderer to whom the Work is awarded as applicable using a CCDC2 Contract

The Town of Ladysmith is referred to as **"the Town"**;

The successful tenderer is referred to as **"the Supplier"**;

The Director of Infrastructure Services is referred to as **"the Director"**;

"Tender Closing Date and Time" means the date and time stipulated in section 2 for the receipt of Tenders;

"Tender Documents" means the Invitation to Tender, the Form of Tender, the Instructions and Conditions of Tendering, the Tender Specifications (Appendix"A"), and all addenda; and

"Work" means all work to be done, performed and completed by the Tenderer under the Contract if awarded the Tender by the Town.

2.0 TENDER CLOSING DATE AND TIME

- 2.1 Sealed Tenders, made on the Tender Form provided, together with all other Tender Documents required will be received by the receptionist at the main reception desk addressed to:

**Matt O'Halloran, Manager of Corporate Services,
The Town of Ladysmith
City Hall
410 Esplanade
PO BOX 220
Ladysmith, BC V9G 1A2**

- 2.2 Tenders will be received up to **2:00 p.m. PST**, on Thursday, August 24, 2023. Tenders received after the closing time will be returned unopened.
- 2.3 The Tender Form being submitted must be signed by an authorized representative of the tenderer.

- 2.4 An award from this tender may require the approval of Town Council which, at its sole and unfettered discretion, can accept or reject any tender offered.
- 2.5 No tenderer may withdraw their tender within 60 days after the actual date of opening.
- 2.6 Tenderers are responsible for all costs relating to the preparation and submission of tenders.
- 2.7 This tender and any subsequent contracts resulting from this tender shall be governed by and interpreted in accordance with the laws of the Province of British Columbia.
- 2.8 It is the Tenderer's responsibility to allow sufficient time for their agent to deliver their Tender by the time and date specified above. The Tenderer should instruct their delivery agent to have the receptionist at the main reception desk at the City Hall time and date stamp the Tender. The Town will apply its date stamp upon receipt of Tenders delivered by Canada Post or courier.

3.0 TENDER OPENING

- 3.1 Tenders will be opened publicly at **2:15 p.m. PST on Thursday, August 24** at Ladysmith City Hall, 410 Esplanade, Ladysmith (corner of Roberts Street and Trans Canada Highway).

4.0 TENDER SUBMISSION

- 4.1 Late Tenders will not be accepted, opened or considered and will be returned unopened to the Tenderer upon the Town determining that the Tender was submitted after the Closing Date and Time.

5.0 FORM OF TENDER

- 5.1 Tenders must be submitted on the form of the Tender Documents provided.

6.0 AMENDMENT OR WITHDRAWAL

- 6.1 Tenders may be amended or withdrawn, provided written notice is received by the receptionist at the main reception desk at the City Hall prior to the stipulated closing time on the Closing Date.
- 6.2 Revisions to bid prices should state changes to unit prices only.
- 6.3 No revisions or withdrawals will be accepted after the Closing Date and Time.

7.0 PRICES AND GST

- 8.1 Prices quoted are to be in Canadian dollars. Goods and Services Tax (GST) is to be shown as a separate item on the Form of Tender.

The prices shown as UNIT COSTS/HOURLY RATES on the Tender Form shall include all material costs, labour costs, and any other charges so as to be the final cost to the Town.

8.0 ORAL, EMAIL AND FACSIMILE TENDERS NOT ACCEPTED

- 9.1 Oral, electronic mail or facsimile Tenders or amendments to Tenders will **not** be accepted.

10.0 Completion of Tender and Errors

All prices and notations must be typewritten or written in ink. No erasures or additions to the Tender Documents are permitted. In the case of mistake in extension of price, unit price will govern.

In case of mistake by the Tenderer, the mistake must not be erased but crossed out with the correction typewritten or written in ink adjacent thereto and such corrections must be initialed by the Tenderer's authorized signing officer or employee referred to in section 10 of the Instructions to Tenderers.

11.0. SIGNATURE REQUIRED

All tenders must be signed in the place provided on the front page and on the Form of Tender by an officer or employee having authority to bind the Tenderer by his or her signature.

12.0. BID IRREVOCABLE

The Tenderer agrees that in submitting a Tender, the Tender will be irrevocable and remain open for acceptance by the Town for 60 (sixty) calendar days from the day following the Closing Date and Time.

No tender may be withdrawn after the Closing Date and Time without the written consent of the Town, which may be withheld in its sole discretion.

13.0. MISTAKE IN TENDER DOCUMENTS

If deemed necessary by the Town, and in its sole discretion, an addendum will be issued to all parties that have indicated an interest in submitting a Tender. The Town reserves the right to revise, expand or delete any portion of the Tender Documents as part of the addendum.

Requests for clarifications must be submitted to the Town in writing and received not less than five (5) working days before the Tender Closing Date.

An addendum issued under this section will be considered to form part of the Tender Documents.

14.0. TENDER AWARD

The Town reserves the right to reject any or all Tenders and the lowest or any Tender will not necessarily be accepted.

Without limiting the generality of section 8.1, the Town reserves the right to:

- waive any informality or irregularity in a Tender;
- reject a Tender which contains qualifying conditions or otherwise fails to conform to these Tender Documents;
- reject any single Tender if only one Tender is received;
- make decisions regarding Tender acceptance with regard to:
 - compliance with specifications, warranties, lead times, price and any other such factors as may be relevant factors in determining which Tender will provide the Town with the best value based on quality, service and price;
 - the overall cost impact of the Tender on the operations of the Town including, where applicable, factors such as acquisition cost, disposal cost, residual value, training cost, maintenance cost, product performance and environmental impact;
 - the reputation and experience of the Tenderer and of the Tenderer's staff to be allocated to the Work, the supply of the goods and services or the supply of any equipment required by this Tender;
 - the technical experience, financial resources, and environmental responsibility of the Tenderer;
 - the Town's assessment of the capability of the Tenderer to perform the Work within the timeframe required by the Town; and
 - demonstration that the Work undertaken will meet or exceed requirements of environmental standards; and

- award the Work based on the best value to the Town based on quality, service, and price, and any criteria set out herein based solely on the Town's assessment of the tender.

15.0. NO DUTY OF CARE

It is the responsibility of the Tenderer to thoroughly examine the Tender Documents including any attachments and appendices to satisfy itself regarding the full requirements of the Tender and the Work.

While the Town has made reasonable efforts in good faith to ensure an accurate representation of information in this Tender, the information contained herein is supplied solely as a guideline for Tenderers, and the Town does not warrant or represent such information to be accurate, or complete.

The Tenderer acknowledges and agrees that in the preparation of the Tender, supply of oral or written information to Tenderers, review of Tenders or the carrying out of the Town's responsibilities under this Tender, the Town does not owe a duty of care to the Tenderers, and waives for itself, its successors and assigns, the right to sue the Town in tort for any loss, including economic loss, costs, expenses, losses, damages, or liability incurred by the Tenderer as a result of or arising out of any error, omission or misrepresentation occurring in the preparation of the Tender Documents, supply of oral or written information to Tenderers, review of Tenders or any document submitted in response to the Invitation to Tender.

Tenderers are solely responsible for their own expenses in preparing a Tender and for subsequent negotiations, if any. If the Town elects to reject any or all Tenders, or to cancel the Tender for any reason, the Tenderer acknowledges and agrees that the Town will not be liable to any Tenderer for any claims, including, without limitation, costs or damages incurred by the Tenderer in preparing the Tender, or loss of any anticipated profit in connection with the Work contemplated by this Tender, or any other matter whatsoever.

16.0 QUERIES

- 16.1 All enquiries regarding the tender submission process may be directed to Matt O'Halloran, Manager of Corporate Services at bid@ladysmith.ca or 250-245-6417.
- 16.2 All queries regarding the technical specifications forming part of this Tender may be made by contacting Chris Barfoot at cbarfoot@ladysmith.ca or 250-245-6421.

17.0 ADDITIONAL INSTRUCTIONS

- 17.1 A non-mandatory site meeting for Contractors is scheduled for 10:00 a.m. local time, on **Friday, August 11, 2023**. The meeting place will be at 701 Oyster Bay Road, Ladysmith B.C.
- 17.2 A detailed progress report must be submitted quarterly. It will contain the overall costs of each portion of work (contract amount), with a current invoiced to date with the percentage of completion. Any additional costs (change orders) or credits will be included in the invoiced to dates grand total.
- 17.2.1 For Changes include the following fee structure:
1. Changes in the Work shall be carried out by actual cost and fixed percentage fees as follows:
 - a General Contractor Cost: actual cost + 10% Overhead and Fee.
 - b Subcontractors Cost: actual cost + 10% Overhead and Fee.
 3. General Contractor's Overhead and Fee on Work performed by subcontractors: 5% of Subcontractors Cost as calculated above.
 4. The contractor will apply on the Towns behalf for any rebates and/or incentives that would be applicable to this project.
- 17.3 The Tenderer will be designated as the Prime Contractor and shall fulfill the Prime Contractor responsibilities as defined in the following materials:
- a WorkSafeBC Occupational Health and Safety Regulation, Notice of Projects, section 20.2 and coordination of multiple-employer workplaces, section 20.3;
 - b Workers Compensation Act (BC). Coordination at multi-employer workplaces, Section 118, subsections (1) & (2); and
 - c General requirements, Section 3.10 WorkSafe BC

18.0 Security Requirements

- 18.1 A bid bond issued by a surety licensed to carry on the business of suretyship in British Columbia in a form reasonably satisfactory to the Owner to be included with all tenders,

- 18.2 A tender must be accompanied by a “Consent of Surety”, issued by a surety licensed to carry on the suretyship in British Columbia. The consent of Surety is to guarantee that a Performance Bond and Labour and Material Payment Bond, each equal to (50%) of the total tender price plus GST, will be issued by the bonding company in accordance with paragraph 5.1.1.1 of the Form of Tender.

END OF SECTION

PART II

Supplementary and Special Conditions

GENERAL CONDITIONS

The following general conditions take precedence over any and all related articles in the CCDC2 Contract between the Town and the Tenderer to whom the Work is awarded.

1. Payment

Payment by the Town, subject to any holdbacks under the *Builder's Lien Act (British Columbia)* or any amounts held back under the Contract for deficiencies or other reason will be made within thirty (30) days after completion of the Work and/or delivery of tendered equipment, receipt of invoice, and acceptance by the Town. The Work will not be accepted for payment until all conditions and tendered specifications have been met.

2. Notices

Any notice required to be given in this contract shall be deemed to be duly given to the Town if sent by registered mail addressed to the Town of Ladysmith, PO BOX 220, Ladysmith, BC V9G 1A2 and to the contractor if sent by registered mail at the address set forth in the Tender.

3. Ownership of Tender & Freedom of Information and Confidentiality

All documents submitted in response to this Tender shall become the property of the Town and as such will be subject to the disclosure provisions of the *Freedom of Information and Protection of Privacy Act*.

The Tenderer should advise the Town in writing if any information is supplied as part of the Tender processing confidence and to which section 21 of the *Freedom of Information and Protection of Privacy Act* applies.

4. Queries

All queries regarding the technical specifications forming part of this Tender may be made by contacting Chris Barfoot at cbarfoot@ladysmith.ca or 250-245-6421.

5. INDEMNIFICATION

- 5.1 In carrying out these works, the Supplier will act as an independent contractor and must agree to keep the Town indemnified against any and all claims, actions or demands that may be brought, made or arise in respect of anything done or omitted to be done by its employees who shall be and remain at all times and for all purposes, the servants or employees of the Supplier.

6 INSURANCE

6.1 The Supplier shall submit to the Town, upon acceptance of the tender, a Certificate of Insurance containing the following:

- a provision naming Town of Ladysmith as an additional insured to the Liability Policy;
- a Cross Liability Clause;
- Comprehensive General Liability in an amount not less than **\$5,000,000.00**;
- A provision requiring the Insurer to give the Town 30 days' notice of cancellation or lapsing or any material change in the insurance policy;
- Liability insurance in an amount not less than **\$5,000,000.00** with the Insurance Corporation of British Columbia on any licensed motor vehicles of any kind.

7 SAFETY

7.1 In tendering for this work, the Supplier, when called upon to enter into contract with the Town, will be bound to comply with and be subject to the provisions, rules and regulations of the Workers' Compensation Act, and with all other Statutes and Municipal by-laws pertaining to the work.

7.2. All materials delivered and services provided must be in accordance with all laws, regulations and requirements of B.C. Workers' Compensation Board and Occupational Health and Safety Legislation.

7.3 Proof of WorkSafe registration must be submitted, along with proof of up-to-date assessment payment, prior to commencement of work.

8. SUB-CONTRACTING

8.1 Sub-contracting of work is not permitted without prior approval, in writing, from the Director of Recreation and Cultural Services.

9. QUANTITIES

9.1 Anticipated quantities listed in the tender forms are estimated annual requirements based on historical and anticipated usage. The Town will not be responsible for any variations in usage.

10. CANCELLATION

10.1 The Town reserves the right to cancel this Tender at any time and for any reason, and will not be responsible for any loss, damage, cost or expense incurred or suffered by any Tenderer as a result of that cancellation.

- 10.2 The Town reserves the right to cancel the Contract, at its sole and absolute discretion, with 30 days' written notice to the Contractor, and the Contractor will have no rights or claims against the Town. Cancellation would not, in any manner whatsoever, limit the Town's right to bring action against the Contractor for damages for breach of contract.

11. TENDERERS' EXPENSES

- 11.1 Tenderers are solely responsible for all their own costs/expenses relating to the preparation and submission of tenders. If the Town elects to reject all tenders, the Town will not be liable to any tenderer for any claims, whether for costs or damages incurred by the tenderer in preparing the tender, loss of anticipated profit in connection with any final Contract, or any other matter whatsoever.

12. LIMITATION OF DAMAGES

- 12.1 Without limiting the provision of the previous clause, the Tenderer, by submitting a Tender, agrees that it will not claim damages, for whatever reason, relating to the Contract or in respect of the competitive process, including any costs incurred by the Tenderer in preparing its Tender and the Tenderer, by submitting a Tender, waives any claim for loss of profits if no Contract is made with the Tenderer.

13. RESPONSIBILITY OF TENDERERS

- 13.1 Each tenderer is responsible for informing themselves as to the contents and requirement of this tender including the Town's Purchasing Policy, which governs the award of this tender. The Purchasing Policy may be requested from City Hall. Each tenderer is solely responsible to ensure that they have obtained and considered all information necessary to understand the requirements of the tender and to prepare and submit their tender. The Town will not be responsible for any loss, damage or expense incurred by a tenderer as a result of any inaccuracy or incompleteness in this tender, or as a result of any misunderstanding or misinterpretation of the terms of the tender on the part of any tenderer.
- 13.2 If a Tenderer is in doubt as to the true meaning of any part of this Tender, or finds omissions, discrepancies or ambiguities, a request for interpretation or correction may be submitted to the office of Manager of Corporate Services and, if deemed necessary by the Town, an addendum will be issued to all firms registered as having received this Tender. This procedure also applies should the Town, of its own accord, wish to expand or delete any part of this Tender.

14. ACCURACY OF INFORMATION

- 14.1 The Town makes no representation or warranty, either expressed or implied, with respect to the accuracy or completeness of any information contained in or referred to in the Tender.

15. DISPUTE RESOLUTION

- 15.1 In the event of a dispute between the Town and the Supplier, both parties agree to appoint representatives who, in good faith, will use their best efforts to resolve the dispute.
- 15.2 Should the representatives be unable to promptly resolve the dispute, both parties shall agree to continue the work as required, being understood that neither party will jeopardize any claim that they may have.
- 15.3 Further to clause 18.2, both parties agree to resolve the dispute using a single arbitrator as provided for under the Commercial Arbitration Act of British Columbia with the costs being split equally between the parties.

16. VERBAL STATEMENTS

- 16.1 Any verbal representations, promises, statements or advice made by any employees of the Town, other than that offered through the Manager of Corporate Services, should not be relied upon.

END OF SECTION

Part III

Form of Tender

FORM OF TENDER

Date:

We the undersigned have received and carefully reviewed all of the Tender Documents, including the Addenda listed below, have full knowledge of the location of the Work and certify that we have complied with the Instructions to Tenderers.

Provided that this Tender is accepted within 60 calendar days from the Closing Date and Time, the undersigned offers and agrees to provide all labour and material to perform and complete the Work as specified in and in strict compliance with the Tender Documents, at the prices quoted in the Tender Documents, within the time specified, and in accordance with the terms and conditions set forth in the Tender Documents.

The undersigned undertakes to achieve substantial completion of the Work that is the subject of the Tender within _____ calendar days from award of the contract under this Tender.

The Tenderer is an [] Individual [] Partnership [] Corporation (check where applicable) incorporated under the laws of

Name and Address of Individual, Partnership, or Corporation Tendering:

Signature and Title of person authorized to sign Tender:

(Print or type name under signature)

.....

.....

.....

.....

Telephone:

Facsimile:

Addenda

Acknowledgment is hereby made of receipt and inclusion of the following addenda to the Tender Documents:

Addendum

No. _____ dated _____; _____ pages

No. _____ dated _____; _____ pages

Schedule of Prices

The following are our tendered prices for the cost of the work for each item as outlined in the respective pay item descriptions in the Tender Documents.

- Note: Tenderers must specify a project total at the end of this Schedule for the construction of the Arts and Heritage Hub.
- Note: Tenderers may also note prices and totals for components of the project, in accordance with the project drawings, in Sections 1-7 of this Schedule. All or part of this form may be used, and additional sheets may be attached if necessary.

Section 1 – Architectural					
Item	Description	Est. Qty	Units [ea/l/s/m ³ / m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 1	

Section 2 – Civil					
Item	Description	Est. Qty	Units [ea/l/s/m ³ / m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 2	

Tenderer's Initials

Section 3 – Structural					
Item	Description	Est. Qty	Units [ea/l/m³/ m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 3	

Section 4 – Mechanical					
Item	Description	Est. Qty	Units [ea/l/m³/ m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 4	

Tenderer's Initials

Section 5 – Electrical					
Item	Description	Est. Qty	Units [ea/l/m³/ m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 5	

Section 6 – Landscape					
Item	Description	Est. Qty	Units [ea/l/m³/ m/vm etc.]	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 6	

Tenderer's Initials

Section 7 – Geotechnical					
Item	Description	Est. Qty	Units <i>[ea/l/m³/ m/vm etc.]</i>	Unit Price	Total
1.1					
1.2					
1.3					
1.4					
1.5					
1.6					
				Total Section 7	

Project Total for the construction of the Arts and Heritage Hub	
Total Amount	

Tenderer's Initials

References and Subcontractors Specifications Plan

List of Subcontractors

It is our intention that the following work will, subject to the Consultant's approval, be subcontracted to the firms indicated below. All other work will be performed by our forces, except as authorized in writing by the Consultant.

- Note: In accordance with the Instructions to Tenderers, list only one Subcontractor for each subtrade you propose to subcontract.

SUBTRADE	NAME AND ADDRESS

List of Materials and Suppliers

The following is a list of suppliers from whom we intend to purchase the various items of material indicated, together with the product brand name or the name of the manufacturer of each.

ITEM	PRODUCT BRAND NAME	SUPPLIER

Schedule of Force Account Rates

The following personnel and equipment rates will form the basis of payment for force account work carried out in accordance with the General Conditions of the Contract.
Personnel:

LIST BY OCCUPATION	HOURLY RATE	OVERTIME RATE
Superintendent		
Foreman		
Labourer		
Flagger		
Others:		

Equipment (Complete with Operator):

DESCRIPTION	HOURLY RATE	OVERTIME RATE
Track Excavator		
Rubber-Tired Backhoe		
Dump Truck		
Dump Truck and Pup		
Compactor		
Excavator with Rock Hammer		
Others:		

Tenderer's Initials

Proposed Alternate Materials

We propose using the following materials as alternates to those specified and shown on the drawings. Should any of these proposed alternates be accepted, we will adjust our total Tender in accordance with the price variation shown below. These prices will represent the total cost difference to the Owner for supply and installation of the proposed alternate products in lieu of those specified.

ITEM	PRODUCT BRAND NAME	SUPPLIER	PRICE VARIATION

Tenderer's Initials

SCHEDULE OF WORK

Herewith is the Schedule of Work referred to in the Tender, submitted and which is an integral part of the Tender.

Commencement Date: _____

Completion Date: _____

Tenderer's Initials

END OF SECTION

Appendices

Appendix A – Architectural

Appendix B – Civil

Appendix C – Structural

Appendix D – Mechanical

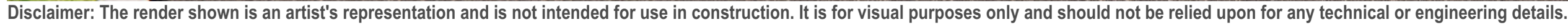
Appendix E – Electrical

Appendix F – Landscape

Appendix E – Geotechnical

APPENDIX A

Architectural



Building Code Analysis

Table A – British Columbia Building Code 2018 Summary

Reference	Title	Permitted or Required
1.3.3.2	Application of Division B	Part 3 Building
1.4.1	Building Area (square metres)	264
–	Gross Building Area (square metres)	264
1.4.1	Number of Storeys	1
1.4.1	Building Height (metres)	5.79
3.1.2	Building Classification (Major Occupancies)	Group A, Division 2 (Assembly occupancies not elsewhere classified in Group A)
3.1.17	Occupant Load	See Table B
3.2.1.1	Mezzanine	No
3.2.2.10	Number of Streets	1
3.2.2.28	Building Classification	Group A, Division 2, One Storey
	Sprinkler System	No
	Permitted Construction	Combustible
	Fire Resistance Ratings (hours)	n/a
	Floors	n/a
	Mezzanines	n/a
	Roof	n/a
	Supporting Structure	n/a
3.2.4.1.(2)(f)	Fire Alarm Required	No
3.2.5.8	Standpipe Required	No
3.2.6	High Building	No
3.3	Safety Within Floor Areas	See Means of Egress Diagram
3.3.1.21	Janitors Rooms	45 minute FRR fire separation
3.4	Exits	See Means of Egress Diagram
3.5	Vertical Transportation	Not Applicable
3.6.2.1	Service Rooms	Electrical room: 1 HR FRR fire separation
3.8	Accessibility	Yes

Table B – British Columbia Building Code 2018, Occupant Load, Table 3.1.17.1, and Washrooms 3.7

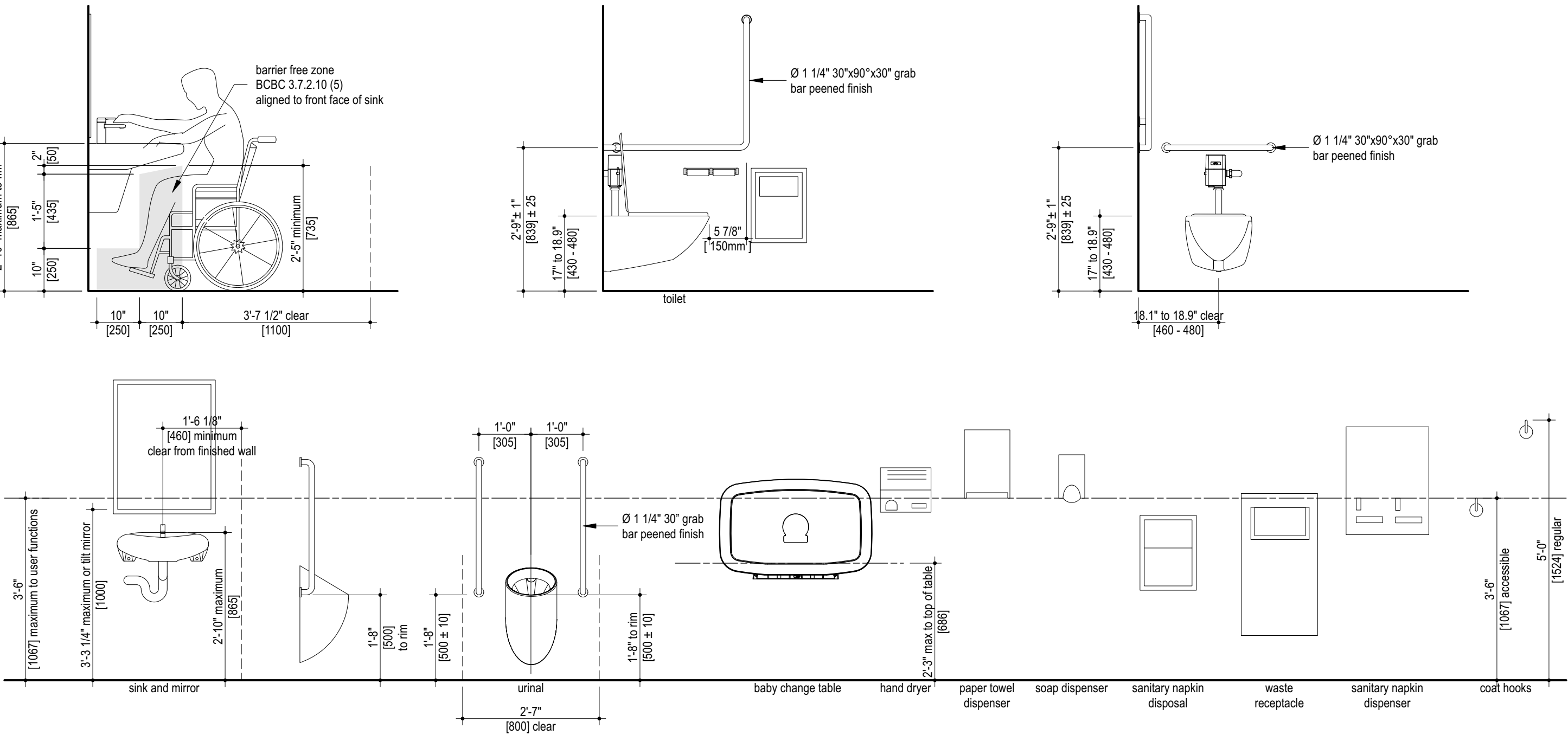
Space	Factor	Area (sf)	Area (sm)	Persons	Washrooms
School shops and vocational rooms	9.3	2221	206	22.2	
Kitchen	9.3	155	14	1.5	
Subtotal				23.7	
Universal Washroom Reduction				-10.0	
Total				13.7	1 male UWC, 1 female UWC Max. Occupancy 50 people

Table C – British Columbia Building Code 2018 Spatial Separation

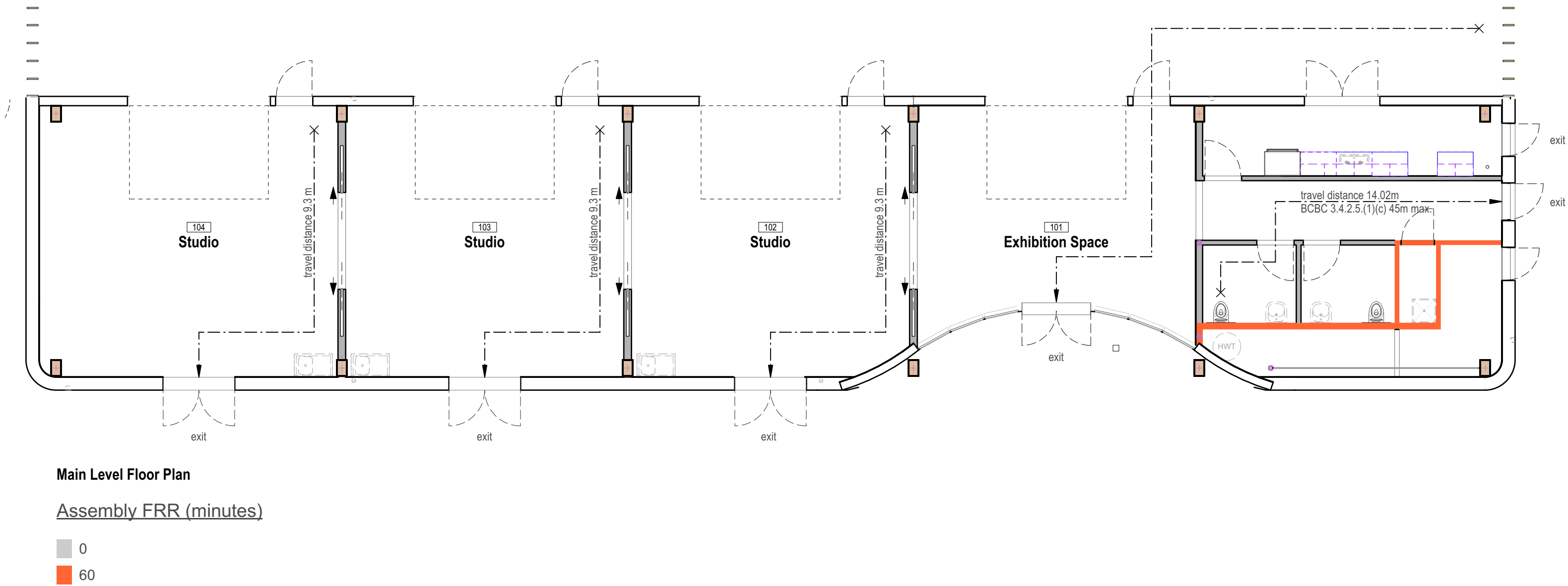
Actual Openings (A)								Construction Requirements (B)			Permitted			
											LD Basis [3] (A, B, U)	BCBC Table	% Opening	Limiting Distance
Direction	Sub	Occupancy	Sprinklered	Wall Area	L/H Ratio	Opening Area	% Opening	FRR [1]	Construction [2]	Cladding [2]				
North	-	A	N	36 sm	< 3:1	11 sm	30.6%	–	C	C	U	3.2.3.1.-B	100.0%	7.00 m
East	-	A	N	189 sm	3:1 to 10:1	56 sm	29.6%	–	C	C	U	3.2.3.1.-B	100.0%	18.00 m
South	-	A	N	36 sm	< 3:1	5 sm	13.9%	–	C	C	U	3.2.3.1.-B	100.0%	7.00 m
West	-	A	N	167 sm	3:1 to 10:1	68 sm	40.7%	1 hr	C	C	A	3.2.3.1.-B	19.0%	6.00 m

- Notes:
- [1] FRR – Fire resistance rating
- [2] C – Combustible, encapsulated mass timber or non-combustible; NC – Non-combustible
- [3] % openings based on: A – actual openings; B – construction requirements; or, U – unlimited (100%)
- [4] Where a municipal fire response is greater than 10 minutes and the building is not sprinklered, limiting distance values to be doubled

Washroom Accessibility



Building Code Means of Egress Diagram



Energy Compliance Path

This building is designed to energy code ANSI/ASHRAE/IESNA 90.1-2016, Zone 4C, as permitted under BCBC 10.2.2.1 and BCBC Bulletin B14-01 "Determining ASHRAE 90.1 Climate Zones"

Energy Standard/Code	BCBC 2018		
	In Accordance With	ASHRAE 90.1-2016	Non-residential
Climate Zone	4		
Compliance Path	Prescriptive		
	Assembly Maximum U Value	Assembly Minimum R Value	Insulation Minimum R Value
Roofs			
Insulation entirely above deck	0.032	31.25	30 CI
Walls, above grade			
Wood-framed and other	0.064	15.63	20.0
Walls, below grade			
Foundation Wall	0.119	8.40	7.5 CI
Floors			
Wood-framed and others	0.033	30.30	30.0
Slab-on-grade			
Unheated	0.520	1.92	15 for 24"
Heated	0.843	1.19	20 for 24"
Opaque Doors			
Swinging	0.370	2.70	–
Non-swinging	0.310	3.23	–
Fenestration – Assembly Max SHGC 0.36; Assembly Min VT/SHGC 1.10 (except skylights)			
Non-metal framing, all	0.31	3.23	–
Metal framing, fixed	0.38	2.63	–
Metal framing, operable	0.46	2.17	–
Metal framing, entrance door	0.68	1.47	–
Skylight (0% to 3% of roof)	0.50	2.00	–
CI = continuous insulation			

Room Finishes Schedule

No.	Room Name	Floor	Base	North Wall	East Wall	South Wall	West Wall	Ceiling	Notes
101	Exhibition Space	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	EXP-1	
102	Studio	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	EXP-1	Wood panels wall protection as per interior elevations
103	Studio	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	EXP-1	Wood panels wall protection as per interior elevations
104	Studio	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	EXP-1	Wood panels wall protection as per interior elevations
105	Corridor	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	GB-2	
106	Male UWC	SPC-1	n/a	CT-8	CT-8	CT-8	CT-8	GB-2	
107	Female UWC	SPC-1	n/a	CT-8	CT-8	CT-8	CT-8	GB-2	
108	Kitchen	RSP-1	BRC-1	GB-2	GB-2	GB-2	GB-2	AT-2	Stainless Steel wall protection as per interior elevations
109	Electrical Rm.	SPC-1	BWP-6	GB-2	GB-2	GB-2	GB-2	AT-2	
110	Utility Rm.	SPC-1	RB	GB-2	GB-2	GB-2	GB-2	AT-2	
111	Janitor	SPC-1	RB	GB-2	GB-2	GB-2	GB-2	GB-2	

- Floor Legend**
- SPC-1 Sealed polished concrete
- RSP-1 Resilient safety floor
- Base Legend**
- BWP-6 Paint-grade 5/8" x 4" pine base moulding - modern
- BRC-1 4" Resilient Base - Coved
- RB 4" rubber base
- Walls Legend**
- GB-2 5/8" gypsum board, primed and painted
- CT-8 6x6 wall tile – 09 30 00 (2)(CT-8) 6" X 6" square ceramic tile
- Ceiling Legend**
- EXP-1 Exposed Fluted GLT - stain finished
- GB-2 5/8" gypsum board, primed and painted, directly screwed to joists above
- AT-2 24" x 48" acoustic tile ceiling, exposed tee, straight edge

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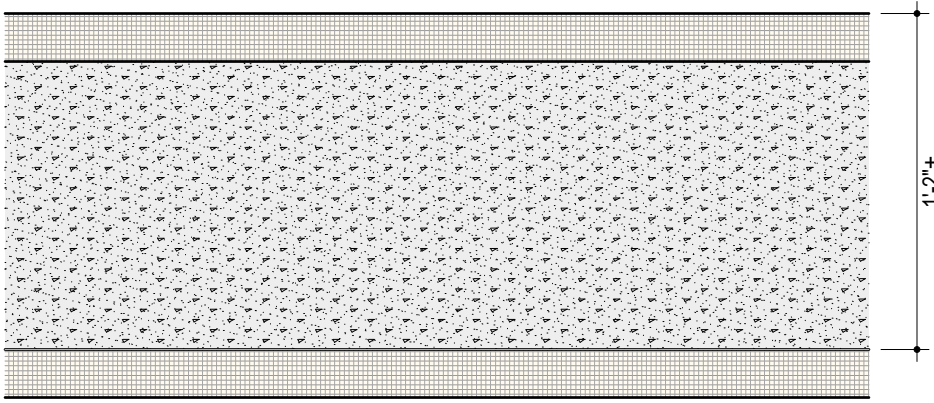
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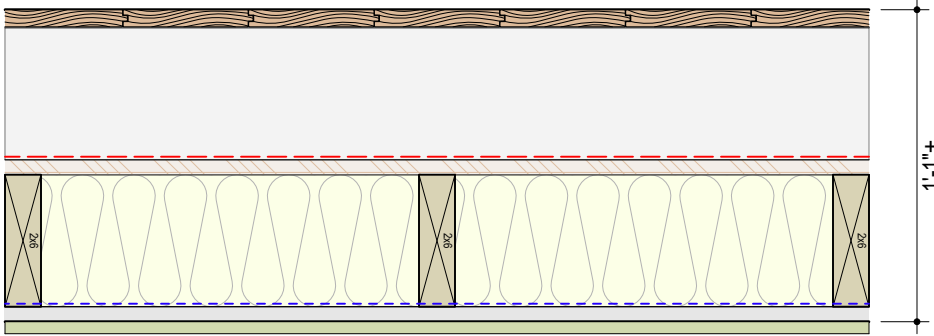
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Wall Assemblies – Exterior

Refer to BCBC Table A.9.10.3.1.A for wall type references unless noted otherwise
Fire and sound ratings noted are for the tested assemblies. For required ratings, refer to sheet A021
* See structural drawings for items with an asterisk



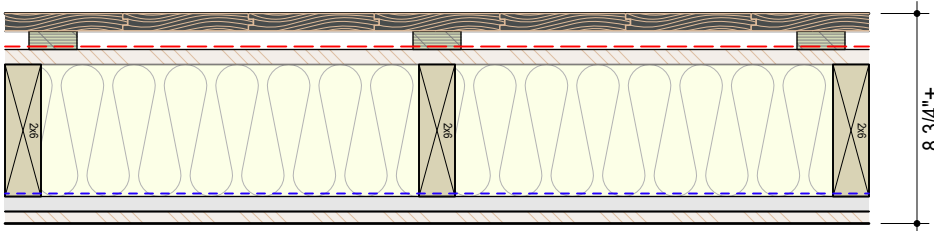
- XC01** **Foundation Grade Beam; Insulated**
- FRR* 60 *BCBC W1a*
- R(eff)* 16.46
- 2" rigid insulation
 - concrete foundation beam*
 - 2" rigid insulation



- XW01** **Exterior Wood Wall w/ interior insulation (canoe siding); Z-girt ventilated cavity**
- FRR* 60 *BCBC EW1a*
- R(eff)* 26.33
- 1x6 T&G vertical cedar boards; clear coated
 - 5 1/2" horizontal Z-Girts; galvanized metal, perforated
 - 5/8" plywood sheathing* c/w air barrier membrane
 - 2x6 wood studs* @ 16" o/c + batt insulation
 - 5/8" type X gypsum board, painted

- 1/2" G1S Douglas Fir Plywood , stained 8'-0" ht. @ studio walls, flushed with GWB.

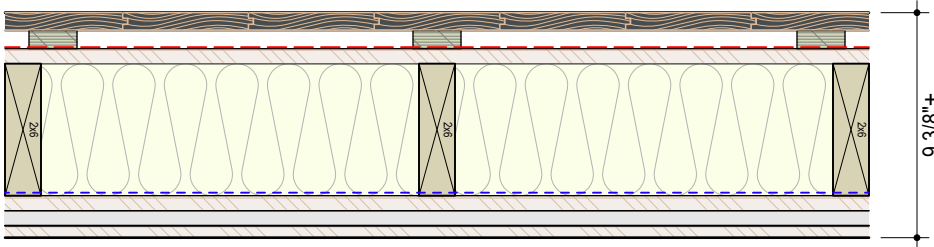
See detail A5301
Use only material from this supplier:
<https://mtrgpc.com/en/products/hardwood-industrial-clear-finish>



- XW02** **Exterior Wood Wall - Dark Stained Cedar**
- FRR* 60 *BCBC EW1a*
- R(eff)* 31.01
- 1x4 T&G vertical cedar boards; dark stained
 - 3/4"x2" diagonal PT plywood rainscreen @ 16" o/c
 - 5/8" plywood sheathing* c/w air barrier membrane
 - 2x6 wood studs* @ 16" o/c + 5 1/2" fiberglass batt insula
 - 5/8" type X gypsum board, painted

- 1/2" G1S Douglas Fir Plywood , stained 8'-0" ht.

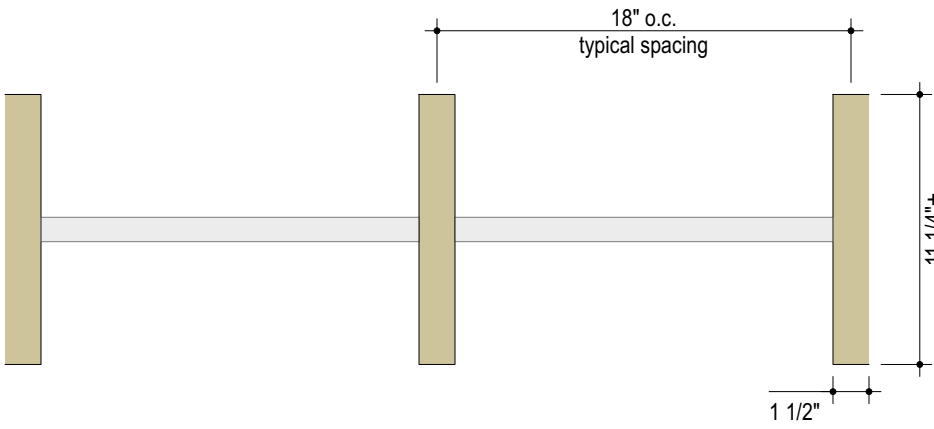
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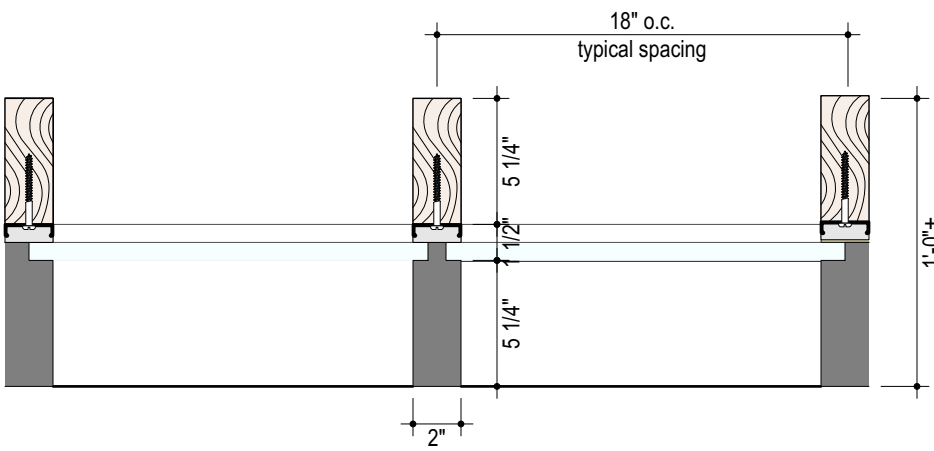
- XW03** **Exterior Wood Wall - Dark Stained Cedar**
- FRR* 60 *BCBC EW1a*
- R(eff)* 31.7
- 1x6 T&G vertical cedar boards; dark stained
 - 3/4"x2" diagonal PT plywood rainscreen @ 16" o/c
 - 5/8" plywood sheathing* c/w air barrier membrane
 - 2x6 wood studs* @ 16" o/c + 5 1/2" fiberglass batt insula
 - 5/8" plywood sheathing* c/w air barrier membrane
 - 5/8" type X gypsum board, painted

- 1/2" G1S Douglas Fir Plywood , stained 8'-0" ht.

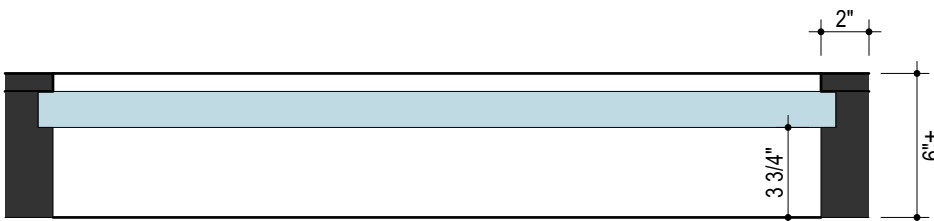
Use only material from this supplier:
<https://mtrgpc.com/en/products/hardwood-industrial-clear-finish>



- XW04** **Wood Louvres**
- FRR* -- *BCBC --*
- R(eff)* --
- 2" x 12" cedar slat; stained @ 18" o.c.
 - 1" stabilization rod as per structural drawings



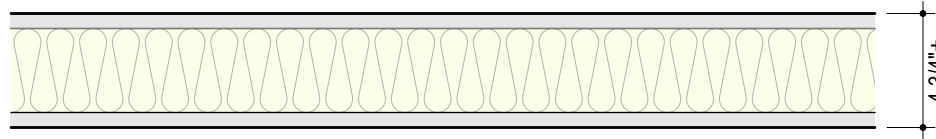
- CW01** **Curtain Wall w/ Wood Louvres (clerestory)**
- FRR* -- *BCBC --*
- R(eff)* .97 (TBC)
- 2" x 6" beauty cap: cap extension stained (real cedar)
 - Base of Design: Raico THERM+ black anodized 2" x 6" w/ real cedar beauty cap
 - Alternative: Kawneer 1620UT aluminum window frame; black anodized w/ real cedar beauty cap (tender both systems)



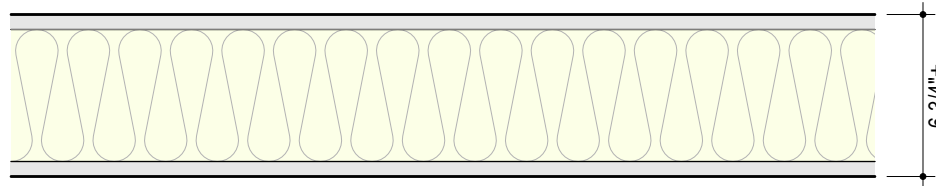
- CW02** **Curtain Wall / Entry Door**
- 2" x 1 1/4" beauty cap, black anodized aluminum
 - 2" x 6" Kawneer 1620UT aluminum window frame, black anodized

Wall Assemblies – Interior

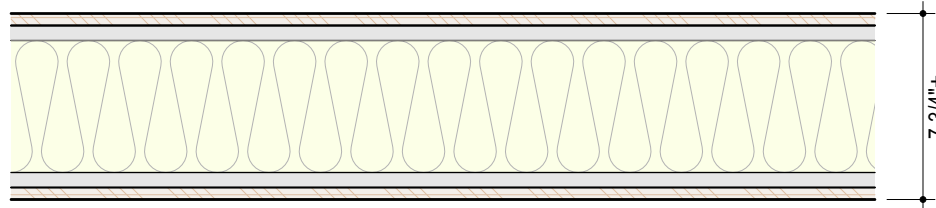
Refer to BCBC Table A.9.10.3.1.A for wall type references unless noted otherwise. Where two ratings for FRR are noted, the first is for loadbearing condition, the second is for non-loadbearing condition
Fire and sound ratings noted are for the tested assemblies. For required ratings, refer to sheet A021
* See structural drawings for items with an asterisk



- WW13i** **2x4, 5/8" type X GWB each side, insulated**
- FRR* 60/60 *BCBC W1a*
- STC* 36 *BCBC W1a*
- 5/8" type X gypsum wall board, painted
 - 2x4 wood studs; fiberglass batt insulation
 - 5/8" type X gypsum board, painted



- WW53i** **2x6, 5/8" type X GWB each side, insulated**
- FRR* 60
- STC* 36
- 5/8" type X gypsum board wall, painted
 - 2x6 wood studs; fiberglass batt insulation
 - 5/8" type X gypsum board wall, painted

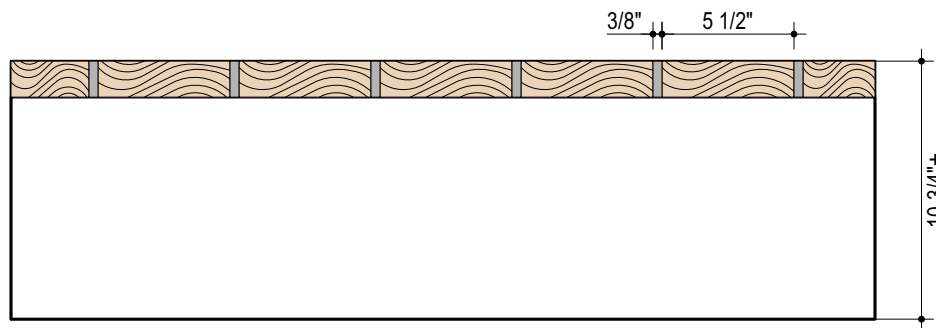


- WW54i** **2x6, 5/8" type X GWB each side, insulated**
- FRR* 60
- STC* 36
- 1/2" G1S Douglas Fir Plywood , stained 8'-0" ht.
 - 5/8" type X gypsum board, painted
 - 2x6 wood studs; fiberglass batt insulation
 - 5/8" type X gypsum board, painted

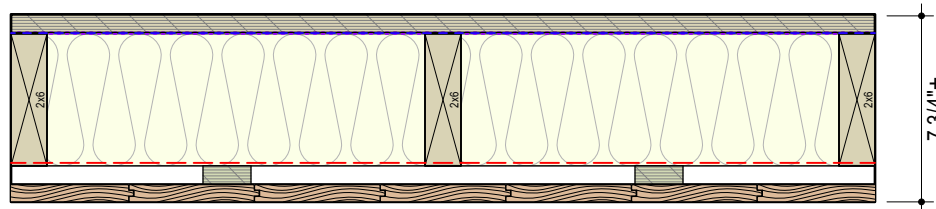
- 1/2" G1S Douglas Fir Plywood , stained 8'-0" ht.

Floor Assemblies – Exterior

Refer to BCBC Table A.9.10.3.1.B for floor type references unless noted otherwise
Fire and sound ratings noted are for the tested assemblies. For required ratings, refer to sheet A021
* See structural drawings for items with an asterisk

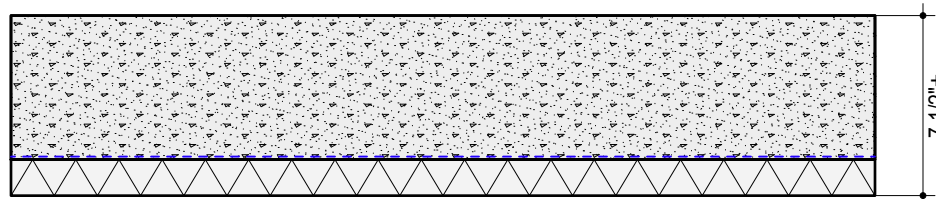


- FW01** **2x6, exterior wood deck on metal frame**
- FRR* --
- R(eff)* 1.35
- 2x6 cedar wood deck
 - 2x10 wood joist @ 12" o.c.



- FW02** **Wood Soffit @ Vestibule**
- FRR* --
- R(eff)* 22.89
- 3/4" plywood
 - 6 mil polyethylene vapour barrier
 - 2x6 joists*, insulated c/w air barrier membrane
 - 3/4" strapping
 - 1x6 cedar ceiling, stained

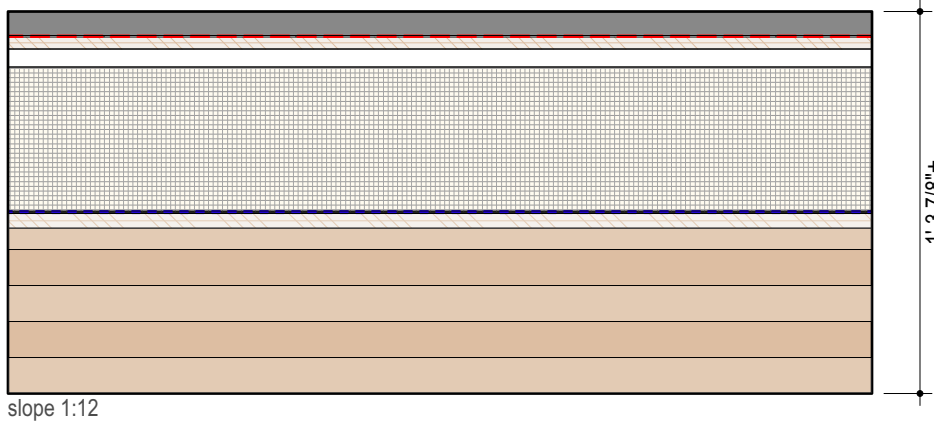
Floor Assemblies – Interior



- FC01** **Slab on Grade**
- FRR* --
- R(eff)* 9.33
- architectural concrete slab*; salt & pepper polished and sealed
 - vapour barrier
 - 1 1/2" XPS insulation

Roof Assemblies

Refer to BCBC Table A.9.10.3.1.B for roof type references unless noted otherwise
Fire and sound ratings noted are for the tested assemblies. For required ratings, refer to sheet A021
* See structural drawings for items with an asterisk



- RW01** **GLT - Standing Seam Roof**
- FRR* --
- R(eff)* 28.08
- 12" Prolok 24 Gauge Standing Seam - Westform Metals
 - Vapor permeable (VP)/ Air Barrier (AB)
 - 1/2" roof sheathing*
 - 3/4" Furring Strips (air cavity)
 - 6" polyiso
 - Non permeable vapour barrier
 - 5/8" T&G D.FIR plywood sheathing
 - 5 ply fluted GLT*, finished see specs.

Interior Finish:
Step 1: Sansin KP-12UVW
Step 2: Sansin SDF Top Coat

Note: dropped ceilings (gypsum board, soffit, t-bar) for floor and roofs are not indicated in the assemblies but are noted on the reflected ceiling plans.
* Refer to Structural Drawings



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Client	Town of Ladysmith	Drawn By	HA	Reviewed By	BC/JAC	Sheet Number	A031
Project Number	2032	Sheet Name	Assemblies				
Scale	n/a	Date	2023.05.23	Issue No.	80	Issued For	IFT - R1
						Revision	--

Door Schedule – ANSI Lockset Functions Legend

Mortise Code	Cylindrical Code	Function Label	Immediate Egress	Non-Keyed Operation
F31	–	exit	yes	no outside trim; latchbolt retracted by inside lever
F01	F75	passage	yes	latchbolt retracted by lever from either side at all times
–	F76	privacy	yes	latchbolt retracted by lever from either side; interior pushbutton lock; outside emergency release
F19	–	privacy w/ deadbolt	yes	latchbolt retracted by lever from either side; interior deadbolt thumbturn; interior lever retracts deadbolt and latchbolt; outside emergency release
F22	–	privacy	yes	latchbolt retracted by lever from either side unless outside lever locked by interior thumbturn; interior lever unlocks outside lever; outside emergency release
–	F77	patio	yes	inside pushbutton lock, inside lever releases button
–	F89	exit	yes	outside always fixed, inside always unlocked

Mortise Code	Cylindrical Code	Function Label	Immediate Egress	Keyed Operation
F80	–	communicating	–	key either side unlocks independently
F20	–	entrance	yes	latchbolt retracted by lever from either side unless outside locked by 20° thumbturn rotation; deadbolt actuation by 90° thumbturn rotation; interior lever retracts deadbolt and latchbolt; outside lever locked until thumbturn restored to vertical position
F09	–	apartment entrance	yes	latchbolt retracted by lever from either side unless outside is locked by key from inside; when locked, latchbolt retracted by outside key or inside lever
F04	F82	office	yes	latchbolt retracted by lever from either side except when outside lever is locked by interior pushbutton or key; unlocked by outside key or inside lever
F05	F84	classroom	yes	latchbolt retracted by lever from either side except when outside lever is locked by outside key; unlocked by exterior key or inside lever
F32	–	classroom security	yes	latchbolt retracted by lever from either side except unless outside is locked by key either side; when locked, latchbolt retracted by outside key or inside lever
F33	–	classroom security DB	yes	latchbolt retracted by lever from either side; deadbolt actuated by inside or outside key; interior lever retracts deadbolt and latchbolt
F07	F86	storeroom	yes	latchbolt retracted by outside key or by lever inside; outside lever always inoperative (fixed)
–	F90	corridor	yes	latchbolt retracted by lever from either side except when outside lever is locked by outside key or interior pushbutton; unlocked by outside key or inside lever
F13	–	corridor	yes	latchbolt retracted by lever from either side; deadbolt actuation by outside key or thumbturn; unlocked by exterior key or inside lever
F21	–	dormitory	no	latchbolt retracted by lever from either side; deadbolt actuation by outside key or thumbturn
–	F91	store lock	no	latchbolt retracted by lever either side; latchbolt locked or unlocked by key either side
F14	–	store lock	no	latchbolt retracted by lever either side; deadbolt actuated by outside key either side
F30	F87	institution	no	latchbolt retracted by key either side; levers both sides always inoperative (fixed)
IND*	–	indicator	yes	latchbolt retracted by lever either side; deadbolt actuation by outside key or inside thumbturn; vacancy/in-use indicator

Mortise Code	Cylindrical Code	Function Label	Immediate Egress	Deadbolt Operation
E01	–	cylinder	no	deadbolt operated by key one side, no trim other side
F16	E41	deadlock double cylinder	no	deadbolt operated by key either side
F17	E51	deadlock single cylinder	no	deadbolt operated by key outside and by thumbturn inside
–	E51IND	deadlock single cylinder	no	deadbolt operated by key outside and by thumbturn inside; vacancy/in-use indicator
F18	E61	one-way	no	deadbolt operated by key only, blank other side
–	E71	classroom	yes	deadbolt operated by key outside, inside thumbturn retract only
–	E91	door bolt	no	deadbolt operated by thumbturn only, no outside trim

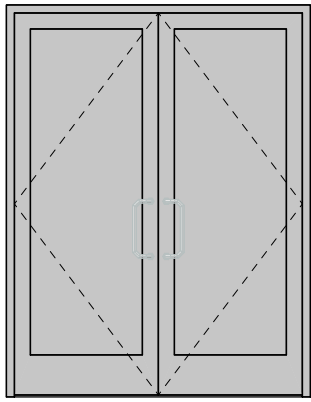
*indicator deadbolt

Exit Device Code	Description
X01	exit only/no trim
X02	entrance by pull/trim when actuating bar is locked down ("dogged"); note - fire exit devices cannot be locked down
X03	entrance by trim when latchbolt is retracted by key (pull side); unit is locked when the key is removed
X04	entrance by trim when latchbolt is retracted by key (pull side) or set in a retracted position by key
X05	entrance by thumbpiece; key (pull side) locks/unlocks thumbpiece
X06	entrance by thumbpiece only when released by key (pull side); unit is locked when the key is removed
X07	entrance by thumbpiece; inside key (on pushside/on active device case) locks/unlocks thumbpiece; outside key (pullside) retracts latch
X08	entrance by lever; key (pull side) locks/unlocks lever
X09	entrance by lever with key (pull side) only; unit is locked when the key is removed
X10	entrance by lever; inside key (push side) locks/unlocks lever; outside key (pull side) only retracts latch
X11	entrance by auxiliary control turnpiece; key (pull side) locks/unlocks auxiliary control
X12	entrance by auxiliary control turnpiece only when released by turning key (pullside); unit is locked when the key is removed

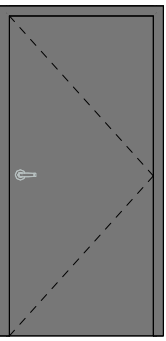
Door Schedule – Materials and Hardware Legend

Door Type	Hinges / Pivots	Kickplate	Access Control
varies	3 total number of hinges	2 number of kickplates	CR card reader
	NRP non-removable pins	H10 height in inches	ES electric strike
	CON continuous hinge		KP keypad
	DA double acting	Stops	ML mag lock (door head)
AL aluminum	OPV offset pivots	F floor stop	PEX push to exit
FG fibreglass	CPV centre pivots	W wall stop	REX request to exit motion
HS hollow steel		K kick stop	VC video comm panel, remote release
HSI hollow steel insulated		+C as above with catch	W wave to open
HCW hollow core wood	Closers*	CL90 limit on closer @ 90°	EHDB electric hinge and door bolts
MCW metal clad wood	STD standard		
SCW solid core wood	D delay	Flushbolts	
WFI wood frame, insulated, metal clad	HO hold-open	M manual	
TG tempered glazing	SF swing-free	MT manual, top only	
	ADO auto door operator, with push buttons	MA manual, astragal	
		A automatic	
		AS astragal only	
Frame Materials	Threshold / Seals	Push / Pull Plates	
ALS aluminum storefront	T threshold, thermally broken	PS push plate	
DW steel knock down drywall	SS seals and sweeps	PL pull plate	
FG fibreglass			
KD steel knock down			
SUW setup and welded steel			
SW solid wood			
TB thermally broken steel			
AKD adjustable knock-down			

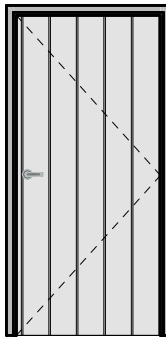
Door Types Legend – Wood/Steel



Type GL

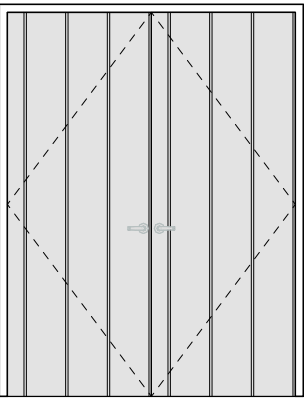


Type M



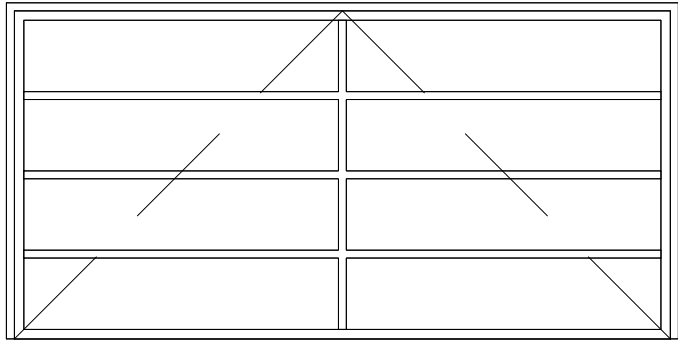
Type M2

Door should be clad to match the siding of the building. Door cladding and siding should be flush and continuous.

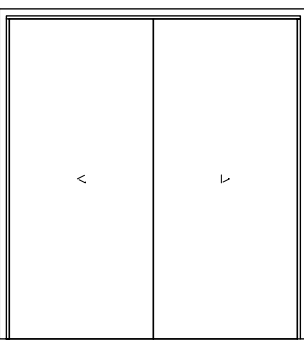


Type MD2

Door should be clad to match the siding of the building. Door cladding and siding should be flush and continuous.

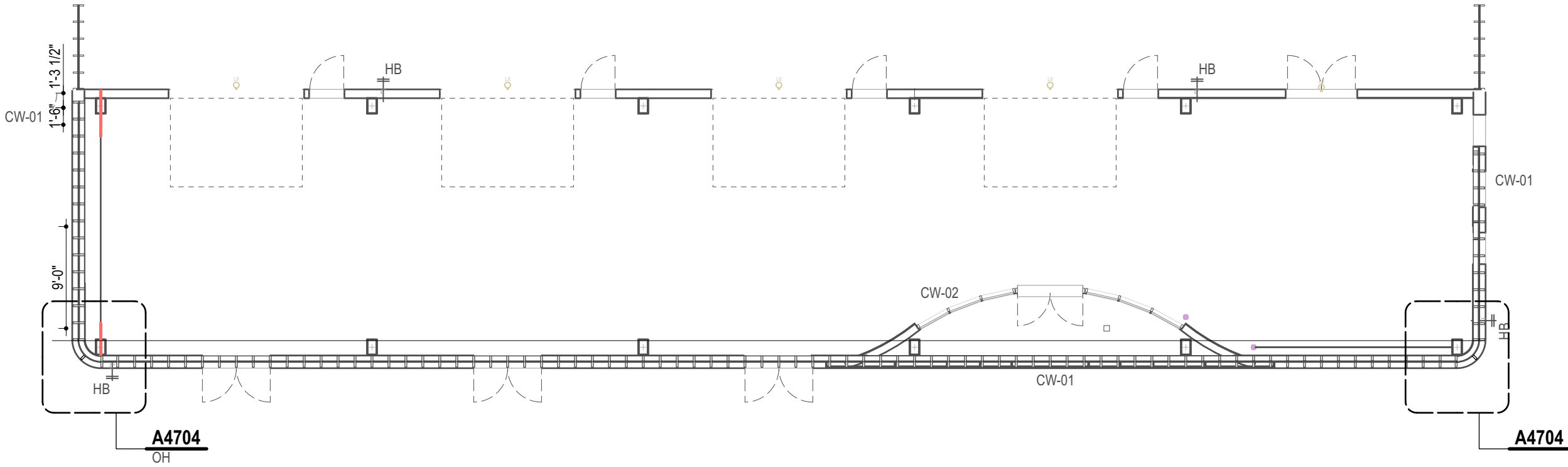


Type OH



Type PMD

Curtain Wall Glazing System



Door Schedule – Materials and Hardware

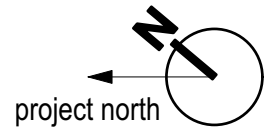
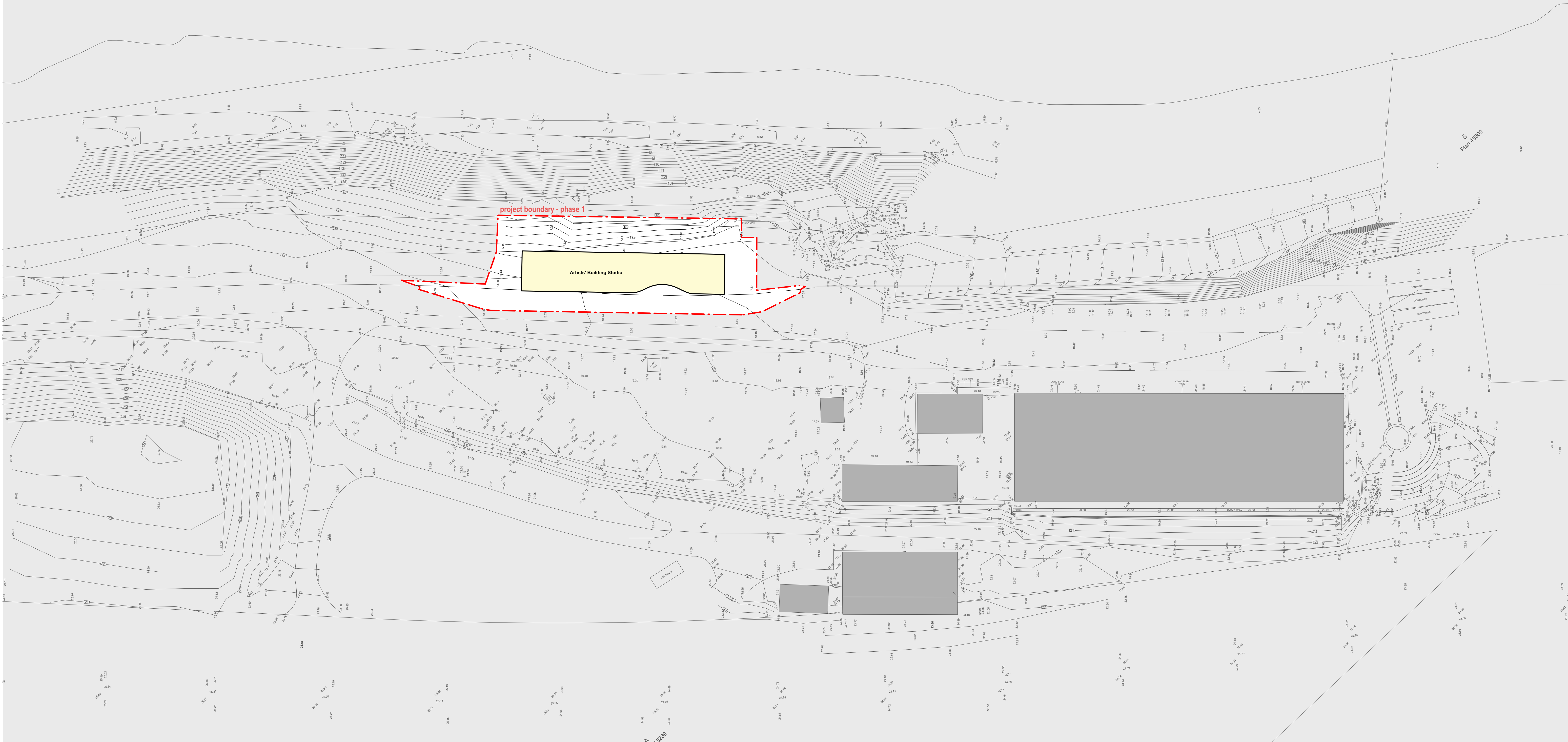
Existing Reference	Adjacent Rooms	Door Type	Fire Rating (Minutes)	Door Width	Door Height	Door Material	Frame Material	Frame Width	Lock Function	Deadbolt Function	Hinges / Pivots	Closer	Threshold / Seal / Sweep	Kickplates	Stop	Flushbolts / Astragal	Pull / Push Plates	Access Control	Notes
101.1	Exhibition Space	GL	–	120"	80"	TG	ALS	4 1/2"	F75	E51	3	ADO	T SS	–	–	–	–	–	–
101.2	Exhibition Space	OH	–	120"	80"	TG	ALS	10 3/8"	–	–	3	–	SS	–	–	–	–	–	–
101.3	Exhibition Space	M	–	30"	79 1/2"	HSI	TB	10 3/8"	F75	E51	3	–	–	–	–	–	–	–	–
102.1	Studio	MD2	–	60"	80"	HSI	TB	12"	F75	E51	OPV	HO	T SS	–	–	M	–	–	flush mount to siding pocket door
102.2	Exhibition Space, Studio	PMD	–	80"	711"	SCW	SW	8 3/4"	F80	–	3	–	–	–	–	–	–	–	–
102.3	Studio	OH	–	120"	80"	TG	ALS	10 3/8"	–	–	3	–	SS	–	–	–	–	–	–
102.4	Studio	M	–	30"	79 1/2"	HSI	TB	10 3/8"	F75	E51	3	–	–	–	–	–	–	–	–
103.1	Studio	MD2	–	60"	80"	HSI	TB	12"	F75	E51	OPV	HO	T SS	–	–	M	–	–	flush mount to siding pocket door
103.2	Studio, Studio	PMD	–	80"	711"	SCW	SW	8 3/4"	F80	–	3	–	–	–	–	–	–	–	–
103.3	Studio	OH	–	120"	80"	TG	ALS	10 3/8"	–	–	3	–	SS	–	–	–	–	–	–
103.4	Studio	M	–	30"	79 1/2"	HSI	TB	10 3/8"	F75	E51	3	–	–	–	–	–	–	–	–
104.1	Studio	MD2	–	60"	80"	HSI	TB	12"	F75	E51	OPV	HO	T SS	–	–	M	–	–	flush mount to siding pocket door
104.2	Studio, Studio	PMD	–	80"	711"	SCW	SW	8 3/4"	F80	–	3	–	–	–	–	–	–	–	–
104.3	Studio	OH	–	120"	80"	TG	ALS	10 3/8"	–	–	3	–	SS	–	–	–	–	–	–
104.4	Studio	M	–	30"	79 1/2"	HSI	TB	10 3/8"	F75	E51	3	–	–	–	–	–	–	–	–
105.1	Corridor	M2	–	30"	68"	HSI	TB	3"	F86	–	3	–	–	–	–	–	–	–	flush mount to siding
106.1	Male UWC, Corridor	M	–	30"	70"	HS	DW	5 3/4"	F75	E51IND	3	–	–	–	–	W	–	–	–
107.1	Female UWC, Corridor	M	–	30"	70"	HS	DW	5 3/4"	F75	E51IND	3	–	–	–	–	W	–	–	–
108.1	Kitchen	M2	–	28"	68"	HSI	TB	3"	F86	–	3	HO	–	–	–	–	–	–	flush mount to siding
108.2	Kitchen	GL	–	60"	711"	TG	ALS	10 3/8"	F75	E51	3	STD	–	–	–	M	–	–	–
108.3	Kitchen, Corridor	M	–	30"	70"	HS	DW	5 3/4"	F82	–	3	STD	–	–	–	W	–	–	–
109.1	Electrical, Rm.	M2	–	28"	68"	HSI	TB	3"	F86	–	3	STD	–	–	–	–	–	–	flush mount to siding
111.1	Janitor, Corridor	M	45	28"	70"	HS	DW	5 3/4"	F86	–	3	STD	–	–	–	–	–	–	–

Confirm keying and locks with owner

- Notes
- See 08 71 10 for door hardware
 - See 08 80 50 for glazing for all doors

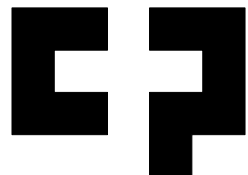
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Artists' Studio Building

ROAD NOT IN CONTRACT, BUT IS PART OF THE PROJECT.
GC IS RESPONSIBLE TO COORDINATE.
THE TOWN OF LADYSMITH WILL BE RESPONSIBLE FOR COMPLETING THE ROAD



1 Site Survey
A101 Scale: 1" = 30'-0"

SURVEY BASED ON: J.E. ANDERSON & ASSOCIATES.
FILE NUMBER: 89903
DATE: MARCH 15, 2021
Topographic Survey of Part of Lot 4 district lots 8g, 11g, 24 and 56 oyster district plan 45800 except plans VIP64405, VIP71943, VIP72131 and EPP100459
See civil drawings for road and utility design



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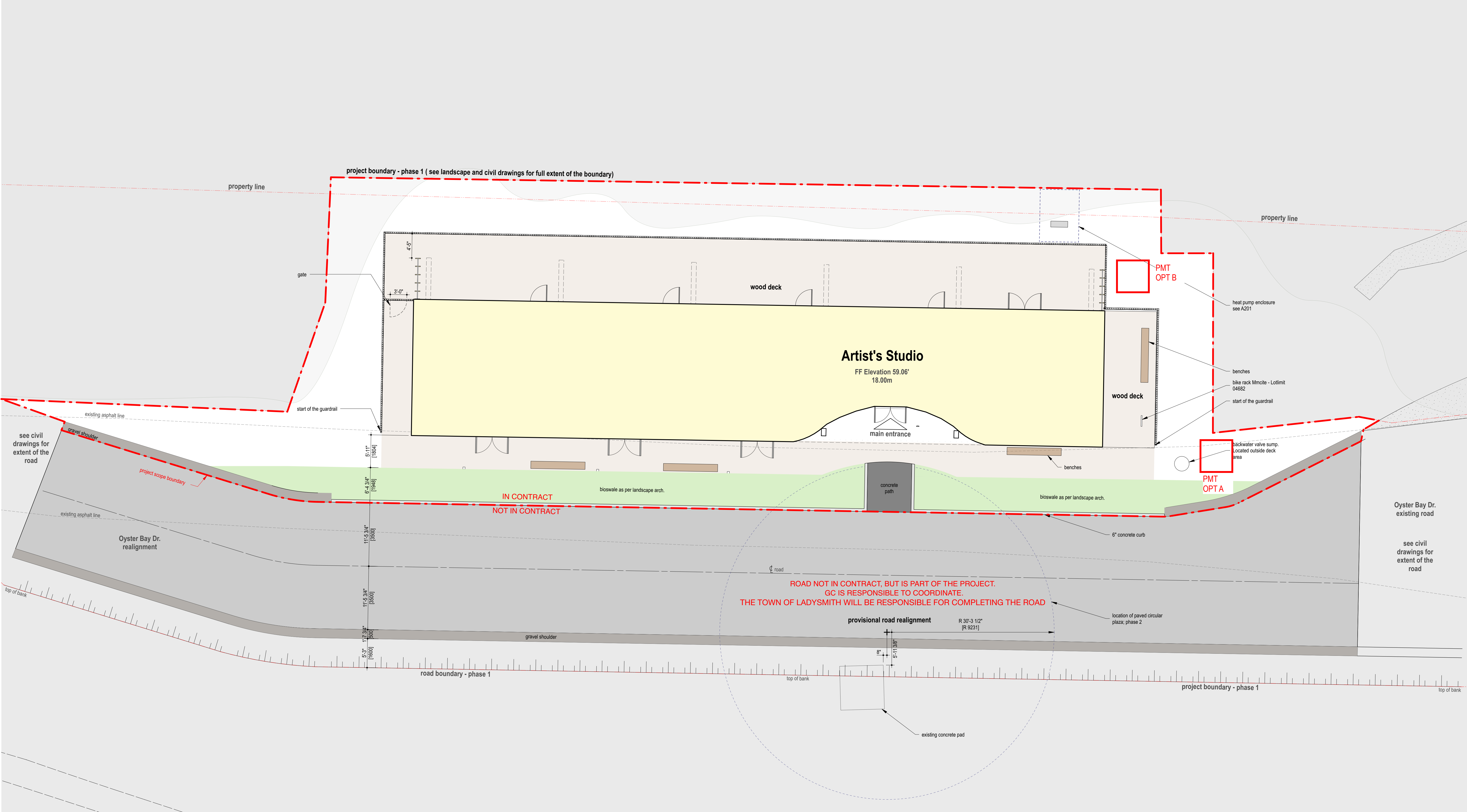
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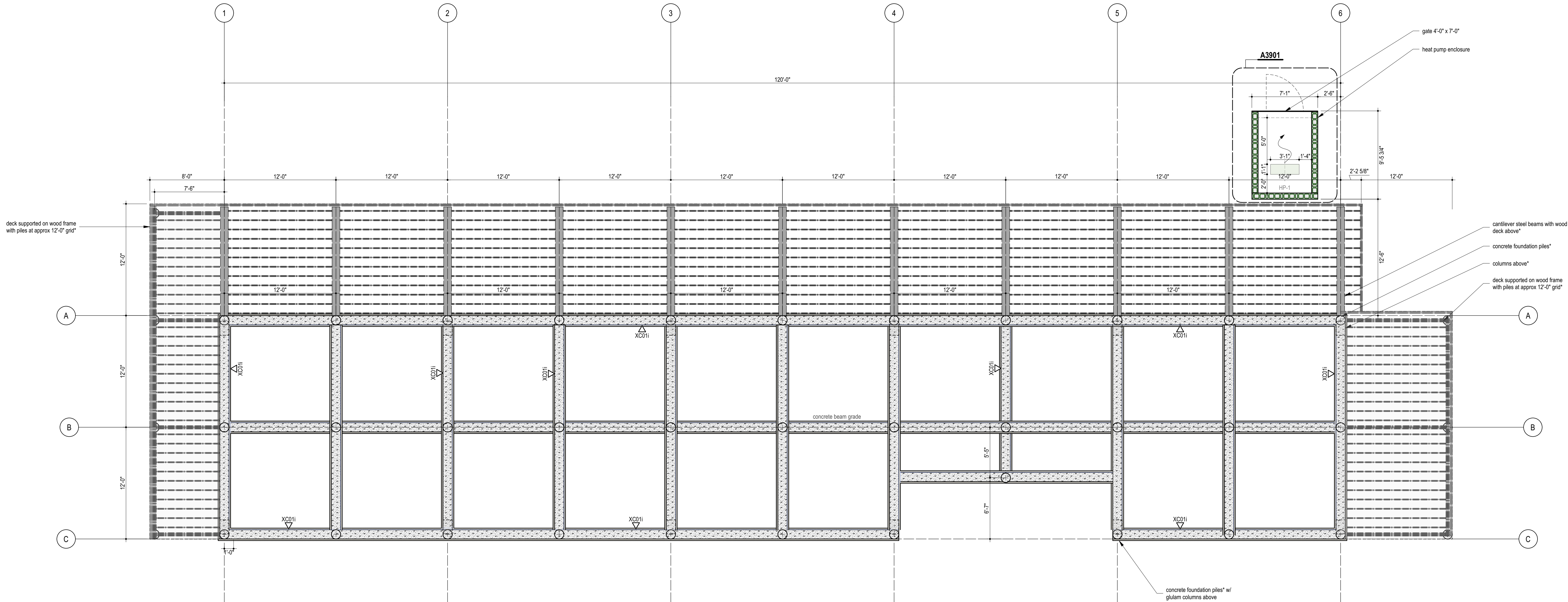
Client Town of Ladysmith		Drawn By HA		Reviewed By BC/JC		Sheet Number A101
Project Number 2032		Sheet Name Survey		Issue No. 80		Revision -
Scale as noted		Date 2023.05.23		Issued For IFT - R1		

ISSUED FOR TENDER

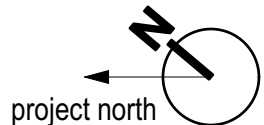


1
A111 Site Plan - Phase 1
Scale: 1/8" = 1'-0"

project north



1
A201 Foundation Plan
Scale: 3/16" = 1'-0"



*refer to structural



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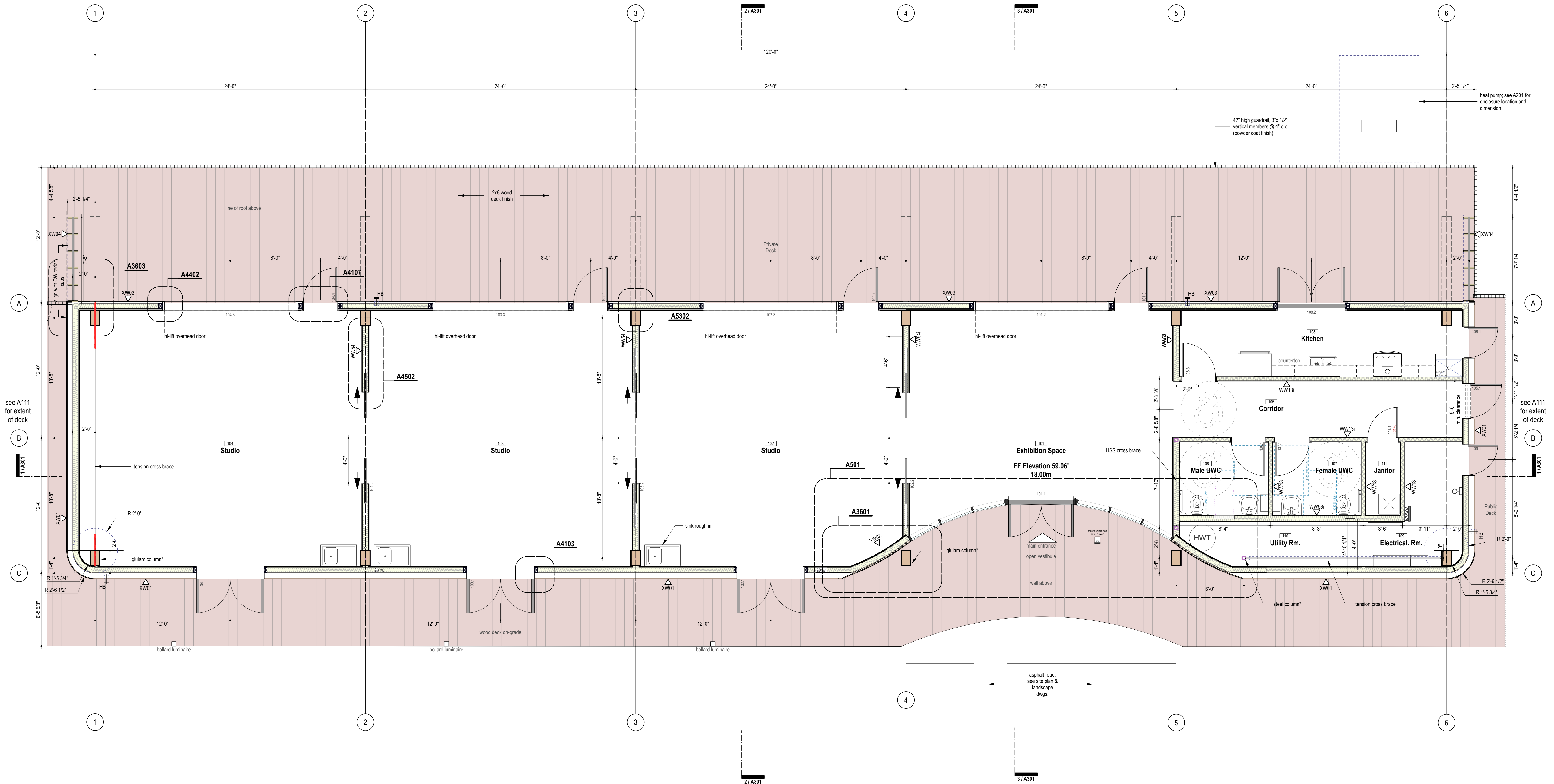
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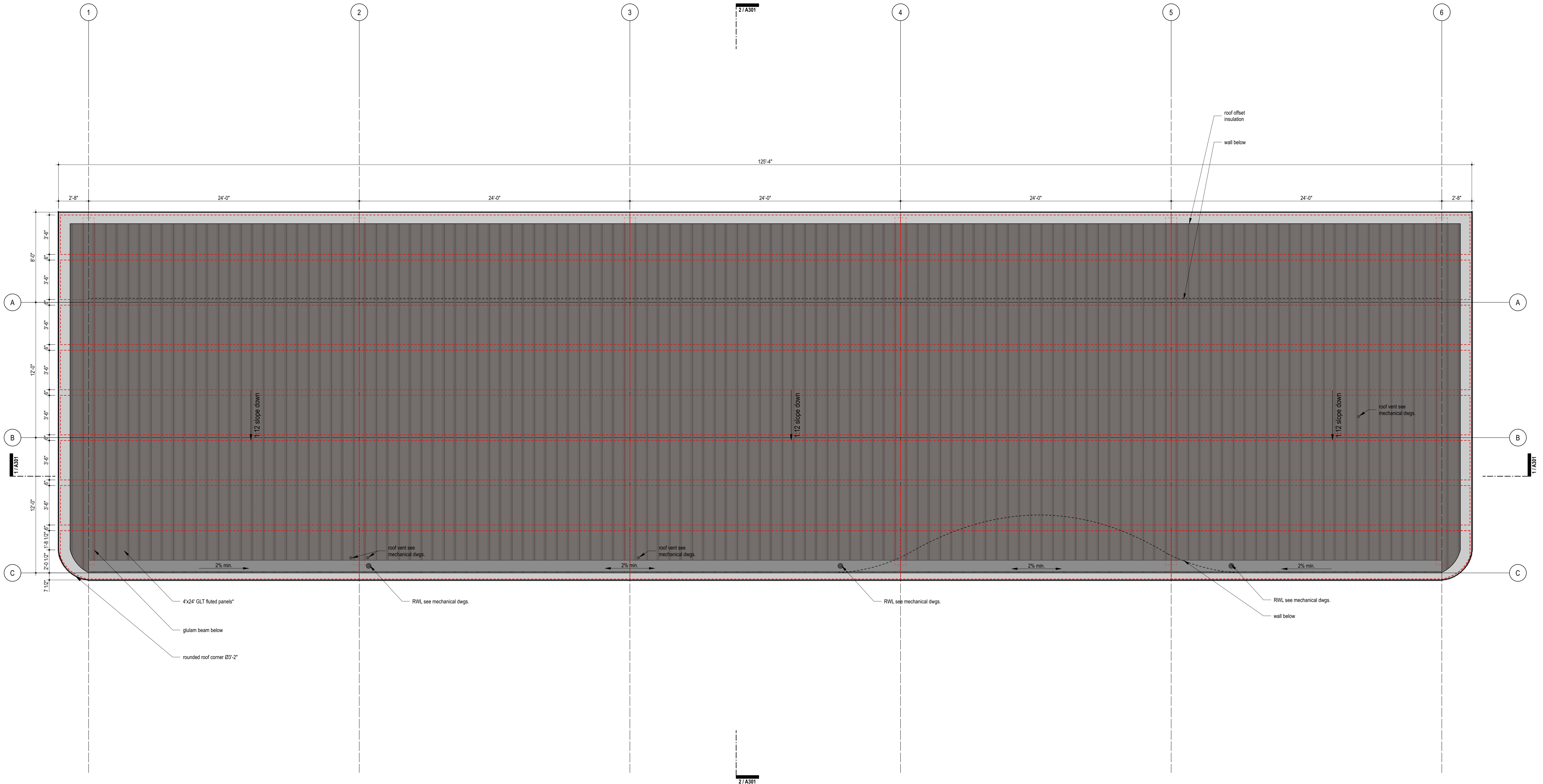
Client	Town of Ladysmith	Drawn By	HA	Reviewed By	BC/JAC
Project Number	2032	Sheet Name	Foundation Plan	Issue No.	80
Scale	as noted	Date	2023.05.23	Issued For	IFT - R1

Sheet Number
A201

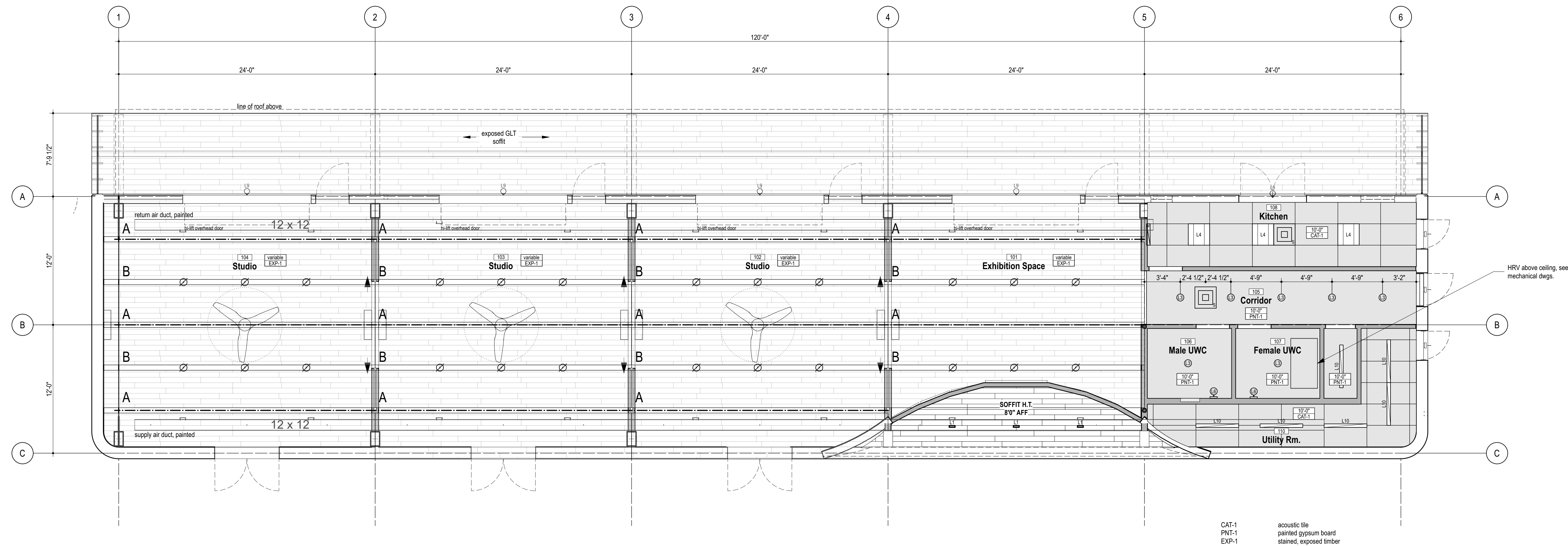


1 Floor Plan
A211 Scale: 1/4" = 1'-0"

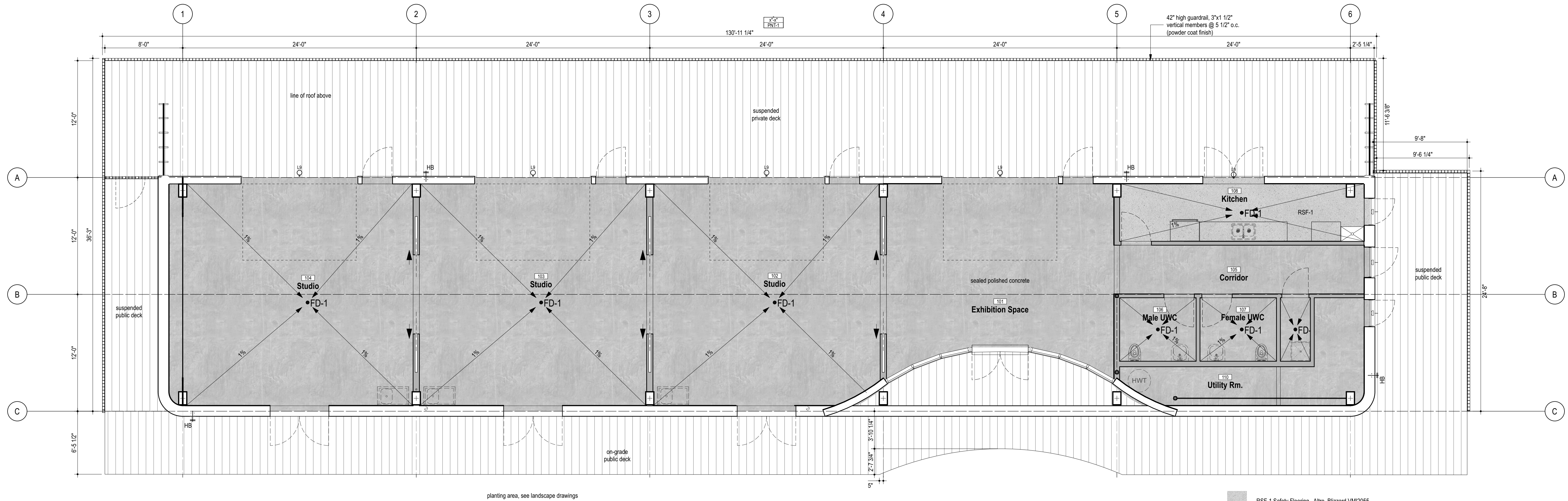
Proposed Interior Area: 2,843 sq. ft. (264 sq. m.)



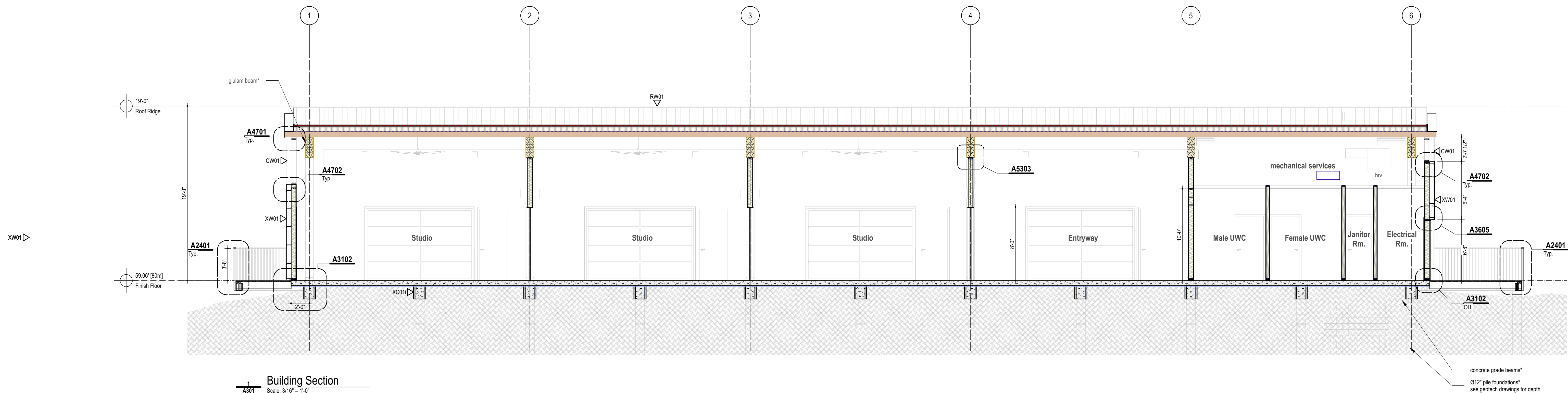
1 Roof Plan
A221 Scale: 1/4" = 1'-0"



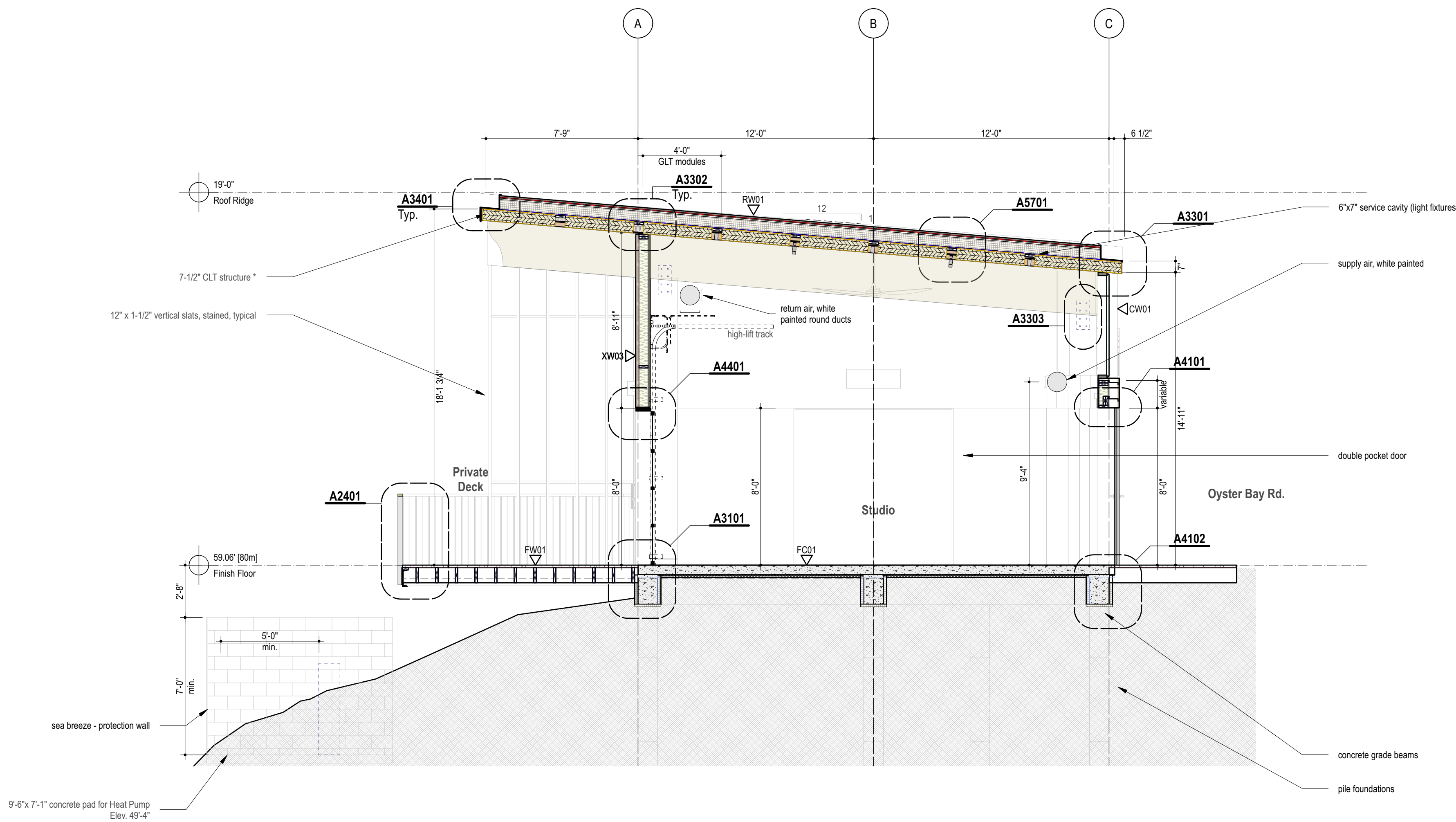
1 Reflected Ceiling Plan
 A231 Scale: 3/16" = 1'-0" FOR LIGHT FIXTURES SEE ELECTRICAL DRAWING E2.0



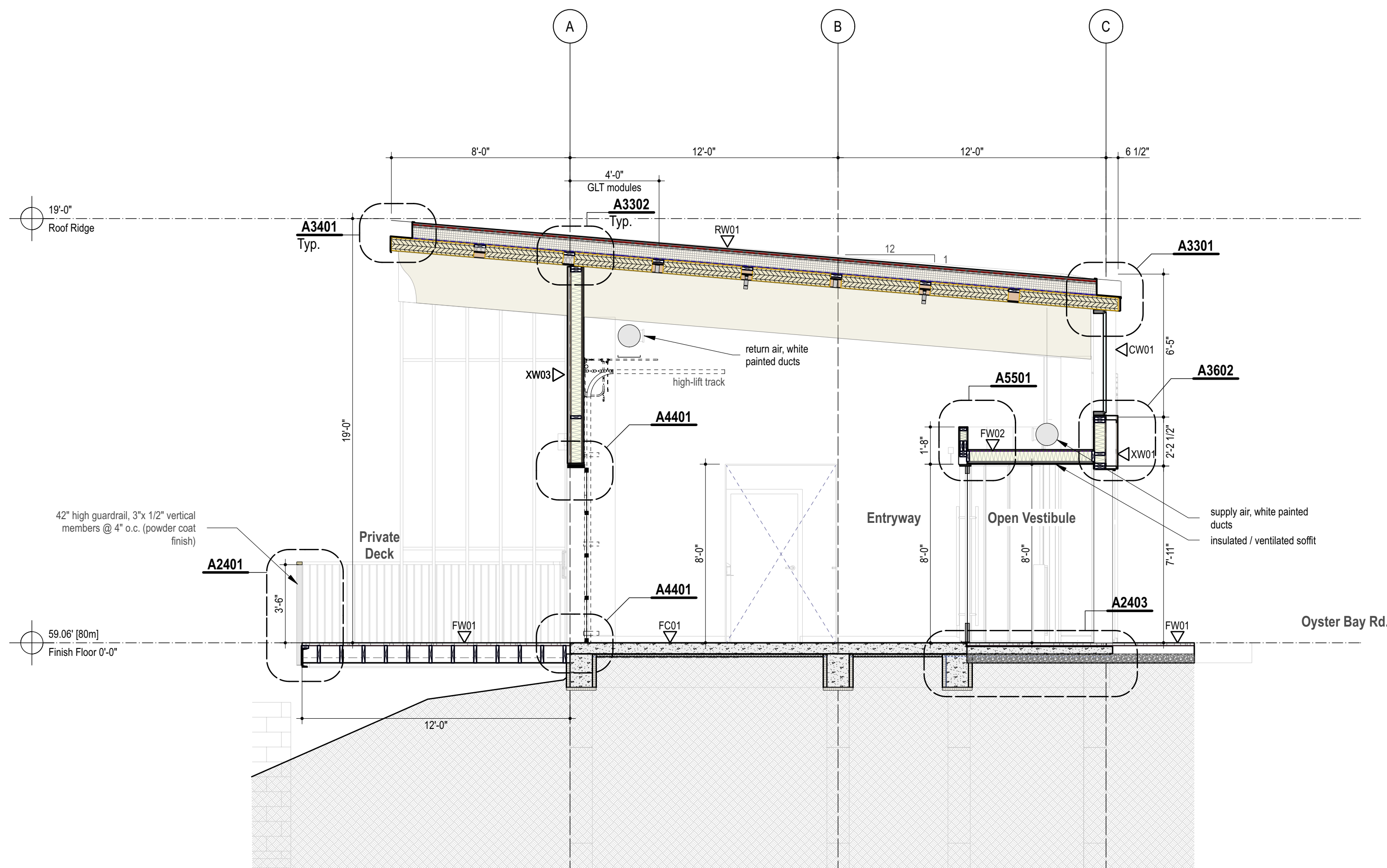
2 Flooring Plan
 A231 Scale: 3/16" = 1'-0"



1 Building Section
A301 Scale: 3/16" = 1'-0"



2 Building Section
A301 Scale: 1/4" = 1'-0"



3 Building Section
A301 Scale: 1/4" = 1'-0"

*refer to structural



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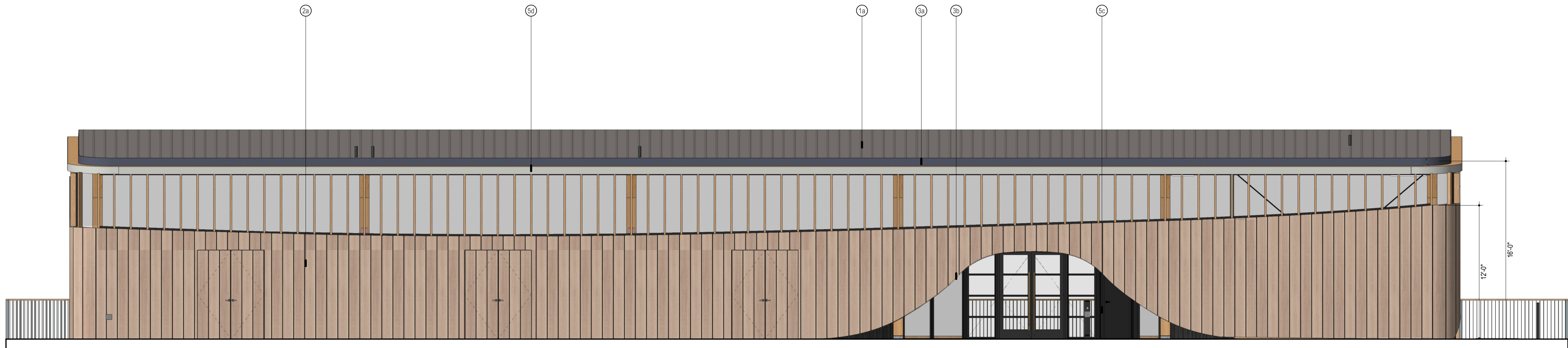
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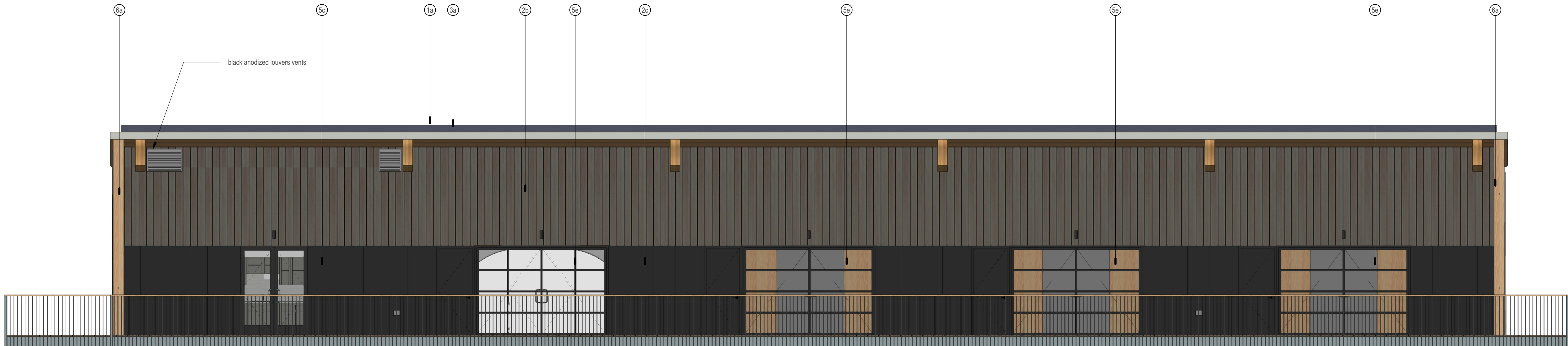
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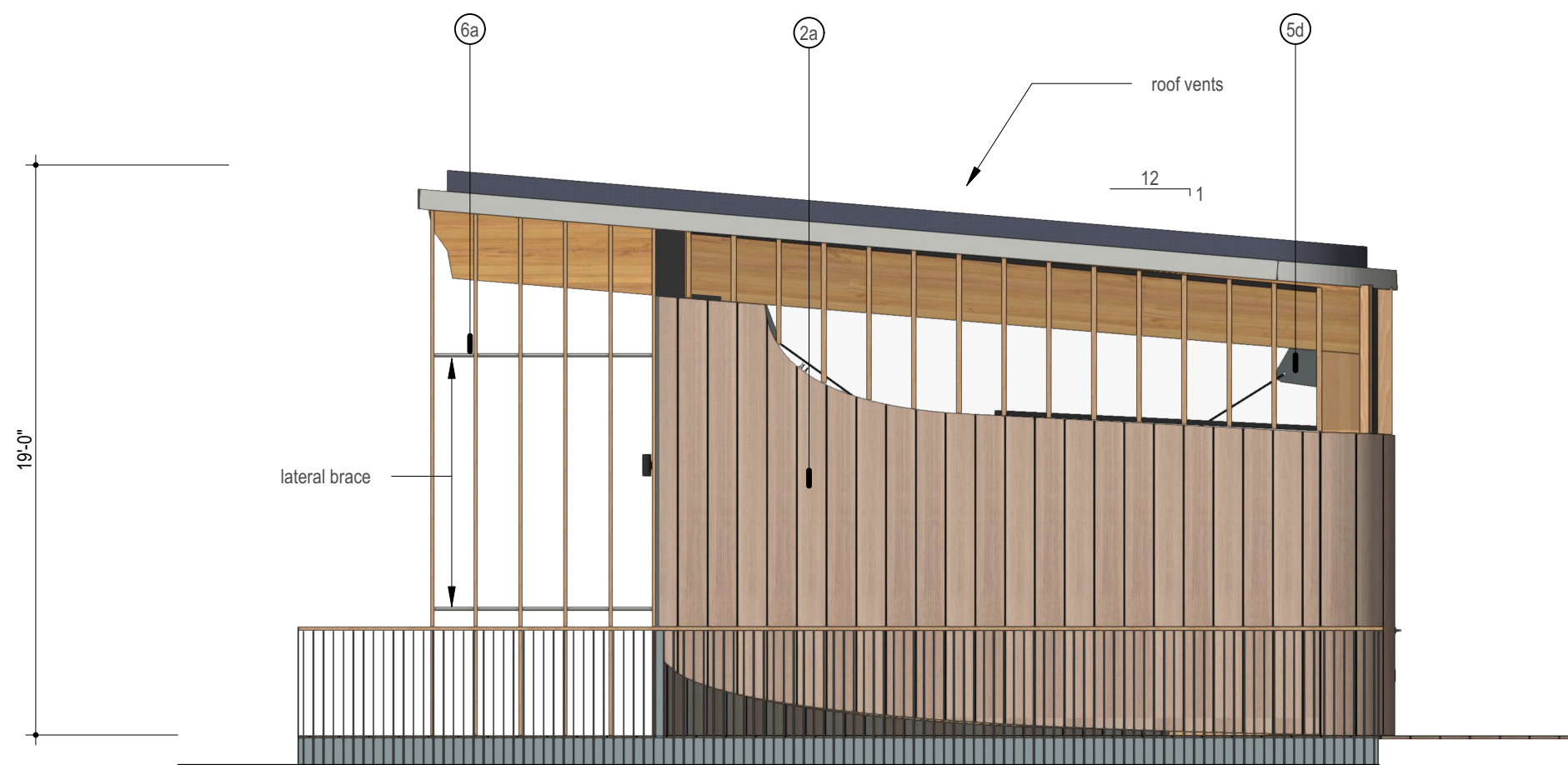
Client	Town of Ladysmith	Drawn By	HA	Reviewed By	BC	Sheet Number	A301
Project Number	2032	Sheet Name	Sections				
Scale	n/a	Date	2023.05.23	Issue No.	80	Issued For	IFT - R1



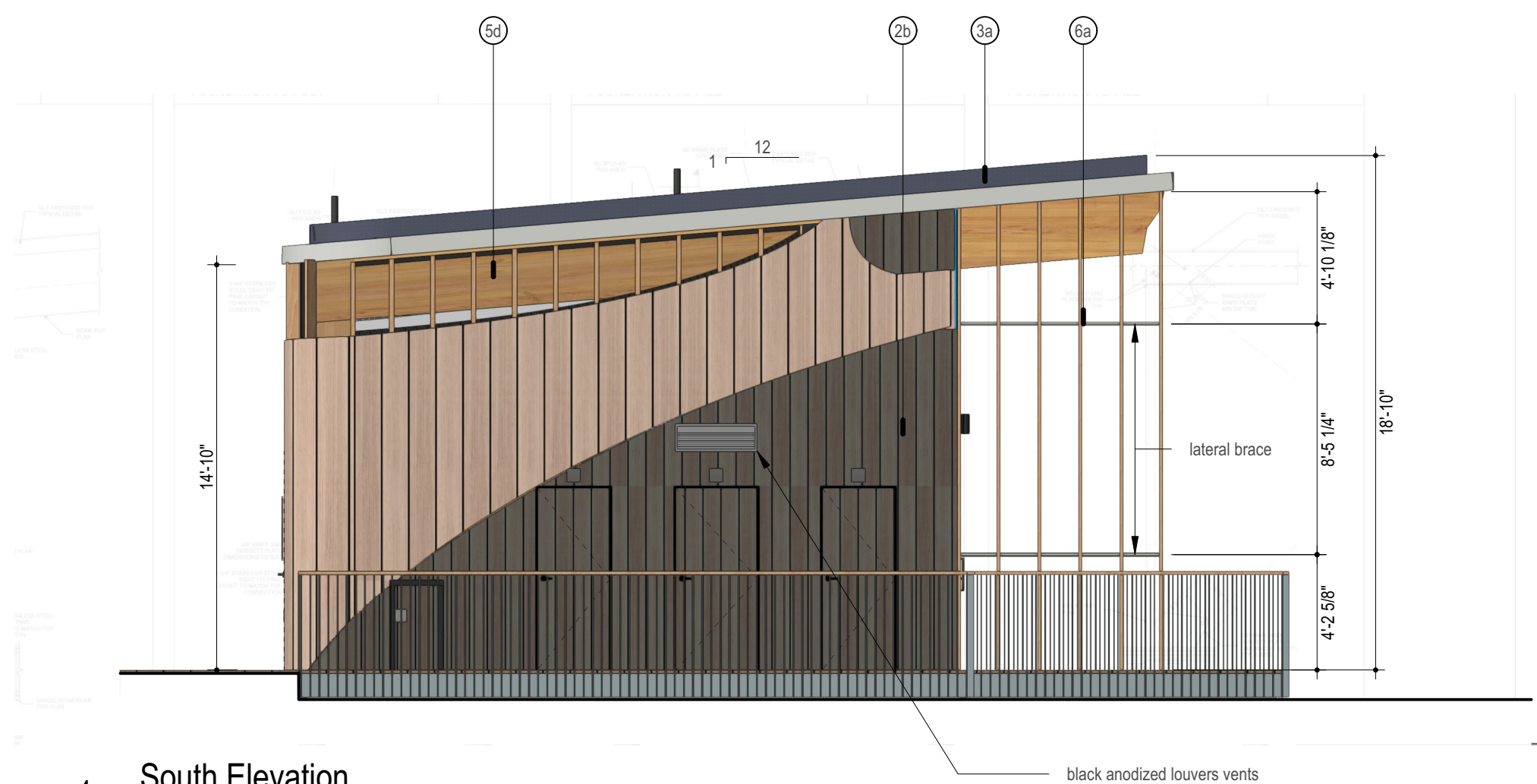
1 Front - West Elevation
A401 Scale: 3/16" = 1'-0"



2 Rear - East Elevation
A401 Scale: 3/16" = 1'-0"



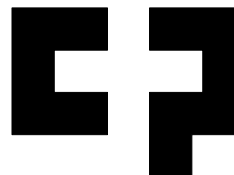
3 North Elevation
A401 Scale: 3/16" = 1'-0"



4 South Elevation
A401 Scale: 3/16" = 1'-0"

Exterior Materials

Material	Finish	Colour	Notes
1 a Roofing – Standing Seam	PVDF	Weathered Zinc	24 gauge - sloped roof 1:12
2 a Cladding – 2x6 cedar, Clear, 3/4" joint gaps	Stained	Light Cedar	Sansin SDF Foundation Cedar
b Cladding – 2x6 cedar, Dark, 3/4" joint gaps	Stained	Dark Cedar	Sansin Woodforce Slate Grey
c Cladding – Fiber Cement Panels	Painted	Iron Gray	-
3 a Flashing – metal	Prefinished	Weathered Zinc	-
b Fascia – wood	Prefinished	-	See details
4 a Soffit – cedar	Stained	Cedar	Clear
b Fascia – wood	Stained	Cedar	-
5 a Doors and frames – metal	Stained	Clear	Cedar clad SDF Foundation Ceda
b Door – metal	Stained	Dark	Cedar clad SDF Foundation Ceda
c Windows – storefront aluminum	Prefinished	Black Anodized	-
d Windows – CW	Prefinished	Black Anodized	Cedar Beauty Caps
e Overhead door – metal w/ glass inserts	Prefinished	Black Anodized	w glass
6 a 1 1/2" x 12" wood slats	Stained	Cedar	Sansin SDF Foundation Cedar



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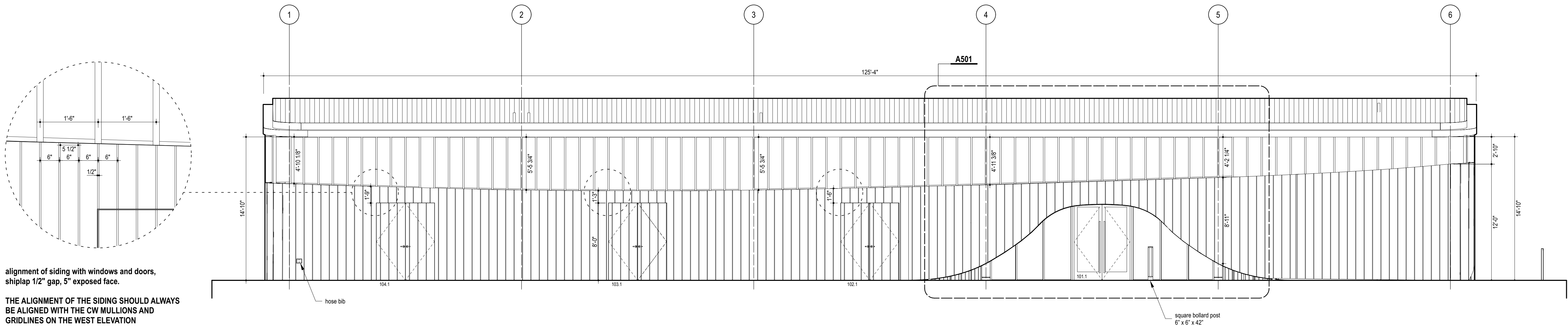
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Client Town of Ladysmith	Drawn By HA	Reviewed By BC	Sheet Number A401
Project Number 2032	Sheet Name Exterior Elevations and Materials	Issue No. 80	Revision -
Scale n/a	Date 2023.05.23	Issued For IFT - R1	



alignment of siding with windows and doors,
shiplap 1/2" gap, 5" exposed face.

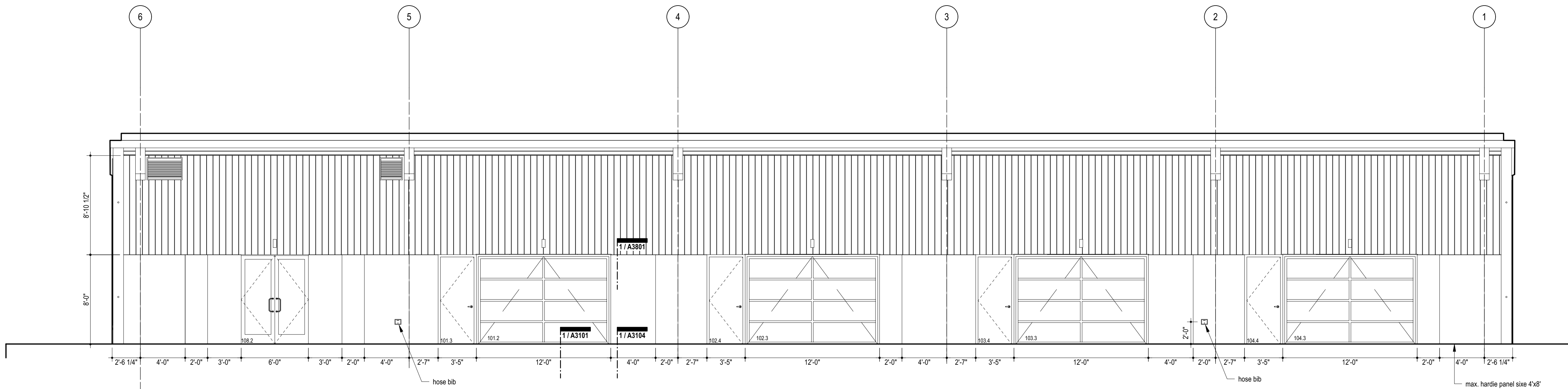
THE ALIGNMENT OF THE SIDING SHOULD ALWAYS
BE ALIGNED WITH THE CW MULLIONS AND
GRIDLINES ON THE WEST ELEVATION

6 Front - West Elevation

A402 Scale: 3/16" = 1'-0"

Cedar Cladding Area: 1,065 sq. ft.
Glazing Area: 730 sq. ft.

Note:
• Canoe outline
• Print the template to cut exterior siding with the desired curvature, please request the CAD file if needed.



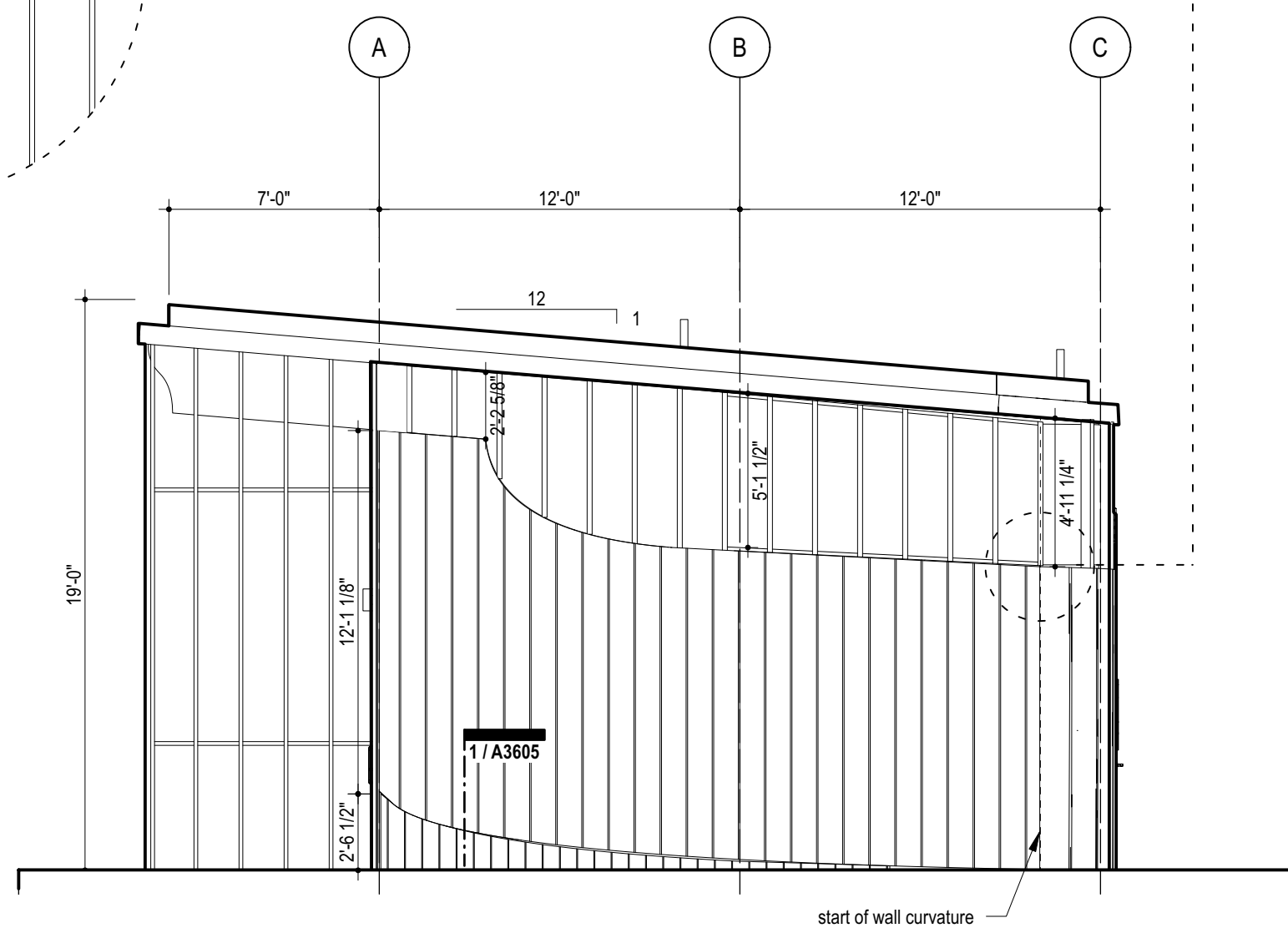
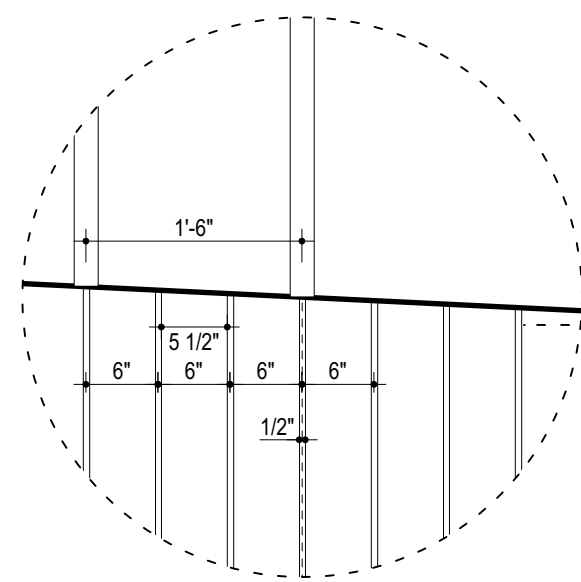
alignment of siding with windows and
doors,
shiplap 1/2" gap, 5" exposed face.

THE ALIGNMENT OF THE SIDING SHOULD
ALWAYS BE ALIGNED WITH THE CW
MULLIONS

7 Rear - East Elevation

A402 Scale: 3/16" = 1'-0"

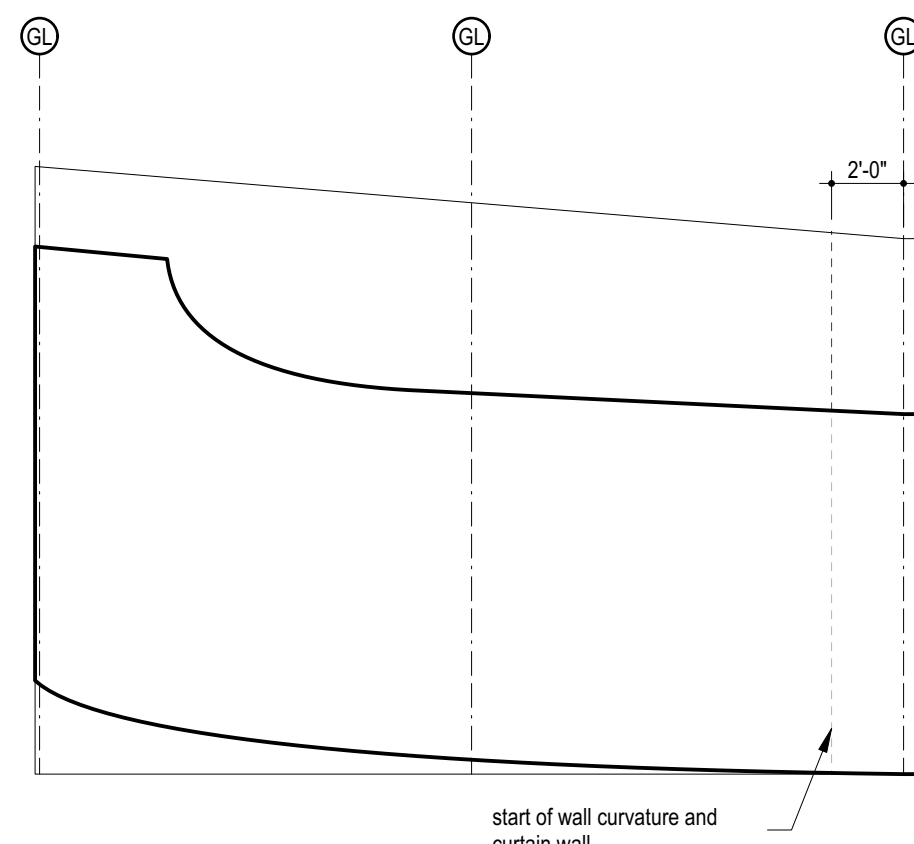
Cedar Cladding Area: 1,107 sq. ft.
Glazing Area (including overhead doors): 605 sq. ft.



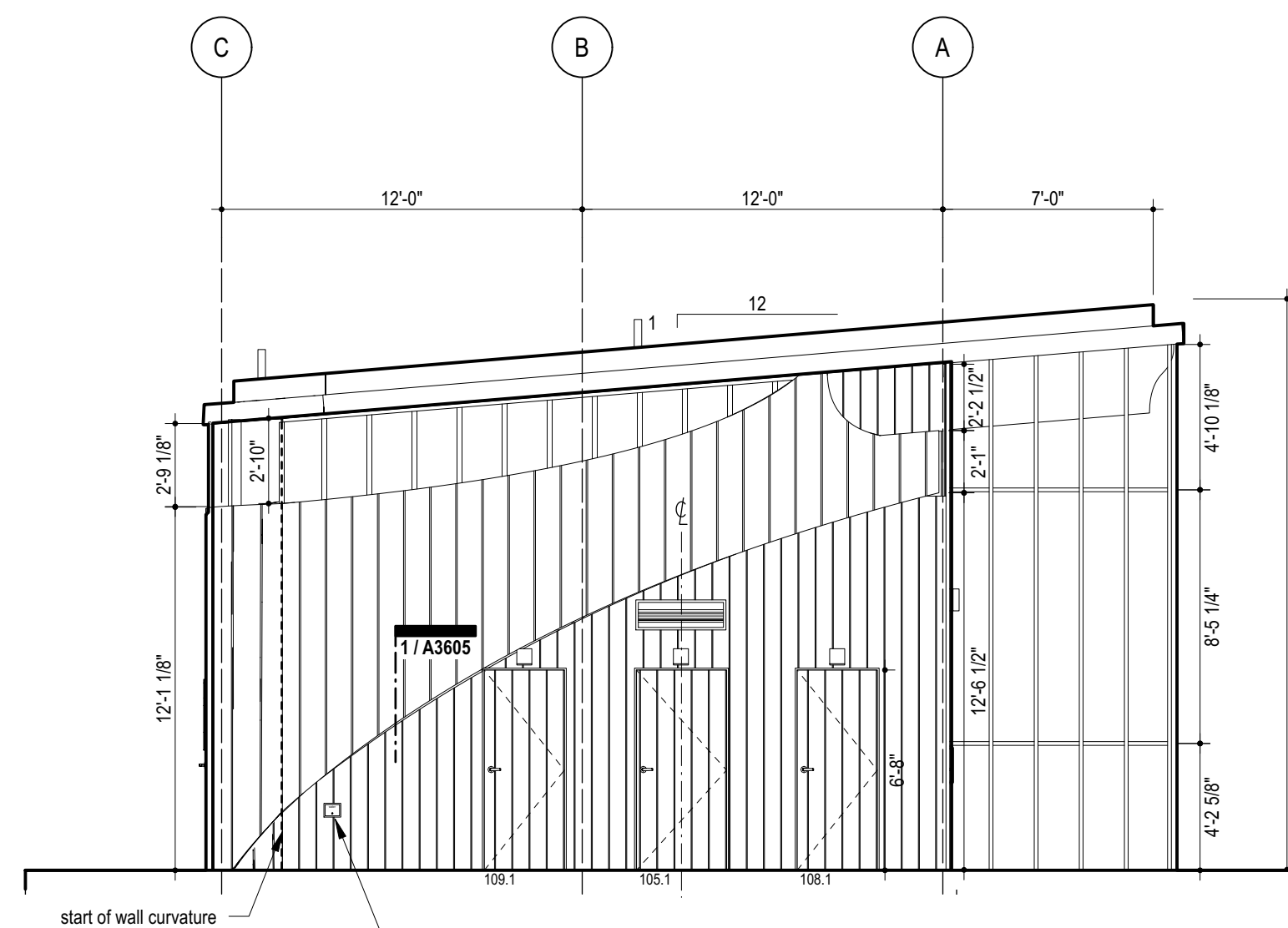
8 North Elevation

A402 Scale: 3/16" = 1'-0"

Cedar Cladding Area: 277 sq. ft.
Glazing Area: 114 sq. ft.



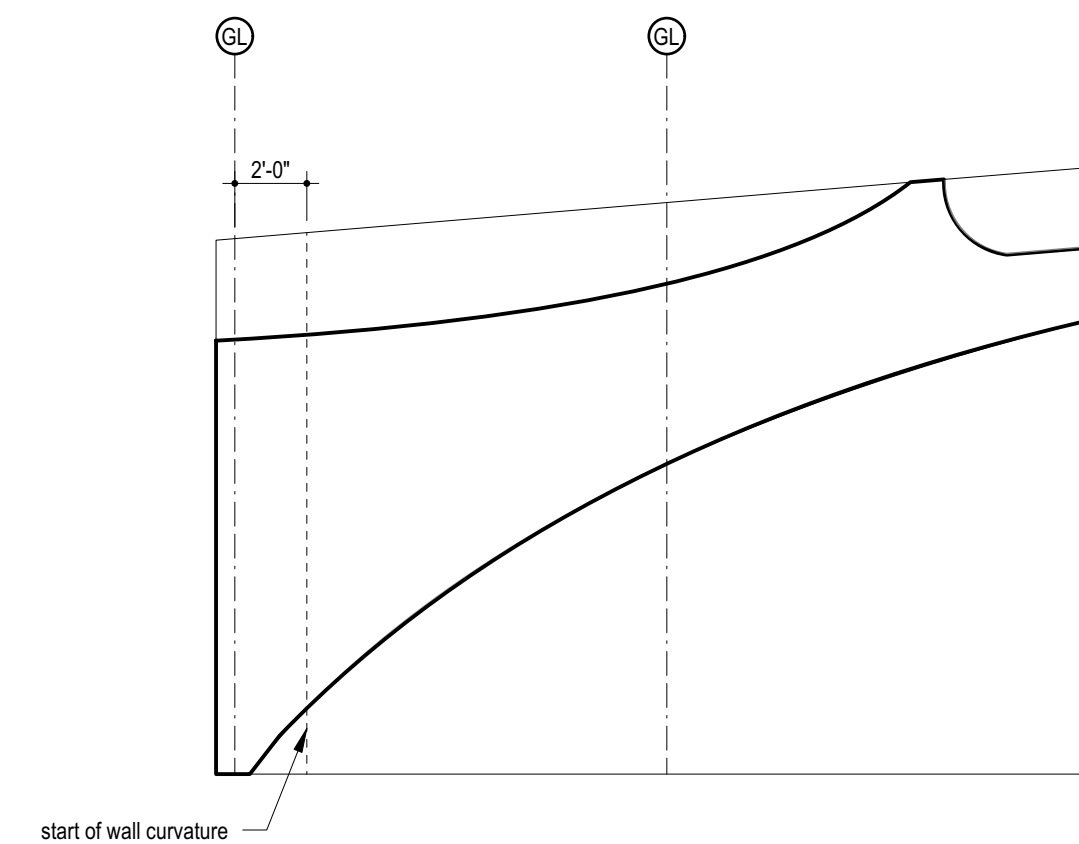
Note:
• Canoe outline
• Print the template to cut exterior siding with the desired curvature, please request the CAD file if needed.



6 South Elevation

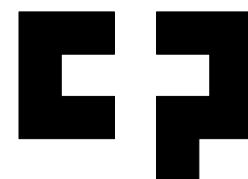
A402 Scale: 3/16" = 1'-0"

Cedar Cladding Area (including doors): 349 sq. ft.
Glazing Area: 43 sq. ft.



Note:
• Canoe outline
• Print the template to cut exterior siding with the desired curvature, please request the CAD file if needed.

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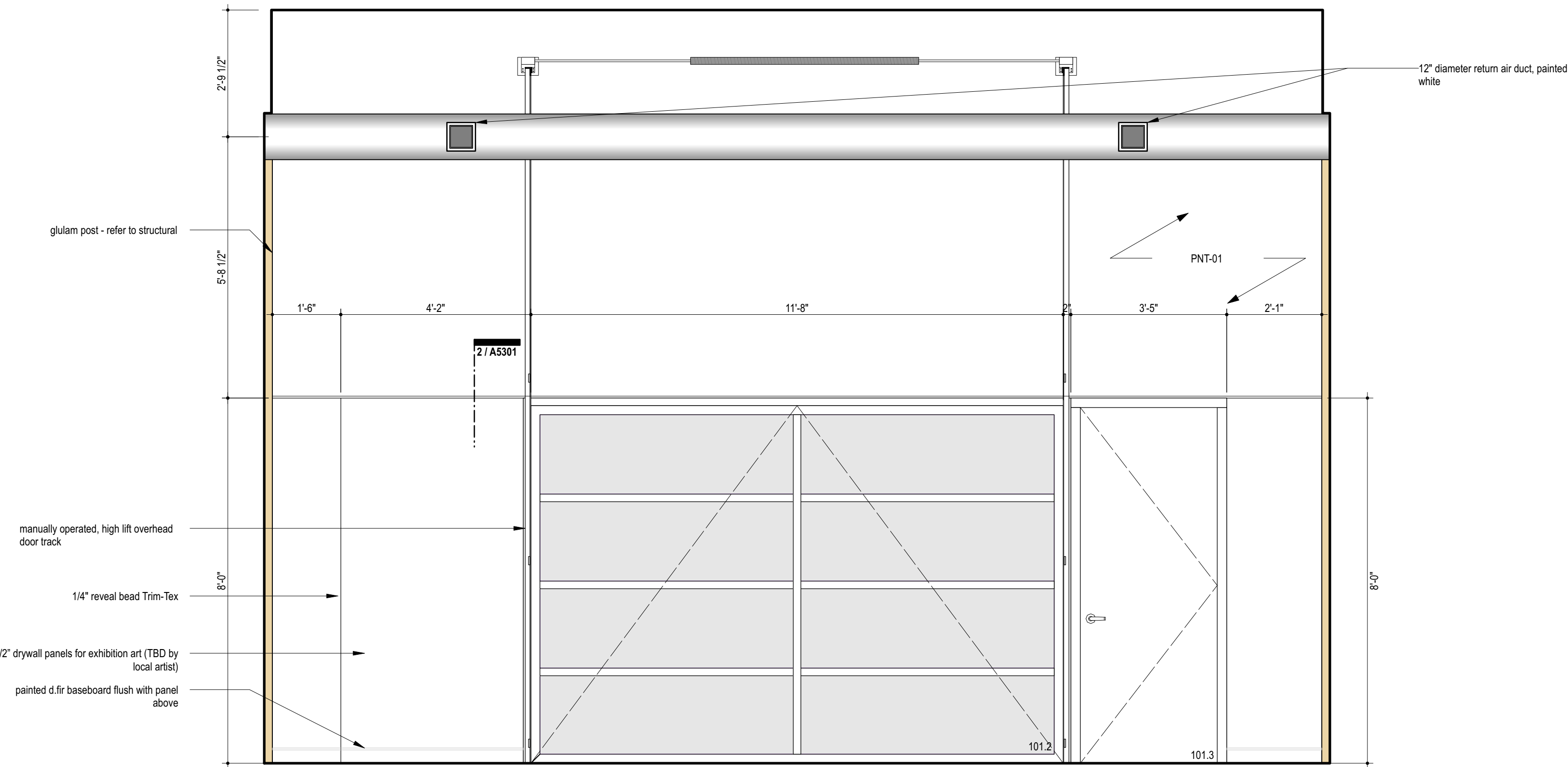
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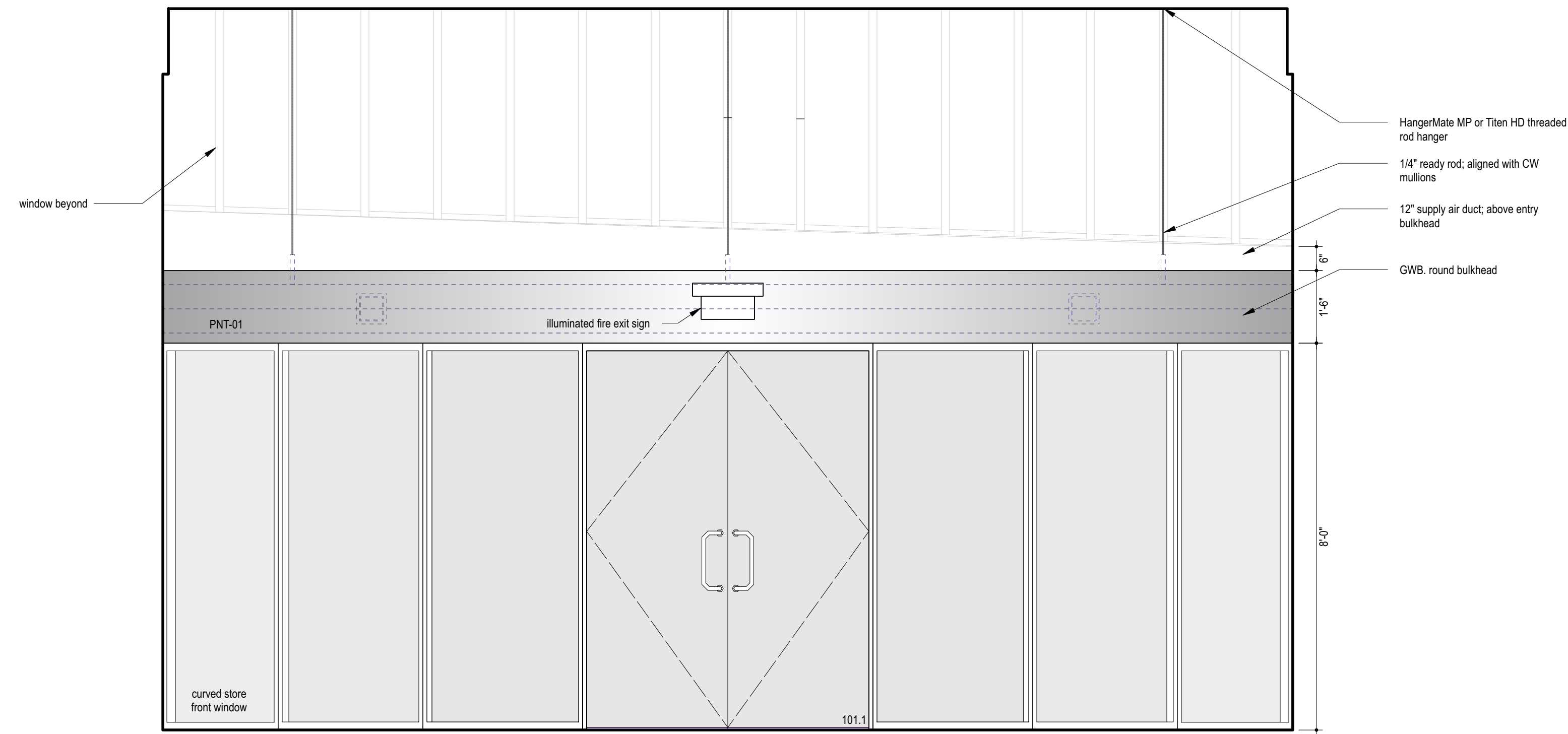
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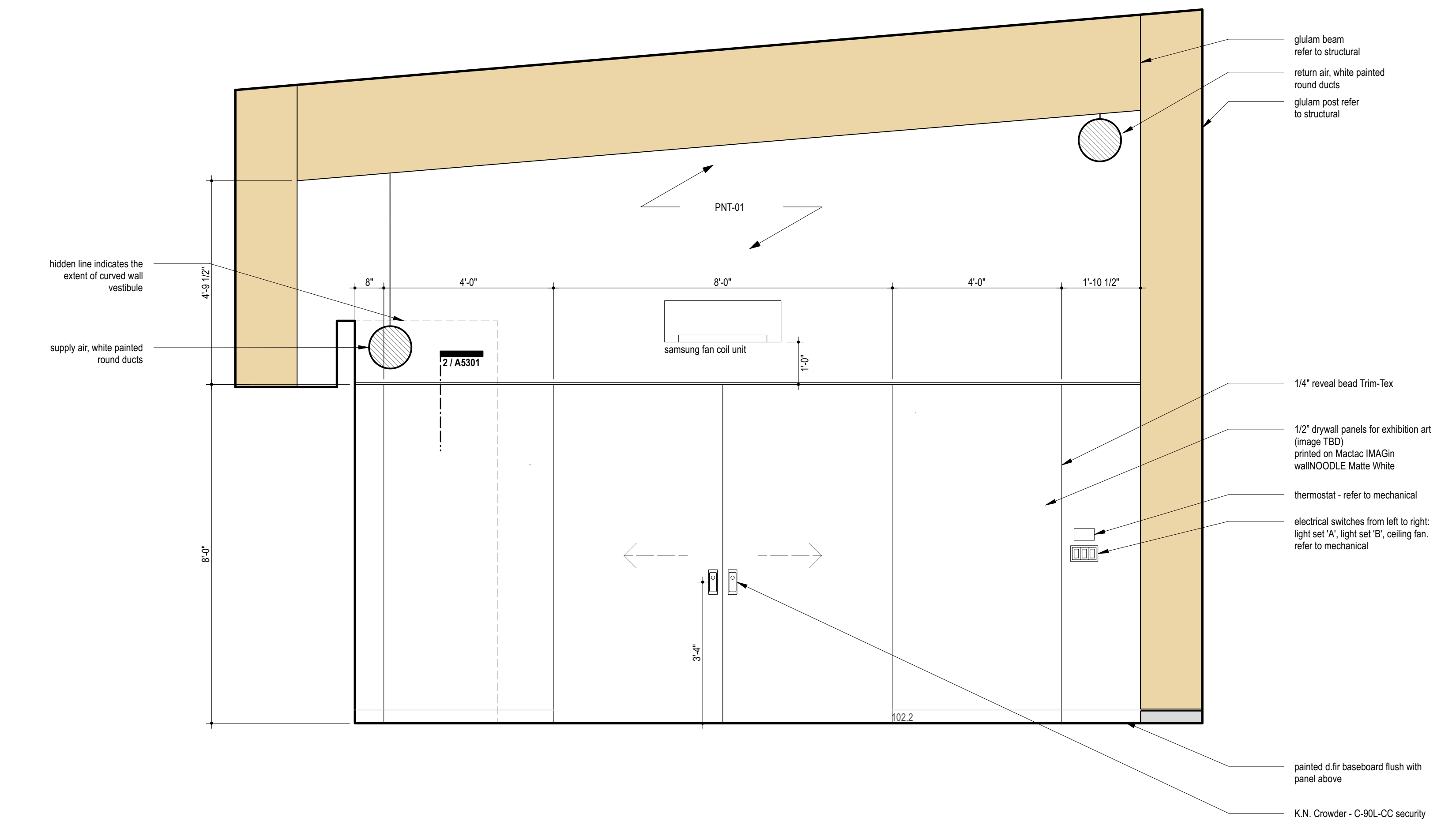
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Project Number	2032	Sheet Name	B&W Exterior Elevations				
Scale	3/16" = 1'-0"	Date	2023.05.23	Issue No.	80	Issued For	IFT - R1
Revision							



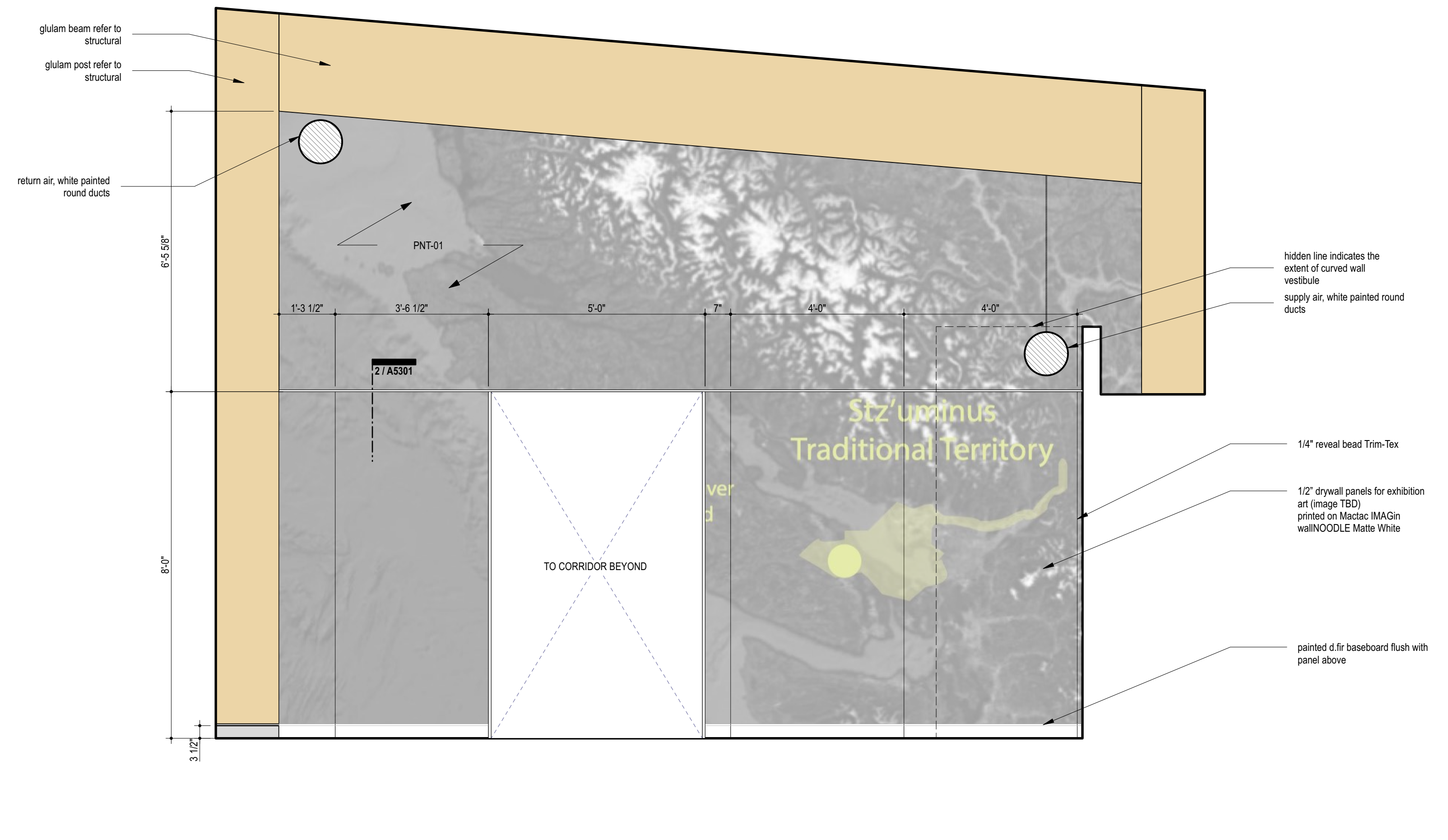
1 East Elevation - Exhibition 101
A502 Scale: 1/2" = 1'-0"



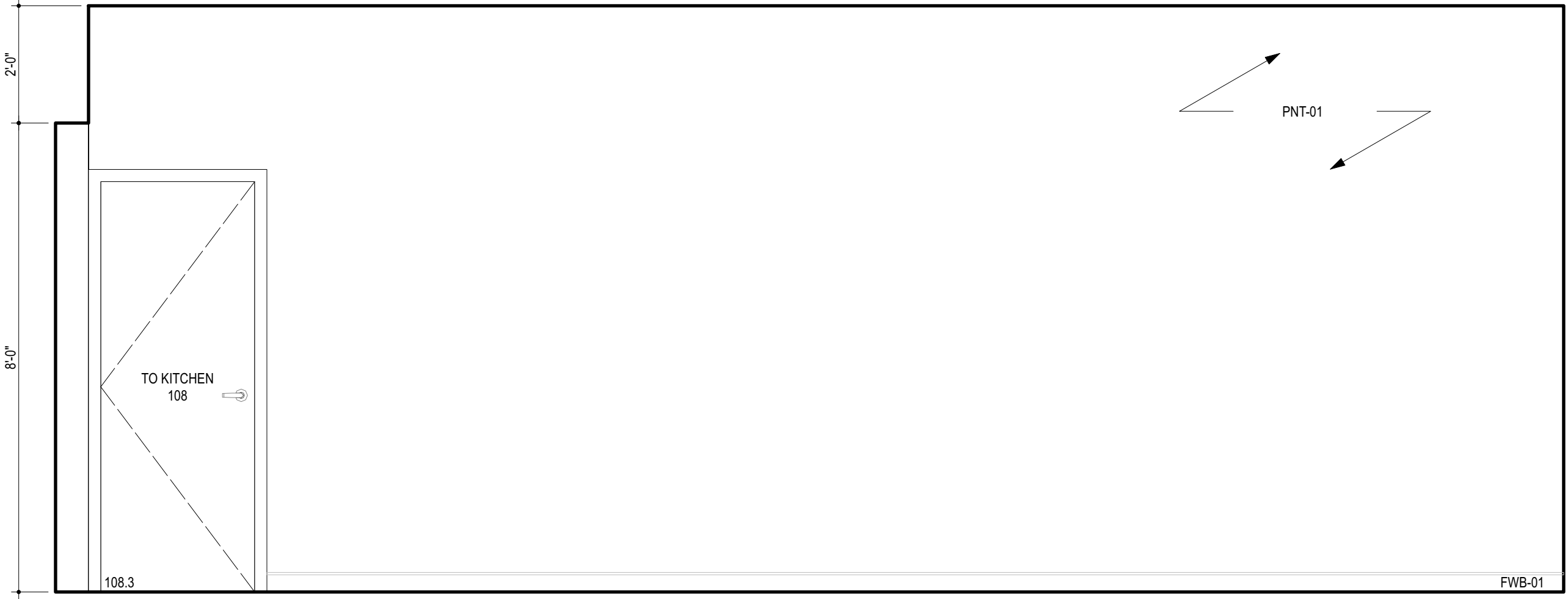
2 West Elevation - Exhibition 101
A502 Scale: 1/2" = 1'-0"



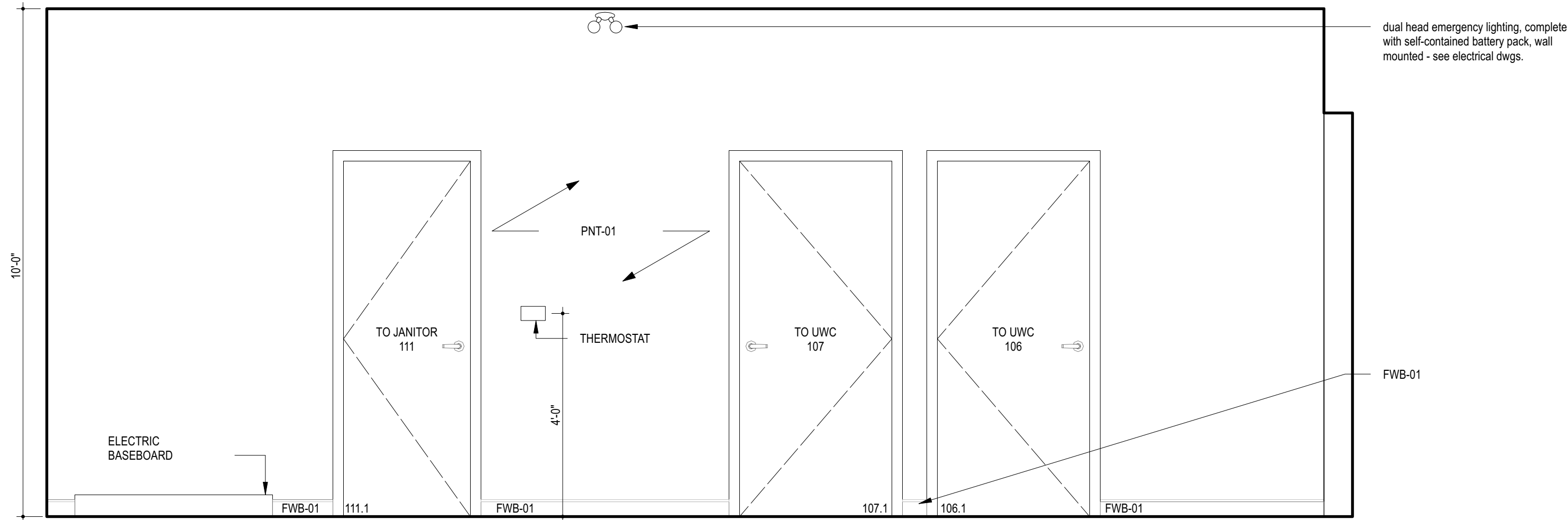
3 North Elevation - Exhibition 101
A502 Scale: 1/2" = 1'-0"



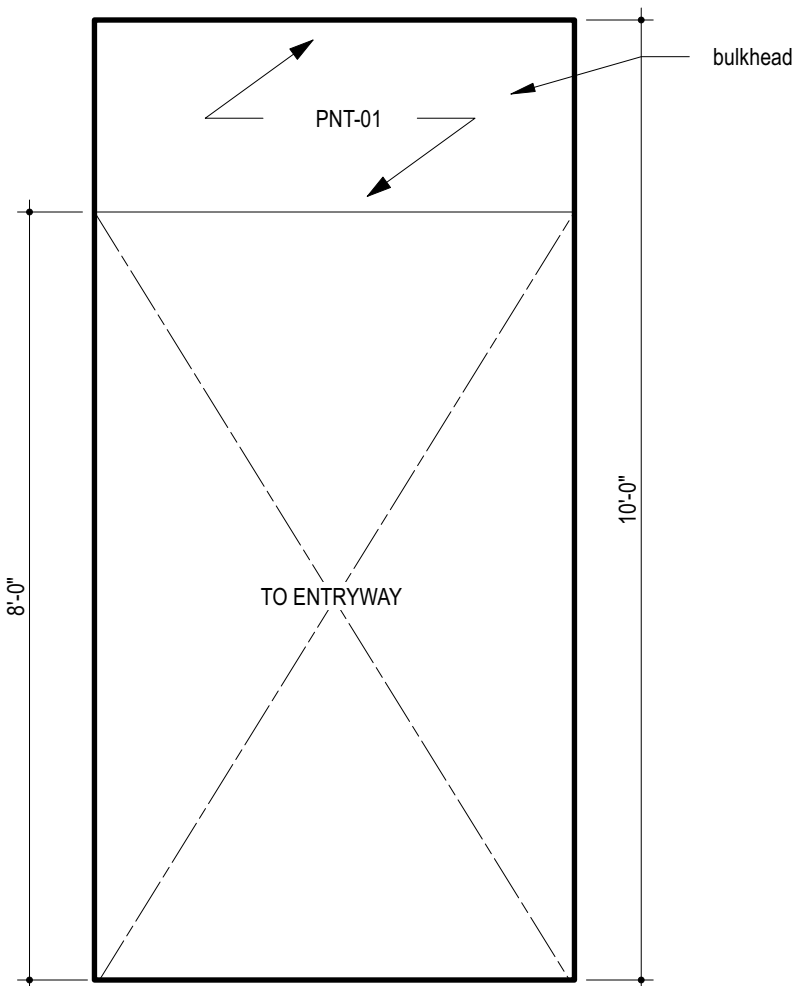
4 South Elevation - Exhibition 101
A502 Scale: 1/2" = 1'-0"



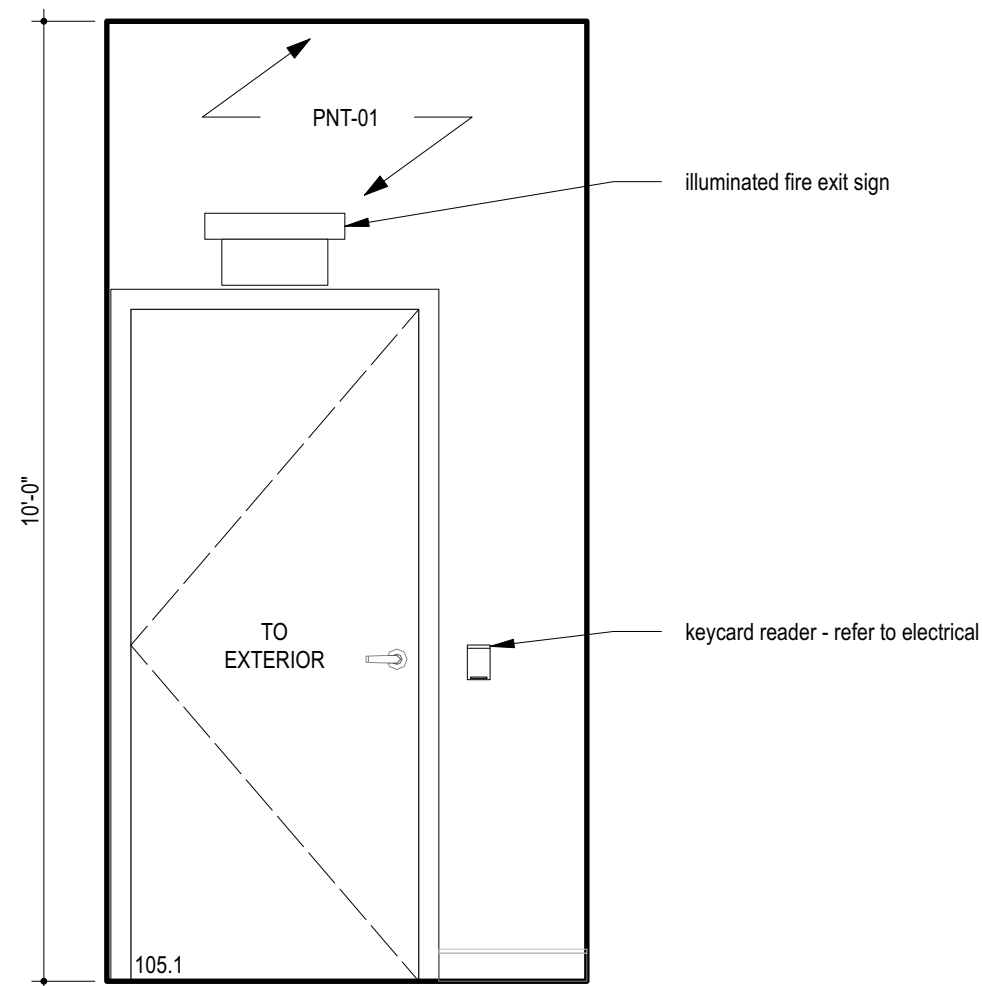
1 East Elevation - Corridor 105
A503 Scale: 1/2" = 1'-0"



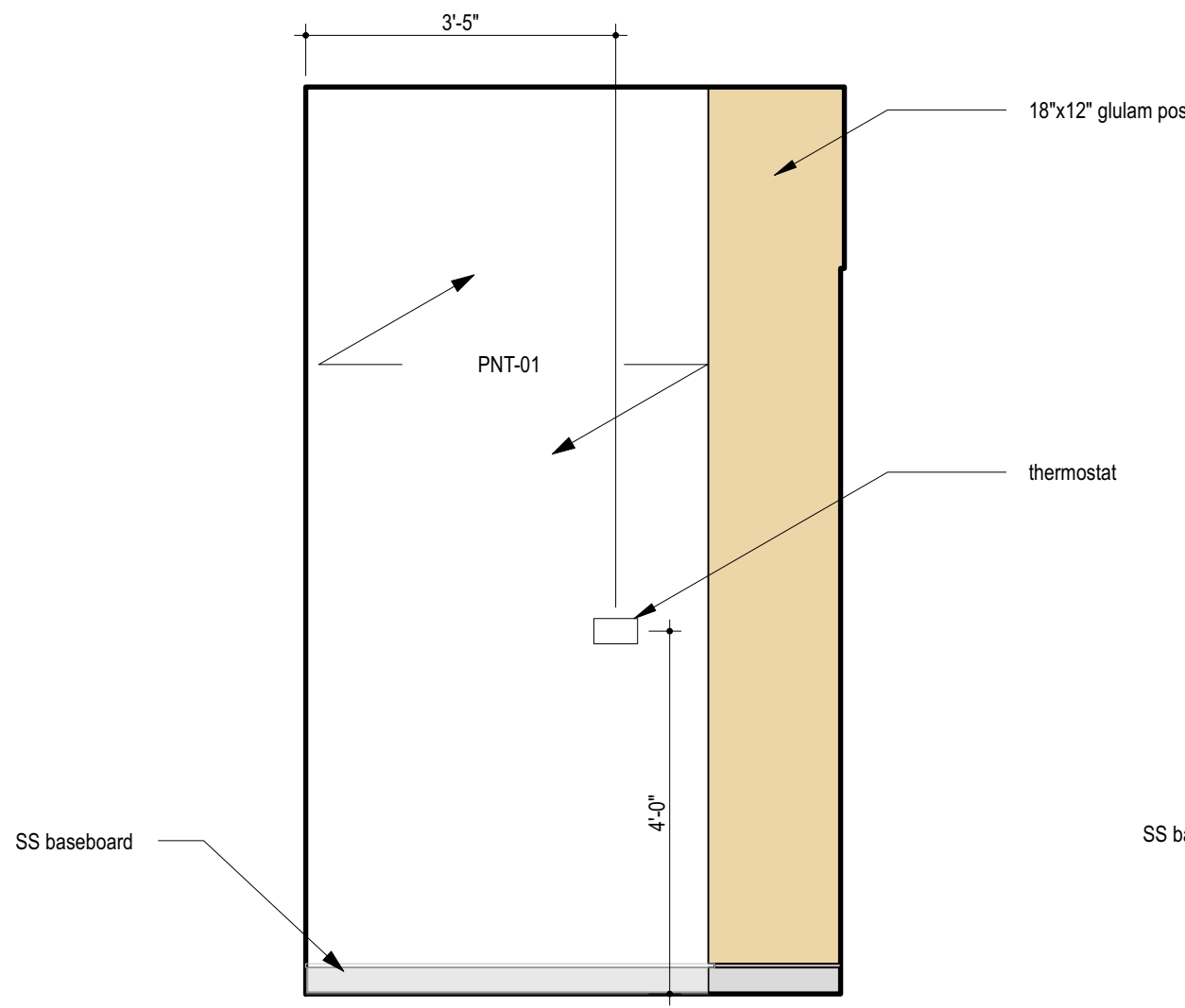
2 West Elevation - Corridor 105
A503 Scale: 1/2" = 1'-0"



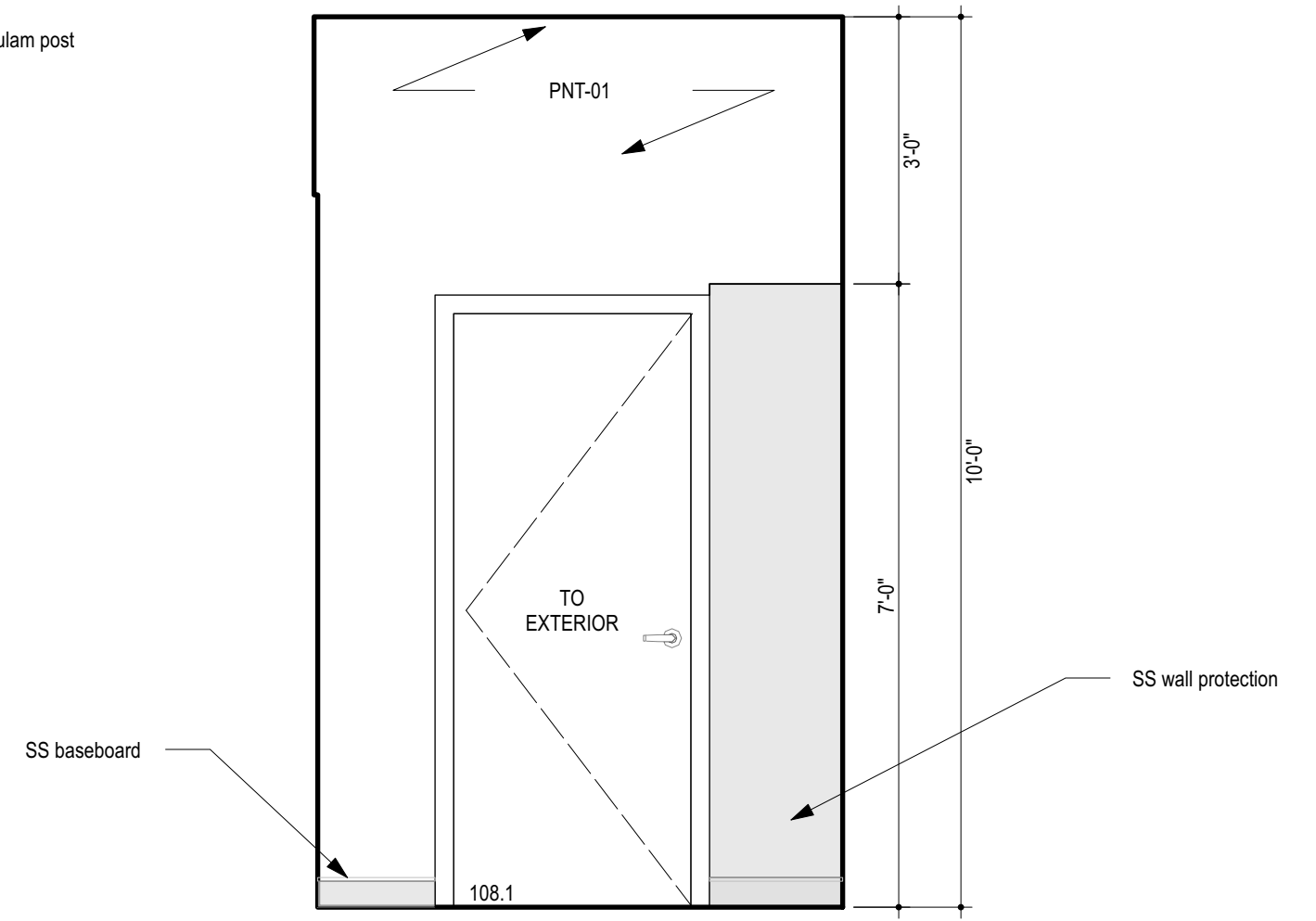
3 North Elevation - Corridor 105
A503 Scale: 1/2" = 1'-0"



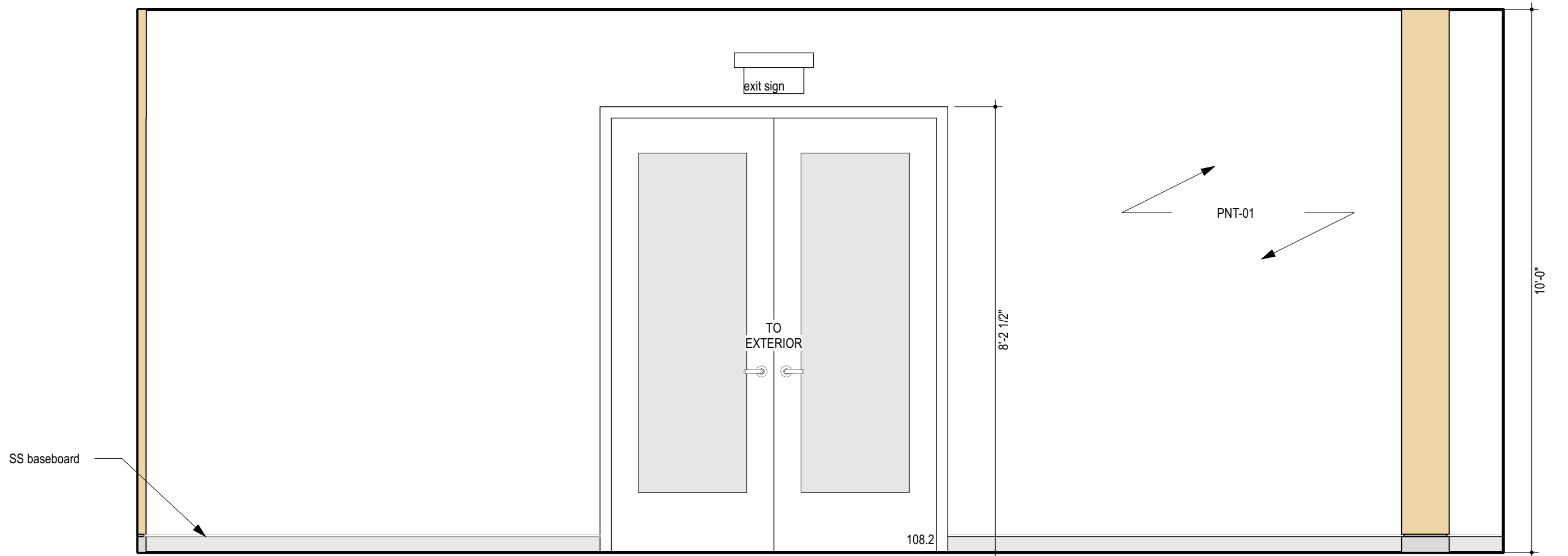
4 South Elevation - Corridor 105
A503 Scale: 1/2" = 1'-0"



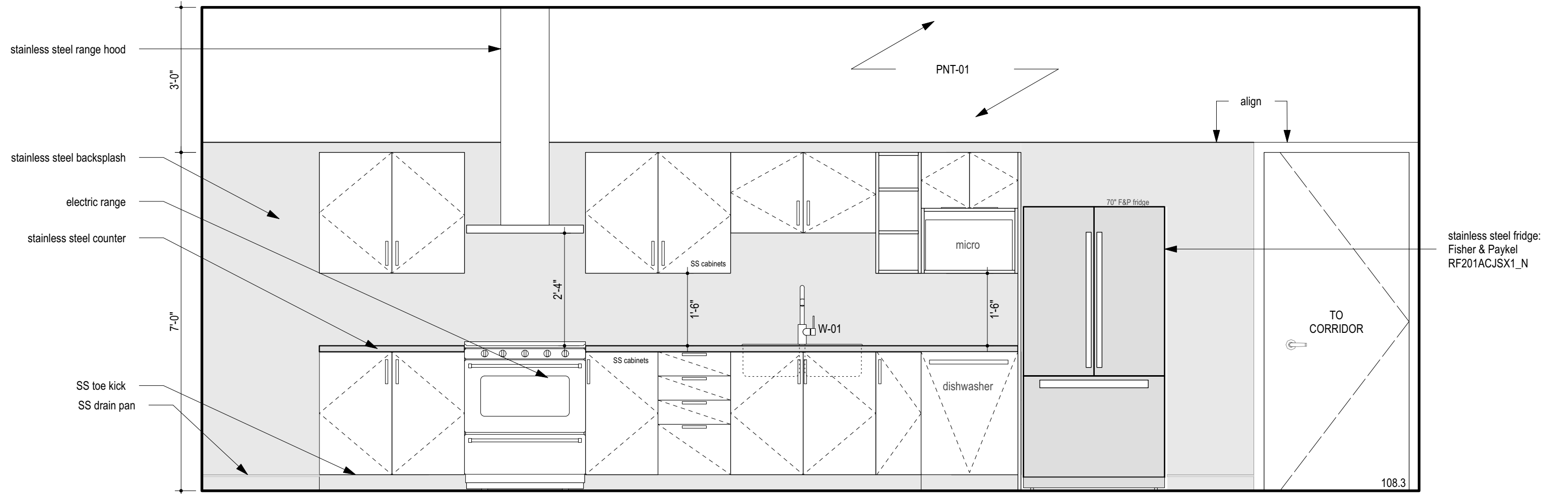
5 North Elevation - Kitchen 108
A503 Scale: 1/2" = 1'-0"



6 South Elevation - Kitchen 108
A503 Scale: 1/2" = 1'-0"



7 East Elevation - Kitchen 108
A503 Scale: 1/2" = 1'-0"



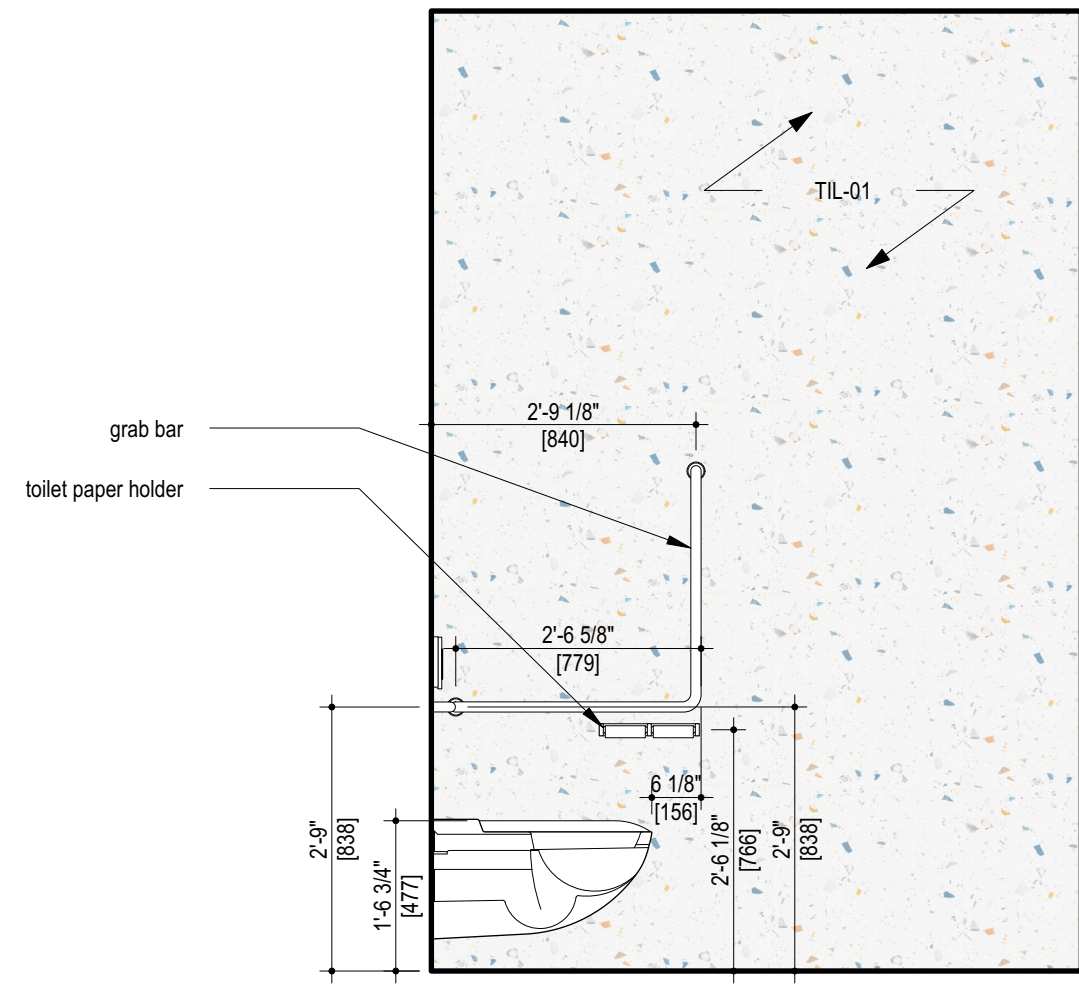
8 West Elevation - Kitchen 108
A503 Scale: 1/2" = 1'-0"



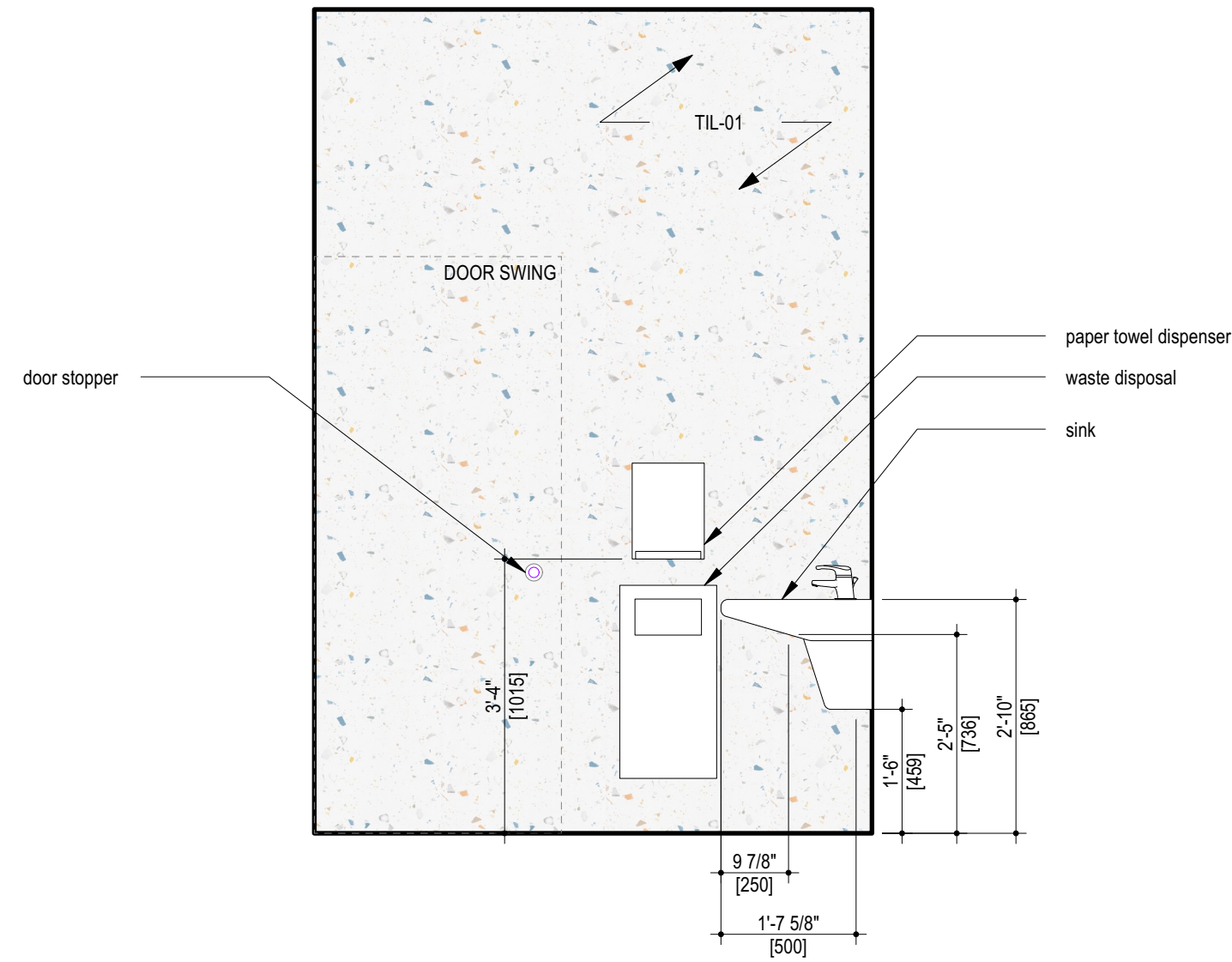
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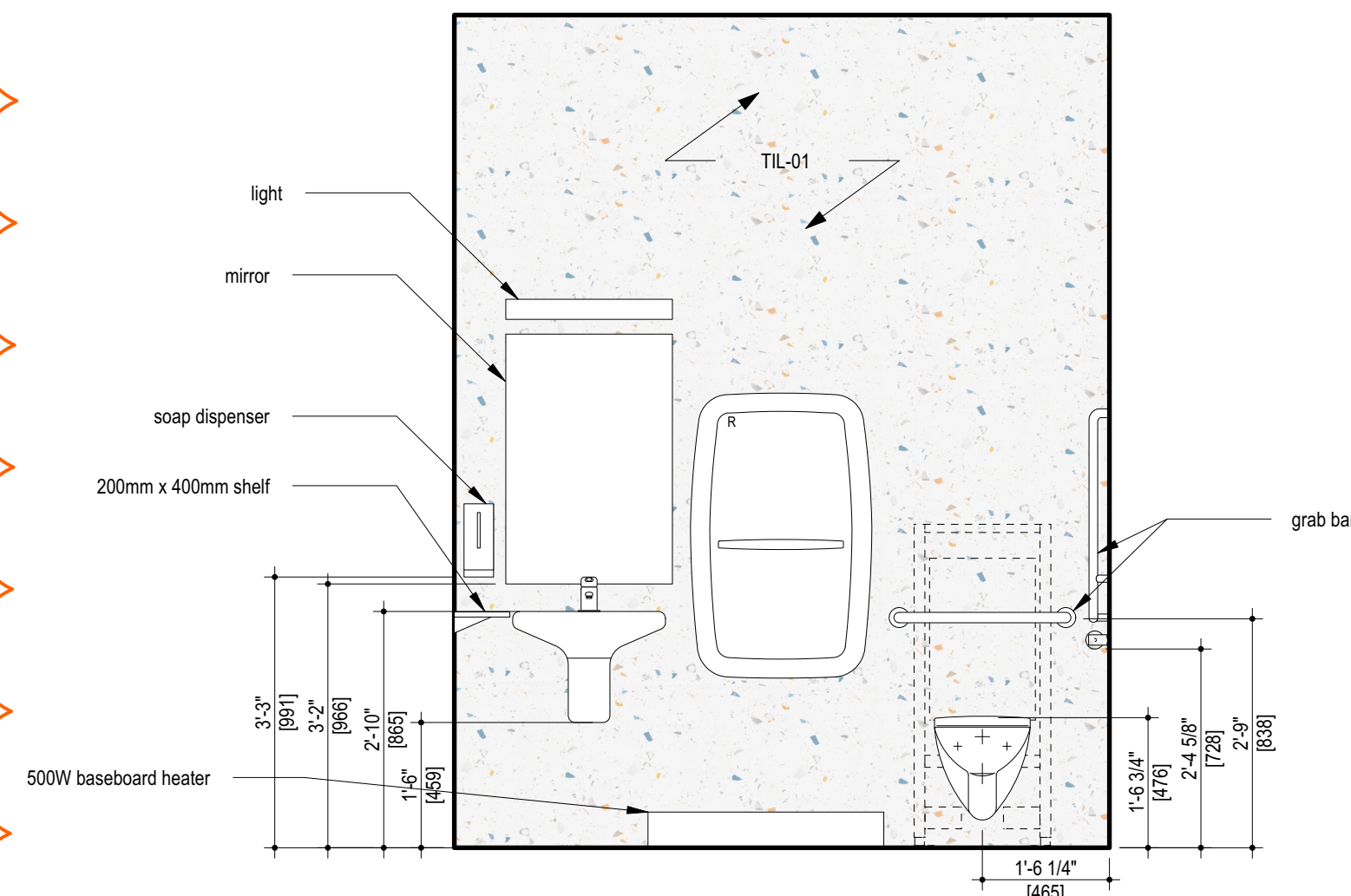
ISSUED FOR TENDER					
Client	Town of Ladysmith	Drawn By	AEP/HA	Reviewed By	BC
Project Number	2032	Sheet Name	Corridor + Kitchen Interior Elevations	Sheet Number	A503
Scale	1/2" = 1'-0"	Date	2023.05.23	Issue No.	80
		Issued For	IFT - R1	Revision	-



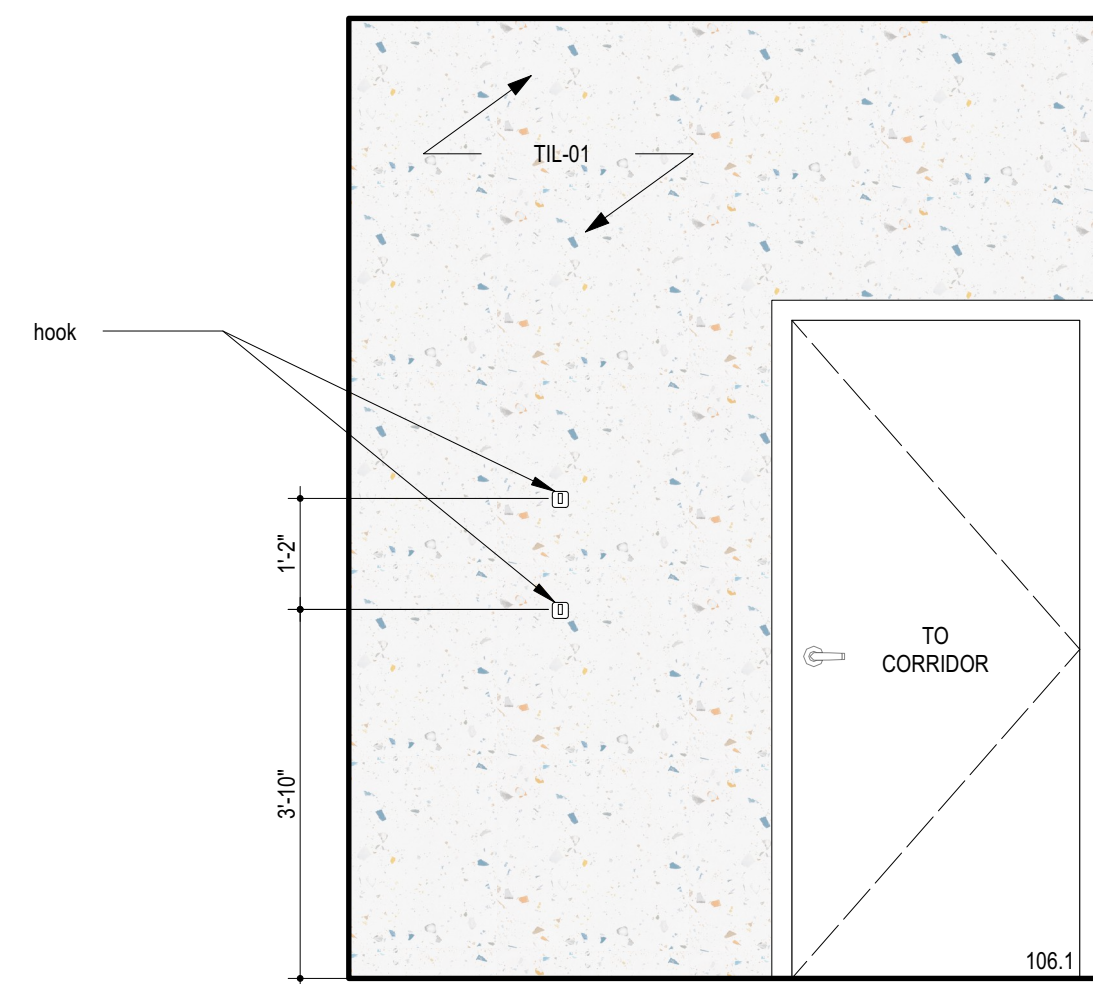
1 North Elevation - UWC 106
A504 Scale: 1/2" = 1'-0"



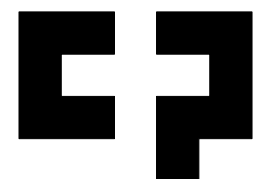
2 South Elevation - UWC 106
A504 Scale: 1/2" = 1'-0"



3 West Elevation - UWC 106
A504 Scale: 1/2" = 1'-0"



4 East Elevation - UWC 106
A504 Scale: 1/2" = 1'-0"



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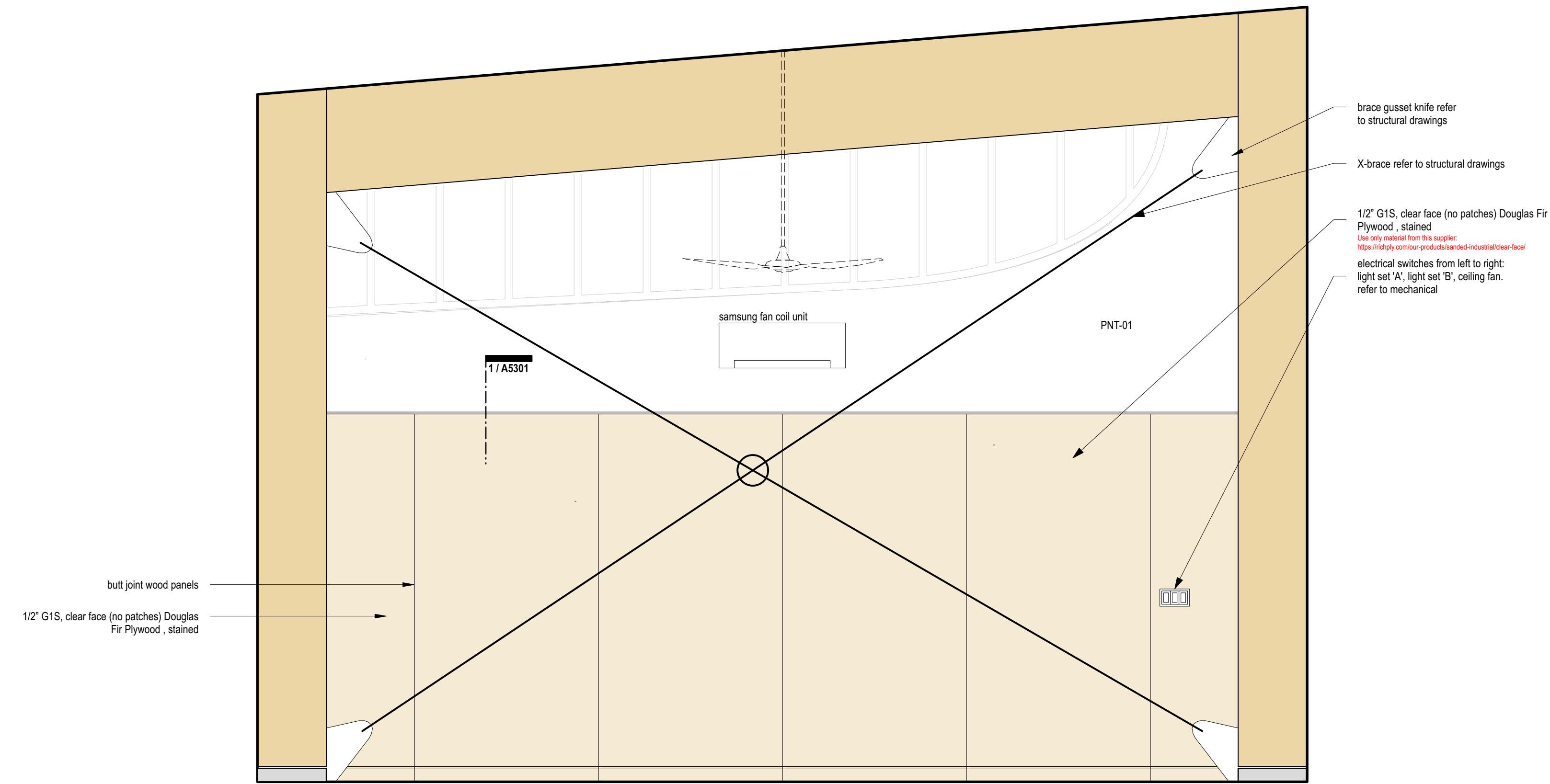
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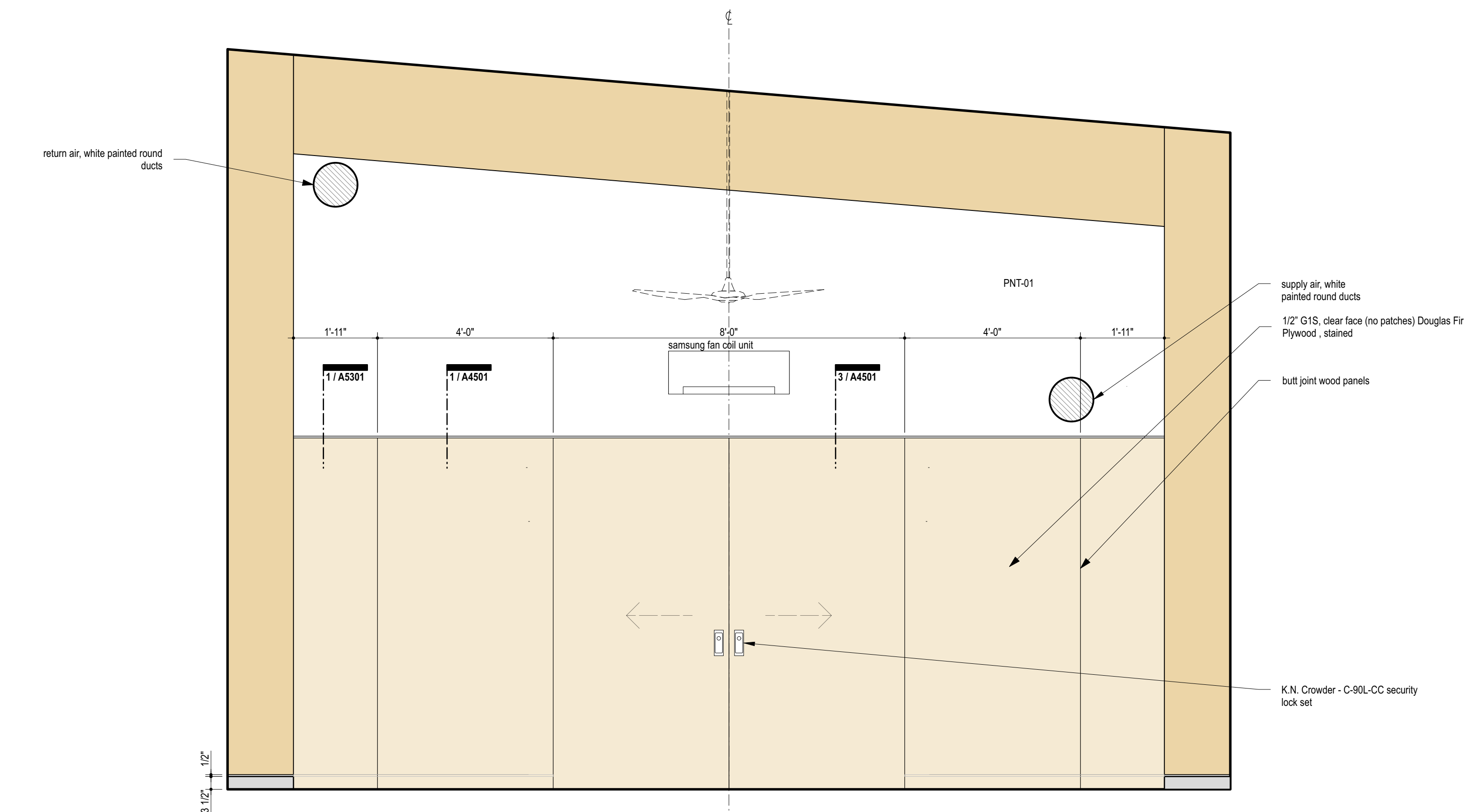
Page 46 of 376

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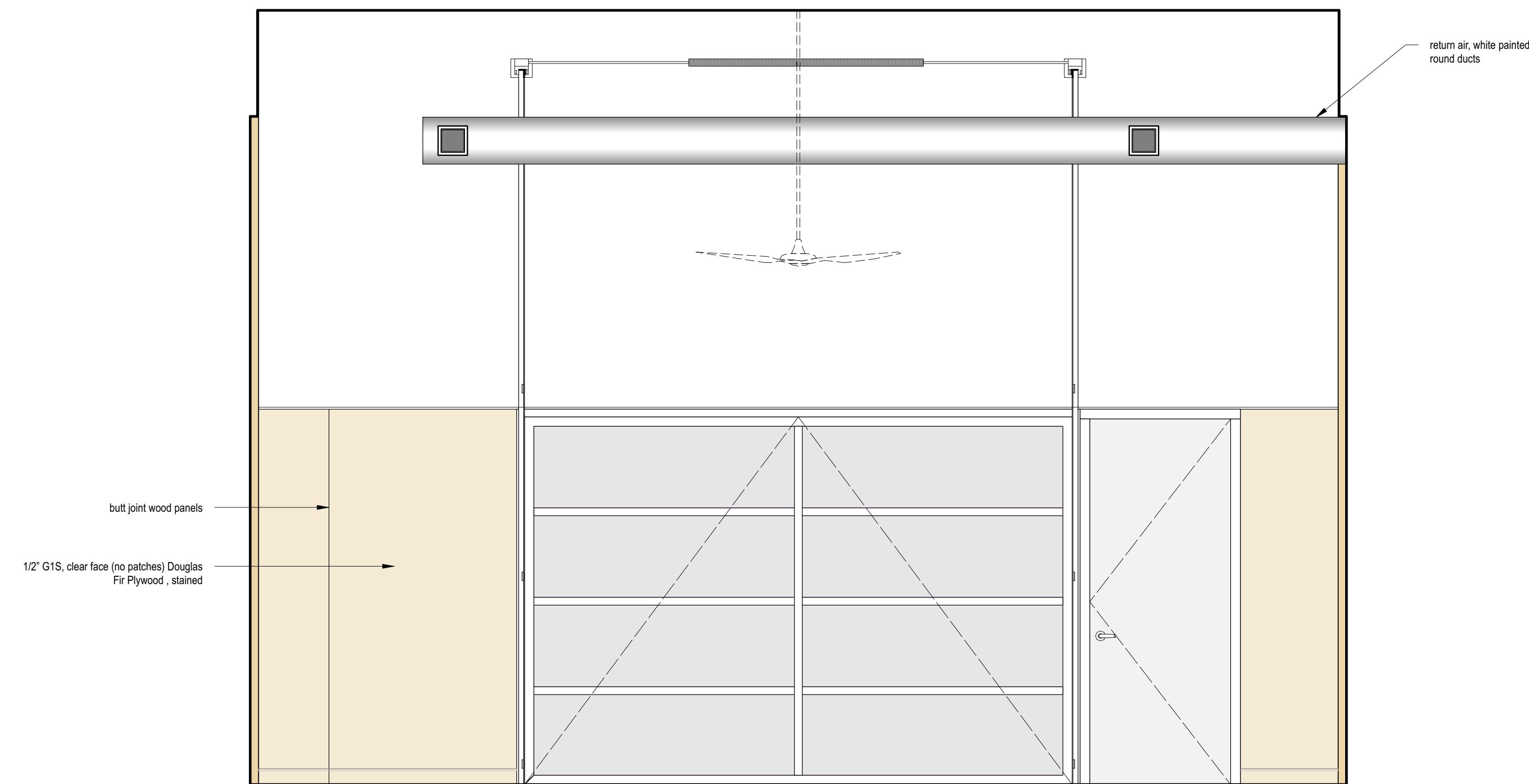
Client Town of Ladysmith	Drawn By AEP/HA	Reviewed By BC	Sheet Number A504
Project Number 2032	Sheet Name Male Universal W/C Interior Elevations		
Scale 1/2" = 1'-0"	Date 2023.05.23	Issue No. 80	Issued For IFT - R1
			Revision -



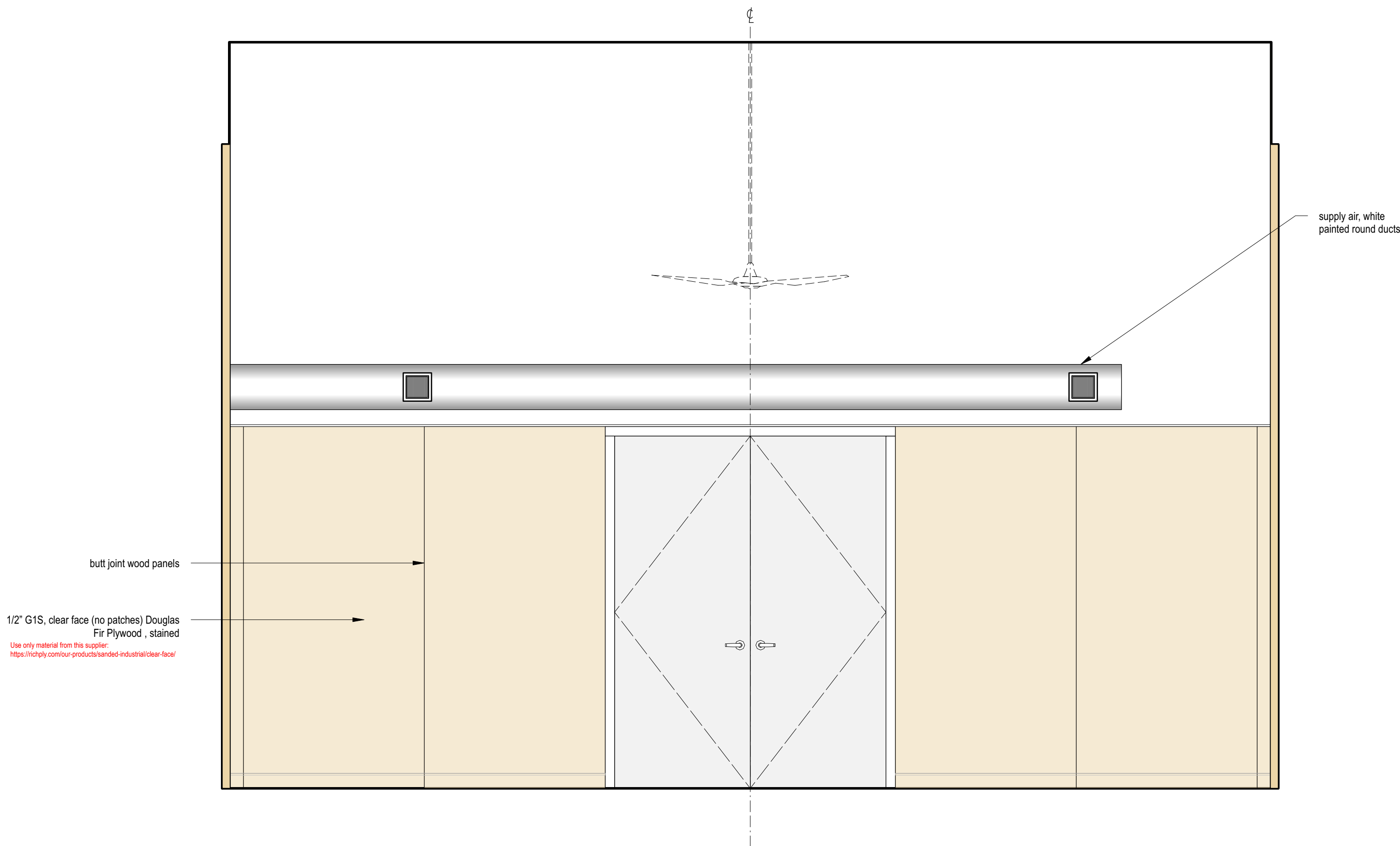
1 North Elevation - Studio 104
A505 Scale: 1/2" = 1'-0"



2 South Elevation - Studio 104
A505 Scale: 1/2" = 1'-0"



3 East Elevation - Studio 104
A505 Scale: 1/2" = 1'-0"



4 West Elevation - Studio 104
A505 Scale: 1/2" = 1'-0"



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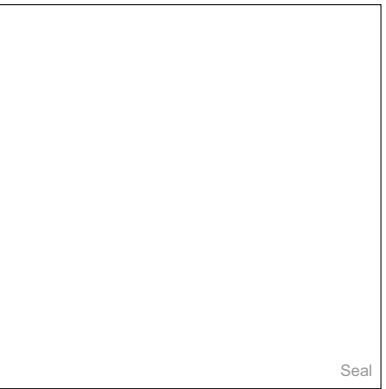
Arts and Heritage Hub Ladysmith, BC

Prepared For: Town of Ladysmith
Prepared By: Checkwitch Poiron Architects Inc.

2023.05.23 Issue 80

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Architectural Details



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<div><div>A2100</div><div>Site Elements</div></div>		<div><div>A3800</div><div>Exterior Surfaces</div></div>	<div><div>A5301</div><div>Sect. - Wall Finish Transition</div></div>
<div><div>A2200</div><div>Exterior Stairs, Ramps and Landings</div></div>			<div><div>A5302</div><div>Plan - Wall to Column</div></div> <div><div>A5303</div><div>Sect. - Wall to Glulam</div></div>
<div><div>A2300</div><div>Patios and Walkways</div></div>		<div><div>A3900</div><div>Mechanical Enclosures</div></div>	<div><div>A5400</div><div>Millwork</div></div>
<div><div>A2400</div><div>Decks & Columns</div></div>		<div><div>A4100</div><div>Steel Doors</div></div>	<div><div>A5500</div><div>Bulkheads</div></div>
<div><div>A2401</div><div>Section - Handrail Deck</div></div>	<div><div>A4101</div><div>Section -Door Header/Sill</div></div>		<div><div>A1002</div><div>Section - Entry CW</div></div>
<div><div>A2402</div><div>Section - Front Deck</div></div>	<div><div>√4101(OLD</div><div>Section -Door Header</div></div>		
<div><div>A2403</div><div>Section - Front Deck / Concrete Slab</div></div>	<div><div>√4102(OLD</div><div>Section - Door Sill - Deck</div></div>		
	<div><div>A4103</div><div>Plan - Door Jamb</div></div>		
	<div><div>√4103(OLD</div><div>Plan - Door Jamb</div></div>		<div><div>A5600</div><div>Fire Rated Details</div></div>
<div><div>A2500</div><div>Trellis & Awnings</div></div>	<div><div>A4103b</div><div>Plan - Door Latch</div></div>		<div><div>A5700</div><div>Mechanical</div></div>
	<div><div>A4104</div><div>Section - Interior Door Header</div></div>		<div><div>A5701</div><div>Section - GLT cavity</div></div>
	<div><div>A4105</div><div>Plan - Interior Door Jamb</div></div>		<div><div>A5702</div><div>Section - GLT cavity</div></div>
<div><div>A2900</div><div>Site Miscellaneous</div></div>	<div><div>A4106</div><div>Section - Interior Door Header</div></div>		
	<div><div>A4107</div><div>Plan - Door Jamb</div></div>		<div><div>A5800</div><div>Specialties</div></div>
		<div><div>A4200</div><div>Vinyl Doors & Windows</div></div>	
<div><div>A3100</div><div>Footing & Foundation Junctions</div></div>			<div><div>A5900</div><div>Miscellaneous</div></div>
<div><div>A3101</div><div>Section - Grade Beam to Steel Beams</div></div>			
<div><div>A3102</div><div>Section - Floor to Deck</div></div>			
<div><div>A3103</div><div>Section - Piles to Deck</div></div>		<div><div>A4300</div><div>Fibreglass Doors & Windows</div></div>	
<div><div>A3104</div><div>Section - Grade Beam to Steel</div></div>			
		<div><div>A4400</div><div>Aluminum Doors & Windows</div></div>	
<div><div>A3200</div><div>Wall & Floor Junctions</div></div>		<div><div>A4400</div><div>Aluminum Doors & Windows</div></div>	
<div><div>A3201</div><div>Section - Wall to Floor Junction</div></div>		<div><div>A4401</div><div>Section - Overhead Door</div></div>	
<div><div>A3202</div><div>Section - Floor to Column</div></div>		<div><div>A4402</div><div>Plan - Overhead Door</div></div>	
<div><div>A3300</div><div>Wall & Roof Junctions</div></div>		<div><div>A4500</div><div>Wood Doors & Windows</div></div>	
<div><div>A3301</div><div>Section - Roof Eave</div></div>		<div><div>A4500</div><div>Wood Doors & Windows</div></div>	
<div><div>A3302</div><div>Section - Roof Ext. to Int.</div></div>		<div><div>A4501</div><div>Section - Pocket Door Header</div></div>	
<div><div>A3303</div><div>Section - Column to Roof</div></div>		<div><div>A4502</div><div>Plan - Pocket Door Jamb</div></div>	
		<div><div>A4503</div><div>Plan - Pocket Door Lock</div></div>	
<div><div>A3400</div><div>Eaves, Ridges & Parapets</div></div>		<div><div>A4600</div><div>Storefront Systems</div></div>	
<div><div>A3401</div><div>Section - Roof Eave Glulam</div></div>			
<div><div>A3500</div><div>Wall, Floor & Roof Junctions</div></div>		<div><div>A4700</div><div>Curtainwall Systems</div></div>	
		<div><div>A4701</div><div>Section - CW Header</div></div>	
		<div><div>A4702</div><div>Section - CW Sill</div></div>	
		<div><div>A4703</div><div>Plan - CW Jamb</div></div>	
		<div><div>A4704</div><div>Plan - CW Jamb Round Corner</div></div>	
<div><div>A3600</div><div>Miscellaneous Junctions</div></div>		<div><div>A4800</div><div>Skylights</div></div>	
<div><div>A3601</div><div>Plan - Wall to Column</div></div>			
<div><div>A3602</div><div>Section - Entry Wall</div></div>			
<div><div>A3603</div><div>Plan - Exterior Slats / Corner</div></div>		<div><div>A4900</div><div>Miscellaneous Openings</div></div>	
<div><div>A3604</div><div>Section - Exterior Slats</div></div>			
<div><div>A3605</div><div>Section - Siding Transition</div></div>			
<div><div>A3700</div><div>Penetrations</div></div>		<div><div>A5100</div><div>Interior Stairs, Ramps and Landings</div></div>	
		<div><div>A5200</div><div>Conveyances</div></div>	
		<div><div>A5300</div><div>Flooring and Walls</div></div>	

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Decks & Columns



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Drawing
Decks & Columns
Project Number
2032
Client
Town of Ladysmith

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Issue No.
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Reviewed By
DP
Issued For
IFT - R1

Scale
n/a

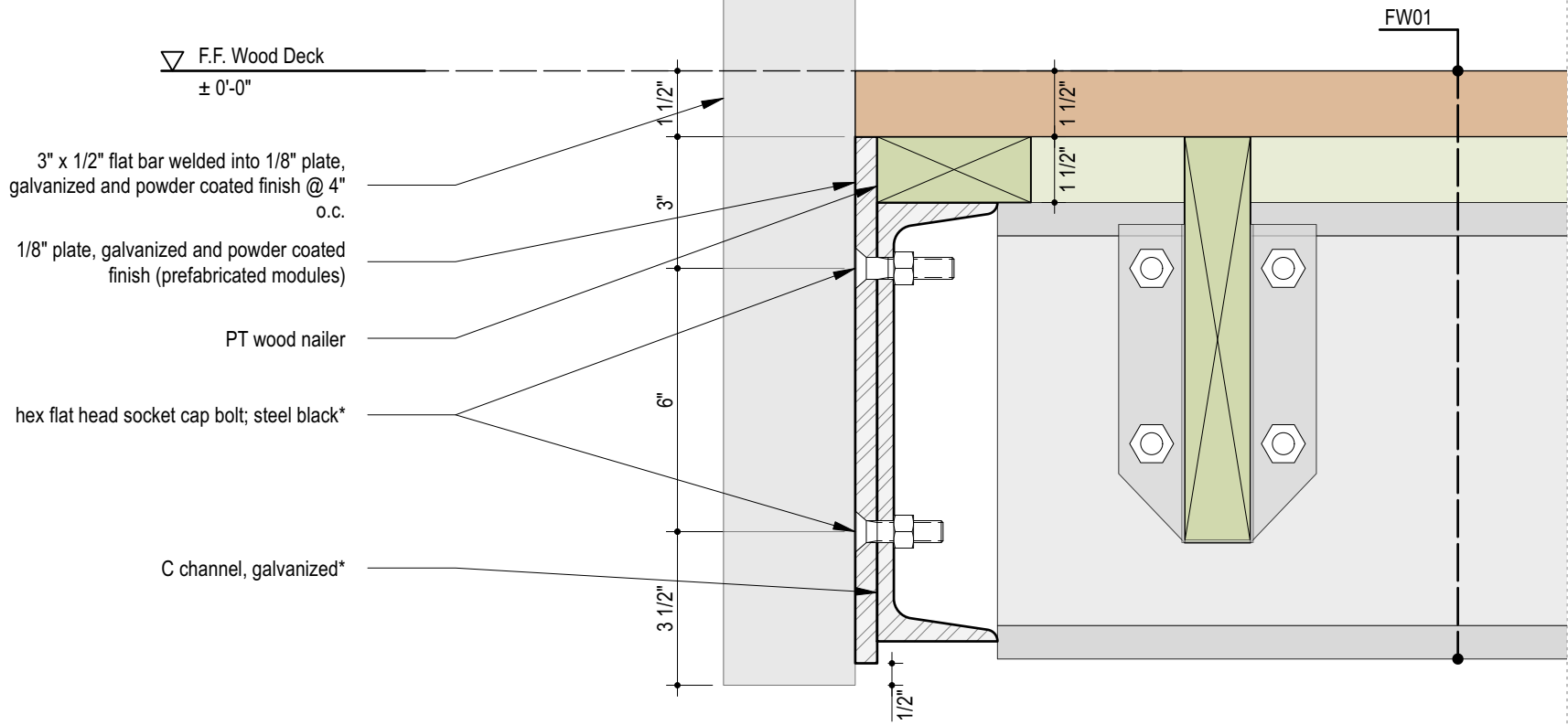
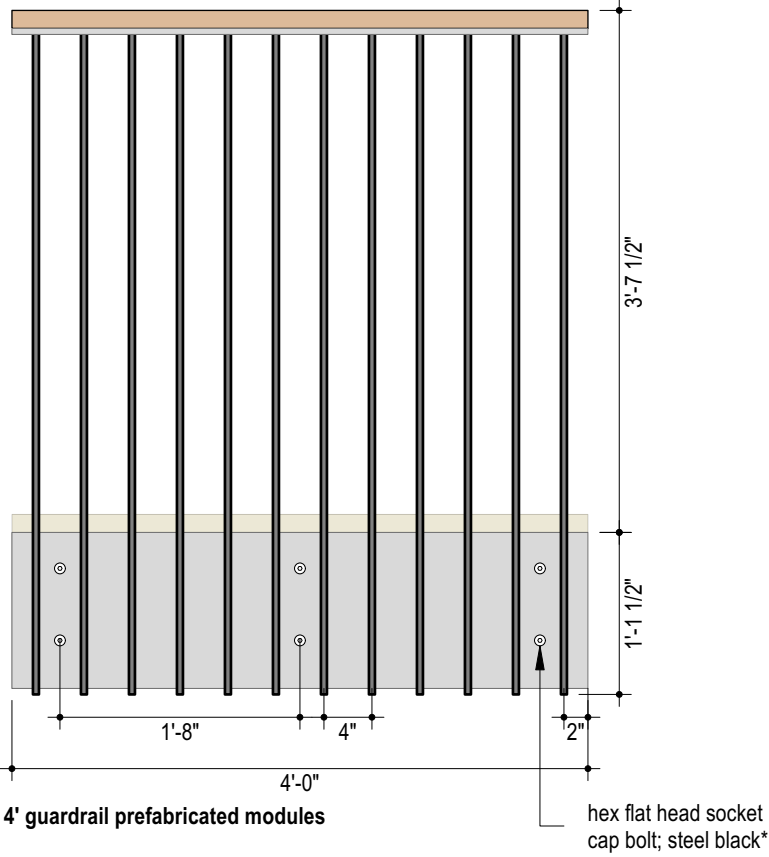
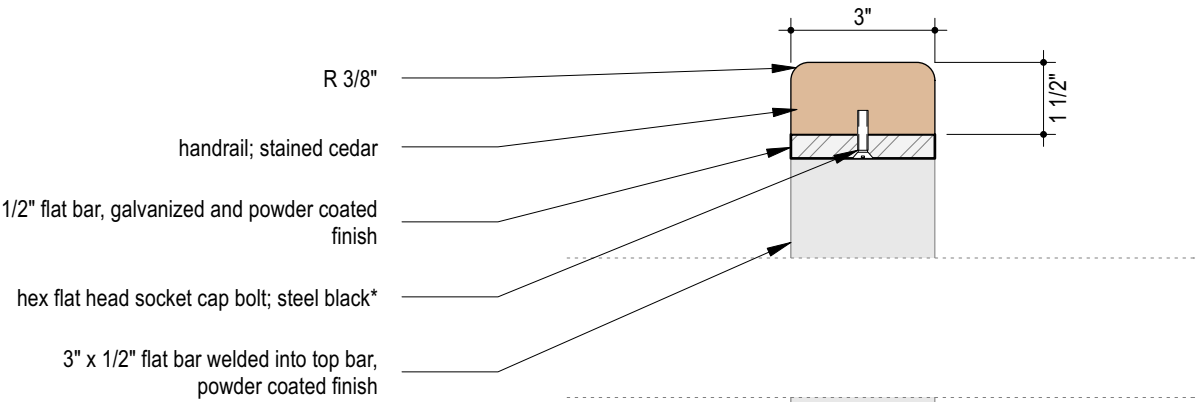
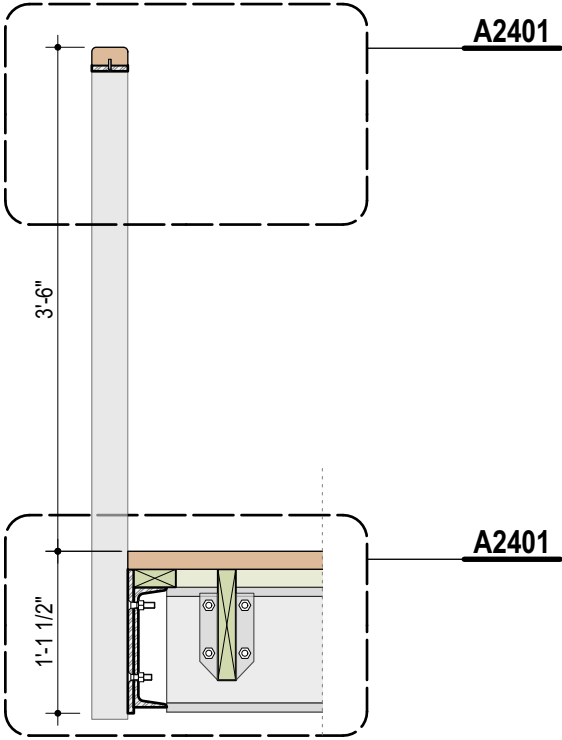
Reference
Date
2023.05.23

Sheet Number
A2400

Seal

Key Section

Flashing Profile



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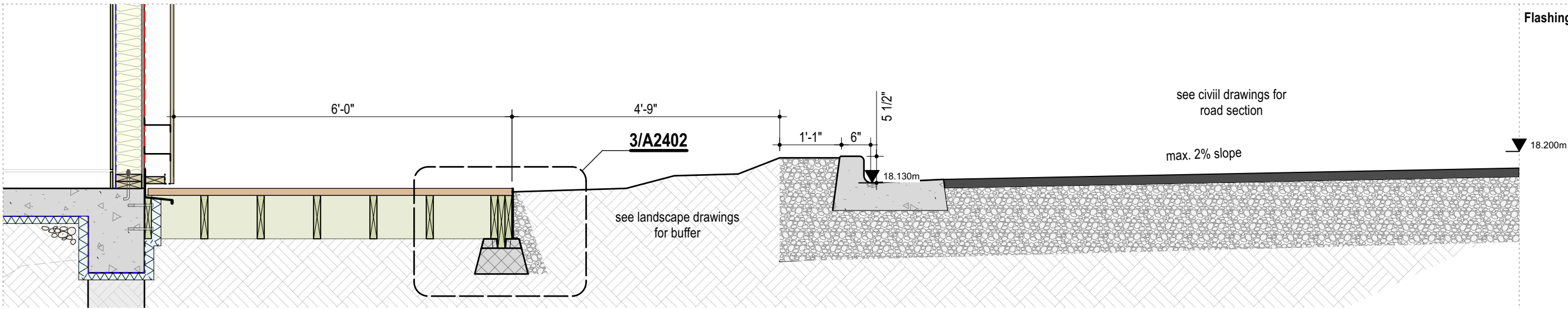
Drawing
Section - Handrail Deck
Project Number
2032
Client
Town of Ladysmith

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Reviewed By
BC
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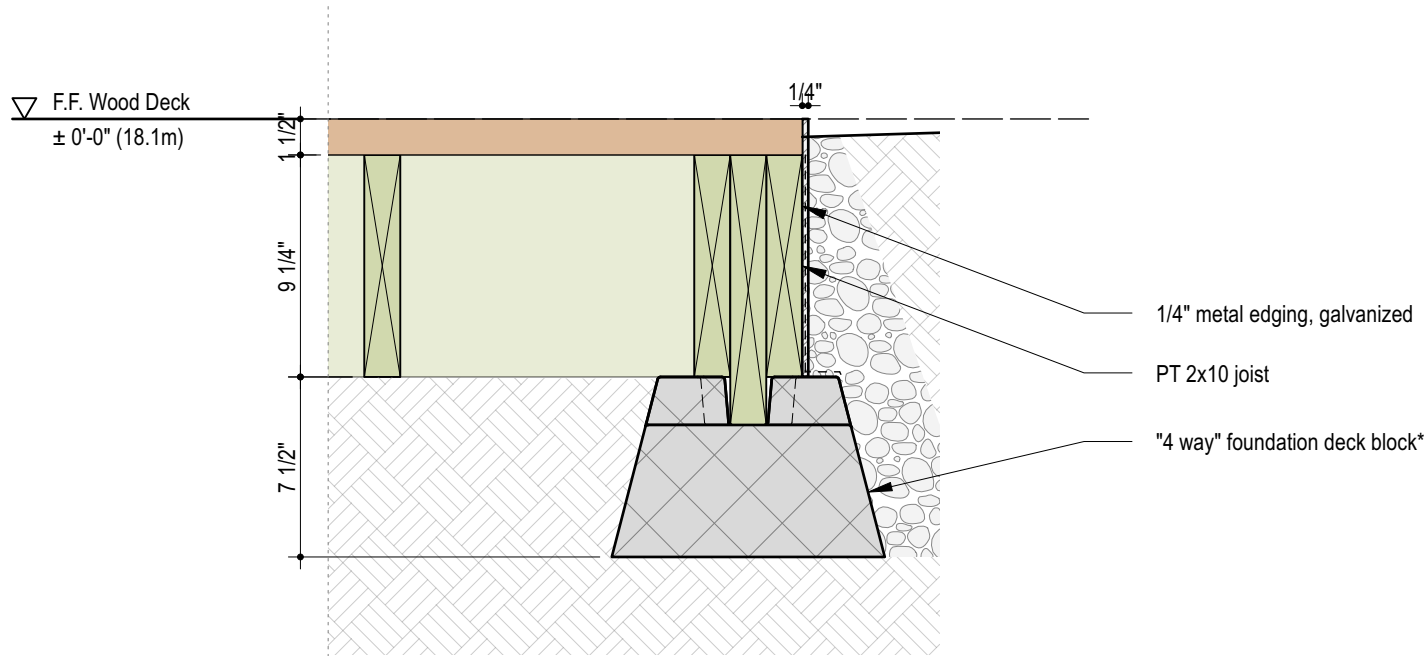
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Reference
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Date
2023.05.23

Sheet Number
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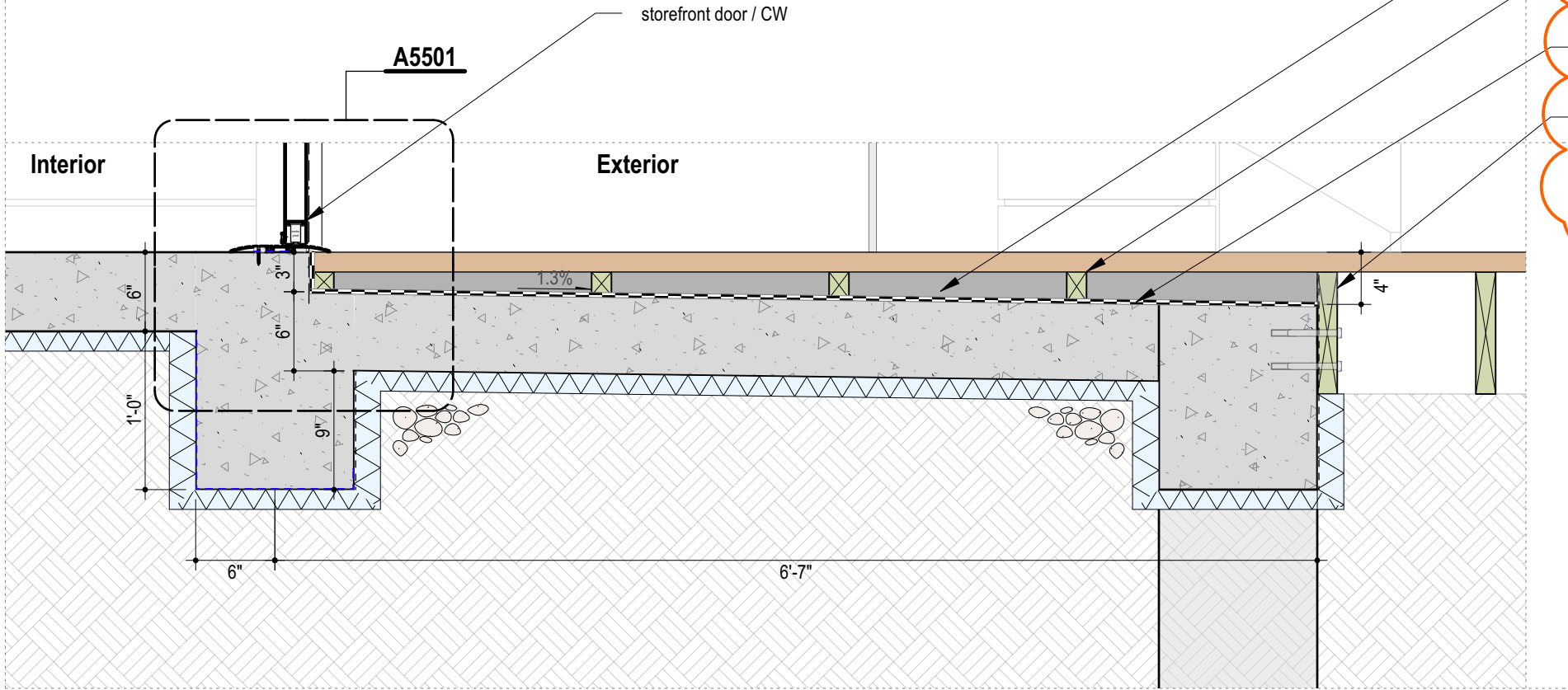


Key Section



3 On-Grade Foundation
A2402 Scale: 1 1/2" = 1'-0"

*refer to structural



SBS membrane

wood sleepers with gaps @12" to allow drainage

tapered or sloped slab as per structural drawings*

gaps @12" to allow drainage

Flashing Profile

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Drawing
Section - Front Deck / Concrete Slab
Project Number
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Client
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Scale
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Sheet Number
A2403

Seal

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Footings & Foundations



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Drawing
Footings & Foundations
Project Number
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Client
Town of Ladysmith

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Issue No.
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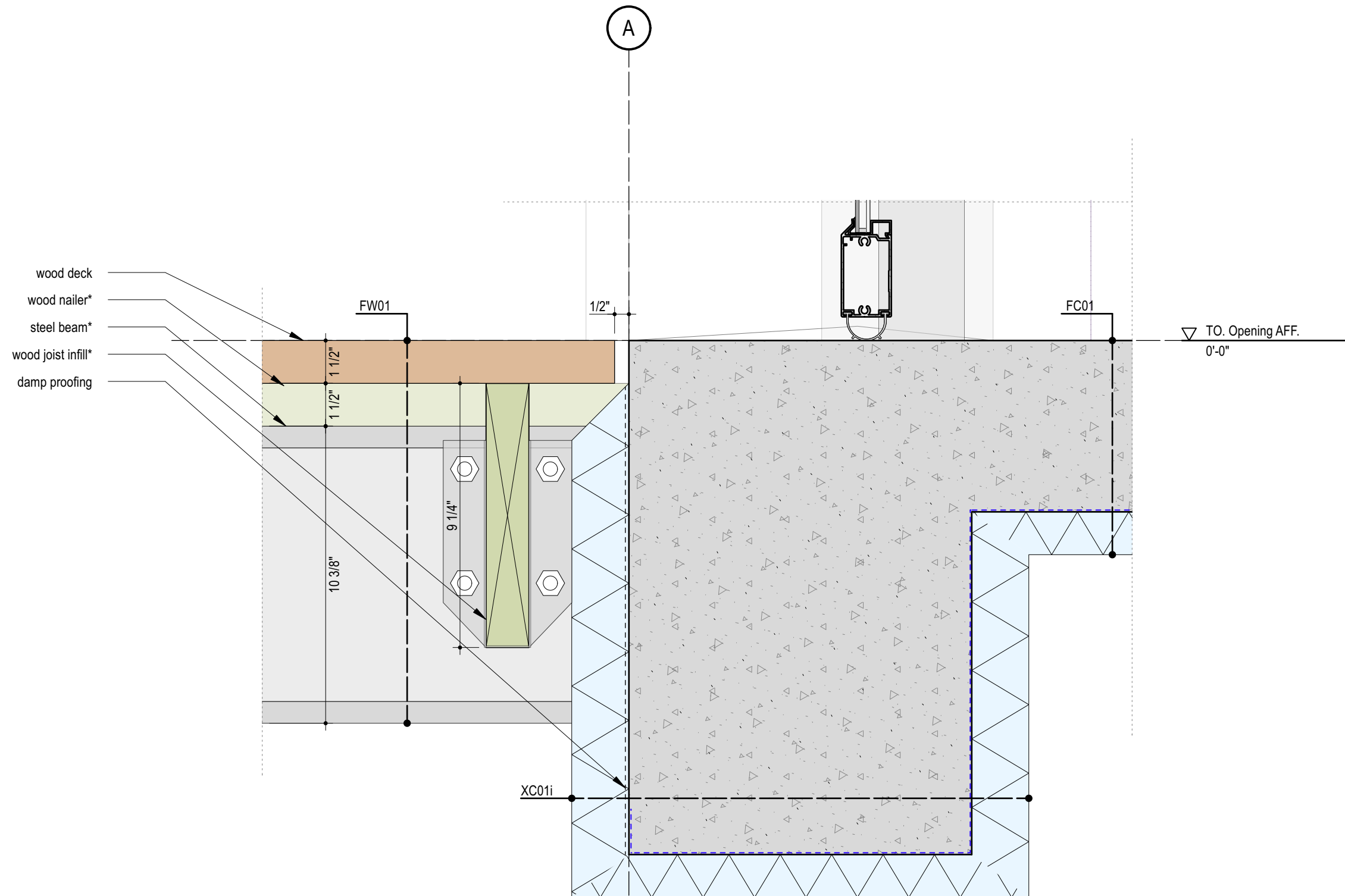
Scale
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Reference
Date
2023.05.23

Sheet Number
A3100

Seal

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- | | |
|---|---|
|  | AB membrane |
|  | AB tape |
|  | AB sealant |
|  | AVB membrane |
|  | WRB membrane |
|  | WRB tape |
|  | VB membrane |
|  | VB tape |
|  | Dampproofing |
|  | Non Vapour Permeable,
Self Adhesive Membrane |
|  | Vapour Permeable,
Self Adhesive Membrane |
|  | SBS Roofing (1 Layer) |
|  | SBS Roofing (2 Layer) |

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Project Name

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Drawing
Section - Grade Beam to Steel Beams

Project Number Client
2032 Town of Ladysmith

Drawn By HA	Reviewed By BC
Issue No. 80	Issued For IFT - R1

Scale
1-1/2"=1'-0"

Reference

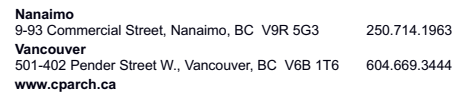
Date
2023.05.23

Sheet Number

A3101

Seal :

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Drawing
Section - Floor to Deck

Project Number	Client
2032	Town of Ladysmith

Drawn By
HA

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BC

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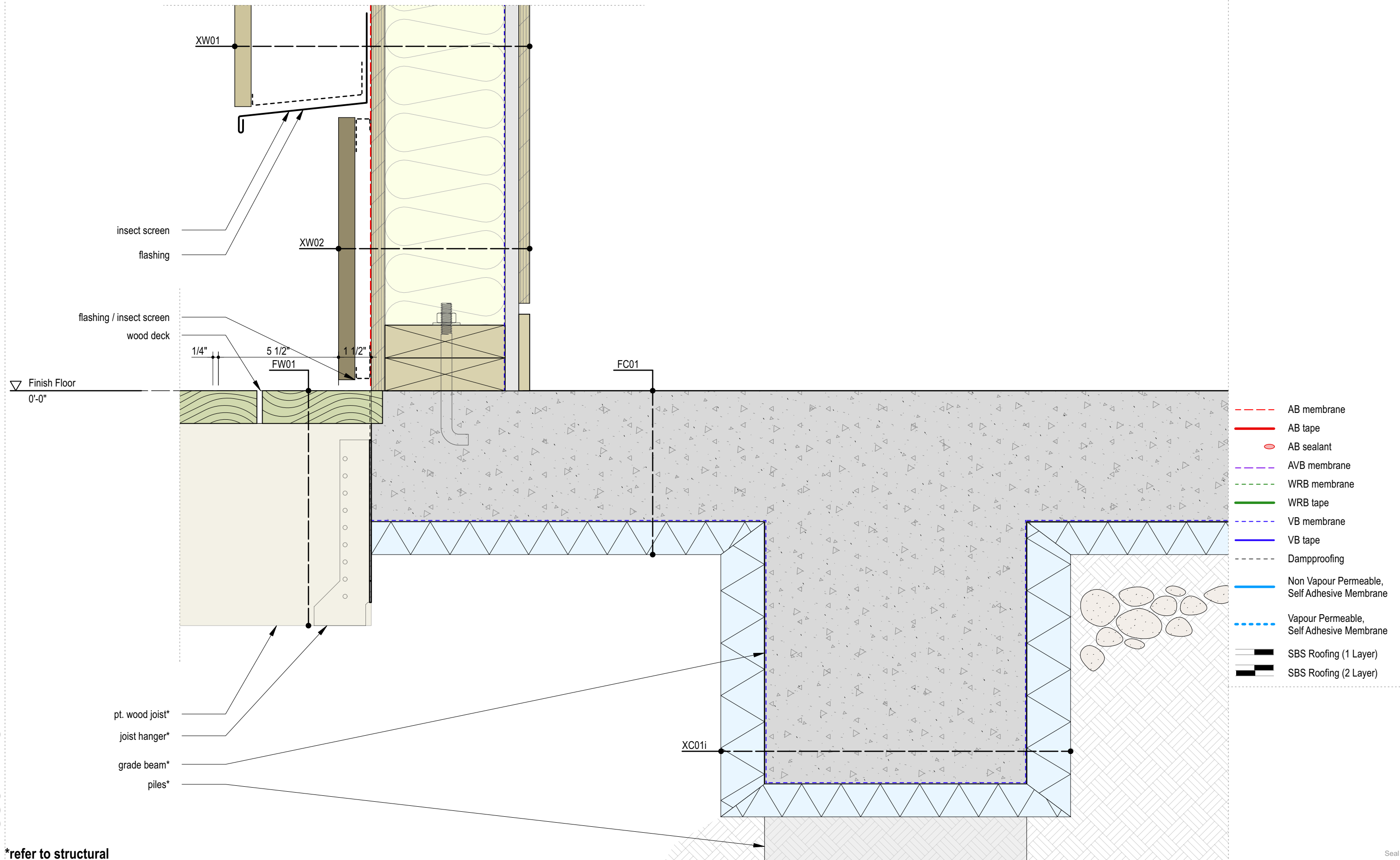
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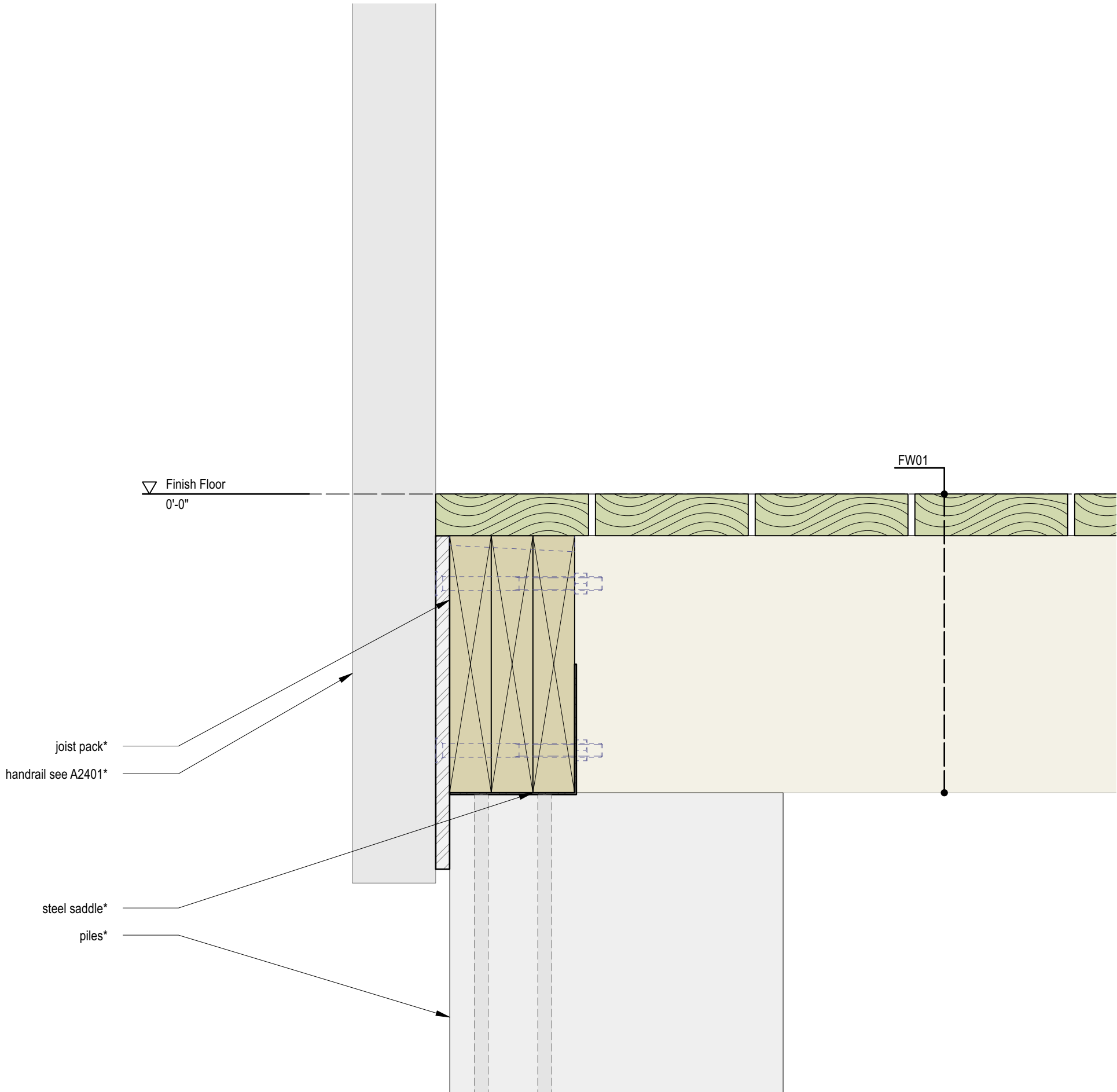
Date
2023.05.23

Sheet Number

A3102



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Project Name
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Drawing
Section - Piles to Deck
Project Number
2032
Client
Town of Ladysmith

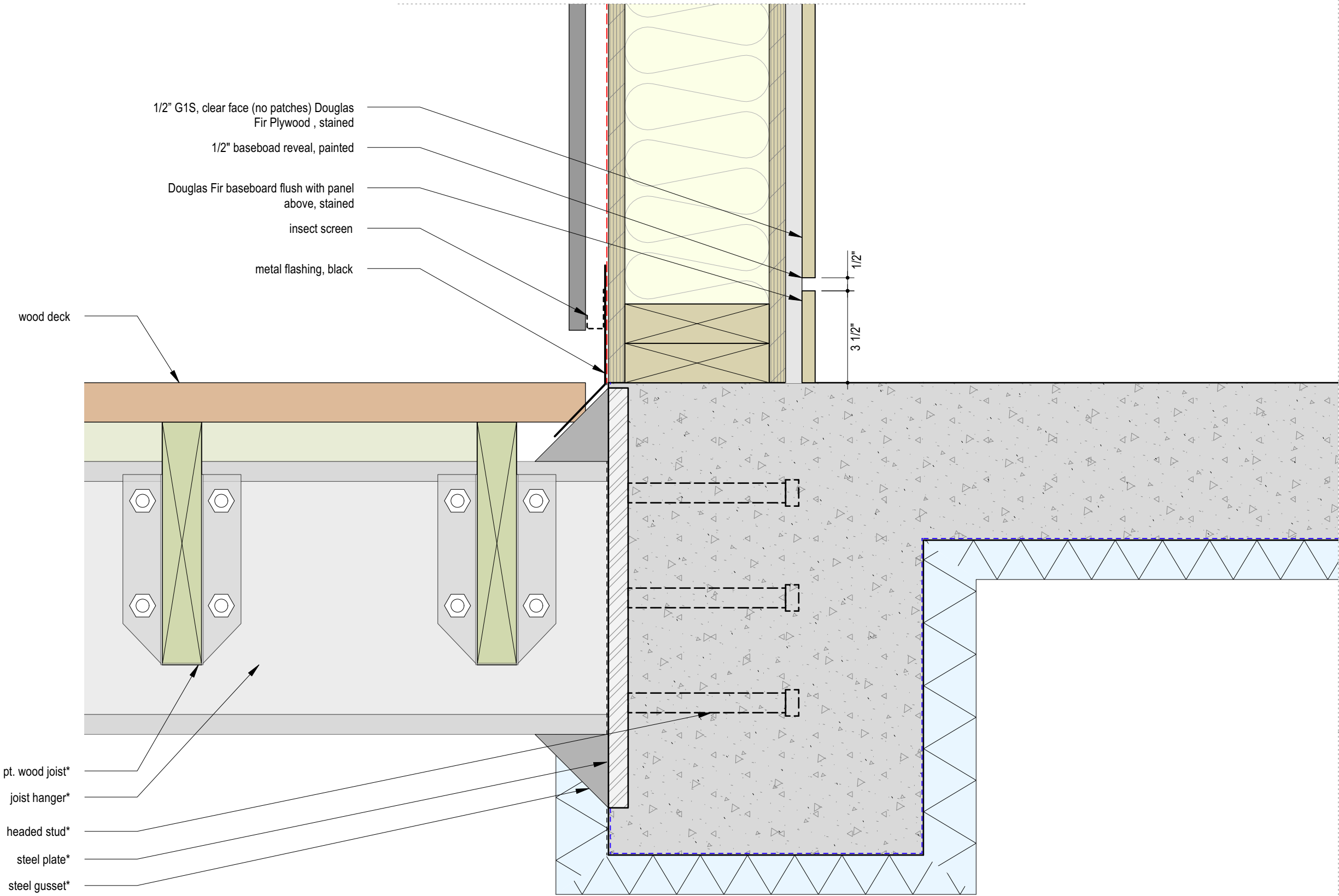
Drawn By
HA
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Issue No.
80
Issued For
IFT - R1

Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A3103

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

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Drawing
Section - Grade Beam to Steel
Project Number
2032
Client
Town of Ladysmith

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Issue No.
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Scale
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Reference
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Sheet Number
A3104

Seal

Wall and Floor Junctions



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Drawing
Wall & Floor Junctions
Project Number
2032
Client
Town of Ladysmith

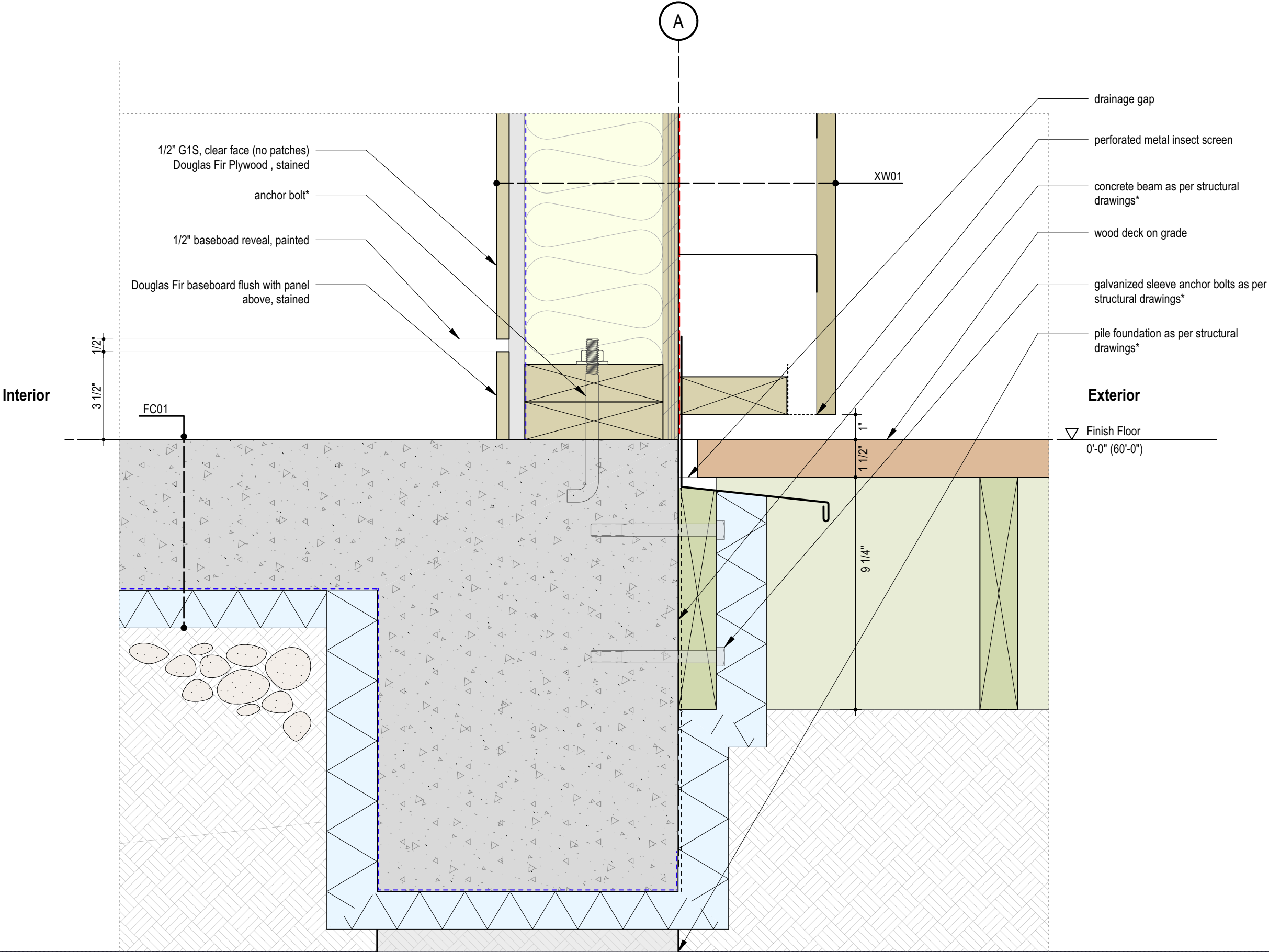
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IFT - R1

Scale
n/a

Reference
Date
2023.05.23

Sheet Number
A3200

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

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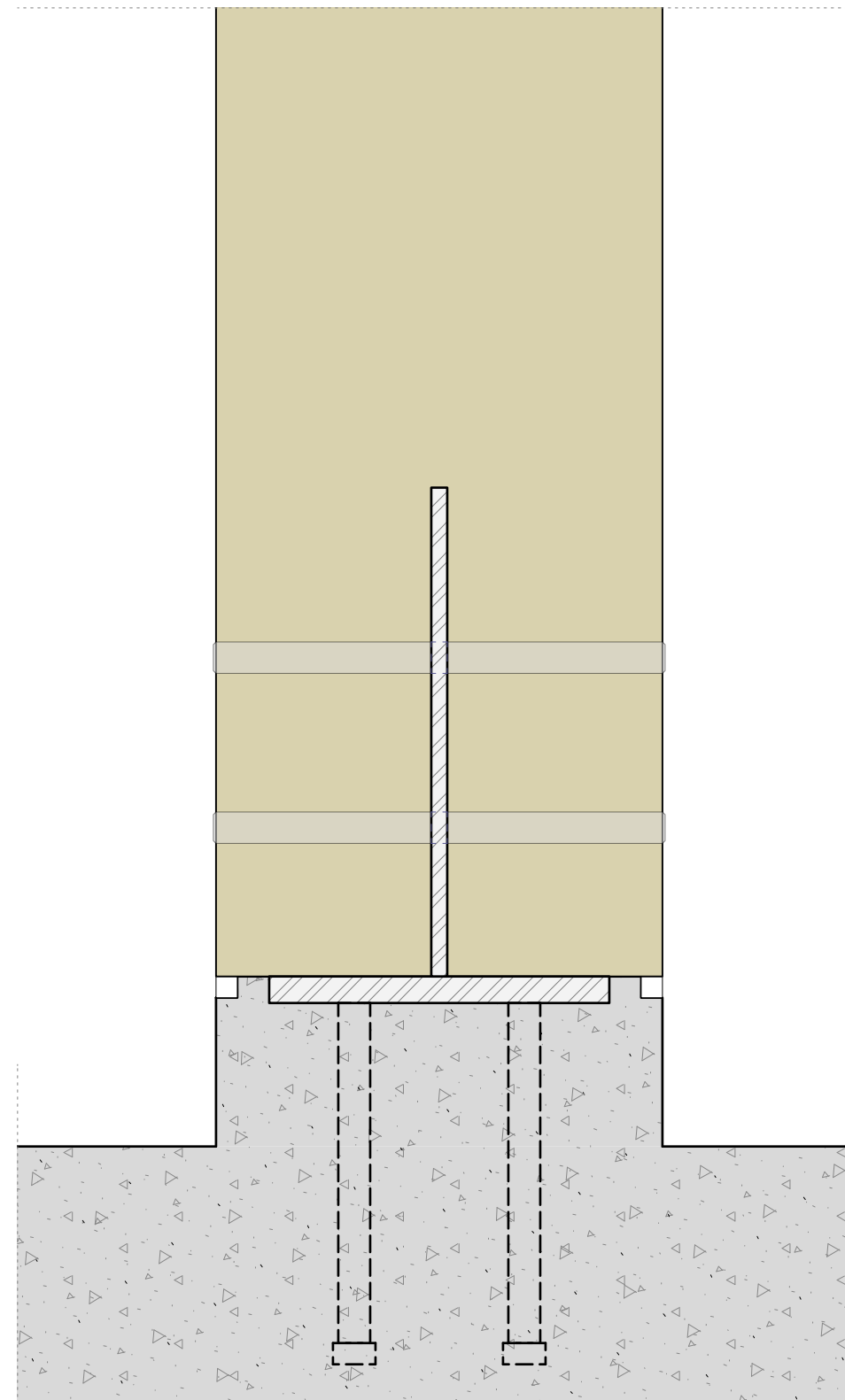
Drawing
Section - Wall to Floor Junction
Project Number
2032
Client
Town of Ladysmith

Drawn By
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Reviewed By
DP
Issue No.
80
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Scale
3"=1'-0"

Reference
Date
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Sheet Number
A3201



- Seal

CP

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A3202

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Wall and Roof Junctions



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Drawing
Wall & Roof Junctions
Project Number
2032
Client
Town of Ladysmith

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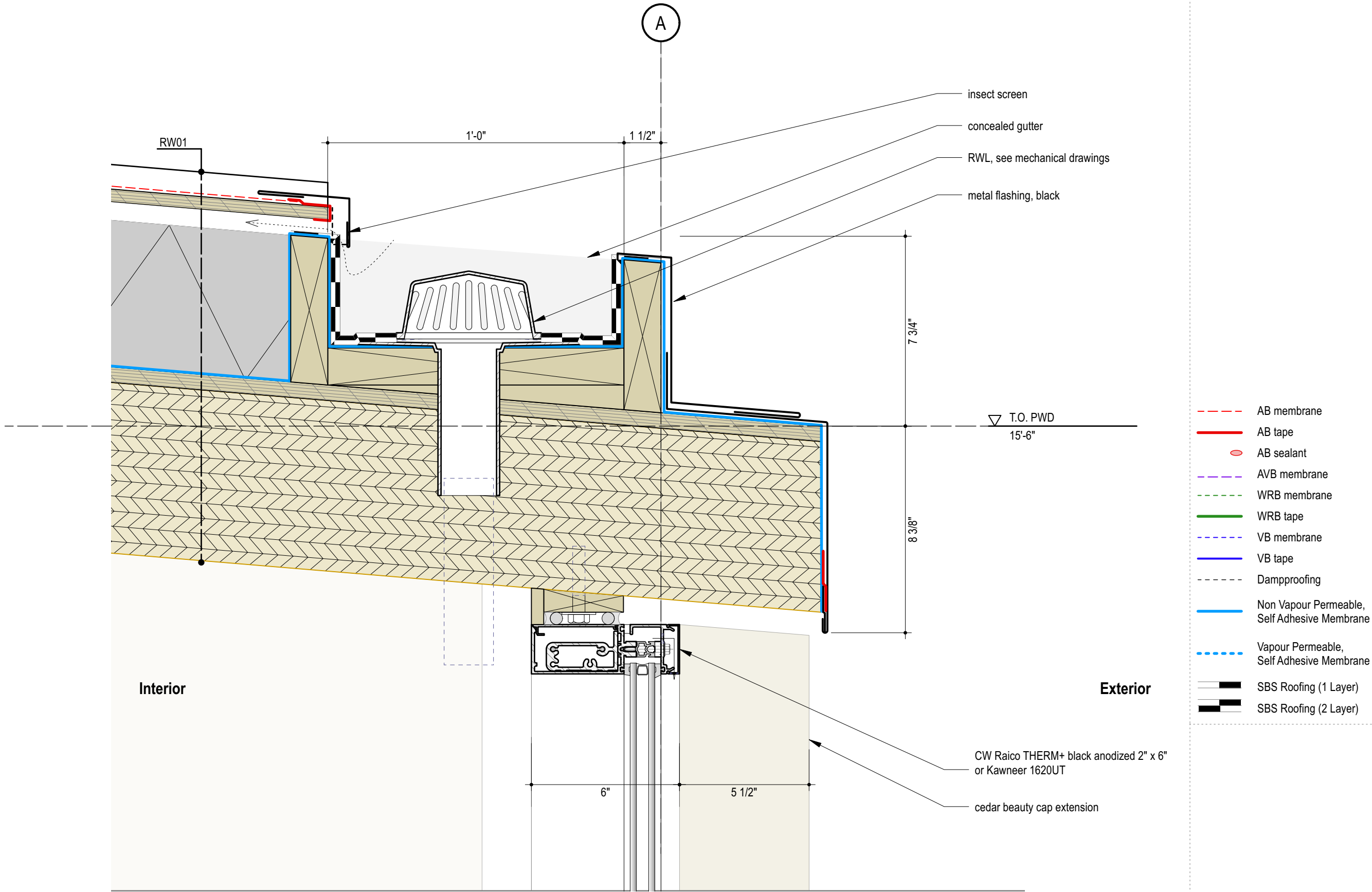
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Reference
Date
2023.05.23

Sheet Number
A3300

Seal

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Drawing
Section - Roof Eave
Project Number
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Client
Town of Ladysmith

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Scale
3"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A3301

GLT roof as per structural drawings
perforated metal insect screen
5/8" furring strips
5/8" diagonal furring strips

Exterior

Interior

tear away z bead

- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

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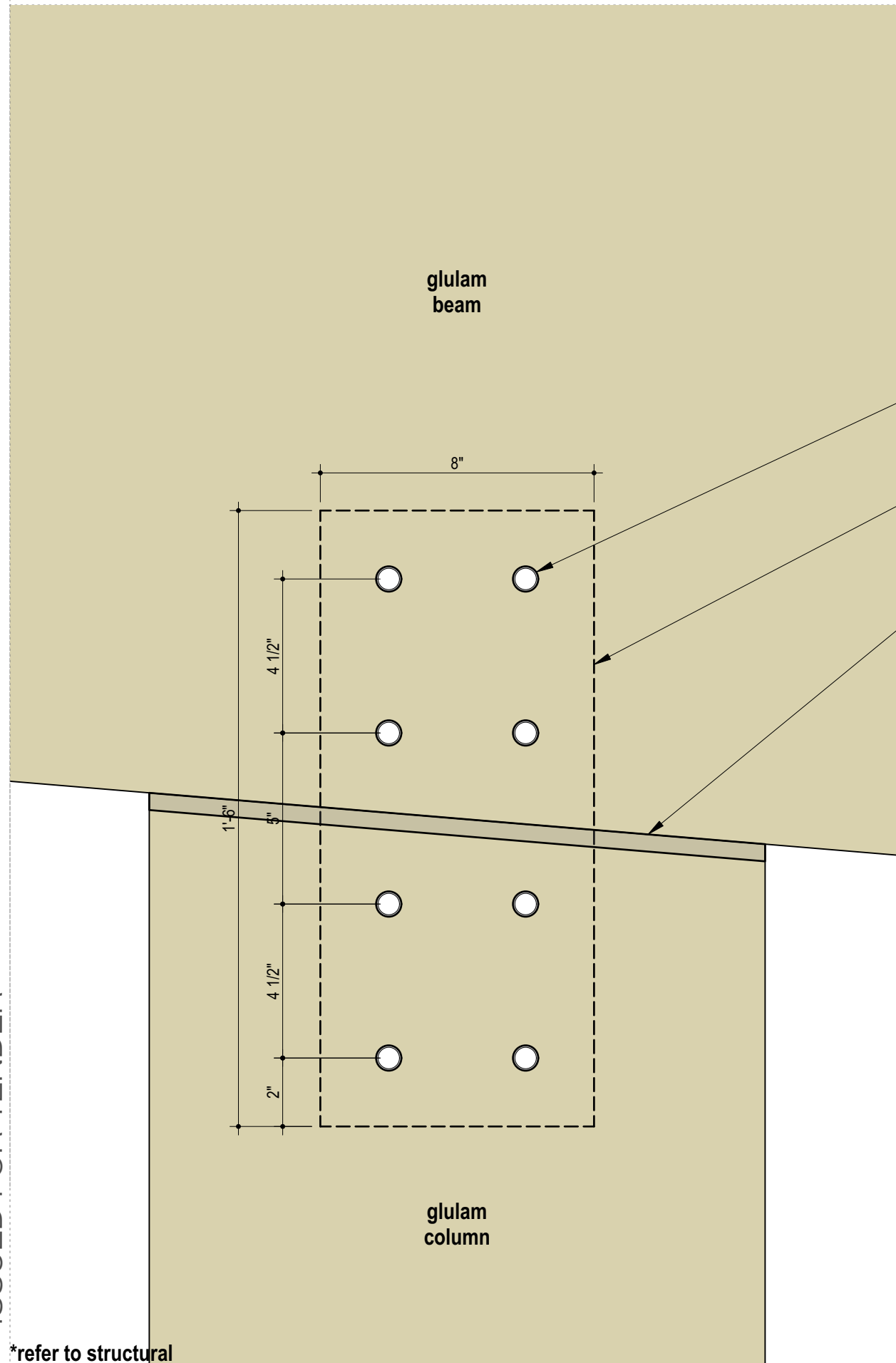
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Section - Roof Ext. to Int.
Project Number
2032
Client
Town of Ladysmith

Drawn By
TC
Reviewed By
DP
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Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A3302



drift pin*

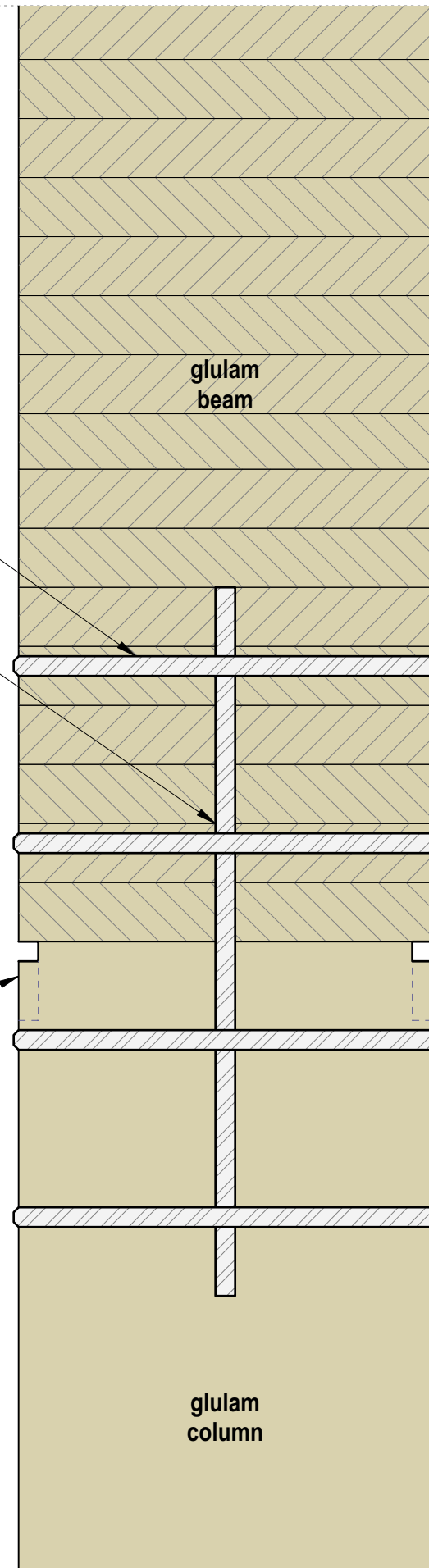
knife plate*

1/2' x 1/2" rabbet shadow line at the top of the column

drift pin*

knife plate*

1/2' x 1/2" rabbet shadow line at the top of the column



*refer to structural



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Drawing
Section - Column to Roof
Project Number
2032

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Town of Ladysmith

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Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A3303

Seal

Eaves, Ridges and Parapets



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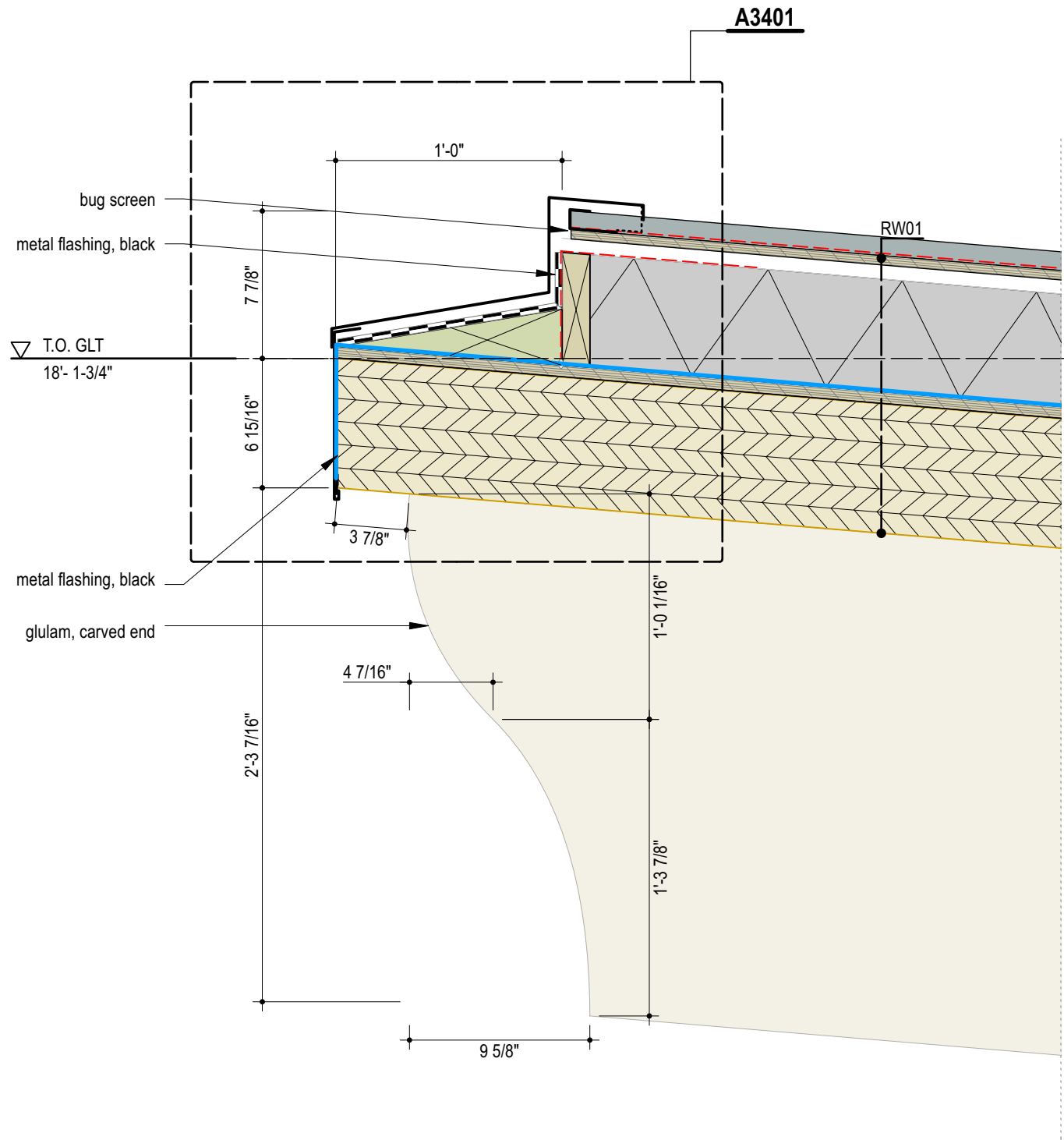
Drawing
Eaves, Ridges & Parapets
Project Number Client
2032 Town of Ladysmith

Drawn By Reviewed By Scale
TC DP n/a
Issue No. Issued For
80 IFT - R1

Reference
Date
2023.05.23

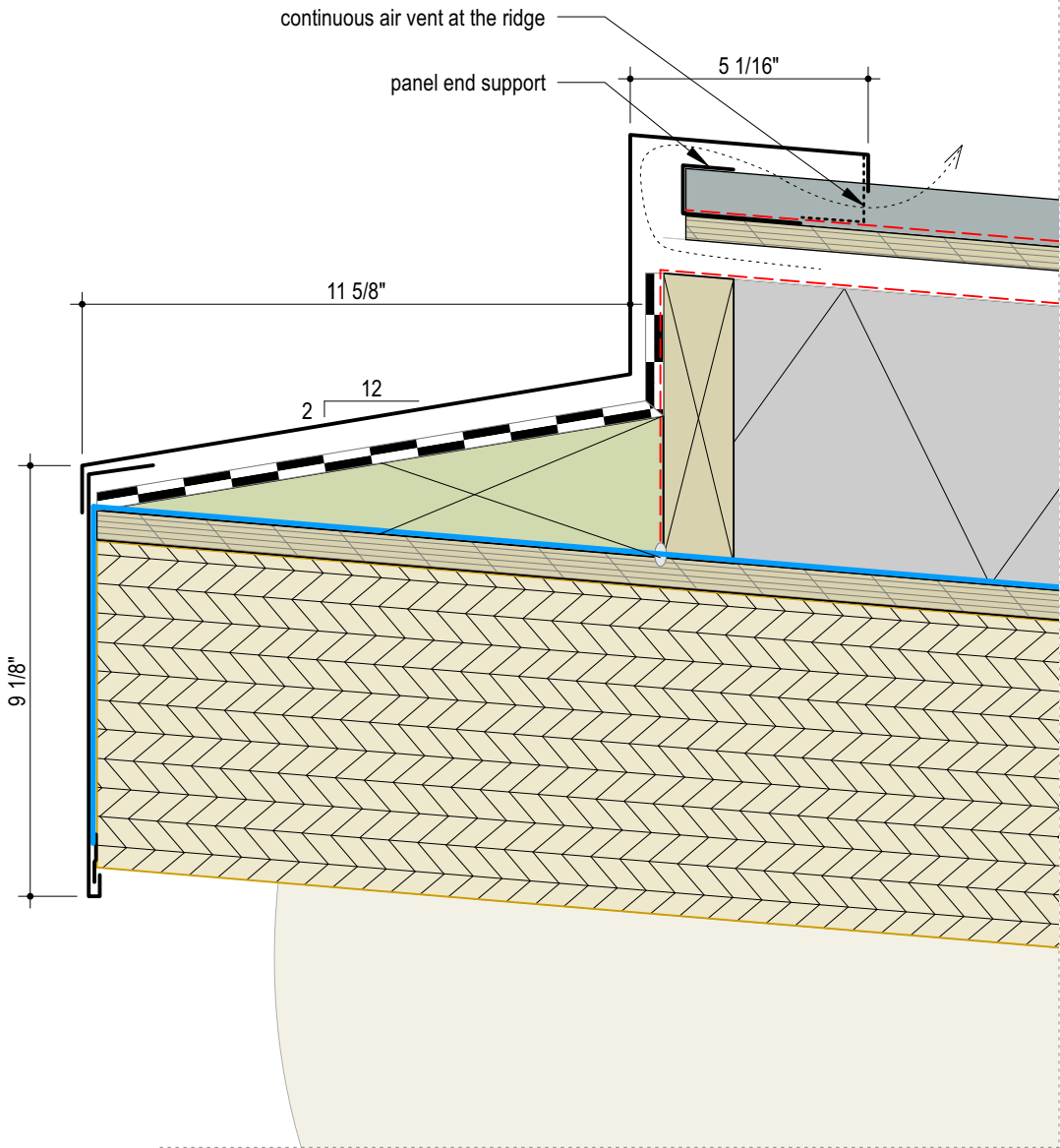
Sheet Number
A3400

Seal



1 Roof Fascia
A3401 Scale: 1 1/2" = 1'-0"

Note:
• Use a CNC router (DWG file) to cut beam end with the desired curvature.



2 Vented Ridge
A3401 Scale: 3" = 1'-0"

Flashing Profile

- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

*refer to structural



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Arts and Heritage Hub

Page 6 of 376

Drawing
Section - Roof Eave Glulam
Project Number
2032
Client
Town of Ladysmith

Drawn By
HA
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BC
Issue No.
80
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Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number

A3401

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Miscellaneous Junctions



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Project Name
Arts and Heritage Hub
Page 68 of 376

Drawing
Miscellaneous Junctions
Project Number
2032
Client
Town of Ladysmith

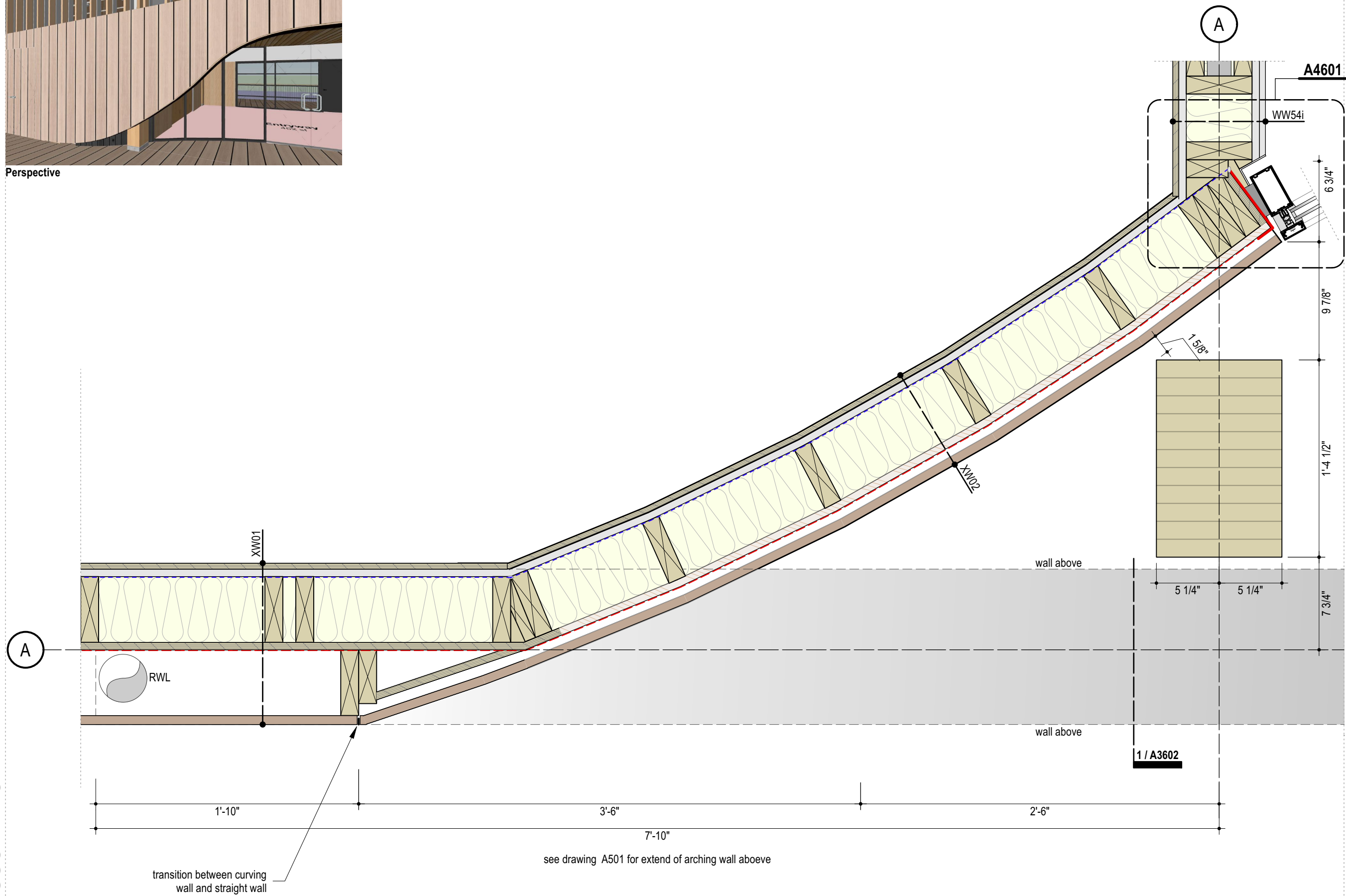
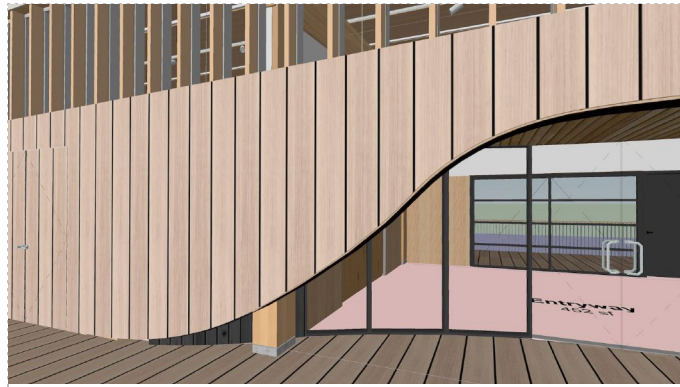
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Sheet Number
A3600

Seal



*refer to structural



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Project Name
Arts and Heritage Hub
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Drawing
Plan - Wall to Column

Project Number	Client
2032	Town of Ladysmith

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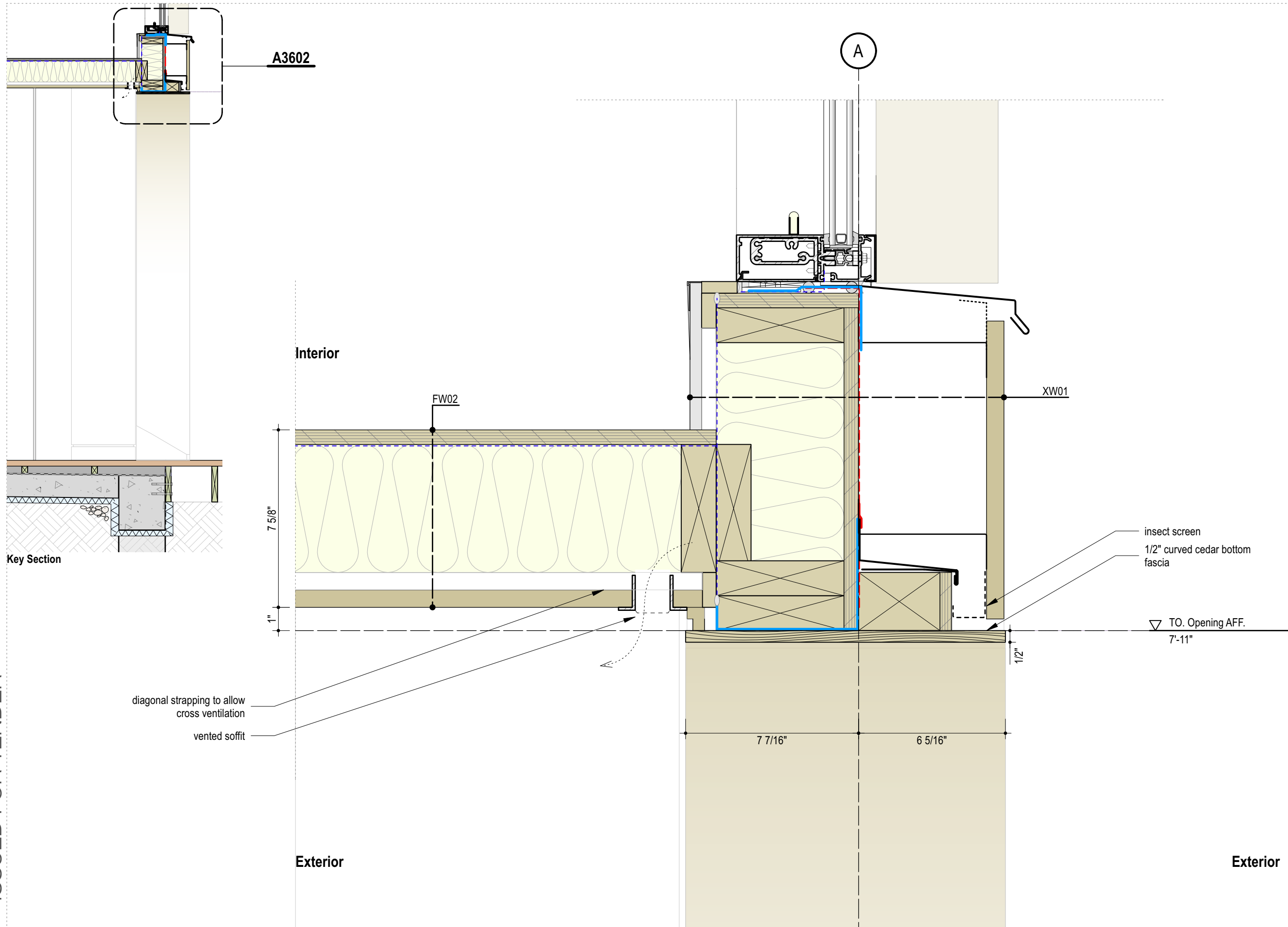
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Date
2023.05.23

Sheet Number

A3601

Seal :



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Arts and Heritage Hub

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Drawing
Section - Entry Wall

Project Number
2032

Client
Town of Ladysmith

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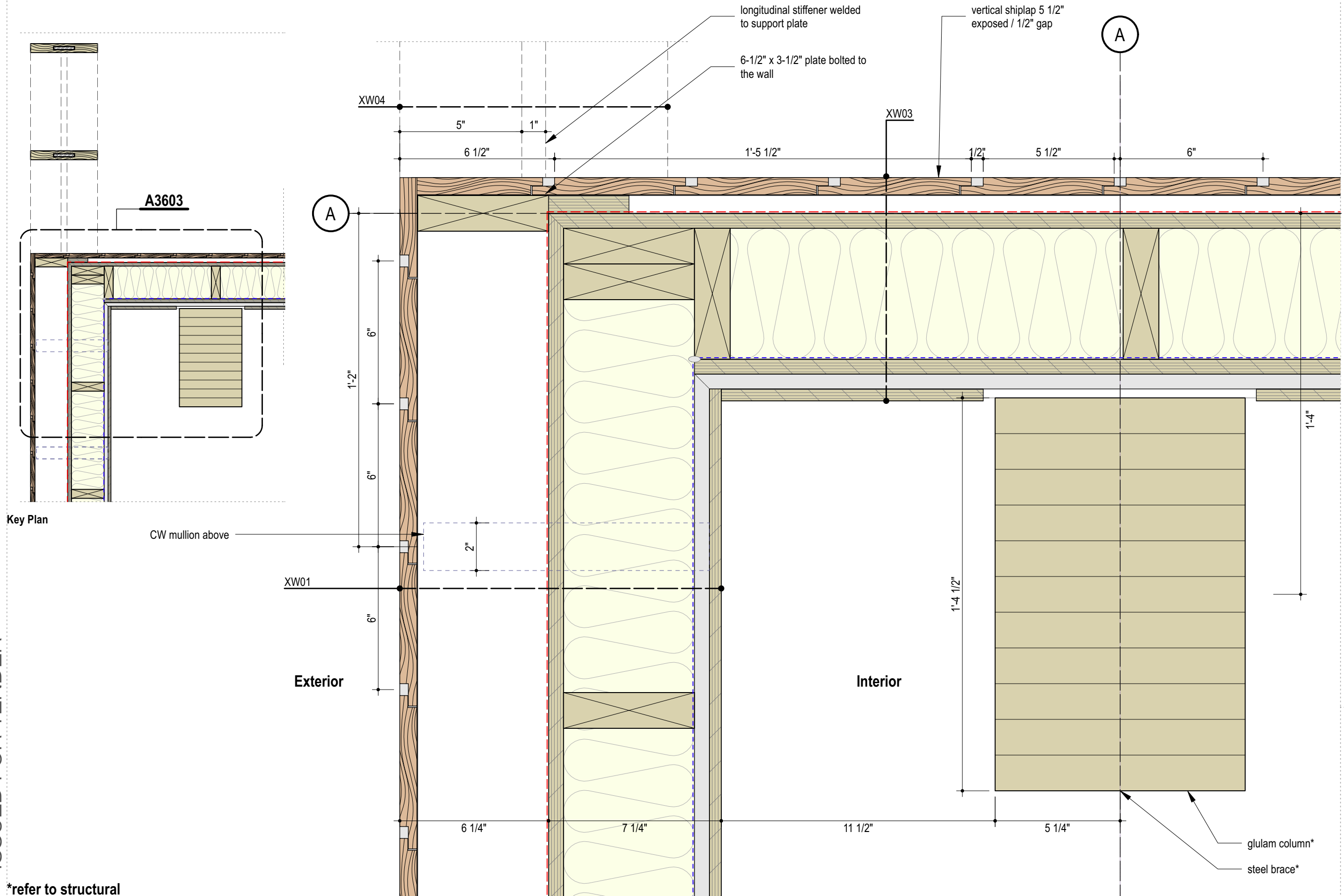
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Reference
2023.05.23

Sheet Number

A3602

Seal



*refer to structural



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Arts and Heritage Hub

Page 11 of 376

Drawing
Plan - Exterior Slats / Corner
Project Number
2032
Client
Town of Ladysmith

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Reviewed By
BC
Issued For
IFT - R1

Scale
3"=1'-0"

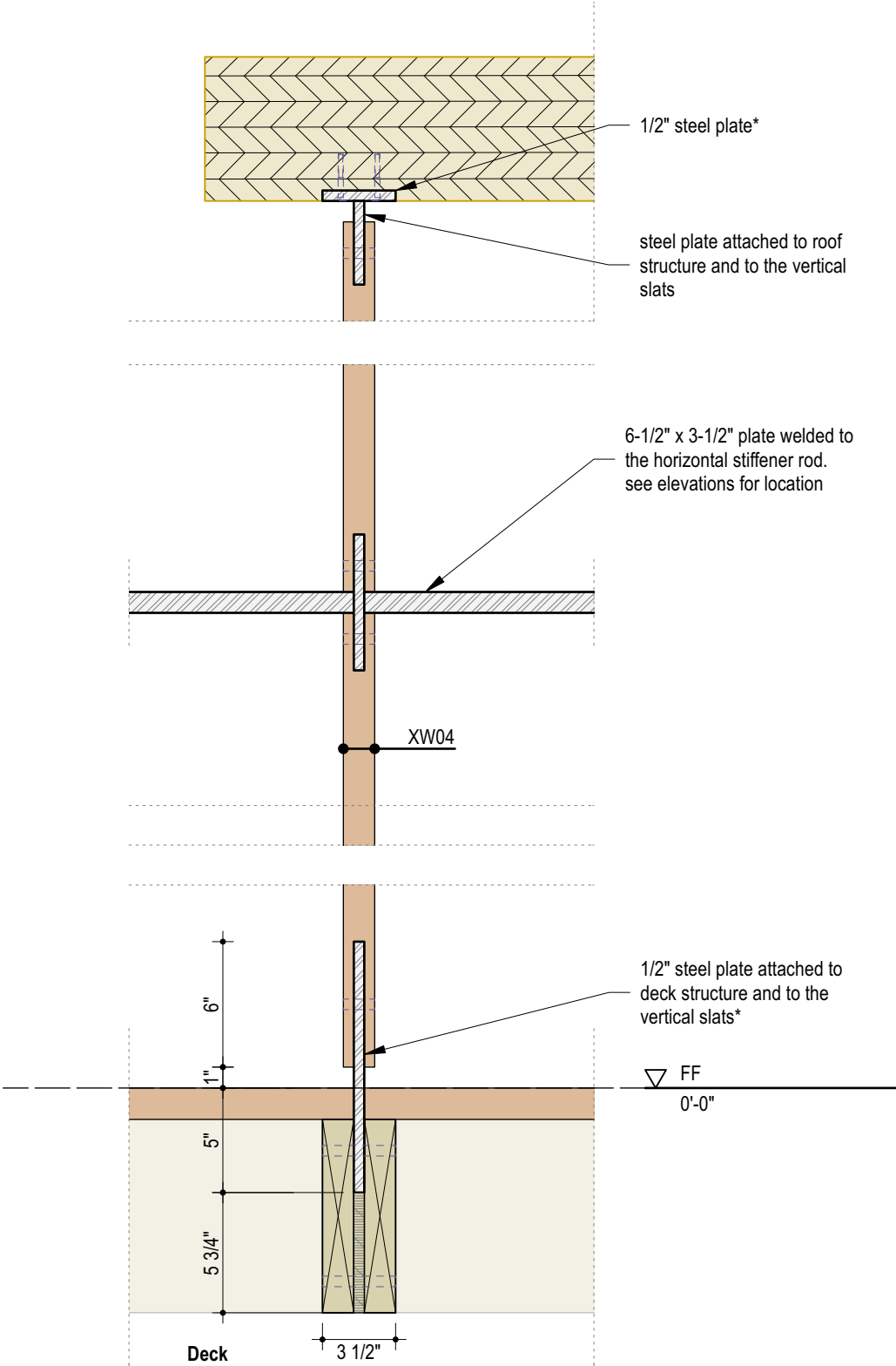
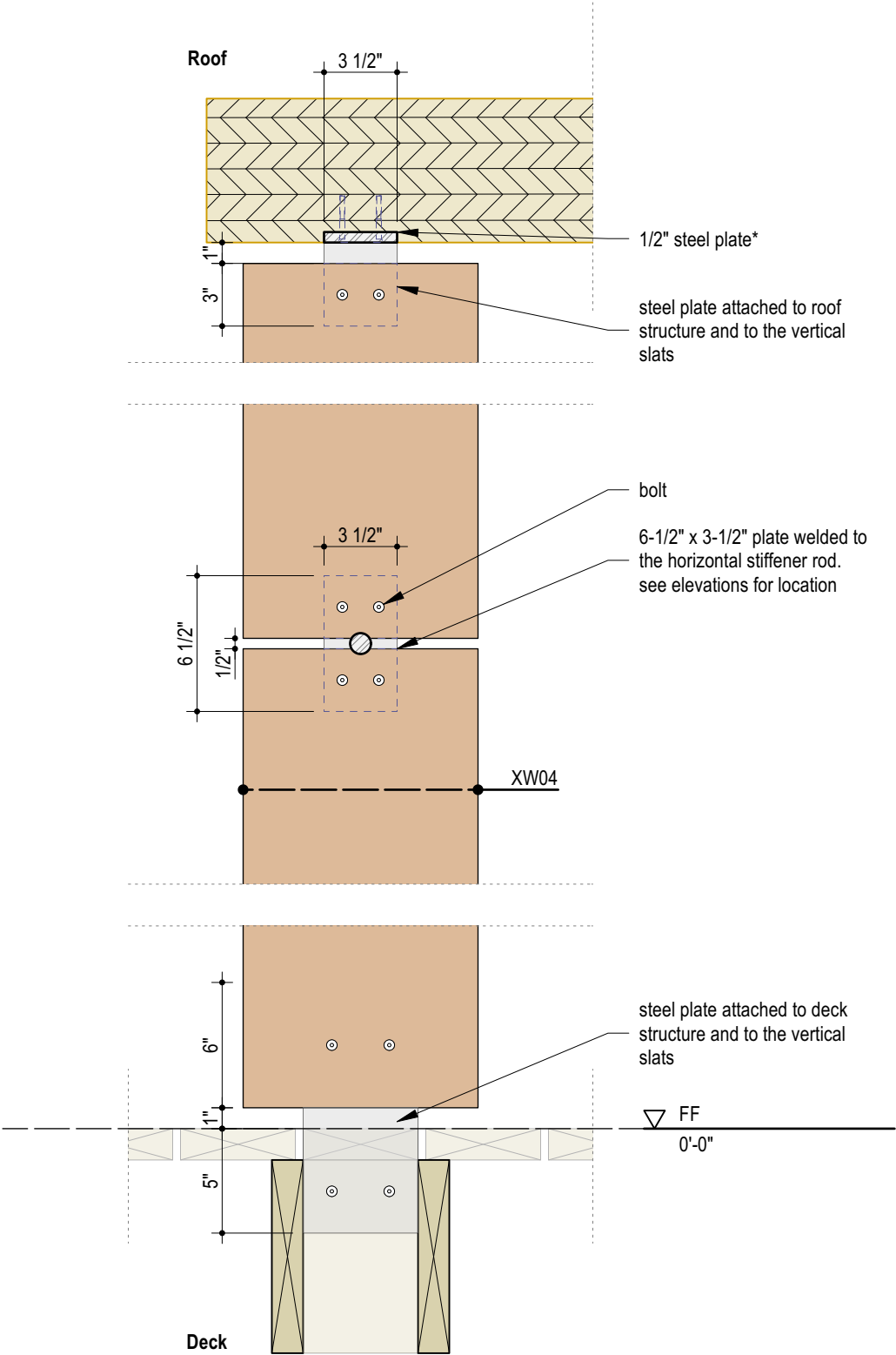
Reference
Date
2023.05.23

Sheet Number

A3603

Seal

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Project Name
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Drawing
Section - Exterior Slats
Project Number
2032
Client
Town of Ladysmith

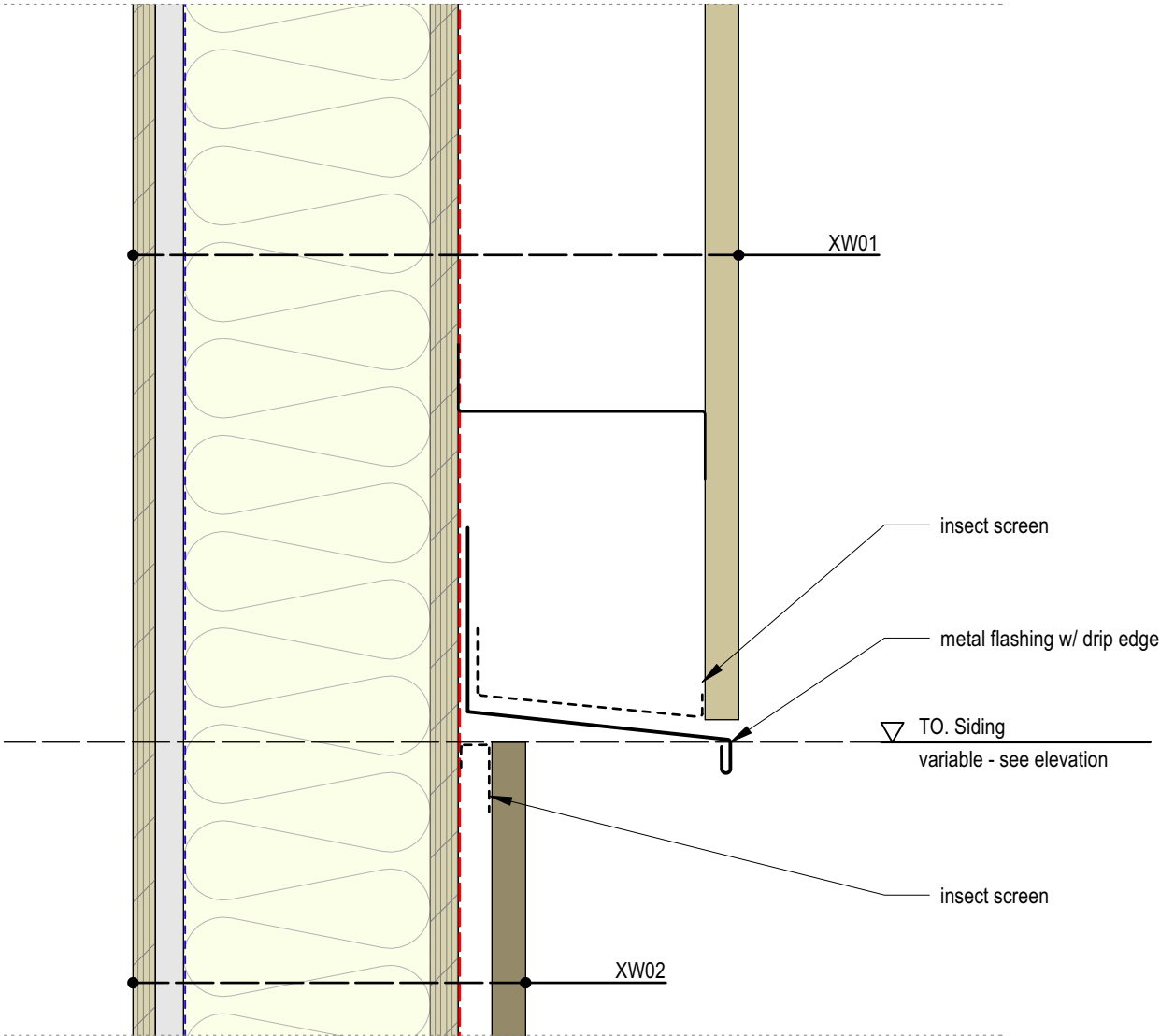
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Reference
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Sheet Number
A3604

Seal



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Exterior Surfaces



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Drawing
Exterior Surfaces
Project Number
2032
Client
Town of Ladysmith

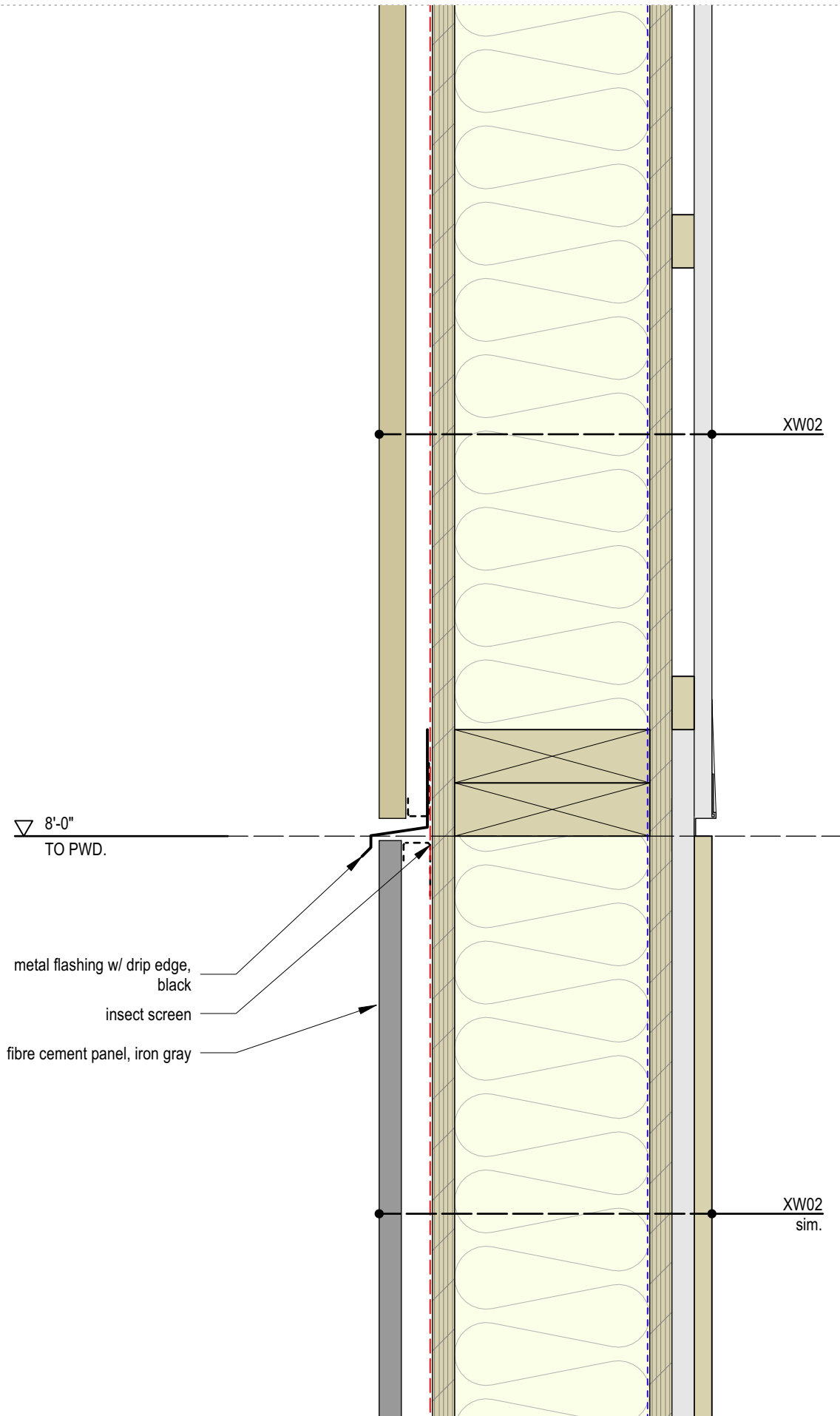
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Scale
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Reference
Date
2023.05.23

Sheet Number
A3800

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Drawing
Section - Wood to Fiber Cement Siding
Project Number
2032
Client
Town of Ladysmith

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Reference
Date
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Sheet Number
A3801

Seal

Mechanical Enclosures



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Drawing
Mechanical Enclosures
Project Number
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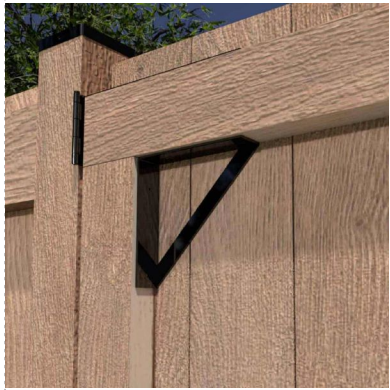
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As Noted

Reference
Date
2023.05.23

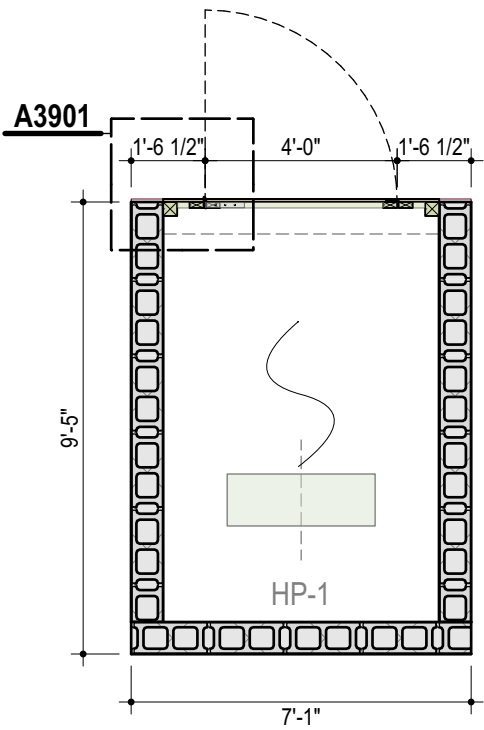
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Seal

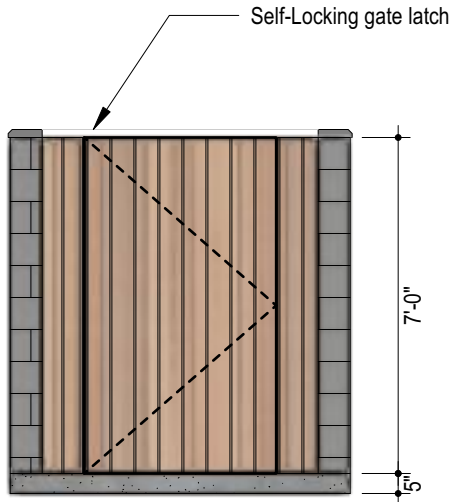
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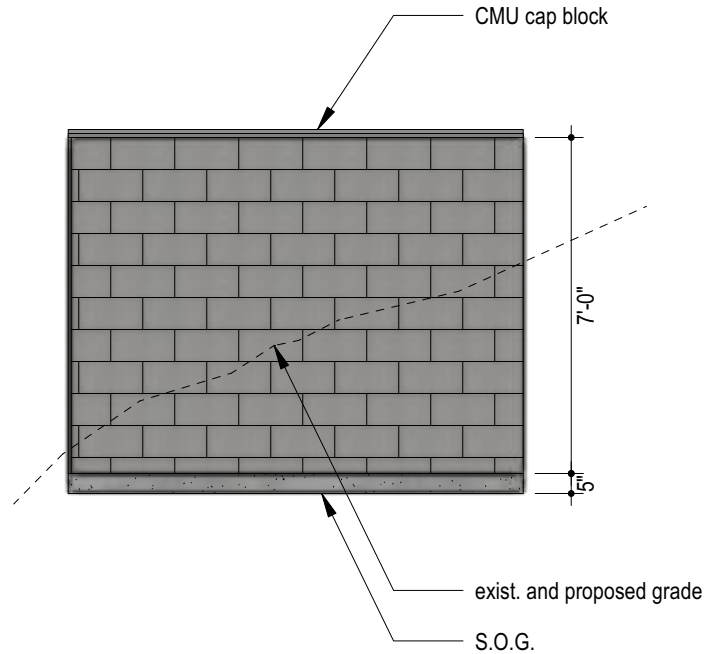
pylex - support hardware



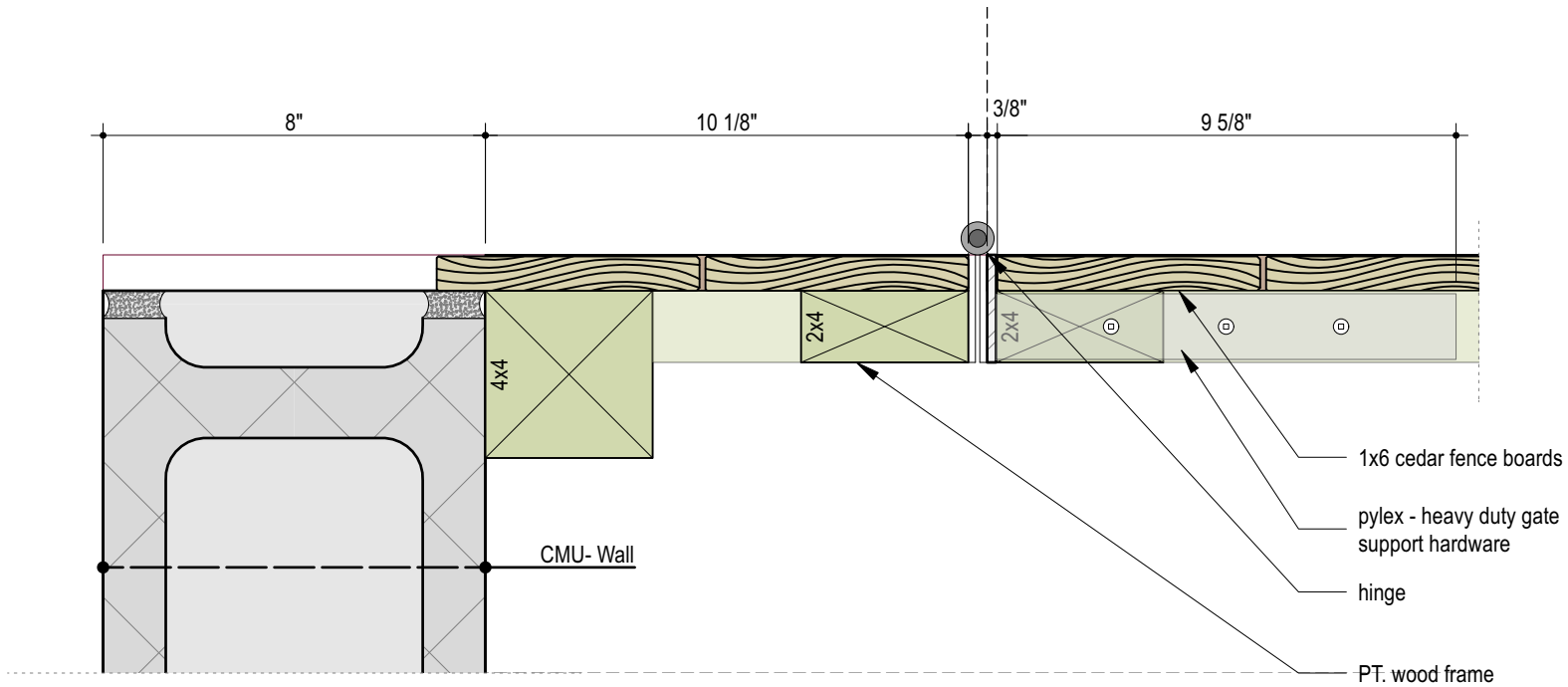
1 Plan View
A3901 Scale: 1/4" = 1'-0"



2 Front Elevation
A3901 Scale: 1/4" = 1'-0"



3 Side Elevation
A3901 Scale: 1/4" = 1'-0"



4 Plan - Hinge Detail
A3901 Scale: 3" = 1'-0"

- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Drawing
Heat Pump Ext. Enclosure
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Seal

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Steel Doors



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Page 13 of 376

Drawing
Steel Doors
Project Number
2032
Client
Town of Ladysmith

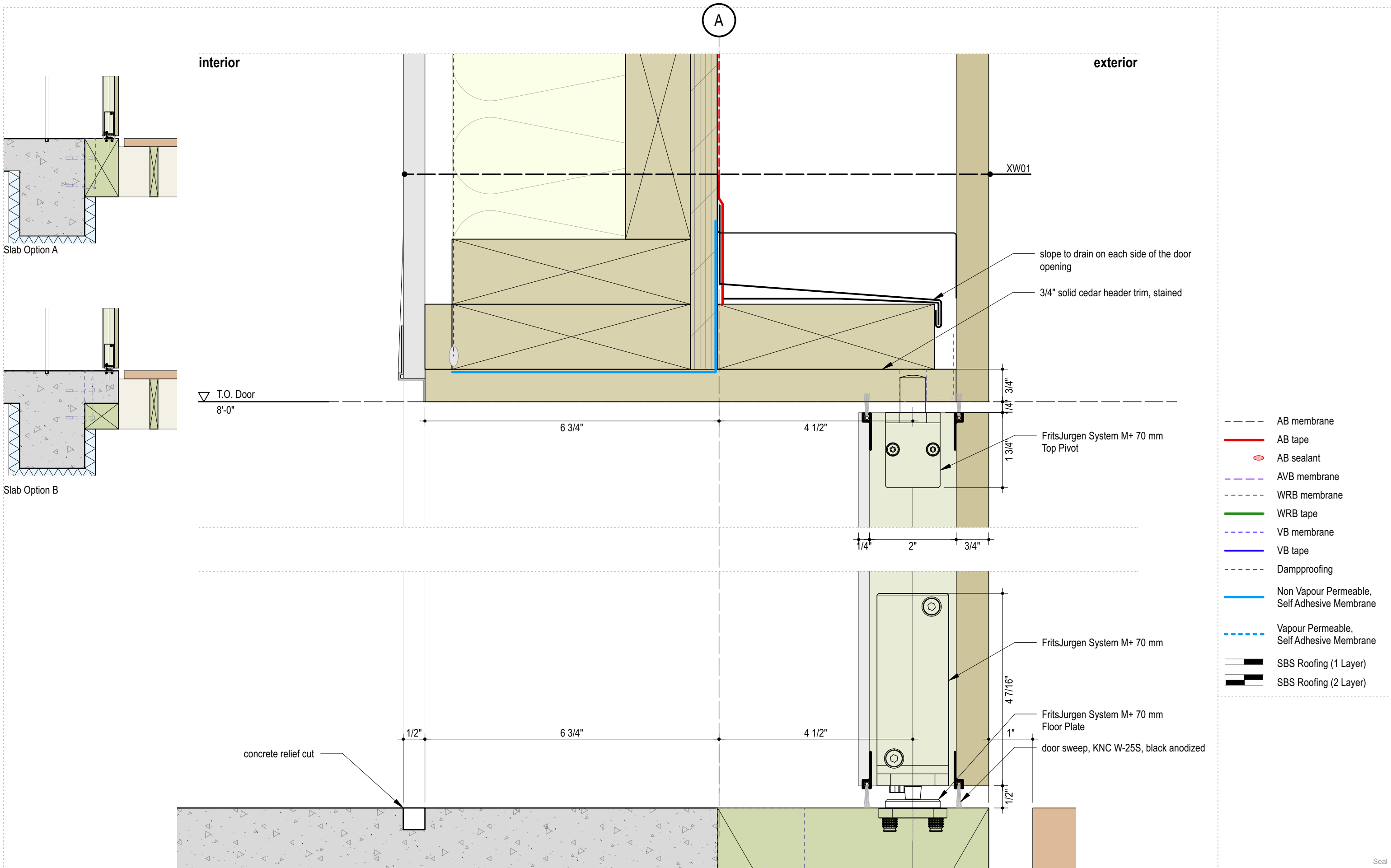
Drawn By
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Scale
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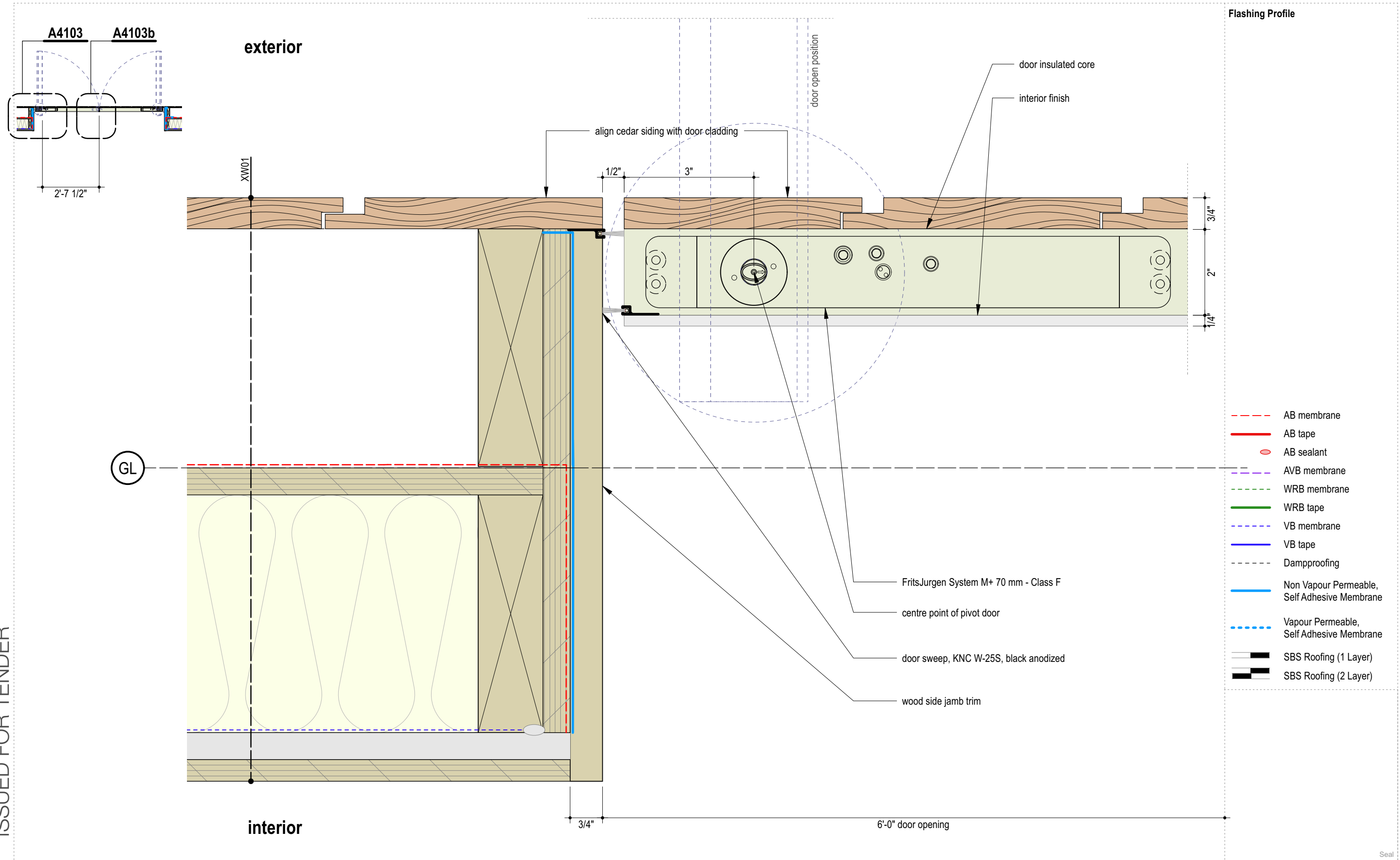
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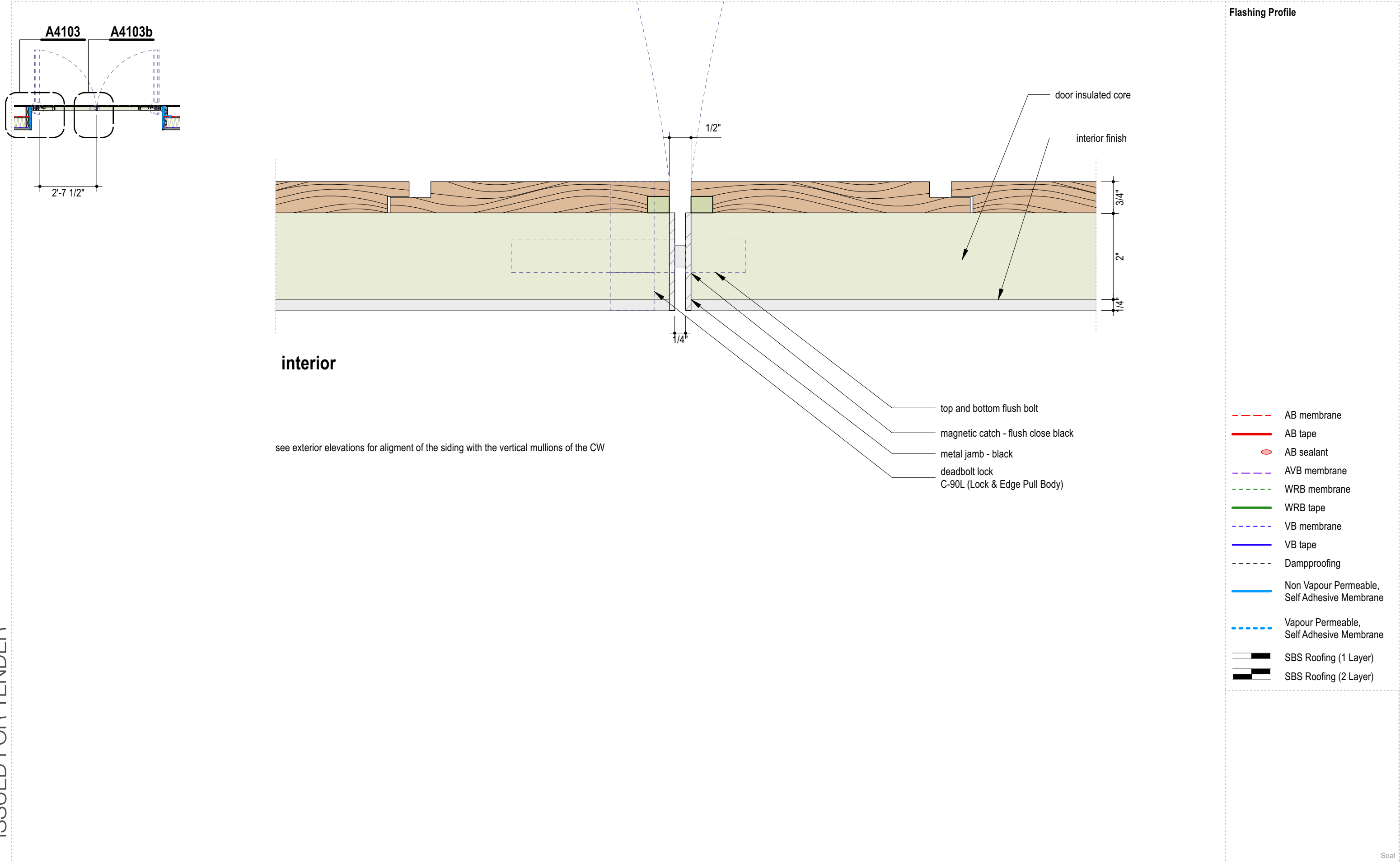
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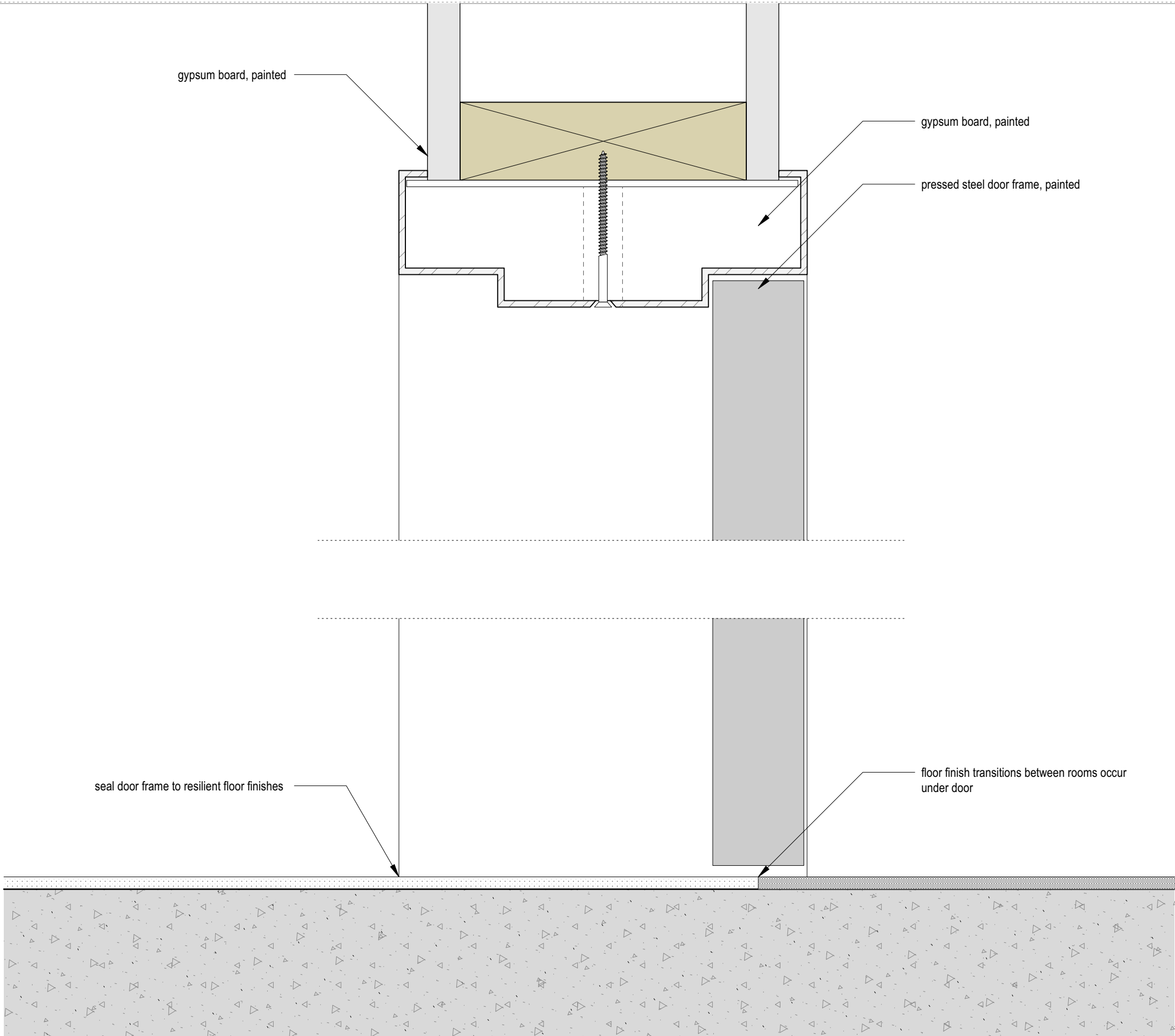
Seal



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Project Name
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Page 12 of 376

Drawing
Section - Interior Door Header
Project Number
2032
Client
Town of Ladysmith

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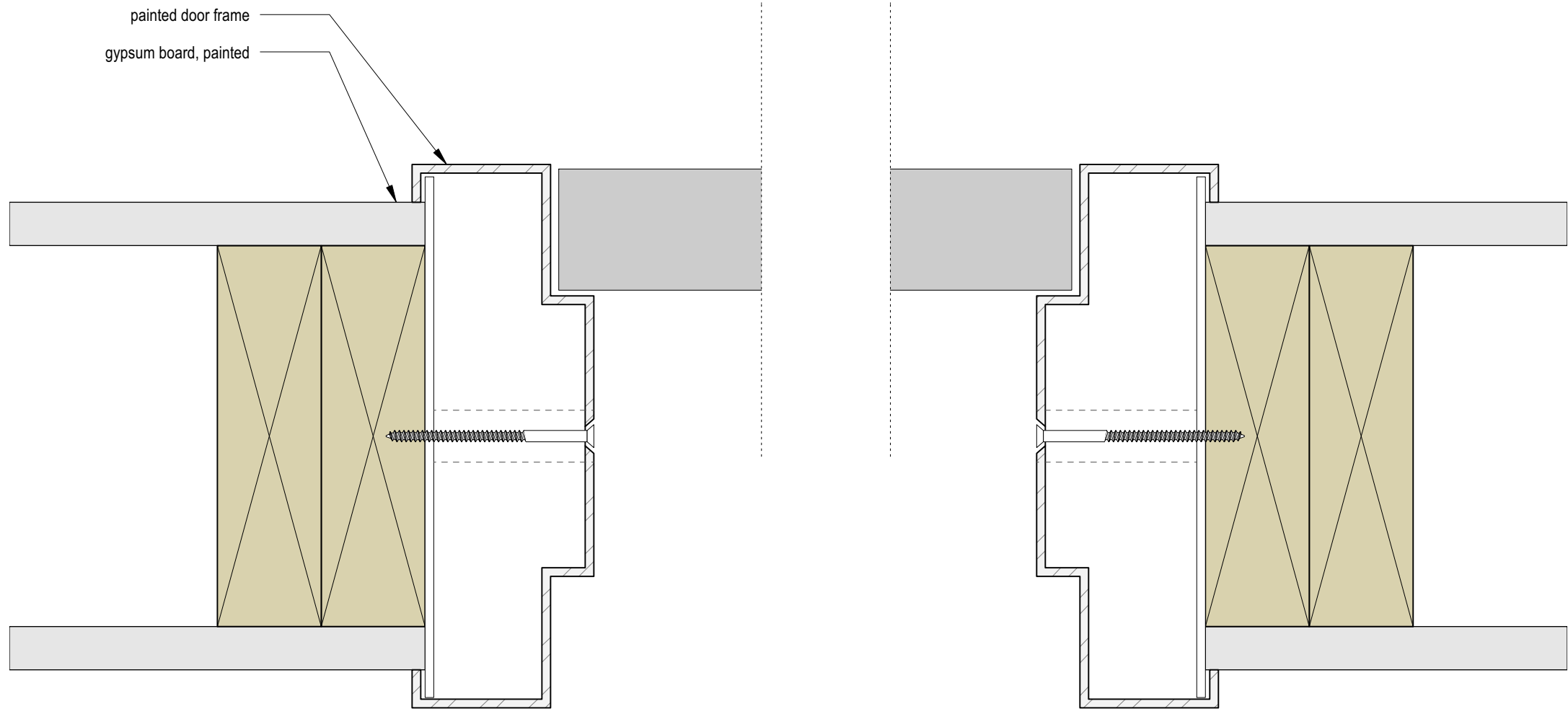
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Reference
Date
2023.05.23

Sheet Number

A4104

Seal



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Project Name
Arts and Heritage Hub
Page 13 of 376

Drawing
Plan - Interior Door Jamb
Project Number
2032
Client
Town of Ladysmith

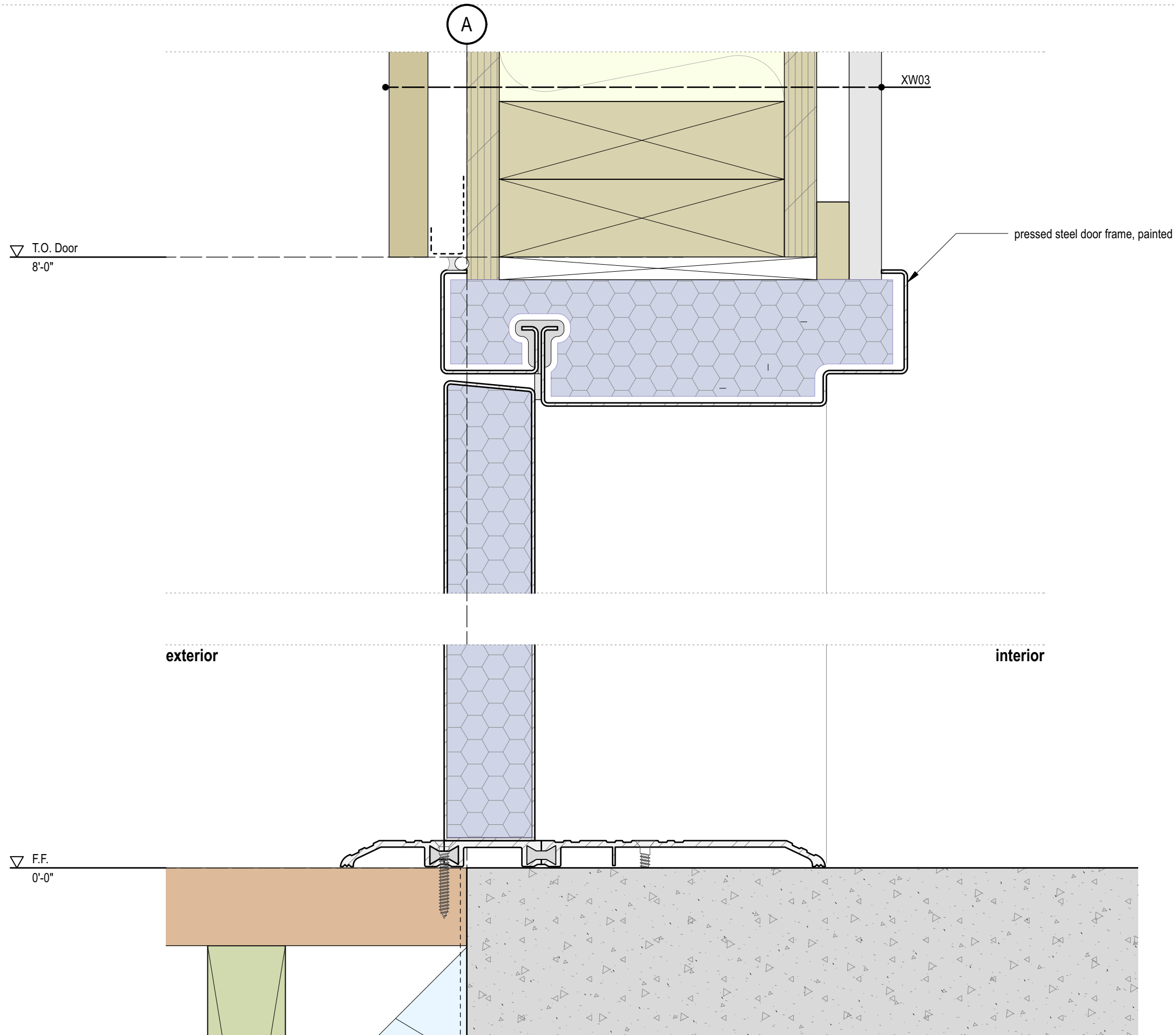
Drawn By
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Scale
6"=1'-0"

Reference
Date
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A4105

Seal



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Project Name
Arts and Heritage Hub
Page 14 of 376

Drawing
Section - Interior Door Header
Project Number
2032
Client
Town of Ladysmith

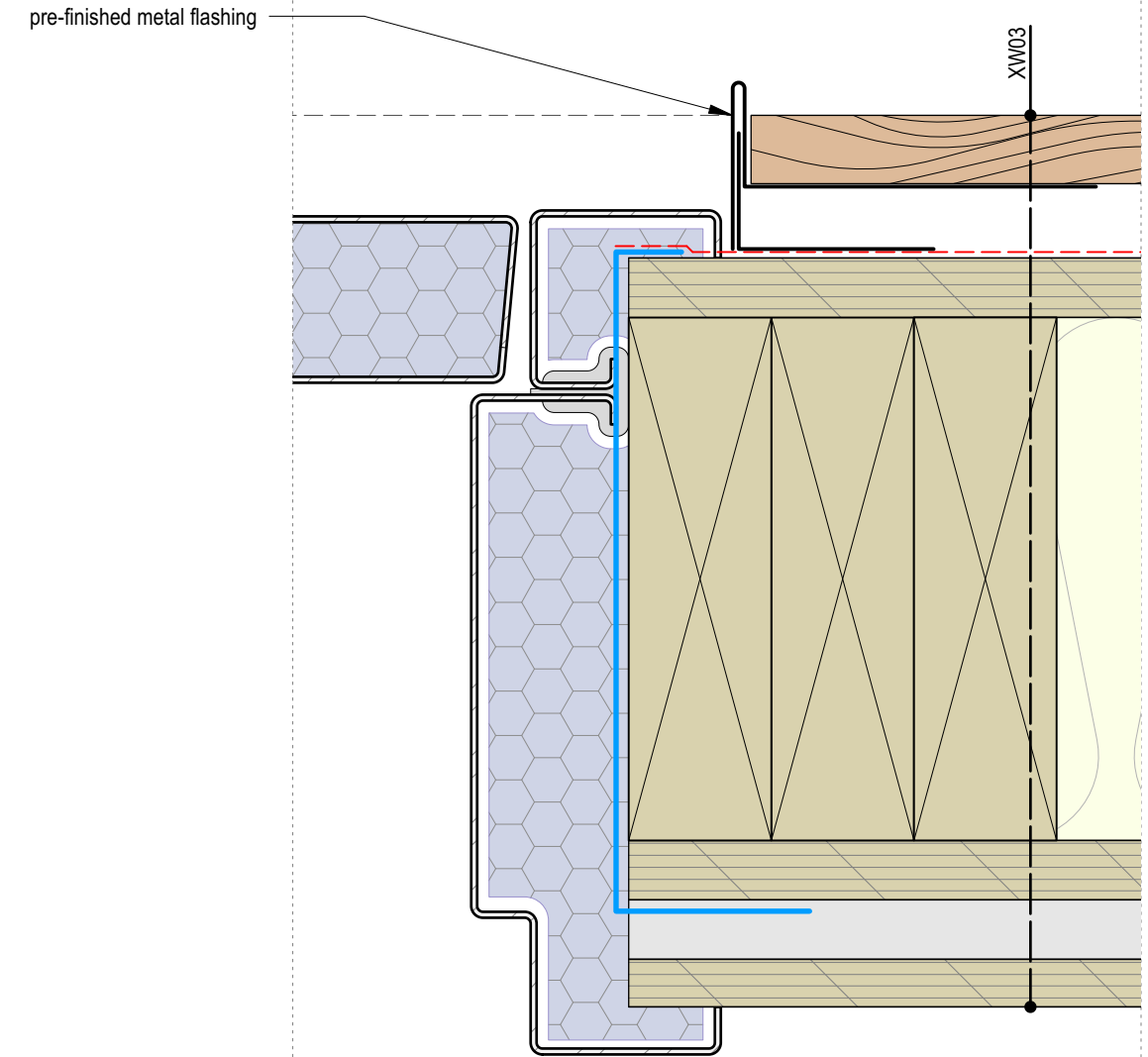
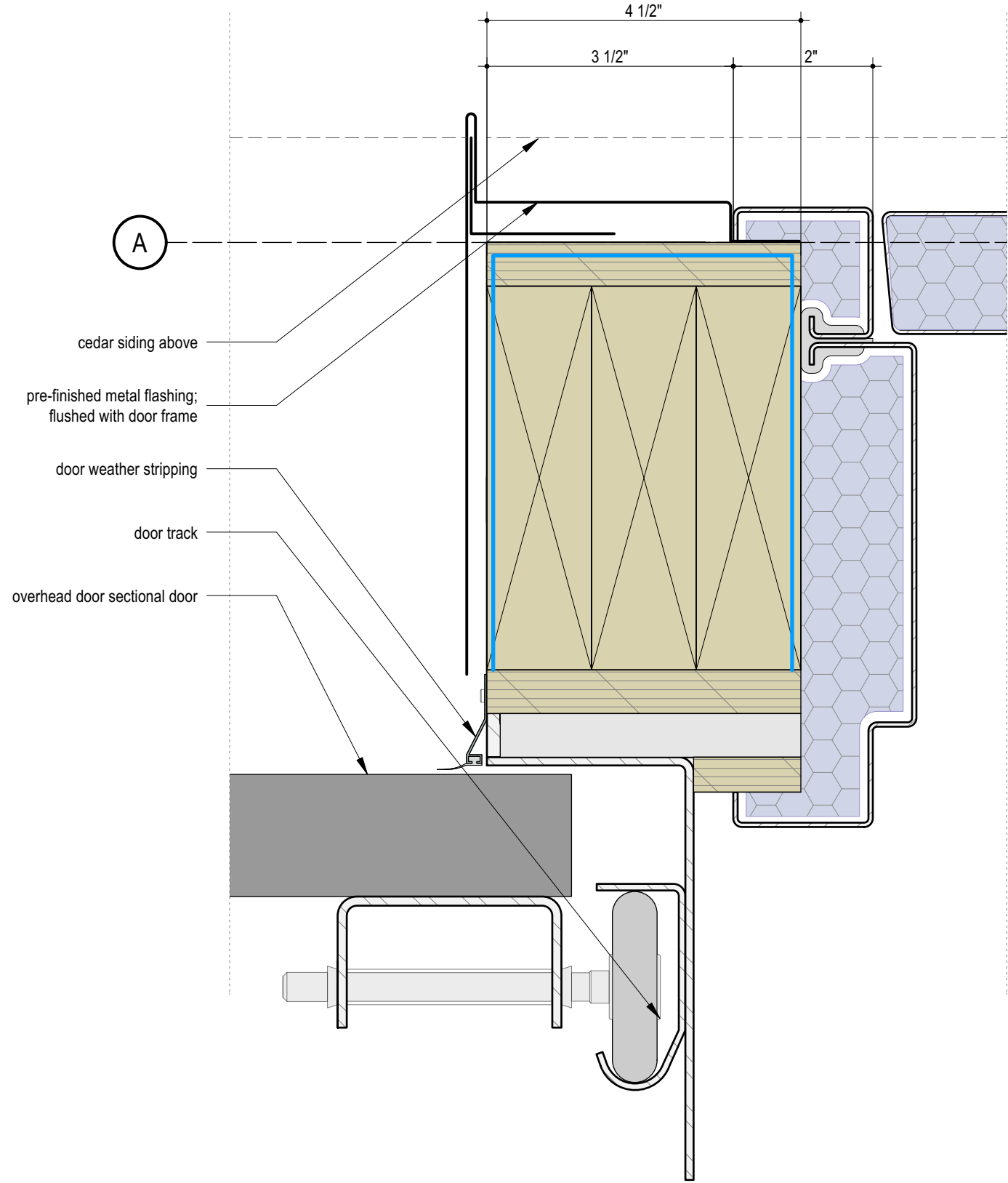
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Scale
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Reference
Date
2023.05.23

Sheet Number
A4106

Seal



- Flashing Profile
- AB membrane (dashed red line)
 - AB tape (solid red line)
 - AB sealant (red oval)
 - AVB membrane (dashed purple line)
 - WRB membrane (dashed green line)
 - WRB tape (solid green line)
 - VB membrane (dashed blue line)
 - VB tape (solid blue line)
 - Dampproofing (dashed black line)
 - Non Vapour Permeable, Self Adhesive Membrane (solid blue line)
 - Vapour Permeable, Self Adhesive Membrane (dashed blue line)
 - SBS Roofing (1 Layer) (solid black line)
 - SBS Roofing (2 Layer) (dashed black line)

Aluminum Doors & Windows



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Page 44 of 376

Drawing
Aluminum Doors & Windows
Project Number
2032
Client
Town of Ladysmith

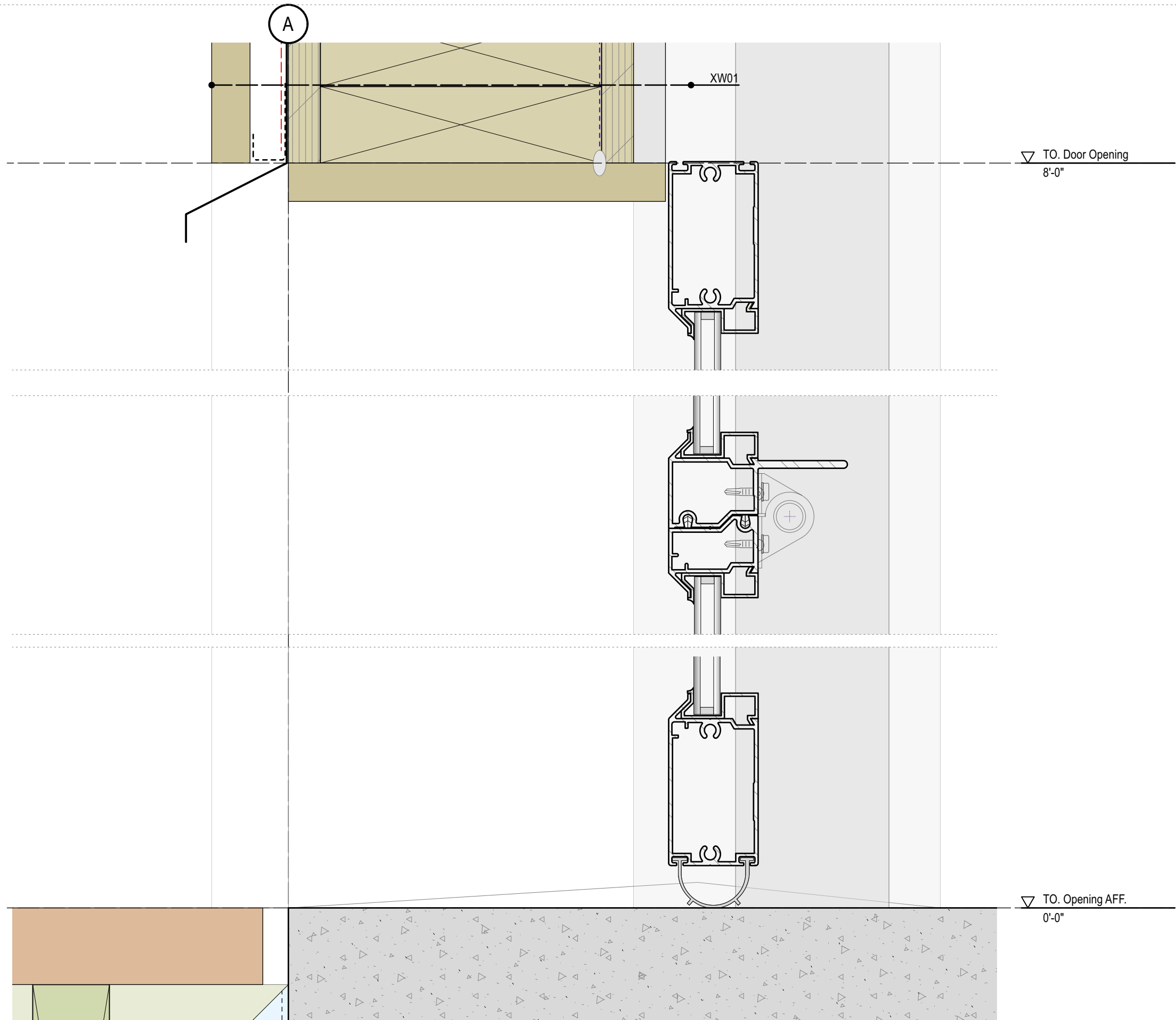
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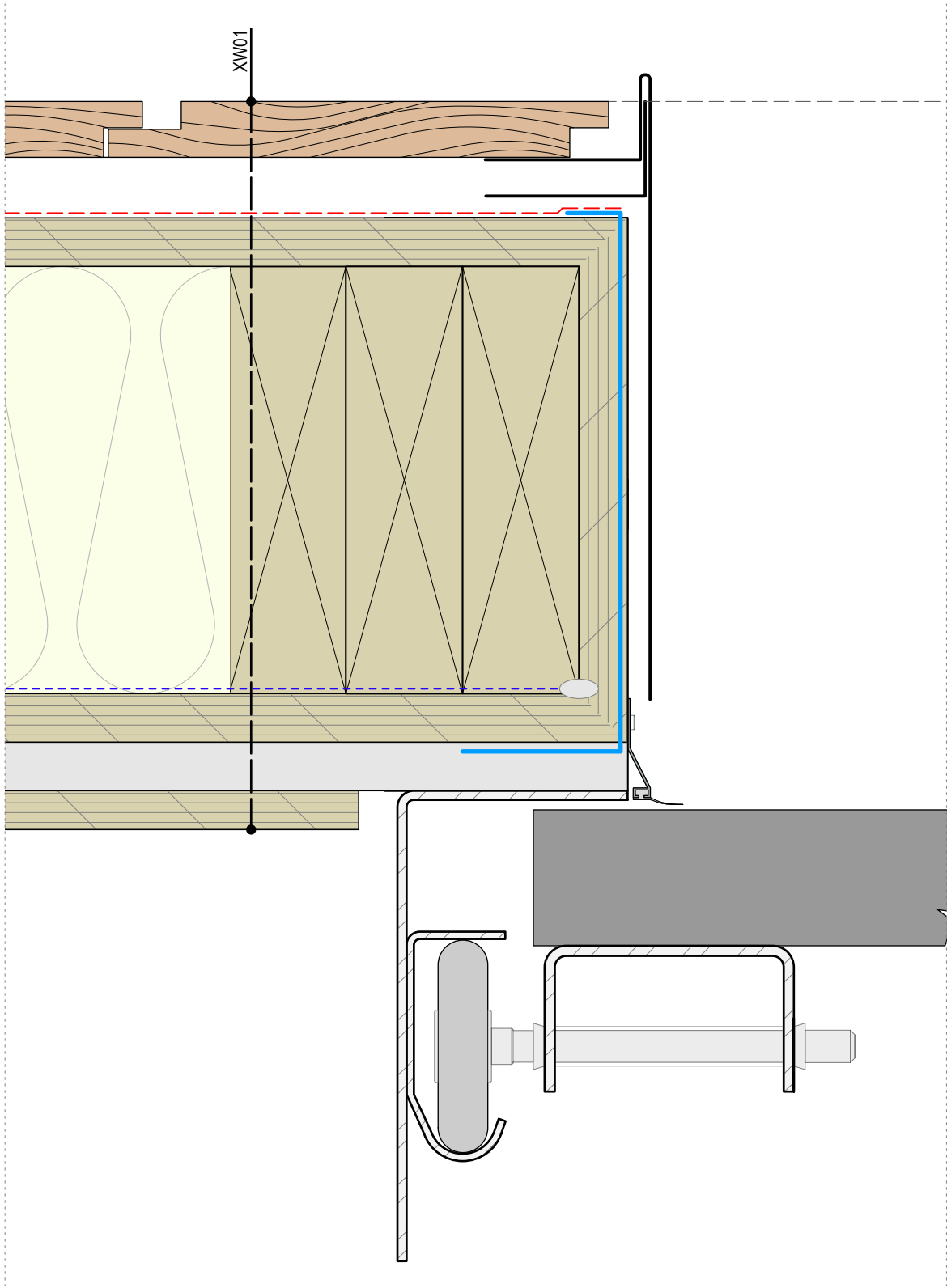
Reference
Date
2023.05.23

Sheet Number
A4400

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Project Name
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Drawing
Plan - Overhead Door
Project Number
2032
Client
Town of Ladysmith

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Scale
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Seal

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Wood Doors & Windows



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Page 29 of 376

Drawing
Wood Doors & Windows
Project Number
2032
Client
Town of Ladysmith

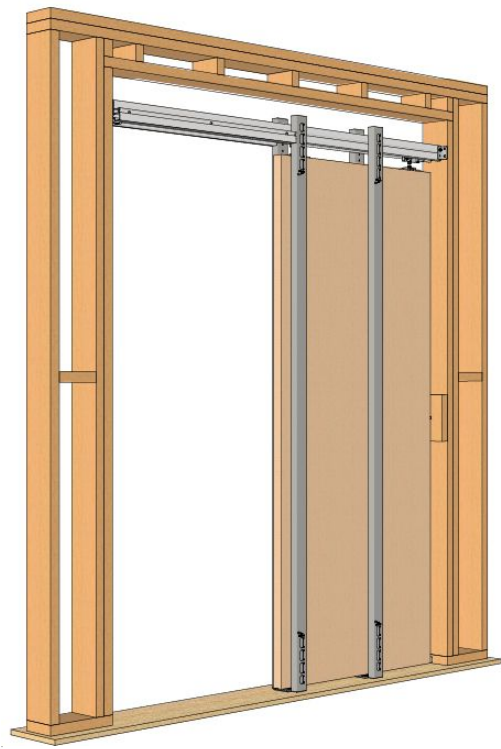
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Scale
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Reference
Date
2023.05.23

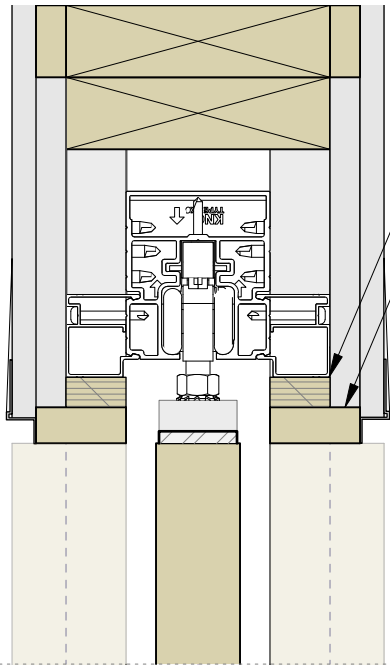
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Seal



Isometric view

▽ TO. Door Opening
8'-0"

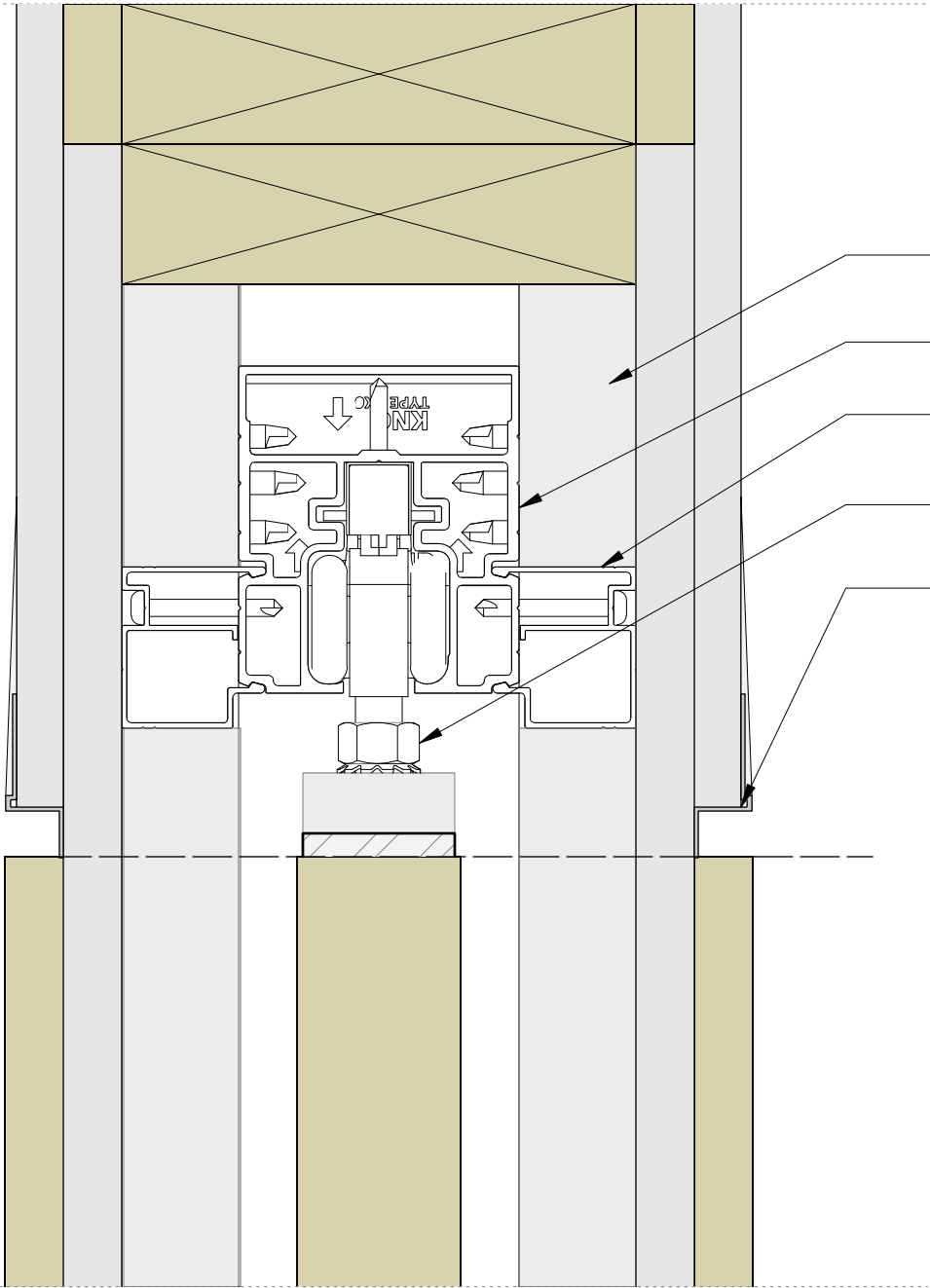


plywood blocking
door header trim

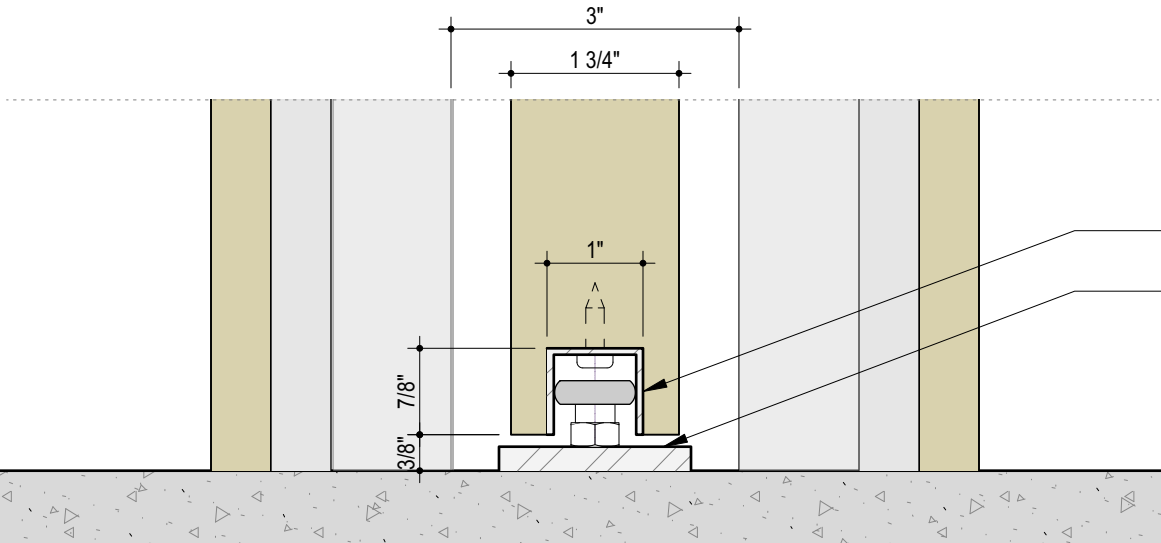
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A4501 Scale: 3" = 1'-0"

Sect. Header Trim

▽ TO. Opening AFF.
0'-0"

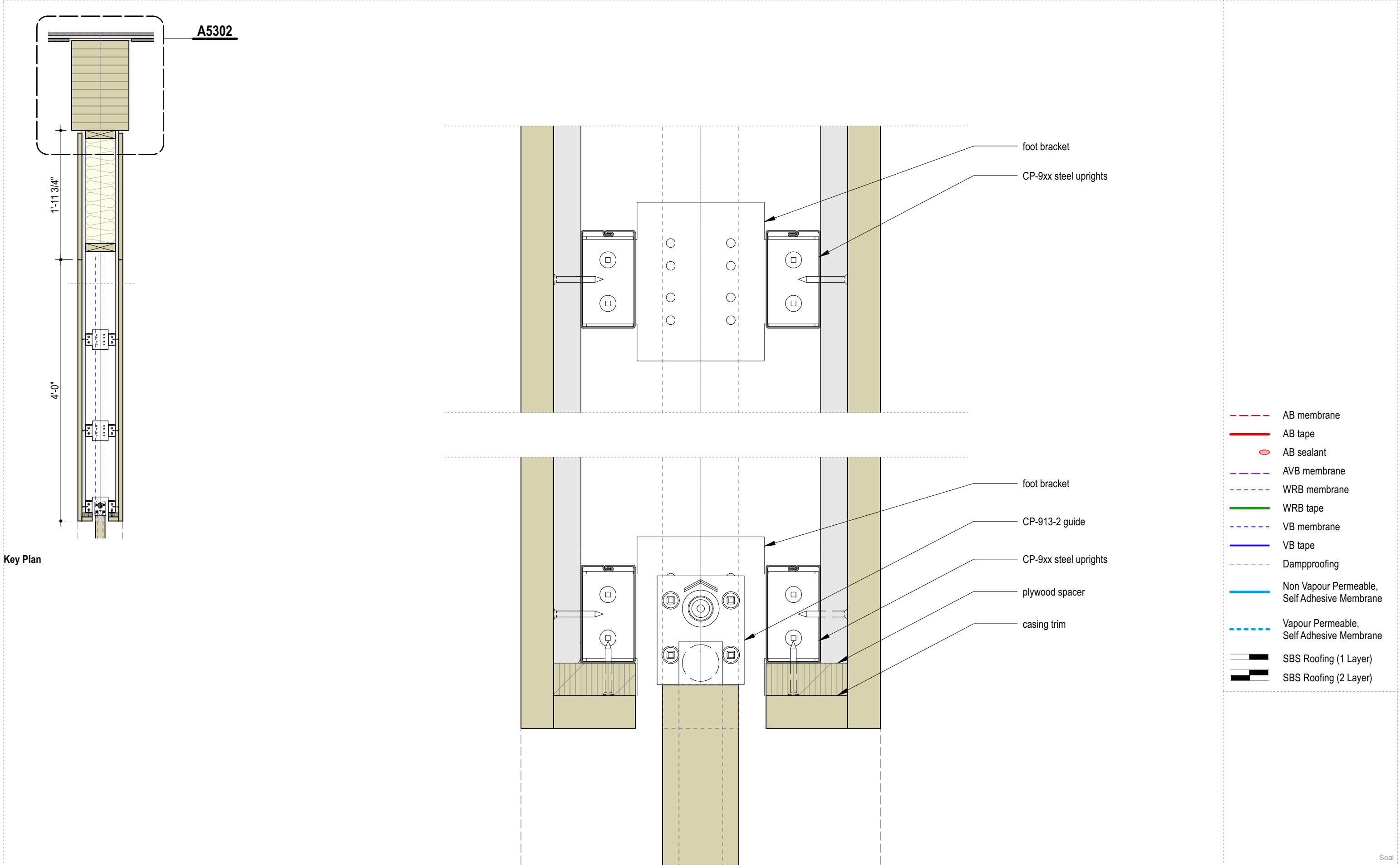


CP-9xx steel uprights
CP-903 header track
CP-930 drywall support
CC-998 hanger
trim-tex architectural Z shadow bead 1/2"



C-914 guide channel
CP-913-2 guide

- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Storefront Systems



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Page 12 of 376

Drawing
Storefront Systems
Project Number
2032
Client
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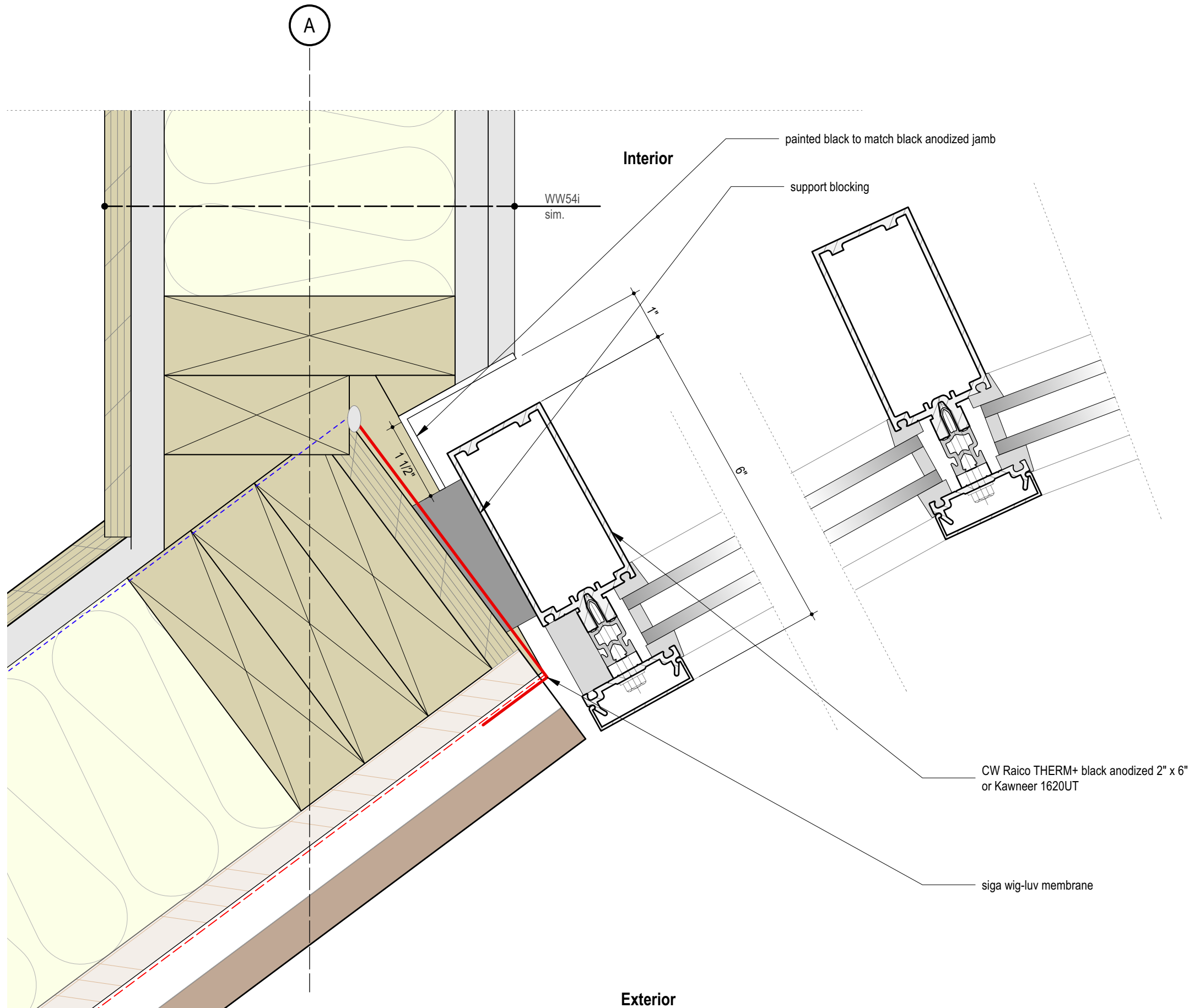
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Scale
n/a

Reference
Date
2023.05.23

Sheet Number
A4600

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Project Name
Arts and Heritage Hub
Page 10 of 370

Drawing
Plan - Entry Door
Project Number
2032

Client
Town of Ladysmith

Drawn By
HA
Issue No.
80

Reviewed By
BC
Issued For
IFT - R1

Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number

A4601

Seal

The image contains two technical drawings of a door and window assembly, showing cross-sections and a legend.

Left Drawing (Door Assembly):

- Dimensions:** 2", 2 3/16", 1 5/8", 3 3/4", 4 1/2", 2 1/4", 3/4", 2".
- Labels:**
 - CRL 3250 door jamb or Standard Aluminum 550T sotrefront black anodized
 - concealed continuous gear hinge
 - Raico Therm+ or Kawneer 1620UT CW Mullion as storefront system
 - custom black anodized mullion angle to attach the entry door
 - Raico Therm+ or Kawneer 1620UT CW Mullion as storefront system

Right Drawing (Window Assembly):

- Dimensions:** 3 9/16", 2".
- Labels:**
 - CRL 3250 door jamb or Standard Aluminum 550T sotrefront black anodized
 - non active leaf
 - active leaf
 - lock cylinder
 - 5000 - 1" diameter push bar

Legend:

- AB membrane (dashed red line)
- AB tape (solid red line)
- AB sealant (red oval)
- AVB membrane (dashed purple line)
- WRB membrane (dashed green line)
- WRB tape (solid green line)
- VB membrane (dashed blue line)
- VB tape (solid blue line)
- Dampproofing (dashed black line)
- Non Vapour Permeable, Self Adhesive Membrane (solid blue line)
- Vapour Permeable, Self Adhesive Membrane (dashed blue line)
- SBS Roofing (1 Layer) (solid black line)
- SBS Roofing (2 Layer) (dashed black line)

Curtainwall Systems



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Project Name
Arts and Heritage Hub
Page 14 of 376

Drawing
Curtainwall Systems
Project Number
2032
Client
Town of Ladysmith

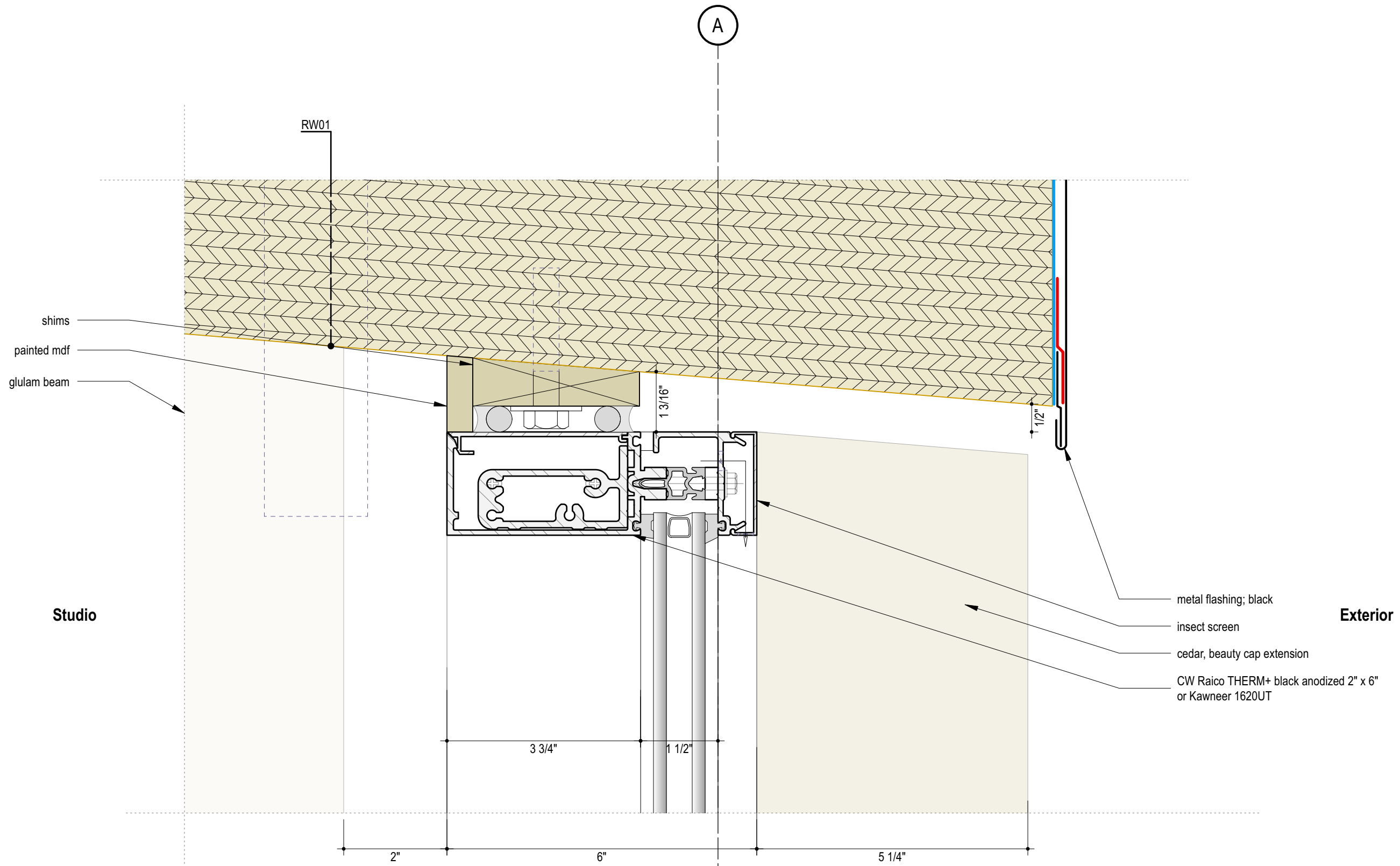
Drawn By
-
Issue No.
80
Reviewed By
-
Issued For
IFT - R1

Scale
As Noted

Reference
Date
2023.05.23

Sheet Number
A4700

Seal



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

*refer to structural



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Drawing
Section - CW Header

Project Number
2032

Client
Town of Ladysmith

Drawn By
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80

Reviewed By
BC

Issued For
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Scale
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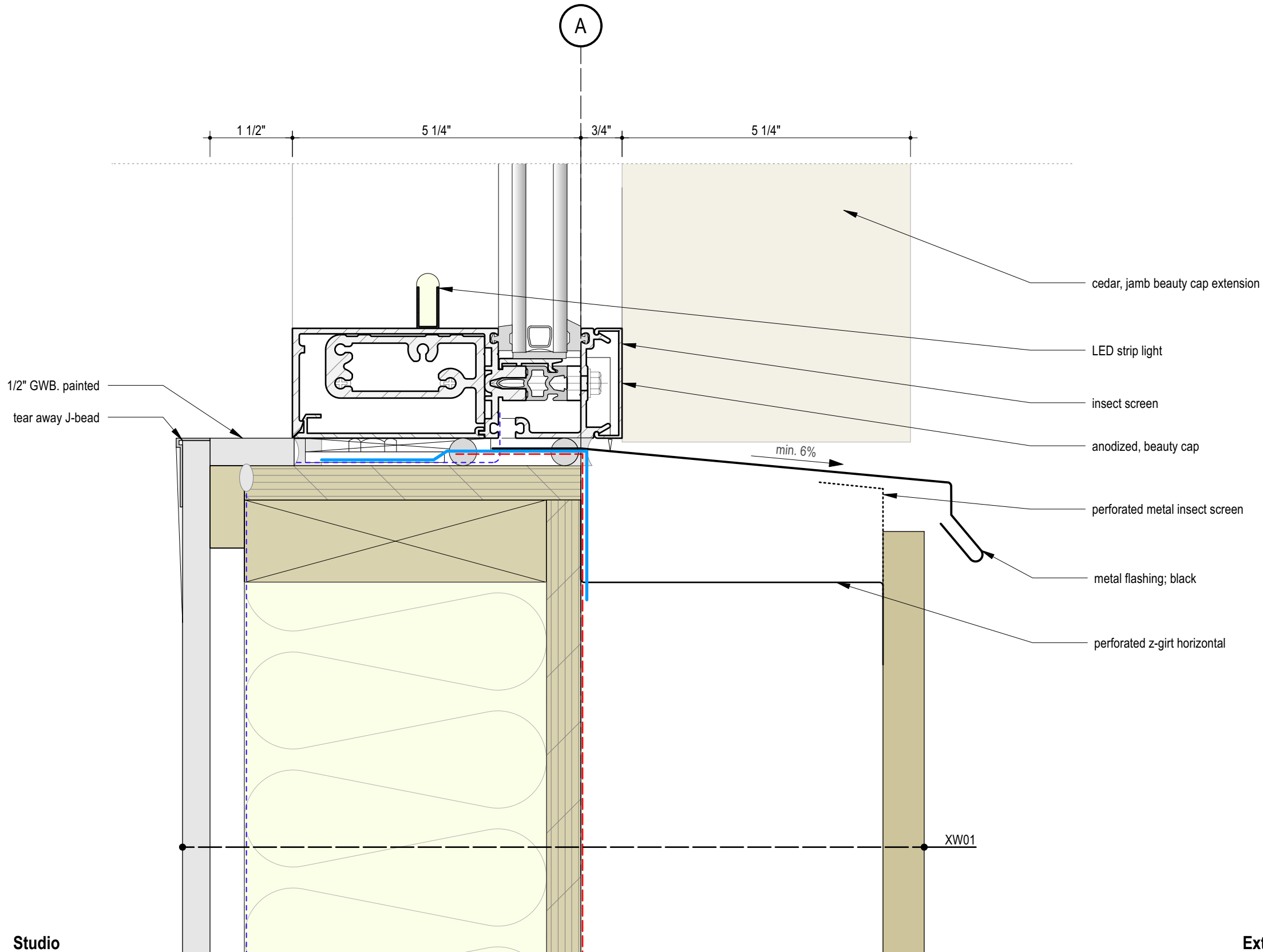
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Date
2023.05.23

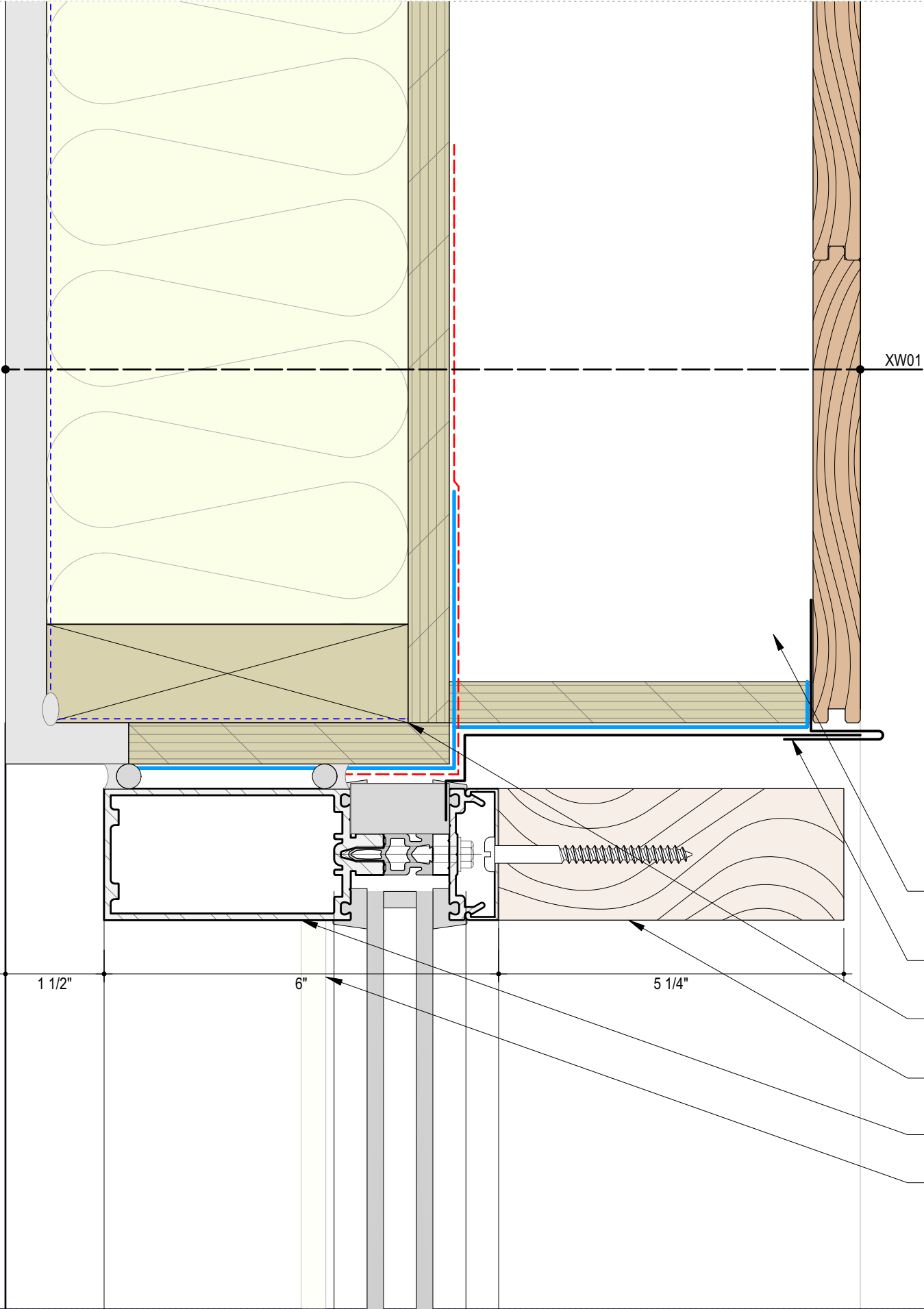
Sheet Number

A4701

Seal

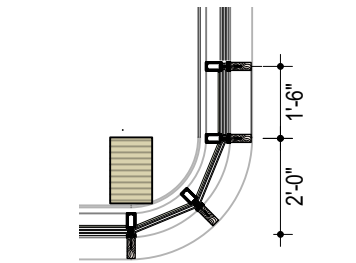


- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



3D render - curatinwall corner

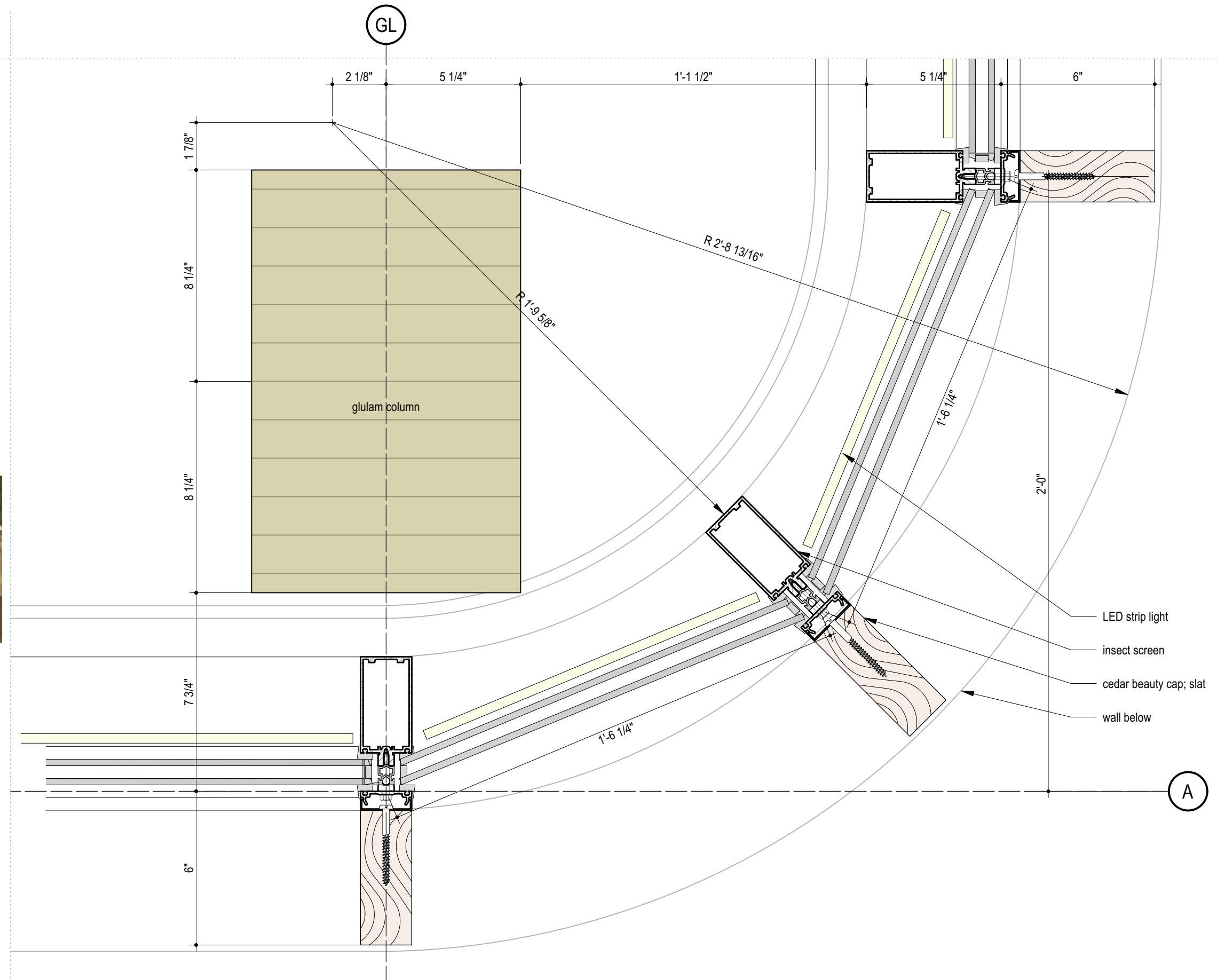
- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



key plan



3D render - curatinwall corner



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)



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Arts and Heritage Hub

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Drawing
Plan - CW Jamb Round Corner
Project Number
2032
Client
Town of Ladysmith

Drawn By
HA
Reviewed By
BC
Issue No.
80
Issued For
IFT - R1

Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number

A4704

Seal

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Flooring and Walls



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Project Name
Arts and Heritage Hub
Page 100 of 376

Drawing
Flooring and Walls
Project Number
2032
Client
Town of Ladysmith

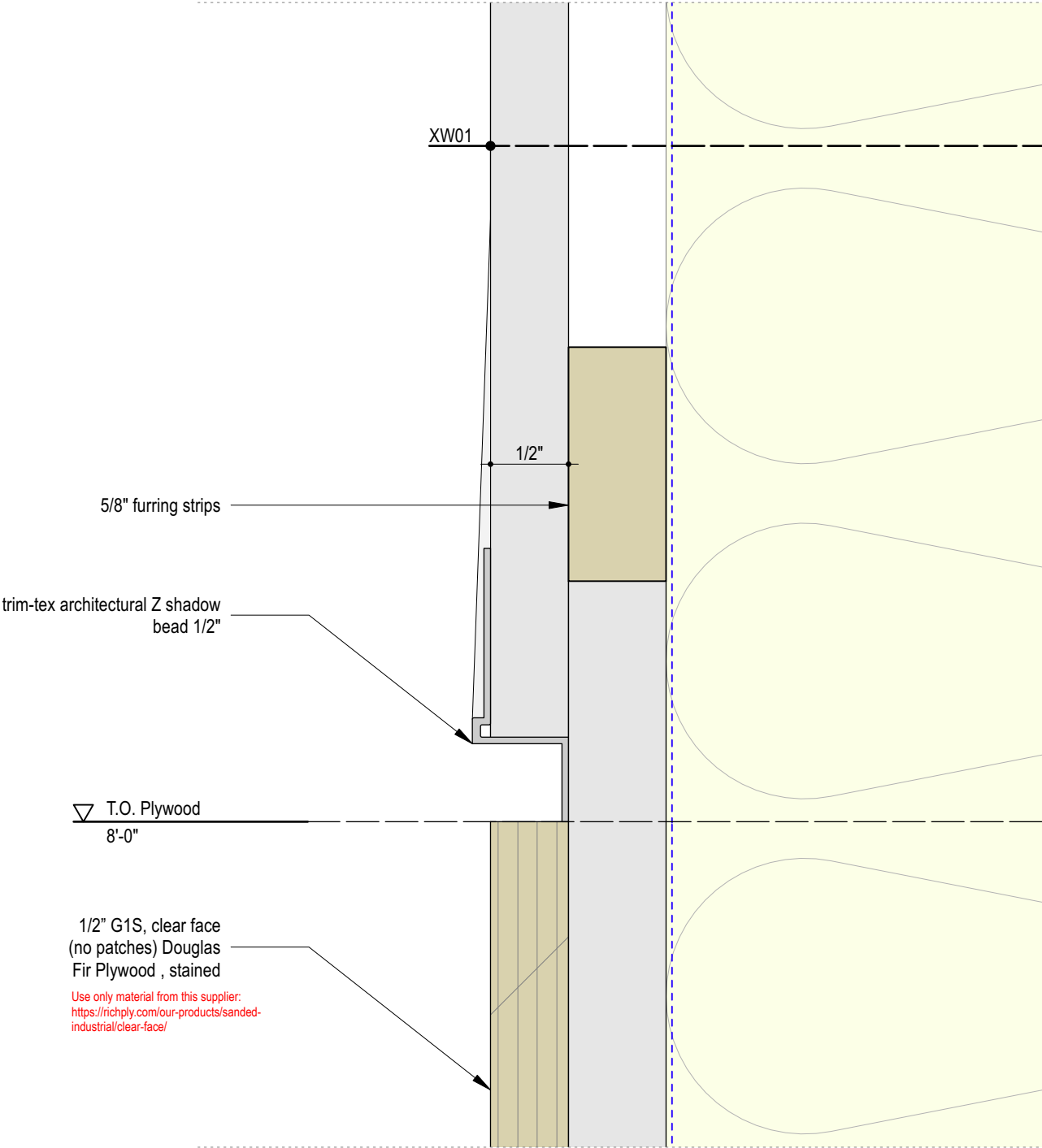
Drawn By
TC
Issue No.
80
Reviewed By
DP
Issued For
IFT - R1

Scale
As Noted

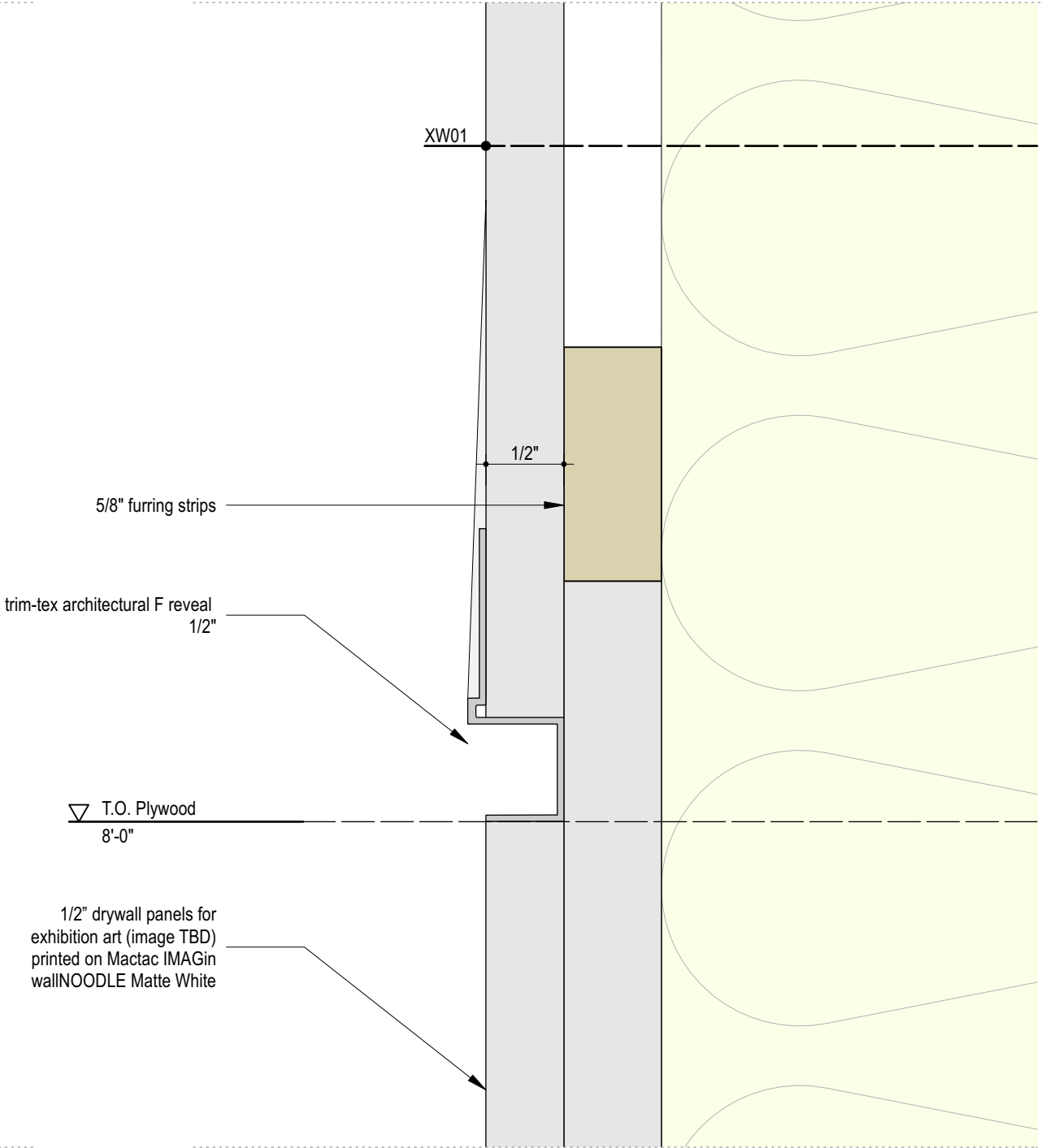
Reference
Date
2023.05.23

Sheet Number
A5300

Seal



1
A5301 Wood Wall Protection to GWB.
Scale: Actual Size



2
A5301 GWB. Wall Protection to GWB.
Scale: Actual Size



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Project Name
Arts and Heritage Hub
Page 101 of 376

Drawing
Sect. - Wall Finish Transition
Project Number
2032
Client
Town of Ladysmith

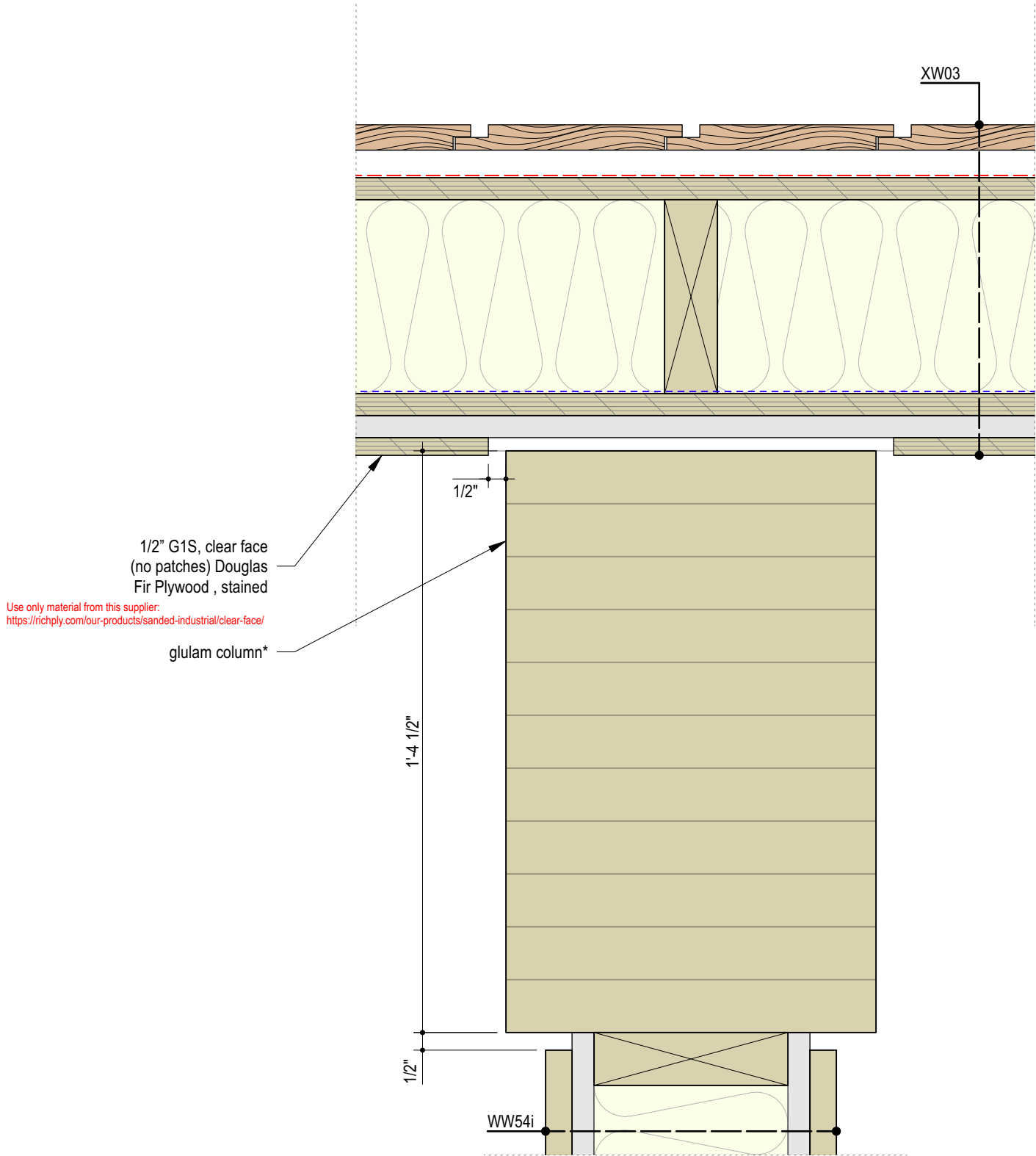
Drawn By
HA
Reviewed By
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Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A5301

Seal



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Project Name
Arts and Heritage Hub
Page 102 of 376

Drawing
Plan - Wall to Column
Project Number
2032
Client
Town of Ladysmith

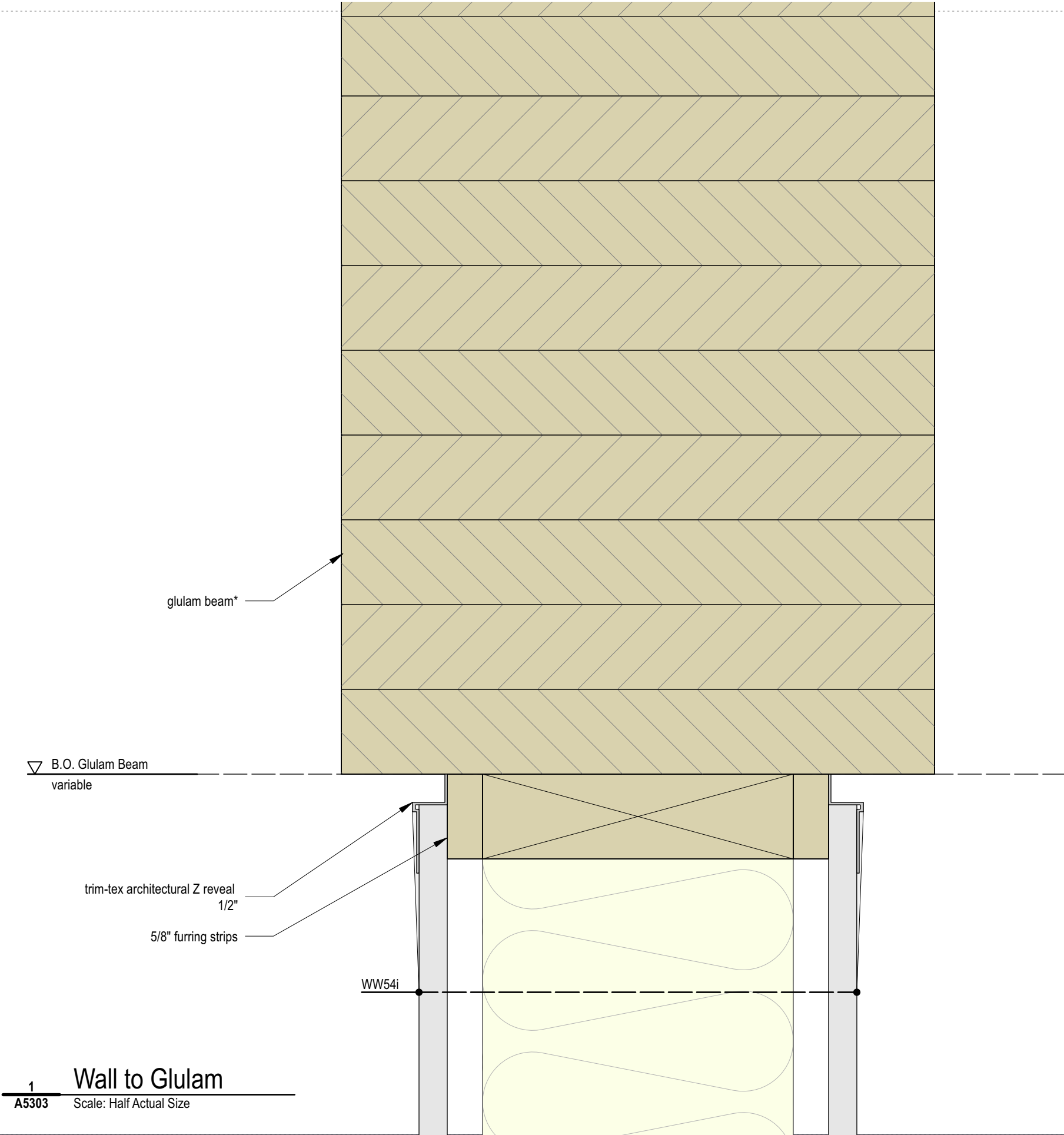
Drawn By
HA
Issue No.
80
Reviewed By
BC
Issued For
IFT - R1

Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A5302

Seal



1 Wall to Glulam
A5303 Scale: Half Actual Size



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Project Name
Arts and Heritage Hub
Page 108 of 376

Drawing
Sect. - Wall to Glulam
Project Number
2032
Client
Town of Ladysmith

Drawn By
HA
Issue No.
80
Reviewed By
BC
Issued For
IFT - R1

Scale
AS NOTED

Reference
Date
2023.05.23

Sheet Number
A5303

Seal

ISSUED FOR TENDER

Bulkheads



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Project Name

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Page 104 of 376

Drawing
Bulkheads

Project Number
2032

Client
Town of Ladysmith

Drawn By
TC

Issue No.
80

Reviewed By
DP

Issued For
IFT - R1

Scale
As Noted

Reference

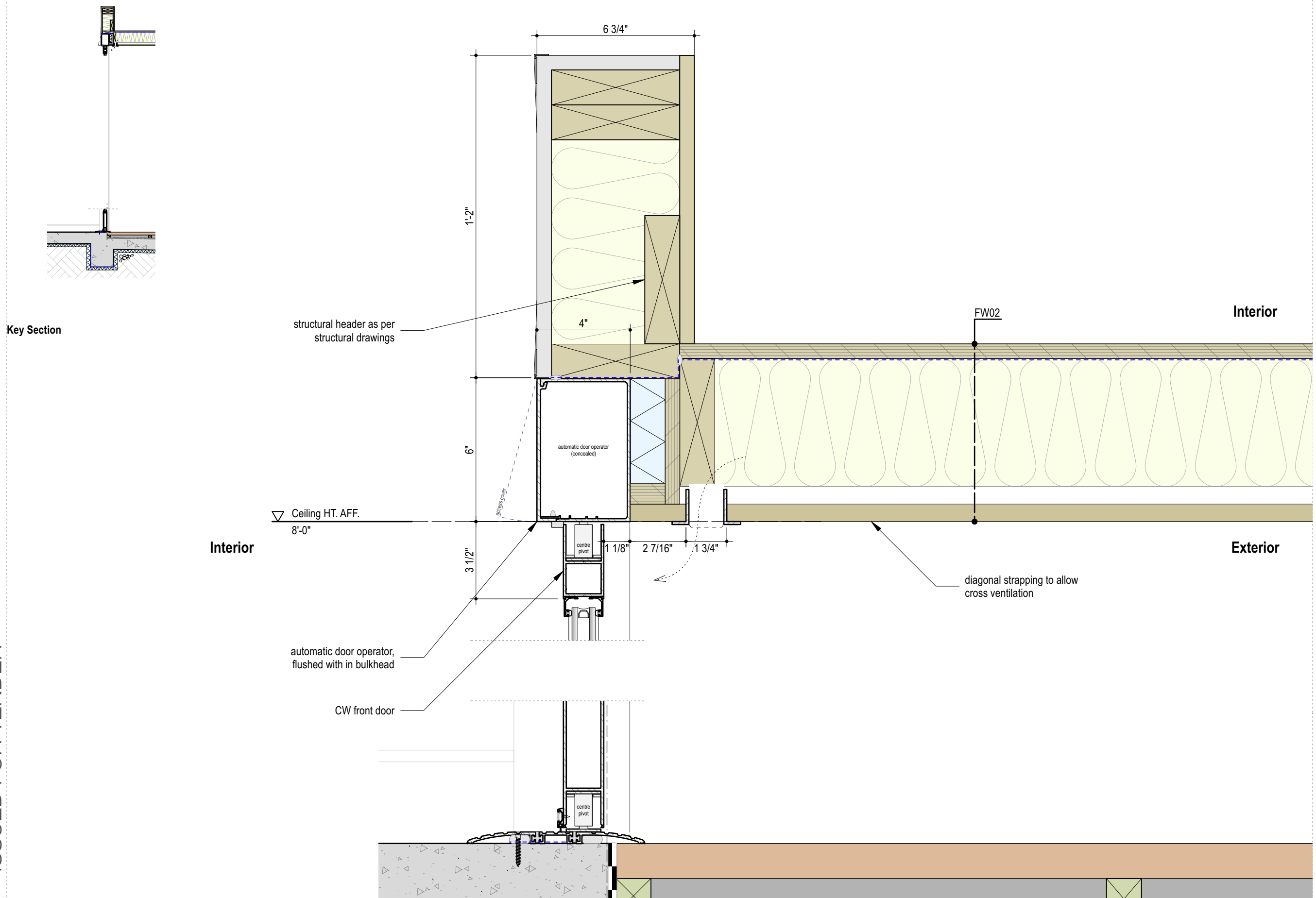
Date
2023.05.23

Sheet Number

A5500

Seal

ISSUED FOR TENDER



ISSUED FOR TENDER

MEP
mechanical, electrical and plumbing



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Project Name
Arts and Heritage Hub
Page 166 of 376

Drawing
MEP
Project Number
2032
Client
Town of Ladysmith

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80
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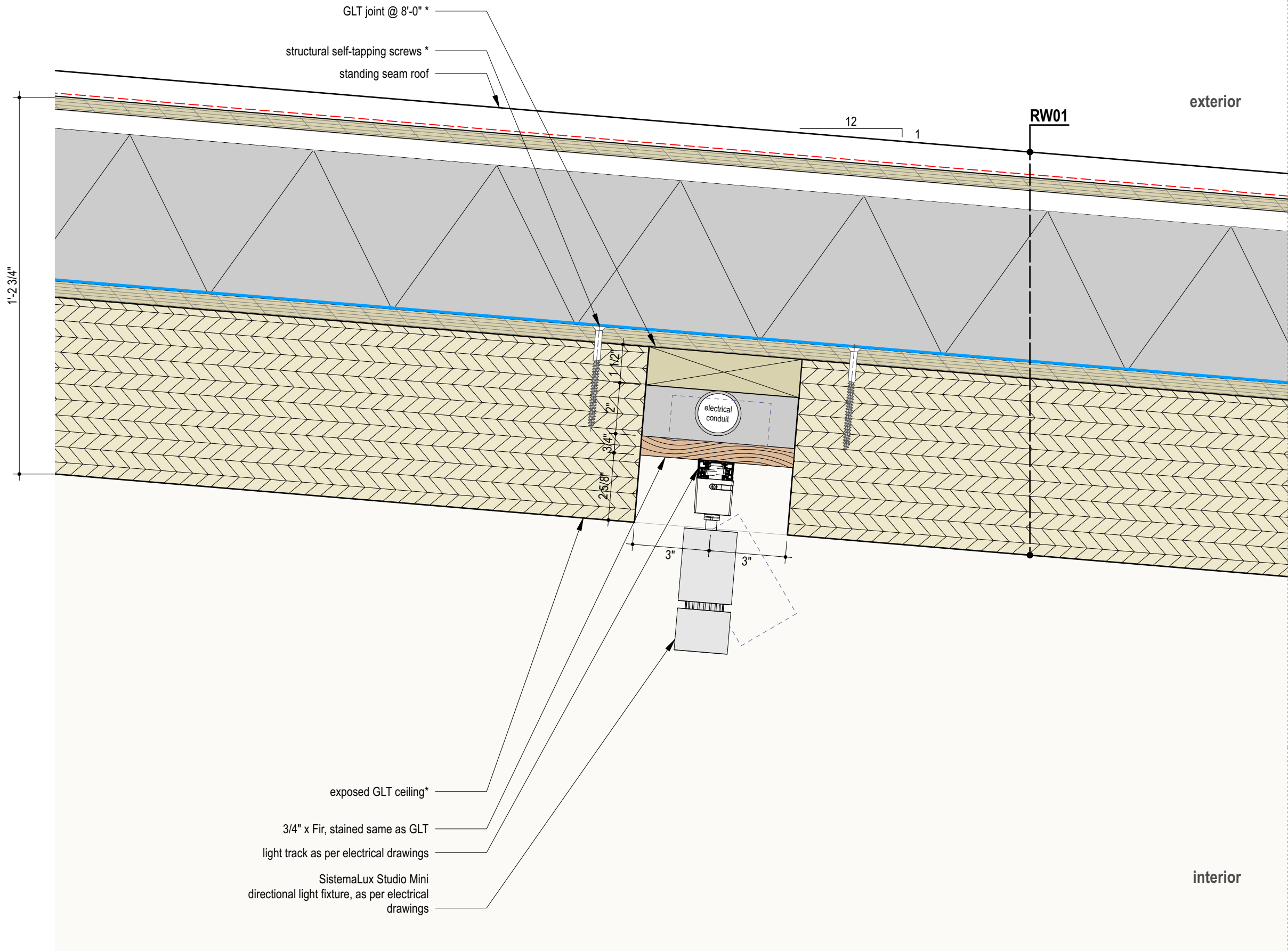
Scale
As Noted

Reference
Date
2023.05.23

Sheet Number
A5700

Seal

ISSUED FOR TENDER



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

*refer to structural



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Project Name
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Page 107 of 376

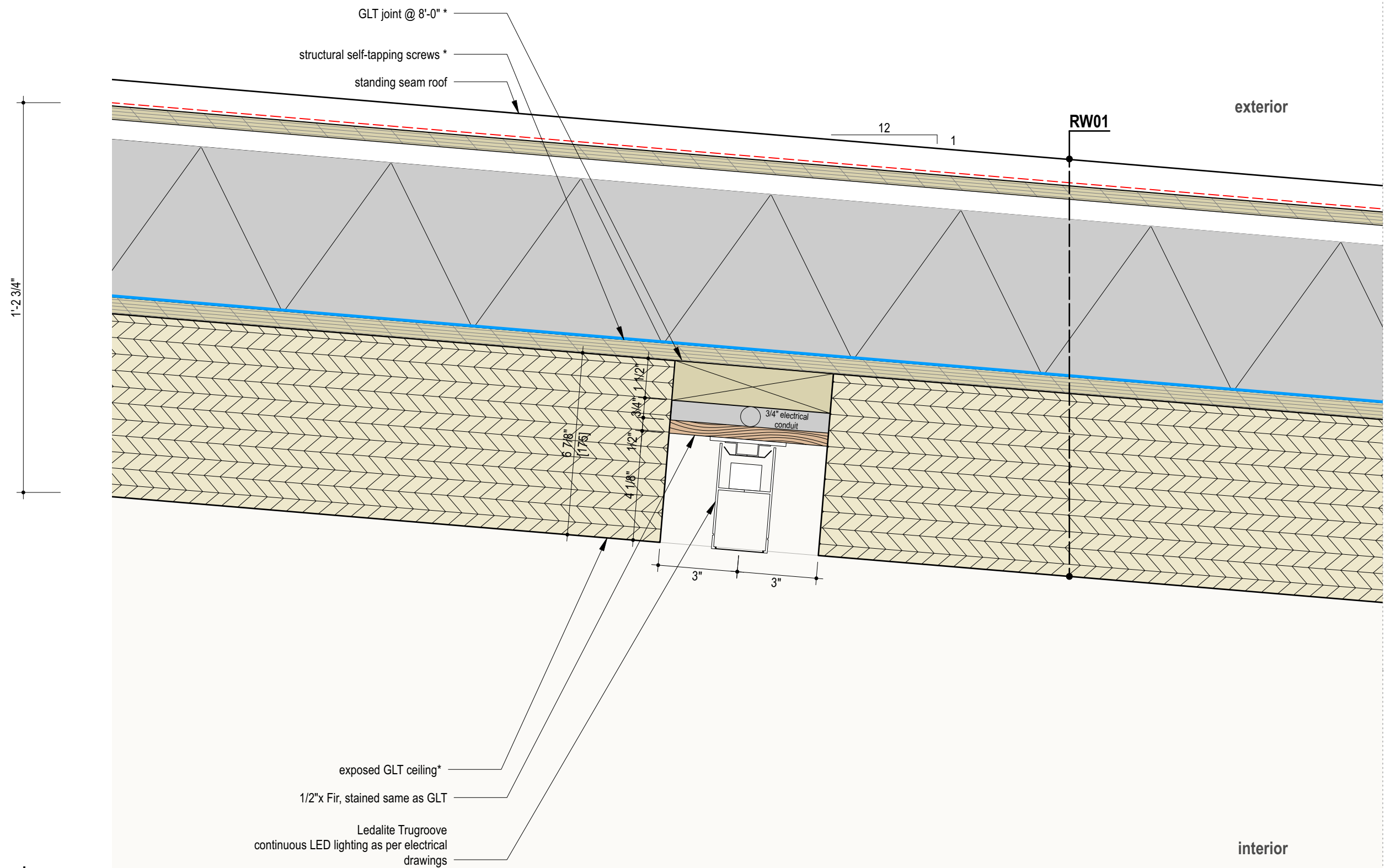
Drawing
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Project Number
2032
Client
Town of Ladysmith

Drawn By
HA
Reviewed By
BC
Issue No.
80
Issued For
IFT - R1

Scale
1-1/2"=1'-0"

Reference
Date
2023.05.23

Sheet Number
A5701



- AB membrane
- AB tape
- AB sealant
- AVB membrane
- WRB membrane
- WRB tape
- VB membrane
- VB tape
- Dampproofing
- Non Vapour Permeable, Self Adhesive Membrane
- Vapour Permeable, Self Adhesive Membrane
- SBS Roofing (1 Layer)
- SBS Roofing (2 Layer)

*refer to structural



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Page 108 of 376

Drawing
Section - GLT cavity
Project Number
2032
Client
Town of Ladysmith

Drawn By
HA
Reviewed By
BC
Issue No.
80
Issued For
IFT - R1

Scale
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Reference
Date
2023.05.23

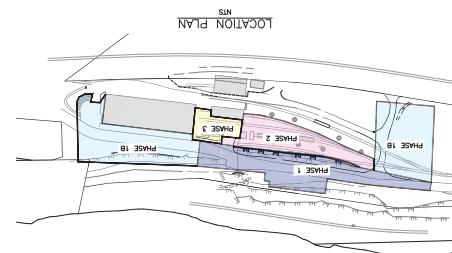
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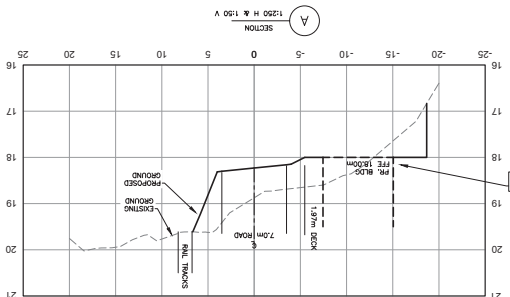
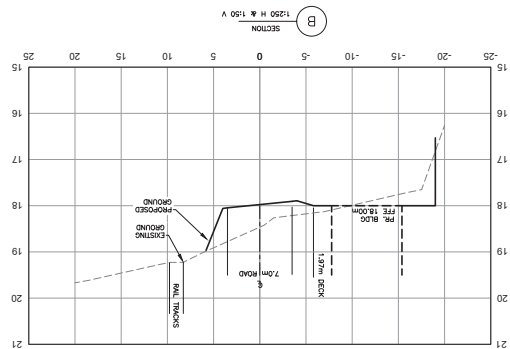
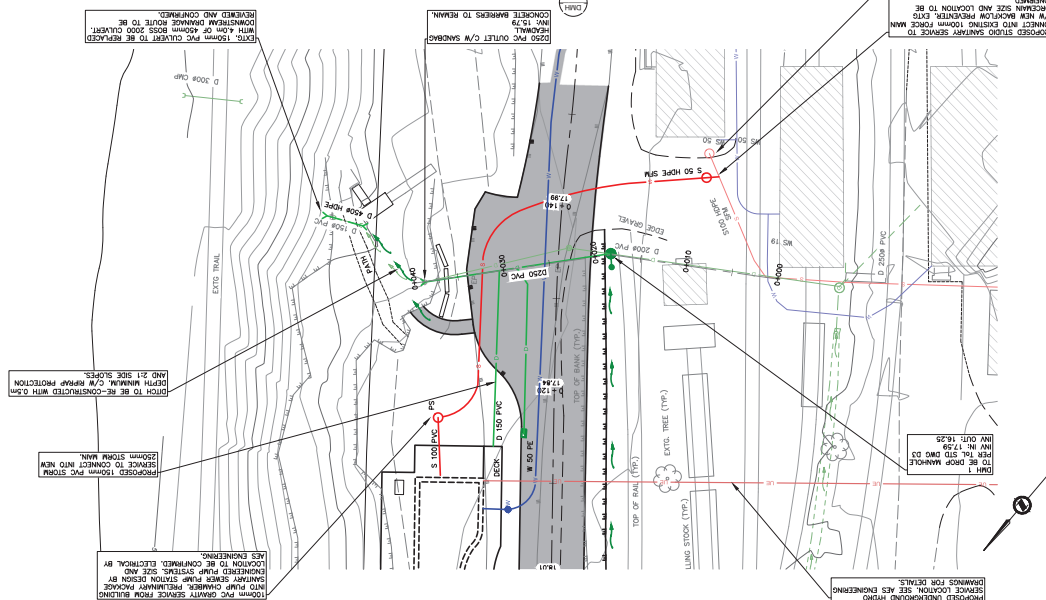
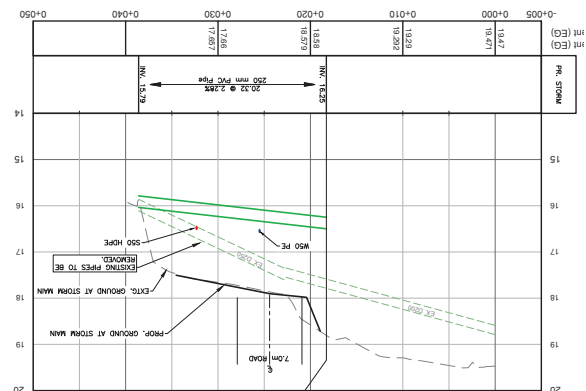
APPENDIX B

Civil

DRAWING LIST		ISSUED DATE	
CITY DRAWING NUMBER	DRAWING NUMBER	DRAWING TITLE	
C1	SITE PLAN AND GENERAL CONSTRUCTION NOTES	APRIL 3 / 23	
C2	ROAD AND WATERWAY - PLAN AND PROFILE	APRIL 3 / 23	
C3	STORM SANITARY AND CROSS SECTIONS	APRIL 3 / 23	

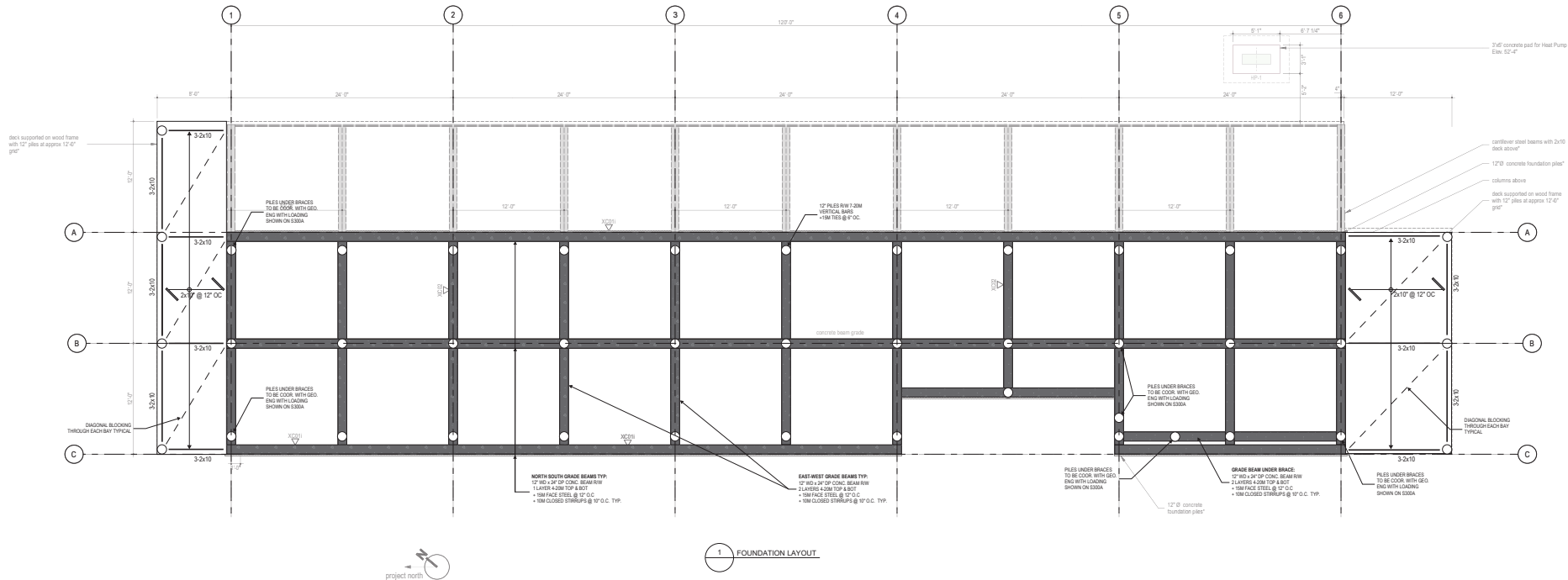
REFERENCE DRAWINGS	DRAWING NUMBER	COMPANY	CHECKWORTH POSITION	AD01 - A503
			PPS STUDIO	LD 00 - P103
			RES ENGINEERING	E10 - E40
			MECHANICAL ENGINEER	ROCKY POINT ENGINEERING
				M0 - M5

[illegible]



APPENDIX C

Structural



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 250-402 Pender Street W., Vancouver, BC V6B 1T6

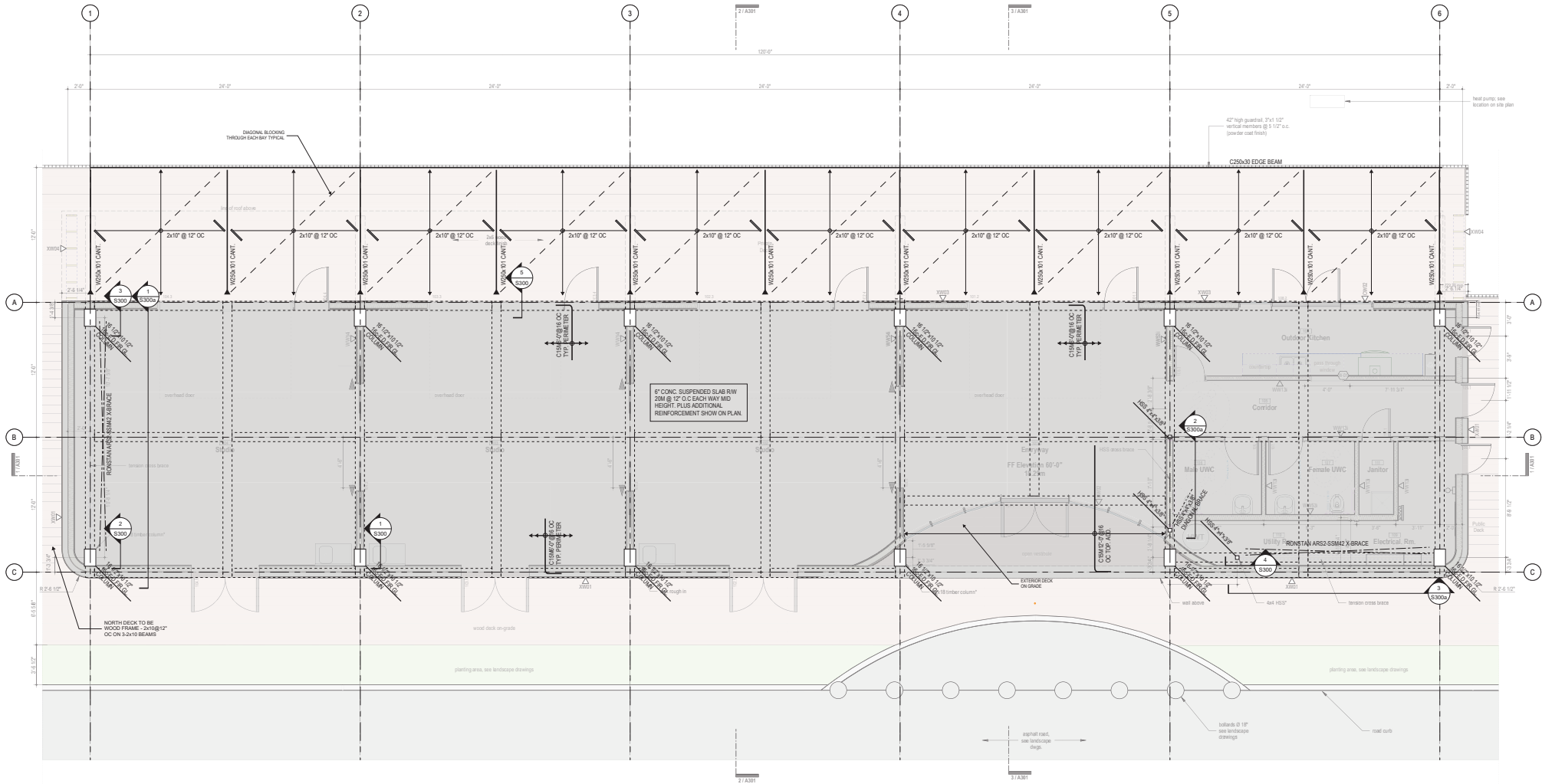
www.cparch.ca
 250.714.1963
 604.653.3444

Fast + Epp
 Suite 302
 307 West 79 Ave
 Vancouver, BC
 Canada V6C 1K1
 T 604 731 7412
 fast@fastepp.com
 fastepp.com

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Arts and Heritage Hub
 Artists' Studio Building

Client Town of Ladysmith	Drawn By NDR	Reviewed By	Sheet Number S200
Project Number 2729	Sheet Name Foundation Design		
Date n/a	City 2023.02.28	Meeting No. 71	Revision BP AND TENDER SET



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 Checkwitch Poirn Architects Inc.
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 301-450 Pender Street W., Vancouver, BC V6B 1T6

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 250.714.1983
 604.659.3444

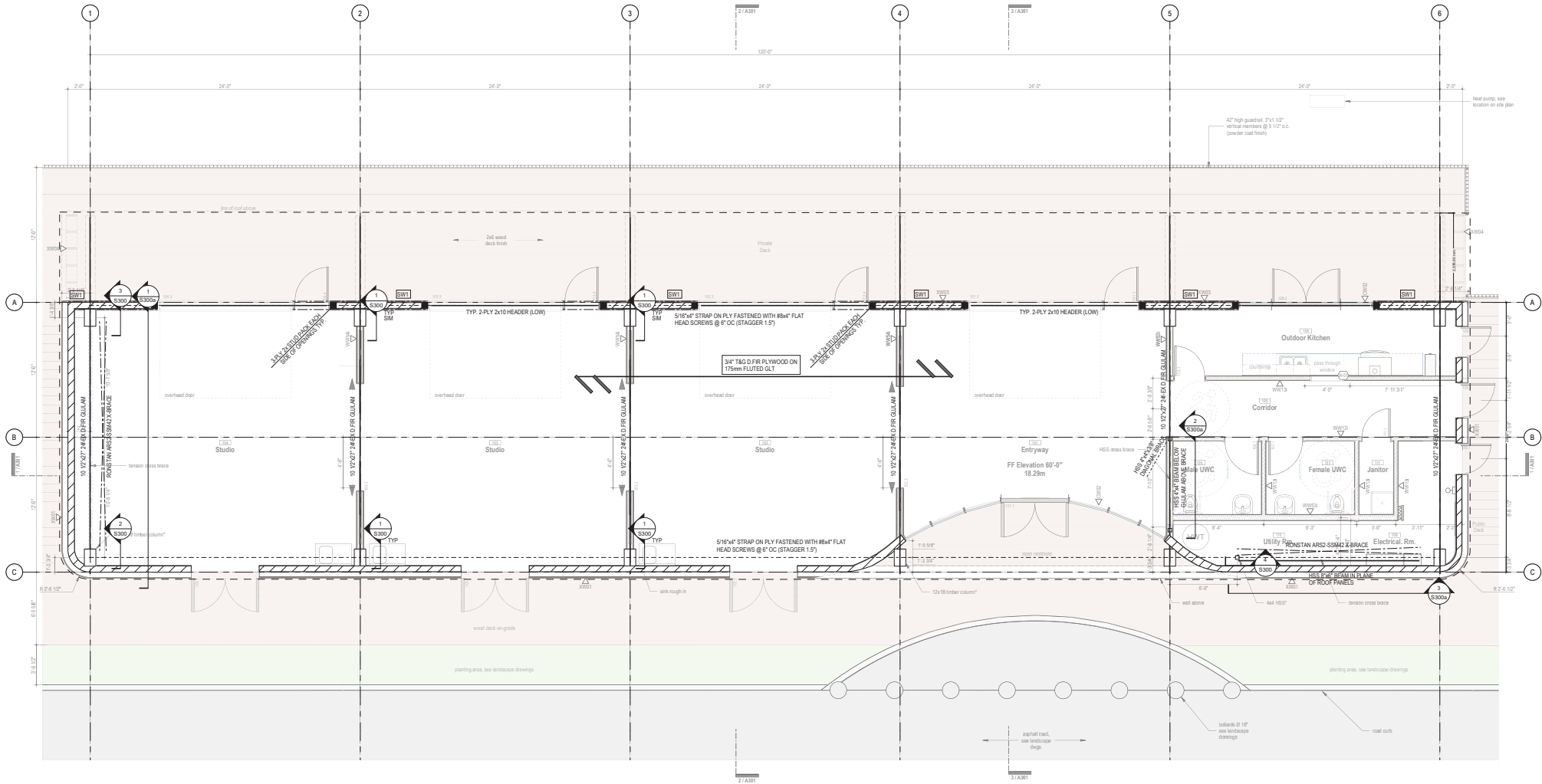
Fast + Epp
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 587 West 79 Ave
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 Canada V6P 1M6
 T 604.731.7412
 fast@fastepp.com
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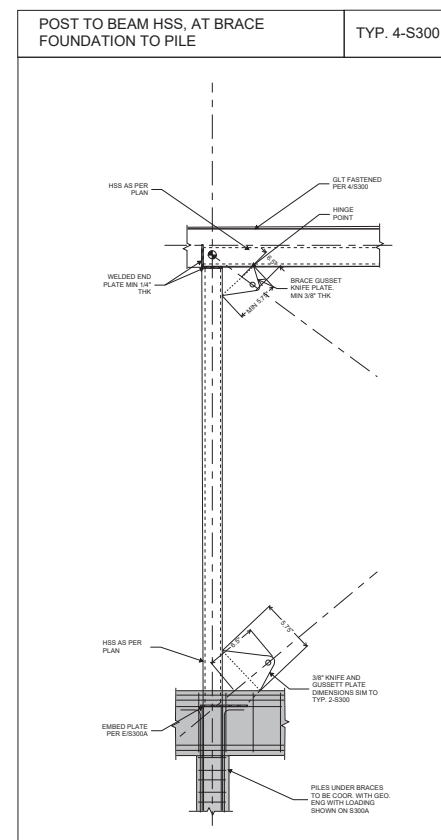
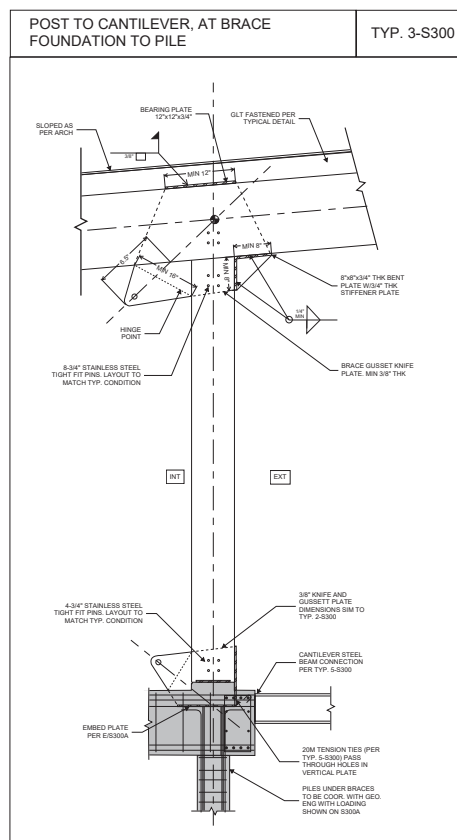
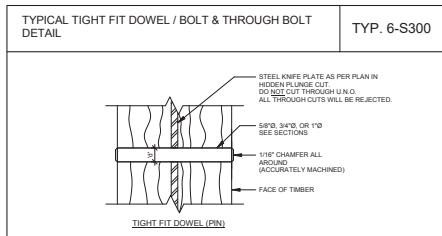
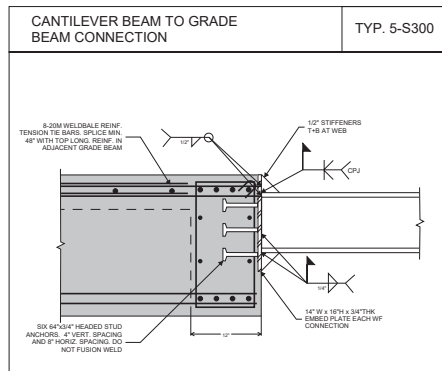
Arts and Heritage Hub

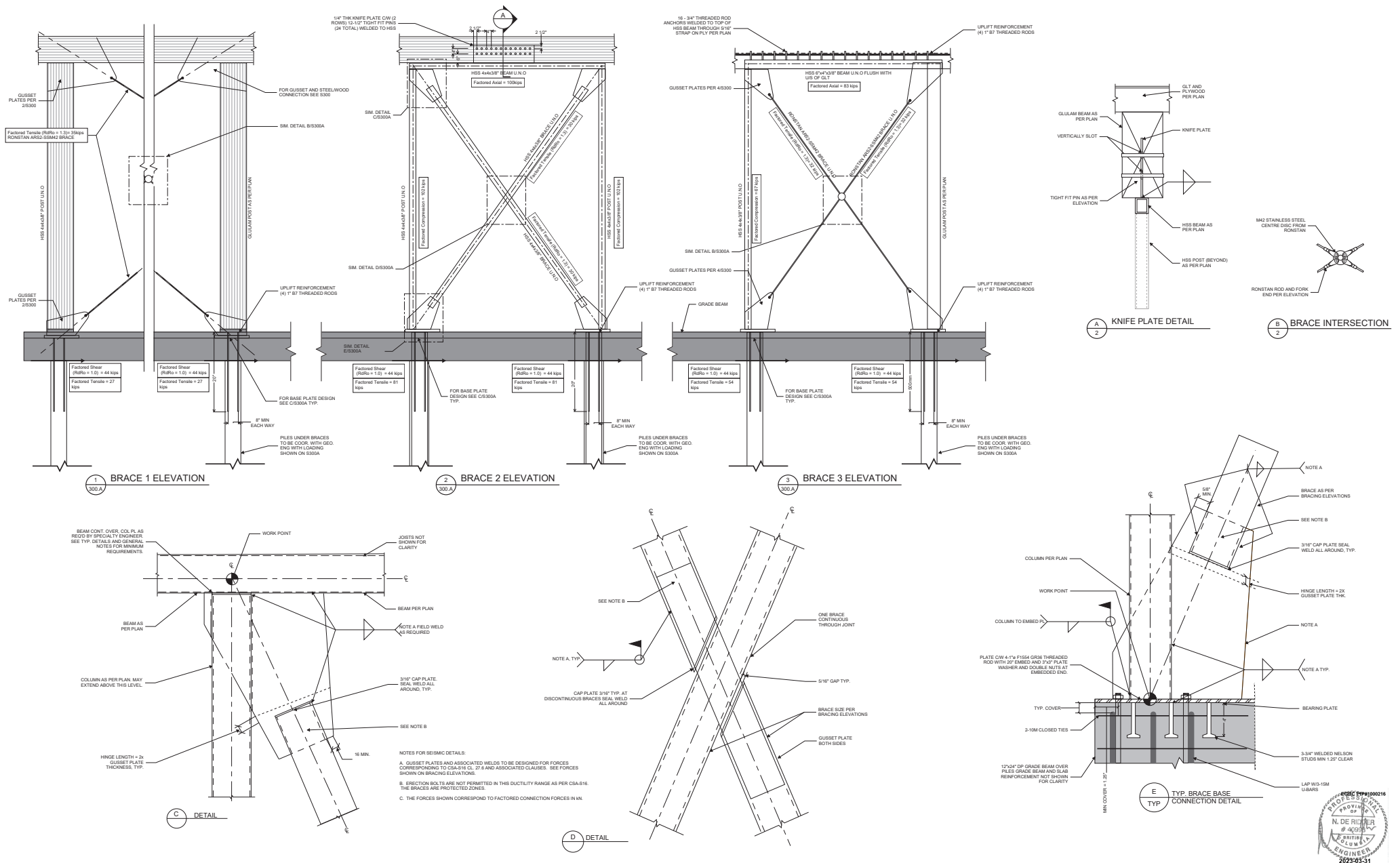
Artists' Studio Building

Client	Town of Ladysmith	Drawn By	NDR	Reviewed By	Sheet Number
Project Number	2729	Sheet Name	Main Floor Framing		S201
Date	n/a	Issue	2023.02.28	Revision No.	BP AND TENDER SET
			73	Revision	--



WOOD SHEAR WALL SCHEDULE							
MARK	SHEATHING	NAIL TYPE	NAIL SPACING @	MIN. RIMBOARD	WALL BOTTOM PLATE	RIMBOARD TO	MUDSILL TO
			PANEL EDGES	BLOCKING	TO RIMBOARD	WALL TOP PLATE	CONCRETE
SW1	10" D. FIR PLYWOOD 2 SIDES	2 1/2" LG x 0.131" (3.3mm)	3" o/c	2x1 3/4" LSL	2 rows 3" LG x 0.131" (3.3mm) each rimboard	LTP4 CLIPS @ 10" o/c each side	3/4" A.B. @ 10" o/c





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PORCINO
ARCHITECTS
INC.**

Checkwitsch Porcino Architects Inc.
940 Commercial Street, Nanaimo, BC V9R 5G3
250-402-2222 or 250-402-2223

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250-714-1983
250-714-1984

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fast@fastepp.com
epp@fastepp.com

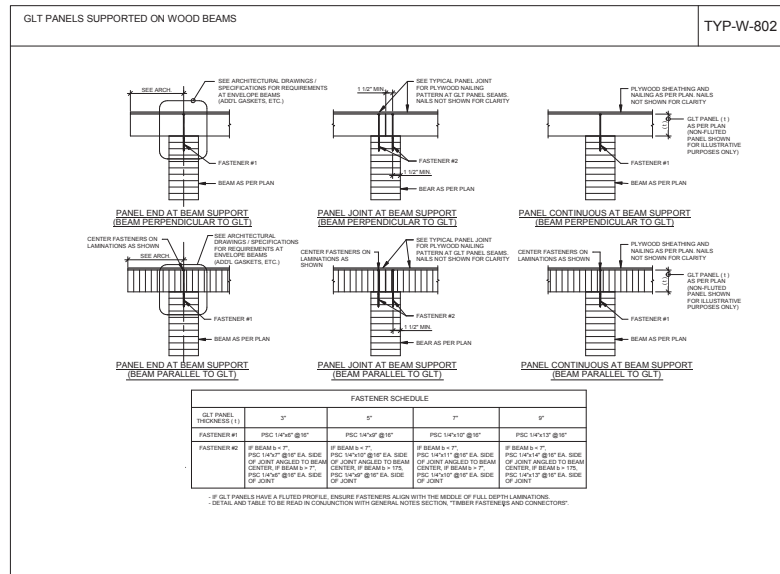
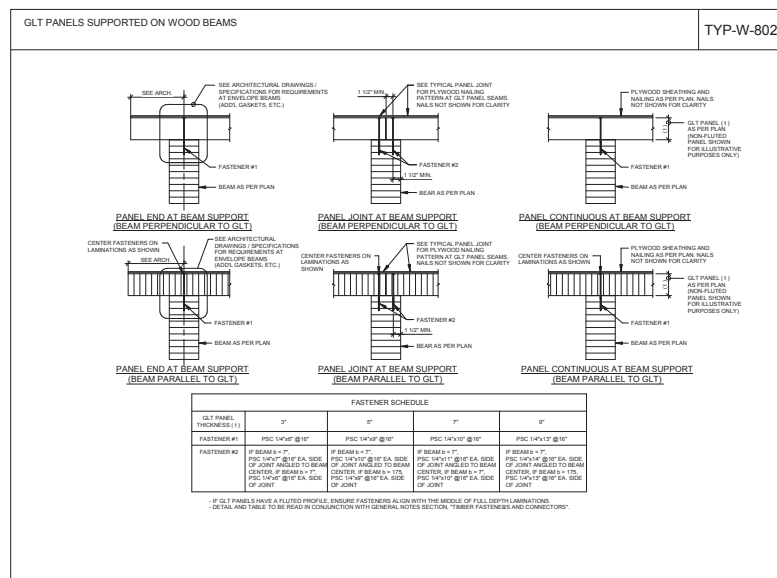
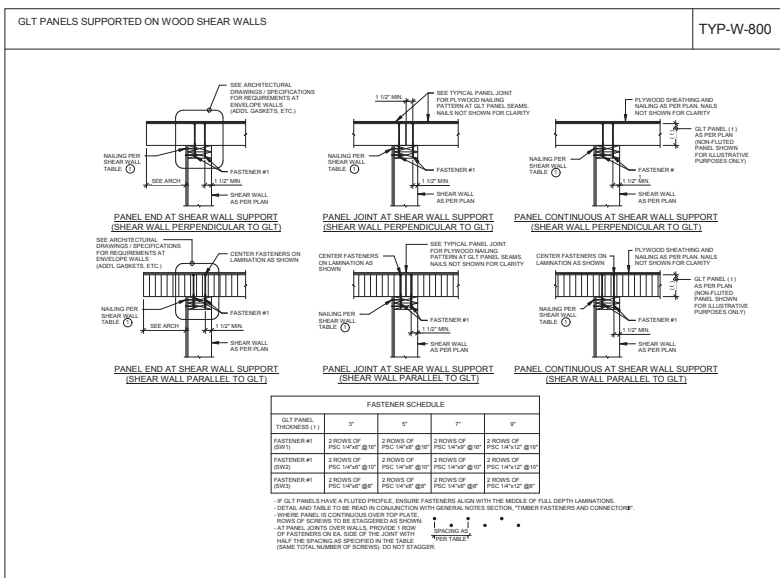
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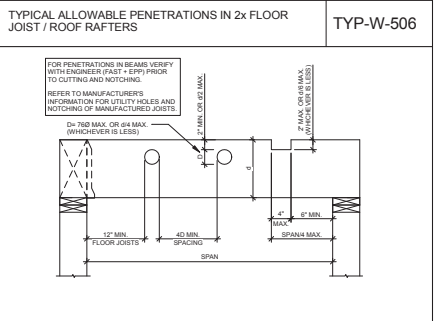
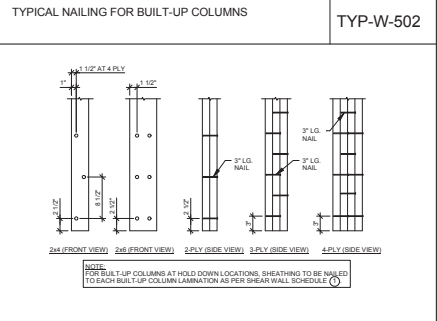
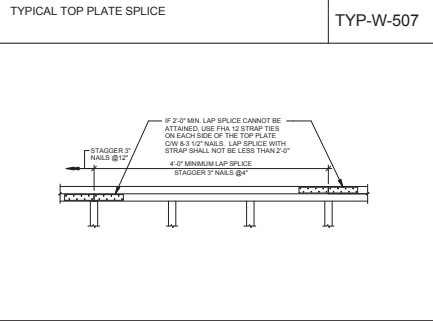
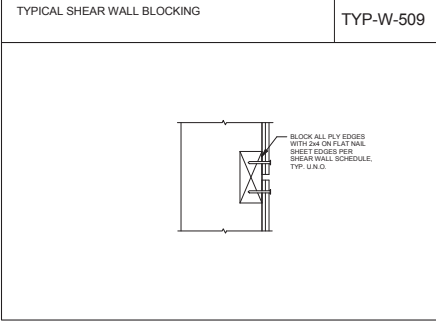
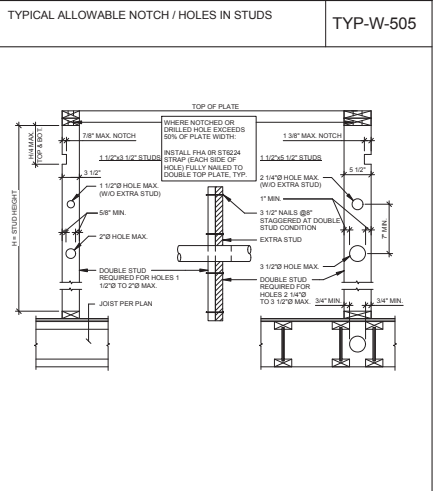
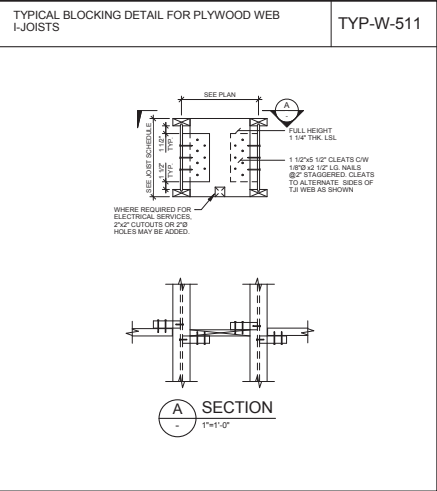
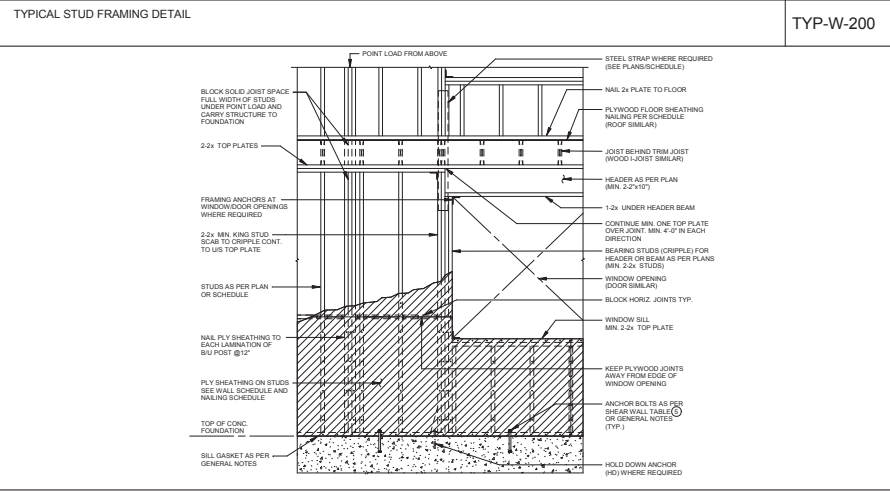
Arts and Heritage Hub

Artists' Studio Building



Client	Town of Ladysmith	Drawn By	NDR	Reviewed By		Sheet Number	S300A
Project Number	2729	Sheet Name	Typical Details				
Date	2023.02.28	Revision No.	71	Revised On	BP AND TENDER SET	Revision	--





APPENDIX D

Mechanical

LADYSMITH ARTS AND HERITAGE HUB

ISSUED FOR BP & TENDER

SITE: 610, 612, 614 AND 616 OYSTER BAY ROAD

RPE PROJECT NUMBER: 20635-N

SANITARY LOAD SUMMARY		
LOADS	FIXTURE UNITS	PIPE SIZE
	FU	IN
FIXTURE LOAD	31,388	4"Ø
TOTAL		
SIZE AND SLOPE REQUIRED:		4"x Ø 1.0%
ADDITIONAL INFORMATION:		

WATER LOAD SUMMARY		
SUPPLY PRESSURE (PSI)		
DESIGN METHOD USED	DRAWN COMMERCIAL	
LOADS	PEAK LOAD	PIPE SIZE REQUIRED
	CPM	IN
TOTAL BUILDING	46	2"Ø
ADDITIONAL INFORMATION:		

STORM LOAD SUMMARY			
RAIN LOAD (30min/15 min)		FROM BCBC 2018	
LOADS	AREA FT2	AREA M2	LOAD L
ROOF	3887	363	3830
TOTAL			3830
SIZE AND SLOPE REQUIRED:			4" @ 1.0%
ADDITIONAL INFORMATION: STORM RAIN LOAD AS PER BCBC 2018			

FIXTURES CONNECTION SCHEDULE									
TAG	FIXTURE	TYPE	SANITARY		DOMESTIC COLD WATER		DOMESTIC HOT WATER		
			FU	SIZE	FU	SIZE	FU	SIZE	
	WASH BASIN - SINK		-	-	6	3/4"	-	-	
	WASHROOM - SINK OR LESS	PUBLIC	1	1-1/2"	1	1/2"	1.50	1/2"	
	SINK - KITCHEN DOMESTIC	PUBLIC	1.50	1-1/2"	3	1/2"	3	1/2"	
	SINK - SERVICE OR MOP SINK	PUBLIC	3	2"	2.25	1/2"	2.25	1/2"	
	WATER CLOSET - FLUSH VALVE	PUBLIC	6	4"	-	1"	-	-	
	DISHWASHER	PUBLIC	1	1-1/2"	1.4	1/2"	-	-	
* DENOTES FLOW AND/OR PIPE SIZING TO BE MEET MANUFACTURERS INSTALLATION REQUIREMENTS									
** FOR FLUSH VALVE SIZING REFER TO TABLES 3.6.3.2.B AND 3.6.3.3.C IN THE 2018 BC PLUMBING CODE									

ABBREVIATION LIST	
BB	BATHROOM HEATER
CB	COMPLETE WITH
EA	EXHAUST AIR
EF	EXHAUST FAN
ET	EXPANSION TANK
HP	HEAT PUMP
LP	LOW PRESSURE GAS
HP	HIGH PRESSURE LIQUID
OA	OUTDOOR AIR
RA	RETURN AIR
SA	SUPPLY AIR
DNH	DOMESTIC HOT WATER
DNH	DOMESTIC HOT WATER RETURN
DNH	DISHWASHER
RS	REFRIGERANT
LS	LAVATORY
JS	JANITOR SINK
SK	KITCHEN SINK
SS	SERVICE SINK
RS	REFRIGERANT RETURN
RS	REFRIGERANT SUPPLY
WC	WATER CLOSET

PIPING AND PLUMBING SYMBOL LEGEND	
	BALL VALVE
	HOSE BIB
	MECHANICAL PUMP
	PIPE BREAK
	PIPE CAP
	PIPE CLEANOUT DOWN
	PIPE CLEANOUT UP
	PIPE TEE DOWN
	PIPE TEE UP
	PIPE TRAP
	PLUMBING PIPE CLEANOUT TO GRADE 2
	SANITARY VENT UP
	VALVE CHECK
	FLOOR DRAIN
	FUNNEL FLOOR DRAIN

ANNOTATION SCHEDULE	
	EQUIPMENT TAG
	PIPE TAG
	AIR TERMINAL TAG

MECHANICAL SYMBOL LEGEND	
	ROUND DUCT
	SQUARE SUPPLY DUCT - DOWN AND UP
	SQUARE RETURN DUCT - DOWN AND UP
	SQUARE EXHAUST DUCT - DOWN AND UP
	ROUND DUCT DOWN (TEE)
	MITERED DUCT ELBOW W/ VANES
	ANGLED DUCT ELBOW W/ VANES
	DUCT ELBOW 180°
	DUCT ELBOW 90°
	DUCT WITH EXTERNAL INSULATION
	DUCT BREAK
	DUCT TRANSITION
	DUCT TAKEOFF
	SUPPLY GRILLE
	RETURN GRILLE
	EXHAUST GRILLE
	DOOR GRILLE
	DOOR UNDERCUT
	FLOW DIRECTION ARROW
	CEILING FAN WALL SWITCH
	OVERHEAD DOOR CONTACT SENSOR
	ROOM TEMPERATURE
	THERMOSTAT
	BALANCE DAMPER
	MECHANICAL DUCT MOTORIZED DAMPER
	MECHANICAL EQUIPMENT FORCE FLOW

Sheet List Table	
Sheet Number	Sheet Title
M-0	COVER SHEET
M-1	PLUMBING - FOUNDATION PLAN
M-2	MAIN FLOOR PLAN - PLUMBING & MAIN FLOOR PLAN VRF PIPING
M-3	MAIN FLOOR PLAN - HVAC & ROOF PLAN - MECHANICAL
M-4	SECTIONS AND SCHEMATICS
M-5	MECHANICAL SCHEDULES

KEYPLAN:

No.	DATE	DESCRIPTION	BY
4	MAR 31, 2023	ISSUED FOR BP & TENDER	KS
3	FEB 17, 2023	ISSUED FOR REV. CDS	KS
2	FEB 03, 2023	ISSUED FOR REV. CDS	KS
1	NOV 21, 2022	ISSUED FOR COORDINATION	KS
REVISIONS:			
COPYRIGHT RESERVED:			
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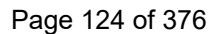
SEAL:
2023-03-31
Permit to Proceed #1060700
CLIENT:

PROJECT:
LADYSMITH ARTS AND HERITAGE HUB
610, 612, 614 AND 616 OYSTER BAY ROAD LADYSMITH, BC V5G 1B8

DRAWING NAME:
COVER SHEET

PROJECT NUMBER:
20635-N
DRAWN BY: KS
DESIGNED BY: SC
APPROVED BY: AM
SCALE: AS INDICATED
DRAWING:

M-0



SUB-CONSULTANT:

KEYPLAN:

No.	DATE	DESCRIPTION	BY
4	MAR. 31, 2023	ISSUED FOR SP4 TENDER	KS
3	FEB. 11, 2023	ISSUED FOR SPV CDS	KS
2	FEB. 02, 2023	ISSUED FOR 70% CDS	KS
1	NOV. 21, 2022	ISSUED FOR COORDINATION	KS

REVISIONS:

SEAL

Signature of Professional Engineer
A. J. MULALEY
PROFESSIONAL
LICENSING
BC ENGINEERING
License # 19488
Date of Issue: 01/01/2018

2023-03-31

Permit to Practice #1000700

CLIENT:

PROJECT:
LADYSMITH ARTS AND
HERITAGE HUB

610, 612, 614 AND 616 OYSTER BAY ROAD
LADYSMITH, BC V9G 1B8

DRAWING NAME:
SECTIONS AND SCHEMATICS

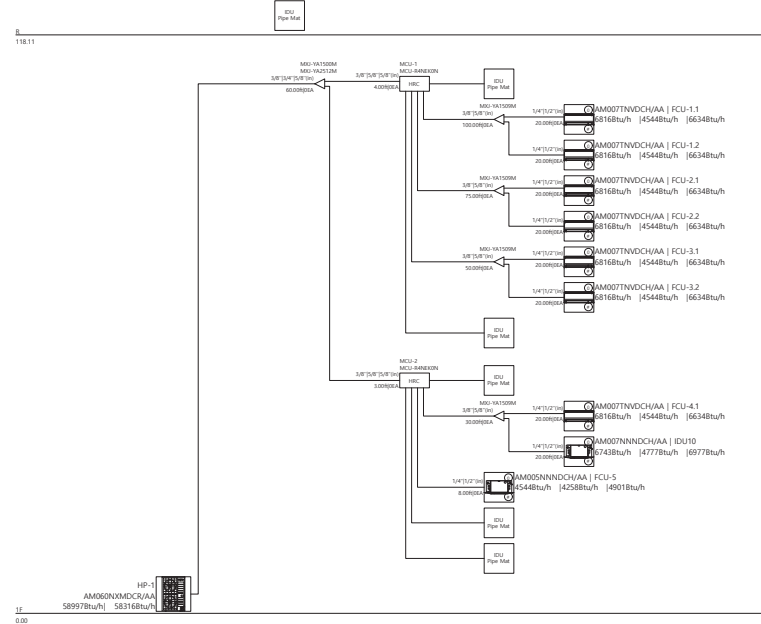
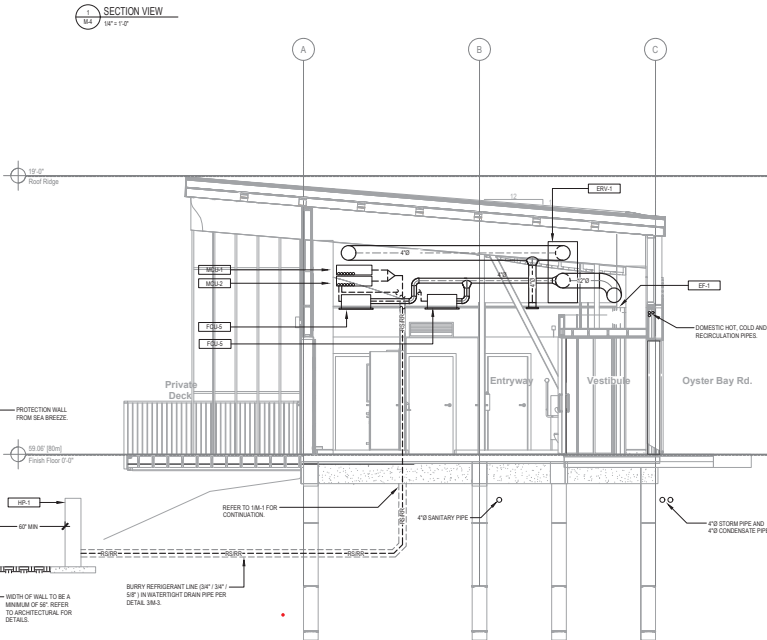
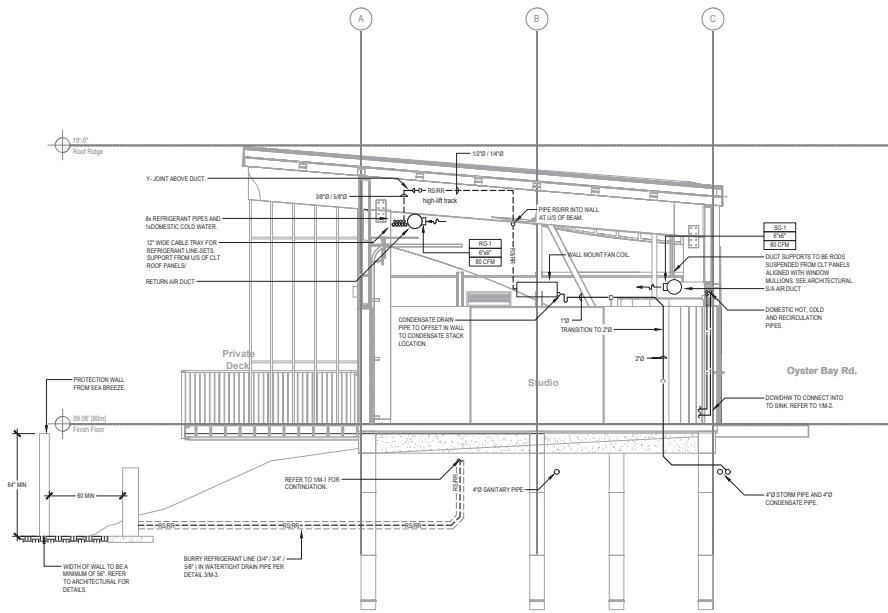
PROJECT NUMBER:
20635-N

DRAWN BY: KS
DESIGNED BY: BC
APPROVED BY: AM
SCALE: AS INDICATED

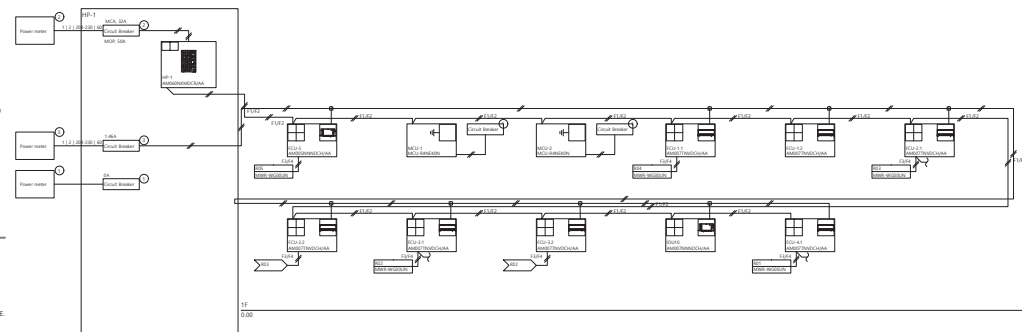
DRAWING:

M-4

5 OF 6



3 HP-1 REFRIGERANT PIPING SCHEMATIC
1/4\"/>



4 HP-1 WIRING AND CONTROLLER SCHEMATIC
N.T.S.

SPECIFICATION DIVISION		SECTION
Division 20	20 05 05	Mechanical Work General Instructions
Mechanical	20 05 10	Basic Mechanical Materials and Methods
	20 05 15	Seismic Control and Restraint
	20 05 20	Mechanical Vibration Control
	20 05 25	Mechanical Insulation
	20 05 45	Mechanical Work Commissioning
	20 05 55	Testing, Adjusting and Balancing
	20 05 60	Firestopping and Smoke Seal Systems
	20 05 70	Piping Expansion Compensation
Division 21	21 20 05	Fire Extinguishers
Fire Protection		
Division 22	22 11 16	Domestic Water Piping and Valves
Plumbing	22 11 19	Domestic Water Piping Specialties
	22 13 16	Drainage Waste and Vent Piping and Valves
	22 13 19	Drainage and Vent Piping Specialties
	22 33 00	Electric Domestic Hot Water Heaters
	22 35 00	Domestic Hot Water Circulating Pumps
	22 35 10	Domestic Water Expansion Tanks
	22 42 00	Plumbing Fixtures and Fittings
Division 23	23 05 13	Motors, Drives, & Guards for Mechanical Systems
Heating, Ventilating, and	23 23 00	Refrigerant Piping, Valves and Accessories
Air Conditioning (HVAC)	23 23 05	Variable Refrigerant Flow System Equipment
	23 25 10	H & AC Condensate Removal Pumps
	23 31 05	Standard Ductwork
	23 33 00	Duct System Dampers and Accessories
	23 33 20	Centrifugal Inline Fans
	23 33 65	Heat Recovery Ventilators
	23 37 13	Grilles and Diffusers

1 GENERAL

1.1 References

- .1 The General Conditions of the Contract, the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.2 Application

- .1 This Section specifies requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.3 Note Re: Bold Lettering

- .1 "**Bold**" type lettering is used throughout this Specification in an attempt to enhance the readability of the text. The use of "**bold**" lettering does not indicate a greater level of importance.

1.4 Submittals

- .1 As specified in this Section, submit the following to the Consultant:
 - .1 **Notice for field reviews:** written notice for attendance at the site for field reviews.
 - .2 **Project close-out documentation:** O & M Manuals, record as-built drawings, and all associated data.
 - .3 **Progress payment breakdown:** a detailed breakdown of the mechanical work cost.
 - .4 **Contractor's P.Eng. Documentation:** the name, qualifications, and evidence of current liability insurance for all professional engineers to be retained by the Contractor to perform work associated with the Contract.
 - .5 **Extended Warranties:** copies of all extended warranties specified, and in the name of the Owner.
 - .6 **List of Acceptable Manufacturers:** a completed List of Acceptable Manufacturers to clearly indicate the names of the manufacturers of products on which the bid price is based.
 - .7 **O & M Training Schedules & Modules:** a proposed schedule of demonstration and training dates and times, and a preliminary copy of the training manual developed for operational and maintenance training.

1.5 Definitions

- .1 The following are definitions of words found in mechanical work Sections of the Specification and on associated drawings:
 - .1 "Concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, walls, and partitions.
 - .2 "Exposed" – means work normally visible, including work in equipment rooms and similar spaces.
 - .3 "Provide" (and tenses of provide) – means supply and install complete.
 - .4 "Install" (and tenses of install) – means install and connect complete.
 - .5 "Supply" – means supply only.
 - .6 "Finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished.
 - .7 "Governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the mechanical work and to which the work must adhere.
 - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner.
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they

are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.

- .4 In the mechanical specification, singular may be read as plural, and vice-versa.

1.6 Quality Assurance

- .1 All mechanical work shall be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on-site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen shall be limited and the journeyman/apprentice ratio is 1 journeyman for every 2 apprentices.
- .2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- .3 An experienced and qualified superintendent shall be on-site at all times when mechanical work is being performed.
- .4 Submit to the Consultant for review, a Quality Assurance Programme within 21 days of Contract award. Upon review and acceptance, the programme shall be implemented for the duration of the Contract.

1.7 Codes, Regulations, and Standards

- .1 All Codes, Regulations, and Standards referred to in this Section and in Sections to which this Section applies are the latest edition of the Codes, Regulations, and Standards in effect at the time of issue of a building permit or bidding on this Project, whichever comes first.
- .2 All work shall be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities, including:
 - .1 The BC Building Code.
 - .2 Inspection branches of Technical Safety BC.
 - .3 Technical Safety BC.
 - .4 National Fire Protection Association
 - .5 CSA
- .3 All mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA Standard B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.
- .4 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all associated costs associated with these submittals.
- .5 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.
- .6 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.8 Imperial and Metric Measurements

- .1 Conform to requirements of CAN/CSA-Z234.1, Canadian Metric Practice Guide.
- .2 If both Metric and Imperial units of measurement are indicated in the Mechanical Specification, Metric measurements are "soft" and have been rounded off.

1.9 Examination of Site and Documents

- .1 When estimating the cost of the work and prior to submitting a bid for the work carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.

- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.10 Drawings and Specification

- .1 Read the mechanical work drawings in conjunction with all other structural, architectural, sprinkler, electrical, etc., drawings and, where applicable, the Code Consultant's report.
- .2 The mechanical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .4 The locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of the equipment and/or materials, other equipment or systems being installed, and of the building, all at your cost.
- .5 Sections of the mechanical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- .6 The mechanical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing schedules, layouts, schematic diagrams, riser diagrams, and details to determine correct quantities.
- .7 The mechanical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 The mechanical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- .9 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the costliest arrangement will take precedence.
- .10 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the costliest arrangement will take precedence.

1.11 Planning and Layout of The Work, and Associated Drawings

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions, including structural components of the building. Unless otherwise specified, the order of right-of-way for services shall be as follows:
 - .1 Piping requiring uniform pitch.
 - .2 Piping 100 mm (4") diameter and larger.
 - .3 Large ducts (main runs).
 - .4 Electrical cable tray and bus duct.
 - .5 Conduit 100 mm (4") diameter and larger.
 - .6 Piping less than 100 mm (4") diameter.
 - .7 Smaller branch ductwork.
 - .8 Conduit less than 100 mm (4") diameter.

- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install piping, ductwork, and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to your work.
- .4 All shut-off valves, balancing devices, air vents, equipment and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .5 **Layout Drawings:** Do not use the Contract Drawing measurements for prefabrication and layout of piping and sheet metal work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with the Contract Drawings, notify the Consultant prior to proceeding with the work.
- .6 **Interference Drawings:** Prepare dimensioned working interference drawings, supplementary to the Contract Drawings for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where your work has been installed in such areas without preparation of interference drawings and conflicts occur, revise your work to suit at no additional cost.

1.12 Alteration Works

- .1 Where existing utilities are removed, relocated, or abandoned, cap, valve, plug, or by-pass to make a complete and working installation.
- .2 A "complete and working installation" includes providing new surfaces identical to the ones removed or disturbed and matching adjacent surfaces with no visible difference between new and existing.
- .3 Where repainting of a surface is required, paint the entire surface between the nearest adjacent corners, i.e. the entire plane of the surface containing the disturbed area.
- .4 Where concealed conditions differ from those indicated on the drawings, immediately notify the Consultant.

1.13 Coordination of the Work

- .1 Review all the Contract Documents and coordinate the work with the work of all subcontractors. Coordination requirements are to include, but not be limited to, the following:
 - .1 Preparation of electronic coordination drawings as required, submitted as for shop drawings, with drawing scale as required to indicate the necessary details.
 - .2 Written notification of all concrete work such as housekeeping pads, sumps, bases, etc., required for mechanical work, and including required dimensions, operating weight of equipment, location, etc.
 - .3 Depth and routing of excavation required for mechanical work, and requirements for bedding and backfill.

- .4 Schematic wiring for all wiring work required for mechanical equipment and systems but not specified to be done as part of the mechanical work, including termination points, wiring type and size, and any other requirements.

1.14 General Re: Installation of Equipment

- .1 Unless otherwise specified all equipment shall be installed in accordance with the equipment manufacturer's recommendations and instructions, Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .2 Ensure that proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Remove and replace any equipment which does not meet this requirement.

1.15 Energy Efficiency Standards

- .1 All applicable mechanical equipment has been selected to meet energy efficiency requirements of the Model National Energy Code of Canada for Buildings or ANSI/ASHRAE/IESNA 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 Permits, Fees, and Certificates

- .1 Apply for, obtain and pay for all permits required to complete the mechanical work.
- .2 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .3 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.17 Workplace Safety

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Worksafe BC Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations.

1.18 Fall Restraint For Roof Mounted Equipment

- .1 Wherever possible, locate roof mounted mechanical equipment or access hatch a minimum of 2 m from the edge of any roof 3 m or higher above the surrounding grade.
- .2 Where mechanical equipment or hatches are located within 2 m from the edge of any roof 3 m or higher above the surrounding grade, supply roof anchors (a minimum of 2 per piece of equipment or roof hatch) capable of withstanding a minimum live load of 800 lb. in any direction and to which personal fall restraint equipment can be secured, and coordinate installation with the roofing trade. Refer also to Part 11 of the Worksafe BC Occupational Health and Safety Regulations.
- .3 Retain the services of a Professional Engineer registered in the Province of British Columbia to ensure that the fall restraint anchors provided are of adequate capacity and correctly installed, and to certify in writing (with signed professional stamp) that the anchor installations have been inspected on-site and are correctly installed and of adequate capacity. Submit the certification to the Consultant.

1.19 Shop Drawings and Product Data Sheets

- .1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as

requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.

- .2 Shop drawings are those prepared specifically for the Project. Product data sheets are copies of manufacturer's standard catalogue, etc., literature.
- .3 Unless otherwise specified or required, submit shop drawings/product data sheets via email in AutoCAD or PDF format only.
- .4 Wherever possible, shop drawings and/or product data sheets are to be 216 mm x 280 mm (8½" x 11"), 216 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps, comments, and identification as specified below.
- .5 Shop drawings and product data sheets must confirm that the product proposed meets all requirements of the Contract Documents.
- .6 Each shop drawing or product data sheet shall be properly identified with the project name and the product drawing or specification reference, i.e. "Exhaust Fan EF-1", and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .7 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure that this requirement is clearly indicated on the submission.
- .8 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "Correct for Review By Consultant", or "Certified to Be In Accordance with All Requirements" and include your company name, the submittal date, and the signature of an officer of your company to indicate your review and approval as above.
- .9 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
 - .1 **"Reviewed" or "Reviewed as Noted"** to indicate that his review is final, and no re-submittal is required.
 - .2 **"Returned for Correction"** to indicate that the submission is rejected and shall be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted.
- .10 The Consultant will retain 1 or 2 copies of each shop drawing or product data sheet submission.
- .11 The following shall be read in conjunction with the wording on the Consultant's review stamp applied to each and every mechanical workshop drawing or product data sheet submitted:

"This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."

1.20 Changes or Revisions to the Work

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.

- .2 Your quotation shall be a detailed and itemized estimate of all products, material, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 Unless otherwise stated in the Contract Documents, the following requirements apply to all quotations submitted:
 - .1 When the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) shall be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work.
 - .2 Material costs are not to exceed those published in local estimating price guides such as Allpriser, less applicable trade discounts.
 - .3 Mechanical material labour unit costs are to be in accordance with the Mechanical Contractors Association of America Labor Estimating Manual, less 25%.
 - .4 Electrical material labour unit costs are to be in accordance with the National Electrical Contractors Association Manual of Labor Units, less 25%.
 - .5 Costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and must reflect the actual personnel performing the work.
 - .6 Cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary.
 - .7 Costs for rental tools and/or equipment are not to exceed local rental costs.
 - .8 If overhead and profit percentages are not specified in the General Conditions of the Contract, Supplementary Conditions, or elsewhere in preceding Sections of the Specification, but allowable under the Contract, then allowable percentages for overhead and profit are to be 20% and 10% respectively.
 - .9 The overhead percentage will be deemed to cover all quotation costs other than actual site labour, product and materials, and rentals.
 - .10 All quotations, including those for deleted work, must include a figure for any required change to the Contract time.
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .5 If, in your opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.
- .6 Do not execute any change or revision until written authorization for the change or revision has been obtained.

1.21 Notice for Required Field Reviews

- .1 Whenever there is a requirement for the Consultant to perform a field review and/or inspection prior to concealment of any work (including piping/duct system leakage testing, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant a minimum of 72 hours written notice.
- .2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.
- .4 When the Consultant is requested to perform a field review and the work is not ready to be reviewed, reimburse the Consultant for all time and travel expenses.
- .5 Give the Consultant a minimum of 2 full working day's notice for attendance at field reviews.

1.22 Scaffolding, Rigging, and Hoisting

- .1 Unless otherwise specified or directed, supply, erect and operate all scaffolding, rigging, hoisting equipment and associated hardware required for your work. Immediately remove from the site all scaffolding, rigging, and hoisting equipment when no longer required.
- .2 Do not place major erection loads on any portion of the structure without approval from the Consultant.

1.23 Trial Usage

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to prove compliance with the Specification and governing Codes and Regulations, prior to Substantial Performance of the work.
- .2 When, in the opinion of the Consultant, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 All tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment or system due to the test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in the Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from the site and replace them with acceptable equipment and/or products, at no additional cost.

1.24 General Re: Project Closeout Submittals

- .1 Prior to application for Substantial Performance, submit all required items and documentation specified, including the following:
 - .1 Operating and Maintenance Manuals.
 - .2 As-built record drawings and associated data.
 - .3 Extended warranties for equipment as specified.
 - .4 All operating test certificates, i.e. Sprinkler test certificate.
 - .5 Final commissioning report and TAB report.
 - .6 Identified keys for mechanical equipment and/or panels for which keys are required, and all other items required to be submitted.
 - .7 Other data or products specified.

1.25 Operating and Maintenance Manual Data

- .1 Operating and Maintenance Manuals will be produced by the TAB Agent or Commissioning Agent retained directly by the Owner. Supply the following documentation to the Agent for incorporation into the O & M Manuals:
 - .1 **Two** clean paper copies of all "Reviewed" status product data sheets and shop drawings, including "as-built" controls shop drawings.
 - .2 **Two** clean paper copies of signed and dated equipment manufacturer's start-up reports for all specified equipment.
 - .3 A digital copy in Microsoft Word or PDF format of end-to-end verification check lists for all control systems.
 - .4 A digital copy in Microsoft Word or PDF format for:
 - .1 Successful leakage tests performed for all piping systems.
 - .2 Inspection Certificates for the domestic water systems, storm and sanitary drainage and vent systems, natural gas system, fire protection systems, and medical gas systems.
 - .3 A signed and dated warranty in accordance with the Contract Documents, and any extended warranties specified.
 - .4 A list of all equipment manufacturers and the products they supplied.
 - .5 A list of all mechanical work subcontractors.

- .6 The valve tag chart, and an "as-built" flow diagram for each system indicating valve locations.
- .5 **Digital O & M Manuals:** Submit 4 digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Mechanical Systems".

1.26 Record "As-Built" Drawings and Data

- .1 As work progresses at the site, clearly mark in red "as -built" conditions in a neat and legible manner on a set of white print drawings printed from a PDF of the mechanical drawings supplied by the Consultant.
- .2 "As-Built" conditions include all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions.
- .3 Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
 - .1 The size, location, route, and extent of ductwork, piping, control devices and wiring conduit, cleanouts, valves, and similar items.
 - .2 The dimensioned location of all inaccessible concealed work the locations of control devices with identification for each.
 - .3 The location of all piping system air vents and water hammer arrestors.
 - .4 The location and tag identification for all tagged valves.
 - .5 For underground piping, including service entrance/exit piping, record dimensions, invert elevations, all offsets, fittings, cathodic protection and accessories if applicable, including invert elevations for underground drainage piping at each cleanout, manhole, and change in direction both inside and outside the building, and locate dimensions from benchmarks that will be preserved after construction is complete.
 - .6 For fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings.
 - .7 The location of all concealed services terminated for future extension.
- .4 **Electronic Files of "As-Built" Drawings:** Include in the Bid Price a prime cost cash allowance of \$1,500.00 to cover the cost for the services of a competent drafting service to transfer all the as-built red line information to PDF electronic drawing files. The Consultant will supply electronic files of the mechanical construction issue drawings to drafting service if requested. Refer to cash allowance requirements specified in this Section.
- .5 **Review and Submittal:** Prior to Substantial Performance of the work, and after the red line site as-built white prints have been transferred to PDF electronic files, plot a set of vellum prints the electronic file as-built drawings, neatly add the notation 'CERTIFIED RECORD DRAWINGS', date and sign the vellum prints, and submit the prints and the electronic files to the Consultant for review. The Consultant will review the drawings and, if necessary, return the electronic files and the marked-up prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the electronic files and vellum prints until they are determined to be acceptable, all prior to Substantial Performance.

1.27 Progress Payment Breakdown

- .1 Submit, prior to submittal of the first progress payment draw, a breakdown of the cost of the mechanical work to assist the Consultant in reviewing and approving monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown shall include one-time claim items such as mobilization and demobilization, insurance, bonds (if

applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, and project closeout submittals.

- .3 Equipment, material and labour costs are to be indicated for site services (if applicable), plumbing and drainage, fire protection, HVAC piping, HVAC sheet metal, controls, and insulation work, etc., in the same manner as they will be indicated on the monthly progress draw.

1.28 Requirements for Contractor Retained Engineers

- .1 All professional engineers retained by you to perform consulting services with regard to your work, i.e. seismic engineer, fire protection engineer, structural engineer, are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 Your engineer's professional liability insurance is to protect your Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss or damage resulting from the professional services rendered by your Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 Coverage shall be a minimum of \$1,000,000.00 inclusive of any one occurrence.
 - .2 The insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice.
 - .3 Liability insurance shall be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work.
 - .4 Evidence of the required liability insurance in such form as may be required shall be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services.

1.29 Guarantee-Warranty

- .1 The Contractor shall furnish a written warranty stating that all work executed will be free from defects of material and workmanship for a period of one year from the date of total performance. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .2 The Contractor further agrees that they will, at their own expense, promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guarantee-warranty

1.30 Identified Prices

- .1 Identified prices for work consist of alternative prices, separate prices, and itemized prices. Definitions of these prices are as follows:
 - .1 **Alternative Price(s):** An alternative price the difference in the bid amount (plus or minus) for substituting specified work or products for alternative work or products.
 - .2 **Separate Price(s):** A separate price is the amount of money to be added to the bid amount for new work not included as part of the Bid Documents.
 - .3 **Itemized Price(s):** An itemized price is the amount of money included in the bid amount for work as described and required for information purposes only.

1.31 Healthcare Facility Infection Control and Standards

- .1 The following CAN/CSA Standards apply to the work of this Project and are to be adhered to:
 - .1 CAN/CSA-Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities: Prepare a list of all areas of the work where the infection control procedures are to be in force and review the list and procedures with the Hospital's Infection Control officer or a designated hospital representative prior to

any work in the areas commencing, and as work proceeds ensure that all infection control procedures are being maintained.

- .2 CAN/CSA-Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities.
- .3 CAN/CSA-Z317.1, Special Requirements for Plumbing Installations in Healthcare Facilities.
- .4 CAN/CSA-Z317.10, Handling of Waste Materials in Healthcare Facilities.
- .5 CAN/CSA-Z318.0, Commissioning of Healthcare Facilities.
- .6 In accordance with CAN/CSA-Z317.1, prepare a separate set of "as-built" white prints in a day-to-day basis for medical gas piping system work only.

1.32 Equipment and System Manufacturer's Certification

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for the equipment/system manufacturer's authorized representative to visit the site to examine the installation, and when any required corrective measures have been made, to certify in writing to the Consultant that the equipment/system installation is complete and in accordance with the equipment/system manufacturer's instructions.

1.33 Equipment and System Start-Up

- .1 When installation of equipment/systems is complete, but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with the following requirements:
 - .1 Submit a copy of each equipment/system manufacturer's blank start-up report sheet to the Consultant for review and incorporate any comments.
 - .2 Under direct on-site supervision and involvement of the equipment/system manufacturer's representative, start-up the equipment/systems, make any required adjustments, document the procedures, leave the equipment/systems in proper operating condition, and submit a complete set of start-up documentation sheets signed by the manufacturer/supplier and the Contractor.

1.34 Equipment and System Commissioning

- .1 Commission mechanical equipment and systems in accordance with the Section entitled Mechanical Work Commissioning.

1.35 Equipment and System O & M Demonstration & Training

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train the Owner's designated personnel in all aspects of operation and maintenance of equipment and systems as specified in mechanical work Sections of the Specification. All demonstrations and training shall be performed by qualified technicians employed by the equipment/system manufacturer/supplier. The number of hours of training and the number of Owner's personnel to be involved will be specified in the mechanical work Sections to which this Section applies.
- .3 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Operating and Maintenance Manuals are to be used during the training sessions, and training modules are to include:
 - .1 **Operational Requirements and Criteria:** Requirements and criteria are to include but not be limited to equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations.
 - .2 **Troubleshooting:** Troubleshooting shall include but not be limited to diagnostic instructions, test and inspection procedures.
 - .3 **Documentation:** Documentation shall include but not be limited to equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like.

- .4 **Maintenance:** Maintenance requirements are to include but not be limited to inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools.
- .5 **Repairs:** Repair requirements are to include but not be limited to diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .4 Assemble the training modules into a training manual and submit a copy to the Consultant for review prior to scheduling training. Ensure that each participant in each training session has all required training material.
- .5 Schedule demonstrations and training at mutually agreed to times with a minimum of 7 working days notice.
- .6 **Training Session DVD:** for equipment/system demonstration and training sessions as specified in mechanical work Sections, submit an identified DVD of the session prepared by a professional photographer with construction project technical training session experience.
- .7 **Demonstration and Training Confirmation:** Obtain a list of personnel to receive demonstration and training from the Consultant, and have each participant sign the list to confirm that he/she understood the demonstration and training session.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more mechanical work Sections of the Specification, and it is intended as a supplement to each Section and shall be read accordingly.

1.2 Submittals

- .1 Submit the following for review:
 - .1 **Product data sheets:** submit for:
 - .1 Pressure gauges and thermometers.
 - .2 Strainers.
 - .3 Drain valves.
 - .4 Electric motors (submit with equipment they are associated with).
 - .2 **Access door locations:** submit white prints of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations in walls and ceilings in finished areas.
 - .3 **Samples:** submit a sample of each proposed type of access door, and samples of materials and any other items as specified in mechanical work Sections of the Specification.
 - .4 **List of equipment nameplates:** submit a list of equipment identification nameplates indicating proposed wording and sizes.
 - .5 **Pipe & duct identification:** submit a list of pipe and duct identification colour coding and wording.
 - .6 **Valve tag chart:** submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
 - .7 **Waste management and reduction plan:** submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section.
 - .8 **Drive belts:** as specified in Part 2 of this Section, submit a spare belt set, tagged and identified, for each belt driven piece of equipment.
- .2 **Additional submittals:** submit any other submittals specified in this Section or other mechanical work Sections of the Specification.

1.3 Equipment and Material Manufacturer Requirements

- .1 Equipment and materials scheduled or specified on the drawings or in the Specification have been selected to establish a performance and quality standard.
- .2 Unless otherwise stated the bid price may be based on products supplied by any of the manufacturers named as acceptable for the particular product. If acceptable manufacturers are not listed for a particular product, base the bid price on the products supplied by the specified manufacturers.
- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics (including energy efficiency if applicable) to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 Do not supply products of different types that have been "bulked" by a supplier who has quoted a lump sum price for the "bulked" products.

1.4 List of Acceptable Manufacturers and Suppliers

- .1 Within 2 days after award of a Contract, submit to the Consultant for review, a list to indicate the name of the manufacturers/suppliers you propose to use for each item of equipment, material, or service listed, except for items such as pipe and fittings, insulation, and similar products. Manufacturers and/or suppliers on the list must be named in the Specification or on the drawings.
- .2 If the List of Acceptable Manufacturers and Suppliers is not submitted within two days after award of a Contract, the products specified and scheduled by manufacturer's name and model number and on which the Project is based are to be supplied. No substitutions whatsoever will be accepted unless previously approved in writing by the Consultant.

1.5 Substituted or Alternative Products

- .1 Products supplied by a manufacturer/supplier other than a manufacturer specified as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of five full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.
- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative manufacturer. In addition, in equipment spaces where substituted or alternative products are used in lieu of the specified or acceptable products and the dimensions of such products differ from the specified or acceptable products, prepare and submit for review, if requested, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.6 Products – Base Bid and Acceptable Manufacturers

PRODUCT	APPROVED MANUFACTURER
Access Doors	Acudor, E.H. Price, Maxam, Milcor, Mifab, Enpoco
Air and Dirt Separators	S.A. Armstrong Ltd., ITT Bell & Gossett, Taco
Air Compressors	DV Systems Inc., Atlas Copco Compressors Canada, CompAir Kellog
Air Handling Unit - Custom	Pace, Tri-Metal Fabricators, Engineered Air, Haakon, Scott Springfield
Air Make-Up Units – Outdoor Gas Fired	Engineered Air, Streling, Caprivaire
Air Separator	SA Armstrong Model "VA", ITT Bell & Gossett "Rolairtrol"
Air Vent (Automatic)	Spirax Sarco Ltd. Type 13W (up to 150 psi) or 13 WH (for over 150 psi) Hoffman, Braukman, Armstrong 1-AV, Maid-O-Mist
Air Vent (Manual)	Cobraco 27 Series, Spirax Sarco Ltd, Hoffman, Braukman, Armstrong, Maid-O-Mist
Boilers – Condensing (Hi-Mass)	Viessman, Cleaver Brooks
Chemical Water Treatment	Pace, IPAC, Enercon, Calgon, Betz-Dearborne

PRODUCT	APPROVED MANUFACTURER
Chimneys (Boilers)	Selkirk-Metalbestos, Van Packer, Ecco, HeatFab, ICC, ProTech
Commissioning Agencies	MDT Systems Ltd., KD Engineering
Coils (Hydronic)	Aerofin, Trane, Engineered Air, McQuay, Carrier, Pace, York, Madok, Sterling, EH Price
Condensate Pumps	Franklin Electric Co. "LittleGiant", Eckerle Industries
Control Dampers – Low Leakage	American Warming, Tamco, Ruskin
Controls – DDC	Reliable, ESC Automation, Automated Logic, Allerton, Johnson Controls, Honeywell, Landis & Staeffa
Dampers – Fire and Smoke	Canadian Advanced Air, Maxam, Ruskin, Controlled Air, Nailor Industries, Pottoroff
Domestic Hot Water Heaters (Instantaneous Gas)	Navien Inc., Rinnai Corp.
Domestic Hot Water Heaters (Gas)	Rinnai, PVI Industries
Ductless Split A/C Systems	Mitsubishi, Fujitsu, Samsung, Daikin
Ductwork – Flexible	Thermaflex, Wiremold, Flexmaster, Canaflex
Ductwork – Round and Oval Spiral	Spiro-Lock, Ecco
Ductwork – Canvas Flexible Connectors	Durodyne, Ventlan
Expansion Tanks – Domestic Water	Watts Canada, Amtrol Inc. "Term-x-trol", Xylem inc. "Bell & Gossett", Taco Inc., Wessels Co.
Expansion Tanks - Hydronic	Amtrol "Extrol", ITT Bell & Gossett Series 'B' (ASME), S.A Armstrong Series "AX-V" Series 'L'.
Expansion Compensation - Piping	Mason Industries inc., The Metraflex Co., Hyspan Precision Products Inc., Flexicraft Industries, Senior Flexonics
Fans – Cabinet	Greenheck, Cook, Delhi, Twin City
Fans – Ceiling Mounted	Loren Cook Co., Greenheck Fan Corp., CML Northern Blower, PennBarry, Broan, Nutone, Twin City Fan and Blower
Fans – Centrifugal	Cook, Pace, Trane, Chicago, Buffalo, Woods, Twin City
Fans – Commercial Kitchen Exhaust	Twin City Fan and Blower, Loren Cook Co., Greenheck Fan Corp., JencoFan, Carnes Company Inc. Captive-Aire
Fans – In-Line Centrifugal	Greenheck Fan Corp., Twin-City Fan and Blower, Loren Cook Co., Carnes Company Inc.
Fans - Plenum	Greenheck Fan Corp., Twin-City Fan and Blower, Loren Cook Co., PennBarry, CML Northern Blower
Fans – Plug Type	Cook, Pace, Trane, Chicago, Buffalo, Woods, Twin City

PRODUCT	APPROVED MANUFACTURER
Fans –Residential Range Hoods	Nutone, Broan
Fans – Roof Mounted Exhaust	Loren Cook Co., Greenheck Fan Corp., Delhi, Twin City Fan and Blower, Carnes Company Inc.
Filters	Farr, Continental, Cambridge, AAF
Firestopping and Smoke Seals	3M Canada “Fire Barrier”, Tremco Inc. Fire Protection Systems Group “TREMstop”, Hilti (Canada) Ltd. Firestop Systems
Flexible Pump Connections	Metraflex Co. “SST” & “Metra-Mini”, Senior Flexonics Inc. “A1” & “A6” Series
Flow and Pressure Switches	Potter, System Sensor
Gas Pressure Regulating Valves	Fisher, Rockwell
Grilles, Registers and Diffusers	Titus, Tuttle & Bailey, Metalaire, Price Industries Inc., Nailor Industries, Krueger Division of Air System Components Inc.
Heat Recovery Ventilator	Greenheck Fan Corp., Venmar CES Inc., Summeraire Manufacturing, Lifebreath, Carrier Corp., Renewaure
Hydronic Terminal Heating Units Baseboard / Convactor / Wallfin / Unit Heaters / Force Flow Heaters	Jaga, Kampmann
Identification – Pipe and Duct	3M, SMS, Duramark, Bradley
Insulation – Piping and Duct	3M, Dow, Fibrex, Knauf, Johns-Manville, Owens Corning, Pittsburgh Corning, Manson, Roxul, Fibreglass Canada, Certainteed
Insulation – Refrigerant Piping	Armaflex, Armstrong, Nomaco
Insulation Jacketing	Childers, Fiberglass, Johns-Manville
Louvres	Airolite, Penn, Westvent, Ruskin, Nailor Industries, EH Price, Titus
Low Water Cutoffs	McDonnell Miller (Float type with manual reset)
Pipe Couplings – Grooved	Victaulic, Grinnell, Shur Joint
Pipe Couplings – Di-Electric	Watts, AG Specialties
Pipe Couplings – Flexible	Mason, Flexonics, Hyspan, Goodall, Victaulic, Proco
Pipe Fittings and Flanges	Crane, Grinnell, Jenkins
Pipe Supports and Hangers	Crane, Unistrut, Myatt, Grinnell, Sarco, Hunt, Taylor
Plumbing Fixtures	Refer to Section 22 42 00
Pressure Gauges	Weiss, Ashcroft, Terice, Marsh, Winter, Miljoco
Pressure Reducing Valves	Watts, Singer

PRODUCT	APPROVED MANUFACTURER
Pressure Relief Valves	ITT Bell & Gossett 3301/4100 or 790/1170, Spirax Sarco Ltd. SVI Series, McDonnell & Miller Models 250 & 260, Watts Industries (Canada) inc. 174A or 740, Conbraco 10-600 Series
Pumps – Domestic Hot Water Circulating	S.A. Armstrong Ltd., ITT Bell & Gossett, Grundfos Canada Inc., Taco Canada Ltd.
Pumps – Hydronic	Grundfos, Taco, Armstrong, Bell & Gossett, WILO
Pumps – Hydronic, Variable Speed	Grundfos Magna
Pump Suction Guides	Armstrong, Bell & Gossett, Taco
Radiant Slab Systems (Hydronic)	Uponor Inc., IPEX, Rehau Inc., Watts Radiant Inc.
Seismic Control and Restraint	Mason Industries Inc., Vibro-Acoustics Ltd.,
Slack Cable Restraints	Square M, Vibra Sonic, VMC-Korfund
Strainers	Red & White, Sarco, Armstrong, Mueller, Watts, Conbraco
Testing, Adjusting and Balancing Agencies	MDT Systems, Scott Technical, Flotech, Honey's Technical, Western Mechanical, KD Engineering, BC Tech Engineering, Stasis, Airmec
Thermometers	Weiss, Ashcroft, Trerice, Marsh, Winter, Miljoco
Valves (Ball, Gate, Globe, Check)	Red & White/Toyo, Grinnell, Watts, Kitz, Crane, Milwaukee, Conbraco
Valves (Butterfly)	Red & White/Toyo, Grinnell, Kitz, Crane, Milwaukee, Keystone, DeZurik, Lukenheimer
Valves (Balancing)	Armstrong, DeZurik, Grinnell
Valves (Circuit Balancing)	Tour & Anderson, Bell & Gossett, Armstrong, Griswald, RWV
Variable Frequency Drives	Yaskawa, Danfoss, Baldor, Hitachi, ABB, Siemens
Variable Refrigerant Systems	LG Electronics Canada Inc, Daikin Industries Inc., Mitsubishi Electric, Samsung
Vibration Isolation	Refer to section 20 05 20 for specific applications

2 PRODUCTS

2.1 Pipe Sleeves

- .1 **Galvanized Sheet Steel:** Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.
- .2 **Polyethylene:** Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- .3 **Waterproof Sleeves:** Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint, or PSI-Thunderline "Century-Line" Model CS HDPE sleeves.
- .4 **Galvanized Steel or Cast-Iron Pipe:** Schedule 40 mild galvanized steel, or Class 4000 cast iron.

2.2 Firestopping and Smoke Seal Materials

- .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in the mechanical work Section entitled Firestopping and Smoke Seal Systems and the work shall be done as part of the mechanical work.

2.3 Waterproofing Seal Materials

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the pipe size and the sleeve size or wall opening size.

2.4 Pipe Escutcheon Plates

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the pipe sleeve or building surface opening, and to fit tightly around the pipe or pipe insulation.

2.5 Piping Hangers and Supports

- .1 **General:** Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with the Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to the following requirements:
 - .1 Unless otherwise specified, all ferrous hanger and support products are to be electro-galvanized.
 - .2 Hangers and supports for insulated piping are to be sized to fit around the insulation and the insulation jacket.
- .2 **Horizontal Suspended Piping:** Hangers and supports are to be:
 - .1 Adjustable steel clevis hanger – Anvil Fig. 260 – MSS Type 1.
 - .2 Adjustable swivel ring band type hanger – Anvil Fig. 69 – MSS Type 10.
- .3 **Horizontal Pipe on Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 Steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170.
 - .2 Heavy-duty steel pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26.
 - .3 Single steel pipe hook - Myatt Fig. 156.
- .4 **Floor Supports for Vertical Risers:** Supports are to be:
 - .1 Copper tubing riser clamp – Anvil Fig. CT-121, Anvil Fig. CT-121C (plastic coated), or Myatt Fig. 150CT – MSS Type 8.
 - .2 Heavy-duty steel riser clamp – Anvil Fig. 261, or Myatt Fig's. 182, 183, 190 and 191 – MSS Type 8.
- .5 **Vertical Piping on Vertical Surfaces:** Epoxy coated steel pipe stays are not permitted. Supports are to be:
 - .1 Steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170.
 - .2 Heavy-duty steel pipe bracket or soil pipe bracket – Anvil Fig. 262 or Myatt Fig. 161 – MSS Type 26.
 - .3 Extension split pipe clamp – Anvil Fig's. 138R or Myatt Fig. 129 – MSS Type 12.
- .6 **Horizontal Pipe on Racks:** Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 Standard galvanized steel U-bolts/clamps supplied by the rack manufacturer.
- .7 **Special Hangers and Supports:** Special hangers and support for various applications are as follows:
 - .1 **Vibration isolated riser supports** – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between the clamp and the floor.

- .2 **For groups of pipes having the same slope** – Anvil Fig. 195 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place.
 - .3 **For sections of piping connected to vibration isolated equipment** – hangers and supports as specified above but complete with MSS Type 48 spring cushions.
 - .4 **For piping on new roofs** – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, all required accessories, channel type aluminum cross members, and galvanized steel pipe hangers and/or supports conforming to MSS Type SP-58, complete with all required accessories.
 - .5 **For glass drain and vent piping** – special padded hangers supplied by the pipe supplier.
 - .6 **For plastic piping above ground** – generally as specified above but in accordance with the pipe manufacturer's printed recommendations.
 - .7 **For fire protection piping** – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of the NFPA Standard applicable to the piping system.
 - .8 **For bare horizontal copper piping** – generally as above but factory vinyl coated to prevent direct copper/steel contact.
 - .9 **For bare copper vertical piping** – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate the pipe from the clamp.
 - .10 **Insulation protection shields to & including 40 mm (1½") diameter** – equal to Anvil "Rib-Lok" Fig. 168 galvanized steel shields with ribs to keep the shield centred on the hanger.
- .8 **Hanger Rods:** Electro-galvanized carbon steel (unless otherwise specified), round, threaded, complete with captive machine nuts with washers at hangers, sized to suit the loading in accordance with Table 3 in MSS SP-58, but, in any case, minimum 9.5 mm (3/8") diameter and in accordance with ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000PSI Tensile Strength, and ASME B18.31.3, Threaded Rods (Inch Series).

2.6 Equipment Bases and Supports

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified, shown or required, minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of the equipment on each side and end, or a minimum of 200 mm (8") from the centreline of equipment anchor bolts to the edge of the base, whichever is larger. Conform to the following requirements:
 - .1 Supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads.
 - .2 Place anchor bolts during the concrete pour and be responsible for all required levelling, alignment, and grouting of the equipment.
 - .3 As a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 **Roof or Grade Metal Frame Supports:** Equal to Eco Support Products "EcoFoot-EcoFrame metal framework support assemblies, each sized to suit the equipment to be mounted and consisting of UV stabilized rubber base mats, support legs adjustable from 300 mm to 450 mm (12" to 18"), galvanized steel fixings for the tubing framework, 15 mm (½") diameter bolts, 50 mm (2") square hot dipped galvanized mild steel tubing.
- .3 **Structural Steel Stands/Supports:** for equipment not designed for base mounting, where required, provide welded or bolted, cleaned and galvanized, prime coat painted structural steel stands or supports conforming to the following requirements:
 - .1 All stands and supports, except those for small equipment, are to be designed by a structural engineer registered in the jurisdiction of the work, and stamped and signed design drawings with calculations are to be submitted as shop drawings for review.
 - .2 All steel stands are to be flange bolted to concrete housekeeping pads.

2.7 Piping Strainers – "Y" Shaped

- .1 Wye shaped strainers, bronze with sweat type or flanged connections in copper piping, cast iron with screwed, flanged, or grooved end connections in steel piping, minimum 1725 kPa (250 psi) rated and complete with a removable perforated type 304 stainless steel 20 mesh screen, and, for strainers 40 mm (1½") diameter and larger, a blow down pipe connection tapping.

2.8 Piping Strainers – Duplex Basket Type

- .1 Duplex basket strainers, cast bronze with flanged connections in copper piping, cast iron with threaded, flanged, or grooved connections in steel piping, each minimum ASME Class 150 1380 kPa (200 psi) rated at 65° C (150° F), and complete with:
 - .1 A top access stainless steel perforated basket cartridge with perforations as recommended by the manufacturer to suit the application.
 - .2 A drain plug for each chamber.
 - .3 A stainless steel flow diverter valve with diverter cartridge seals.
 - .4 A lever operating handle.

2.9 Piping Drain Valves

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm (¾") diameter, straight pattern full port bronze ball valves, each complete with a lever handle, threaded outlet suitable for coupling connection of 20 mm (¾") diameter garden hose, and a cap and chain.

2.10 Access Doors

- .1 Prime coat painted steel (unless otherwise specified) flush access doors, each complete with a minimum #16 gauge frame, minimum #18 gauge door panel, heavy-duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing features to suit the particular construction in which it shall be installed.
- .2 Access door sizes are to suit the concealed work for which they are supplied, and wherever possible they are to be of a standard size for all applications, but, in any case, they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .3 Access doors in fire rated construction are to be ULC listed and labelled and of a rating to maintain the fire separation integrity.
- .4 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout, and constructed of stainless steel with a #4 finish.

2.11 Pressure Gauges and Thermometers

- .1 **Pressure Gauges:** Adjustable, glycerine filled, 100 mm or 115 mm (4" or 4½") diameter, each accurate to within 1% of scale range and complete with a type 304 stainless steel case with relief valve and polished stainless steel bayonet, stainless steel rotary movement with stainless steel bushings and socket, a clear acrylic window, a dual scale white dial with a scale range such that the working pressure of the system is at the approximate mid-point of the scale, and black pointer.
- .2 **Pressure Gauge Accessories & Additional Requirements:** Accessories and additional requirements are as follows:
 - .1 A bronze ball type shut-off valve shall be provided in the piping to each pressure gauge.
 - .2 Each pressure gauge for piping and equipment with normal everyday flow shall be equipped with a brass pressure snubber.
 - .3 Pressure gauges in fire protection piping must be ULC listed and labelled.
 - .4 Wetted parts of pressure gauges in domestic water piping are to be ANSI/NSF 61 certified lead free.

- .3 **Thermometers:** Round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, each accurate to within 1% of full scale and complete with a hermetically sealed stainless steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, white aluminum dual scale dial with black and blue markings and a range such that the working temperature of the system is the approximate mid-point of the scale, black aluminum pointer, double strength glass window, 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem, a suitable thermowell, and, for thermometers in domestic water piping, ANSI/NSF 61 lead free certification.

2.12 Equipment Belt Drives

- .1 ANSI/RMA Standard V-belt type rated at minimum 1.5 times the motor nameplate rating, and in accordance with the following requirements:
 - .1 Belts are to be reinforced cord and rubber, and multiple belts are to be matched sets.
 - .2 Sheaves are to be cast iron or steel, secured to shafts with removable keys unless otherwise specified, standard adjustable pitch ($\pm 10\%$ range) for motors under 10 HP, fixed pitch type with split tapered bushing and keyway for motors 10 HP and larger, and, if required, replaced as part of the mechanical work to suit system air/water quantity testing and balancing work.
 - .3 Motor slide rail adjustment plates are to allow for centre line adjustment.
- .2 Supply a spare belt set (tagged and identified) for each belt drive and hand to the Owner upon Substantial Performance of the work.

2.13 Equipment Drive Guards and Accessories

- .1 **For V-belt drives** - removable, four sided, fully enclosed, galvanized sheet steel guards to OSHA standards, cleaned, factory primed and painted with yellow equipment enamel, complete with a 2-piece full length hinged front panel to permit belt maintenance or replacement without removing the guard, and 40 mm (1½") diameter tachometer openings at each shaft location.
- .2 **For flexible couplings** - removable "U" shaped galvanized steel guards to OSHA Standards with a 2.3 mm (3/32") thick frame and expanded mesh face.
- .3 **For unprotected fan inlets & outlets** - unless otherwise specified, removable 20 mm (¾") galvanized steel wire mesh with galvanized steel frames, all to OSHA Standards.

2.14 Electric Motors

- .1 Unless otherwise specified, motors are to conform to EEMAC Standard MG1, applicable IEEE Standards, and applicable CSA C22.2 Standards, and are to meet NEMA standards for maximum sound level ratings under full load. Confirm motor voltages prior to ordering.
- .2 Vertically mounted and submersible motors are to be purposely designed for mounting in this attitude.
- .3 **AC Motor Efficiency:** The efficiency of single phase AC motors to 1 HP shall be in accordance with CAN/CSA C747. The efficiency of all three phase motors 1 HP and larger shall be in accordance with CAN/CSA C390 or IEEE 112B.
- .4 **Single Phase AC Motors:** Unless otherwise specified, AC motors smaller than ½ HP are to be 115 volt, continuous duty capacitor start type with an EEMAC 48 or 56 frame size, solid base, heavy-gauge steel shell with solid die-cast end shields, dynamically balanced die-cast rotor, integral automatic reset thermal overload protection, Class "B" insulation, and a 1.15 service factor at 40°C (105°F) ambient temperature.
- .5 **Brushless DC Motors:** Energy efficient electronically commutated motors (ECM) are to be brushless DC motors with an integral inverter, a permanent magnet on the rotor, and a programmable microprocessor based motor controller which will accept a remote adjustment signal for integration into a DDC building automation system
- .6 **Explosion-Proof AC Single Phase Motors:** totally enclosed, fan cooled, 115 volt continuous duty capacitor start type in accordance with CSA C22.2 No. 145, as specified for

standard single phase motors but suitable for use in Class 1 Group D hazardous locations and complete with a rolled steel shell and a 1.0 service factor at 40°C (105°F) ambient temperature.

- .7 **Three Phase AC Motors:** Unless otherwise specified, motors ½ HP and larger are to be totally enclosed, fan cooled, 3 phase, T-frame, squirrel cage continuous duty induction motors suitable for voltages indicated on the Drawings, EEMAC Design "B" for normal starting torque or Design "C" for high starting torque as required by the application, each complete with Class "B" insulation, a 1.5 service factor at 40°C ambient temperature, grease lubricated open ball bearings with grease fittings to permit re-lubrication without dismantling the motor, a cast iron frame with cast iron feet where required, cast iron end bracket and precision machined bearing fit, and balanced carbon steel shaft assembly with die-cast aluminum rotor windings.
- .8 **Explosion-Proof Three Phase AC Motors:** totally enclosed fan cooled motors in accordance with CSA C22.2 No. 145, generally as specified above for standard 3 phase motors but suitable for use in Class 1 Group D hazardous locations and with a 1.0 service factor at 40°C (105°F) ambient temperature.
- .9 **Motors for VFD's:** Motors for equipment with variable frequency drives are to be generally as specified above but inverter duty type to NEMA Standard MG-1, Section IV, Part 31, quantified by CSA for operation from a variable frequency drive of the type specified, and complete with Class "H" insulation and a shaft grounding bearing protection ring.
- .10 **AC Motors with "Wye-Delta" Starters:** Motors 150 HP and larger with "wye-delta" reduced voltage starters are to be complete with six leads for connection to the motor starter.

2.15 Motor Starters and Accessories

- .1 Loose motor starters and accessories, disconnect switches, and motor control centres for mechanical equipment will be provided as part of the electrical work.

2.16 Mechanical Work Identification Materials

- .1 **Equipment Nameplates:** Minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - .1 Unless otherwise specified or required, each nameplate shall be white, complete with bevelled edges and black engraved capital letter wording to completely identify the equipment and its use with no abbreviations.
 - .2 Wording is generally to be as per the drawings, i.e. Fan ef-1, and shall include equipment service and building area/zone served, but must be reviewed prior to engraving.
 - .3 Supply stainless steel screws for securing nameplates in place.
 - .4 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- .2 **Valve Tags:** Coloured, 40 mm (1½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match the piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V2

100 mm (4")

CHILL. WATER

NORMALLY OPEN
- .3 **Standard Pipe Identification:** Standard pipe identification shall be equal to Smillie McAdams Summerlin Ltd. or Brady vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
 - .1 For pipe to and including 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around the pipe or pipe insulation.

- .2 For pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.

- .4 **Standard Pipe Identification Wording and Colours:** Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
Domestic cold water	Green	DOM. COLD WATER
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic hot water recirculation	Green	DOM. HW RECIRC.
Tempered domestic water	Green	TEMP. DOM. WATER
Storm drainage	Green	STORM
Sanitary drainage	Green	SAN.
Plumbing vent	Green	SAN. VENT
Fire protection standpipe	Red	F.P. STANDPIPE
Fire protection sprinklers	Red	F.P. SPRINKLER
Natural gas	To Code	To Code, c/w pressure
Natural gas vent	To Code	To Code
Heating water supply	Yellow	HTG. WTR. SUPPLY
Heating water return	Yellow	HTG. WTR. RETURN
Heating water drain	Yellow	HTG. WTR. DRAIN
Refrigerant suction	Yellow	REFRIG. SUCTION
Refrigerant liquid	Yellow	REFRIG. LIQUID
Refrigerant hot gas	Yellow	REFRIG. HOT GAS

- .5 **Colours for Legends & Arrows:** Colours for pipe identification legends and directional arrows are to be as follows:

IDENTIFICATION COLOUR	LEGEND & ARROW COLOUR
Yellow	Black
Green	White
Red	White

- .6 **Duct Identification:** Custom made Mylar stencils with 50 mm (2") high lettering to accurately describe the duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with the lettering background.

2.17 Flexible Connectors

- .1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by the manufacturer to suit the application. Shop drawings or

product data sheets must indicate construction and performance requirements that suit the application.

3 EXECUTION

3.1 General Piping and Ductwork Installation Requirements

- .1 Unless otherwise specified, locate and arrange horizontal pipes and ducts above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
- .2 Unless otherwise specified, install all work concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Refer to and examine the Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Note that walls which are painted are considered finished.
- .3 Install all pipes and ducts parallel to building lines and to each other.
- .4 Neatly group and arrange all exposed work.
- .5 **Service and Maintenance Access:** Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all valves, dampers and any other equipment which will or may need maintenance or repairs and which are installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate the accessories at the floor level.
- .6 **Dissimilar Metal Pipe Connections:** Make all connections between pipes of different materials using proper approved adapters. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .7 **Cleaning:** Carefully clean all ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .8 **Insulation Clearance:** Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around the pipe or duct, except for ductwork at fire barriers, in which case the insulation will be terminated at each side of the duct fire damper.
- .9 **Surfaces to Receive Your Work:** Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
- .10 **Piping Rust and Dirt:** Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both shall be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean the piping prior to being concealed.
- .11 **Drain Pans:** Provide continuous galvanized sheet metal drip pan under all drain, water and water solution piping extending through all rooms with electrical equipment such as electrical, elevator equipment and transformer rooms, and all other spaces provided primarily for the installation of electrical equipment. Drip pans are to be complete with a drain pipe connection and drain piping shall be extended to the closest drain.
- .12 **Repair of Finished Surfaces:** for factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work shall match the original finish. This requirement also applies to galvanized finishes.

- .13 **Unions and Flanges:** Whether shown or specified on the drawings or not, provide screwed unions or flanges in all piping connections to equipment, and in regular intervals in new piping runs in excess of 12 m (40') to permit removal of sections of piping.
- .14 **Elbows and Eccentric Reducers:** Unless otherwise specified and except where space limitations do not permit, all piping elbows are to be long radius. Eccentric reducers are to be installed with the straight side at the top of the piping.

3.2 Pipe Joint Requirements

- .1 Do not make pipe joints in walls or slabs.
- .2 Ream all piping ends prior to making joints.
- .3 **Screwed Steel Piping:** Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After the pipe has been screwed into the fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- .4 **Welded Steel Piping:** Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove all scale and oxide from the bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- .5 **Welding Requirements:** Welded joints are to be made by CWB certified, currently licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed.
 - .1 Each weld shall be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved.
 - .2 Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 **Weld Testing Requirements:** Include (and pay for) magnetic particle testing of 10% of the welds in piping systems indicated below. Testing shall be done by a specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by the Consultant. Testing shall be done to ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51, and requirements of governing authorities. Systems to be tested are as follows:
 - .1
- .7 **Flanged Joints:** Unless otherwise specified, make all flanged joints with EDPM gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than the length necessary to screw the nut up flush to the end of the bolt. Bolts used for flanged connections in all piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193, Grade B-7, with heavy hexagon nuts to ASTM A-194, CL-2H. Provide suitable washers between each bolt head and the flange and between each nut and the flange.
- .8 **Examination of Flanged Joints:** A random check of bolted flanged connections will be made to verify that flanged connections are properly mated with no shear force acting on bolts. Supply all labour to disconnect and reconnect the selected flanged joints. If improperly mated joints are found, remove and reinstall the affected piping so that the flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .9 **Soldered Joints:** Unless otherwise specified make all soldered joints in copper piping using flux suitable for and compatible with the type of solder being used. Clean the outside of the pipe end and the inside of the fitting, valve, or similar accessory prior to soldering. Comply with requirements of ASTM B828, Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

- .10 **Mechanical Joints:** Install mechanical joint fittings and couplings in accordance with the manufacturer's instructions.
- .11 **Grooved Pipe & Coupling Joints:** Make arrangements with the coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to the manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.
- .12 **Pressure Crimped Piping Joints:** If pressure crimped couplings and fittings are used, ensure that gaskets are fully compatible with the piping fluid, and that all valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with the manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .13 **PVC Piping Solvent Weld Joints:** Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with the manufacturer's recommendations, ASTM D2855, and CSA requirements.
- .14 **PVC Piping Gasketed Joints:** Install PVC piping with gasketed joints in accordance with the manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.3 Installation of Pipe Sleeves

- .1 Where pipes pass through new concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 **In poured concrete slabs:** unless otherwise specified - minimum #16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves.
 - .2 **In concrete or masonry walls:** Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- .2 **Waterproof Sleeves:** Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a water stop plate in accordance with the drawing detail. Provide waterproof sleeves in the following locations:
 - .1 In mechanical room floor slabs, except where on grade.
 - .2 In slabs over mechanical, fan, electrical and telephone equipment rooms or closets.
 - .3 In all floors equipped with waterproof membranes.
 - .4 In the roof slab.
 - .5 In waterproof walls.
- .3 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the pipes, or where the pipe is insulated, a 12 mm (½") clearance around the pipe insulation.
- .4 Pack and seal the void between the pipe sleeves and the pipe or pipe insulation in non-fire rated construction for the length of the sleeves as follows:
 - .1 **Interior construction:** pack sleeves in interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound.
 - .2 **Exterior walls above grade:** pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified.
 - .3 **Exterior walls below grade:** seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below.
- .5 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .6 Terminate piping for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.

- .7 "Gang" type sleeving will not be permitted.

3.4 Installation of Waterproof Mechanical Seals

- .1 Provide watertight link type mechanical seals in exterior wall openings where shown or specified.
- .2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.
- .3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.5 Duct Openings

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by the trade responsible for the particular construction in which the opening is required.
- .2 Ensure that openings for fire dampers to 600 mm (24") high are sized to suit the damper arrangement with the folding blade out of the air stream.
- .3 For all duct openings except where fire dampers are required, pack and seal the space between the duct or duct insulation and the duct opening as specified above for pipe openings in non-fire rated construction.

3.6 Sleeve and formed Opening Location Drawings

- .1 Prepare and submit for review, white print drawings indicating the size and location of all required sleeves, recesses and formed openings in new poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.7 Installation of Pipe Escutcheon Plates

- .1 Provide escutcheon plates suitable secured over all new exposed piping passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover pipe sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate shall fit tightly around the sleeve.

3.8 Installation of Fastening and Securing Hardware

- .1 Provide all fastening and securing hardware required for mechanical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components. Submit support details for review prior to installation.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and CAN3-Z166.2.

3.9 Installation of Pipe Hangers and Supports

- .1 Provide all required pipe hangers and supports.
- .2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from the structure only.
- .3 **For Insulated Pipe:** Size the hanger or support to suit the diameter of the insulated pipe and install the hanger or support on the outside of the insulation and insulation finish.
- .4 **Underground (in earth/backfill) Piping:** Support requirements for underground piping in earth/backfill are as follows:
 - .1 Support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs, all as per the drawing detail.
 - .2 Ensure that all bedding and supports for underground pipes are flat and true and that allowances are made for pipe hubs, couplings, or other protrusions so that no voids are left between the pipe and the bedding.
- .5 **Horizontal Above Ground Piping:** Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe to and including 25 mm (1") diameter are to be clevis type or adjustable ring type, and hangers for suspended pipe 40 mm (1½") diameter and larger are to be adjustable clevis type. Space hangers and supports in accordance with the following:
 - .1 **Cast iron pipe:** hang or support at every joint with maximum 2.4 m (8') spacing.
 - .2 **Plastic pipe:** conform to pipe manufacturer's recommended support spacing.
 - .3 **Glass pipe:** conform to pipe manufacturer's recommended support spacing and support requirements.
 - .4 **Copper and steel pipe:** hang or support at spacing in accordance with the following schedule:

PIPE DIA.	MAX. SPACING STEEL (meters)	MAX. SPACING COPPER (meters)
To 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .5 **Flexible grooved pipe/coupling joint piping:** as above but with not less than 1 hanger or support between joints.
- .6 **Changes in direction:** where pipes change direction, either horizontally or vertically, provide a hanger or support on the horizontal pipe not more than 300 mm (12") from the elbow, and where pipes drop from tee branches, support the tees in both directions not more than 50 mm (2") on each side of the tee.
- .7 **Grouped piping:** when pipes with the same slope are grouped and a common hanger or support is used, space the hanger or support to suit the spacing requirement of the smallest pipe in the group and secure pipes in place on the common hanger or support.

- .8 **Roller hangers & supports:** provide roller hangers or supports for all heat transfer piping 150 mm (6") diameter and larger and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to the pipe to protect the piping insulation.
- .9 **Inline centrifugal pumps:** support piping at both sides of inline centrifugal pumps.
- .6 **Vertical Piping:** Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with the following:
 - .1 Support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser.
 - .2 For sections of vertical piping with a length less than 3 m (10'), support the pipe at least once.
 - .3 For all vertical cast iron plain end pipe (mechanical joint type), secure the riser or pipe clamp around the pipe under a flange integral with the pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support.
 - .4 For all vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to the pipe to carry the load.
 - .5 For vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between the riser clamps and the floor.
 - .6 For piping subject to vertical movement exceeding 40 mm (1½") due to vertical pipe expansion, provide suitable engineered constant support hangers.
- .7 **Piping on The Roof:** Support piping on the roof in accordance with requirements of the drawing detail.
- .8 **Piping on The Roof:** Support piping on the roof as follows:
 - .1 **On new roof** - supply manufactured roof supports as per Part 2 of this Section to accommodate the piping involved and support spacing specified above, and hand the supports to the roofing trade on the roof for installation as part of the roofing work, then secure piping in place on the supports
- .9 **Isolation for Bare Copper Tubing:** Each hanger, support or securement for horizontal bare copper tubing shall be plastic coated to prevent direct contact between the pipe and the ferrous hanger. Each wall or floor clamp for vertical bare copper piping shall be isolated from the pipe by means of strips of flexible rubber inserts. The use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.
- .10 **Insulation Protection Shields:** for insulated horizontal piping to and including 40 mm (1½") diameter, provide galvanized steel insulation protection shields between the insulation and the hanger or support. Install shields immediately after the pipe is insulated.
- .11 **Pipe Support from Steel Deck:** Do not support piping from steel deck without written consent from the Consultant.

3.10 Installation of Pipeline Strainers

- .1 Provide strainers in piping systems where shown on the drawings.
- .2 Equip each strainer with a construction screen and remove after piping has been flushed and cleaned. Install permanent screens/mesh.
- .3 Provide isolating valves in piping a maximum of 3 m (10') from the strainer on each side of a strainer.
- .4 For "Y" shaped strainers 40 mm (1½") diameter and larger, provide blow-off piping complete with a shut-off valve with cap and chain, and terminate blow-off piping downward in a vertical position.
- .5 For duplex basket strainers, equip each chamber drain plug with valved drain piping.

3.11 Installation of Equipment Drains and Piping Drain Valves

- .1 Unless otherwise shown or specified, provide minimum 40 mm (1½") diameter type DWV copper drain piping from equipment overflows, condensate drain pans, pump bases, fresh air intake plenum drains, etc., to a floor drain location. Equip the drain piping with deep seal traps located in heated areas.
- .2 Provide a drain valve at the bottom of piping risers, at all other piping low points, and wherever else shown and/or specified.

- .3 Locate drain valves so that they are easily accessible.

3.12 Supply of Access Doors

- .1 Supply access doors to give access to all mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on the drawings.
- .2 Locate access doors as inconspicuously as possible in walls and partitions and arrange mechanical work such that it is clearly within view and accessible for inspection and servicing, and to suit access door locations shown on the reviewed and approved white prints of reflected ceiling plan and elevation drawings submitted as per Part 1 of this Section.
- .3 Group piping and ductwork to ensure the minimum number of access doors is required. Access doors will be installed by the trades responsible for the particular type of construction in which the doors are required.
- .4 Submit a sample of each proposed access door for review prior to ordering.

3.13 General Re: Installation of Valves

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where the valves are specified, however, regardless of locations shown or specified, the following requirements apply:
 - .1 Provide shut-off valves to isolate all systems, at the base of all vertical risers, in branch take-offs at mains and risers on all floors, to isolate all equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance.
 - .2 Install shut-off valves with handles upright or horizontal, not inverted, and located for easy access.
 - .3 Unless otherwise specified, provide a check valve in the discharge piping of each pump.
 - .4 Valve sizes are to be the same as the connecting pipe size.
 - .5 Valves are to be permanently identified with the size, manufacturer's name and figure number, and wherever possible, valves are to be the product of the same manufacturer.
 - .6 The manufacturer's name, valve model or figure number, and the pressure rating are to be clearly marked on each valve.
 - .7 For valves in insulated piping, the design of the valve stem, handle and operating mechanism shall be such that the insulation does not have to be cut or altered in any manner to permit valve operation.

3.14 Installation of Pressure Gauge & Thermometer Access Fittings

- .1 Provide pressure gauge and thermometer access fittings in 6.4 mm (¼") threaded opening fittings for insertion/removal of piping mounted pressure gauges and thermometers. Where piping is insulated, provide extended length access fittings to accommodate the insulation.
- .2 Unless pressure gauges and/or thermometers are provided with equipment, provide access fittings in the following locations:
 - .1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.

- .2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.
 - .3 In expansion tank(s) or piping immediately at the expansion tank.
 - .4 In all water connections to hot water heaters.
 - .5 In the downstream side of mixing valves.
 - .6 In separate domestic hot water storage tank(s).
 - .7 At the top most outlet in each standpipe fire protection system riser.
 - .8 In piping at each side of a pressure reducing valve.
 - .9 In domestic water service piping downstream of the meter.
 - .10 Wherever else shown and/or specified on the drawings or in the Specification.
- .3 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

3.15 Installation of Pressure Gauges and Thermometers

- .1 **Pressure Gauges:** Provide pressure gauges in the following locations:
- .1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump.
 - .2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.
 - .3 In expansion tank(s) or piping immediately at the expansion tank.
 - .4 In separate domestic hot water storage tank(s).
 - .5 In piping at each side of a pressure reducing valve.
 - .6 In domestic water service piping downstream of the meter.
 - .7 Wherever else shown and/or specified on the drawings or in the Specification.
- .2 **Thermometers:** Provide thermometers in the following locations:
- .1 In supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, liquid to liquid heat exchangers, main coils, etc., unless temperature indication is supplied with the equipment.
 - .2 In all water piping connections to hot water heaters.
 - .3 In the downstream side of mixing valves.
 - .4 Wherever else shown and/or specified herein or on the drawings.
- .3 **Installation Requirements:** Conform to the following installation requirements:
- .1 For installation of thermometers in piping wells, provide a coat of metallic base heat transfer paste or grease in the piping well.
 - .2 For pressure gauges in piping at equipment locations, install the pressure gauge between the equipment and the first pipe fitting.
 - .3 Locate, mount, and adjust all instruments so they are easily readable.
 - .4 Where pressure gauges and/or thermometers are located at high level or in an area where they cannot be easily seen, provide remote reading instruments.
 - .5 All metal surfaces that are in contact with domestic water are to be NSF/ANSI 61 certified.

3.16 Installation of Equipment Drive Guards and Accessories

- .1 Provide OSHA guards for all exposed accessible rotating parts such as belt drives, couplings, fan wheels, and shaft ends on all mechanical equipment.
- .2 Install belt guards to allow movement of motors for adjusting belt tension.
- .3 Provide a means to permit lubrication and use of test instruments with guards in place.
- .4 Secure guards to the equipment or equipment base but do not bridge sound or vibration isolation.
- .5 Where equipment oil level gauges, oil reservoirs, grease cups, or grease gun fittings are integral with the equipment but are not easily accessible for service, extend to an accessible location using aluminium or copper tubing.

3.17 Mechanical Work Identification

- .1 **Exposed Piping & Ductwork:** Identify new exposed piping and ductwork as per Part 2 of this Section in locations such that it can be seen from the floor or service platforms, as follows:
 - .1 At every end of every piping or duct run.
 - .2 Adjacent to each valve, strainer, damper, and similar accessory.
 - .3 At each piece of connecting equipment.
 - .4 On both sides of every pipe and duct passing through a floor, wall, or partition.
 - .5 At 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length.
 - .6 At least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 **Concealed Piping & Ductwork:** Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
 - .1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas.
 - .2 At maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room.
 - .3 At each access door location.
 - .4 At each piece of connected equipment, automatic valve, etc.
- .3 **Equipment:** Provide an identification nameplate for each new piece of equipment, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate all nameplates in the most conspicuous and readable location. Unless otherwise specified, equipment identification terminology shall be as per drawing identification.
- .4 **Natural and/or Propane Gas Piping:** Paint new gas piping with primer and two coats of yellow paint in accordance with Code requirements and requirements of the Painting Section in Division 09. Identify the piping at intervals as specified above.
- .5 **Valve Tagging & Chart:** Tag valves and prepare a valve tag chart in accordance with the following requirements:
 - .1 Attach a valve tag to each new valve, except for valves located immediately at the equipment they control.
 - .2 Prepare a computer printed valve tag chart to list all tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed).
 - .3 Frame and glaze one copy of the chart and, unless otherwise directed, affix to a wall in each main mechanical and/or equipment room.
 - .4 Include a copy of the valve tag chart in each copy of the operating and maintenance instruction manuals.
 - .5 Hand an identified and packaged (jewel case) compact disc of the valve tag chart to the owner at the time the O & M Manuals are submitted.
- .6 **Ceiling Tacks or Stickers:** Where new shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in the ceiling panel material, or stickers equal to Brady "Quick Dot" on the ceiling grid material to indicate locations of the items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:

.1 HVAC piping valves and equipment	yellow
.2 Fire protection valves and equipment	red
.3 Plumbing valves and equipment	green
.4 HVAC ductwork dampers and equipment	blue
.5 Control system hardware and equipment	orange

3.18 System Flow Diagrams

- .1 Prepare AutoCAD, coloured, 1200 mm x 900 mm (48" x 36") flow diagrams of mechanical systems to identify all equipment and valves.
- .2 Install framed and glazed diagrams in equipment rooms housing the system equipment. Confirm location prior to installation.
- .3 Include reduced size copies of the diagrams in each copy of the O & M Manuals.

3.19 Finish Painting of Mechanical Work

- .1 Touch-up paint all damaged factory applied finishes on mechanical work products.
- .2 Finish painting of exposed mechanical work is specified in Division 09 and is part of the work of Division 09.

3.20 Pipe Leakage Testing

- .1 Before new piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test all piping for leakage.
- .2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 **Gravity Drainage & Vent Piping:** Securely close all openings and pipe ends and fill piping with water up to the highest level, and ensure that the water stands at the same level for a minimum of 2 hours. After the fixtures and fittings are set and the pipes connected to the building drain or drains, turn on water into all pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Make a smoke test if required by the Municipality. at your option, drain and vent piping may be pressure tested with cold water at 345 kPa (50 psi) for 2 hours with zero leakage.
- .5 **Domestic Water Piping:** Test piping with cold water at a pressure of 1½ times normal working pressure and maintain the pressure for a minimum of 2 hours.
- .6 **Sprinkler System Piping:** Test all system piping in accordance with requirements of NFPA No. 13, "INSTALLATION OF SPRINKLER SYSTEMS", and in accordance with any additional requirements of governing authorities.
- .7 **Heat Transfer (HVAC) System Piping:** Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.
 - .1 0 kPa to 105 kPa (0 psi to 15 psi) low pressure piping - 690 kPa (100 psi).
 - .2 110 kPa to 690 kPa (16 psi to 100 psi) medium pressure piping - 1035 kPa (150 psi).
 - .3 Greater than 690 kPa (100 psi) high pressure piping - 1380 kPa (200 psi).
- .8 **Natural Gas Piping:** Test piping in accordance with the requirements of CAN/CSA - B149.1. After completion of the verification test, locate the required tag stating the results of the verification test at the point of entry of the gas main into the building, affixed to the pipe in a secure manner. Check all piping joints and connections for leaks with a water/soap solution while the piping is under pressure.
- .9 **Refrigerant Piping:** Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of the ASHRAE HANDBOOK - FUNDAMENTALS.
- .10 **General Re: All Testing:** The following requirements apply to all testing:
 - .1 Ensure that all piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing.
 - .2 Temporarily remove or valve off all piping system specialties or equipment which may be damaged by test pressures prior to pressure testing the systems, and flush piping to remove foreign matter.

- .3 When testing is carried out below the highest level of the particular system, increase the test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point.
- .4 Include for temporary piping connections required to properly complete the tests.
- .5 Piping under test pressure shall have zero pressure drop for the length of the test period.
- .6 Make tight leaks found during tests while the piping is under pressure, and if this is impossible, remove and refit the piping and reapply the test until satisfactory results are obtained.
- .7 Where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions.
- .8 Tests are to be done in reasonably sized sections so as to minimize the number of tests required.
- .9 In addition to the leakage tests specified above, demonstrate proper flow throughout the systems including mains, connections and equipment, as well as proper venting and drainage, and Include for any necessary system adjustments to achieve the proper conditions.

3.21 Supply of Motor Starters and Accessories

- .1 Motor starters for mechanical equipment, except for starters integral with packaged equipment and starters factory installed in equipment power and control panels, will be provided as part of the electrical work.

3.22 Electrical Wiring Work for Mechanical Work

- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment will be done as part of the electrical work:
 - .1 "Line" side power wiring to motor starters or disconnect switches in motor control centres and starters or disconnects on motor starter panels, and "load" side wiring from the starters or disconnects to the equipment.
 - .2 "Line" side power wiring to individual wall mounted starters, and "load" side wiring from the starters to the equipment.
 - .3 "Line" side power wiring to pre-wired power and control panels and variable frequency drives, and "load" side power wiring from the panels and VFD's to the equipment.
 - .4 Provision of receptacles for plug-in equipment.
 - .5 Provision of disconnect switches for all motors that are in excess of 10 m (30') from the starter location, or that cannot be seen from the starter location, and all associated power wiring.
 - .6 All motor starter interlocking in excess of 24 volts.
 - .7 Wiring from motor winding thermistors in motors 30 HP and larger to motor starter contacts.
 - .8 Provision of dedicated 120 volt, 15A-1P circuits terminated in junction boxes in mechanical equipment rooms for automatic control and building automation system wiring connections to be made as part of the automatic controls work.
 - .9 120 volt power connections to electrical receptacles integral with small ceiling exhaust fans, including wiring through light switches or speed controllers.
 - .10 120 volt wiring connections to lighting fixture/switch combinations integral with air handling units.
 - .11 120 volt wiring connections to duplex receptacles integral with air handling unit control panels.
- .2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work shall be installed in conduit and shall be done as part of the mechanical work in accordance with wiring requirements specified for the electrical work.

3.23 Installation of Equipment Bases and Supports

- .1 **Concrete Housekeeping Pads:** Unless otherwise specified, shown, or required, set all floor or grade mounted equipment on reinforced concrete housekeeping pads.

- .2 **Steel Framework Supports:** Where indicated, support base mounting smaller HVAC equipment such as heat pumps, condensing units, and fan equipment on galvanized steel adjustable tubular steel framework support assemblies.
- .3 **Structural Steel Stands/Supports:** for equipment not designed for base mounting, where required, provide welded, cleaned, and prime coat painted structural steel stands or supports flange bolted to concrete housekeeping pads.

3.24 Concrete Work for Mechanical Equipment Bases/Pads

- .1 All concrete work required for mechanical equipment bases/pads will be provided as part of the concrete work of Division 03.
- .2 Exactly locate bases/pads at the site and be present during the concrete pour to ensure that anchor bolts, inserts, plates, and similar hardware are not damaged or dislodged.
- .3 Coordinate base/pad installations with the concrete trade and ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.25 Concrete Work for Mechanical Equipment Bases/Pads

- .1 Provide all poured concrete work, including reinforcing and formwork, required for mechanical equipment bases/pads. Perform concrete work in accordance with requirements specified in Division 03.
- .2 Concrete shall be minimum 20,700 kPa ready-mix concrete in accordance with CAN/CSA-A23.1 and the Building Code.
- .3 Ensure that bases and pads are keyed into the structure to meet seismic restraint requirements.

3.26 Excavation and Backfill Work

- .1 Excavation, backfill and related work such as dewatering required for mechanical work will be performed as part of the excavation and backfill work, except for final hand grading work which shall be done as part of the mechanical work.
- .2 Inverts and locations of existing site services have been shown on the drawings. The inverts and locations shown are approximate, and it is your responsibility to confirm and satisfy yourself that the inverts and locations as shown are correct, prior to commencing site service work.
- .3 Accurately mark-out the location and routing of excavation required for your work, as well as the required depth.
- .4 Ensure that pipe bedding is proper prior to laying pipes. Hand excavate under pipe hubs, couplings, flanges, and similar items to ensure even bearing along the entire barrel of each length of pipe.
- .5 Ensure that piping is inspected, leakage tested and approved prior to backfilling. Supervise the initial backfilling operation to ensure that the buried work is not disturbed.

3.27 Excavation and Backfill Work

- .1 Do all excavation, backfill and related work required for your work. Perform such work in accordance with requirements of the Excavation and Backfill work Section, except as modified by this Article. Obtain a copy of the soil test report and review during the bidding period.
- .2 Grade the bottom of trench excavations as required.
- .3 In firm, undisturbed soil, lay pipes directly on the soil, unless otherwise directed.
- .4 Unless otherwise specified, backfill trenches within the building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact the first layers up to a compacted level of minimum 300 mm (12") above the top of the pipe. Hand or machine compact the balance up to grade.

- .5 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .6 Unless otherwise specified, backfill trenches outside the building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.
- .7 You will be held responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
- .8 After the first lift of backfill has been compacted, mark the entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.

3.28 Flashing for Mechanical Work Penetrating the Roof

- .1 Do all required flashing work, including counterflashing, for mechanical work penetrating and/or set in the roof.
- .2 Perform flashing work in accordance with requirements of drawing details, and requirements specified in Division 07.

3.29 Cleaning Mechanical Work

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean all mechanical work prior to application for Substantial Performance of the work.
- .3 Include for vacuum cleaning the interior of air handling units and ductwork systems.

3.30 Use of Mechanical Systems for Temporary Heating

- .1 Permanent building mechanical systems are not to be used for temporary heating purposes during construction.
- .2 Permanent mechanical systems in the building may be used for temporary heating during construction subject to the following conditions:
 - .1 Each entire system is complete, pressure tested, cleaned, and flushed out.
 - .2 Specified water treatment system has been commissioned, and treatment is being continuously monitored.
 - .3 Building has been closed in and areas to be heated/ventilated are clean and will not thereafter be subjected to dust-producing processes.
 - .4 There is no possibility of damage from any cause.
 - .5 Supply ventilation systems are protected by minimum MERV 7 filters, which are to be inspected every other day, and changed every 2 weeks, or more frequently as required.
 - .6 Return air systems have approved construction filters over all openings, inlets, and outlets.
 - .7 All systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis.
 - .8 Warranties are not affected in any way.
 - .9 Regular preventive and all other manufacturer's recommended maintenance routines are performed.
 - .10 Before Substantial Performance, each entire system shall be refurbished, cleaned internally and externally, restored to "as-new" condition, and filters in air systems replaced.
 - .11 Energy costs are to be paid by the Contractor.

3.31 Maintaining Equipment Prior to Acceptance

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior to start-up, testing, and commissioning.

- .2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- .3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.
- .4 All filters are to be new upon Substantial Performance of the work. This is in addition to any spare filters specified.

3.32 Connections to Other Equipment

- .1 Carefully examine the Contract Documents during the bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.33 Waste Management and Disposal

- .1 Separate and recycle waste materials in accordance with requirements specified in Division 01.
- .2 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.
- .3 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .4 Place materials defined as hazardous or toxic waste in designated containers.
- .5 Ensure emptied containers are sealed and stored safely for disposal.

3.34 Seismic Restraint Anchor Points for Equipment

- .1 All mechanical equipment requiring seismic restraint (see the mechanical work Section entitled Seismic Control and Restraint) shall be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by the equipment manufacturers, so that the equipment may be bolted down or restrained in the field.
- .2 The equipment to be restrained must be designed such that the strength and anchorage of the internal components of the equipment exceeds the force level used to restrain and anchor the equipment itself to the supporting structure.

3.35 Installation of Flexible Connectors

- .1 Provide flexible connectors in piping connections to all seismically restrained equipment, and wherever else shown.
- .2 Provide flexible connectors in all piping connections to vibration isolated equipment.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies seismic control and restraint requirements that are common to mechanical work Sections of the Specification, it is a supplement to each Section and shall be read accordingly.

1.2 Seismic Consultant

- .1 Retain and pay for the services of an experienced Seismic Consultant who is a registered professional engineer licensed in the jurisdiction of the work and a member in good standing of a Professional Engineers Association in the jurisdiction of the work.
- .2 The Seismic Consultant shall:
 - .1 Determine the proper seismic hazard level, design, recommend, and review all proposed mechanical work seismic restraint shop, placement and securing drawings, and sign and stamp all drawings prior to submittal for review as specified below.
 - .2 Supervise installation of all mechanical work seismic restraint and, when work is complete, certify in writing that the seismic restraint work has been installed in accordance with signed, stamped, and reviewed drawings.
 - .3 Prepare and submit to the Municipality and authorities having jurisdiction, on a form approved by the Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when the work is complete, original signed and sealed Letters of Assurance for the design, installation and field review of all seismic restraint work.

1.3 Submittals

- .1 **Shop Drawings/Product Data Sheets:** Obtain all required equipment information and submit manufacturer's shop drawings/product data sheets for all restraining devices and steel bases. Include placement data, and details of attachment to both the equipment and the structure meeting requirements of the forces involved. All product data sheets and drawings are to be signed and stamped by the Seismic Consultant referred to above.
- .2 **Seismic Consultant's/Seismic Control Product Manufacturer's Certification Letters:** Submit copies of the Seismic Consultant's Letters of Assurance as specified above. Submit copies of the Seismic Consultant and seismic control manufacturer's certification letters as specified in Part 3 of this Section.
- .3 **Samples:** If requested, submit samples of seismic restraint materials for review.

1.4 Quality Assurance

- .1 Seismic restraints are to be designed by a Seismic Consultant as specified above, and are to be installed by qualified tradesmen under the supervision of and to the approval of the Seismic Consultant.
- .2 Unless otherwise specified seismic control and restraints are to be designed in accordance with:
 - .1 BC Building Code.
 - .2 ANSI/SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - .3 CAN/CSA-S832, Seismic Risk Reduction of Operational and Functional Components (OFC's) of Buildings.
 - .4 ANSI/SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.
- .3 Seismic control and restraints for fire protection piping and equipment are to be in accordance with NFPA requirements. When specified and/or required, design is also to include Factory Mutual requirements.

2 PRODUCTS

2.1 General

- .1 All restraint products must be tested in an independent testing laboratory, or certified by the Vibration Isolation and Seismic Control Manufacturer's Association and Seismic Consultant, to confirm that the restraint products meet all requirements of this Section.

3 EXECUTION

3.1 Installation of Seismic Restraint Materials

- .1 Provide seismic restraint for all mechanical system equipment, piping, and ductwork, etc., as per the requirements of specified Codes and Standards.

3.2 Seismic Restraint of Piping Systems

- .1 Provide seismic restrain for all new piping systems with the following exceptions:
 - .1 Natural gas piping less than 25 mm (1") diameter.
 - .2 Domestic water piping 32 mm (1¼") diameter and smaller in mechanical equipment rooms.
 - .3 All other piping 65 mm (1½") diameter and smaller.
 - .4 All piping suspended by individual hangers 300 mm (12") or less in length from the top of the pipe to the bottom of the hanger.

3.3 Seismic Restraint of Duct Systems

- .1 Provide seismic restraint for all new ductwork systems with the following exceptions:
 - .1 All rectangular ducts less than 0.56 sq. m (6 sq. ft.) in cross-sectional area.
 - .2 All round ducts less than 710 mm (28") in diameter.
 - .3 All ductwork suspended by individual hangers 300 mm (12") or less in length from the top of the duct to the bottom of the hanger.

3.4 Seismic Restraint for Motor Driven Equipment

- .1 Connect slack cable restraints to ceiling hung or in-line pumps in such as way that the axial projection of the wires passes through the centre of gravity of the equipment. Orient the restraint wires at approximately 90° to each other (in plan), and tie back to the ceiling or structure above at an angle not exceeding 90°.
- .2 Connect slack cable restraints to ceiling hung fans in such as way that the axial projection of the wires passes through the centre of gravity of the equipment. Orient the restraint wires at approximately 90° to each other (in plan), and tie back to the ceiling or structure above at an angle not exceeding 90°.
- .3 Provide seismically rated spring mount isolators for fans installed on floor structures or inside air handling unit casings. Refer to the mechanical Section entitled Mechanical Vibration Control.
- .4 For roof mounted fans supplied with seismically rated roof curbs, the Seismic Consultant shall determine the appropriate methods of attachment of the roof curbs to the roof structure.

3.5 Seismic Restraint of Non-Isolated Equipment

- .1 Bolt all non-isolated equipment to the structure by means of anchors and bolts designed for 2 g applied horizontally through the centre of gravity, and as selected by the Seismic Consultant. This requirement is applicable to:
 - .1 Boilers.
 - .2 Expansion tanks.
 - .3 Water source heat pumps.
 - .4 Domestic hot water heaters.
- .2 The use of perforated steel strap hangers to attach non-residential type tanks to walls is not permitted.

3.6 Site Inspection and Letters of Certification

- .1 When all seismic control products have been installed, arrange for the Seismic Consultant to examine the installation of all seismic control products and to certify in writing that the products have been properly installed in accordance with governing Codes and Regulations, reviewed shop drawings and product data, and recommendations and instructions. The Seismic Consultant shall apply his signed and dated professional stamp to the letter.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies vibration isolation product requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Submittals

- .1 **Product Data:** Submit copies of manufacturer's product data sheets for all products specified in this Section. Product data sheets shall include product characteristics, limitations, dimension, finishes, and installation recommendations.

1.3 Quality Assurance

- .1 Mechanical vibration isolation product manufacturers are to be current members of the Vibration Isolation & Seismic Restraint Manufacturers Association.

1.4 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.
- .2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	ACCEPTABLE MANUFACTURERS
Isolation Pads	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Rubber Floor Isolators	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Spring Floor Isolators	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Open Spring Mounts	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Close Spring Mounts	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Totally Restrained Spring Mounts	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Spring Hangers	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Neoprene Hanger Isolators	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Concrete Inertia Type Equipment Base	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Steel Equipment Base	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Combination Steel/Concrete Inertia Equipment Base	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics
Slung Steel Base	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics

PRODUCT	ACCEPTABLE MANUFACTURERS
Continuous Rail Type Isolation for Roof Mounted Equipment	Mason Industries Inc., Kinetics Noise Control Inc., The VMC Group, Vibro-Acoustics

1.5 Seismic Restraint Requirements

- .1 Refer to the mechanical work Section entitled Seismic Control and Restraint for requirements for use of a Seismic Consultant, and seismic restraint requirements applicable to vibration isolated materials and equipment.

2 PRODUCTS

2.1 General

- .1 Vibration isolation products are to be in accordance with the drawing schedule and details, and as specified below.
- .2 **Springs:** All springs are to be stable, colour coded, selected to operate at no greater than $\frac{2}{3}$ solid load, designed in accordance with the Society of Automotive Engineers Handbook Supplement 9 entitled Manual on Design and Application of Helical and Spiral Springs, and with spring diameters in accordance with the manufacturer's recommendations to suit the static deflection and maximum equipment load.
- .3 **Finishes:** All steel components of isolation products not exposed to the weather or moisture are to be zinc plated or finished in powder coated enamel. All steel components of isolation products exposed to the weather or in a damp, moist environment are to be hot dipped galvanized or factory finished with rust inhibiting primer and 2 coats of neoprene.
- .4 Where the weight of isolated equipment may change significantly due to draining or filling with a liquid, vibration isolators are to be equipped with limit stops to limit spring extensions.
- .5 **Seismic Rated Vibration Isolation:** All seismic restraints supplied with vibration isolation are to meet requirements specified in the mechanical work Section entitled Seismic Control and Restraint.
- .6 **Flexible Piping Connections:** Flexible piping connections to vibration isolated equipment are specified in the appropriate piping sections of the Specification.

2.2 Isolation Pads

- .1 Sandwich type pads, 20 mm ($\frac{3}{4}$ ") nominal thickness, selected for 3.2 mm ($\frac{1}{8}$ ") static deflection unless otherwise specified, consisting of two waffle type or ribbed 50 durometer neoprene elastomer in-shear pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets.

2.3 Elastomeric Isolators

- .1 Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral cast or ductile iron housing and steel plate with integral equipment anchor bolt holes.

2.4 Spring Floor Isolators

- .1 Seismically rated captive spring mount isolator complete with levelling bolts, upper and lower neoprene spring cups, neoprene cushion, ductile iron housing, neoprene sound pads, and neoprene isolation grommets for securing bolts.

2.5 Open Spring Mounts

- .1 Base mount free-standing assemblies, each complete with a stable colour coded steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm ($\frac{5}{8}$ ") diameter level adjustment bolt.

2.6 Closed Spring Mounts

- .1 Base mount free-standing enclosed assemblies, each complete with stable colour coded spring(s), two piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to the base of the closed housing, and an external level adjustment bolt.

2.7 Totally Retained Spring Mounts

- .1 Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of the mounted equipment, each complete with stable colour coded spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to the bottom of the housing, vertical limit adjusting hardware, and a level adjustment bolt.

2.8 Spring Hangers

- .1 Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers.

2.9 Neoprene Hanger Isolators

- .1 Neoprene elastomeric in-shear double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.

2.10 Concrete Inertia Type Equipment Base

- .1 Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to the frame.

2.11 Steel Equipment Base

- .1 Fully welded structural steel equipment and motor support bases, each complete with a wide flange steel frame, full depth cross members, brackets for spring mounts, and adjustable motor slide rails.

3 EXECUTION

3.1 Isolator Requirements:

- .1 Sleeper Mounted AHU – None, units are internally isolated.
- .2 Roof Curb Mounted MUA – None, units are internally isolated.
- .3 Roof Mounted VRF Heat Pumps – Neoprene Pad Isolators
- .4 Roof Mounted Condensing Units – Neoprene Pad Isolators
- .5 Suspended Fan Coils – Neoprene Hanging isolators.
- .6 Fans – Spring Hanging Isolators
- .7 Floor Mounted Pumps = Steel Equipment Base with Vibration Isolation.
- .8 Boilers – Neoprene Pad Isolators

3.2 Installation of Vibration Isolation Materials

- .1 Provide vibration isolation products for mechanical work in accordance with the drawing schedule and details, and requirements specified herein and/or on the drawings.
- .2 Supply to the vibration isolation product manufacturer or supplier a copy of a "Reviewed" shop drawing or product data sheet for each piece of equipment to be isolated, and dimensioned pipe layouts of associated piping to be isolated.
- .3 Unless otherwise specified, all vibration isolation products are to be the product of one manufacturer.

- .4 Ensure that the vibration isolation manufacturer coordinates material selections with equipment provided in order to ensure adherence to performance criteria. Allow for expansion and contraction when material is selected and installed.
- .5 Maintain a minimum clearance of 50 mm (2") between vibration isolated equipment and adjacent structures, piping, ductwork, equipment, and similar items.
- .6 **Isolation for Base Mounted Equipment:** Unless otherwise indicated, install isolation materials for base mounted equipment on concrete housekeeping pad bases which extend at least over the full base and isolated area of the isolated equipment. Additional requirements are as follows:
 - .1 Block and shim all bases level so that all ductwork and piping connections can be made to a rigid system at the proper operating level, before isolated adjustment is made, and ensure that there is no physical contact between isolated equipment and the building structure.
 - .2 All steel bases are to clear the sub-base by 25 mm (1").
 - .3 All concrete bases are to clear the sub-base by 50 mm (2").
- .7 **Isolation of Piping:** Isolate all piping larger than 25 mm (1") dia. directly connected to motorized and/or vibration isolated equipment with 25 mm (1") static deflection spring hangers at spacing intervals in accordance with the following:
 - .1 For pipe to and including 100 mm (4") diameter – first three points of support.
 - .2 For pipe 125 mm (5") to 200 mm (8") diameter – first four points of support.
 - .3 For pipe 250 mm (10") diameter and larger – first six points of support.
 - .4 The first point of isolated piping support shall have a static deflection of twice the deflection of the isolated equipment but maximum 50 mm (2").
 - .5 Secure the top of the spring hanger frame rigidly to the structure, and do not install spring hangers in concealed locations.
 - .6 Where it is impossible to use at least two spring hangers, provide Senior Flexonics Ltd. Style 102 (or 102-U as required) or equal, twin sphere, moulded rubber flexible connection assemblies, selected by the manufacturer and suitable in all respects for intended application, and complete with required nipples and connections to provide proper vibration isolation.
- .8 **Control Wiring Connections:** for all control wiring connections to vibration isolated equipment ensure that flexible metallic conduit with 90° bend is used for conduit 25 mm (1") dia. and smaller, and for conduit larger than 25 mm (1") dia., use Crouse Hinds EC couplings. Connections are to be long enough so that the conduit will remain intact if the equipment moves 300 mm (12") laterally from its installed position, and flexible enough to transmit less vibration to the structure than is transmitted through the vibration isolation. Coordinate these requirements with the mechanical trades involved. If electrical power connections are not made in a similar manner as part of the electrical work, report this fact to the Consultant.
- .9 **Seismic Restraint Isolation:** Refer to the mechanical work Section entitled Seismic Control and Restraint for requirements pertaining to seismically restrained vibration isolation.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies thermal insulation requirements that are common to mechanical work Sections of the Specification. It is a supplement to each Section and shall be read accordingly.

1.2 Submittals

- .1 **Product Data Sheets & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each insulation system product. Product data sheets must confirm that the product conforms to requirements of referenced Codes, Standards, and thermal conductivity and density values.
- .2 **Fire Rated Duct Wrap Certification Letter:** As per Part 3 of this Section, submit a letter from the fire rated duct wrap supplier to certify that the duct wrap has been properly installed.

1.3 Definitions

- .1 "Concealed" means insulated mechanical services and equipment located in suspended ceiling spaces, non-accessible chases, and furred-in spaces.
- .2 "Exposed" means not concealed as defined above, and visible to building occupants.
- .3 "Insulation system" means insulation material, fasteners, jacket, and any other accessory.
- .4 "BCICA" means British Columbia Insulation Contractors Association.
- .5 "QAC" means the BCICA Quality Assurance Certificate
- .6 "Mineral fibre" means glass fibre, rock wool fibre, and slag wool fibre.
- .7 "Domestic water" means all piping (cold, hot, tempered) extended from the building Municipal supply main.
- .8 "WHMIS sheets" means Workplace Hazardous Materials Information System sheets
- .9 "PEX" means cross-linked polyethylene
- .10 "TIAC" means Thermal Insulation Association of Canada.

1.4 Quality Assurance

- .1 **Insulation System Materials, Application, and Finishes:** Insulation system materials, application, and finishes must, as a minimum, conform to the standards listed in the current version of the BCICA "Quality Standards for Mechanical Insulation."
- .2 **Insulation Values:** Minimum piping and duct insulation thickness / R values shall conform to the current version of ASHRAE 90.1 – Section 6.4.4. HVAC System Construction and Insulation.
- .3 **Qualification of Applicators:** Mechanical insulation shall be applied by tradespersons with a BCICA membership and a Red Seal or TQ designation in the Heat and Frost Insulation Trade. Registered apprentice tradespersons must be under direct, daily, on-site supervision of a journeyman.
- .4 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .5 Ensure that all surfaces to be insulated are clean and dry.
- .6 Ensure that the ambient temperature is minimum 13°C (55°F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .7 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material shall be removed from the site and replaced.

2 PRODUCTS

2.1 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2.2 Fire Hazard Ratings

- .1 Unless otherwise specified, all insulation system materials inside the building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.3 Thermal Performance

- .1 Unless otherwise specified, thermal performance, i.e. conductivity, of insulation shall meet or exceed the values given in the National Energy Code of Canada for Buildings and ANSI/IES/ASHRAE Standard 90.1.
- .2 Insulation thickness around pipe fittings, including shoulders and hardware, to be the same thickness as the adjacent or adjoining pipe insulation. Pipe and fitting insulation to be equal thickness and thermal performance throughout the entire system.
- .3 Pipe insulation to be continuous through hanging supports. Hangers, supports, anchors, etc. that are secured directly to cold surfaces (ie-piping) will be adequately insulated and vapor sealed to prevent condensation.

2.4 Pipe Insulation Materials

- .1 **Horizontal Pipe Insulation at Hangers & Supports:** Equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, premoulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and Kraft paper vapour barrier jacket and a 180° captive galvanized steel saddle.
- .2 **Specialty insulation for Piping:** Factory fabricated foamed glass or closed cell foamed plastic insulation fittings specifically made for pipe mechanical joint fittings and couplings, and pipe risers at riser clamps. Equal to Armacell Canada Inc. or Owens Corning "FOAMGLASS".
- .3 **BCICA Standard 1501, Type A2, Preformed Mineral Fibre:** Rigid, sectional, sleeve type insulation to ASTM Standard C 547, Standard Specification for Mineral Fibre Pipe Insulation, supplied in 915 mm (3') lengths with a factory applied vapour barrier jacket and adhesive jacket closure to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, with a minimum thermal conductivity of 0.033 W @ 24°C.
- .4 **BCICA Standard 1501, Type A5, Flexible Foam Elastomeric:** Closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation in accordance with requirements of ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form, minimum thermal conductivity of 0.039 A @ 24°C, minimum density of 96 kg/m³, and supplied with all required installation accessories.

2.5 Barrier-Free Lavatory/Sink Piping Insulation Kits

- .1 Removable, flexible, reusable, white moulded PVC insulation kits with internal fasteners for barrier-free fixture drain piping and domestic water supplies exposed under the fixture.

2.6 Ductwork System Insulation Materials

- .1 **BCICA Standard 1502, Type A2, Rigid Mineral Fibre Board:** Preformed board type insulation to ASTM C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation, with a factory applied reinforced aluminum foil and kraft paper facing to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for

Thermal Insulation, a minimum thermal conductivity of 0.033 W @ 24°C., and a minimum density of 48 kg/m³.

- .2 **BCICA Standard 1502, Type B2, Flexible Mineral Fibre:** Roll form insulation to ASTM C1290, Standard Specification for Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts, with a factory applied vapour barrier facing to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, a minimum thermal conductivity of 0.042 W @ 24°C., and a minimum density of 12 kg/m³.
- .3 **Flexible Foam Elastomeric Sheet:** Sheet form, CFC free, closed cell, self-adhering elastomeric EDPM rubber insulation in accordance with requirements ASTM C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular form, with all required installation accessories.

2.7 Fire Rated Duct Wrap

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, 40 mm (1½") thick, suitable for installation with zero clearance to combustibles, and ULC tested and listed (ULC Designs FRD-3 & 5 for ventilation ducts, ULC Design FRD-4 for kitchen exhaust duct) to facilitate a 1 or 2 hour fire resistance rating to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.
- .2 Acceptable manufacturers are:
 - .1 3M Fire Protection Products "Fire Master".
 - .2 CL4 Inc. "CL4Fire".
 - .3 Unifrax Corp. "FyreWrap Elite 1.5".
 - .4 Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.8 Equipment Insulation Materials

- .1 **BCICA Standard 1503, Type A1D, Semi-Rigid Mineral Fibre:** Roll form insulation to ASTM Standard C553, Standard Specification for Mineral Fibre Blanket Thermal Insulation, (Types I, II, & III), with a factory applied vapour barrier facing, to ASTM C1136, Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation, and a minimum thermal conductivity of 0.042 W @ 24°C.

2.9 Insulating Coatings

- .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 Anti-condensation coating, "No Sweat-FX".
 - .2 Thermal insulating coating, "thermalite".

2.10 Insulation Fastenings

- .1 **Wire:** Minimum #15 gauge galvanized annealed wire.
- .2 **Aluminium Banding:** Equal to Childers Products Co. "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.
- .3 **Stainless Steel Banding:** Equal to Childers Products Co. "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
- .4 **Duct Insulation Fasteners:** Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1½") square zinc plated steel self-locking washers.
- .5 **Tape Sealant:** Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.
- .6 **Adhesive - Mineral Fibre Insulation:** Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, WHMIS classified as non-hazardous,

- .7 **Adhesive – Flexible Elastomeric Insulation:** Armacell "Armaflex" #520 air-drying contact adhesive.
- .8 **Adhesive – Closed Cell Foamed Glass Insulation:** Equal to Pittsburgh Corning PC88 multi-purpose two-component adhesive.
- .9 **Lagging Adhesive:** White, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.
- .10 **Sheet Metal Screws:** No. 10 stainless steel sheet metal screws.

2.11 Insulation Jackets and Finishes

- .1 **BCICA Type D1, PVC:** Roll form sheet and fitting covers in accordance with ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, minimum 15 mil thick, white, PVC, 25/50 rated, complete with installation and sealing accessories.
- .2 **BCICA Type D2, Rigid Aluminium:** Equal to Childers Metals "Lock-on" 0.406 mm (5/32") thick embossed aluminum jacket material to ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, and "Fabstraps" and butt straps to cover end to end joints. Fittings are to be 2-piece epoxy coated pressed aluminum with weather locking edges.
- .3 **Protective Coating - Flexible Foam Elastomeric Insulation:** Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.
- .4 **BCICA Type D11, Canvas:** ULC listed and labelled, 25/50 rated, roll form, minimum 170 g (6 oz.) canvas jacket material.

2.12 Duct Lining

- .1 Minimum 25 mm (1") thick acoustic lining material meeting NFPA 90A requirements, requirements of ASTM C1071, Standard Specification for Fibrous Duct Lining Insulation (Thermal and Sound Absorbing Material), and flame spread and smoke developed fire hazard ratings of CAN/ULC-S102, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on the inside (airside) face with a black fire-resistant coating.
 - .1 Where shown on drawings.
 - .2 Supply and return air ductwork (10ft) from all fan coils, HRV's and AHU's
 - .3 Air transfer ducts

2.13 Firestopping

- .1 Refer to Section 20 05 60 – Firestopping and Smoke Seal Systems

3 EXECUTION

3.1 General Insulation Application Requirements

- .1 Unless otherwise specified, do not insulate the following:
 - .1 Factory insulated equipment and piping.
 - .2 Heating piping within radiation unit enclosures, including blank filler sections of enclosures.
 - .3 Heating piping in soffits and/or overhang spaces and connected to bare element radiation in the spaces.
 - .4 Branch domestic water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories.
 - .5 Exposed chrome plated domestic water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories.
 - .6 PEX piping within suites.

- .7 Heated liquid system pump casings, valves, strainers and similar accessories.
- .8 Domestic water and heating system expansion tanks.
- .9 Fire protection pump casings.
- .10 Manufactured expansion joints and flexible connections.
- .11 Acoustically lined ductwork and/or equipment.
- .12 Domestic hot and tempered water and heating system piping unions.
- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure that all surfaces to be insulated are clean and dry.
- .4 Ensure that the ambient temperature is minimum 13° C (55° F) for at least one day prior to the application of insulation, and for the duration of insulation work, and that relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 All insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from the site and replaced.
- .6 Install insulation directly over pipes and ducts and not over hangers and supports.
- .7 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .8 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .9 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect the insulation jacketing from the action of condensation at its junction with the metal.
- .10 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above the lowest pipe fitting, and thereafter at 4.5 m (15') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- .11 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover the exposed end of the insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .12 Insulation thickness must be maintained even where there is interference between weld bead, mechanical joints, etc. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- .13 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in the insulation and provide a suitable grommet in the opening.
- .14 Insulate, vapour seal, and finish all seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of the adjacent pipe or equipment finish, to match the piping and/or equipment insulation.
- .15 Provide removable and replaceable insulated metal covers for all equipment with removable heads to permit the heads to be removed and replaced without damaging the adjacent insulation work.

3.2 Insulation for Pipe Mechanical Joint Fittings & Couplings, etc.

- .1 Provide manufactured insulation fittings, the same thickness as the adjoining pipe insulation, for mechanical joint fittings and couplings, and for piping at riser clamps through the floor. Cover with purpose made PVC covers with joints sealed with tape.

3.3 Insulation for Horizontal Pipe at Hangers and Supports

- .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe

insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply the insulation sections to the piping installers for installation as the pipe is erected.

3.4 Pipe Insulation Requirements – Inside Building & Above Ground

- .1 Insulate pipe inside the building and above ground, as scheduled below, in accordance with BCICA Quality Standard 1501, Piping, as follows:
 - .1 **Material:** Type A2 mineral fibre.
 - .2 **Insulation application:**
 - .1 1501-H for hot piping.
 - .2 1501-C for cold piping.
 - .3 **Insulation finish:** PF2 for exposed piping in mechanical rooms. PF5 for exposed piping outside of mechanical rooms. Where PF5 finish used on cold water piping, do not use staples or pins for fastening covers, to avoid compromising vapour barrier.

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Domestic cold water	to 100 mm	25 mm
	larger than 100 mm	40 mm
Domestic hot water, supply & recirculation	to 40 mm	25 mm
	larger than 40 mm	50 mm
Tempered domestic water	all	25 mm
Storm drainage from roof drains (see note #1)	all	25 mm
Plumbing vent, 3 m back from roof penetration	all	25mm
Condensate drain from A/C equipment drain pans	all	25 mm
Refrigerant suction & hot gas (see Note # 3)	all	25 mm
Refrigerant hot gas by-pass	all	25 mm

Notes:

- 1. Insulate all indoor storm piping from roof drain to grade. Including RWL in exterior walls.
- 2. Insulate drainage piping from refrigerated drinking fountains from the fountain to nearest 75 mm drain.
- 3. BCICA Standard 1501 Type A6 insulation may be used in lieu of Type A2, with Type 1501-AA /CA application.
- 4. Dry fire protection zone piping drum drips in unheated areas will be traced with electric heating cable.
- 5. Use non-combustible rock slag mineral fiber insulation for insulated pipe penetrating through fire rated construction, and for high temperature piping insulation such as high pressure steam and condensate.

3.5 Pipe Insulation Requirements – Outside Building & Above Ground

- .1 Insulate pipe outside the building and above ground, as scheduled below, in accordance with BCICA Quality Standard 1501, Piping, as follows:
 - .1 **Material:** Type A2 mineral fibre.
 - .2 **Insulation application:**
 - .1 1501-H for hot piping.
 - .2 1501-C for cold piping.
 - .3 **Insulation finish:** PF4.

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Refrigerant suction & hot gas (see Note #1)	all	25 mm
Domestic cold water	to 25 mm	50 mm
	larger than 25 mm	65 mm
Heating water, supply & return	to 25 mm	50 mm
	larger than 25 mm	65 mm

Notes:

1. BCICA Standard 1501, Type A5 insulation with 1501-CA application may be used in lieu of mineral fibre insulation.

3.6 Pipe Insulation Requirements – Underground Inside & Outside Building

- .1 Insulate pipe underground inside and outside the building, as scheduled below, in accordance with BCICA Quality Standard 1501, Piping, as follows:
 - .1 **Material:** Type A7 closed cell cellular glass.
 - .2 **Insulation application:** 1501-U.
 - .3 **Insulation finish:** weather-proof coating as per insulation manufacturer's instructions.

PIPE SERVICE	DIAMETER	INSULATION THICKNESS
Heating water, supply & return	all	50 mm
Heating glycol solution, supply & return	all	50 mm

3.7 Ductwork System Insulation Requirements – Inside Building

- .1 Insulate duct systems inside the building and above ground, as scheduled below, in accordance with BCICA Quality Standard 1502, Ductwork and Plenums, as follows:
 - .1 **Material:**
 - .1 Type A2 rigid mineral fibre for exposed rectangular ducts, and all plenums.
 - .2 Type B2 flexible mineral fibre for concealed rectangular ducts, and concealed and exposed round or oval ducts.
 - .2 **Insulation application:**
 - .1 ER/1 for heating and ventilating system rigid insulation.
 - .2 ER/2 for heating and air conditioning system rigid insulation.
 - .3 EF/1 for heating and ventilation system flexible insulation.
 - .4 EF/2 for heating and air conditioning system flexible insulation.
 - .3 **Insulation finish:** RF/3 for exposed duct systems.

DUCT SYSTEM SERVICE	INSULATION THICKNESS	
	Rigid Insulation	Flexible Insulation
Fresh (outside) air ducts	40 mm	50 mm
Fresh (outside) air casings and plenums	40 mm	N/A
Mixed air casings and plenums	25 mm	N/A
Mixed air supply ducts (except where exposed in area served)	25 mm	40 mm
3 m of exhaust discharge ducts downstream (back) from exhaust openings to atmosphere	25 mm	40 mm

DUCT SYSTEM SERVICE	INSULATION THICKNESS	
Exhaust air casings and plenums within 3 m of exhaust openings to atmosphere	25 mm	N/A
Heat recovery system fresh heated air.	25 mm	40 mm

Notes:

1. Provide commercial quality corner bead on rigid duct, plenum, and casing insulation in all equipment rooms where the insulation is subject to damage.

3.8 Duct System Insulation Requirements – Outside Building

- .1 Insulate all exposed exterior ductwork and any associated casings and plenums (except fresh air intake systems) outside the building and above ground, with 20 mm (3/4") thick flexible foam elastomeric sheet insulation applied in 2 layers with staggered tightly butted joints and secured in place with adhesive in strict accordance with the insulation manufacturer's instructions. Ensure that sheet metal joints are sealed water-tight prior to the insulation application.

3.9 Common Duct System Insulation Requirements: Insulation application requirements common to all types of rigid ductwork are as follows:

- .1 At duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a top strip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or alternatively, increase the insulation thickness to the depth of the flange and cover the top of the flanges with tape sealant.
- .2 The installation of fastener pins and washers shall be concurrent with the duct insulation application.
- .3 Cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant.
- .4 Accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers.
- .5 Prior to concealment of insulation by either construction finishes or canvas jacket material, patch all vapour barrier damage by means of tape sealant.
- .6 At trapeze hanger locations for rectangular duct install insulation between the duct and the hanger.
- .7 At each duct hanger for round and provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between the duct and the hanger.

3.10 Equipment Insulation Requirements – Inside Building

- .1 Insulate equipment inside the building the building, as scheduled below, in accordance with BCICA Quality Standard 1503, Equipment, as follows:

- .1 **Material:** Type A1D semi-rigid mineral fibre.
- .2 **Insulation application:**
 - .1 1503-H for hot tanks and equipment.
 - .2 1503-C for cold tanks and equipment.
- .3 **Insulation finish:**
 - .1 EF/2 for hot tanks and equipment.
 - .2 CF/2 for cold tanks and equipment.

EQUIPMENT	INSULATION THICKNESS
Roof drain sumps where inside building	25 mm

3.11 Duct Wrap Requirements – Fire Rated Material

- .1 Provide blanket type fire rated duct wrap system material for the following ductwork to produce the fire rating indicated:
 - .1 Kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating.
- .2 Install the duct wrap material in accordance with ULC design requirements and the wrap supplier's instructions.
- .3 Coordinate installation of duct wrap with the installation of the ductwork.
- .4 Arrange and pay for the duct wrap supplier to examine the completed duct wrap system at the site. Submit a letter from the supplier to certify that the duct wrap system has been properly installed.

3.12 Application of Insulating and Protective Coatings

- .1 Apply insulating and protective coatings in accordance with the manufacturer's instructions. Remove any splatter from adjacent surfaces. Apply insulating/protective coating to the following surfaces:
 - .1 Paint all bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of the pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating.
 - .2 Paint all bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "thermalite" insulating coating.
 - .3 paint all seismic restraint hardware such as hanger rods, braces, anchors, etc., as specified on .1 and .2 above
 - .4 coat elastomeric foamed insulation (pipe & duct) with 1 coat of the specified coating on all insulation inside the building and 2 coats (with 24 hours between coats) of the specified coating on all insulation outside the building.

3.13 Chilled & Cold Water Pipe Insulation Vapour Damage Protection

- .1 Ensure that all pipe insulation longitudinal and circumferential joints are properly sealed.
- .2 Ensure that there are no perforations to insulation vapour barriers.
- .3 Provide properly sealed vapour dams in locations as follows:
 - .1 on butt ends at all locations where the insulation terminates
 - .2 on butt ends and other exposed insulation surface on either side of fittings, tees, flanges, couplings, valves, strainers, and similar pipe accessories.
 - .3 butt ends at every 3rd section of insulation (maximum 6 m (20') intervals) on horizontal piping.
 - .4 on butt ends at every 2nd section of insulation (maximum 2.4 m (8') intervals) in vertical piping

3.14 Valves

- .1 Provide valve stem extensions as required to enable insulation of valve stems. Insulate void space around valve fittings. Valves to be fully operational without compromising the insulation integrity.

3.15 Insulation Finish Requirements

- .1 **Canvas:** Accurately cut canvas with scissors or a knife. Do no rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.
- .2 **White PVC:** Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal all joints to produce a

neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.

- .3 **Rigid Aluminum:** Install aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for the following insulation:
 - .1 Exposed roof mounted piping.
- .4 **Protective Coating - Foamed Glass Insulation:** Apply 2 heavy coats of "PITTCOTE 404" coating with 24 hours between coats to all foamed glass insulation exposed above grade.
- .5 **Protective Coating – Flexible Elastomeric Insulation:** Apply 1 coat of the specified coating to all insulation inside the building. Apply 2 coats (with 24 hours between coats) of the specified coating to all insulation outside the building.

3.16 Installation of Barrier Free Lavatory/ Sink Insulation Kits

- .1 Provide manufactured insulation kits to cover exposed drainage and water piping under new barrier free lavatories/sinks.

3.17 Installation of Duct Lining

- .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 Wherever shown and/or specified on the drawings.
 - .2 Supply ductwork downstream of fan coils for a distance of 2.4 m (8') measured along the duct and outward from the box in all directions.
 - .3 For all transfer air ducts.
- .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.18 Insulation of Seismic Restraint Hardware:

- .1 Insulate all seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from the piping or equipment with insulation and finish to match the pipe or equipment insulation. Coat all seismic restraint hardware for a distance of 300 mm (12") from the termination of the insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies commissioning requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Reference

- .1 Refer to commissioning requirements specified in Division 01.

1.3 Commissioning Agent Involvement vs Warranty Obligations

- .1 The involvement of the Commissioning Agent performing duties as described in this Section does not in any way void or alter any Contractual warranty obligations.

1.4 Submittals

- .1 **Shop Drawings/Product Data Sheets:** Submit to the Commissioning Agent, at the same time as submittal to the Consultant, 1 copy of each shop drawing or product data sheet associated with equipment or systems to be commissioned.
- .2 **Commissioning Plan, Procedures, Schedule, and Data Sheets:** Submit for review, a Commissioning Plan with schedule, commissioning procedures for all commissioning events, and a copy of the Commissioning Agent's commissioning data sheets for all equipment/systems to be commissioned.
- .3 **List of Commissioning Instruments:** Submit a list of commissioning instruments and for each instrument, indicate the purpose of the instrument and include a recent calibration certificate.
- .4 **Start-Up and Test Report Sheets:** Submit equipment and system manufacturer's start-up and test report sheets for review a minimum of 1 month prior to equipment and system start-up procedures.
- .5 **Letters to Certify Readiness for Functional Performance Testing:** After start-up and successful pre-functional performance testing and submittal of completed forms, submit, for each system or subsystem, a letter to confirm that pre-functional performance testing has been successfully completed and the system or subsystem is ready for functional performance testing and the commissioning process to commence.

1.5 Definitions

- .1 The following are definitions of words used in this Section:
 - .1 **Commissioning:** the process of demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, all as further described below.
 - .2 **Commissioning Agent:** the commissioning authority who will supervise the commissioning process, and who will recommend final acceptance of the commissioned mechanical work.
 - .3 **Start-Up and Adjusting:** the process of equipment manufacturer's/supplier's technical personnel, with the Contractor, starting and operating equipment and systems, making any required adjustments, documenting the process, and submitting manufacturer's/supplier's start-up reports to confirm that the equipment has been properly installed and is operational as intended, and a pre-requisite to operational performance testing.
 - .4 **Operational Performance Testing:** testing, adjusting and operating of components, equipment, systems and/or subsystems, by the Contractor, after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract

Documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions, and including submittal of pre-functional performance testing documentation sheets.

- .5 **Functional Performance Testing:** a repeat of successful operational performance testing by the Contractor, in the presence of the Commissioning Agent and Consultant with completed Commissioning Agent's commissioning documentation sheets to document, validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .6 **Commissioning Documentation Sheets:** prepared sheets for operational performance testing and for functional performance testing supplied by the Commissioning Agent for each piece of equipment/system to be commissioned, each sheet or set of sheets complete with the Project name and number, date of commissioning, equipment/system involved, equipment/system name and model number, equipment tag as per the drawings, and, for each commissioning procedure listed, a column giving the expected data as per the Contract Documents, a column to fill in the observed data during commissioning, and space for signatures of the Contractor and Commissioning Agent.
- .7 **BAS:** building automation system.
- .8 **Systems Operating Manual:** a manual prepared by the Commissioning Agent to present an overview of the building mechanical systems and equipment to be used by building maintenance personnel to assist them in daily operation of the systems.
- .9 **Validate:** to confirm by examination and witnessing tests the correctness of equipment and system operation.

1.6 Commissioning Agent

- .1 Retain the services of a qualified Commissioning Agent.

1.7 Quality Assurance

- .1 Commissioning work shall be in accordance with requirements of the following:
 - .1 CSA Z8001, Commissioning of Health Care Facilities.
 - .2 CSA Standard Z320, Building commissioning.
 - .3 ASHRAE Guideline 1.2, The Commissioning Process for Existing HVAC&R Systems.
 - .4 ASHRAE Guideline 1.5, Commissioning Smoke Control Systems.
- .2 The Commissioning Agent shall meet the following qualifications:
 - .1 Be a member of the Professional Engineers Association in the Province of the work.
 - .2 Be a member of the Building Commissioning Association, and a Certified Commissioning Professional (CCP) as designated by the Building Commissioning Association.
 - .3 Have a minimum of 5 years of successful documented commissioning experience on projects of similar size and complexity as this Project.
 - .4 Supply a qualified P. Eng. and a Building Commissioning Association Certified Commissioning Professional (CCP) or an ASHRAE Commissioning Project Management Professional (CPMP) on site to supervise the commissioning process.

1.8 Commissioning Objectives

- .1 Objectives of the commissioning process are as follows:
 - .1 To support quality management by means of monitoring and checking the installation.
 - .2 To verify equipment/system performance by means of commissioning of the completed installation.
 - .3 To move the completed equipment/systems from the "static completion" state to the "dynamic" operating state so as to transfer a complete and properly operating installation from the Contractor to the Owner.

1.9 Testing Equipment

- .1 The Contractor shall supply all instruments and test equipment required to conduct start-up and testing. The Commissioning Agent shall supply all instruments and test equipment required commissioning procedures.

1.10 LEED Commissioning Requirements

- .1 Refer to the mechanical work Section entitled LEED Certification Requirements.
- .2 In addition to the commissioning specified in this Section, perform all tasks consistent with the Project achieving LEED credits specified in the LEED Certification Requirements Section.

2 PRODUCTS

2.1 NOT APPLICABLE

3 EXECUTION

3.1 Commissioning

- .1 Commission the mechanical work in accordance with requirements of this Section of the Specification.
- .2 **Prerequisites to Commissioning:** Prerequisites to successful completion of commissioning are as follows:
 - .1 Submittal of signed start-up and test reports.
 - .2 Completion by the Contractor of system testing, adjusting, and balancing, and acceptance of the TAB reports.
 - .3 Permanent electrical and control connections of all equipment.
 - .4 Successful completion and documentation of operational performance testing.
 - .5 Submittal of letters to the Consultant certifying that the systems and subsystems have been started, tested, adjusted, successfully operationally performance tested, are ready for functional performance testing, and are in accordance with requirements of the Contract Documents.

3.2 Phasing of Commissioning

- .1 The Project will be constructed in phases as described in the Specification. Commissioning must be phased to suit the progress and phases of the work.

3.3 Deficiencies Listed During Commissioning

- .1 Deficiencies listed by the Consultant and Commissioning Agent during the commissioning process are to be corrected by the Contractor within 10 calendar days unless agreed otherwise with the Consultant, and when deficiencies have been corrected, notify the Consultant and Commissioning Agent at once.

3.4 Systems to be Commissioned.

- .1 Mechanical systems to be commissioned include, but are not to be limited to, the systems described below.
- .2 **Drainage Systems:** Commissioning of drainage systems shall include:
 - .1 Commissioning of all drainage pumps and controls by means of tests recommended by the manufacturer to confirm proper operation and performance.
 - .2 Commissioning of all equipment such as interceptors and backwater valves.
- .3 **Fire Protection Systems:** Commissioning of fire protection systems will be considered complete upon preparation and submittal by the Contractor of completion certificates required by applicable NFPA Standards, demonstration of proper system operation to the local Fire Chief and any other authorities, including the Owner's insurance underwriter as required, and coordination and cooperation with fire alarm system commissioning procedures, in particular smoke control systems and other such fan system control sequences.
- .4 **Water Systems:** Commissioning of water systems (all piping extended from the Municipal main) shall include:
 - .1 Commissioning of pumps and controls.
 - .2 Commissioning of water heaters.

- .3 Commissioning of piping specialties such as backflow preventers, pressure reducing valves, mixing valves, and similar components.
- .4 Commissioning of trap seal primer units, including adjustment of water flows and confirmation of water flow at each connected trap.
- .5 Commissioning of plumbing fixtures by successful operation of each fixture.
- .5 **Compressed Air System:** Commissioning of the compressed air system shall include all "head end" compressor equipment, pressure reducing equipment, and outlets.
- .6 **Natural Gas System:** Commissioning of the natural gas system shall include all pressure regulating equipment and shall be in accordance with requirements of CAN/CSA-B149.1, and any supplemental requirements of governing authorities.
- .7 **Heating Systems:** Commissioning of heating systems shall include all piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .8 **Cooling Systems:** Commissioning of cooling systems shall include all piping, piping specialties, equipment, and control, as well as checking and validating temperature and flow documentation contained in TAB reports. If TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .9 **HVAC Chemical Treatment Systems:** Commissioning of HVAC chemical treatment systems shall include all feed and monitoring equipment, and testing of system fluids to confirm proper concentration of chemical.
- .10 **Air Handling Systems:** Commissioning of air handling systems shall include all equipment, ductwork, ductwork specialties, controls, interlocks, and checking and validating air capacities and flows as per TAB reports.
- .11 **Controls:** Control work commissioning shall include confirmation of proper operation of all individual control components, and overall operation of the controls in conjunction with the operation of the connected building systems, including heating season/cooling season testing requirements specified above.
- .12 **Building Automation System:** Commissioning of the BAS shall include confirmation of proper operation of all components, all input/output points, all hardware and software, and demonstration of the system performing all required procedures.
- .13 **Special Usage Room Controls:** Commissioning of special usage room controls shall include confirmation of proper operation of all individual components, and proper operation of the overall control system, all in accordance with governing Codes and Standards.
- .14 **Noise and Vibration Control Systems:** Commissioning of noise and vibration control equipment shall include noise and vibration measurements to confirm proper operation of the equipment.
- .15 **Existing Systems:** The following existing systems, revised as part of the mechanical work, are to be commissioned as for new systems:

3.5 Commissioning Process

- .1 The commissioning process shall be performed in stages and shall include, but not be limited to, the following:
 - .1 **Stage 1:** Commissioning of mechanical equipment/systems as listed in this Section, which is a prerequisite to an application for Substantial Performance and includes supervising and validating results of functional performance testing, and submittal of the reviewed Systems Operating Manual.
 - .2 **Stage 2:** Commissioning work to be performed twelve months after issue of a Certificate of Substantial Performance and which includes supervision of the

Contractor's "fine tuning" of equipment/systems through seasonal occupancy, and any other such work to achieve optimal comfort and performance conditions.

- .3 **Stage 3:** Successful completion of satisfactory equipment/system operation during the first month after issue of a Certificate of total Performance of the Work.
- .4 **Stage 4:** Successful completion of satisfactory equipment/system operation during the 3rd month after issue of a Certificate of total Performance of the Work.
- .5 **Stage 5:** Successful seasonal commissioning of the building.

3.6 Responsibilities of the Commissioning Agent

- .1 **Construction Phase:** During the construction phase the Commissioning Agent shall:
 - .1 Review the Contractor's shop drawings for commissioning related issues and report any such issues to the Consultant.
 - .2 As soon as possible after project start-up, prepare and issue a Commissioning Plan based on the Contractor's construction schedule.
 - .3 Prior to tests, supply and issue operational performance test commissioning data sheets for all equipment and systems to be commissioned.
 - .4 Monitor and inspect the installation on a regular basis throughout the construction stages, issue reports identifying any issues which may have an impact on the commissioning process, and work with the project team to expeditiously resolve any problems that may arise due to site conditions.
 - .5 Arrange with the Contractor for on-site commissioning meetings on an as-required basis, to be attended by the Contractor and applicable subcontractors, the Owner, and the Consultant, chair the meetings, and prepare and distribute meeting minutes to all attendees.
 - .6 Witness and validate tests, identify deficiencies, and issue progress reports.
 - .7 Coordinate commissioning scheduling with the Contractor.
 - .8 Review the final TAB report on site with the Contractor, and check 100% of TAB results for fan equipment, 30% of TAB results for duct systems outward from fan equipment and issue a report to the Consultant.
 - .9 For smaller multiple items of equipment such as air terminal boxes, fan coil units, backflow preventers, and similar equipment, review completed commissioning data sheets submitted by the Contractor and review data sheet information on-site with the Contractor for 30% of the quantity of each item of equipment.
 - .10 Review operational performance test commissioning data sheets submitted by the Contractor, then witness and supervise functional performance testing and supervise and direct the commissioning process, validate the commissioning procedures, witness completion of commissioning data sheets by the Contractor, and sign the completed data sheets.
 - .11 Perform a preliminary review of the Contractor's O & M Manuals, before they are issued to the Consultant, and issue any comments to the Consultant.
 - .12 Coordinate with the Contractor and Owner the training and instructions by the Contractor and his equipment and system manufacturers/suppliers to the Owner's operating and maintenance personnel, and comment on the quality of the training and instructions to the Consultant.
 - .13 Prepare and issue to the Owner prior to equipment and system training by the Contractor, the Systems Operation Manual.
- .2 **Post Construction Phase:** During the post construction phase the Commissioning Agent shall:
 - .1 Prepare and issue the final report on commissioning, identifying any deficiencies that remain outstanding.
 - .2 Recommend any training and/or instructions to be given to the Owner's operating and maintenance personnel in addition to training and instructions already given.
 - .3 After Substantial Performance, witness system checks and validate documentation by the Contractor as follows:
 - .1 Once during the 1st month of building operation.
 - .2 Once during the 3rd month of building operation.

- .3 Once between the 4th and 10th month of building operation but during a season opposite to the 1st or 3rd month visits.
- .4 Ensure that any deficient work resulting from system checks described above are corrected.
- .5 3 months after Substantial Performance, attend a question and answer session(s) with the Contractor to answer any questions and concerns related to commissioning work from the Owner's operating personnel.

3.7 Responsibilities of the Consultant

- .1 **Construction Phase:** Responsibilities of the Consultant are as follows:
 - .1 Review the Contractor's shop drawing/product data submissions for general conformance requirements of the Contract and add any review comments made by the Commissioning Agent as applicable.
 - .2 Review the Contractor's delivery schedule and installation program to ensure that the installation sequences have been coordinated with the construction schedule.
 - .3 Monitor and inspect the mechanical work throughout the construction stages to ensure that the work is in accordance with requirements of the Contract, witness tests, note deficient work, and ensure that deficient work is corrected.
 - .4 Attend site commissioning meetings requested by the Commissioning Agent and arranged by the Contractor.
 - .5 When informed by the Contractor that work is essentially complete, inspect the equipment and systems, issue deficiency reports, and ensure that deficiencies are corrected in a timely manner.
 - .6 With the Commissioning Agent, review the Commissioning Plan to ensure that proposed tests and the sequencing and methods of tests conform to Contract requirements, and that the testing and commissioning sequences coincide with the construction schedule.
 - .7 With the Commissioning Agent, certify completion of the commissioning.

3.8 Responsibilities of the Contractor

- .1 **Construction Phase:** Responsibilities of the Contractor during the construction phase are as follows:
 - .1 Prepare and submit an installation schedule which shall include the time schedule for each activity with lead and lag time allowed and indicated, shop drawing/product data and working detail drawing submissions, and major equipment factory testing and delivery dates.
 - .2 Prepare and submit a commissioning schedule which shall include a time schedule coordinated with the installation schedule referred to above, and allowances for additional time for re-tests as may be required and update the schedule on a monthly basis as required.
 - .3 When requested by the Commissioning Agent, arrange site commissioning meetings with the Owner, Consultant, and applicable subcontractors present, to be chaired by the Commissioning Agent who will also prepare and distribute meeting minutes.
 - .4 Promptly correct all reported deficient work, and report when corrective work is complete.
 - .5 Where required by Codes and/or the Specification, retain equipment manufacturers/suppliers or independent third parties to certify correct installation of equipment/systems.
 - .6 Under the supervision of equipment manufacturers/suppliers, start-up and adjust all equipment to design requirements, and submit start-up sheets which include all equipment data such as manufacturer and model number, serial number where applicable, and performance parameters, all signed by the equipment manufacturer/supplier and the Contractor.
 - .7 Complete the Commissioning Agent's commissioning data sheets for all multiple items of smaller equipment such as air terminal boxes, fan coil units, backflow preventers, etc., submit the sheets to the Commissioning Agent, accompany the Commissioning

- Agent for an on-site check of 30% of the data sheet information for each type of equipment, and perform any corrective action required as a result of the site checks.
- .8 Perform system testing, adjusting and balancing and, when complete, issue a copy of the final report to the Commissioning Agent for review and a site check of results, and perform any corrective work required as a result of site checks by the Commissioning Agent.
 - .9 In accordance with the updated commissioning schedule and actual progress at the site, certify in writing to the Consultant and the Commissioning Agent that equipment and/or systems are complete, have been checked, started and adjusted, successfully operationally performance tested and documented, and are ready for functional performance testing and the commissioning procedures, giving the Consultant and Commissioning Agent a minimum of 5 working days notice.
 - .10 Perform system and subsystem functional performance testing in the presence of the Commissioning Agent and under the supervision of the Commissioning Agent, and submit to the Consultant and Commissioning Agent, completed and signed functional performance testing and commissioning data sheets (issued by the Commissioning Agent) and also signed by the Commissioning Agent.
- .2 **Post Construction Phase:** Responsibilities of the Contractor during the post construction phase are as follows:
- .1 Optimize system operation in accordance with the building's occupant's needs and comments using the System Operation Manual prepared by the Commissioning Agent as reference.
 - .2 Complete all commissioning procedures, activities, and performance verification procedures that were delayed or not concluded during the construction phase.
 - .3 Accompanied by the Commissioning Agent, complete system checks and "fine tuning" with signed documentation as follows.
 - .1 Once during the 1st month of building operation.
 - .2 Once during the 3rd month of building operation.
 - .3 Once between the 4th and 10th months in a season opposite to the 1st and 3rd month visits.
 - .4 Correct all deficiencies revealed by the system checks described above, and, where required, involve equipment manufacturers/suppliers during corrective actions, and report completion of corrective work.
 - .5 Schedule for 3 months after Substantial Performance and conduct question and answer session(s) at the building with the Owner's operating and maintenance personnel, with the duration of the session(s) dictated by the number of questions and concerns that have to be addressed.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies mechanical system testing, adjusting, and balancing requirements that are common to mechanical work Sections of the Specification and it is a supplement to each applicable Section and shall be read accordingly.

1.2 Contractual Relationship with a Testing and Balancing Agency

- .1 Testing, adjusting, and balancing work specified in this Section will be done by an agency directly retained by and paid by the Owner, with no contractual relationship with the Contractor.
- .2 Retain and pay for the services of a qualified testing and balancing agency to perform testing, adjusting and balancing work specified in this Section.

1.3 Submittals

- .1 **Name and Qualifications of Testing and Balancing Agency:** within 30 days of work commencing at the site, submit the name and qualifications of the proposed testing and balancing agency in accordance with requirements of the article below entitled Quality Assurance.
- .2 **Drawing Evaluation Report:** Submit a report by the Agency to indicate the Agency's evaluation of the mechanical drawings with respect to service routing and location or lack of balancing devices. Include the set of drawings used and marked-up by the Agency to prepare the report.
- .3 **Draft Report:** Submit a draft report, as specified in Part 3 of this Section.
- .4 **Final Report:** Submit a final report, as specified in Part 3 of this Section.
- .5 **Post Construction Site Visit Reports:** Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.4 Definitions

- .1 The following are definitions of words used in this Section:
 - .1 "TAB" – means testing, adjusting, and balancing to determine and confirm quantitative performance of equipment and systems and to regulate the specified fluid flow rate and air patterns at the terminal equipment, e.g., reduce fan speed, throttling, etc.
 - .2 "Hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
 - .3 "Air systems" – includes all outside air, supply air, return air, exhaust air, and relief air systems.
 - .4 "Flow rate tolerance" – means the allowable percentage variation, minus to plus, of actual flow rate values in the Contract Documents.
 - .5 "Report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form the permanent record to be used as the basis for required future testing, adjusting and balancing.
 - .6 "Terminal" – means the point where the controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
 - .7 "Main" – means the duct or pipe containing the system's major or entire fluid flow.
 - .8 "Sub-main" – means the duct or pipe containing part of the systems' capacity and serving two or more branch mains.
 - .9 "Branch main" – means duct or pipe servicing two or more terminals.
 - .10 "Branch" – means duct or pipe serving a single terminal.

1.5 Quality Assurance.

- .1 **Testing and Balancing Agency:** The testing, adjusting and balancing agency shall have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of 5 projects similar to this Project within the past 3 years, and shall be certified as an independent agency **in all required categories** by 1 of the following:
 - .1 AABC - Associated Air Balance Council.
 - .2 NEBB - National Environmental Balancing Bureau.
- .2 **Standards:** Testing, adjusting, and balancing of the complete mechanical systems shall be performed over the entire operating range of each system in accordance with 1 of the following publications:
 - .1 National Standards for A total System Balance published by the Associated Air Balance Council.
 - .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by the National Environmental Balancing Bureau.
 - .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 EXECUTION

2.1 Scope of Work

- .1 The TAB Agency shall perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and comfort conditions and recording and reporting the results.
- .2 Mechanical systems to be tested, adjusted, and balanced include:
 - .1 **Domestic Water Systems:** TAB of domestic water systems (all piping extended from the Municipal main) shall include:
 - .1 Domestic hot water recirculation piping.
 - .2 Tempered water piping flows.
 - .2 **Swimming Pool Systems:** TAB of swimming pool systems shall include all pool
 - .3 **Heating Systems:** TAB of heating systems shall include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - .4 **Cooling Systems:** TAB of cooling systems is also to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
 - .5 **Air Handling Systems:** TAB of air handling systems shall include all equipment and ductwork air temperatures, capacities, and flows.
 - .6 **Existing Systems:** The following existing systems, revised as part of the mechanical work, are to be tested, adjusted, and balanced as for new systems:

2.2 Testing, Adjusting and Balancing

- .1 **General Requirements:** Conform to the following requirements:
 - .1 As soon as possible after award of Contract, the Agency shall carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and shall issue a report listing the results of the evaluation.
 - .2 The set of drawings examined by the Agency shall be returned with the evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices.
 - .3 Testing, adjusting, and balancing is not to begin until:
 - .1 Building construction work is substantially complete and doors have been installed.

- .2 Mechanical systems are complete in all respects, and have been checked, started, and adjusted.
- .4 All mechanical systems to be tested, adjusted, and balanced are to be maintained in full, normal operation during each day of testing, adjusting and balancing.
- .5 Obtain copies of reviewed shop drawings of all applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences.
- .6 The Agency shall walk each system from the system "head end" equipment to terminal units to determine variations of installation from design, and the system installation trades will accompany the Agency.
- .7 The Agency shall check all valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment.
- .8 Wherever possible, the Agency shall lock all balancing devices in place at the proper setting, and permanently mark settings on all devices.
- .9 For belt-driven equipment, the Agency shall report any situation where fan drive sheaves have to be replaced to suit testing and balancing, and replacements are to be done by the Contractor at no cost.
- .10 **Noise:** the Agency shall balance all systems with due regard to objectionable noise which shall be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at the design conditions, the Agency shall immediately report the problem and submit data, including sound readings, to permit an accurate assessment of the noise problem to be made.
- .11 **Stratification:** the Agency shall check all supply air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design requirements, the Agency shall report the problem and issue a detail sketch of plenum baffle(s) required to eliminate the stratification.
- .12 **Tolerances:** the Agency shall perform testing, adjusting and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values.
- .13 **Filters** for all air handling systems equipped with air filters, test and balance the systems with simulated 50% loaded (dirty) filters by providing a false pressure drop.
- .14 **Seasonal requirements:** test, adjust and balance air conditioning systems during the summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- .2 **Preparation of Reports:** Prepare reports as indicated below.
 - .1 **Draft Reports:** Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be handwritten, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - .2 **Final Report:** Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on the Project Documents. The final report is a prerequisite to Substantial Performance.
 - .3 **Report format:** Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, 3-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the divisions listed below, separated by divider tabs:
 - .1 General Information and Summary.
 - .2 Plumbing Systems.
 - .3 Air Systems.

- .4 Hydronic Systems.
- .5 Temperature Control Systems.
- .6 Special Systems.
- .4 **Report Contents:** The Agency shall provide the following minimum information, forms, and data:
 - .1 Inside cover sheet to identify the Agency, the Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of the instrumentation used for the procedures along with the proof of calibration.
 - .2 The remainder of the report shall contain the appropriate forms containing as a minimum, the information indicated on the standard AABC or NEBB report forms prepared for each respective item and system.
 - .3 The Agency shall include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying all equipment, terminals, and accessories.
 - .4 The Agency shall include report sheets indicating building comfort test readings for all rooms.
- .3 **Verification of Reports:** After the final testing and balancing report has been submitted, the Agency shall visit the site with the Contractor and Consultant to spot check results indicated on the balancing report. The Agency shall supply all labour, ladders, and instruments to complete spot checks. Note that if results of spot checks do not, on a consistent basis, agree with the final report, the spot check procedures will stop and the Agency shall then rebalance the systems involved, resubmit the final report, and again perform spot checks with the Contractor and Consultant.
- .4 **Certification:** When the final report has been accepted, the Contractor shall submit to the Owner, in the name of the Owner, a certificate equal to the AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond.

Post Balancing Site Visits: Include for two 8-hour day site visits after Total Performance of the work. During each return visit and accompanied by the Owner's representative, the Agency shall spot rebalance terminal units as required to suit building occupants and eliminate complaints.

END OF SECTION

1 GENERAL

1.1 Application

- .1 This Section specifies fire stopping and smoke seal requirements that are common to mechanical work Sections of the Specification and it is a supplement to each Section and shall be read accordingly.

1.2 Submittals

- .1 **Firestop & Smoke Seal System Samples:** at least four weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Identify each system with the manufacturer's name and type, the ULC designation, and the proposed use. When the samples are approved, all work shall conform to the approved samples.
- .2 **Product Data & WHMIS Sheets:** Submit a product data sheet and a WHMIS sheet for each firestopping and smoke seal product.
- .3 **Name & Experience of Proposed Applicator:** Submit for approval the full company name and experience of the proposed firestopping and smoke seal system applicator.
- .4 **Letter of Certification:** Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.3 Quality Assurance

- .1 **Applicator:** The applicator shall have a minimum of 3 years of successful experience on projects of similar size and complexity, and shall be approved by the Consultant.
- .2 **Environment Conditions:** Comply with the firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 PRODUCTS

2.1 Firestopping and Smoke Seal System Materials

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115, Standard Method of Fire Tests of Firestop Systems and CAN/ULC-S101, Standard Method of Fire Endurance Tests of Building Construction and Materials for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding fire rated construction.
- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.
- .3 Pipe insulation forming part of a fire and smoke seal assembly is specified in the Mechanical Insulation Section.

2.2 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

3 EXECUTION

3.1 Installation of Firestopping and Smoke Seal Materials

- .1 Where mechanical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-

S115 (ratings F, FT, FH, and FTH as required), CAN/ULC-S101, and all other governing authorities to seal the penetrations.

- .2 **Preparation:** Abide by the following requirements:
 - .1 Examine substrates, openings, voids, adjoining construction, and conditions under which the firestop and smoke seal system shall be installed, and confirm compatibility of surfaces.
 - .2 Verify penetrating items are securely fixed and properly located with the proper space allowance between penetrations and surfaces of openings.
 - .3 Report any unsuitable or unsatisfactory conditions to the Contractor and Consultant in writing, prior to commencement of work, and note that commencement of work will mean acceptance of conditions and surfaces.
 - .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces, and remove stains on adjacent surfaces.
- .3 **Application:** Conform to the following application requirements:
 - .1 Use an experienced applicator approved by the manufacturer of the firestopping material manufacturer.
 - .2 Prime substrates in accordance with the product manufacturer's written instructions.
 - .3 Provide temporary forming as required and remove only after materials have gained sufficient strength and after initial curing.
 - .4 Tool or trowel exposed surfaces to a neat, smooth, consistent finish.
 - .5 Remove excess compound promptly as work progresses and upon completion.
 - .6 At all fusible link damper locations, seal the perimeter of the angle iron framing on both sides of the wall or slab with ULC listed and labelled sealant materials to provide a positive smoke seal.
- .4 **Inspection:** Notify the Consultant when the work is complete and ready for inspection, and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies. Arrange for final inspection of the work by the Municipal Building Inspector prior to concealing or enclosing work. Make any corrections required.
- .5 **Certification:** On completion of the firestopping and smoke sealing installation submit a letter of assurance to the Consultant certifying that the firestopping and smoke sealing installation has been carried out throughout the building to all mechanical service penetrations and that the installation has been done in strict accordance with the requirements of the Provincial Building Code, any applicable local Municipal Codes, ULC requirements, and the manufacturer's instructions.

END OF SECTION

1 GENERAL

1.1 Design Engineer and Services

- .1 A professional engineer meeting requirements specified in the mechanical work Section entitled Mechanical Work General Instructions, and with a minimum of 3 years of experience in the design of piping expansion systems, shall be employed by the manufacturer of the piping expansion compensation products to complete final design of the piping expansion facilities and pipe anchors to adequately protect the systems. The P. Eng. shall:
 - .1 Do required calculations including pipe stress design and resulting forces and moments at the point of building attachment for all piping.
 - .2 For pipe riser terminations and branch lines off the main riser(s), analyse piping stress and limit the pipe stress at the connection to the riser to allowable limits prescribed in ASME B31.9.
 - .3 Base calculations on an installation temperature of 10°C (50°F), a safety factor of 30%, and piping system temperatures as per piping system design.
 - .4 Prepare and submit shop drawings and product data sheets as specified below, all dated, stamped and signed.
 - .5 Review and inspect the expansion compensation installation, and prepare and submit a stamped and signed report to certify that the installation is correct and in accordance with "reviewed" submittal data.

1.2 Submittals

- .1 **Shop Drawings and Product Data:** Submit shop drawings and product data sheets for products specified in this Section. Submittals are to include:
 - .1 For expansion joints, a schedule indicating the manufacturer's model number, size, location, maximum temperature and pressure rating, and maximum expansion compensation.
 - .2 For flexible vee piping connectors, maximum temperature and pressure ratings, face-to-face length, live length, hose wall thickness, hose convolutions per meter (ft.) and per assembly, fundamental frequency of the assembly, braid structure, total number of wires in the braid, and test reports certifying force displacements under the system's pressure.
 - .3 Pipe alignment guide model numbers, construction, attachment details, finish, dimensions, capacities, and operating loads to the structure.
 - .4 Pipe anchor material and construction, dimensions, attachment details, and operating loads to the structure.
 - .5 For all copper and stainless steel piping risers, verification of intermediate guide spacing requirements.
 - .6 Selection calculations for all products.
 - .7 Detailed installation instructions, and, for each expansion joint and pipe guide, a permanent identification tag that will match tags shown on the submittal shop drawings.
- .2 **Inspection Report:** Submit an expansion compensation installation site review and inspection report prepared by, stamped, and signed by the design P. Eng. as specified in Part 3 of this Section.

1.3 Anchor Locations and attachments

- .1 The exact location and method of attachment to the structure for piping anchors must be reviewed with the Project Structural Consultant prior to installation.

1.4 Reference Standards

- .1 The Expansion Joint Manufacturers Association (EMJA) Standards.
- .2 ASME B31.5, Refrigerant Piping and Heat Transfer Components.
- .3 ASME B31.9, Building Service Piping.

1.5 Coordination with Seismic Restraint and Control

- .1 Coordinate expansion compensation product selection and installation with seismic control and restraint products and installation.

1.6 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 General

- .1 All expansion compensation products are to be the product of a single manufacturer.
- .2 All expansion joints used under pressure are to be registered with and bear a CRN tag.
- .3 All expansion joints used in potable water systems are to be NSF/ANSI 61 lead-free certified.

2.2 Flexible Vees

- .1 Flexible vees are to consist of two braided stainless hoses joined by a 60°“V” fitting at the base and 120°return elbows. Vees are to be capable of plus or minus 25 mm (1”) motion in all planes. Flexible vees in carbon steel piping are to have 304 stainless hose and braid, and in copper piping, bronze hose and braid. All flanged connectors are to have free floating flanges at each end to allow for the misalignment of piping flange holes and 360°rotation into optimum available space.
- .2 Vees are to have a minimum burst pressure of four times their rated pressure at 21° C (70°F), and are to be equipped with steel threaded nipples, weld ends, roll grooved ends, copper sweat ends, or raised face floating carbon steel flanges on both ends, as required. Fixed flanges are not acceptable.

2.3 Externally Pressurized Expansion Compensators and Joints

- .1 Externally pressurized expansion compensators and joints are to be manufactured with an externally pressurized 304 stainless steel bellows sealed within a steel housing. The housing is fixed and pipe movement is taken up by extending or contracting the internal bellows.
- .2 The internal, minimum two-ply bellows shall be protected from fluid or steam flow by an internal pipe sleeve to prevent wear. Clearances between the bellows and outer housing as well as the internal pipe are to be a minimum of 3.2 mm (1/8”). Bellows must not rub.
- .3 Expansion compensators 15 mm (½”) through 100 mm (4”) are to be rated for 50 mm (2”) of compression and 15 mm (½”) of extension, and 890 kPa at 21° C (200 psi at 70° F), with a minimum burst pressure of 3115 kPa (700 psi).
- .4 Expansion joints 50 mm (2”) through 355 mm (14”) are to be rated for 100 mm (4”) of compression and 20 mm (¾”) extension or, 200 mm (8”) compression and 40 mm (1½”) extension, and 1000 kPa (225 psi) at 21°C (70°F), and a minimum burst pressure of 3515 kPa (790 psi).
- .5 Both expansion compensator and joint pressure ratings are to be lowered as needed at higher temperatures.
- .6 All carbon steel and stainless steel expansion compensators and expansion joints are to be equipped with:
 - .1 Permanent locking bolts to maintain length during installation and removal for servicing.
 - .2 Drain plug at each end of the housing.
 - .3 Lifting ring located at the center of gravity, 75 mm (3”) and larger.
 - .4 Measurement scale to confirm starting position and operating movements.

2.4 Expansion Loops

- .1 Field or shop fabricated to meet the piping system expansion based on temperature of the service and field space parameters and designed by the expansion compensation design P. Eng. Stress levels are to be at or below 155,130 kPa (22,500 psi).

2.5 Pipe Alignment Guides

- .1 Pipe guides are to be sized to suit the pipe size, including insulated pipe where required, manufactured from black steel with stainless steel wrapping the carbon steel sliding foot where it passes through horizontal "U" guides similarly lined to prevent corrosion, and factory finished with enamel.
- .2 The base plate shall have multiple holes for bolting to beam flanges or flat surfaces. Bases may be welded into position in lieu of bolting. Height must be adjustable to accept different thicknesses of insulation up to 100 mm (4"). Guides are to be load rated for bottom, overhead, side mounted, or riser positioning to provide both load bearing and guiding capabilities.
- .3 Sliding guides must allow 100 mm (4") axial movements for pipe sizes 20 mm to 65 mm ($\frac{3}{4}$ " to $2\frac{1}{2}$ "), and 150 mm (6") axial movement for pipe sizes 75 mm to 300 mm (3" to 12"). Should motion exceed these numbers, guides must be manufactured to suit requirements.

2.6 Pipe Anchors

- .1 Welded structural black steel anchors of a design, size, and type to securely anchor the pipe at the point shown. Each anchor shall withstand 150% of axial thrust, and shall be designed and detailed by the expansion compensation design P. Eng.

3 EXECUTION

3.1 Installation

- .1 Provide expansion compensation products and systems indicated on the drawings. In addition, install expansion compensation products to eliminate stress on equipment connections.
- .2 All expansion devices are to be installed in accordance with the latest Standards of the Expansion Joint Manufacturers Association, directions from the manufacturer's design P. Eng., and as indicated on the drawings.
- .3 Pipe anchors are to be installed at the indicated locations (reviewed with the Consultant), and consistent with the submitted and reviewed shop drawings and product data. Pipes are to be anchored only when the ambient temperature is greater than 0°C (32°F).

3.2 Inspection

- .1 Arrange and pay for the expansion joint manufacturer's design P. Eng. to review the installation of expansion hardware, anchors, and guides around expansion joints and loops. Submit a written report, prepared by the design P. Eng., stamped and signed, confirming that expansion hardware, anchors, and guides are installed in accordance with joint manufacturer's recommendations and "reviewed" shop drawings and product data.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.

1.2 Quality Assurance

- .1 **Codes and Standards:** Fire extinguishers are to be in accordance with the following Codes and Standards:
 - .1 National Fire Code of Canada.
 - .2 NFPA 10, Standard for Portable Fire Extinguishers.
 - .3 CAN/ULC-S508-02 (including Amendments 1 and 2), Standard for the Rating and Fire Testing of Fire Extinguishers.

2 PRODUCTS

2.1 General

- .1 All fire extinguishers are to be pressurized (stored pressure) rechargeable type, in accordance with NFPA 10, and UL and/or ULC listed and labelled for the class of fires and hazard locations for which they are specified.
- .2 Each extinguisher shall be complete with:
 - .1 A manufacturer's identification label indicating the extinguisher model number, rating, and operating instructions.
 - .2 An anodized aluminum or chrome plated forged brass valve with positive squeeze grip on-off operation and a pull-pin safety lock.
 - .3 Discharge hose with nozzle or horn and hose securing clip.
 - .4 For wall mounted extinguishers, a wall mounting bracket.

2.2 10B:C Rated Carbon Dioxide Extinguishers

- .1 10 B:C carbon dioxide extinguishers are to be 175 mm (6½") diameter, 6.8 kg (15 lb.), each complete with a steel cylinder with a safety red baked enamel finish.

2.3 3A10B:C Rated Dry Chemical Extinguishers

- .1 Multi-purpose 3A10B:C dry chemical extinguishers are to be 100 mm (4") diameter, 2.27 kg (5 lb.), each complete with a steel cylinder with a safety red baked enamel finish and a waterproof stainless steel pressure gauge.
- .2 mount non-magnetic hardware.

2.4 Fire Extinguisher Cabinets

- .1 **Surface Mounted:** Rectangular break-glass type enclosures sized to suit the extinguishers to be housed, constructed of #18 gauge corrosion resistant steel with a bake white enamel finish, front glass panel, break-glass mechanism, and keyed alike cylinder lock.
- .2 **Semi-Recessed:** Rectangular cabinets sized to suit the extinguishers to be housed, with a #18 gauge corrosion resistant white enamelled steel tub, #14 gauge cleaned, and prime coat painted steel door and adjustable trim assembly with rounded corners, semi-concealed piano hinge, safety glass panel, and flush stainless steel door latch. Where recessed cabinets are in fire rated construction the cabinet construction shall maintain the fire rating. Shall be able to be mounted in 2x4 stud wall construction.

2.5 Fire Blankets

- .1 Equal to National Fire Equipment Ltd. Model #FB-6078-MC 300 mm x 400 mm (12" x 16") red enamelled #16 gauge surface mounting steel cabinet identified "FIRE BLANKET" and "Pull Tab to Remove", complete with non-combustible glass fibre fire blanket pressure fit into the cabinet and equipped with pull-back release straps.

3 EXECUTION

3.1 Installation of Fire Extinguishers

- .1 Provide fire extinguishers of the type(s) specified and as per requirements of NFPA 10.
- .2 Unless otherwise shown or specified, wall mount extinguishers using wall brackets supplied with the extinguishers.
- .3 Do not install extinguishers until after wall finishing work is complete.
- .4 You will be responsible for fire extinguishers until after Substantial Performance of the Work.
- .5 If extinguishers are indicated adjacent to a door, locate the extinguishers at the strike side of the door.

3.2 Installation of Fire Extinguisher Cabinets

- .1 Provide wall cabinets for fire extinguishers where shown.
- .2 Unless otherwise shown or specified, locate cabinets so that the centreline is approximately 1.2 m (4") above the finished floor.
- .3 Confirm exact locations prior to installation.

3.3 Installation of Fire Blankets

- .1 Provide fire blankets in wall mounted cabinets in the Kitchen. Confirm exact locations prior to installation.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings, and chlorine.
- .2 **Water Purity Data:** Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance.

1.2 NSF/ANSI 61, Drinking Water System Components-Health Effects

- .1 All products specified in this Section that are in contact with domestic water are to be NSF/ANSI 61 certified.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

- .1 **PVC:** ULC listed, rigid, Class 150, DR18, 1035 kPa (150 psi) pressure rated bell and spigot pattern PVC pipe to CAN/CSA-B137.3, and CSA certified fittings to CAN/CSA B137.2, and AWWA C900, complete with gasket joints, and for "Uni-Flange" or equal restraint collars as per Part 3 of this Section.
- .2 **Soft Copper:** Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.
- .3 **Hard Copper - Solder Joint:** Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using NSF/ANSI 61 certified silver alloy lead-free solder for cold water pipe, and 95% tin/5% Antimony or silver alloy lead free solder for other services.
- .4 **Copper Pressure Coupled Joint:** Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress" copper fittings with "Smart Connect" feature, EDPM seals, and pressure type crimped joints made by use of a Rigid tool Co. Model 330-B or Model 330-C electro-hydraulic crimping tool.
- .5 **Stainless Steel:** Schedule 40 Type 304/304L to ASTM A312/A312M, threaded with screwed stainless steel fittings to ASTM A403/A403M for piping to 65 mm (2½") diameter, Schedule 10 roll grooved for piping larger than 65 mm (2½") diameter with Victaulic Co. factory grooved end Type 304/304M stainless steel fittings and cast stainless steel coupling joints with gaskets meeting NSF/ANSI 61 requirements and Type 316 stainless steel bolts, Victaulic Series 489 rigid type or Series 77S flexible type as required by the location and application.
- .6 **Semi-Rigid Polyethylene Tubing:** Equal to Versa Fittings and Mfg. Inc. 12 mm (½") diameter, high density, semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.
- .7 **CPVC:** Ipex "AquaRise" SDR 11 CPVC pipe and fittings to CAN/CSA B137.6, 25/50 flame spread and smoke developed rated in accordance with CAN/ULC S102.2, certified to NSF/ANSI 61, complete with primer/solvent weld joints, and with a pressure rating of 690 kPa (100 psi) at 82.2°C (180°F).
- .8 **PEX Tubing:** Non-barrier type cross-linked polyethylene piping in accordance with CAN/CSA-B137.5, NSF 372, and ASTM F876, and tested for compliance by an independent third-party agency. The piping shall be complete with brass inserts and crimping joint fittings and couplings.
- .9 **Factory Insulated PEX Tubing:** Equal to Uponor Ltd. "EcoFlex" cross-linked polyethylene piping in accordance with CAN/CSA-B137.5, NSF/ANSI 61, supplied in a single length with no fittings, and factory insulated with 50 mm (2") thick multi-layer PEX foam insulation covered by a corrugated water-proof HDPE jacket.

2.2 Dielectric Unions

- .1 Lead-free dielectric unions, each complete with a thermoplastic liner and rated minimum 1725 kPa (250 psi) at 120° C (250° F).

2.3 Shut-Off Valves

- .1 **Brass & Bronze Ball Valves:** Lead free, Class 600, 4140 kPa (600 psi) non-shock WOG rated, 2-piece, full port ball type valves, each complete with a forged brass or bronze body, blowout-proof stem, solid forged brass or bronze chrome plated ball, "Teflon" or "PTFE" seat, a removable coated steel lever handle marked with valve identification and ends to suit the piping being connected. Valves in insulated piping are to be complete with stem extensions. Acceptable manufacturers are:
 - .1 Toyo Valve Co.
 - .2 Milwaukee Valve Co.
 - .3 Kitz Corporation.
 - .4 Combraco Industries Inc. Apollo.
 - .5 Watts Water Technologies Inc.
- .2 **CPVC Ball Valves:** Iplex "AquaRise" CPVC ball valves, 15 mm to 50 mm (½" to 2") diameter, 1600 kPa (232 psi) rated at 23°C (73°F).
- .3 **Butterfly Valves - Flanged Joint:** Lead free, non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with the valve in position and either side of the connecting piping removed. Butterfly valves to and including 100 mm (4") diameter are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") diameter are to be equipped with worm gear operators. Acceptable products are:
 - .1 DeZurik Inc.
 - .2 Kitz Corporation.
 - .3 Toyo Valve Co.
 - .4 Bray Valve and Controls Canada.
 - .5 Combraco Industries Inc. Apollo.
 - .6 Watts Water Technologies Inc.

2.4 Check Valves

- .1 **Horizontal:** Class 125, bronze, lead-free with identifying tag, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with ends to suit the connecting piping. Acceptable products are:
 - .1 Toyo Valve Co.
 - .2 Milwaukee Valve Co.
 - .3 Kitz Corporation.
 - .4 Combraco Industries Inc. Apollo.
 - .5 Watt Water Technologies Inc.
- .2 **Vertical:** Equal to Kitz Corp. Code 26, bronze, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with ends to suit the connecting piping.

2.5 Balancing Valves

- .1 Solder or flanged end type as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter. Acceptable products are:
 - .1 S.A. Armstrong Model CBV Series.
 - .2 Tour and andersson Model ST Series.
 - .3 Watts Industries (Canada) Inc. Model CSM Series.

2.6 Drain Valves

- .1 Refer to Part 2 of the mechanical work Section entitled Basic Mechanical Materials and Methods

2.7 Pressure Reducing Valves

- .1 For piping to and including 50 mm (2") diameter, lead free, non-corrosive, non-ferrous direct spring acting pressure reducing valves to CAN/CSA B356, Water Pressure Reducing Valves for Domestic Water Supply Systems, each factory set at 345 kPa (50 psi) unless otherwise specified or required, each field adjustable from 175 kPa (25 psi) to 520 kPa (75 psi) and each complete with an integral inlet strainer. Acceptable products are:
 - .1 Conbraco 36C Series.
 - .2 Zurn/Wilkins 600XL Series.
 - .3 Watts Industries (Canada) Inc. #LF25AUB Series.
 - .4 Cash-Acme EB-25 Series.
 - .5 Caleffi Hydronic Solutions.
- .2 For piping 65 mm (2½") diameter and larger, non-corrosive pilot operated pressure reducing valve to CAN/CSA B356, Water Pressure Reducing Valves for Domestic Water Supply Systems, factory set at the required pressure, field adjustable, and complete with screwed or flanged connections, and brass body pilot valve with stainless steel seat. Acceptable products are:
 - .1 Singer Valve Model 106-PR.
 - .2 Zurn/Wilkins Model ZW109.
 - .3 Watts Industries (Canada) Inc. Series N223.

2.8 Domestic Clothes Washer Wall Box Water Connection

- .1 One-piece white plastic recess wall box assembly with bottom raised drip lip to channel any hose leaks to drain, ¼ turn indexed hot and cold-water brass ball valves with hose ends and tailpieces, and a centre or side indirect drain connection suitable for a drain hose.

2.9 Chlorine

- .1 Sodium hypochlorite to AWWA B-300, Hypochlorites.

3 EXECUTION

3.1 Piping Installation Requirements

- .1 Provide all required domestic water piping.
- .2 Piping, unless otherwise specified, shall be as follows:
 - .1 For underground piping 100 mm (4") diameter and larger outside and/or inside the building - rigid PVC.
 - .2 For underground piping less than 100 mm (4") diameter inside building - Type "K" soft copper or factory insulated PEX tubing in a continuous length.
 - .3 For 12 mm (½") diameter trap seal primer tubing located underground or in concrete or masonry construction - semi-rigid polyethylene.
 - .4 For pipe inside the building and above ground in sizes to 100 mm (4") diameter- Ipex "aquarise" rigid CPVC.
 - .5 For branch hot and cold piping above ground from mains and risers to fixtures, fittings, and equipment where fire rated construction is not penetrated, and at your option, PEX tubing installed and joined in strict accordance with the manufacturer's printed instructions.
 - .6 For pipe inside building and above ground - Type "L" hard copper with solder joints or, **at your option**, Type "L" hard copper with pressure coupled mechanical joints, or Type 304/304L stainless steel with screwed joints or grooved end coupling joints.
- .3 If and where required, brace and secure underground water service pipe entering the building at bends, tees and similar fittings with restraint devices, and provide concrete thrust blocks in accordance with Municipal standards and details. Regardless of what is specified

elsewhere in this Specification regarding provisions of concrete, provide thrust block concrete. Paint all restraint devices with two coats of corrosion resistant black asphalt base coating prior to backfilling.

- .4 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, the pipe has a smooth and uniform invert. Keep pipe thoroughly clean so that jointed compound will adhere. Inspect the pipe for defects before being lowered into the trench.
- .5 Slope all piping so that it can be completely drained.
- .6 Provide proper dielectric unions in all connections between copper pipe and ferrous pipe or equipment.
- .7 Secure trap seal primer tubing embedded in concrete to reinforcing steel in a secure manner and be present during the concrete pour to ensure that the tubing is not damaged or dislodged.

3.2 Installation of Shut-Off and Check Valves

- .1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .2 Valves to and including 100 mm (4") diameter are to be ball type. Valves larger than 100 mm (4") diameter are to be butterfly type.
- .3 Valves in CPVC rigid piping are to be Ipex "Aquarise" CPVC ball valves.

3.3 Installation of Balancing Valves

- .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
- .2 Locate each valve such that it is easily accessible.

3.4 Installation of Drain Valves

- .1 Refer to Part 3 of the mechanical work Section entitled Basic Mechanical Materials and Methods.

3.5 Installation of Partition Stops

- .1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near the floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.6 Installation of Pressure Reducing Valves

- .1 Provide domestic water pressure reducing valves in piping where shown and/or specified. Install so that each valve is readily accessible. Whenever possible, provide pressure reducing valves factory pre-set to required pressures.
- .2 Check and test operation and adjust as required.

3.7 Piping Expansion and Contraction Facilities

- .1 Provide piping expansion loops or expansion compensators with guides and anchors where indicated for piping expansion and contraction facilities. Refer to requirements in the mechanical work Section entitled Piping Expansion Compensation.
- .2 Confirm exact locations prior to installation.

3.8 Installation of Clothes Washer Water & Drain Connection Boxes

- .1 Provide a flush wall mounted clothes washer water and drain connection box assembly for each clothes washer where indicated.
- .2 Confirm exact location prior to installation, and ensure that water piping is insulated.

- .3 Connect washer hoses to the valves and firmly insert the washer drain piping into the drain connection.

3.9 Flushing and Disinfecting Piping

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
- .2 Flush piping until all foreign materials have been removed and the flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .3 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with requirements of the BC Drinking Water Protection Act and Drinking Water Protection Regulation and to Municipal Requirements, under the supervision of a P. Eng. authorized by the Professional Engineers of British Columbia to perform such work.
- .4 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the systems.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section.
- .2 **Backflow Preventer Inspection/Test Results:** Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.
- .3 **Anchor Fabrication Drawing:** Submit anchor shop drawing(s) to detail the fabrication and installation of water piping anchors. The drawing(s) must be prepared and stamped by a Professional Structural Engineer registered and licensed in the jurisdiction of the work.
- .4 **Anchor Installation Certification:** As specified in Part 3 of this Section, submit a letter from the anchor design engineer stating that the anchor installation has been examined at the site and the anchors are properly fabricated and installed.

1.2 NSF/ANSI 61, Drinking Water System Components-Health Effects

- .1 All products specified in this Section that are in contact with domestic water are to be certified to NSF/ANSI/CAN 61, Drinking Water System Components – Health Effects.

1.3 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.
- .2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:
 - .1 **Water meter** – Neptune Technology Group (Canada)Ltd., Badger Meter Inc., and Xylem Inc. "Sensus".
 - .2 **Non-freeze wall and grade hydrants** – Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., Watts Industries (Canada) Ltd., and Wade Canada.
 - .3 **Trap seal primers** – Precision Plumbing Products Inc., Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., Watts Industries (Canada) Ltd., and Wade Canada.
 - .4 **Shock absorbers** - Precision Plumbing Products, Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., Watts Industries (Canada) Ltd., and Wade Canada.
 - .5 **Water hammer arrestors** - Precision Plumbing Products, Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., Watts Industries (Canada) Ltd., and Wade Canada.
 - .6 **Backflow preventers** – Watts Industries (Canada) Ltd., Zurn Industries Ltd., and Conbraco "Apollo".
 - .7 **Lavatory supply fitting thermostatic mixing valves** - Watts Water Technologies (Canada) Ltd. "Powers", Lawler Manufacturing Co. Inc., Leonard Valve Co., and Symmons Industries Inc.

2 PRODUCTS

2.1 Water Meter

- .1 Tamper-proof, in line serviceable, lead free meter, direct reading, positive displacement mutating disc type in accordance with requirements of AWWA C700, Cold-Water Meters – Displacement Type, or compound type in accordance with requirements of AWWA C702, Cold-Water Meters – Compound Type, depending on meter size, location, and requirements of the Municipality, complete with:
 - .1 A sealed register measuring in cubic meters and suitable for connection of a remote automatic reading and billing unit.
 - .2 A surface wall mounting automatic meter reading and billing unit with encoder register, polycarbonate housing, roll-sealed copper shell, and ABS plastic receptacle.
- .2 The meter is also to be complete with hardware for interface connection to the building automation system for water flow and consumption monitoring.

2.2 Interior Wall Hydrants

- .1 Surface - Exposed - Cold Water - Unfinished Areas: Bronze, anti-siphon wall faucet with:
 - .1 Vandal-resistant operating stem.
 - .2 20 mm ($\frac{3}{4}$ ") diameter FPT inlet with wall flange.
 - .3 20 mm ($\frac{3}{4}$ ") hose end outlet with external vacuum breaker.
- .2 **Surface Exposed - Unfinished Areas - Hot and Cold Water:** Surface wall mounting, automatically drainable, hot and cold water faucet complete with:
 - .1 2 independent check valves.
 - .2 Indexed handles.
 - .3 20 mm ($\frac{3}{4}$ ") inlet connections.
 - .4 20 mm ($\frac{3}{4}$ ") hose end outlet with vacuum breaker.

2.3 Exterior Non-Freeze Wall Hydrants

- .1 **Semi-Recessed:** Self-draining, anti-siphon hydrants, each complete with:
 - .1 A copper casing and all bronze interior parts.
 - .2 An integral backflow preventer.
 - .3 A ceramic disc cartridge.
 - .4 An operating rod assembly to suit the wall thickness.
 - .5 20 mm ($\frac{3}{4}$ ") diameter solder or female threaded inlet connection.
 - .6 20 mm ($\frac{3}{4}$ ") hose connection outlet.

2.4 Floor Drain Trap Seal Primers

- .1 Precision Plumbing Products Inc. primers certified to CSA-B125.3, Plumbing Fittings, as follows:
 - .1 **Primer Valve Type:** Brass trap primer valve, activated by water flow or by a 70 kPa (10 psi) water pressure drop, complete with:
 - .1 "O" ring seals.
 - .2 Backflow protection, and vacuum breaker ports.
 - .3 12 mm ($\frac{1}{2}$ ") diameter inlet and outlet connections.
 - .4 #60 mesh stainless steel screen.
 - .5 For priming 2 traps from the same primer, a copper/brass dual outlet distribution unit.
 - .2 **Primer Valve Type with Manifold:** Piston operated brass trap primer valve constructed as specified above, complete with:
 - .1 A copper/brass 3 or 4 outlet distribution unit for priming 3 or 4 traps.
 - .2 A supply tube assembly with combinations of 2, 3, and 4 outlet distribution units for priming from 5 to 6 traps.
 - .3 **Electronic Type:** Surface wall mounting, CSA certified, 115 volt, 1 phase, 60 Hz., electronic, automatic trap priming manifold sized to suit the number of drain traps or interceptors serviced, and complete with:
 - .1 An EEMAC 1 galvanized steel cabinet with screw-on cover and ANSI 61 grey polyester powder paint finish.
 - .2 20 mm ($\frac{3}{4}$ ") diameter NPT copper pipe inlet with shut-off valve and water hammer arrestor.
 - .3 A solenoid valve, an atmospheric vacuum breaker, and a discharge manifold with 12 mm ($\frac{1}{2}$ ") diameter compression type copper tube connections on 40 mm ($1\frac{1}{2}$ ") centres with quantity to suit the number of items to be primed.
 - .4 A control panel with circuit breaker, test switch 5 ampere fuse, 24 hour timer, and manual override toggle switch.

2.5 Shock Absorbers

- .1 Type 304 stainless steel piping shock absorbers, each sized to suit the connecting domestic water pipe and equipment it is provided for and each complete with:
 - .1 A nesting type bellows.

- .2 A casing of sufficient displacement volume to dissipate the kinetic energy generated in the piping system.

2.6 Water Hammer Arrestors

- .1 Watts Canada Series LF15M2 piston type, factory sealed and pressurized, hard drawn copper construction water hammer arrestors suitable for either vertical or horizontal installation, each complete with solder ends and sized in accordance with the following schedule:

Fixture Units	Model No.	Size
1-11	LF15M2-AS	15 mm (½")
12-32	LF15M2-BS	20 mm (¾")
33-60	LF15M2-CS	25 mm (1")
61-113	LF15M2-DS	25 mm (1")

2.7 Backflow Preventers

- .1 Watts Canada lead free reduced pressure zone, dual spring-loaded accessible check valve design backflow preventers in accordance with CAN/CSA B64, Backflow Preventers and Vacuum Breakers (including supplements), cULus listed, each in-line serviceable, and equipped with:
 - .1 An intermediate relief valve.
 - .2 Ball valve type test cocks.
 - .3 A properly sized air gap fitting.
- .2 Backflow preventers 15 mm to 50 mm (½" to 2") size are to be Series LF919 with:
 - .1 A bronze inlet strainer.
 - .2 A cast copper silicone alloy body.
 - .3 ¼ turn inlet and outlet ball valves.
- .3 Backflow preventers 65 mm (2½") and larger are to be Series LF909 with:
 - .1 An epoxy coated ductile iron body.
 - .2 Stainless steel internal parts.
 - .3 An epoxy coated cast iron inlet strainer.
 - .4 Rising stem OS&Y gate type inlet and outlet shut-off valves.

2.8 Air Vents

- .1 Equal to Caleffi NA5026 "PLUMBVENT" cast brass, 1035 kPa (150 psi) rated float type automatic air vent with anti-drip hygroscopic cap and 15 mm (½") diameter NPT threaded connection.

2.9 TMV-1 - Dual Thermostatic Mixing Valve Assembly with Recirc Pump

- .1 Lawler model 803 Parallel Manifold Recirculation System on Mounting Strut. Master water mixing valves shall be of the thermostatic type with liquid-filled thermal motor. They shall have bronze body construction with replaceable corrosion-resistant components. Valve construction shall employ a sliding piston control mechanism. Sliding piston and liner shall be of stainless steel material. Valve shall come equipped with union end stop and check inlets with removable stainless steel union end stop and check inlets with removable stainless steel strainers. Valves shall provide protection against hot or cold supply line failure and thermostat failure.
- .2 Mixing valves shall be incorporated into a pre-piped manifold system which includes a recirculation pump, circuit setting balancing valve, thermometers, ball valves and mounting strut.
- .3 Set to 110°F

3 EXECUTION

3.1 Installation of Water Meter

- .1 Provide the domestic water service meter where shown. Secure the meter in place on a concrete housekeeping pad and connect with piping, including a backflow preventer and valved by-pass.
- .2 Installation of water meter must comply with Municipal standards.
- .3 Provide a remote meter reader and install on an exterior wall where shown. Confirm exact location prior to installation. Connect the remote reader to the meter with wiring in conduit in accordance with the meter manufacturer's instructions and the wiring standards of the electrical work.
- .4 Test and prove proper operation of the interface with the building automation system (BAS).

3.2 Installation of Wall Hydrants

- .1 Provide wall hydrants where shown and/or specified on the drawings.
- .2 Unless otherwise shown, specified, or required, mount hydrants approximately 1 m (3') above the floor. Confirm exact locations prior to roughing-in.

3.3 Installation of Exterior Non-Freeze Wall Hydrants

- .1 Provide non-freeze wall hydrants where shown.
- .2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.
- .3 Provide a shut-off valve inside the building to each exterior non-freeze wall hydrant.

3.4 Installation of Trap Seal Primers

- .1 Provide all required accessible trap seal primers to automatically maintain a water seal in floor drain traps, whether shown on the drawings or not.
- .2 **Trap Primer Valves:** Provide trap primer valves to prime single or multiple (1 to 6) traps. Install trap primer valves in domestic cold water piping to frequently used plumbing fixtures. Where from 2 to 6 traps are to be primed from the same primer valve, provide the appropriate supply and distribution tube assemblies. Ensure that primer valves are accessible and provide a shut-off valve in the cold water connection to the primer.
- .3 **Packaged Electronic Trap Primers:** Provide 115 volt, electronic, surface wall mounting trap primer assemblies for multiple (4 to 30) traps. Include for a 115 volt 15 ampere panel breaker (with "lock-on") and wiring in conduit from the closest panelboards to each primer assembly, all to the wiring standards of the electrical work. Adjust primer water flow and timing to suit the number of traps served.
- .4 Ensure that trap primer piping is secured to floor drain primer tapplings and not terminated through the tapping in the throat of the drain.

3.5 Installation of Shock Absorbers

- .1 Provide accessible shock absorbers, complete with shut-off valves, in domestic water piping where shown, specified, or detailed on the drawings.
- .2 Ensure that the size of each shock absorber is properly selected to suit the size of the domestic water pipe and the equipment the pipe is connected to.

3.6 Installation of Water Hammer Arrestors

- .1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:
 - .1 In headers at groups of plumbing fixtures.
 - .2 At the top of risers.
 - .3 At ends of long horizontal runs of piping.

- .4 In piping connecting solenoid valves or equipment with integral solenoid valves.
 - .5 Wherever else shown or required by Code.
- .2 Install each unit in a piping tee complete with a shut-off valve, either horizontally at the end of the line closest to the supply source or vertically in the path of potential water shock in accordance with the manufacturer's published instructions and details.

3.7 Installation of Backflow Preventers

- .1 Provide backflow preventers where shown, including in each direct domestic cold water connection to equipment other than plumbing fixtures and fittings, and specialties equipped with vacuum breakers.
- .2 Locate each backflow preventer on a wall between 765 mm and 1.5 m (30" and 60") above the floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.
- .3 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

3.8 Installation of Air Vents

- .1 Provide accessible air vents with shut-off valves in domestic water piping where shown to prevent air binding.
- .2 Locate exact vent locations on as-built record drawings.

3.9 Installation of Domestic Hot Water Thermostatic Mixing Valves

- .1 Provide a factory assembled, dual mixing valve, high-low flow assembly where shown and connect with piping as indicated. Adjust all settings to specified requirements, then:
 - .1 Install components supplied loose with the assembly.
 - .2 Perform start-up and certify the assembly ready for commissioning as specified in the Mechanical Work General Instructions Section.
 - .3 Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
 - .4 Refer to the article entitled Equipment and System O & M Demonstration and Training in the Mechanical Work General Instructions Section, and include for 2 hours of on-site training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section except pipe and fittings.
- .2 **Plumbing Inspection Certificate:** Submit a copy of the plumbing inspection certificate prior to application for Substantial Performance.

1.2 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.
- .2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	ACCEPTABLE MANUFACTURERS
Shut-Off, Check & Drain Valves	Watts Canada, Apollo Valves, Crane & Jenkins Valve Group, Red-White Valve Corp.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

- .1 Refer to Part 3 of this Section.

3 EXECUTION

3.1 Drain and Vent Piping Installation Requirements

- .1 Provide all required drainage and vent piping. Pipe, unless otherwise specified, shall be as follows indicated below.

- .2 Piping Underground:

PIPE	FITTINGS	JOINTS
For 100 mm (4") & larger, rigid DR35 PVC hub & spigot pattern sewer pipe to CAN/CSA-B182.2, 345 kPa (50 psi) rated	PVC-DWV fittings to CAN/CSA-B182.2	Solvent weld made with solvent & primer supplied by pipe manufacturer
For piping less than 100 mm (4") dia., rigid PVC-DWV hub & spigot pattern pipe to CAN/CSA-B182.2	PVC-DWV fittings to CAN/CSA-B182.2	Solvent weld made with solvent & primer supplied by pipe manufacturer

- .3 Piping Above Ground:

PIPE	FITTINGS	JOINTS
For piping to 75 mm (3") dia., Type DWV copper to ASTM B306	Forged copper solder joint drainage fittings to ASME/ANSI B16.29	50% lead/50% tinned solder type
For piping 75 mm (3") dia. and larger, Class 4000 cast iron to CAN/CSA-B70	Cast iron soil pipe fittings to CAN/CSA-B602	Mechanical coupling type equal to Anaco "Husky" Series 400, 4-strap for pipe to 100 mm (4") & 6-strap for pipe larger than 100 mm (4"), all to CAN/CSA-B602

- .4 Unless otherwise specified, slope horizontal drainage piping above ground in sizes to and including 75 mm (3") diameter 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") diameter and larger 25 mm (1") in 2.4 m (8').
- .5 Install and slope underground drainage piping to inverts or slopes indicated on the drawings to facilitate straight and true gradients between the points shown. Verify available slopes before installing the pipes.
- .6 Unless otherwise specified, slope horizontal branches of vent piping down to the fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .7 Extend vent stacks up through the roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above the roof (including roof parapets) in vent stack covers.
- .8 Provide proper dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.2 Installation of Building Footing Drainage System Piping

- .1 Provide all required building footing drainage piping and extend to a concrete sand settling sump as shown and detailed on the drawings.
- .2 Piping shall be rigid, perforated, PVC pipe and fittings with solvent weld joints to CSA B182.1.
- .3 Provide all required sand settling sump piping, and connect the sump discharge to a storm main terminated 1.5 m (5') outside the building.

3.3 Installation of Shut-Off and Check Valves

- .1 Provide a shut-off valve and a check valve in the discharge piping of each drainage pump.

- .2 Locate valves so that they are easily accessible without the use of ladders or other such devices.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.
- .2 **Certification Letters:** Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this Section.

2 PRODUCTS

2.1 Cast Iron Drain Pipe Elbow Restraints

- .1 Holdrite 117 Series no-hub stainless steel restraint kits to suit the pipe size and fitting types and locations.

2.2 Vent Stack Covers

- .1 Equal to MENZIES vandalproof cap, seamless, spun aluminum, 165 mm (6.5") high vent stack covers with a factory applied asphalt primer coating on the top and bottom of the flange.

2.3 Cleanouts

- .1 **Horizontal Piping:** TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 **Vertical Piping:** Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.

2.4 Floor Cleanout Terminations

- .1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit the floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware. Acceptable products are:
 - .1 Zurn Industries # ZN-1602-SP Series.
 - .2 Jay R. Smith Mfg. Co. #4020-F-C Series.
 - .3 Mifab Inc. # C1100-XR-1 or #C1000-R-3.
 - .4 Watts Industries (Canada) Ltd. # CO-200-R-1.
 - .5 Bibby-Ste-Croix "Wade".
- .2 All cleanout terminations in areas with a tile or sheet vinyl floor finish are to be as above but with a square top in lieu of a round top.

2.5 Floor Drains

- .1 Unless otherwise specified or scheduled, floor drains are to be vandal-proof drains in accordance with CSA B79 and the drawing schedule, each complete with a cast iron body and a trap seal primer connection. All cast iron components are to be factory finished with latex based paint coating.
- .2 All floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.
- .3 In general, floor drains to have a surface membrane clamp. Refer to drawings and schedules.
- .4 Acceptable manufacturers are:
 - .1 Zurn Industries.
 - .2 Jay R. Smith Mfg. Co.
 - .3 Mifab Inc.
 - .4 Watts Industries (Canada) Ltd.
 - .5 Bibby-Ste-Croix "Wade".

2.6 Roof Drains

- .1 Unless otherwise specified or scheduled, roof drains are to be cast iron body drains with aluminium domes, in accordance with CSA B79 and the drawing schedule. All cast iron components are to be factory finished with a latex based paint coating.
- .2 Acceptable manufacturers are:
 - .1 Zurn Industries.
 - .2 Jay R. Smith Mfg. Co.
 - .3 Mifab Inc.
 - .4 Watts Industries (Canada) Ltd.
 - .5 Bibby-Ste-Croix "Wade".

2.7 Backwater Valves

- .1 Latex paint coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, site supplied stainless steel piping extension to suit conditions with a length to extend up to a polished nickel-bronze scoriated cleanout cover with stainless steel securing screws. Acceptable products are:
 - .1 Zurn Industries #ZN-1095-15-MJ.
 - .2 Jay R. Smith Mfg. Co. #7022.
 - .3 Mifab Inc. BV 1200-R Series.
 - .4 Watts Industries (Canada) Inc. BV-230-R.
 - .5 Bibby-Ste-Croix "Wade".

2.8 Grease Interceptor (GI-1)

- .1 Schier Great Basin grease interceptor **model # GB-250** shall be lifetime guaranteed and made in USA of seamless, rotationally-molded polyethylene. Interceptor shall be furnished for above or below grade installation. Interceptor shall be certified to ASME A112.14.3 (Type D for 100 gpm, type C for 200 gpm) and CSA B481.1, with adjustable cover adapters, Safety Star access restrictor built into each cover adapter, built in flow control for 200 gpm and three outlet options. Interceptor flow rate shall be 200 GPM. Interceptor grease capacity shall be 1196 lbs @ 200 gpm. Cover shall provide water / gas-tight seal and have minimum 16,000 lbs load capacity.
 - .1 Connections: 4" FPT with 4" plain end adapters, single inlet, and triple outlet.
 - .2 Cover: composite cover, bolted 24" gas/watertight, traffic load rated for 16,000 lbs (C24H2)
 - .3 4"-34" (x2) field cut risers.
 - .4 Pump out port.

2.9 Oil Interceptor (OI-1)

- .1 Striem Oil Reserve oil/sand separator **model # OS-100** shall be lifetime guaranteed and made in USA of seamless, rotationally molded polyethylene. Separator shall be furnished for above or below grade installation, with field adjustable riser system, snap-in flow control and (2) vent connections. Separator flow rate shall be 100 GPM. Separator oil capacity shall be 144 gallons. Sand capacity shall be 95 gallons. Covers shall provide water / gas-tight seal and have a maximum 16,000 lbs load capacity.
- .2 Notes:
 - .1 Snap-in flow control (ship with unit)
 - .2 Seamless medium density polyethylene tank.
 - .3 Unit supplied with built-in adapter for up to 5" of adjustability. Additional riser(s) available for deeper burial depth.
 - .4 Cover placement allows full access to tank for proper maintenance.
 - .5 **CPRK (x2) 11"-90" corrugated pipe riser kit.**

3 EXECUTION

3.1 Supply of Vent Stack Covers

- .1 Supply a properly sized vent stack cover for each vent stack penetrating the roof.
- .2 Hand the vent stack covers to the roofing trade at the site for installation and flashing into roof construction as part of the roofing work. Coordinate installation to ensure proper locations. Provide waterproofing caps over vent stacks.

3.2 Installation of Cleanouts

- .1 Provide cleanouts in drainage piping in locations as follows:
 - .1 In the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap.
 - .2 At or as close as practicable to the foot of each drainage stack.
 - .3 At maximum 15 m (50') intervals in horizontal pipe 100 mm (4") diameter and smaller.
 - .4 At maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") diameter.
 - .5 Wherever else shown on the drawings.
- .2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") diameter, and not less than 100 mm (4") diameter in piping larger than 100 mm (4") diameter.
- .3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.

3.3 Installation of Floor Cleanout Terminations

- .1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor, and provide a cleanout termination set flush with the finished floor.
- .2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish.
- .3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.
- .4 Ensure that cleanout termination covers in tiled floor are square in lieu of round.

3.4 Installation of Floor Drains

- .1 Provide floor drains where shown on the drawings.
- .2 Equip each drain with a trap.
- .3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .4 Confirm the exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
- .5 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final cleanup work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where the cast iron finish has been damaged or removed, including rusted areas.

3.5 Installation of Roof Drains

- .1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and provide accessories.
- .2 Protect roof drains from damage and entrance of debris until roofing work is complete, and refinish any areas where the cast iron factory finish has been damaged or removed, including rusted areas.

3.6 Installation of Backwater Valves (Elevator pit drain before Oil Interceptor)

- .1 Provide backwater valves in drainage piping where shown on the drawings and connect with piping as indicated.
- .2 Set the backwater valve assembly such that the cover is flush with the finished floor. Provide an extension piece if required due to the depth of the piping.

3.7 Installation of Drainage Interceptor

- .1 Provide an interceptor in drainage piping where shown.
- .2 Ensure that the unit is easily accessible for maintenance. Confirm exact location prior to roughing-in.
- .3 Install as per manufacturers installation instruction.
- .4 **Equipment and System Start-Up:** Refer to requirements of the article entitled Equipment and System Start-Up in the Mechanical Work General Instructions Section.
- .5 **Manufacturer's Certification:** Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section. Submit a copy of the letter prior to Substantial Performance.
- .6 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .7 **Demonstration and Training:** Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 2 hours of on-site training for 2 groups of 2 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.

1.2 Quality Assurance

- .1 All electric hot water heaters are to be certified to CAN/CSA-C191, Performance of Electric Storage Tank Water Heaters for Domestic Hot Water Service.

1.3 Seismic Control and Restraint

- .1 Seismic control and restraint is a requirement for this Project. Refer to the mechanical work Seismic Control and Restraint Section, and ensure that appropriate seismic control and restraint hardware is supplied with equipment specified in this Section.

2 PRODUCTS

2.1 Electric Hot Water Heater

- .1 CSA certified electric hot water heater with model number and performance as specified on the drawings, and complete with:
 - .1 A 1035 kPa (150 psi) rated (working pressure) steel tank, glass lined, insulated (except for control panel area) with injected minimum R-16 foam insulation, covered with an enamelled steel jacket, and equipped with 40 mm (1½") diameter NPS brass nipple water inlet and outlet connections, a drain valve, and sacrificial anode rods
 - .2 Removable multiple immersion heating elements, each consisting of a wire filament in a sealed stainless steel sheath
 - .3 An ASME rated temperature and pressure relief valve
 - .4 A factory prewired power and control panel
- .2 The enamelled steel ventilated control panel is to be equipped with removable glass fibre insulation to cover the bare area of the tank, a hinged door, multiple knockouts, a ground screw, and the following:
 - .1 A terminal block for power wiring connections
 - .2 Magnetic contactors for heating elements
 - .3 An adjustable immersion thermostat
 - .4 Manual reset immersed high temperature limit control for each element
 - .5 Fuse block with fuses
 - .6 An element diagnostic panel with LED's for each element to monitor the on-off operation of each element
 - .7 An aluminium drain/drip pan 50 mm (2") diameter wider than the heater base and complete with 50 mm (2") high rolled edges and a 25 mm (1") diameter drain connection spigot with PVC fitting
- .3 Equip the heaters with factory fabricated type "L" hard copper inlet and outlet manifolds.
- .4 Acceptable manufacturers are:
 - .1 Rheem
 - .2 John Wood
 - .3 A.O. Smith
 - .4 Bradford White

2.2 Domestic Hot Water Storage Tank

- .1 Refer to the Section entitled Domestic Hot Water Storage Tanks.

3 EXECUTION

3.1 Installation of Electric Hot Water Heater

- .1 Provide an electric domestic hot water heater where shown.
- .2 Secure the heater in place, level and plumb, in a drip pan on a concrete housekeeping pad and:
 - .1 Pipe the temperature/pressure relief valve outlet to drain
 - .2 Pipe the drip pan to drain
 - .3 Coordinate installation with the electrical trade who will connect the heater with power wiring.
- .3 Ensure that the housekeeping pad is keyed to the structure, and that the tank assembly is secured to the structure by slack cable restraints. Refer to the mechanical work Section entitled Seismic Control and Restraint.
- .4 Install the inlet and outlet manifolds supplied with the heaters.
- .5 Set the thermostat to produce 60° C (140° F) hot water.
- .6 **Manufacturer's Certification:** Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section. Submit a copy of the letter prior to Substantial Performance.

3.2 Manufacturer's Certification

- .1 Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section. Submit a copy of the letter prior to Substantial Performance.

3.3 Equipment and System Start-Up

- .1 Refer to requirements of the article entitled Equipment and System Start-Up in the Mechanical Work General Instructions Section.

3.4 Commissioning

- .1 Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

3.5 Demonstration and Training

- .1 Refer to the article entitled Equipment and System O & M Demonstration & Training in the Section entitled Mechanical Work General Instructions. Include for 1 hours of on-site training for 1 group of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section. Include pump performance curves and motor product data sheets.

1.2 Lead-Free Requirements

- .1 All parts of circulating pumps in contact with domestic water are to be NSF/ANSI 61 certified.

2 PRODUCTS

2.1 Horizontal In-Line Circulating Pumps

- .1 All bronze construction centrifugal pumps in accordance with the drawing schedule and complete with:
 - .1 A lead-free cast bronze casing with flanged pipe connections.
 - .2 An alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze sleeve bearings.
 - .3 A balanced lead-free cast bronze impeller.
 - .4 A motor conforming to requirements of the mechanical work Section entitled Basic Mechanical Materials and Methods, connected to the motor by means of a 4-spring coupling with guard.
 - .5 A mechanical seal.

2.2 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

3 EXECUTION

3.1 Installation of Circulating Pumps

- .1 Provide horizontal in-line domestic hot water circulating pumps where shown.
- .2 Install the pumps in place in vertical piping approximately 1.2 m (4') above the floor in accordance with the pump manufacturer's instructions.

3.2 Manufacturer's Certification

- .1 Refer to requirements of the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section. Submit a copy of the letter prior to Substantial Performance.

3.3 Equipment and System Start-Up

- .1 Refer to requirements of the article entitled Equipment and System Start-Up in the Mechanical Work General Instructions Section.

3.4 Commissioning

- .1 Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.

3.5 Demonstration and Training

- .1 Refer to the article entitled Equipment and System O & M Demonstration & Training in the Section entitled Mechanical Work General Instructions. Include for 2 hours of on-site training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.

1.2 Lead-Free Requirements

- .1 All parts of expansion tanks in contact with domestic water are to be in accordance with NSF/ANSI 61 requirements.

2 PRODUCTS

2.1 Domestic Water Expansion Tanks

- .1 **Tanks:** Lead free, fixed or replaceable bladder type steel tank in-line or stand type as indicated, certified to NSF/ANSI Standard 61, factory pressurized (adjustable) with permanent separation of air and water, suitable for a maximum working pressure of 1035 kPa (150 psi) at 115°C (240°F), constructed and stamped in accordance with the ASME Code Section VIII for Unfired Pressure Vessels and complete with a red oxide primer finish and the following:
 - .1 A NPT stainless steel system connection.
 - .2 A Schrader air charging valve.
 - .3 A heavy-duty butyl rubber bladder.
 - .4 A polypropylene liner.
 - .5 A tapping for installation of a pressure gauge.
 - .6 A tapping for a drain valve.
 - .7 For horizontal tanks only, enamelled steel mounting saddles supplied loose.
 - .8 Factory secured seismic restraint connection hardware.

2.2 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

3 EXECUTION

3.1 Installation of Domestic Water Expansion Tanks

- .1 Provide domestic water expansion tanks where shown.
- .2 Secure the vertical tank stand to a concrete housekeeping pad by means of machine bolts.
- .3 Connect each tank with valved piping as indicated. Check the tank air charge and adjust to suit the system.
- .4 Provide a pressure gauge with cock to indicate system pressure. Provide a drain valve. Pressure gauges and drain valves are to be as per the mechanical work Section entitled Basic Materials and Methods.
- .5 Ensure that the housekeeping pad is keyed to the structure, and that the tank assembly is secured to the structure by slack cable restraints. Refer to the mechanical work Section entitled Seismic Control and Restraint.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data Sheets:** Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings.
- .2 **Colour Charts:** Submit fixture manufacturer's standard colour charts for all fixtures where colours are available, but a particular colour is not specified.

1.2 Quality Assurance

- .1 Plumbing fixtures and fittings, where applicable, are to be in accordance with requirements of the following standards:
 - .1 CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including supplements.
 - .2 ASME A112.18.1/CSA B125.1, Plumbing Supply Fittings.
 - .3 ASME A112.18.2/CSA B125.2, Plumbing Waste Fittings.
 - .4 ASME A112.18.6/CSA B125.6, Flexible Water Connections.
 - .5 CSA B125.3, Plumbing Fittings.
 - .6 CAN/CSA-B651, Accessible Design for Self-Service Interactive Devices.
 - .7 NSF/ANSI/CAN 61, Drinking Water System Components-Health Effects.
 - .8 British Columbia Building Code, Section 3 for barrier-free requirements.

1.3 Base Bid and Acceptable Manufacturers

- .1 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	ACCEPTABLE MANUFACTURERS
Vitreous China Fixtures	American Standard, Kohler Co., Toto Ltd.
Flush Valves	Sloan Valve Co., American Standard, Delta Faucet Co., Zurn Industries Ltd., Kohler Co., Toto Ltd.
Janitor's Mop Sinks	Fiat Products, Stern-Williams Co., Acorn Engineering Co.
Fixture Water Supply and Drain Fittings	American Standard, Delta Faucet Co., Zurn Industries Ltd., Chicago Faucet, Cambridge Brass Inc., Moen Inc.
Refrigerated Drinking Fountains	Sunroc. Corp., Haws Co., Elkay Manufacturing Co., Oasis International
Stainless Steel Sinks	Franke Kindred Canada Ltd., Elkay Manufacturing Co., Deschenes Group "Regionox", Kohler Co.
Acrylic Shower Stalls	Mirolin Industries Corp., MAAX Bath Co.
Shower Mixing Valves and Heads	Symmons Industries, Watts "POWERS", Delta Faucet Co., Zurn Industries Ltd., Leonard Valve Inc., Moen
Laundry Tubs	Fiat Products, Cashel LLC, E.L. Mustee & Son
Slow Closing Water Closet Seats	Bemis Manufacturing Co., Centoco Plastics Ltd., Toto Ltd., American Standard

PRODUCT	ACCEPTABLE MANUFACTURERS
Shower Drains	Watts Industries (Canada) Ltd., Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., and Bibby-Ste-Croix "Wade"
Fixture Carriers	Watts Industries (Canada) Ltd., Jay R. Smith Mfg. Co., Zurn Industries Ltd., Mifab Inc., and Bibby-Ste-Croix "Wade"
Emergency Fixtures	Haws Co., Guardian Equipment, Western Safety Products, Bradley Corp.

2 PRODUCTS

2.1 General Re: Plumbing Fixtures and Fittings

- .1 Unless otherwise specified, all vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .2 Unless otherwise specified, all fittings and piping exposed to view are to be chrome plated and polished.
- .3 All fittings located in areas other than private washrooms are to be vandal-resistant.
- .4 All water supply fittings are to be lead-free in accordance with NSF/ANSI 61 requirements.
- .5 **Fixture Carriers:** All fixture carriers are to be suitable in all respects for the fixture they support and the construction in which they are located.
- .6 **Water Closet Floor Flanges:** Floor flanges for floor mounted water closets are to be cast iron or brass, secured to the floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .7 **Water Closet Wall Seals:** Proper seal to mate with the fixture carrier flange and produce a water-tight installation.
- .8 **Fixture Exposed Traps:** Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit the fixture type and drain connection.
- .9 **Fixture Concealed Traps:** Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to adjustable cast brass with cleanout plugs, all to suit the fixture type and drain connection.
- .10 **Fixture Exposed Supplies:** Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit the fixture. Dahl Brothers Canada Ltd, chrome plated "mini-ball" valve assemblies will be acceptable.
- .11 **Fixture Concealed Supplies:** Water piping as specified, complete with ball type shut-off valves as specified with the water piping or Dahl Bros. Canada Ltd. ¼ turn "mini ball" valves.

2.2 Fixtures

WC-1

TOILET - WALL-HUNG

DXV D23010S000.415 D28015000.150 Toilet - COSSU™, Tank type Toilet, Wall-hung with wall outlet, 3.0 LPF (0.8 GPF) partial flush and 6.0 LPF (1.6 GPF) full flush, Canvas white finish Vitreous china, Elongated bowl, Siphon jet flush action, Manual, Platinum nickel Skate Cosmopolitan dual flush actuator (D28015000.150), Tank not lined, Without tank cover locking device, Gravity-assisted flush, Tank coupling components, Mounting hardware included, Includes color-matched 5020A15G TRADITIONAL elongated toilet seat with cover, polypropylene, slow-close top-mounting easy lift-off hardware, 368 mm (14-1/2") wide, 533 mm (21") from finished wall, 349 mm (13-3/4") high. Compliances: ASME A112.6 compliant, CSA B125.3 compliant, EPA WaterSense® compliant.

GROHE 38996000 Carrier - Single

SK-1

FLOOR MOUNTED, SCULLERY SINK

Franke Commercial SSL2424L-1-2 Sink - Single compartment sink, 203 mm (8") centerset, Scullery sink, with overall dimension 1273 mm (50-1/8") long, 724 mm (28-1/2") wide, 1118 mm (44") high, constructed from Grade 18-10 14 gauge Type 304 Stainless steel, Bowl dimensions are 610 mm (24") long, 610 mm (24") wide, 356 mm (14") deep, Finished with rolled rim, Polished to #4 satin finish, With backsplash, Fully welded square corner construction, Drainboard is located to the left of sink bowl, Less overflow, Stainless steel tubular legs with adjustable feet for leveling, Center waste location, 38 mm (1-1/2") (DN38) brass tailpiece, 89 mm (3-1/2") crumb cup strainer, waste fitting included, Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant.

Chicago Faucets 631-ABCP Faucet - Wall-hung, Manual, Two handles, Sink faucet, Polished chrome finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 and ANSI/NSF 372 compliant, ECAST® brass construction, Less supply, 10 mm (3/8") offset inlet supply arms, Quatern™ compression cartridge (90° turn), 8.3 LPM (2.2 GPM) maximum flowrate, Pressure compensating Softflo™ aerator, Gooseneck spout, 89 mm (3-1/2") spout reach, 222 mm (8-3/4") high, Vandal-resistant 102 mm (4") wrist blade handles with indexed buttons, Less drain, 13 mm (1/2") NPT female thread inlet.

McGuire 202C P-Trap - Solid heavy duty cast brass, Chrome-plated finish, With cleanout plug, Cast brass slip nuts, 52 mm (2") minimum water seal

SI-1

HAIR, PLASTER & SEDIMENT INTERCEPTOR W/FLUSH COVER

Watts SI-742-X-SS Interceptors - Epoxy coated steel, Hair, Plaster & Sediment Interceptor, Hair, Plaster & Sediment Interceptor w/Flush Cover, 51 mm (2") I.P.S. threaded connections, removable stainless steel sediment basket, Gasketed cover, Stainless steel top.

SK-2

COUNTER MOUNTED, DROP-IN, COMMERCIAL SINKS

Franke Commercial LBD7508-1-3 Sink - Double compartment sink, 203 mm (8") centerset, Commercial sinks, with overall dimension 845 mm (33-1/4") long, 559 mm (22") wide, 203 mm (8") high, constructed from 20 gauge Type 302 Stainless steel, Left bowl is 381 mm (15") long and right bowl is 381 mm (15") long, Left bowl is 432 mm (17") wide and right bowl is 432 mm (17") wide, Left bowl is 203 mm (8") deep and right bowl is 203 mm (8") deep, Polished to #4 satin finish, Factory installed EZ TORQUE™ fasteners, Factory applied rim seal, Center back waste location, 38 mm (1-1/2") (DN38) brass tailpiece, standpipe with guard, 89 mm (3-1/2") crumb cup strainer, Undercoated to reduce condensation and resonance, Codes and Compliances: ASME A112.19.3 compliant, CSA B45.4 compliant.

Chicago Faucets 201-AGN8AFC317ABCP Faucet - Counter mounted, Manual, Two handles, Sink faucet, Polished chrome finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 compliant, ECAST® brass construction, Less supply, 1/4 turn compression cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, Male thread with laminar flow control insert in spout inlet, Gooseneck spout, 203 mm (8") spout reach, 333 mm (13-1/8") high, 102 mm (4") wrist blade handle with indexed buttons, Less drain, 13 mm (1/2") NPSM supply inlet for 10 mm (3/8") or 13 mm (1/2") flexible riser.

McGuire LFCK165LK Supply - Lead free, Pipe to compression, Integral check supply kit, Chrome-plated finish, 3/8" I.P.S x 3/8" O.D, 305 mm (12") chrome-plated risers, Loose key, Faucet, Shallow wall flange

McGuire 202C P-Trap - Solid heavy duty cast brass, Chrome-plated finish, With cleanout plug, Cast brass slip nuts, 52 mm (2") minimum water seal

FFD-1

FLOOR DRAIN WITH OVAL FUNNEL

Watts FD-103NH-EG-7-1 Floor Drain - Floor drain, Trap primer tapping, Oval Funnel, Epoxy coated cast iron, No hub (MJ) outlet, 76 mm (3") pipe size, 102 mm (4") x 229 mm (9") oval nickel bronze funnel, With anchor flange, Reversible clamping collar with primary & secondary weepholes

JAN-1

FLOOR MOUNTED, MOP SERVICE SINKS

Stern Williams SB-900-T-10-VB-T-35-T-40-BP Sink - Single compartment sink, Mop service sinks, with overall dimension 610 mm (24") long, 610 mm (24") wide, 305 mm (12") high, constructed from Precast terrazzo, Bowl dimensions are 546 mm (21-1/2") long, 546 mm (21-1/2") wide, 254 mm (10") deep, Pearl grey marble chips and white portland cement, 76 mm (3") pipe size, cast integrally and provides for a caulked lead connection not less than 25 mm (1") deep to a 76 mm (3") pipe, flat stainless steel strainer, Without tiling flange, With stainless steel cap, Chrome finish mop service sink fitting with vacuum breaker, Hose and wall hook, Mop hanger, Splash catcher.

American Standard 7293172H.002 Faucet - HERITAGE, Wall-hung, Manual, Two handles, Mop sink faucet, Polished chrome finish, 203 mm (8") centerset, Lead Free ANSI/NSF 61 compliant, Brass construction, Less supply, Ceramic disc cartridge, 5.7 LPM (1.5 GPM) maximum flowrate, Pressure compensating aerator, Brass gooseneck spout, 216 mm (8-1/2") spout reach, 265 mm (10-7/16") high, Wrist blade handle, Less drain, 13 mm (1/2") female inlet.

HB-1

MODERATE CLIMATE WALL HYDRANT WITH CHROME PLATED FACE, INTEGRAL VACUUM BREAKER

Watts HY-430 Hydrant - Moderate Climate wall Hydrant with chrome-plated face, integral vacuum breaker, all bronze, chrome-plated face, seat casting, loose key, 19 mm (3/4") hose connection, integral vacuum breaker, 19 mm (3/4") female x 25 mm (1") male pipe connection, Complies with ASSE 1019-2004, UPC/IAMPO listed. Max. operating pressure 125 psi.

2.3 Caulking

- .1 General Electric Series SCS 1200 Silicone Construction Sealant or Dow Corning 781 silicone sealant. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by the Consultant from the sealant manufacturer's standard colour range.

3 EXECUTION

3.1 Installation of Plumbing Fixtures and Fittings

- .1 Provide all required plumbing fixtures and fittings.
- .2 Connect plumbing fixtures and fittings with piping sized in accordance with the drawing schedule.
- .3 Confirm the exact location of all plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.
- .4 When installation is complete, check and test the operation of each fixture and fitting. Adjust or repair as required.
- .5 **Barrier-Free Fixtures:** Comply with mounting height and other requirements of the governing Code.
- .6 **Counter Mounted Fixtures and Trim:** Supply templates for all counter mounted fixtures and trim and hand to the trades who will cut the counter. Ensure openings in the counter are properly located.
- .7 **Electronic Faucets:** Locate control panels for electronic faucets under the lavatories and recessed into the wall. Coordinate panel installations with the electrical trade who will provide 115 volt power wiring to the boxes.
- .8 Connect tempered water piping to each box, and from each box to the faucet. Set each faucet sensor to deliver water for approximately 10 seconds.
- .9 **Shower Bases:** Protect all shower bases from damage during construction and finishing work.
- .10 **Shower Fittings:** Confirm exact mixing valve and shower head locations prior to roughing-in.
- .11 **Emergency Eye Wash Fixtures:** Install eye wash fixtures in accordance with the manufacturer's printed instructions. Ensure that exposed piping is painted.
- .12 **Mixing Valves for Emergency Fixtures:** Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above the floor and secure in place. Check and confirm valve operation and the temperature of the tempered water supply. Provide cabinets where shown. Identify each cabinet and hand three identified cabinet keys to the Consultant prior to Substantial Performance.
- .13 **Mop Service Basins:** Set mop service basins on the floor over drain piping and connect to the roughed-in service. Install wall supply trim and any accessories specified.

3.2 Caulking at Plumbing Fixtures and Fittings

- .1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.
- .2 Clean areas/surfaces to be caulked and prime in accordance with the sealant manufacturer's instructions. Where damage to a building surface may occur, mask the surface to prevent damage and ensure a clean exact edge to the caulking bead.
- .3 Apply caulking using a gun with the proper size and shape of nozzle and force the sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.

- .4 If joints have been masked the sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before the sealant begins to skin.

3.3 Clothes Washer Connections

- .1 Provide roughed-in water and drain connections for Owner supplied clothes washer consisting of:
 - .1 A 15 mm (½") diameter piping connection for both hot and cold water, each terminated in a Dahl "Mini-Ball" Valve with hose end and water hammer arrestor.
 - .2 A 40 mm (1½") diameter standing waste with a height to suit the washer drain and complete with a P trap.

3.4 Commissioning

- .1 Commission plumbing fixtures and fittings by proving proper operation.

END OF SECTION

1 GENERAL

- .1 This specification section includes all motor, drives and guards associated with mechanical equipment supplied by the mechanical contractor.

1.2 Referenced Codes and Standards and Regulatory Bodies

- .1 ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers.
- .2 ASHRAE 90.1 Energy Standard for Buildings Except Low Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .3 Canadian Electrical Code
- .4 CSA – Canadian Standards Association.
- .5 CSA C390- Test methods, marking requirements, and energy efficiency levels for three-phase induction motors
- .6 EEMAC - Electrical Equipment Manufacturers' Association Council.
- .7 IEEE - Institute of Electrical and Electronic Engineers.
- .8 IEEE Standard 519 - IEEE Guide for Harmonic Content and Control
- .9 MSDS - Material Safety Data Sheets.
- .10 NEMA – National Electrical Manufacturers Association
- .11 NEMA - ICS 7.0, AC Adjustable Speed Drives
- .12 NEMA MG 1 Standard
- .13 UL - Underwriters laboratories
- .14 UL508C - Power Conversion Equipment
- .15 WHMIS - Health Canada/Workplace Hazardous Materials Information System.
- .16 WorkSafeBC standards

1.3 Scope of Work

- .1 The minimum specifications for the supply and installation standards of electrical motors required operating the mechanical equipment covered under this specification.
- .2 Refer to equipment schedules and equipment specifications for detailed motor requirements.
- .3 Provide premium efficiency motors that meet or exceed current local, CSA C390 and to ASHRAE 90.1.

1.4 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 23 05 00 Common Work Results for HVAC – Submittal.

1.5 Closeout Submittals

- .1 Provide maintenance data for the equipment for incorporation into the manuals specified in accordance with Section 23 05 00 Common Work Results For HVAC.

1.6 Delivery, Storage, And Handling

- .1 Packing, shipping, handling, and unloading:
 - .1 Deliver, store, and handle in accordance with manufacturer's written instructions.

2 PRODUCTS

2.1 Motors

- .1 All motors shall meet the standards and requirements of the Canadian Electrical Code, NEMA MG 1 Section IV Part 31.
- .2 All motors shall be "Premium Efficiency" motors meeting the NEMA Premium Efficiency standards and bear the "NEMA Premium" label.
- .3 Three Phase General Purpose Motors
 - .1 General purposes motors are defined as:
 - .1 General Purpose Electric Motor (Subtype I).
 - .1 The term "General Purpose Electric Motor (Subtype I)" means any motor that meets the definition of „General Purpose" where General purpose motor means any motor which is designed in standard ratings with either:
 - .1 Standard operating characteristics and standard mechanical construction for use under usual service conditions, such as those specified NEMA Standards Publication MG11, "Usual Service Conditions," and without restriction to a particular application or type of application; or
 - .2 Standard operating characteristics or standard mechanical construction for use under unusual service conditions, such as those specified in NEMA Standards Publication MG-1, "Unusual Service Conditions," or for a particular type of application, and which can be used in most general purpose applications.
 - .2 General Purpose Electric Motor (Subtype II).
 - .1 The term "General Purpose Electric Motor (Subtype II)" means motors incorporating the design elements of a general purpose electric motor (subtype I) that are configured as 1 of the following:
 - .1 A U-Frame Motor.
 - .2 A Design C Motor.
 - .3 A close-coupled pump motor.
 - .4 A Footless motor.
 - .5 A vertical solid shaft normal thrust motor (as tested in a horizontal configuration).
 - .6 An 8-pole motor (900 rpm).
 - .7 A poly-phase motor with voltage of not more than 600 volts (other than 230 or 460 volts).
 - .3 NEMA Design B general-purpose motors from 201-500 hp as defined in NEMA MG1 IEC Design N motors rated 151-375 kW should be included.
 - .4 Fire pump motors as defined in NEMA MG1 Fire pump motors are not defined in any NEMA Standard.
 - .1 The requirements for fire pump motors in are contained in NFPA 20.
 - .2 General purpose motors shall be used to power the following equipment:
 - .1 Circulating pumps,
 - .2 Air handling unit fans,
 - .3 Exhaust fans,
 - .4 Any other stationary equipment motor.
 - .3 General duty motors shall:
 - .1 Totally enclosed, fan cooled.
 - .2 NEMA T frame,
 - .3 NEMA F1 assembly for horizontal applications
 - .4 Have an operating environment of -15°C to 40°C.
 - .5 Enclosure:
 - .1 Enclosures shall be rolled steel band or cast iron construction depending on horsepower. End brackets shall be die cast aluminum with steel bearing inserts or cast iron construction. Conduit box shall be die cast aluminum or cast iron construction.

- .2 Motors shall have drain openings suitably located for the type assembly being provided.
- .3 For frames 215T and above, shouldered lifting eyebolts or cast provisions within the frame shall be furnished for handling convenience.
- .4 Motor enclosures shall have a bi-directional, spark-proof, abrasion, and corrosive resistant fan made of a material that is strong and durable. Fan will be keyed to shaft on frames 254T and above.
- .5 Motor nameplate shall be mounted on enclosure with stainless steel fastening pins. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG-1-20.60.
- .6 Motor bearing numbers shall be included on nameplate. Motor connection diagram shall be attached to motor and easily readable.
- .6 Motor Terminal Boxes and Leads
 - .1 Motor terminal boxes shall be sized larger than required by NEC or ULC standards, pipe drilled for conduit and shall be attached to the motor frame with cadmium-plated hex head cap screws. Cover shall be installed with cadmium plated hex head cap screws. The conduit box shall come completely assembled to the motor.
 - .2 Motor leads in the conduit box shall be sized in accordance with NEC suggested minimum ampacity values using a minimum of 125°C insulated lead wire. The wiring shall be clearly identified every inch or the lead shall have a metal band in accordance with ANSI C6.1, latest revision.
 - .3 Motors shall be provided with a compression-type grounding lug mounted in the conduit box by drilling and tapping into the motor frame or by a double ended cap screw of silicon bronze.
- .7 Electrical and Mechanical Design Requirements
 - .1 Motors shall be premium efficiency severe duty type, NEMA Design B (normal starting torque, full voltage starting), squirrel cage, induction type. Where other designs are required, they will be specified on the Equipment Schedule.
 - .2 Motors shall be wound for 200, 230, 460V or 575-volt, three-phase, 60-hertz, 1.15 service factor.
 - .3 Windings shall be copper magnet wire rated at 200°C and moisture resistant. Magnet wire insulation varnish must be of a type designed to resist transient spikes, high frequencies, and short time rise pulses
 - .4 Insulation shall be a Class F, non-hygroscopic varnish. The maximum permissible temperature for the insulation is not exceeded when the motor operates at service factor load in a 40°C ambient. Magnet wire shall have a service coating equivalent in thickness to a commercial "heavy" coating. The combination of magnet wire and varnish when tested in accordance with IEEE No. 57, latest revision, shall show a thermal rating of not less than 150°C for duration of 30,000 hours life. Normal temperature rise for a 1.0 service factor operation shall not exceed a Class B rise.
 - .5 Windings shall be firmly held in the stator slots to prevent coil shifts. Sharp edges and burs shall be removed from the stator core slots before inserting the winding. All coils shall be phase insulated using Nomex paper or equal and laced down such that the windings will not move during repetitive starting. All stator connections will be securely made.
 - .6 The insulation resistance of the sealed stator winding shall be greater than 100 megohms when measured at 25°C with a megohm bridge having 1000-volt direct current.
 - .7 The motor design shall use the best available materials and methods to achieve premium efficiency, power factor, and long-life operation.
 - .8 Motors shall be designed for operation in either direction of rotation without a physical change in the motor.

- .9 All motors shall have anti-friction, vacuum-degassed steel ball bearings electric motor quality. Grease fittings and reliefs are supplied for external lubrication while machine is in operation. Fittings and reliefs are plugged.
- .10 The bearings shall have a rated fatigue life of L-10 (B-10) of 150,000 hours for direct-coupled applications and 50,000 hours for belted applications minimum. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43. The calculation will be determined from the pulley centerline being at the end of the motor shaft.
- .11 The motor shall have tight mechanical bearing housing fits. Either the D.E. or O.D.E. bearing must be locked to limit axial shaft movement.
- .12 Bearing cavities and greasing passages shall be thoroughly cleaned of all debris before lubricating. Motors shall be lubricated at the factory with Exxon Mobil Polyrex™ EM grease or equal. Customer-specified grease may be supplied upon request as noted on the motor data sheet.
- .13 Motors, unless otherwise noted, shall be furnished with standard NEMA T-frame shaft for V-belt drives even though motors are for direct connected drive duty.
 - .1 In general, motor shall be inter-changeable for horizontal, vertical, or belt-driven mounting.
- .14 Maximum vibration allowed shall be 0.15 inches per second velocity measured at the bearing housings.
- .15 Rotor assemblies shall be die cast aluminum for NEMA frames. Rotors shall be keyed and shrunk or pressed to the shaft. Welding will not be acceptable. Keyed rotors shall be press-fitted on a shoulder the full length of the rotor utilizing the full shaft surface diameter.
- .16 Rotor shaft extension run out shall not exceed:
 - .1 0.002" TIR for shaft diameter 0.1875 - 1.625 inches
 - .2 0.001" TIR for shaft diameter over 1.625 - 6.500 inches
- .17 All shafts shall be precision machined from high-strength carbon steel suitable for belt and pulley drives.
- .8 Testing & Final Inspection
 - .1 Electrical Tests
 - .1 Each motor design shall receive the testing called out for "Polyphase Induction Motors and Generators", IEEE 112, latest edition. The routine tests shall, as a minimum, conform to the NEMA MG-1 tests. In addition to the normal factory tests and those already covered in this specification, the following tests may be performed:
 - .2 The completed insulation system shall be capable of withstanding continuously a phase-to-ground RMS voltage of 1000 volts minimum for a period of 30 minutes minimum.
 - .3 The winding shall also be capable of passing a 2500 volt AC minimum, phase-to-ground test for one second.
 - .4 Surge comparison test shall be performed using 3000 volts AC minimum; phase-to-phase comparison waveforms on the test unit shall be supplied.
 - .5 Full load amperes, watts, power factor, and RPM.
 - .6 Locked rotor current at rated voltage.
 - .2 Mechanical Inspection
 - .1 Shaft runout shall be checked after the motor is completely assembled and recorded.
 - .2 Inches/second velocity vibration data.
 - .3 Sliding Base Requirements
 - .1 Sliding bases of the heavy-duty type shall be furnished for V-belt drives.
 - .4 Fabrication
 - .1 Base construction shall be fabricated from heavy steel to withstand vibration and corrosive atmosphere.

- .2 Base shall be of single unit construction with a double-supported slide and adjusting bolts.
- .3 Base shall have a corrosion resistant finish.
- .4 Three Phase Inverter Duty Motors
 - .1 Inverter duty motors shall meet all of the requirements of the general-purpose motor specifications.
 - .2 Inverter duty winding insulation ratings shall exceed NEMA MG1- Part 31.4.4.2 standards and have a Voltage Withstand Capability of 2000 V in 0.1 μ s..
 - .3 Inverter duty motors shall be NEMA Design B as defined in the ANSI/NEMA MG 1 Standard
 - .4 The motor winding insulation shall have a minimum peak voltage rating of 2000 volts.
 - .5 Inverter duty motors to include factory installed shaft grounding rings to eliminate bearing damage resulting from common mode voltage.
- .5 Single Phase Motors
 - .1 Electronically Commutated Motors
 - .1 Electronically commutated motors (ECM) run more efficiently and have a greater reliability and longer operational life.
 - .2 All unitary packaged equipment shall be supplied with an ECM motor. This shall include:
 - .1 Fan coil units, Unit Ventilators
 - .3 All equipment, with the exception of unit ventilators, shall be provided with motors equipped with the ability to adjust the motor speed through a minimum of four (4) steps over the operating speed range of the motor.
 - .1 At minimum, the discreet speed range shall vary between 50% of maximum RPM to 100% RPM.
 - .4 Motors used in a unit ventilator application shall be provided with motors equipped to have an analogue signal input (0Vdc to 10Vdc) vary the motor speed from 300 RPM to 1300 RPM.
 - .5 Motor Requirements:
 - .1 Motor Specifications:
 - .1 Variable Speed, Constant Torque motor
 - .2 Designed for direct drive blower applications
 - .3 120V or 208/240/277V AC single phase input, 50/60Hz
 - .4 Available in 1/15hp (low speed only) as well as 1/8hp and 1/4hp (high and low speed)
 - .5 Operating speed range: High Speed - 300 -1800 RPM and Low Speed 300 -1200 RPM
 - .6 NEMA 42 frame
 - .7 UL and cur recognized component
 - .8 RoHS Compliant
 - .2 Motor Features:
 - .1 Multiple input options
 - .2 PWM Variable speed operation
 - .3 3 Selectable Discrete Line Voltage Speeds
 - .4 24 Volt Discrete input Selection
 - .5 6kV Surge Protection
 - .6 BlakBox enabled
 - .7 Ball Bearing construction
 - .3 Motor Applications:
 - .1 Fan coils
 - .2 Unit Heater
 - .2 Single Phase Motors
 - .1 When ECM motors CANNOT be provided, single phase, capacitor start motors shall be supplied.
 - .2 Single phase motor applications on pumps shall:
 - .1 The motors shall operate on 120 VAC.

- .2 Totally enclosed, fan cooled.
- .3 Contain an automatic reset, thermal overload switch that shuts the motor down upon overheating.
- .4 Motor windings shall be Class F, with a maximum total temperature range of 155°C.
- .5 The motor shall have a service factor of 1.15.
- .6 100%, continuous duty cycle.
- .7 Motors shall be Premium Efficiency, two capacitor motors with minimum efficiency ratings as follows:

HP	1/4	1/3	1/2	3/4	1	1.5
EFF	65%	62%	67%	71%	82%	84%

HP	2	3	5	7.5	10	15
EFF	82%	82%	86%	86%	86%	86%

- .8 Due to the generation of high noise levels, motors shall operate at a maximum of 1800 RPM.
 - .9 Motor bearing shall be customized to fit the motor application, shaft drive configuration, and mounting orientation.
 - .10 Motor shall be complete with a rigid mounting base designed for the motor application, shaft drive configuration, and mounting orientation.
- .3 Motor Sheaves
- .1 Fit reinforced belts in sheave matched to drive.
 - .1 Multiple belts to be matched sets.
 - .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
 - .3 For motors less than 10 HP use standard adjustable pitch drive sheaves having $\pm 10\%$ range.
 - .1 Use mid position of range for specified r/min.
 - .4 For motors 10 HP and over use sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned.
 - .1 Provide sheave of correct size to suit balancing.
 - .5 Minimum drive rating: 1.5 times nameplate rating on motor.
 - .1 Keep overhung loads within manufacturer's design requirements on prime mover shafts.
 - .6 Motor slide rail adjustment plates to allow for centre line adjustment.
 - .7 Supply one set of spare belts for each set installed in accordance for each motor supplied.
- .4 Belt, Drive Line, and Fan Guards
- .1 Provide guards for unprotected belts and drivelines.
 - .2 The guard shall have:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia. holes on both shaft centres for insertion of tachometer.
 - .3 The guard shall be removable for servicing.
 - .4 Provide means to permit lubrication and use of test instruments with guards in place.
 - .5 Install belt guards to allow movement of motors for adjusting belt tension.
 - .6 Guards for flexible coupling shall be:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.

- .2 Securely fasten in place.
- .3 Removable for servicing.
- .7 Provide guards for unprotected fan inlets or outlets. The guards shall be:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing

2.2 Variable Speed Drives

- .1 General
 - .1 Scope
 - .1 Provide infinitely variable speed drive package for pumps and fans as specified.
 - .2 Drive to be sized properly and compatible with motor being controlled, and appropriate for the voltage and phase supply.
 - .3 Submit complete service and maintenance manuals including wiring and connection diagrams for review and inclusion in Maintenance Manuals.
 - .4 Provide inverter duty motors as per NEMA 1 MG1-2011, page 30 and 31 for motor drive compatibility.
 - .5 Provide a full 3-year extended warranty for labour and material on the variable speed drive and its components.
 - .2 Submittals
 - .1 Submit shop drawing information including, but not limited to the following:
 - .1 CSA approval
 - .2 Unit tag number and equipment number it serves
 - .3 Voltage, horsepower
 - .4 Wiring schematic
 - .5 Physical dimensions
 - .6 Copy of start-up and commissioning report as per district standard which include programmed settings
 - .7 Operation procedures and maintenance
 - .3 Quality Assurance
 - .1 VFD shall have a minimum MTBF (mean time between failures) rating of 28 years (245,280 hours).
 - .2 Manufacturer must have a minimum of 25 years of documented experience specializing in variable frequency drives.
- .2 Products
 - .1 Variable Speed Pump Drive Package
 - .1 The only two approved drives are the Z1000 series by Yaskawa and the ACH550 series by ABB. NO alternative drives will be accepted.
 - .2 Motors shall be inverter duty rated per NEMA MG1 parts 30 and 31, for motor-drive compatibility.
 - .3 Provide enclosed variable frequency drives suitable for operation at the current, voltage and horsepower indicated on equipment schedules.
 - .4 VFD must operate without fault or failure, when voltage varies plus 10% or minus 15% from rating, and frequency varies plus or minus 5% from rating.
 - .5 VFD shall be 208 volts, 60Hz, 3 Phase.
 - .6 Displacement Power Factor: 0.98 over entire range of operating speed and load.
 - .7 Service Factor 1.0.
 - .8 Operating Ambient Temperature: -10°C to 40°C (14°F to 104°F)
 - .9 Ambient storage temperature: -20°C to 70°C (-4°F to 158°F)
 - .10 Humidity: 0% to 95% non-condensing
 - .11 Altitude: to 1000m, higher altitude achieved by derating
 - .12 Vibration: 9.81m/s² (1 G) maximum at 10 to 20 Hz, 2.0 m/s² (0.2 G) at 20 Hz to 55 Hz.
 - .13 Minimum Efficiency: 96% at half speed, 98% at full speed
 - .14 Starting Torque: 100% starting torque shall be available from 0.5 Hz. to 60 Hz.

- .15 Overload capability: 110% of rated FLA (Full Load Amps) for 60 seconds; 150% of rated FLA peak.
- .16 Controlled Speed range of 40:1.
- .17 The VFDs shall include EMI/RFI filters. The onboard RFI filter shall allow the entire VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.
- .18 Total Harmonic Distortion (THD) Compliance:
 - .1 Given the information provided by the customer's electric power single line diagram and distribution transformer data, the VFD manufacturer shall carry out an analysis of the system. The analysis reviews the potential for the proposed equipment, and any existing equipment, to meet IEEE 519 (tables 10.2 and 10.3) recommendations at the Point of Common Coupling (PCC). The result of the analysis shall determine if additional power quality improvement measures should be included in the proposal to meet the THD recommendations of IEEE 519. The PCC shall be at the primary side of the main distribution transformer.
- .19 VFDs must be suitable for use on a circuit capable of delivering not more than 100,000 RMS symmetrical amperes
- .2 Design Requirements
 - .1 VFDs shall employ microprocessor-based inverter, logic, isolated from all power circuits.
 - .2 VFD shall include surface mount technology with protective coating.
- .3 VFD shall employ a PWM (Pulse Width Modulated) power electronic system, consisting of:
 - .1 Input Section:
 - .1 VFD input power stage shall convert three-phase AC line power into a fixed DC voltage via a solid-state full wave diode rectifier, with MOV (Metal Oxide Varistor) surge protection.
 - .2 A minimum of 5% DC bus impedance to minimize reflected current.
 - .2 Intermediate Section:
 - .1 DC bus as a supply to the VFD output Section shall maintain a
 - .2 fixed voltage with filtering and short circuit protection.
 - .3 DC bus shall be interfaced with the VFD diagnostic logic circuit, for continuous monitoring and protection of the power components.
 - .3 Output Section
 - .1 Insulated Gate Bipolar Transistors (IGBTs) shall convert DC bus voltage to variable frequency and voltage.
 - .2 The VFD shall employ PWM sine coded output technology to power the motor.
- .4 The VFD must be rated for operation at a carrier frequency of 5 kHz to satisfy the conditions for current, voltage, and horsepower as indicated on the equipment schedule.
- .5 VFD shall have an adjustable carrier frequency, from 1 kHz to 12.5 kHz.
- .6 VFD must include an adjustable dynamic noise control for quiet motor operation.
- .7 VFD shall have embedded Building Automation System (BAS) protocols for network communications; BACnet and Modbus/Memobus. These protocols shall be accessible via a RS-422/485 communication port.
- .8 VFD shall include two independent analog inputs. Selectable for either 0-10 VDC or 4-20 mA. Either input shall respond to a programmable bias and gain.
- .9 VFD shall include a minimum of seven multi-function digital input terminals, capable of being programmed to determine the function on a change of state. These terminals shall include, but not limited to:
 - .1 Remote/Local operation selection
 - .2 Customer Safeties
 - .3 BAS / Damper Interlock
 - .4 Emergency Override
 - .5 Preset Speed
 - .6 PI control enable / disable

- .10 VFD shall include two selectable 0-10 VDC or 4-20 mA analog outputs for monitoring, or "speed tracking" the VFD. The analog output signal will be proportional to output frequency, output current, output power, PI (Proportional & Integral control) feedback or DC bus voltage.
- .11 VFD shall provide terminals for remote input contact closure, to allow starting in the automatic mode.
- .12 VFD shall provide 24 Vdc, 150ma transmitter power supply
- .13 VFD shall include at least one external fault input, which shall be programmable for a normally open or normally closed contact. These terminals can be used for connection of firestats, freezestats, high pressure limits or similar safety devices.
- .14 VFD shall include three programmable form "A" contacts and one fixed "Fault" form "C" contact, capable of being programmed to determine conditions that must be met in order for them to change state. These output relay contacts shall be rated for at least 2A at 120 VAC and shall include, but not limited to:
 - .1 Speed agree detection
 - .2 Damper control
 - .3 Hand / Auto Status
 - .4 No load detection (broken belt alert)
 - .5 Contactor Control for External Bypass
 - .6 Drive Faulted
 - .7 Serial communication status
- .15 VFD shall include a power loss ride through capable of 2 seconds.
- .16 VFD shall have DC injection braking capability, to prevent Pump "wind milling" at start or stop, adjustable, current limited.
- .17 VFD shall have a motor preheat function to prevent moisture accumulation in an idle motor.
- .18 VFD shall include diagnostic fault indication, time and date stamped faults storage and heatsink cooling fan operating hours.
- .19 VFD shall have a digital operator with program copy and storage functions to simplify set up of multiple drives. The digital operator shall be interchangeable for all drive ratings.
- .20 VFD shall include a front mounted, sealed keypad operator, with an English language illuminated LCD display. The operator will provide complete programming, program copying, operating, monitoring, real time clock and diagnostic capability. Keys provided shall include industry standard commands for Hand, Off, and Auto functions. (P-1000 series: external Hand-Off-Auto selector switch and manually speed adjusting potentiometer)
- .21 VFD plain language display shall provide readouts of; output frequency in hertz, PI feedback in percent, output voltage in volts, output current in amps, output power in kilowatts, D.C. bus voltage in volts, interface terminal status, heatsink temperature and fault conditions. All displays shall be viewed in an easy-to-read illuminated LCD.
- .22 VFD shall have an internal time clock. The internal time clock shall include a backup via battery. The time clock will be used to date and time stamp faults and record operating parameters at the time of fault. The internal time clock can be programmable to control start/stop functions, constant speeds, PID parameter sets and output Form-C relays.
- .23 VFD unit shall include the following meters to estimate use of energy:
 - .1 Elapsed Time Meter
 - .2 Kilowatt Meter
 - .3 Kilowatt Hour Meter
- .24 VFD shall include a user selectable PI control loop, to provide closed loop set point control capability, from a feedback signal, eliminating the need for closed loop output signals from a building automation system. The PI controller shall have a differential feedback capability for closed loop control of fans and pumps for pressure, flow, or temperature regulation in response to dual feedback signals.

- .25 VFD shall have an independent, PI loop that can be used with a second analog input that will vary the VFD analog output and maintain a set point of an independent process (valves, dampers....).
- .26 VFD shall include HVAC specific application macros. The macros can be used to help facilitate start-up. The macros will provide initialization to program all parameters and customer interfaces for a particular application (Pumps) to reduce programming time
- .27 An energy saving sleep function shall be available in both open loop (follower mode) and closed loop (PI) control, providing significant energy savings while minimizing operating hours on driven equipment. When the sleep function senses a minimal deviation of a feedback signal from set point, or low demand in open loop control, the system reacts by stopping the driven equipment. Upon receiving an increase in speed command signal deviation, the drive and equipment resume normal operation.
- .28 VFD shall include loss of input signal protection, with a selectable response strategy including speed default to a percent of the most recent speed.
- .29 VFD shall include electronic thermal overload protection for both the drive and motor. The electronic thermal motor overload shall be approved by UL. If the electronic thermal motor overload is not approved by UL, a separate UL approved thermal overload relay shall be provided in the VFD enclosure.
- .30 VFD shall include the following program functions:
 - .1 Critical frequency rejection capability: 3 selectable, adjustable dead bands.
 - .2 Auto restart capability: 0 to 10 attempts with adjustable delay between attempts.
 - .3 Ability to close fault contact after the completion of all fault restart attempts.
 - .4 Stall prevention capability.
 - .5 "S" curve soft start / soft stop capability.
 - .6 Bi-directional "Speed search" capability, in order to start a rotating load.
 - .7 14 preset and 1 custom volts per hertz pattern.
 - .8 Heatsink over temperature speed fold back capability
 - .9 Terminal status indication.
 - .10 Program copy and storage in a removable digital operator.
 - .11 Programmable security code
 - .12 Current limit adjustment capability, from 30% to 200% of rated full load current of the VFD.
 - .13 Motor pre-heat capability
 - .14 Input signal or serial communication loss detection and response strategy.
 - .15 Anti "wind-milling" function capability.
 - .16 Automatic energy saving function.
 - .17 Undertorque/Overtorque Detection.
 - .18 Pump failure detection and selectable drive action
 - .19 Bumpless" transfer between Hand and Auto modes
 - .20 Seven preset speeds
- .31 VFD shall include factory settings for all parameters, and the capability for those settings to be reset.
- .32 VFD shall include user parameter initialization capability to re-establish project specific parameters.
- .33 VFD shall include programmable HVAC specific application macros
- .34 VFD shall include a USB Type B port for quick and easy PC Connection
- .35 VFD shall include the capability to adjust the following functions, while the VFD is running:
 - .1 Speed command input.
 - .2 Acceleration adjustment from 0 to 6000 seconds.
 - .3 Deceleration adjustment from 0 to 6000 seconds.
 - .4 Select from 7 preset speeds.
 - .5 Analog monitor display.
 - .6 Removal of digital operator.
- .36 VFD shall include Input and Output Line Reactors, properly sized and located in a separately vented cabinet. Reactors mounted to allow easy and unencumbered access. Heat generated from the reactor shall not cause the reactor cabinet or VFD

cabinet to exceed 45°C. Refer to the Electrical drawings for installation details. The line and load reactors will be installed within a separate vented enclosure, typically located below the variable speed drives. The line and load reactors can be mounted within same cabinet, but VFDs cannot be installed within the same cabinet.

- .4 Interface with Building Automation System
 - .1 Provide the following items to allow interface with building control system:
 - .1 Terminals shall allow dry remote contacts (building automation system computer) to stop and start the Pump.
 - .2 A set of dry contacts shall indicate the Pump status for the remote computer (indicate whether the drive is running or not).
 - .3 Terminals shall interlock the high temperature (fire stat or smoke detector) protection contacts and shut down the HVAC system.
 - .4 Terminals shall interlock the low temperature (freeze stat) protection contacts and shut down the HVAC system.
 - .5 Terminals to accept a 0 to 10VDC input signal from the DDC system to establish unit speed setpoint.
 - .6 Terminals to produce a 4 to 20 mA signal output from the VFD that is proportional to the drives actual speed for monitoring by the DDC system.
 - .7 All control interfaces must be electronically isolated from the building automation system to prevent the creation of ground loops.

3 EXECUTION

3.1 On-Site Commissioning

- .1 Include for the services of a qualified technician to assist the Contractor in setting up the flow control system on the job site. The technician shall have at least five years experience in heating, ventilating, and air conditioning systems and their controls. Include for a minimum of one (1) man-day per system.
- .2 Provide a start-up and commissioning report which documents the procedures used and confirms the correct operation of the equipment at various system capacities. Report the voltage and amperage draw of each motor being controlled at three intermediate points and compare with expected values at those capacities. Measure wave forms with an oscilloscope and print results in report. Use the scales that show the best detail of the wave forms.
- .3 Provide complete check out to ensure all protective equipment to ensure reliable operation of drive and motor has been installed and wired correctly.
- .4 Provide secondary visits to the site to fine tune/adjust drive resulting from nuisance trips/failures.
- .5 Provide written confirmation that drive has been fully installed and commissioned in accordance with drive and motor supplier recommendations for reliable operation.
- .6 Provide for two hours on site, factory certified training to instruct the Owner's maintenance department in the proper operation, maintenance, trouble shooting and repair of the variable speed drive.

3.2 Manufacturer's Instructions

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet for the installation of motors, drives, and guards.

3.3 Installation

- .1 Motors
- .2 Fasten securely in place. Make removable for servicing, easily returned into, and positively in position.

- .3 Install and adjust motor to ensure proper alignment between the motor shat, sheave, and driveline.
- .4 Do not over tension or under tension drive belts.
- .5 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting, and cleaning of product.

END OF SECTION 23 05 13

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in Part 2 of this Section except for pipe and fittings. Ensure that product data sheets confirm that products proposed meet all requirements of the Contract Documents.
- .2 **Refrigerant Piping Schematics:** Submit, in shop drawing form, a schematic piping diagram for each refrigerant piping system indicating pipe sizes, slopes, valves, traps, and piping specialties. Piping schematics must be reviewed, approved, and signed by the refrigeration equipment manufacturers prior to being submitted to the Consultant for review.
- .3 **Certification Reports:** Submit letters from equipment suppliers certifying proper installation and start-up of the piping systems and equipment as specified in Part 3 of this Section.

1.2 Quality Assurance

- .1 **Codes and Standards:** Refrigerant piping systems are to be in accordance with CSA B52, Mechanical Refrigeration Code and BC Environmental Management Act and any applicable local Codes and Regulations.
- .2 **Installation Personnel:** Refrigerant piping and direct expansion refrigeration equipment must be installed by or under direct on-site supervision of Technical Safety BC certified and licensed journeyman refrigeration mechanics.

1.3 Seismic Control and Restraint

- .1 Seismic control and restraint is a requirement for this Project. Refer to the mechanical work Seismic Control and Restraint Section, and ensure that appropriate seismic control and restraint hardware is supplied with equipment specified in this Section.

2 PRODUCTS

2.1 Pipe, Fittings and Joints

- .1 Type ACR hard drawn seamless copper refrigerant tubing to ASTM B280, Standard Specification for Seamless Copper Tubing for Air Conditioning and Refrigeration Field Service, factory degreased, deburred, dehydrated, pressurized with nitrogen and capped, complete with factory washed and bagged wrought copper soldering fittings to ASME B16.22, and brazed joints made with high melting point silver brazing alloy conforming to AWS Classification BcuP-5.

2.2 Piping Line Sets

- .1 Equal to Great Lakes Copper Inc. "EZ-Roll" soft annealed copper to ASTM B280, suitable for use with the refrigerant involved, factory cleaned, pressurized with nitrogen, and capped, and with sizes and lengths as required.

2.3 General Re: Valves and Piping Specialties

- .1 All refrigerant valves and piping specialties specified below are to factory cleaned, degreased, and supplied to the site with capped ends.
- .2 Unless otherwise specified, acceptable manufacturers are:
 - .1 Mueller Industries Inc.
 - .2 Sporlan Valve Co.
 - .3 Superior Refrigeration Products/Sherwood.

2.4 Shut-Off Valves

- .1 **Ball Valves:** Mueller Industries Inc. "Ballmaster", ¼ turn, CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with carbon filled Teflon ball seals, two O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into the body, a ball position indicator on the stem, and extended

copper tube connections to permit brazing the valve into the line without disassembling the valve.

- .2 **Diaphragm Valves:** Mueller Industries Inc. "Linemaster" forged brass, frost-proof, Type 1 Series, CSA certified packless diaphragm valves, each suitable for a 3445 kPa (500 psi) working pressure and complete with an O-ring to prevent moisture from entering the diaphragm chamber, one phosphor bronze and two stainless steel diaphragms, and extended copper tube brazing connections.

2.5 Check Valves

- .1 Mueller Industries Inc. "Checkmaster" straight through type for valves 6.4 mm to 16 mm ($\frac{1}{4}$ " to $\frac{5}{8}$ ") diameter, globe type for valves 22 mm ($\frac{7}{8}$ ") diameter and larger, each complete with extended tubing for brazing connections, and as follows:
 - .1 Straight through type check valves are to be complete with a machined brass gasketed body, phosphor bronze spring, and neoprene seat.
 - .2 Globe type check valves are to be complete with a cast bronze body, forged brass cap, phosphor bronze spring, Teflon seat disc, and neoprene O-ring seal.

2.6 Piping Traps

- .1 Mueller Industries Inc. Style No. WE-554P brazing end copper "P" traps.

2.7 Pressure Vessel Relief Valves

- .1 Mueller Industries Inc. "Safety-master", factory set pressure relief valves, straight through or angle type as required, each constructed in accordance with requirements of ANSI Code B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire.

2.8 Refrigerant Liquid Moisture Indicators

- .1 Mueller Industries Inc. "Vuemaster", forged brass, triple sealed, CSA certified liquid moisture indicators, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with a liquid indicator which shows "FULL" when the system is fully charged with refrigerant and remains blank when there is a restriction or shortage of refrigerant in the liquid line, a moisture indicator which changes colour from blue to pink when moisture is present in the system, a plastic dust cover, and extended copper tube brazing connections.

2.9 Liquid Line Filter-Drier

- .1 Mueller Industries Inc. "Drymaster Micro-Guard" CSA certified filter-driers, each suitable for a maximum 3445 kPa (500 psi) working pressure and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.

2.10 Flexible Piping Connections

- .1 Senior Flexonics Canada "VIBRA-SORBERS" phosphor bronze construction, factory cleaned, dried, and sealed flexible piping connections with copper tube brazing ends. Acceptable manufacturers are:
 - .1 Senior Flexonics Canada.
 - .2 The Metraflex Co.

2.11 Refrigerant

- .1 Refrigerant shall be R410a.

3 EXECUTION

3.1 Installation of Refrigerant Piping, Valves & Specialties

- .1 Refer to VRF system manufacturer installation instruction. Installer must be trained and approved by VRF system manufacturer.

- .2 Provide all required refrigerant piping. Piping shall be type ACR copper with wrought copper fittings. Install piping in accordance with requirements of reviewed refrigerant piping schematics referred to in Part 1 of this Section.
- .3 Make all refrigerant piping joints using a light coat of approved brazing flux applied to both pipe and fitting. Do not use acid flux. During the brazing process, ensure that the pipe and fittings are kept full of nitrogen or carbon dioxide to prevent scale formation inside the pipe and fitting.
- .4 Where shown or specified, use soft copper refrigerant piping line sets.
- .5 Provide shut-off valves to isolate each piece of equipment if shut-off valves are not supplied integral with the equipment. Shut-off valves inside the building are to be ball or diaphragm type. Shut-off valves outside the building are to be diaphragm type.
- .6 Provide a refrigerant charging valve for each system if such a valve is not supplied integral with the equipment.
- .7 Provide all refrigerant piping accessories shown and/or required and install in accordance with the manufacturer's recommendations.
- .8 Provide all required refrigerant.
- .9 Provide flexible connections at piping connections to roof mounted condensing units. Install in accordance with the manufacturer's instructions.
- .10 Provide expansion valves where shown and/or required, each matched to the coil and installed in accordance with the manufacturer's instructions.

END OF SECTION

1. GENERAL

1.1 SYSTEM DESCRIPTION

- A. The variable capacity, heat pump/heat recovery air conditioning system shall be a SAMSUNG Electronics DVM S (Variable Refrigerant Flow) System. The DVM S systems shall be HR (simultaneous cooling and heating) split system heat recovery or HP (cool/heat) split system heat pump with multiple indoor units.

1.2 PIPING

- A. Piping to multiple indoor units requires additional piping components. The VRF equipment manufacturer's Y-joint fittings and/or Heat Recovery Mode Control Units (MCU) must be used to branch the main refrigerant lines.
- B. The VRF equipment manufacturer's Tee fittings must be used to connect outdoor units when multiple module systems are being installed (systems with more than one outdoor unit).

1.3 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit. Additional refrigerant is required based on diameters and lengths of system liquid refrigerant lines and indoor equipment model and quantity.
- E. The installing contractor must have attended Samsung DVM S installation training prior to installing the system.
- F. Service and installation manuals must be readily available on the manufacturer's website without entering a username and password.

2. OUTDOOR UNITS

2.1 DVM S ECO HEAT RECOVERY CONDENSING UNIT (208/230V, 1Ø)

- A. The heat recovery system shall consist of an AM060NXMDCR/AA outdoor unit, multiple indoor units, and SAMSUNG DVM S NASA Control Network Solution (Control systems). The AM060NXMDCR/AA outdoor unit shall be a horizontal discharge, 208/230-volt, single phase unit. The AM060NXMDCR/AA outdoor system model numbers and the associated number of connectable indoor units per AM060NXMDCR/AA outdoor unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.

A. General:

- 1. The heat recovery outdoor unit shall be specifically used with SAMSUNG DVM S Heat recovery components. The SAMSUNG DVM S ECO HR system shall consist of

- AM0**NXMDCR/AA outdoor unit, HR Changer (MCU-R4NEK0N), additional MCU's (mode control units) if required, indoor units, and SAMSUNG DVM S NASA Control Network Solution (Control systems). AM060NXMDCR/AA outdoor units shall be equipped with multiple circuit boards that interface to the SAMSUNG DVM S NASA Control Network Solution (Control systems) and shall perform all functions necessary for operation. The outdoor unit shall have a powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
2. The sum of connected capacity of all indoor air handlers shall range from 50% to 130% of outdoor rated capacity.
 3. The heat recovery system compressors shall be SAMSUNG, hermetically sealed, inverter driven, Twin BLDC Rotary type flash injected, asymmetric scroll (AM060NXMDCR/AA only). No fixed capacity compressors shall be present in the refrigerant system.
 4. All refrigerant lines from the outdoor unit shall be insulated.
 5. The heat recovery outdoor unit shall have an accumulator.
 6. The heat recovery outdoor unit shall have a high-pressure safety switch, over-current protection, thermal fan protection, low pressure protection, compressor overcurrent protection, fan motor voltage protection, current transformer(s), crank case heating, and intelligent logic to ensure proper operation within unit design limitations and operational parameters.
 7. The heat recovery outdoor unit shall have the ability to operate with a maximum height difference of 164 feet with the condensing unit installed higher than the indoor units or 131 feet with the condensers installed lower than the indoor units. The greatest length is not to exceed 492 (574 equivalent) feet between outdoor unit and the farthest indoor unit.
 8. The heat recovery outdoor unit shall be capable of operating in cooling mode between 0°F ~ 118°F (-18°C ~ 48°C) outdoor ambient temperatures. When outdoor temperature is between 0°F ~ 23°F (-18°C ~ -5°C), wind baffles are required. When outdoor temperature is between 0°F ~ 23°F (-18°C ~ -5°C), 50% operating capacity should be maintained to ensure reliability while in cooling mode.
 9. The heat recovery outdoor unit shall be capable of operating in heating mode between -13°F ~ 75°F (-25°C ~ 24°C) ambient temperatures.
 10. The heat recovery system shall have installer enabled snow blowing settings to prevent snow accumulation in front of idle outdoor units during when below 42° F.
 11. The heat recovery shall have the ability to adjust cooling and heating temperature/pressure compensation values depending on project conditions thus saving energy.
 12. The heat recovery outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 13. The heat recovery outdoor unit shall have a flat plate type sub-cooler to sub cool liquid refrigerant further to increase capacity and performance with long pipe lengths and to decrease refrigerant sounds at indoor equipment.

14. The heat recovery system shall have optional night quite modes to reduce unit sound in evenings (automatic activation or manual activation using MIM-B14 external contact interface module).
15. The heat recovery system shall have current control to limit current adjustable at outdoor unit. Maximum current limitation shall allow setting of 50 ~ 100% current limitation from design current in 5% increments.
16. The heat recovery outdoor unit shall have a removable EEPROM at the main PCB to store all unit data. All data on the outdoor unit EEPROM shall be viewable from the manufacturer provided service software. The outdoor unit main EEPROM shall be removable allowing replacement of outdoor unit PCB without losing digital, field programmed data. The outdoor unit removable EEPROM shall store the following unit data: unit model number, unit serial number, unit main PCB firmware and MICOM version, sub-PCB firmware and MICOM version, fan PCB firmware and MICOM version, inverter PCB 1 and inverter PCB 2 firmware and MICOM version, auto-trial commissioning startup data, the last 30 minutes of operation data, and field programmed unit name/tag viewable on controls and service software.
17. The heat recovery outdoor unit shall have outdoor unit pump-down operation capability allowing storage of refrigerant while opening sealed refrigerant pipe system outside of outdoor unit chassis while performing service. The outdoor unit refrigerant storage shall be greater than the supplied factory R-410A charge.
18. The heat recovery outdoor unit shall have individual outdoor module pump-out operation capability allowing the majority of refrigerant in an outdoor unit to be pumped out. The pump-out feature shall allow service of sealed refrigerant system within an outdoor unit chassis.
19. In the event of system error due to outdoor unit failure, the heat recovery outdoor unit shall display codes that specify a precise cause of error.
20. The heat recovery outdoor unit shall have adjustable defrost operation characteristics adjustable at the outdoor PCB.
21. The heat recovery outdoor unit shall support the installation of an optional Samsung base pan heater kit (MCH-015EE). The optional base pan heater function shall be field enabled after installation of the kit.

B. Unit Cabinet:

1. The chassis shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The heat recovery outdoor unit shall be furnished with 2 axial fans with BLDC motors.
2. All fan motors shall have inherent protection, thermal protection, and have permanently lubricated bearings, and be completely variable speed.
3. All fan motors shall be mounted for quiet operation.
4. All fans shall be provided with a raised guard to prevent contact with moving parts.
5. The outdoor unit shall have horizontal discharge airflow.

A. Refrigerant:

1. R410A refrigerant shall be required for the heat recovery system.
2. Additional refrigerant is required. Amount is based on installed refrigerant pipe diameters and lengths and connected indoor unit models.

D. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.
2. The coil shall be protected with an integral metal guard.
3. The Heat Recovery condensing unit salt spray test method: ASTM B117 - the heat exchanger showed no unusual rust or corrosion development to 2,280 hours.

E. Compressor:

1. Refrigerant flow from the AM060NXMDCR/AA heat recovery unit shall be controlled by means of a capacity modulation capable scroll compressor with flash injection. Flash injection technology is used to increase performance in both heating and cooling modes. This will be automatically enabled by the outdoor unit by forcing saturated refrigerant flash directly into the scroll compression cycle increasing mass flow and overall system capacity.
2. The heat recovery outdoor unit compressors shall have a soft-start function to reduce electricity demand during system start and to increase compressor reliability.
3. The compressors shall have crankcase heating capability.
4. The outdoor unit compressor shall have compressor controls that will allow modulation of capacity.
5. The compressor will be equipped with an internal thermal overload.
6. The compressor shall be mounted to avoid the transmission of vibration.

F. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.
2. The 208/230 VAC unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The outdoor unit shall be controlled by integral microprocessors.
4. The control circuit between the indoor units and the outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, 16 AWG, shielded, two-core cable to provide total integration of the system.

2.2 HR CHANGER (MODE CONTROL UNIT) FOR DVM S ECO 1Ø HEAT RECOVERY SYSTEMS (MCU-R4NEK0N)

A. General:

The HR CHANGER MCU (Mode Control Unit) shall be specifically used with R410A, AM0**NXMDCR/AA heat recovery outdoor units. These units shall be equipped with a circuit board that interfaces to the SAMSUNG DVM S NASA Control Network Solution (Control systems) and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The HR Changer MCU (Mode Control Unit) shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. The unit shall be mounted indoors.

Indoor unit connection data is noted below.

<u>MCU Model Number</u>	<u>Connectable Indoor Unit Qty.</u>	<u>Port Qty.</u>	<u>Sum of Indoor Unit Capacity (maximum)</u>
MCU-R4NEK0N	1 - 12	4	Up to 76,000 Btu/h

- MCU-R4NEK0N (HR Changer) shall have 4 ports with a maximum connected quantity of 12 indoor units (maximum 3 indoor units per port). The sum of indoor unit's capacity shall not exceed 19 MBH (19,000 btu/h) per port, and 76 MBH (76,000 btu/h) total. Two (2) adjacent ports shall be twinned using Y-Joint part number MXJ-YM1206R (purchased separately) when connecting indoor unit(s) greater than 19 MBH (19,000 btu/h), but less than 48 MBH (48,000 btu/h). The MCU-R4NEK0N shall not connect under-ceiling indoor units without the installation of single zone EEV kits (MEV-A**SA). MCU-R4NEK0N shall allow series connection of additional MCU's reducing Y-joint installation to a maximum capacity of (76 MBH) 76,000 btu/h. The MCU-R4NEK0N is only compatible with AM***NXMDCR/AA (DVM S ECO), and must be installed on every system.

B. HR CHANGER MCU (Mode Control Unit) Cabinet:

- The chassis shall be fabricated of galvanized steel.
- Each cabinet shall house multiple refrigeration control solenoid valves and electronic expansion valves.
- MCU-R4NEK0N shall house four tube-in-tube subcooling devices with electronic expansion valve and temperature sensors to maintain design refrigerant temperatures (sub cooling). All pipe connections shall be brazed type.

C. Refrigerant:

- R410A refrigerant shall be required for MCU's (Mode Control Units).

D. Refrigerant valves:

- The unit shall be furnished with multiple two position solenoid valves.
- When connecting an indoor unit greater than 19,000 btu/h and less than or equal to 48,000 btu/h to MCU-R4NEK0N (HR Changer) or MCU-S4NEK3N, two adjacent branch circuits shall be joined together at the branch controller to deliver an appropriate amount of refrigerant. The two refrigerant valves shall operate simultaneously. The Y-joints necessary to connect 2 circuits or ports are sold separately.
- Electronic expansion valves and solenoid valves shall be used to control the variable refrigerant flow inside each HR Changer MCU (Mode Control Units).

E. Integral Drain Pan:

- Drain connection is not required.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1 phase, and 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
3. The MCU (Mode Control Unit) shall be controlled by integral microprocessors.
4. The control circuit between the indoor units, MCU (Mode Control Unit) and the heat pump/heat recovery outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two conductor, 16 AWG, shielded cable to provide total integration of the system.

3. INDOOR UNITS AND ACCESSORIES

3.1 WINDFREE™ MINI 4-WAY CEILING CASSETTE WITH GRILLE INDOOR UNIT (AM0**NNNDCH/AA)

A. General:

The indoor unit shall be a WindFree™ mini 4-way cassette style indoor unit that recesses into the ceiling with a ceiling grille (ordered separately, WindFree™ fascia panel part number: PC4SUFMUN) and shall have a modulating expansion device. The mini 4-way cassette shall be compatible with DVM S HR (Heat Recovery) outdoor units and MCU (Mode Control Unit) or DVM S HP (Heat Pump) outdoor units. The WindFree™ mini 4-way cassette shall have an optional motion detection sensor (MCR-SMD) to enable/disable the unit based on motion with optional time delay settings. (Refer to Part 4 of this specification for more MCR-SMD details). The WindFree™ mini 4-way cassette shall support individual control using SAMSUNG DVM S NASA Control Network Solution (Control systems).

1. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air (Nitrogen gas) before shipment from the factory.
2. The indoor unit shall include a WindFree™ function that will close the supply air outlet louvers while in cooling mode to gently disperse cool air into the space through thousands of micro-holes on the fascia panel without blowing directly onto occupants. WindFree™ operation prevents direct airflow onto occupants thus increasing occupant comfort.
3. The WindFree™ feature is optional and can be enabled using local and central control options provided by the VRF manufacturer.
4. The indoor unit WindFree™ fascia panel shall include a humidity sensor to prevent condensation formation by restricting WindFree™ operation in high humidity conditions.

** The WindFree™ unit delivers an air current that is under 0.15 m/s while in WindFree™ mode. Air velocity that is below 0.15 m/s is considered "still air" as defined by ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers).*

B. Unit Cabinet:

1. The cabinet shall be space-saving ceiling-recessed cassette.

2. Service of electronics, high and low voltage connection, condensate pump, fan, fan motor, sensors, EEV, condensate pan, and other components shall be accessible from the bottom of the cassette unit not requiring access from the sides of the unit.
3. Construction shall be insulated HIPS chassis with a galvanized steel frame and fascia panel certified to UL94 V0.
4. The cabinet panel shall have provisions for a field installed, filtered, outside air intake. A booster fan is necessary. A 12V DC relay terminal is available to control the booster fan (with separate PCB connector).
5. The compact cabinet size can be installed in one standard ceiling tile (24" x 24").
6. The indoor unit fascia panel shall have LED indicator lights on the front and an IR receiver for wireless controller use.
7. PC4SUFMUN cassette fascia panel is 24 3/8" X 24 3/8" to not overlap past a standard 24" X 24" ceiling grid.

C. Fan:

1. The indoor fan assembly shall be a turbo fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
1. The indoor fan shall consist of three (3) speeds, Low, Mid, and High. Auto fan speed setting is available.
3. The auto air swing vanes (4) shall be capable of automatically swinging up and down for uniform air distribution.
4. The supply air vanes shall have independent control capability (32° – 65° control range) adjustable with optional wireless or wired controllers.
5. The cabinet shall have a fresh air intake opening to accommodate the introduction of fresh air into the space.

D. Filter:

1. Return air shall be filtered by means of a long-life washable permanent filter included with fascia panel.

E. Coil:

1. The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain outlet shall be provided under the coil.

6. The coil fins are coated with hydrophilic paints.
7. The condensate lift mechanism shall be able to raise drain water 29 inches above the condensate pan with float switch.
8. Both refrigerant lines to the mini four-way cassette indoor units shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, and 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The control circuit between the indoor units, MCU (Mode Control Unit) and the heat pump/heat recovery outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable to provide total integration of the system
4. The indoor unit shall have a thermal fuse under high-voltage terminal block to disable unit in the event of overheating due to electrical malfunction/poor connection.

G. Controls:

1. This unit shall use controls provided by the VRF manufacturer to perform functions necessary to operate the system. Please refer to the "Controls" section of this guide specification for details on controllers and other control options.
2. The indoor unit shall have a removable EEPROM on its PCB to store all unit data. All data on the indoor unit EEPROM shall be viewable from the manufacturer provided service software. The indoor unit main EEPROM shall be removable allowing replacement of indoor unit PCB without losing digital, field programmed data. The indoor unit removable EEPROM shall store the following unit data: unit model number, unit serial number, unit PCB firmware and MICOM version, and field programmed unit name/tag viewable on controls and service software.
3. The indoor unit shall have advanced external heater control programming capability for supplemental heat. External heat control shall be done with MIM-B14 external contact control module (refer to the "Controls" section of this guide specification). External heat control signal shall enable and disable a supplemental heat source based on selectable room temperature and set temperature differences. External heat control signal shall include a selectable time delay before the supplemental external heat source is activated.
4. The indoor unit shall have advanced unoccupied room control capability. Unoccupied room control can be used to reduce system demand when a room is not occupied by changing zone settings. Unoccupied room control shall be done with MIM-B14 external contact control module (refer to the "Controls" section of this guide specification). The unoccupied settings can be modified central control gateways provided by the VRF manufacturer or programmed with the manufacturer provided service software. Unoccupied room control shall provide four setting options to modify indoor unit operation when in "unoccupied mode". Settings shall include indoor unit ON/OFF, fan speed, and set temperature adjustment.
5. The indoor unit shall feature a Dual Set point function that allows users to set separate heating and cooling set temperatures using MWR-WG00UN wired controller and central control options MIM-D01AUN, MIM-B17BUN, and MIM-B18BUN. Dual set temperature allows the

user to specify a dead-band where the unit will not heat or cool when room temperature is between the heating and cooling set temperatures. Dual set temperature can be used with heat pump or heat recovery systems.

6. The indoor unit shall feature an Emergency Temperature Output (ETO) function that will provide a signal when an indoor unit is in error status. When enabling ETO, a high room temperature threshold can also be programmed to provide a signal when the room temperature limit has been exceeded. The ETO signal can be used to activate backup systems, provide a simple signal to a building management system, or to provide a simple visual/audible notification locally (ex: LED, buzzer, etc.). An MIM-B14 External Contact Control interface module is required for each unit that will provide or receive an ETO signal.

3.2 WINDFREE™ HIGH WALL INDOOR UNIT (AM0**TNVDCH/AA)

A. General:

The wall-mounted indoor unit section shall have a slim silhouette. The wall-mounted indoor unit shall be compatible with DVM S HR (Heat Recovery) outdoor units and MCU (Mode Control Unit, MCU-S*NE**N) or DVM S HP (Heat Pump) outdoor units. The wall-mounted indoor unit shall support individual control using SAMSUNG DVM S NASA Control Network Solution (Control systems

Indoor Unit:

1. The indoor unit shall feature WindFree™ operation. WindFree™ mode will close the air outlet louver and disperse air into the space through thousands of micro-holes on the front of chassis and the air outlet louver keeping the space cool without cold drafts. The WindFree™ unit delivers an air current that is under 0.15 m/s while in WindFree™ mode. Air velocity that is below 0.15 m/s is considered “still air” as defined by ASHRAE 55-2013 (American Society of Heating, Refrigerating, and Air-Conditioning Engineers).
2. WindFree™ mode only operates in Cooling and Dry modes.
3. The indoor unit shall automatically enter WindFree™ mode, as the room temperature approaches set temperature, when 2-Step cooling function is set.
4. The indoor unit can be manually put into “WindFree™” mode with an optional wired controller, wireless controller, or central control.
5. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, control circuit board and fan motor.

B. Unit Cabinet:

1. The casing shall have a gloss white finish, HIPS chassis certified to UL94 V0.
2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and four (4) directions for draining shall be standard.
3. Drain hose shall be on the right-hand side of the drain pan (when facing the front) as standard with optional left-hand side connection.
4. There shall be a separate galvanized steel mounting plate which secures the unit firmly to the

wall.

5. The indoor unit shall have easy-access pipe and drain connections via access panel on front of unit for easier installation and service allowing maintenance without pulling the unit out from the wall thus preventing property damage.
6. Two digit, 7-segment display on the front of the unit, shall provide unit operation, temperature, and error status.

C. Fan:

1. The indoor fan assembly shall be a crossflow fan direct driven by a single motor.
2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
3. Motorized air sweep louvers shall provide automatic change in airflow by directing the air up and down and left to right to provide uniform air distribution.
4. The indoor fan shall consist of three (3) speeds, High, Mid, and Low. Auto fan speed setting is available.

D. Filter:

1. Return air shall be filtered by means of an electro-static, pleated, easily removable, washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with slit fins on copper tubing.
2. The tubing shall have inner grooves for high efficiency heat exchange.
3. All tube joints shall be brazed with phos-copper or silver alloy.
4. The coils shall be pressure tested at the factory.
5. A condensate pan and drain shall be provided under the coil.
6. The coil fins are coated with hydrophilic paints.
7. Both refrigerant lines to the wall-mounted indoor unit shall be insulated.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).
3. The control circuit between the indoor units, MCU (Mode Control Unit) and the heat pump/heat recovery outdoor unit shall be 0.5VDC - 7VDC completed using stranded, annealed copper conductor, two-core, 16 AWG, shielded cable to provide total integration of the system.

4. The indoor unit shall have a thermal fuse under the high-voltage terminal block to disable unit in the event of overheating due to electrical malfunction/poor connection.

G. Controls:

1. This unit shall use controls provided by the VRF manufacturer to perform functions necessary to operate the system. Please refer to the "Controls" section of this guide specification for details on controllers and other control options.
2. The indoor unit shall have An EEPROM on its PCB to store all unit data. All data on the indoor unit EEPROM shall be viewable from the manufacturer provided service software. The indoor unit EEPROM shall store the following unit data: unit model number, unit serial number, unit PCB firmware and MICOM version, and field programmed unit name/tag viewable on controls and service software.
3. The indoor unit shall have advanced external heater control programming capability for supplemental heat. External heat control shall be done with MIM-B14 external contact control module (refer to the "Controls" section of this guide specification). External heat control signal shall enable and disable a supplemental heat source based on selectable room temperature and set temperature differences. External heat control signal shall include a selectable time delay before the supplemental external heat source is activated.
4. The indoor unit shall have advanced unoccupied room control capability. Unoccupied room control can be used to reduce system demand when a room is not occupied by changing zone settings. Unoccupied room control shall be done with MIM-B14 external contact control module (refer to the "Controls" section of this guide specification). The unoccupied settings can be modified central control gateways provided by the VRF manufacturer or programmed with the manufacturer provided service software. Unoccupied room control shall provide four setting options to modify indoor unit operation when in "unoccupied mode". Settings shall include indoor unit ON/OFF, fan speed, and set temperature adjustment.
5. The indoor unit shall feature a Dual Set point function that allows users to set separate heating and cooling set temperatures using MWR-WG00UN wired controller and central control options MIM-D01AUN, MIM-B17BUN, and MIM-B18BUN. Dual set temperature allows the user to specify a dead-band where the unit will not heat or cool when room temperature is between the heating and cooling set temperatures. Dual set temperature can be used with heat pump or heat recovery systems.
6. The indoor unit shall feature an Emergency Temperature Output (ETO) function that will provide a signal when an indoor unit is in error status. When enabling ETO, a high room temperature threshold can also be programmed to provide a signal when the room temperature limit has been exceeded. The ETO signal can be used to activate backup systems, provide a simple signal to a building management system, or to provide a simple visual/audible notification locally (ex: LED, buzzer, etc.). An MIM-B14 External Contact Control interface module is required for each unit that will provide or receive an ETO signal.

4. CONTROLS

4.1 CONTROLS OVERVIEW

A. General:

The DVM S Controls Network Solution shall be capable of supporting remote controllers, schedule timers, system controllers, centralized controllers, an integrated web based interface,

graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

B. Electrical Characteristics:

1. General:

- (a) Local DVM S Controls Solution devices shall operate at 12V DC. Controller power and communications shall be via a common communications bus.
- (b) Central DVM S Controls Solution devices shall communicate via a common central layer communications bus.

C. Wiring:

- 1. Main system control wiring (COM1, F1/F2) shall be installed in a system daisy chain configuration from the indoor equipment to MAIN outdoor unit. This cable shall be 16 AWG X 2, shielded cable.
- 2. Zone control wiring (COM2, F3/F4) to wired remote controllers (MWR-*****N) shall be run from the indoor unit terminal block to the controller associated with that unit. This cable shall be 16 AWG X 2, shielded cable.
- 3. Control wiring for system controllers and centralized controllers (upper level) shall be installed in a daisy chain configuration from main condensing unit to main condensing unit (R1/R2), to system controllers.
- 4. Communication wire connection (OF1/OF2) between main outdoor unit modules (systems with 2 or more modules) must be connected from the MAIN unit to SUB1 and SUB2 (where applicable). This wire shall be 2-conductor, 16 AWG X 2, shielded cable.
- 5. MST-P3P (S-NET 3 software) shall be capable of being networked with up to 16: MIM-D00AN (DMS2), MIM-D01AUN (DMS2.5), MIM-B17N (BACnet gateway 2.0), MIM-B17BUN (BACnet gateway 2.5), MIM-B18 (LonWorks gateway2.0), and/or MIM-B18BUN (Lon Works gateway 2.5) system controllers for web/LAN based control for consolidated control.

D. Wiring type:

- 1. COM1 and COM2 control wiring shall be 2-conductor, 16 AWG X 2, shielded cable.
- 2. Network wiring shall be CAT-5e with RJ-45 connection.

4.2 DVM CONTROL NETWORK SOLUTION

A. General:

The SAMSUNG DVM S NASA Control Network Solution consists of remote controllers, system controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The SAMSUNG DVM S NASA Control Network Solution shall support operation monitoring, scheduling, error monitor, power distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces.

4.3 MULTI-FUNCTION CONTROLLER – ADVANCED WIRED CONTROLLER (MWR-WG00UN)

A. Compatibility:

1. DVM S systems (AM*****AA, MCM-D211UN), DVM Chiller FCU kits (MCM-F00N), 2020 RAC single zone high-wall units (AR**TSF*BWKNCV, RNS***BT), CAC indoor units (AC0***N****/AA) and FJM indoor units (AJ0**TN*DCH/AA, JNH***DT).

B. Connection:

1. The wired controller shall control up to 16 SAMSUNG indoor units (defined and controlled as one group).

C. Dimensions:

1. The wired controller shall be approximately 4 3/4" x 4 3/4" in size and white in color.

D. The wired controller shall control SAMSUNG indoor units as follows:

1. Air handler operation ON/OFF
2. Air handler operation mode, set temperature, air flow direction, fan speed, individual louver control (with supported indoor units).
3. Discharge air temperature (with supported indoor units)
4. Dual Set Temperature (with supported indoor units)
5. Setback function
6. Quiet and sleep modes
7. Error display (up to 10 error codes with descriptions)
8. Filter replacement alarm display and reset.
9. Single indoor unit control or multiple unit control (maximum 16 units)
10. Energy saving operation:
 - (a) Upper/lower temperature setting
 - (b) Automatic operation stop function
 - (c) Energy saving operation mode.
 - (d) Energy consumption monitoring
11. Weekly operating schedule setting:
 - (a) Weekly and yearly operating schedule
 - (b) Options to set: desired A/C operation mode, setting temperature, power mode (ON/OFF), and fan speed to operate based on weekly or daily schedules

(c) Optional schedule exception day setting

12. Advanced HP auto changeover control and configuration

13. Supports multiple languages.

14. Error code display with description (ten most recent error codes)

E. Other wired controller features:

1. Different button permission levels

2. Partial button lock option (on/off, temperature setting, fan speed, all modes, auto mode, cool mode, heat mode, dry mode, fan mode, and schedule setting buttons can be locked individually)

3. Backlight with option to dim the display after a specified time.

4. Daylight savings clock advance option

5. Upper and lower temperature setting restriction.

6. Heat mode skip (cooling only)

7. Restrict wireless controller signal (optional)

8. Real-time clock function - current time/day display function

9. Built in IR receiver for indoor unit control using a wireless controller and integral room temperature sensor.

10. Indoor unit operation state display

11. Indoor unit service mode support

12. Micro SD card slot for simple firmware updating.

13. Individual louver/blade control for 4-way and mini 4-way cassettes.

14. Individual air direction control for 360 Cassette indoor units.

15. Quiet Mode setting (for supported units)

16. Service mode for connected indoor unit operation monitoring, addressing, and set-up.

17. Built-in room temperature sensor

18. Indoor unit operation state display

19. Service mode support (Indoor unit addressing, indoor unit cycle data monitoring, option code monitoring and setting, and option setting/monitoring).

20. Time synchronization with central control gateways provided by the VRF manufacturer.

21. WindFree™ display and control for supported indoor unit models.

22. Motion Detection Sensor Control (On/Off, Indirect/Direct) for supported indoor unit models. Indirect/Direct control only applies to supported units that have MCR-SMC and MCR-SMD installed.
23. Clean and Long reach function for supported indoor unit models.
24. Automatic air volume enable and status viewing (for Duct S models AM0**MNMDCH/AA, AM0**MNHDCH/AA, and AM0**RNMDCH/AA).
25. Maximum current control for DVM S 3Ø outdoor systems

F. Specifications:

1. Two (2) conductor connection, PLC, (F3/F4).
2. DC 12V (power supplied by indoor unit via F3/F4 connection).
3. RS485 communication (F3/F4).
4. Can sense temperature via internal sensor, temperature sensor inside the air handler, or use the average temperature between controller and air handler temperature sensors.
5. The wired controller shall have two screw terminals for wiring connections. Wire is not included with controller.
6. 16AWG X 2 shielded cable is necessary for proper operation.
7. The wired controller shall allow up to 328 feet of wire from the farthest connected indoor unit to the controller.

4.4 EXTERNAL CONTACT CONTROL INTERFACE MODULE (MIM-B14)

A. Function:

1. Indoor unit control/monitoring
 - (a) Control option to enable/disable and monitor a single indoor unit.
 - (b) Direct indoor unit control by external dry contact, 0 volts OPEN/CLOSE signal.
 - (c) Emergency control with simple contact input.
 - (d) Unoccupied room control with applicable indoor units.
 - (e) Supplemental, external heat control output with applicable indoor units.
 - (f) Indoor unit operation (thermal or operation)/error state output through relay contacts.
2. Outdoor unit control/monitoring
 - (a) System error monitoring (dry output).
 - (b) Manual nighttime quiet mode activation (for applicable systems).

B. Connection:

1. Installs inside or on the side of a single indoor unit.
2. Installs inside a MAIN outdoor unit.
3. Connection to indoor unit with included wire harnesses.

PRODUCTS

- .1 Acceptable manufacturers are:
 - .1 Samsung (Basis of Design)
 - .2 Daikin
 - .3 Mitsubishi Electric.
 - .4 LG

2 EXECUTION

2.1 Installation of Variable Refrigerant Flow System Equipment

- .1 Provide variable refrigerant flow system heating and air conditioning equipment for rooms and areas as shown.
- .2 Install equipment generally as shown but confirm exact locations prior to installation.
- .3 Provide all required refrigerant piping, valves, and accessories. Use Y-branch piping kits supplied by the system manufacturer for connecting multi-frame configuration outdoor units.
- .4 Ensure that ducts are connected to each indoor unit by means of flexible connection material, and that all field installed piping is site insulated.
- .5 Coordinate electrical power wiring to equipment with the electrical trade who will make the connections.
- .6 Do all required control and interconnection wiring in conduit (unless otherwise specified) in accordance with the equipment manufacturer's wiring diagrams and wiring requirements specified in electrical work Sections of this Specification.
- .7 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .8 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .9 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .10 **Demonstration and Training:** Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 8 hours of on-site heat recovery ventilator operation demonstration and training session for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section. Submit motor product data sheets and certified performance curves with all pump product data.

1.2 Base Bid and Approved Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Condensate Removal Pump

- .1 **Pump Model No. & Construction:** “Little Giant” Model No. CSA certified, tank mounted vertical centrifugal pump set with ABS pump housing, switch housing, and tank, polypropylene impeller, thermally protected fan cooled PSC motor with stainless steel shaft, two 28.6 mm (1 $\frac{1}{8}$ ”) diameter inlet openings, a 9.5 mm ($\frac{3}{8}$ ”) discharge opening with check valve, automatic start-stop, dual function NO and NC safety overflow switch with 125 mm (5”) lead wires, a high water level alarm contact, and 1.8 m (6’) of 3-conductor power cord with grounded 3-prong plug prewired to the pump motor.

3 EXECUTION

3.1 Installation of Condensate Removal Pumps

- .1 **Ducted fan coils have integral condensate pumps. Pipe condensate from all ducted fan coils to the nearest drain, sink / lav trap or rainwater leader.**
- .2 Provide condensate removal pumps where shown.
- .3 Provide all required mounting and connection hardware and secure in place where indicated.
- .4 Provide suction and discharge tubing. Indirectly terminate discharge tubing with proper slope over a suitable drain point.
- .5 Plug each pump into an adjacent receptacle, and prove proper operation in the presence of the Consultant.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section except shop fabricated ductwork and fittings.
- .2 **Test Data:** Submit duct leakage test data prior to ductwork being covered from view.

1.2 Quality Assurance

- .1 Ductwork shall be in accordance with requirements of the following Standards:
 - .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible.
 - .3 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems.
 - .4 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
 - .5 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

2 PRODUCTS

2.1 Galvanized Steel Ductwork

- .1 **General:** Galvanized steel sheet shall be hot dipped in accordance with requirements of ASTM A653. Galvanizing for bare uncovered duct to be finish painted shall be G60. All other galvanizing shall be G90.
- .2 **Rectangular:** Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.
- .3 **Round:** Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings, and couplings.
- .4 **Flat Oval:** Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings, and couplings.

2.2 Flexible Metallic Ductwork

- .1 **Flexible Ductwork is Not approved for healthcare project.**
- .2 **Bare:** Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, ANSI/SMACNA Form "M-UN", ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.
- .3 **Insulated:** Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, ANSI/SMACNA Form "M-I", ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1½") thick, 12 kg/m³ (0.75 lb/ft³) density, minimum 6 R-value fibreglass insulation with a vinyl jacket meeting flame spread and smoke developed requirements of CAN/ULC-S102.

2.3 Metal Duct System Joint Sealant

- .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 maximum flame spread rating of 5 and smoke developed rating of 0.

2.4 Acoustic Lining

- .1 Minimum 25 mm (1") thick acoustic lining material meeting NFPA 90A requirements and flame spread and smoke developed fire hazard ratings of CAN/ULC-S102, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fibreglass mat coated on the inside (airside) face with a black fire-resistant coating.

3 EXECUTION

3.1 Fabrication and Installation of Galvanized Steel Ductwork

- .1 Provide all required standard galvanized steel ductwork, rectangular and/or round and/or flat oval as shown. **Note** that where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
- .2 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct pressure class designation of **minimum** 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so that the ductwork does not "drum". All flat surfaces of rectangular ductwork are to be cross-broken. Duct system sealing shall meet ANSI/SMACNA Seal Class A requirements.
- .3 Prior to fabrication of ductwork, check all drawings for ceiling space, conflict with structural and architectural features and conditions, and the work of other trades, and if duct routing problems or obstructions occur, notify the Consultant immediately.
- .4 **Duct Routing and Dimensions:** Confirm the routing of all ductwork at the site and site measure ductwork prior to fabrication. Note that duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at the site are not grounds for a claim for an extra cost.
- .5 **Ducts Run within or Through OWSJ:** Refer to structural drawings. Where ductwork shall be run within or through open web steel joists, note that ductwork shown on the mechanical drawings is schematic only and shall be altered as required to suit the steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.
- .6 **Ductwork Located at Sprayed Fireproofing:** Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install the ductwork only after the fireproofing work is complete and do not compromise the fire rating of the sprayed fireproofing.
- .7 **Automatic Control Components:** Install (but do not connect) all duct system mounted automatic control components supplied as part of the automatic control work.
- .8 **Heat Transfer Equipment Connections:** Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
- .9 **Separate Reheat Coils:** Flange connect ductwork to reheat coils in accordance with requirements of the reheat coil connection detail in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. The coils will be suspended independent of connecting ductwork as part of the heat transfer work.
- .10 **Rectangular Duct Support Inside Building:** Support horizontal rectangular ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for all ducts that are exposed, and all concealed ducts wider than 500 mm (20").
- .11 **Round and Flat Oval Duct Support Inside Building:** Support round and flat oval ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If the duct is insulated, size the strap to suit the diameter of the insulated duct.
- .12 **Flanged Duct Joints:** Where flanged duct joints are used, do not locate the joints in wall or slab openings, or immediately at wall or slab openings. **Do not use flanged joints for exposed uninsulated ducts in finished areas.**

- .13 **Support of Roof Mounted Ducts:** As specified in the mechanical work Section entitled Duct System Dampers and Accessories.
- .14 **Watertight Ductwork:** Where watertight horizontal ductwork is required, construct the ducts without bottom longitudinal seams. Solder or weld the joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide the drain points. Provide watertight ductwork for:
 - .1 All galvanized steel ductwork outside the building or otherwise exposed to the elements.
 - .2 Fresh air intakes.
 - .3 Wherever else shown.
- .15 **Application of Sealants:** Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of the sealant.
- .16 **Protective Coating for Exposed Exterior Ducts:** Clean exterior exposed (uninsulated) ducts with a heavy full coverage of Bakor #410-02 black metal paint.
- .17 **Connection of Dissimilar Metal Ducts:** Where dissimilar metal ducts are to be connected, isolate the ducts by means of flexible duct connection material as specified in the Section entitled Duct System Dampers and Accessories.
- .18 **Cleanliness of Installed Ductwork:** Maintain all new ductwork in a clean condition. If, at Substantial Performance, in the Consultant's opinion, new ductwork is not in a clean condition, retain and pay for a certified duct cleaning company to clean all new ductwork using compressed air and vacuum cleaning equipment.
- .19 **Counterflashing Duct Roof Curbs:** Do all required counterflashing work for roof curbs for ductwork penetrating the roof. Counterflashing materials are to match roof flashing materials provided as part of the work of Division 07. Caulk around the top edge of the counterflashing, and attach vertical counterflashing to the curb using non-ferrous screws with coloured heads to match counterflashing if coloured material is used. Counterflashing work shall be watertight.
- .20 **Seismic Requirements:** In addition to ANSI/SMACNA duct construction standards specified above, ductwork shall be constructed and installed to meet seismic requirements of the Building Code and ANSI/SMACNA The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.2 Installation of Flexible Ductwork

- .1 **Flexible ductwork is not approved for healthcare projects.**
- .2 Provide maximum 900 mm (36") long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on the drawings.
- .3 Stretch out lengths of duct prior to cutting and installation.
- .4 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.
- .5 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
- .6 Do not penetrate fire barriers with flexible duct.

3.3 Installation of Acoustic Lining

- .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 Wherever shown and/or specified on the drawings.

- .2 Supply ductwork downstream of fan coils for a distance of 2.4 m (8') measured along the duct and outward from the box in all directions.
- .3 For all transfer air ducts.
- .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.4 Duct System Protection, Cleaning and Start-Up

- .1 Temporarily cover all open ends of new ducts during construction.
- .2 Vacuum all dirt and foreign matter from the entire duct systems and clean duct system terminals and the interior of air handling units prior to operating fans.
- .3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.
- .4 Provide cheesecloth over all duct system inlets and outlets and run the system for twenty-four hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.
- .5 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.

3.5 Testing, Adjusting, and Balancing

- .1 When work is complete and equipment is operating as intended, test, adjust and balance air flows and temperatures in accordance with requirements specified in the mechanical work Section entitled Testing, Adjusting, and Balancing.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for all products specified in this Section.
- .2 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all items for which a finish colour shall be selected.

1.2 Quality Assurance

- .1 Duct system dampers and accessories are to be in accordance with requirements of the following Standards:
 - .1 ASTM A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A240, Standard Specification for Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .3 ASTM A480, Specification for General Requirements for Flat-Trolled Stainless and Heat Resisting Steel Plate, Sheet, and Strip.
 - .4 ASTM B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - .5 ANSI/SMACNA HVAC Duct Construction Standards- Metal and Flexible.
 - .6 ANSI/SMACNA Round Industrial Duct Construction Standards.
 - .7 ANSI/SMACNA Rectangular Industrial Duct Construction Standards.
 - .8 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilation Systems.
 - .9 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
 - .10 CAN/ULC-S102, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
 - .11 American Conference of Governmental Hygienists, Industrial Ventilation: A Manual of Recommended Practice for Design.

1.3 Base Bid and Acceptable Manufacturers

- .1 Refer to the article entitled Equipment and Material Manufacturer Requirements in the Section entitled Mechanical Work General Instructions.
- .2 The following is a list of base bid and acceptable manufacturers for products specified in this Section:

PRODUCT	MANUFACTURERS
Manual Balancing (Volume) Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Backdraft Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Fusible Link Dampers	Nailor Industries Inc., NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Combination Fire/Smoke Dampers	Nailor Industries Inc., NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.
Flexible Connection Material	Duro Dyne Canada Inc., Dyn Air Inc.
Louvres	Price Industries Inc., The Airolite Co. LLC, Construction Specialties Inc., Nailor Industries Inc., Greenheck Fan Corp.
Motorized Control Dampers	Nailor Industries Inc., T. A. Morrison & Co. Inc. "TAMCO", NCA Manufacturing Ltd., Greenheck Fan Corp., Ruskin Co.

2 PRODUCTS

2.1 Round to Rectangular Duct Connections

- .1 Galvanized steel, flared, flanged or notched as required, "SPIN-IN" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.2 Splitter Dampers

- .1 Minimum #20 gauge damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to Dyn Air Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.3 Air Turning Vanes

- .1 For square elbows - multiple-radius turning vanes with runner channels, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.4 Manual Balancing (Volume) Dampers

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of the same material as the connecting ductwork unless otherwise specified, each designed to maintain the internal free area of the connecting duct, and each complete with:
 - .1 A hexagonal or square shaft extension through the frame.
 - .2 Non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers.
 - .3 Blade stops for single blade dampers, designed to prevent the blade from moving more than 90°.
 - .4 Linkage for multiple blade dampers.
 - .5 A locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.
- .2 **Rectangular Dampers:** Maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 **Round Dampers:** Maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 **Multiple Rectangular Damper Section Assembly:** Rectangular assembly supplied with the dampers or site constructed of the same material as the damper and designed for tight and secure mounting of the individual dampers.

2.5 Backdraft Dampers

- .1 Counterbalanced backdraft dampers, 65 mm (2½") deep, sized as shown and complete with:
 - .1 Extruded aluminum frame and blades, minimum 1.58 mm (1/16") thick, with captive extruded silicone blade gaskets and side seals in slots integral with the aluminum extrusions.
 - .2 Damper blade counterweights internal to the frame and consisting of adjustable weights fastened to brackets which are riveted to the blades.

- .3 Dual PVC linkage tracks at each end of the blades, and non-corrosive linkage with hard alloy aluminum pivot arm and bearings equal to Ticona "Celcon" acetal copolymer bearings.

2.6 Fusible Link Dampers

- .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to Standard CAN/ULC-S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1 1/2 hour or 3 hour rated as required, and complete with a constant force type 301 stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.
- .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with the folded curtain blade out of the air stream except where damper size or location requires the use of type "A" dampers with the curtain blade in the air stream.

2.7 Combination Fire/Smoke Dampers

- .1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) combination fire/smoke dampers, ULC classified to Standard CAN/ULC-S112, 1 1/2 hour fire rated, leakage Class I smoke rated, normally closed, low pressure drop design, dynamically tested, type "B" or "C" as required, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the fire barrier opening, a fusible link to close and lock the damper without disengaging the actuator, and an electric 115 volt actuator to automatically close the damper upon receiving an external signal, and to automatically open the damper when the system is reset.

2.8 Flexible Connection Material

- .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.
- .2 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.

2.9 Roof Duct Supports

- .1 Equal to Lexcor (Lexsuo Corp.) Series SS-A215 "Flash-Tite" adjustable height, insulated aluminum structural supports, each complete with two-piece telescoping flashing, a baseplate to suit the application, a threaded cap with plate, and a 12 mm x 40 mm (1/2" x 1 1/2") threaded stainless steel top stud.

2.10 Duct Access Doors

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, generally with sizes suitable in all respects for the purpose for which they are provided but minimum 225 mm x 225 mm (9" x 9") for hand access and 450 mm x 450 mm (18" x 18") for man access, and, unless otherwise specified, constructed of the same material as the duct they are associated with.

2.11 Ductwork Drain Points

- .1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm (3/4") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.12 Instrument Test Ports

- .1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leak-proof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.13 Wire Mesh (Bird Screen)

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm ($\frac{1}{2}$ " x $\frac{1}{2}$ ") secured in a rigid galvanized steel or aluminum framework, sized as indicated on the drawings, and constructed so as to be removable.

2.14 Louvres

- .1 Factory assembled, stationary, drainable, 100 mm (4") or 150 mm (6") deep (to suit wall thickness) storm-proof louvres sized as indicated on the drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, mounting and securing hardware to suit the application, and 12 mm ($\frac{1}{2}$ ") mesh aluminum bird screen in an aluminum frame.
- .2 Louvres are to be factory finished with a finish equal to PPG Industries "Duranar" fluoropolymer powder coating over primer with colour as selected from the manufacturer's standard colour range.

2.15 Louvre Blank-Off Panels

- .1 Insulated, framed, sandwich construction panels consisting of 40 mm ($1\frac{1}{2}$ ") thick rigid insulation (meeting NFPA 90A requirements) between minimum #20 gauge galvanized sheet steel with the exterior face of the panels finished to match the finish of the exterior wall louvres.

2.16 Motorized Control Dampers

- .1 Factory assembled, 100 mm (4") deep, flanged aluminum control dampers with AMCA certified maximum leakage through a 1.2 m x 1.2 m (4' x 4') damper of 52 L/s/m² (110 ft³/min) against 1 kPa (0.145 psi) differential static pressure. Control dampers for mixing applications are to be parallel blade type. Control dampers for open-shut service are to be opposed blade type.
- .2 **Standard Damper:** Standard dampers are to be complete with:
 - .1 Extruded 6063T5 aluminum frame and blades, each with an integral slot to receive a gasket.
 - .2 Extruded silicone frame gaskets and extruded EPDM blade gaskets.
 - .3 Slip-proof aluminum and corrosion resistant plated steel linkage concealed in the frame, equipped with self-sealing and self-lubricating bearings consisting of an inner bearing equal to a Ticona "Celcon" bearing fixed on the hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in the frame.
- .3 **Insulated Damper:** As specified for standard dampers but with all 4 sides of the frames insulated with injected polyurethane foam, and with the blades thermally broken and insulated with expanded polyurethane foam.
- .4 **Damper Motor:** Equal to Belimo CSA certified, spring return, direct coupled electric motor damper actuator, 120 volt or 24 volt as required, electronic overload protected, complete with position indicator, a housing to suit the mounting location, and additional features as required to suit the application and control sequence.

2.17 Sheet Metal Shields for Electrical Equipment

- .1 Galvanized G90 trough type shields, water-tight, sized as required to protect Electrical Room and Equipment Room electrical distribution equipment and other electrical system equipment from water from overhead fire protection sprinklers, with metal gauges appropriate for the size of the assembly, and sloped to drain at a end cap drain connection.

3 EXECUTION

3.1 Installation of Round to Rectangular Duct Connections

- .1 Cut round holes in rectangular ducts using a purpose made hole cutter and provide round to rectangular "Spin-In fittings with dampers for connection of flexible round ductwork. Seal the cut duct around the fitting.

3.2 Installation of Splitter Dampers

- .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on the drawings. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location. Ensure that operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.3 Installation of Turning Vanes

- .1 Provide turning vanes in ductwork square elbows where shown on the drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.4 Installation of Manual Balancing (Volume) Dampers

- .1 Provide manual balancing dampers in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install balancing dampers at least 2 m (6') upstream of grilles and diffusers where space permits.
- .3 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .4 Where a duct for which a balancing damper is required has dimensions larger than the dimensions of the maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.
- .5 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.5 Installation of Backdraft Dampers

- .1 Provide backdraft dampers where shown, including at the inlet to any exhaust fan not equipped with an automatic control damper.
- .2 Install and secure the dampers so that they cannot move or rattle.

3.6 Installation of Fusible Link Dampers

- .1 Provide fusible link dampers where shown and/or specified on the drawings. Ensure that the damper rating (1½ or 3 hr.) is suitable for the fire barrier it is associated with.
- .2 Install dampers with retaining angles on all four sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper manufacturer's instructions and details to meet Code requirements.
- .3 Provide expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.
- .4 When requested by the Owner or Consultant, demonstrate operation of several randomly picked fire dampers, and reset after successful demonstration.

3.7 Installation of Combination Fire/Smoke Dampers

- .1 Provide combination fire/smoke dampers where shown and/or specified on the drawings. Install dampers with retaining angles on all four sides of each side of the damper, and,

where required, connect with ductwork, all in accordance with the damper manufacturer's instructions and details, and Code requirements.

- .2 Coordinate damper installation with the electrical work where electrical connections to damper actuators are specified.

3.8 Installation of Flexible Connection Material

- .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or casings connect to fans, and wherever else shown or specified.
- .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.9 Installation of Roof Mounted Duct Supports

- .1 Supply supports for roof mounted ductwork as indicated.
- .2 Hand the adjustable structural supports to the roofing trade on the roof for installation and flashing into roof construction as part of the roofing work. Accurately mark the exact locations and spacing of the structural supports and supervise installation. Provide properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and provide galvanized steel banding to secure ducts to the angles.

3.10 Installation of Duct Access Doors

- .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Locate access doors at both the air entering and leaving side of each device.
- .2 Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure that the doors are properly located for damper maintenance.
- .4 When requested, submit a sample of proposed duct access doors for review.
- .5 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce the ductwork to suit the access door installed.

3.11 Installation of Instruments Test Ports

- .1 Provide instrument test ports in all main ducts at connections to fans, plenums, or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.
- .2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.12 Installation of Wire Mesh (Bird Screen)

- .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on the drawings. Rigidly secure in place but ensure the panels are removable.
- .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on the drawings or not.

3.13 Installation of Louvres

- .1 Provide louvres for wall openings where shown.

- .2 Install louvre assemblies and secure in place in accordance with the manufacturer's instructions and details.
- .3 Confirm exact louvre sizes and finish prior to ordering.

3.14 Installation of Louvre Blank-Off Panels

- .1 Provide blank-off panels for inactive portions of exterior wall louvres.
- .2 Secure the panels in place with non-ferrous hardware so that they cannot move or rattle, yet are easily removable.
- .3 Confirm exact finish of panels prior to fabrication.

3.15 Installation of Brick and Block Vents

- .1 Supply brick or block vents for installation in exterior walls where shown.
- .2 Hand the assemblies to the masonry trade for installation.
- .3 Accurately mark exact locations and coordinate installation.

3.16 Installation of Motorized Control Dampers

- .1 Provide motorized control dampers where shown. Secure in place to prevent movement or rattle, and to prevent air bypass around the damper.
- .2 Provide insulated dampers in fresh air intake ductwork or openings, and for exhaust air service at exterior walls.
- .3 Equip each damper with an electric motor actuator, 120 volt or 24 volt as required. Ensure that each actuator is equipped with all required features to suit the application.

3.17 Installation of Shop Fabricated Exhaust Hoods

- .1 Provide shop fabricated exhaust hoods where shown. Abide by installation requirements in the American Conference of Governmental Hygienists, Industrial Ventilation: A Manual of Recommended Practice for Design.
- .2 Rigidly secure each hood in place. Connect with ductwork as indicated.
- .3 Support and securement hardware shall be manufactured from the same material/finish as the hood.

3.18 Control Wiring

- .1 Provide all required power wiring for controls from 15A-1P circuits terminated in junction boxes adjacent to the control work, and do all control wiring to connect control components.
- .2 Install wiring in conduit in accordance with electrical work wiring material and installation requirements.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for inline fans and accessories. Include the following:
 - .1 Certified fan performance curves.
 - .2 Product data for all accessories.
 - .3 Product data for fan motors.
- .2 **Factory Inspection Report:** Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O & M Manual project close-out data.
- .3 **Site Inspection and Start-Up Report:** Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.

1.2 Quality Assurance

- .1 Inline fan manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.
 - .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance.
 - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
 - .4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance.
 - .5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

1.3 Base Bid and Approved Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Centrifugal Inline Fans

- .1 Centrifugal, ULC listed, factory run tested rectangular inline fans as per the drawing schedule.
- .2 **Housing:** Heavy-gauge galvanized steel with removable side panels to permit removal of the power assembly without disturbing duct connections, universal mounting brackets and hardware including spring vibration isolators to accommodate horizontal or vertical mounting as required, a flanged inlet panel with inlet venturi, a flanged outlet panel, both with duct connection collars, and galvanized steel wire grid fan inlet/outlet guard(s).
- .3 **Fan Wheel:** Non-overloading aluminium wheel with backward inclined blades with matching inlet venturi, statically and dynamically balanced as an assembly.
- .4 **Motor and Disconnect Switch:** TEFC motor conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods, mounted out of the airstream, complete with a cover, and factory prewired to a NEMA 4 disconnect switch.
- .5 **Accessories:** for fans as scheduled, factory supplied accessories as follows:
 - .1 For fans as scheduled, housing insulation (lining), consisting of neoprene spray coated glass fibre semi-rigid insulation meeting NFPA 90A requirements and 25/50 smoke developed/flame spread requirements of CAN/ULC S102, permanently secured in place with no exposed edges.
 - .2 For fans as scheduled, a galvanized steel filter box with frame suitable for 25 mm (2") thick MERV 7 disposable panel type filters.
 - .3 Factory secured seismic restraint connection hardware.

3 EXECUTION

3.1 Installation of Centrifugal Inline Fans

- .1 Provide inline centrifugal fans where shown.
- .2 Secure each fan in place from the structure with vibration isolation, either horizontally or vertically as indicated, independent of connecting ductwork and in accordance with the fan manufacturer's published instructions.
- .3 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.
- .4 Ensure that duct connections are made using flexible connection material.
- .5 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .6 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .7 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .8 **Demonstration and Training:** Refer to the article entitled Equipment and System O & M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for heat recovery ventilators, including accessories, and all required power and control wiring schematics.
- .2 **Factory Inspection Report:** Submit with delivery of each unit a copy of the factory inspection report, and include a copy of each report with O & M Manual project close-out data.
- .3 **Site Inspection and Start-Up Report:** Submit a site inspection and start-up report from the manufacturer's representative as specified in Part 3 of this Section.
- .4 **Spare Filters:** Supply a spare filter set for each ventilator and store at the site where directed prior to Substantial Performance.
- .5 **Extended Warranty:** Submit a signed extended warranty direct from the manufacturer to the Owner covering the energy recovery wheel from material and workmanship defects for an additional 4 years after the Contract warranty expires.
- .6 **Roof Opening Coordination:** Supply reviewed copies of ventilator/curb assembly shop drawings or product data to the trade who will cut the roof openings for the ventilators, and ensure that the openings are properly located.

1.2 Quality Assurance

- .1 Heat recovery ventilator manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:
 - .1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.
 - .2 AMCA Standard 211, Product Rating Manual for Fan Air Performance.
 - .3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans.
 - .4 AMCA Standard 311, Product Rating Manual for Fan Sound Performance.
 - .5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.
 - .6 ANSI/AHRI Standard 1060, Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation.
 - .7 ASHRAE 84, Method of Testing Air-to-Air Heat/Energy Exchangers.
 - .8 UL 1812, Ducted Heat Recovery Ventilators.
 - .9 CSA or ETL certification for all electrical components.

1.3 Base Bid and Approved Manufacturers

- .1 Refer to the article entitled Base Bid and Acceptable Manufacturers in the Section 20 05 10 – Basic Mechanical Materials and Methods.

2 PRODUCTS

2.1 Heat Recovery Ventilators

- .1 Factory assembled, internally wired heat recovery ventilators as per the drawing schedule, with ARI certified energy recovery ratings.
- .2 **Interior Unit Casings and Frame:** Internal frame type casing constructed of heavy-gauge G90 galvanized sheet steel with interior surfaces lined with 25 mm (1") thick, 24 kg/m³ (1½ lb./ft.³) density coated glass fibre duct lining material meeting 25/50 flame spread and smoke developed ratings of CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies, and installed with all exposed edges tucked under flanges. Additional features and requirements are as follows:
 - .1 Casings are to be complete with factory sealed metal-to-metal joints, a solid integral base with up-turned lips around bottom openings, separate openings and knock-outs

- for power and control wiring conduit connections, top panels, where joints are required, are to be equipped with a standing seam, and all metal exposed to the weather shall be factory cleaned, primed, and finished with baked enamel.
- .2 Removable gasketed panels or hinged gasketed access doors are to be provided for access to all interior components.
 - .3 A stainless steel drain pan pitched for positive drainage and equipped with captive condensate drain pipe connection.
- .3 **Exterior Unit Casings and Frame:** Internal frame type double wall weather-proof casing constructed of heavy-gauge G90 galvanized sheet steel, minimum #18 gauge for exterior panels, minimum #24 gauge with interior panels, with 25 mm (1") thick, 24 kg/m³ (1½ lb./ft.³) density coated glass fibre insulation material meeting 25/50 flame spread and smoke developed ratings of CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies secured in place between the panels such that it will not sag. Additional features and requirements are as follows:
- .1 Casings are to be weather-tight, complete with factory sealed metal-to-metal joints, a solid integral base with up-turned lips around bottom openings, and separate openings and knock-outs for power and control wiring conduit connections.
 - .2 Removable gasketed panels or hinged gasketed access doors are to be provided for access to all interior components.
 - .3 A stainless steel drain pan pitched for positive drainage and equipped with captive condensate drain pipe connection.
 - .4 Downturned design air intake and exhaust hoods constructed and factory finished as for casings, each with an "A" water penetration classification rating up to 200 mm/hr (8"/hr) rainfall at 22 m/s (50 mph) when tested in accordance with AMCA Standard 500-L, Laboratory Method of Testing Louvres for Rating, and washable aluminium mesh pre-filters.
 - .5 A minimum 200 mm (8") high, full perimeter, galvanized steel insulated roof curb supplied loose with each unit for field assembly, consisting of die-formed sections with gasket material for installation between the curb and the unit base.
- .4 **Filters:** Disposable glass fibre media filters, UL/ULC 900 listed, side removable, 50 mm (2") thick, pleated, MERV 13 rating, factory or field installed in a die-formed galvanized steel filter rack at the air intake opening.
- .5 **Fan and Motor Assemblies:** Centrifugal, draw-through with in reference to the energy recovery wheel, double width and inlet exhaust and supply fans with forward curved blades, belt driven or direct driven as indicated, statically and dynamically balanced, mounted to the unit base with neoprene vibration isolation, and equipped with:
- .1 Ground and polished steel fan shafts mounted in permanently lubricated sealed ball bearing pillow blocks selected for a minimum L-10 life in excess of 200,00 hours at maximum operating speed.
 - .2 Motors and where indicated, belt drives conforming to requirements specified in the mechanical work Section entitled Basic Mechanical Materials and Methods.
- .6 **Electrical and Control Connection Facilities:** Each ventilator shall be equipped with a sealed and factory pre-wired control box containing terminal blocks for power and control wiring connections, integral door interlocking disconnect switch, an overload protected contactor for each motor, fuses, and 24 VAC secondary control transformer.
- .7 **Control System:** As per the drawing control schematic/sequence, and to include if indicated, all required hardware and circuitry for connection into the building automation system using protocol as specified with the system.
- .8 **Fan Variable Speed Drives:** Factory supplied, mounted, and wired variable frequency drives conforming to requirements of the mechanical work Section entitled Variable Frequency Drives.
- .9 **Seismic Restraint Hardware:** Factory secured seismic restraint connection hardware.

3 EXECUTION

3.1 Installation of Heat Recovery Ventilators

- .1 Provide heat recovery ventilators where shown.
- .2 For suspended units, provide galvanized steel mounting brackets with vibration isolators and suspend each unit, level, and plumb, by means of hanger rods. Provide supplementary support steel as required.
- .3 Secure each indoor floor mounted ventilator in place, level and plumb, on neoprene-steel-neoprene vibration isolation pads on a concrete housekeeping pad.
- .4 Supply an assembled roof curb for each outdoor roof mounted ventilator and hand to the roof trade at the site on the roof. Carefully locate and size roof openings. Provide gasket material supplied with the curb on the perimeter of the curb and secure the ventilator in place.
- .5 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.
- .6 Coordinate power wiring connection and provision of a disconnect switch for each ventilator in accordance with the electrical work Specification where the power wiring is specified.
- .7 **Equipment and System Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .8 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .9 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .10 **Demonstration and Training:** Refer to the article entitled Equipment and System O&M Demonstration & Training in the Mechanical Work General Instructions Section. Include for 4 hours of on-site heat recovery ventilator operation demonstration and training for 2 groups of 6 people.

END OF SECTION

1 GENERAL

1.1 Submittals

- .1 **Product Data:** Submit product data sheets for grilles and diffusers. Product data shall include capacity, throw and terminal velocity, noise criteria, pressure drops, and neck velocity.
- .2 **Damper Adjustment Keys:** Supply and hand to the Owner at Substantial Performance, a minimum of 10 identified (with tags) grille/diffuser volume control damper and flow pattern adjustment keys.
- .3 **Colour Chart(s):** Submit manufacturer's colour chart(s) for all grilles and diffusers for which a finish colour shall be selected.

1.2 Quality Assurance

- .1 Grilles and diffusers are to be tested and performance certified to the Air-Conditioning and Refrigeration Institute Standard ARI 650, Standard for Air Outlets and Inlets.
- .2 Acceptable manufacturers are:
 - .1 Price Industries Inc.
 - .2 Mestek Co. "Anemostat".
 - .3 Krueger Division of Air System Components Inc.
 - .4 Titus.
 - .5 Nailor Industries Inc.

2 PRODUCTS

2.1 Grilles and Diffusers

- .1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.
 - .1 **Diffuser face:** perforated, laminar flow face constructed of aluminum with quarter-turn fasteners for removal and access to fan-motor and filter.
 - .2 **Mounting gasket:** roll type gasket material supplied with the units for site installation on T-bar ceiling members.
 - .3 **Seismic restraint hardware:** factory secured seismic restraint connection hardware.

3 EXECUTION

3.1 Installation of Grilles and Diffusers

- .1 Provide grilles and diffusers where shown on the drawings. Wherever possible, grilles and diffusers are to be the product of one manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting arrangement, ceiling layout, ornamental and other wall treatment.
- .4 Equip supply diffusers having a basic four-way or all round air pattern for operation in one, two, or three way pattern where indicated on the drawings.
- .5 Provide sheet metal plenums, constructed of the same material as the connecting duct, for linear grilles and/or diffusers where shown. Construct and install the plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip the duct connection collar(s) with volume control device(s).

- .6 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip the diffusers/grilles in place using clip supplied by the diffuser/grille manufacturer.
- .7 Confirm grille and diffuser finishes prior to ordering.
- .8 Brace and secure each unit in accordance with requirements specified in the mechanical work Section entitled Seismic Control and Restraint.
- .9 **Equipment Manufacturer's Certification:** Refer to the article entitled Equipment and System Manufacturer's Certification in the Mechanical Work General Instructions Section.
- .10 **Start-Up:** Refer to the article entitled Equipment and System Start-up in the Mechanical Work General Instructions Section.
- .11 **Commissioning:** Refer to commissioning requirements specified in the Mechanical Work General Instructions Section.
- .12 **Demonstration and Training:** Refer to the article entitled Demonstration and training in the Mechanical Work General Instructions Section. Include for a three hour on-site operation demonstration and training session for two groups of six people

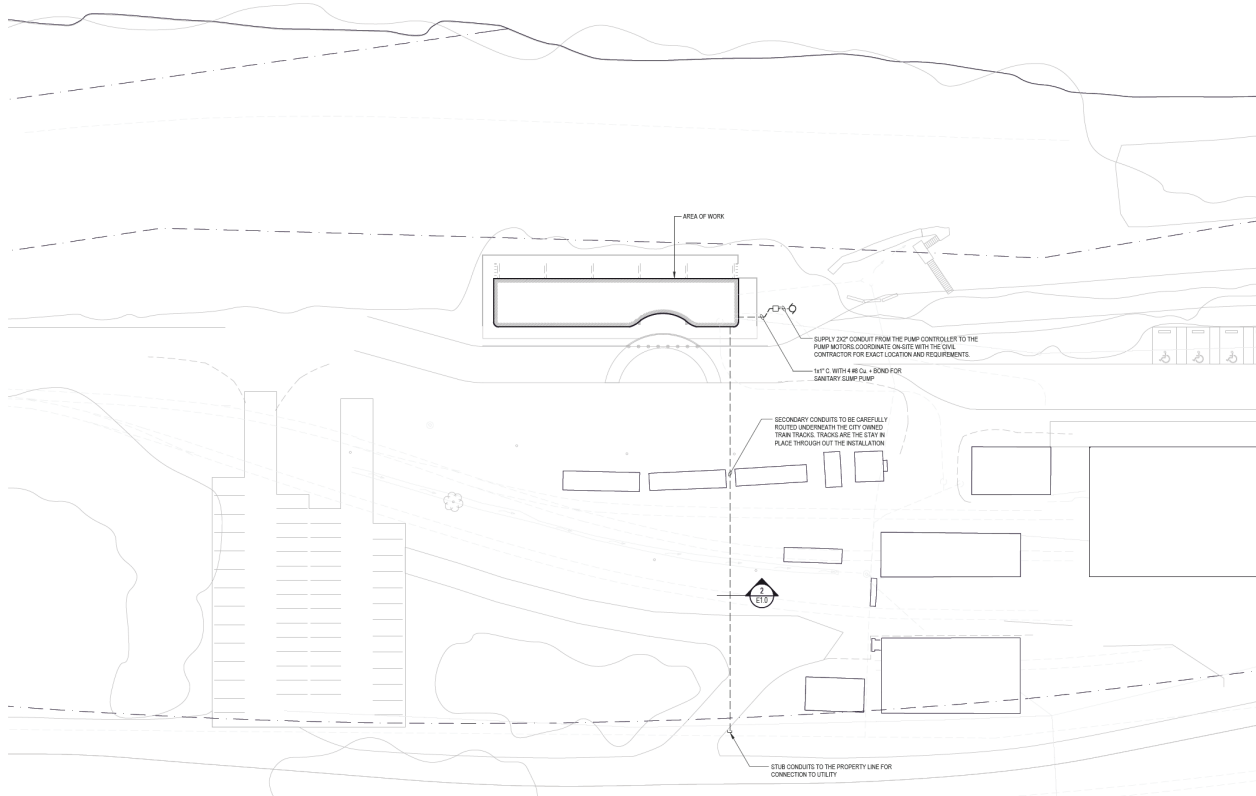
3.2 Supply of Door Grilles

- .1 Supply door grilles as shown and scheduled.
- .2 Hand the grilles to the appropriate trade at the site for installation.

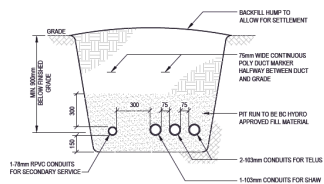
END OF SECTION

APPENDIX E

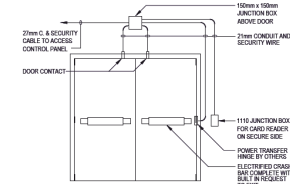
Electrical



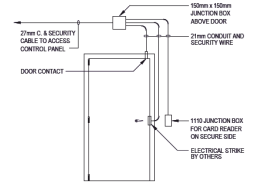
1 SITE PLAN ELECTRICAL LAYOUT
E1.0 1"=30'-0"



2 TRENCH DETAIL
E1.0 NOT TO SCALE



3 SECURITY DOOR DETAIL D1
E3.01 NOT TO SCALE



4 SECURITY DOOR DETAIL D2
E3.01 NOT TO SCALE

ELECTRICAL SYMBOL LEGEND		
ABBREVIATIONS	POWER	
WP DENOTES WEATHER PROOF DEVICE	⊕ DUPLEX RECEPTACLE	
⊕ DENOTES DOOR TAG NUMBER	⊕ ABOVE COUNTER DUPLEX RECEPTACLE	
LIGHTING		
□ SURFACE MOUNTED LUMINAIRE	⊕ 5.03R DUPLEX RECEPTACLE (1-6.00T)	
□ CEILING RECESSED LUMINAIRE	⊕ FOUR PLEX RECEPTACLE	
□ STROP LIGHT	⊕ ABOVE COUNTER FOUR PLEX RECEPTACLE	
□ FLEXIBLE LUMINAIRE	⊕ 5.03R DUPLEX RECEPTACLE (1-6.00T) GROUND FAULT INTERRUPTER (GFCI)	
○ RECESSED DOWN LIGHT	⊕ ABOVE COUNTER 5.03R DUPLEX RECEPTACLE (1-6.00T) GROUND FAULT INTERRUPTER (GFCI)	
□ WALL MOUNTED LUMINAIRE	⊕ ABOVE COUNTER GROUND FAULT INTERRUPTER DUPLEX RECEPTACLE	
— TRACK	⊕ ABOVE COUNTER 5.03R DUPLEX RECEPTACLE (1-6.00T) WITH 2.00 PORTS	
□ TRACK HEAD	⊕ MICROWAVE/RANGEHOOD RECEPTACLE (1-6.00T)	
□ ROLLAD LUMINAIRE	⊕ FRIDGE RECEPTACLE	
↑ SINGLE POLE TOGGLE SWITCH, GANGED AS SHOWN	⊕ RANGE RECEPTACLE	
⊕ DIMMER SWITCH	⊕ THERMOSTAT	
⊕ OCCUPANCY SENSOR, CEILING MOUNTED	⊕ BASEBOARD HEATER, WATTAGE AS NOTED ON PLANS	
⊕ LOW VOLTAGE OCCUPANCY SENSOR, CEILING MOUNTED	⊕ FORCE FLOW HEATER	
⊕ EXIT SIGN, DIRECTION AS INDICATED ON PLANS	⊕ PANEL BOARD	
⊕ DUAL HEAD EMERGENCY LIGHTING COMPLETE WITH SELF-CONTAINED BATTERY PACK, WALL MOUNTED	⊕ GROUND BUS	
SECURITY		
⊕ PERIMETER DOOR ALARM CONTACT	⊕ CEILING FAN CONNECTION	
⊕ CCTV CAMERA	⊕ MECHANICAL MOTOR CONNECTION	
⊕ CARD READER	⊕ DISCONNECT SWITCH	
⊕ ELECTRIC DOOR STRIKE	⊕ MECHANICAL EQUIPMENT CONNECTION	
⊕ KEY PAD	⊕ AUTOMATIC DOOR OPERATOR	
⊕ REQUEST TO EXIT SENSOR	COMMUNICATIONS	
⊕ 180° INTRUSION MOTION DETECTOR	⊕ WIRELESS ACCESS POINT	⊕ COMBINATION DATA/TEL OUTLET (10/11 NUMBER OF DATA AND TEL PORTS AS INDICATED ON PLANS)
⊕ 360° INTRUSION MOTION DETECTOR	⊕ COMBINATION DATA/TEL OUTLET (10/11 NUMBER OF DATA AND TEL PORTS AS INDICATED ON PLANS)	
⊕ INTRUSION ALARM CONTROL PANEL	⊕ ELECTRIC DOOR CONTACT	
⊕ ELECTRIC DOOR CONTACT		
⊕ ACCESS CONTROL SYSTEM		

LAHH	AUTHOR	Bryan Kilback
ELECTRICAL LOAD CALCULATION	LAST ACCESSED	2023-03-31
\\sawc001\projects\2023\2023-03-31-081\LAHH-CE23-021	LAST SAVED	2023-03-15
BASIC LOAD		
INDUSTRIAL AND COMMERCIAL	280 m ² x 25 W/m ²	= 7000 W
TOTAL BASIC LOAD		= 7000 W
EQUIPMENT		
SPECIALTY LIGHTING		2000 W
MECHANICAL EQUIPMENT		= 31207 W
KITCHEN EQUIPMENT		= 5000 W
TOTAL EQUIPMENT LOAD		38207 W
TOTAL LOAD		45207 W
SERVICE MINIMUM AMPACITY	45207 W @ 208V 3PH	= 125 A
MIN OVERCURRENT PROTECTION	125 A @ 125%	= 157 A
SERVICE MAINSWITCH		200 A
SUPPLY ARRANGEMENT		UNDERGROUND

UNDERGROUND CABLES EXTENDING TO PROPERTY LINE

3-Phase 480V CONDUIT

HYDRO METER

CT

MAIN ELECTRICAL ROOM

MAIN BREAKER
200A, 3P

NOTE 1

200A, 3PH, 480/277V LOWVOLT INTERMEDIATE RATED PANEL #1

15A, 2P

15A, 2P

15A, 2P

15A, 2P

CT

CT

CT

4:4 TECT

4:4 C/W 10A, 3P

SANITARY SEW PUMP

SINGLE 100

20A, 3P C/W 10A, 3P MAIN BREAKER

SINGLE 100

20A, 3P C/W 10A, 3P MAIN BREAKER

SINGLE 100

20A, 3P C/W 10A, 3P MAIN BREAKER

NOTES:

1. SUPPLY & INSTALL REVENUE GAUGE METERING ON ALL STUDIO FEEDER FOR CLIENT BILLING STANDARD OF ACCEPTANCE. TRANSA AND SERIES. PROVIDE POWER SUPPLY AND DATA CONNECTION.

1.1 SINGLE LINE DIAGRAM

NOT TO SCALE

LIGHTING COMPLIANCE DOCUMENTATION			
CODE	YES	NO	N/A
2000-06-26/28	X		
NEC 2015		X	
COMPLIANCE PATH			
PRESCRIPTIVE		X	
SPRINT SPACE			X
BUILDING AREA			X
PERFORMANCE			X
INDEPENDENT PROVISIONS CHECKLIST			
LIGHTING CONTROLS		X	
AUTOMATIC LIGHTING SHUTOFF CONTROLS ARE PROVIDED BASED ON A SCHEDULING DEVICE OR A SCHEDULING SENSOR			
EACH LIGHTING SPACE HAS ITS OWN CONTROL INCLUDING LEVEL OF OCCUPANCY BASED WHEN REQUIRED.			
CONTROLS FOR PARKING GARAGES, INCLUDING LEVEL, TRANSITION AND PERMETRIC CONTROL AS REQUIRED.			
AUTOMATIC DAYLIGHT CONTROLS FOR PRIMARY SELECTED AREAS			
AUTOMATIC DAYLIGHT CONTROLS FOR TOP LIGHTING			
ADDITIONAL CONTROLS FOR DAYLIGHT/ACCENT, GUEST, QUEST ROOM, RECEPTION, AND OBSERVATION/CONFERENCE APPLICATIONS.			
EXTERIOR LIGHTING CONTROL HAS ITS OWN AUTOMATIC SHUTOFF AND B/L LEVEL AS REQUIRED.			
EIGHT FOOT NEXT CLOSETED FACE			
INTERIOR LIGHTING POWER ALLOW ALLOMABLE LFD			
EXTERIOR LIGHTING POWER ALLOW ALLOMABLE LFD			
FUNCTIONAL TESTING TO BE PERFORMED BY FACTORY CERTIFIED TECHNICIAN			

PANELBOARD SCHEDULE									
JOB NO./NAME	:	1-21-0081/LAHH							
PANEL	:	5							
SYSTEM	:	1200V/3PH, 4W							
TYPE	:	LOAD CENTER							
LOCATION	:	STUDIO							
MOUNTING	:	RECESSED							
NO CIRCUITS	:	24							
BUS SIZE	:	100A							
SYSTEM FAULT RATING	:	100A							
FEED THROUGH LUGS	:	NO							
TUBS	:	1							
MAIN BREAKER	:	60A							

DESCRIPTION	BRK	POLE	CIRC	CIRC	POLE	BRK	DESCRIPTION
LIGHTS	20	1	1	2	1	20	RECEP/TAPE
LIGHTS	20	1	3	4	1	20	RECEP/TAPE
ENT SIGN	15	1	5	6	1	15	GF-1
			7	8	2	15	FCU
SPARE	15	1	9	10			
SPARE	15	1	11	12	2	15	FCU
SPARE	15	1	13	14			
SPARE	15	1	15	16	1	20	SPARE
			17	18	1	20	SPARE
			19	20	1	20	SPARE
			21	22	1	20	SPARE
			23	24			

GF/CIR BREAKER	AC						
AC/FIR BREAKER	**						REFER TO SINGLE LINE DIAGRAM

PANELBOARD SCHEDULE									
JOB NO./NAME	1-21-0081/LAHN								
SYSTEM	H								
TYPE	120/208V 3PH, 4W								
LOCATION	SERVICE RATED								
MOUNTING	ELECTRICAL ROOM								
NO. CIRCUITS	SURFACE								
BUS SIZE	84								
SYSTEM FAULT RATING	200A								
FEED THROUGH LUGS	NO								
TUBS	1								
MAIN BREAKER	200A								
DESCRIPTION	BRK.	POLE	CIRC.	CIRC.	POLE	BRK.	DESCRIPTION		
STUDIO 102	60	3	1	2	3	60	STUDIO 104		
			1	4					
			5	6					
			7	8					
STUDIO 103	60	3	9	10	1	20	EXTERIOR LIGHTING		
			11	12	1	20	EXTERIOR LIGHTING		
LIGHTS	20	1	13	14	1	15	EXIT SIGNS		
LIGHTS	20	1	15	16	1	15	SERVICE ROOM LIGHTS		
KITCHEN REC	20	1	17	18	1	15	FRIDGE		
KITCHEN HOOD FAN	20	1	19	20	1	20	COUNTER TOP REC		
RANGE	50	2	21	22	1	15	JANITOR REC		
			23	24	1	20	JANITOR REC		
BATHROOM REC	15	1	25	26	1	20	ELECTRICAL ROOM REC		
BASEBOARD HEATER	30	2	27	28	1	15	DATA/RACK REC		
			29	30			JBP		
FORCE FLOW HEATER	30	2	31	32	1	15	COMMUNICATIONS REC		
			33	34	1	15	COMMUNICATIONS REC		
CE-4	15	1	35	36	2	15	MCU-1		
FCU 4.1	15	2	37	38					
			39	40	2	15	MCU-2		
FCU 4.2	15	2	41	42					
			43	44					
HP-1	40	2	45	46			DHW		
			47	48					
EX-LF&F-2	15	1	49	50					
ERV-1	20	3	51	52	3	20	DH-1		
			53	54					
			55	56	2	15	FCU-5		
RECEPTACLES	20	1	57	58					
DIGITAL METER REC	15	1	59	60	2	30	BASEBOARD HEATER		
SANITARY SUMP	15	1	61	62					
			63	64	1	15	ACS		
			65	66	1	20	EXTERIOR REC		
SPARE	15	1	67	68	1	20	EXTERIOR REC		
SPARE	15	1	69	70	1	20	SPARE		
SPARE	15	2	71	72	2	20	SPARE		
			73	74	2	20	SPARE		
			75	76					
			77	78					
			79	80					
			81	82					
			83	84					

REFER TO SINGLE LINE DIAGRAM

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CHECKWICH POIX
 ARCHITECTS
 4363 Commercial Street, Nanaimo, BC V9S 5G3
 250-774-1983
 402-422 Prud'Homme Street, Nanaimo, BC V9B 1T5
 604-556-3444

Checkwich Poix Architects Inc.
 www.cpoix.ca
 250-774-1983
 604-556-3444

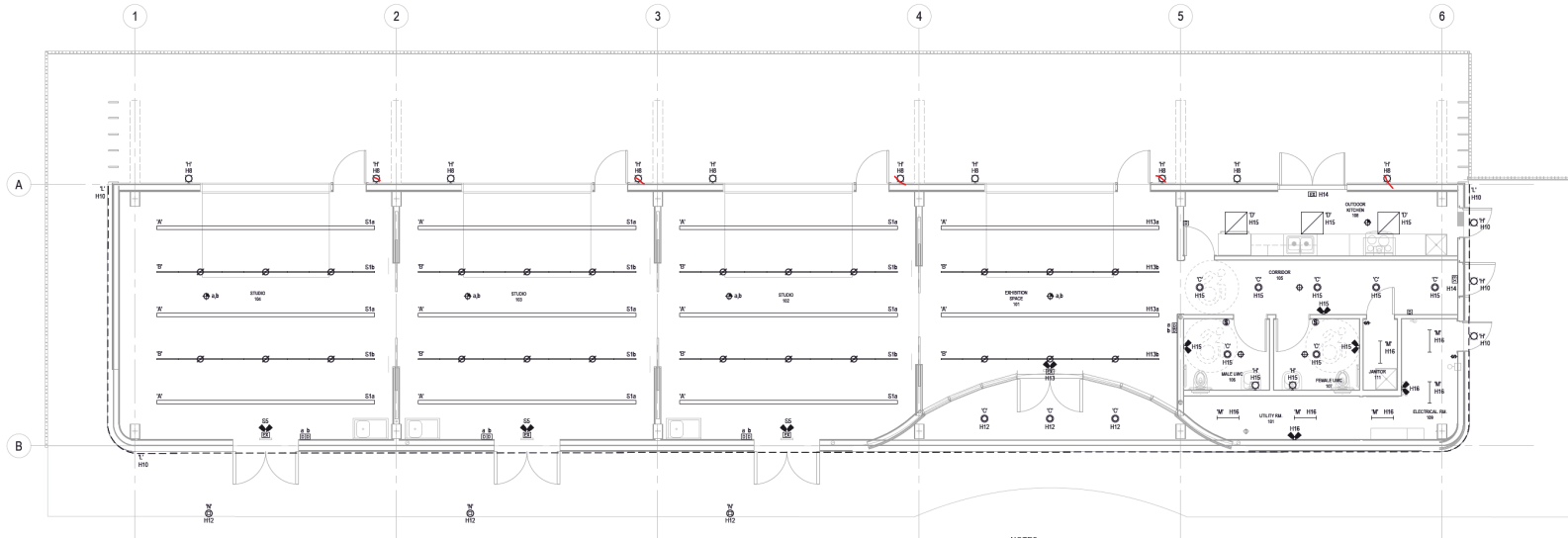

AES
 Engineering & Architectural Services
 801-278-2200 (Nanaimo, BC) 604-555-1100 (Vancouver, BC)
 250-774-1983 (Nanaimo, BC) 604-556-3444 (Vancouver, BC)
 CALGARY | EDMONTON | VANCOUVER

2015-05-25
 Design to Proceed for Construction

PROJECT NO. 14513
 4363 COMMERCIAL STREET
 NANAIMO, BC
 ENGINEER

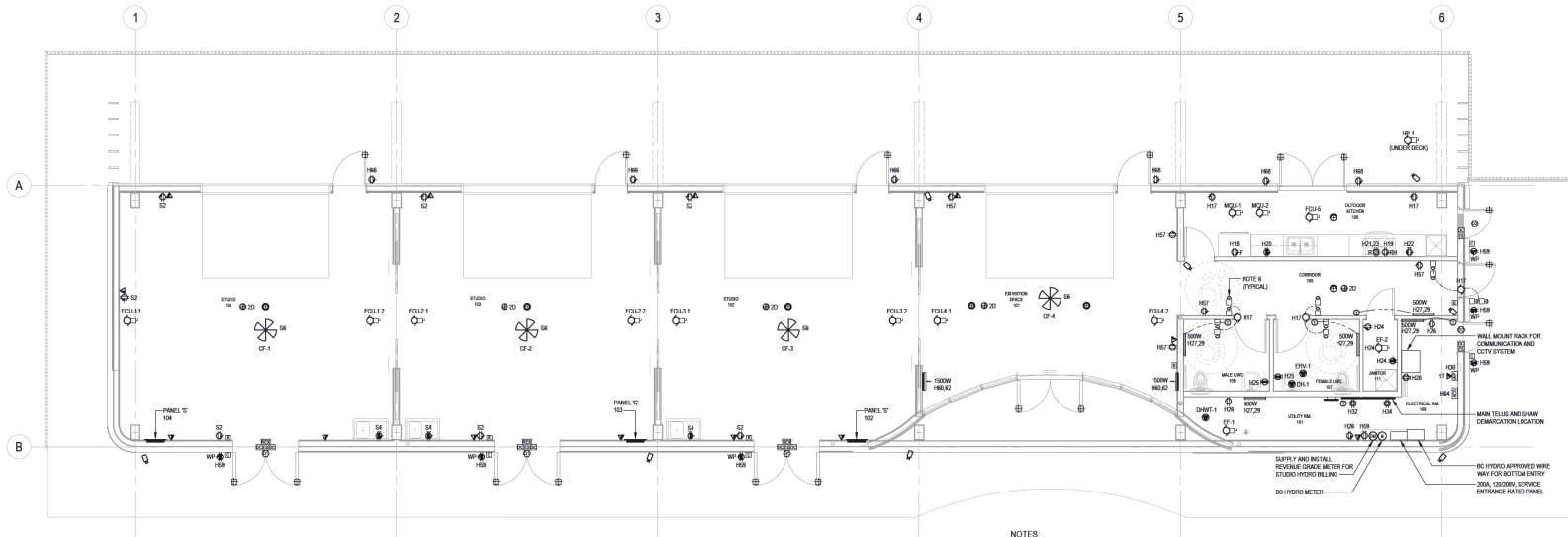
I hereby certify that the above is a true and correct copy of the original as submitted to the City of Nanaimo.

Arts and Heritage Hub
Ladysmith, BC



1 FLOOR PLAN LIGHTING LAYOUT
E2.0

- NOTES:
- SUPPLY AND INSTALL WIRELESS LIGHTING CONTROL IN EACH STUDIO SPACE AND COMMON AREAS.
 - EXTERIOR LIGHTING TO BE CONTROLLED BY AN AUTONOMOUS TIME CLOCK COORDINATE WITH THE END USER FOR EXACT TIMES.



2 FLOOR PLAN POWER AND SYSTEMS
E2.0

- NOTES:
- CONFIRM ALL EXTERIOR CAMERA LOCATIONS WITH ARCHITECTURAL DRAWINGS.
 - SUPPLY AND INSTALL ALL REQUIRED WIRING AND DEVICES FOR A COMPLETE AND OPERATIONAL INTRUSION DETECTION SYSTEM. REFER TO SPECIFICATIONS FOR PRODUCT INFORMATION.
 - SUPPLY AND INSTALL ALL REQUIRED DEVICES AND WIRING FOR A COMPLETE AND OPERATIONAL CCTV SYSTEM.
 - SUPPLY AND INSTALL ALL REQUIRED DEVICES AND WIRING FOR A COMPLETE AND OPERATIONAL ACCESS CONTROL SYSTEM.
 - PROVIDE WIRELESS ACCESS DEVICES AS INDICATED ON THE DRAWINGS. APPROVED BY PRODUCT IS CISO #383 24472.
 - TWO-TOUCH BUTTONS TO BE PLACED A MINIMUM OF 600mm FROM THE DOOR. PUSH BUTTONS HEIGHTS ARE TO BE 150-300mm AND 160-180mm ABOVE FINISHED FLOOR.

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CHECKSWITCH
POINTE-CLER
INC.

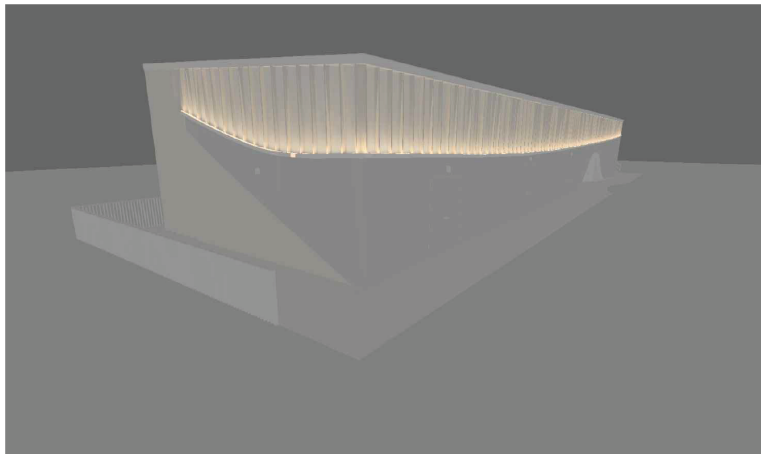
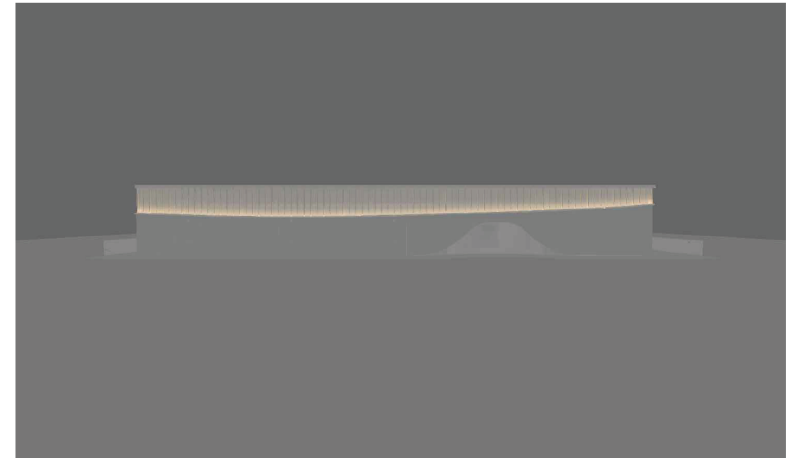
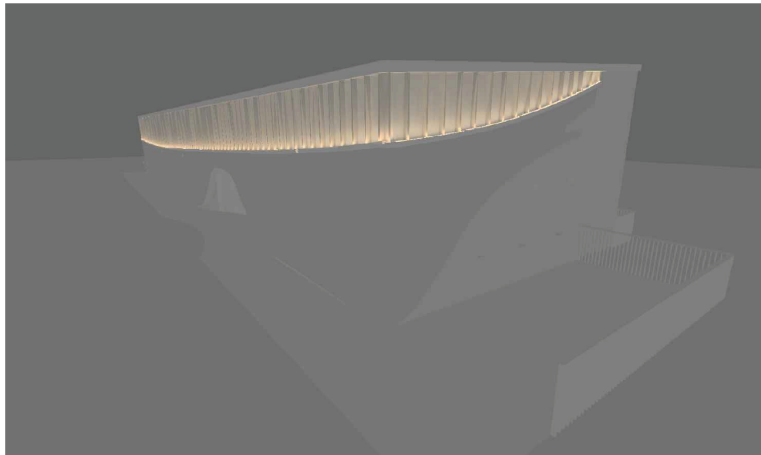
Checkswitch Pointe Architects Inc.
9-83 Commercial Street, Nanaimo, BC V8R 9G3
250.714.1963
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QUANTITY (REVISION) (REVISION) (REVISION)



Arts and Heritage Hub
Ladysmith, BC

Client	Town of Ladysmith	Designed/Drawn by	BAKITS	Reviewed by	PB	Sheet Number	E2.0
Project Number	9129-0881	FL FLOOR PLAN ELECTRICAL LAYOUTS					
Date	AS NOTED	Issue No.	1	Issue For	BUILDING PERMIT	Revision	2
Date	6/30/123	Issue No.	2	Issue For	TENDER		



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POIRON
ARCHITECTS
INC.** Checkswitch Poiron Architects Inc. www.cparch.ca
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501-482 Pender Street W., Vancouver, BC V6B 1T6 604.686.3444

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Ladysmith, BC

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Client: Town of Ladysmith		Designed/Drawn By: BAKITS	Reviewed By: PB	Sheet Number: E3.1
Project Number: 0121.0081	Sheet Name: LIGHTING MODEL IMAGES			
Date: AS NOTED	Date: 03/31/23	Issue No: 1	Issued For: BUILDING PERMIT	Revision: 2
	Date: 03/31/23	Issue No: 2	Issued For: TENDER	

NOT FOR CONSTRUCTION – FOR REVIEW ONLY				
Client Town of Ladysmith		Designed/Drawn By BAK/TS		Reviewed By PB Sheet Number E4.0
Project Number 0121.0081		Sheet Name ELECTRICAL SPECIFICATIONS		
Scale AS NOTED	Date 03/31/23	Issue No. 1	Issued For BUILDING PERMIT	Revisions 2
	Date 03/31/23	Issue No. 2	Issued For TENDER	

APPENDIX F

Landscape

ARTS AND HERITAGE HUB - Phase 1
LADYSMITH, BC

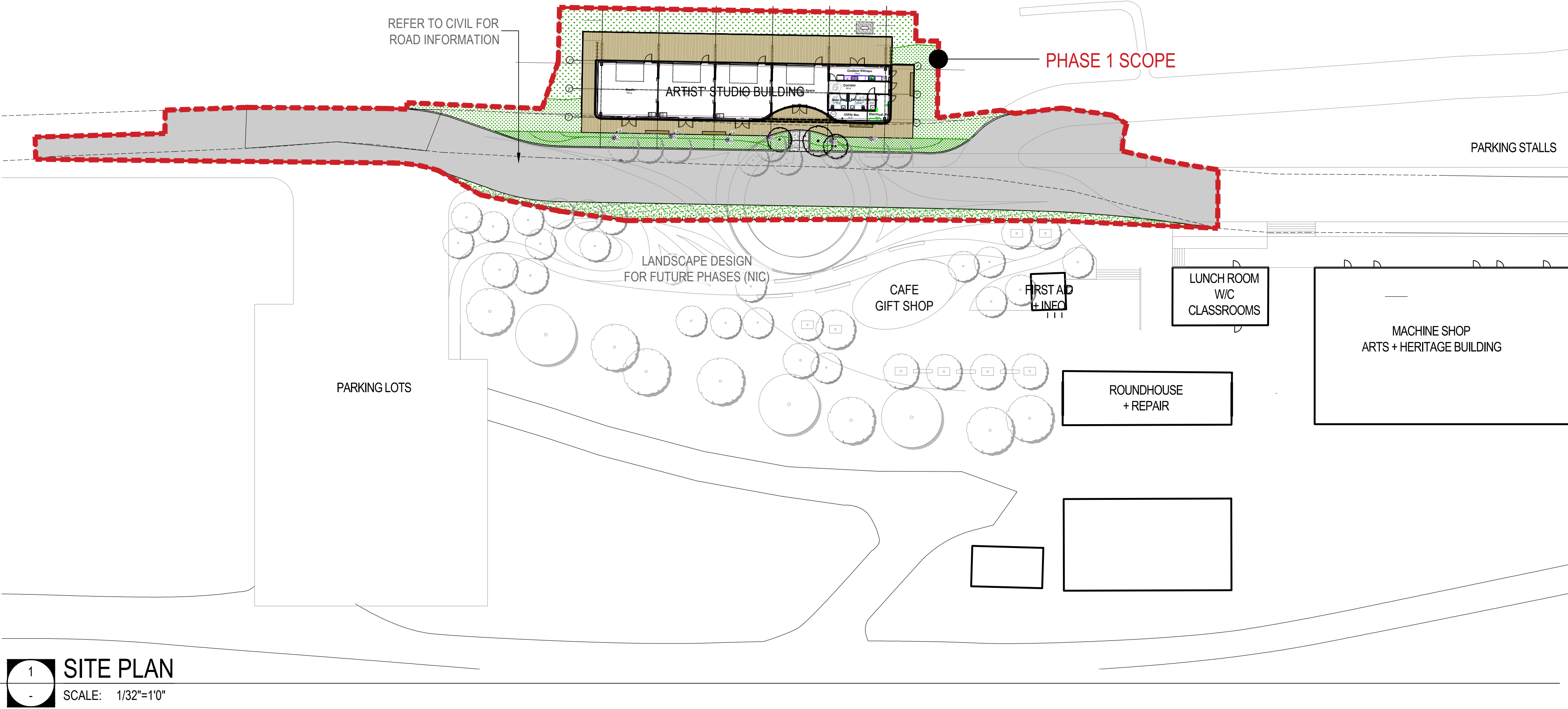
Issued for Tender (IFT) & Issued for Building Permit (BP)
March 31, 2023
LANDSCAPE ARCHITECTURE

DRAWING LIST

LANDSCAPE ARCHITECTURAL DRAWINGS	
L.G.00	COVER PAGE
L.0.01	TREE MANAGEMENT PLAN
L.1.01	MATERIALS PLAN
L.2.01	LAYOUT PLAN
L.3.01	LIGHTING PLAN
L.4.01	GRADING PLAN
L.5.01	PLANTING PLAN
L.6.01	IRRIGATION PLAN
L.7.01	LANDSCAPE SECTIONS
L.9.01	DETAILS - PLANTING
L.9.02	DETAILS - PAVING
L.9.03	DETAILS - SITE FURNISHINGS

LANDSCAPE ARCHITECTURAL SYMBOLS

Section Detail Drawing No.	
Plant Type Quantity	
Detail No. Drawing No.	
Detail No. Drawing No.	
Elevation marker (For elev. view)	
Elevation marker (For plan view)	
North Arrow	



1 SITE PLAN
SCALE: 1/32"=1'0"

GENERAL NOTES :

- Existing survey information is based on the following drawings:
 - dwg: 89903 topo 2021 03 15.dwg
provided by: Town of Ladysmith
date: 03.15.2021
 - dwg: 12-128-4_190103.dwg
provided by: Town of Ladysmith
date: 01.25.2021
- Prior to commencement of construction, the contractor must make careful examination of existing site surface conditions and topography and advise the Landscape Architect of any unsatisfactory site surface conditions and topography. No allowances will be made later for any expenses incurred through failure to note unsatisfactory existing site surface conditions and topography.
- Do not scale drawings. Use dimensional info as noted on drawing. Contact the Landscape Architect immediately if there is any ambiguity, lack of information or inconsistency. Disregard of this note and extra costs incurred will not be accepted.
- The Contractor will clean and reinstate all areas damaged or affected by works outside the limit of work to the conditions that existed prior to construction or better and to the satisfaction of the Landscape Architect.
- The Contractor shall verify dimensions shown on drawings and notify the Landscape Architect of any discrepancies or inconsistencies prior to construction.
- Contractor shall be responsible for verifying all underground utilities and taking the necessary precautions prior to and during construction. For comprehensive utilities/servicing plan, refer to civil drawings and Utility Upgrade Project As-Built plans.
- All lines and dimensions are parallel or perpendicular to the lines from which they are measured/ referenced unless noted otherwise.
- All curves or transitions of concrete paving or seating shall be sinuous, and shall not transition abruptly. On site adjustments may be necessary to achieve smooth transitions between the curve data provided on the drawings. Curves shall be laid out and confirmed by the Landscape Architect prior to installation.
- Contractor to provide a staked-out location on site for review and approval by Landscape Architect prior to any excavation or installation.
- Please contact the Town of Ladysmith Landscape inspector to inspect the site prior to construction. The inspector will assess and record all pre-construction site conditions, including trees to be retained during the construction process. This is to ensure any remediation as necessary to pre-existing landscaping.

LANDSCAPE ARCHITECTURAL ABBREVIATIONS

AD	Area Drain	DWG	Drawing	NIC	Not in Contract	SECT	Section
ALT	Alternate	EJ	Expansion Joint	NO	Number	SQ	Square
ALUM	Aluminum	ENG	Engineer/ Engineering	NTS	Not to Scale	SS	Stainless Steel
ARCH	Architect/ Architectural	EQ	Equal	OC	On Center	STA PT	Station Point
AVG	Average	EX	Existing	OD	Outside Diameter/Dimension	STD	Standard
B	Bottom	FC	Flush Curb	PC	Point of Curvature	STL	Steel
BC	Bottom of Curb Elevation	FDN	Foundation	PERP	Perpendicular	STR/STRUC	Structure/ Structural
BLDG	Building	FG	Finish Grade	PI	Point of Intersection	T	Top
BOL	Bollard	FIN	Finish	PL	Property Line	T+B	Top and Bottom
BS	Bottom of Step/ Stair Elevation	FTG	Footing	PLNT	Plant/ Planting	TAN	Tangency
BTW	Between	GALV	Galvanized	PO	Point of Origin	TC	Top of Curb Elevation
BW	Bottom of Wall Elevation	HEF	Horizontal Each Face	PP	Pedestrian Pole	TD	Trench Drain
CB	Catch Basin	HP	High Point	PIP	Pour-in-Place	TEMP	Temporary
CIV	Civil	HT	Height	PSI	Pounds per Square Inch	THK	Thick
CJ	Control Joint	ID	Inside Diameter/Dimension	PT	Point of Tangency	TOS	Top of Slab
COJ	Construction Joint	INCL	Include/ Including	QTY	Quantity	TOL	Town of Ladysmith
COMP	Compacted	JT	Joint	R	Riser	TPZ	Tree Protection Zone
CONC	Concrete	LA	Landscape Architect	RA	Radius	TS	Top of Step/ Stair Elevation
DEG	Degree	LOW	Limit of Work	REBAR	Reinforcing Bar	TW	Top of Wall Elevation
DET	Detail	LT	Light	REQ	Required	TYP	Typical
DIA	Diameter	M	Meters/ Metres	ROW	Right of Way	VERT	Vertical
DIM	Dimension	MAX	Maximum	SB	Setback	VEF	Vertical Each Face
DN	Down	MIN	Minimum	SHT	Sheet	w/	with
		MISC	Miscellaneous	SPEC	Specifications	w/o	without

CLIENT:

PROJECT TEAM:

LANDSCAPE ARCHITECT
PFS Studio
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Vancouver, BC V6J 1K7

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ISSUANCE:

No.	Date	Details	By
1	2022-08-03	ISSUED FOR COSTING	SMC
2	2023-02-02	PHASE 1 - ISSUED FOR 75% CD	SMC
3	2023-02-21	PHASE 1 - ISSUED FOR 90% CD	SMC
4	2023-03-31	PHASE 1 - IFT & BP	SMC

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STAMP:



PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

COVER PAGE

PFS PROJECT NUMBER:
20042

DATE:
JUNE 2022

DRAWN BY:
SMC/SD

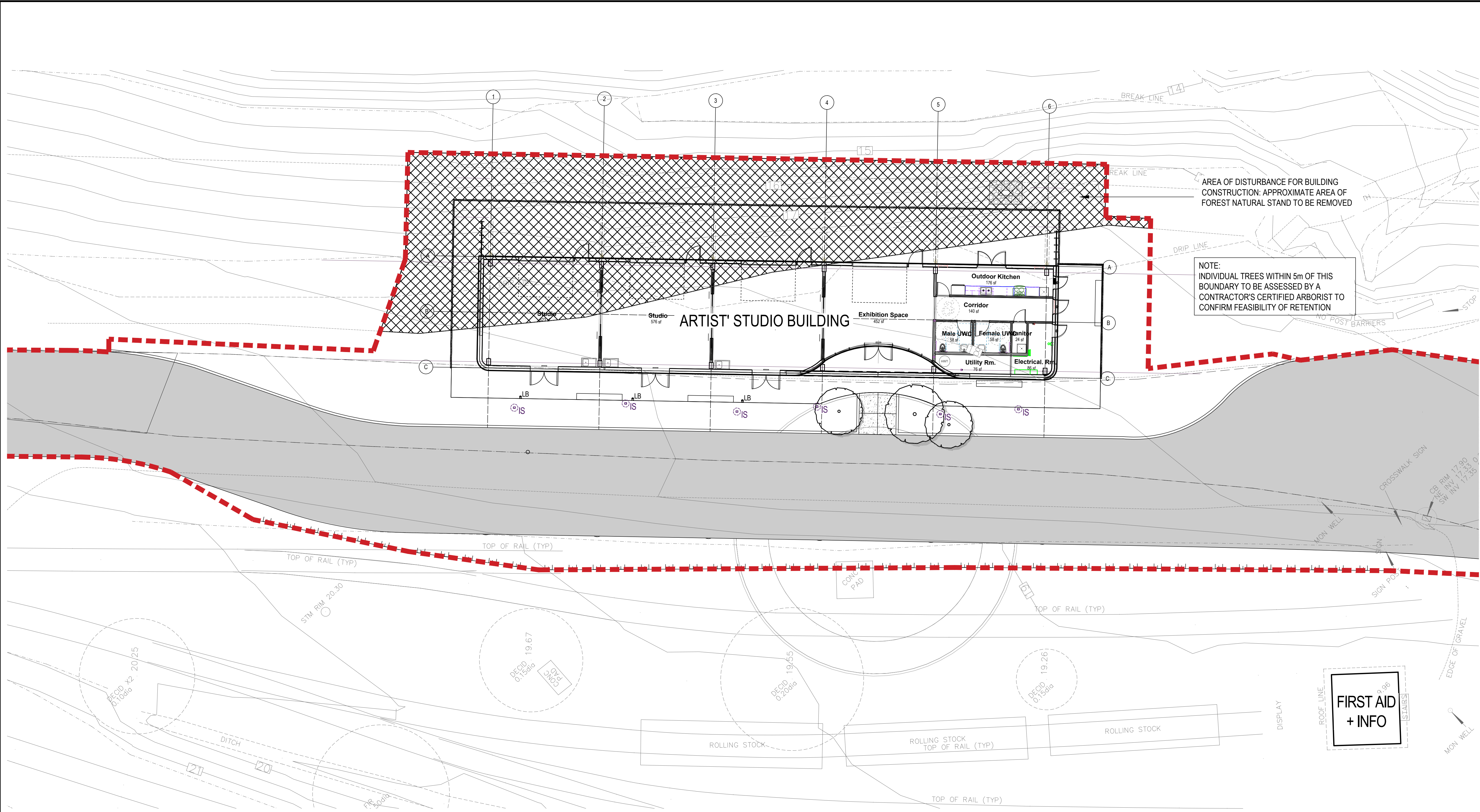
CHECKED BY:
KM

SCALE:
1/32" = 1' - 0"

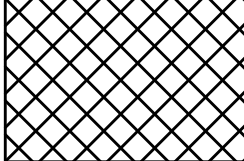
DWG. NO.:

LG.00

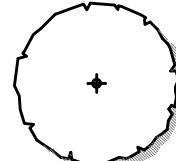
OF:



TREE MANAGEMENT LEGEND



AREA OF DISTURBANCE OF EXISTING FOREST (4048 SF, APPROXIMATE)



PROPOSED NEW TREE
REFER TO L5.01 PLANTING PLAN

- TREE MANAGEMENT NOTES:**
1. PROPOSED RETENTION AND REMOVAL OF EXISTING TREES TO BE CONFIRMED BY TOWNSHIP OF LADYSMITH
 2. ALL TREES INDICATED TO REMAIN SHALL BE PROTECTED AS PER TOWNSHIP OF LADYSMITH STANDARDS AND SPECIFICATIONS
 3. CONTRACTOR'S CERTIFIED ARBORIST TO PERFORM A FULL TREE ASSESSMENT AND VALUATION. ALL TREE-RELATED COSTS SHALL BE BORNE BY THE PROJECT, INCLUDING LOSS OF ASSET VALUE
 4. THE CONTRACTOR IS REQUIRED TO HIRE A CERTIFIED ARBORIST

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PROJECT TEAM:

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3	2023-02-21	PHASE 1 - ISSUED FOR 90% CD	SMC
4	2023-03-31	PHASE 1 - IFT & BP	SMC

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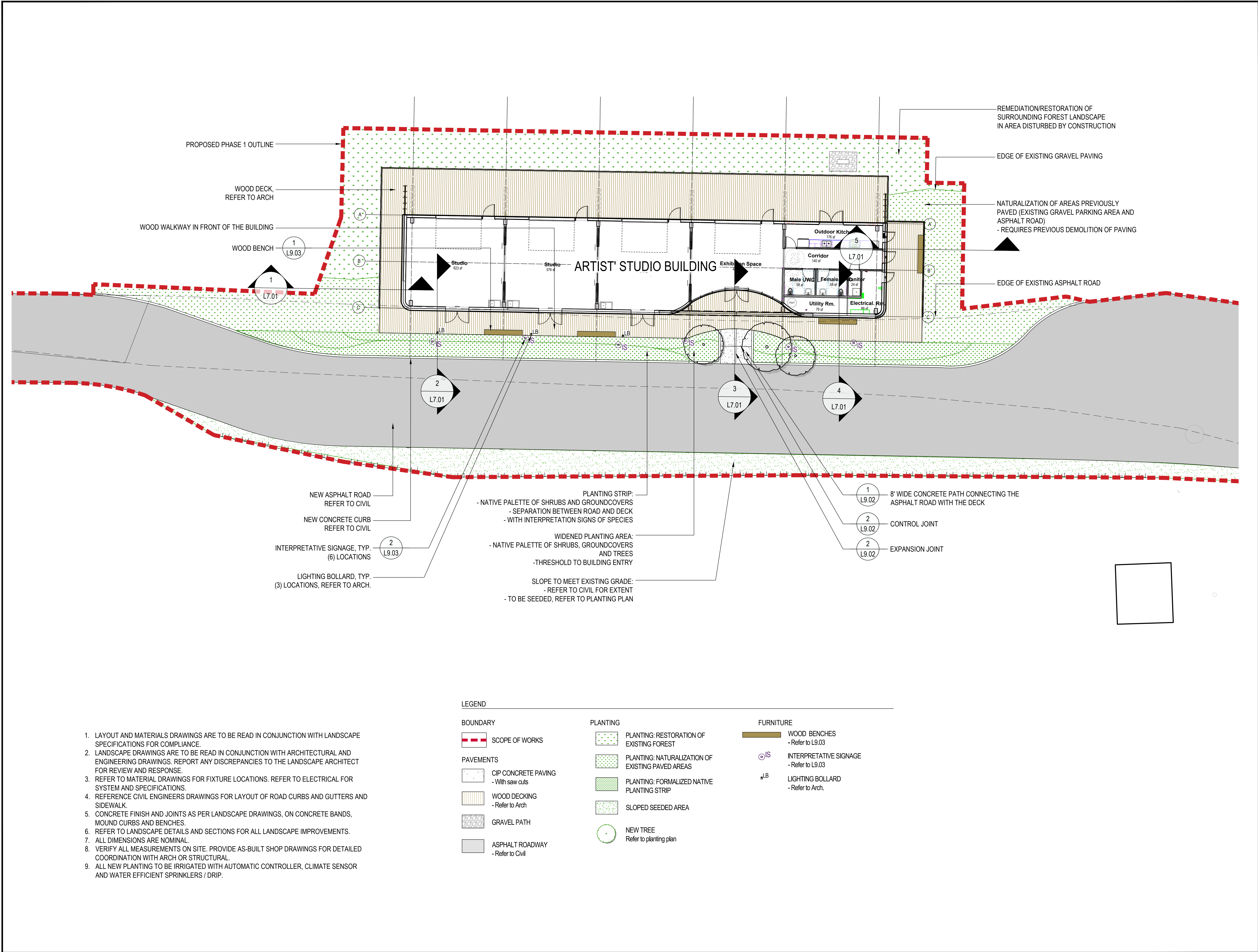
BRITISH COLUMBIA SOCIETY OF
REGISTERED
MEMBER
Kelty McKinnon
325
LANDSCAPE ARCHITECT'S

PROJECT NAME:
**ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC**

DRAWING TITLE:
TREE MANAGEMENT PLAN

PFS PROJECT NUMBER: 20042	DATE: JUNE 2022
DRAWN BY: SMC/SD	CHECKED BY: KM
SCALE: 3/32" = 1' - 0"	
DWG. NO.:	

L0.01 OF:



CLIENT:

PROJECT TEAM:

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3	2023-02-21	PHASE 1 - ISSUED FOR 90% CD	SMC
4	2023-03-31	PHASE 1 - IFT & BP	SMC

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pfs@pfs.bc.ca
www.pfs.bc.ca

STAMP:



PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

MATERIALS PLAN
PHASE 1

PFS PROJECT NUMBER:
20042

DATE:
JUNE 2022

DRAWN BY:
SMC/SD

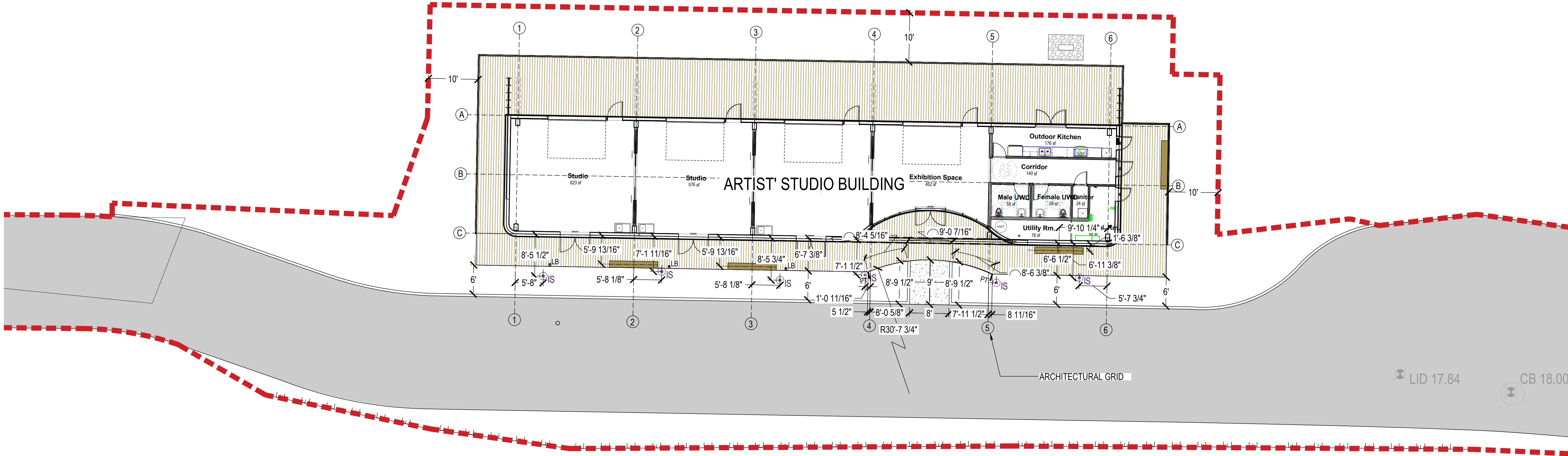
CHECKED BY:
KM

SCALE:
3/32" = 1' - 0"

DWG. NO.:

L1.01

OF:



- LAYOUT AND MATERIALS DRAWINGS ARE TO BE READ IN CONJUNCTION WITH LANDSCAPE SPECIFICATIONS FOR COMPLIANCE.
- LANDSCAPE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH ARCHITECTURAL AND ENGINEERING DRAWINGS. REPORT ANY DISCREPANCIES TO THE LANDSCAPE ARCHITECT FOR REVIEW AND RESPONSE.
- REFER TO MATERIAL DRAWINGS FOR FIXTURE LOCATIONS. REFER TO ELECTRICAL FOR SYSTEM AND SPECIFICATIONS.
- REFERENCE CIVIL ENGINEERS DRAWINGS FOR LAYOUT OF ROAD CURBS AND GUTTERS AND SIDEWALK.
- CONCRETE FINISH AND JOINTS AS PER LANDSCAPE DRAWINGS, ON CONCRETE BANDS, MOUND CURBS AND BENCHES.
- REFER TO LANDSCAPE DETAILS AND SECTIONS FOR ALL LANDSCAPE IMPROVEMENTS.
- ALL DIMENSIONS ARE NOMINAL.
- VERIFY ALL MEASUREMENTS ON SITE. PROVIDE AS-BUILT SHOP DRAWINGS FOR DETAILED COORDINATION WITH ARCH OR STRUCTURAL.
- ALL NEW PLANTING TO BE IRRIGATED WITH AUTOMATIC CONTROLLER, CLIMATE SENSOR AND WATER EFFICIENT SPRINKLERS / DRIP.

LAYOUT NOTES:

- Refer to LG.00 for General Notes.

LAYOUT LEGEND

PT Tangent Point, tie into
Architectural grid

CLIENT:

PROJECT TEAM:

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Vancouver, BC V6J 1K7

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4	2023-03-31	PHASE 1 - IFT & BP	SMC

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PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

LAYOUT PLAN

PFS PROJECT NUMBER: 20042
DATE: JUNE 2022

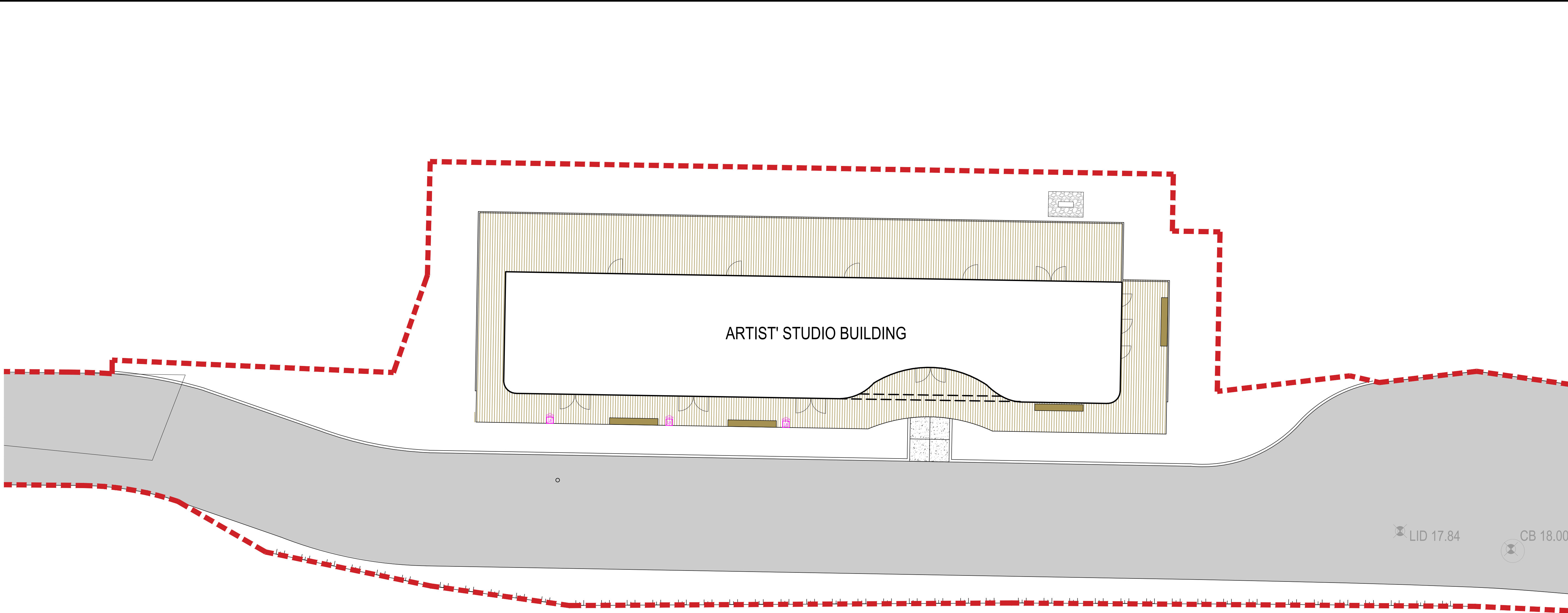
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CHECKED BY: KM

SCALE: 3/32" = 1' - 0"

DWG. NO.:

L2.01

OF:



FIRST AID
+ INFO

LIGHTING NOTES:

1. Light fixtures are identified for location only. Refer to Electrical for specification.
2. Refer to Architecture for wall light locations at Building exits.
3. Refer to Electrical Drawings for connections, wiring, and junction box details.
4. Drivers / Junction boxes to go in planting where possible. Driver can be set into wood deck in Stainless steel (or other approved material) Waterproof box approved by Electrical.

LANDSCAPE LEGEND

 LIGHTING BOLLARD
REFER TO ELECTRICAL

CLIENT:

PROJECT TEAM:

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DRAWING TITLE:

LIGHTING PLAN

PFS PROJECT NUMBER:
20042

DATE:
JUNE 2022

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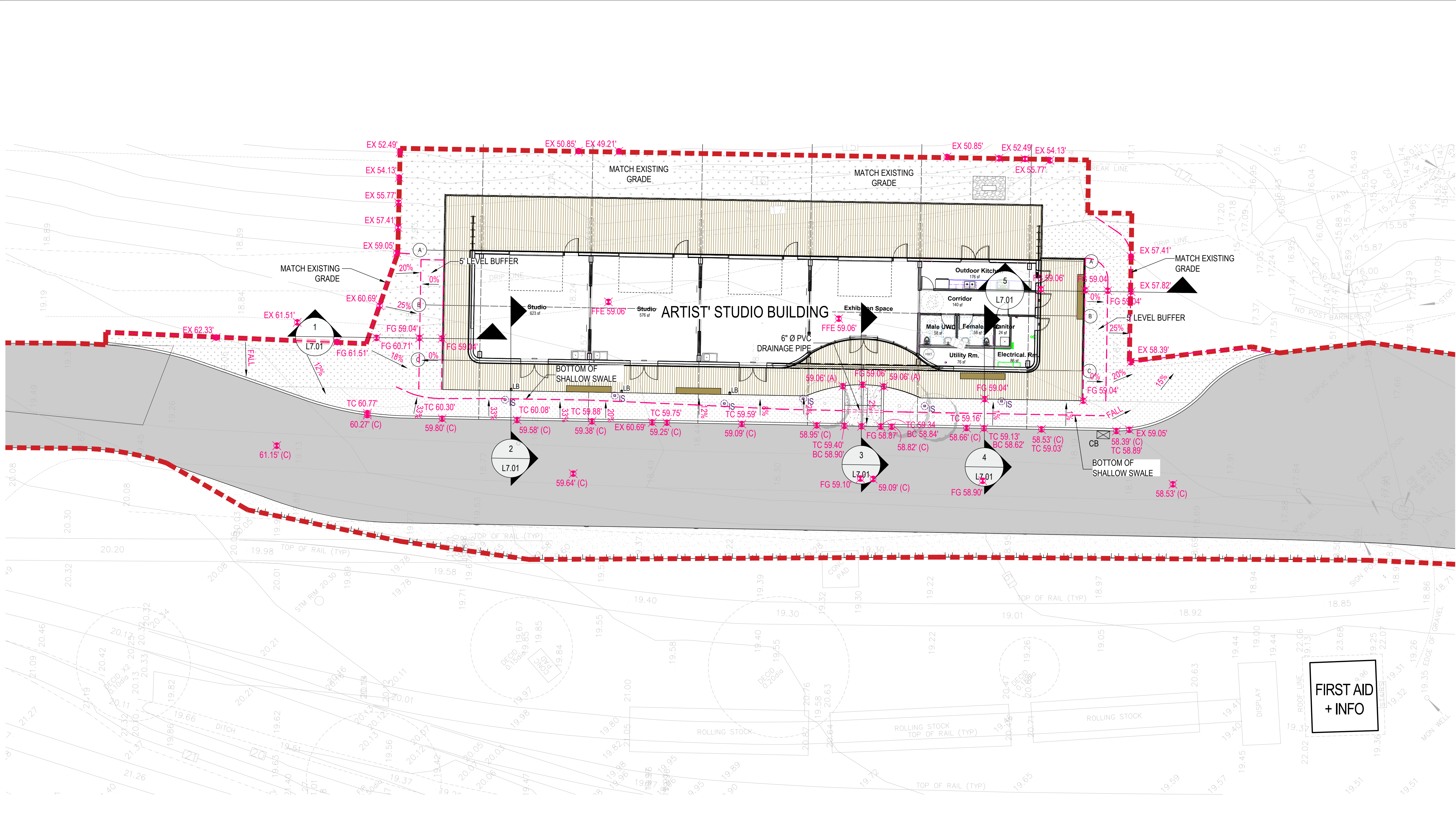
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SCALE:
3/32" = 1' - 0"

DWG. NO.:

L3.01

OF:



- GRADING NOTES:
- Refer to LG.00 for General Notes
 - Existing elevations are based on survey drawings.
 - All proposed spot elevations in imperial feet measurement units unless otherwise indicated, survey elevations in metres.
 - Refer to Architectural, Mechanical and Civil drawings for all subsurface drainage.
 - Ensure positive drainage away from buildings and to storm drains and water channels.
 - Provide adequate sub-surface drainage in all planted areas.
 - Refer to Civil road grading
 - Orient all Area drains to align to direction of paving.

- KEY
- XX% SLOPE
 - DN STAIRS
 - AREA DRAIN
REFER MECHANICAL / CIVIL
 - CATCH BASIN
REFER MECHANICAL / CIVIL
 - LINEAR DRAIN
REFER MECHANICAL / CIVIL
 - EXISTING SPOT ELEVATION
EX.XXX'
 - NEW SPOT ELEVATION
X.XX'
 - SPOT ELEVATION
AS PER ARCH.
(A) X.XX'
 - SPOT ELEVATION
AS PER CIVIL
(C) X.XX'

- LEGEND
- BOUNDARY
 - SCOPE OF WORKS

CLIENT:

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GRADING PLAN

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DATE:
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SCALE:
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PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

PLANTING PLAN

PFS PROJECT NUMBER:
20042

DATE:
JUNE 2022

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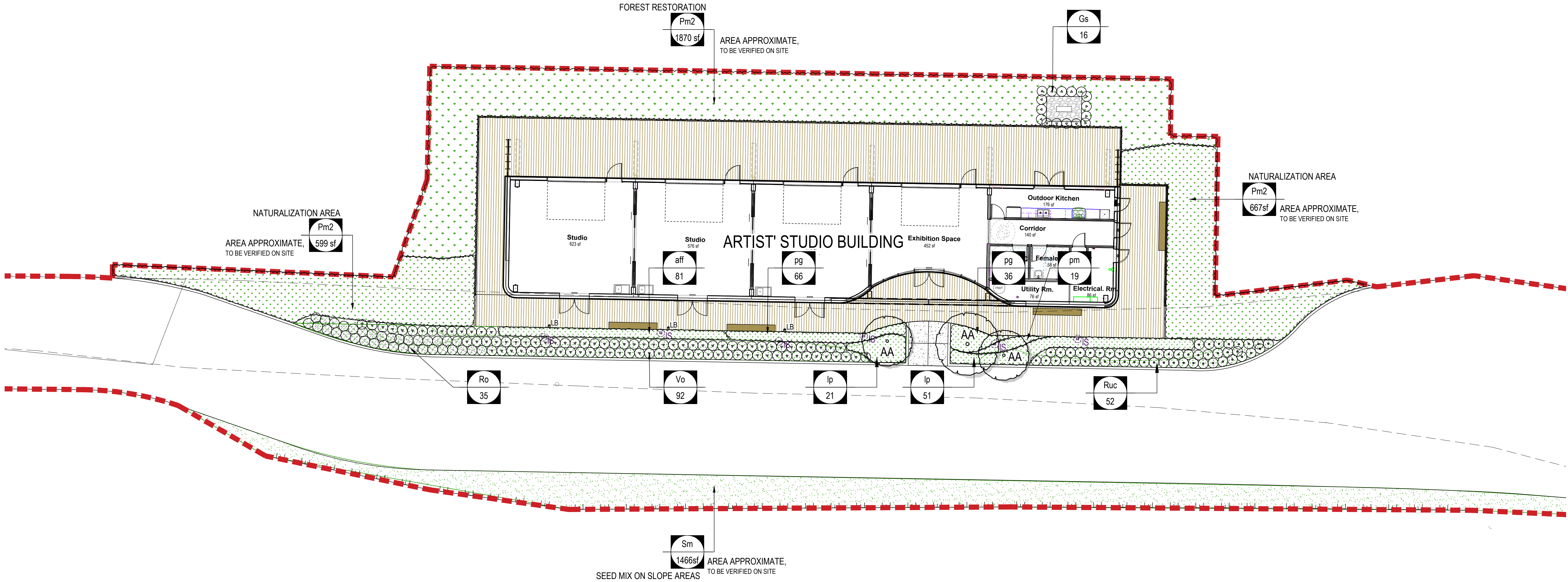
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DWG. NO.:

L5.01

OF:



FIRST AID
+ INFO

TREES

KEY	QTY	BOTANICAL NAME	COMMON NAME	SPACING	SIZE / DESCRIPTION
AA	3	<i>Amelanchier grandiflora</i> x ' <i>Autumn Brilliance</i> '	Autumn Brilliance Serviceberry	As Shown	5cm Cal., B&B, 3 stems, min. 3m ht.

UNDERSTORY

KEY	QTY	BOTANICAL NAME	COMMON NAME	SPACING	SIZE / DESCRIPTION
-----	-----	----------------	-------------	---------	--------------------

SHRUBS

⊙ Gs	16	<i>Gaultheria shallon</i>	Salal	As Shown	#2 POT
⊙ Ruc	52	<i>Ribes uva-crispa</i>	Gooseberry	As Shown	#2 POT
⊙ Ro	35	<i>Rubus occidentalis</i>	Wild Raspberry	As Shown	#2 POT
⊙ Vo	92	<i>Vaccinium ovatum</i>	Evergreen Huckleberry	As Shown	#2 POT

PERENNIALS / GROUNDCOVERS

aff	81	<i>Athyrium filix-femina</i>	Lady Fern	12" o.c.	#2 POT
lp	72	<i>Lonicera pileata</i>	Privet Honeysuckle	18" o.c.	#2 POT
pg	102	<i>Polypodium glycyrrgiz</i>	Licorice Fern	12" o.c.	#2 POT
pm	19	<i>Polystichum munitum</i>	Sword Fern	12" o.c.	#2 POT

Plant Mix 2: Forest Restoration and Naturalization Area
Pm2 3136 f²

AREAS APPROXIMATE,
TO BE VERIFIED ON SITE

FOREST RE-ESTABLISHMENT AREA

%	QTY	BOTANICAL NAME	COMMON NAME	SPACING	SIZE/DESCRIPTION
10%	105	<i>Amelanchier Alnifolia</i>	Pacific Serviceberry	3' o.c.	#2 POT
5%	52	<i>Mahonia Aquifolium</i>	Tall Oregon Grape	Plant species in groups of 5, 9 and 15 to achieve a natural look	#2 POT
40%	420	<i>Rosa Nutkatensis</i>	Nootka Rose		#2 POT
30%	315	<i>Rubus Spectabilis</i>	Thimbleberry		#2 POT
5%	50	<i>Gaultheria Shallon</i>	Salal		#2 POT
10%	103	<i>Symphoricarpos Albus</i>	Common Snowberry		#2 POT

Seed Mix on Slope Areas

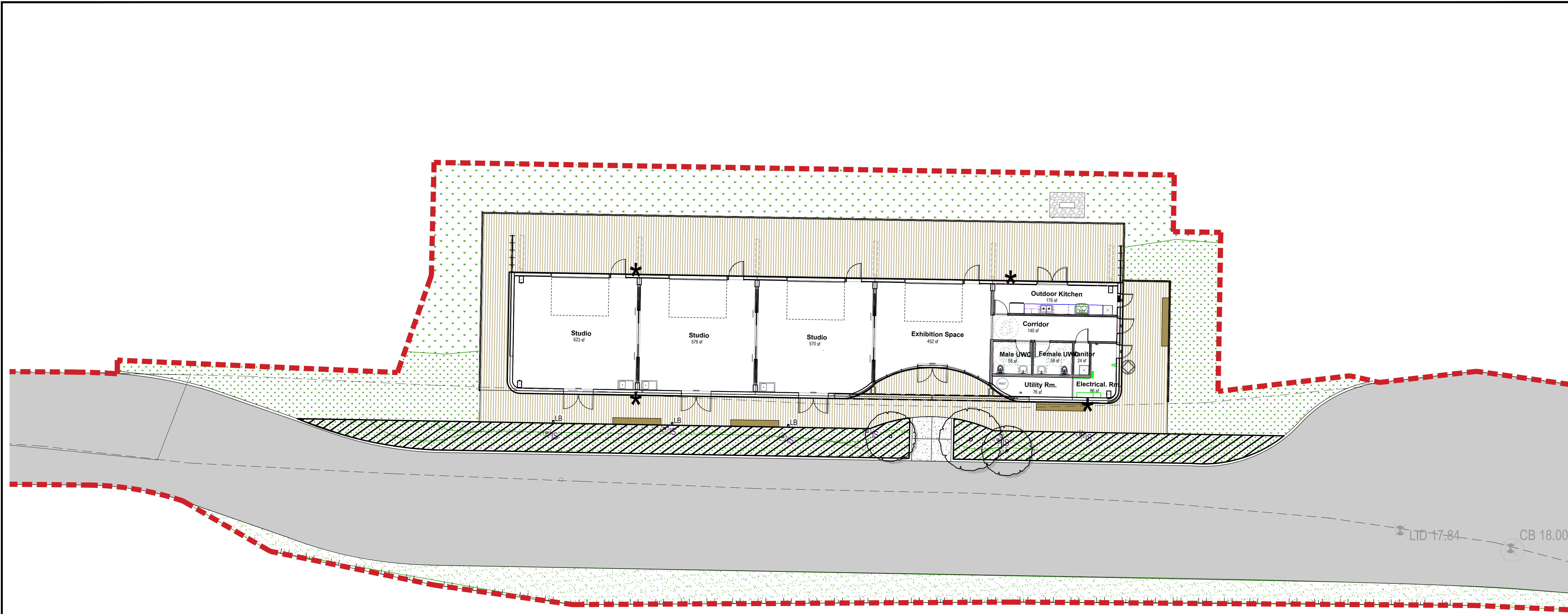
Sm 1466 f²
AREA APPROXIMATE,
TO BE VERIFIED ON SITE

PT 454 NATIVE URBAN MEADOW MIX

Refer to <https://ptlawnsseed.com/collections/native-seeds/products/pt-454-native-urban-meadow-mix> for details

PLANTING NOTES:

- Refer to G.00 for General Notes.
- All plant material and landscape construction to conform to the CSLA Landscape Standards.
- Plant material sizes specified are the minimum acceptable sizes to be supplied to this project.
- All plant material shall be well-established and uniform in shape and size.
- Prior to the start of construction, the contractor shall confirm the availability of the plant material specified as per specifications, allowing for any and all required approvals. Plant substitutions not confirmed and approved by the Consultant will be rejected.
- The Contractor shall provide a growing medium analysis for review by the Consultant - as per specifications - prior to the start of construction. Growing medium supplied to the site or installed on site prior to consultant approval shall be rejected at no cost to the owner.
- Final spacing, quantity and tree species to the satisfaction of the General Manager of Engineering Services, new trees must be of good standard, minimum 8cm caliper, and installed with approved root barriers, tree guards and appropriate soil. All planting to conform to the Engineering and Parks Standards.
- Ensure adequate sub-surface drainage for planting areas.
- Provide an automatated irrigation system for all soft landscaping.
- Search area for all plant material shall include all of Western North America or as specified.
- Nursuries to be 'SOD' certified.
- All trees to be staked and planting areas to be laid out for Landscape Architect to review and approve prior to planting.



IRRIGATION NOTES:

1. Refer to LG.00 for General Notes.
2. All re-establishment planting to have hose bibs and watered during establishment.
3. Irrigation system to include weather sensor, soil moisture sensor, and high efficiency sprinkler heads and/or drip system. Weather sensor to be installed on roof over Outdoor Kitchen, details to be confirmed with Architect. The Town of Ladysmith use Toro irrigation systems and equipment.
4. Controller to be located in building electrical room with separate, dedicated power receptacle.
5. Irrigation system to be design & build system by the Contractor, using qualified irrigation specialist and suppliers. Shop Drawings required for approval by Owner's representative before finalizing and installation.

IRRIGATION LEGEND

- * Hose bib locations See arch. Drawings for location
- Irrigation main water connection
- ▨ Areas to have automatic irrigation system

CLIENT:

PROJECT TEAM:

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PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

IRRIGATION PLAN

PFS PROJECT NUMBER: 20042 DATE: JUNE 2022

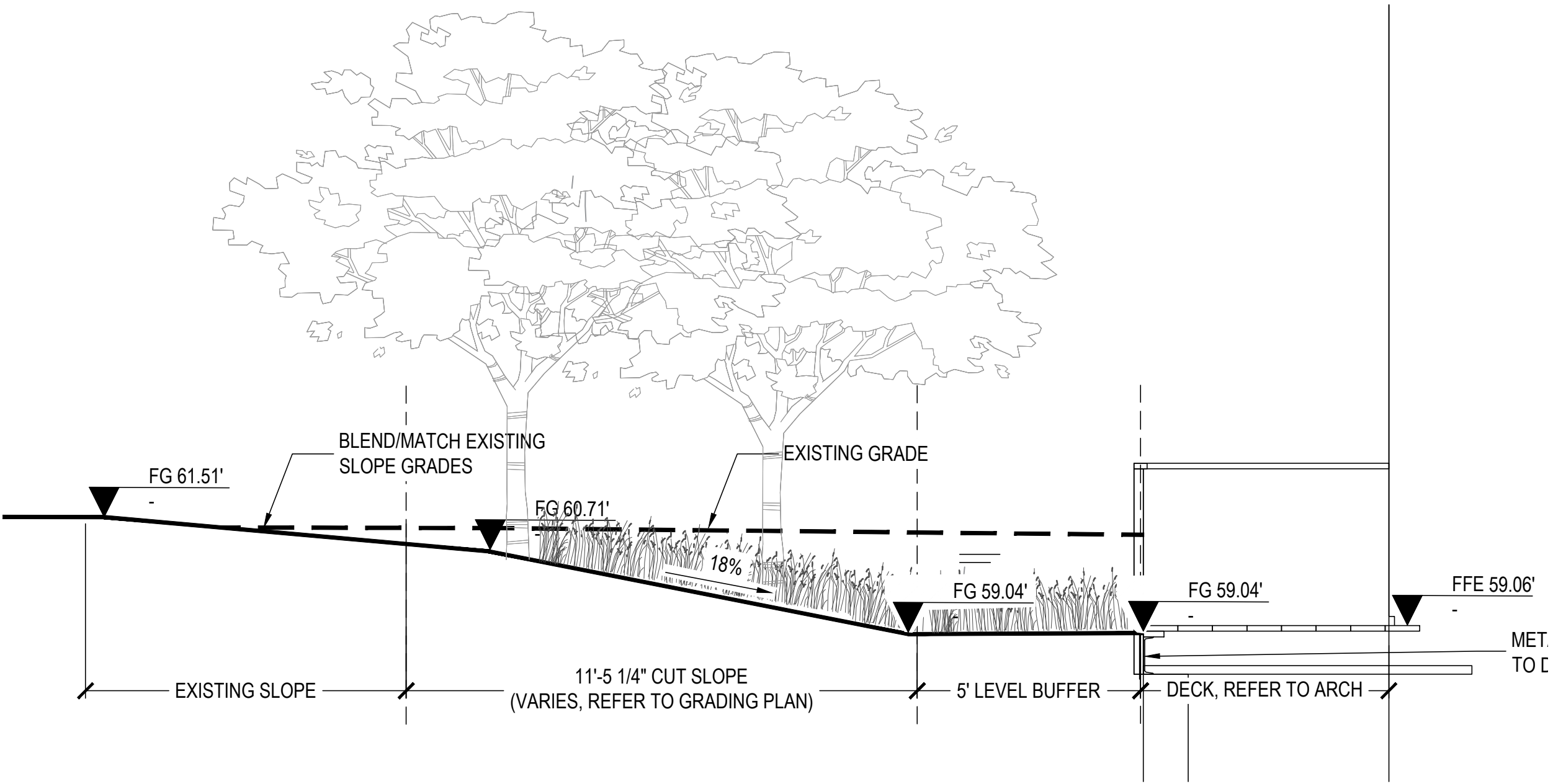
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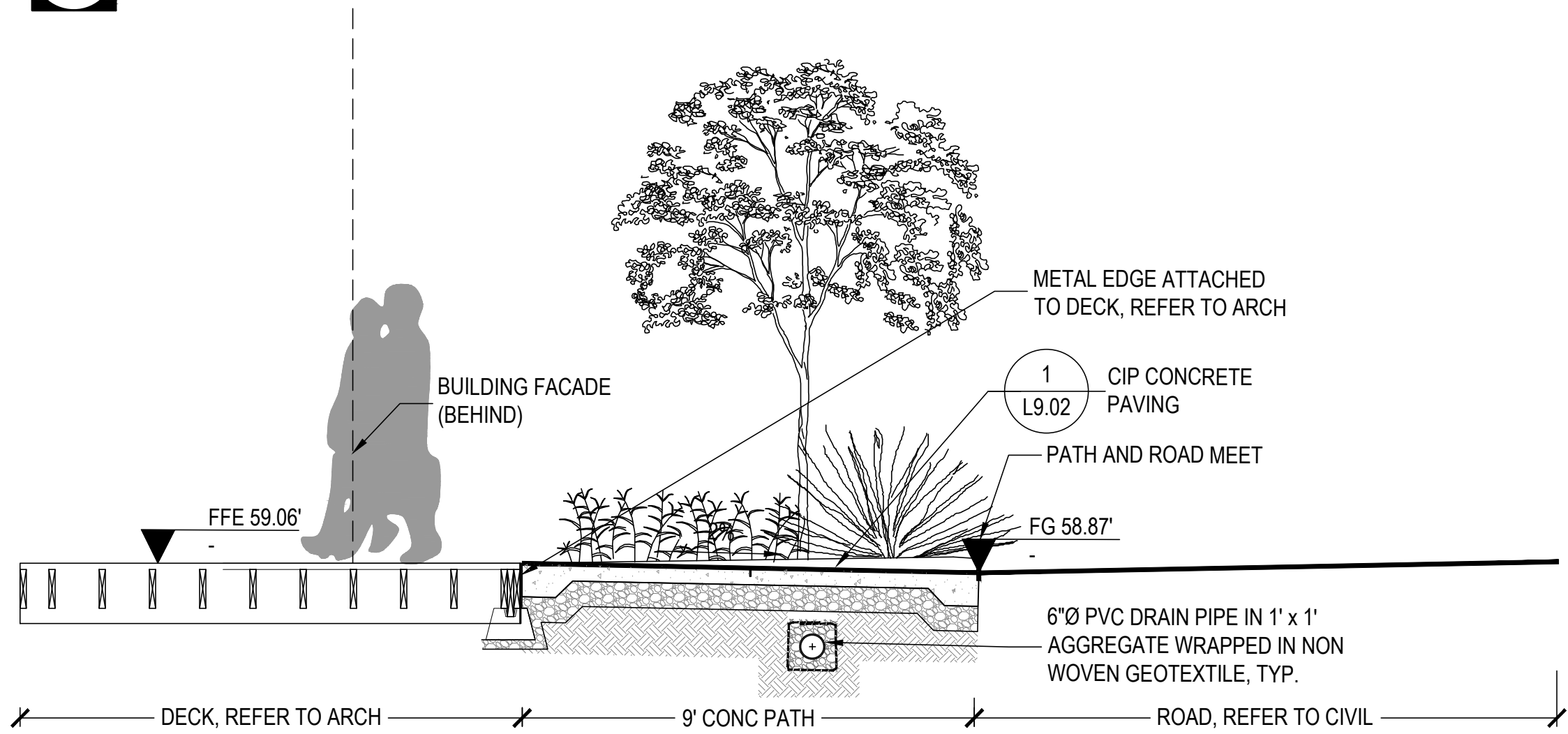
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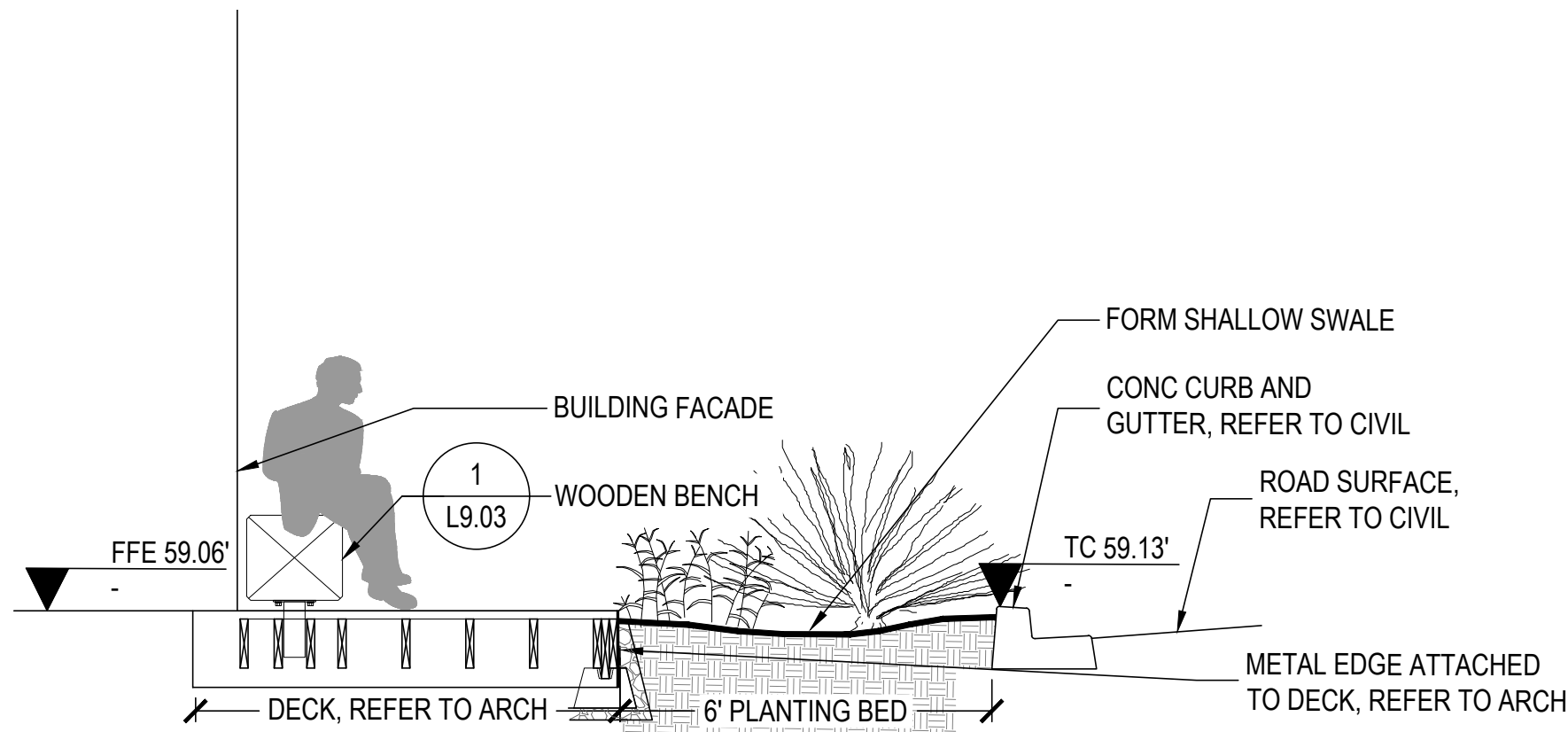
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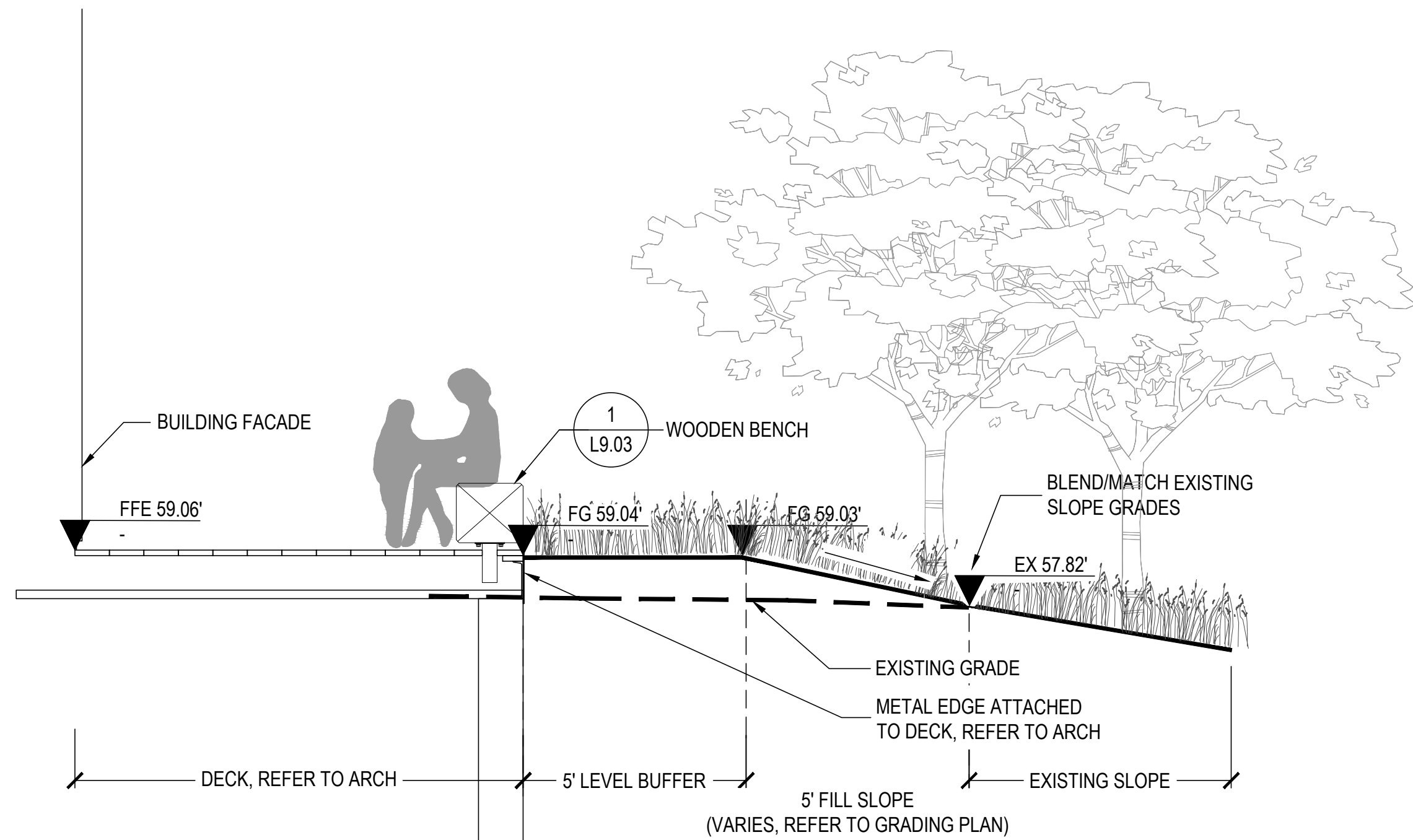
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2 SECTION B
SCALE: 3/8"=1'-0"

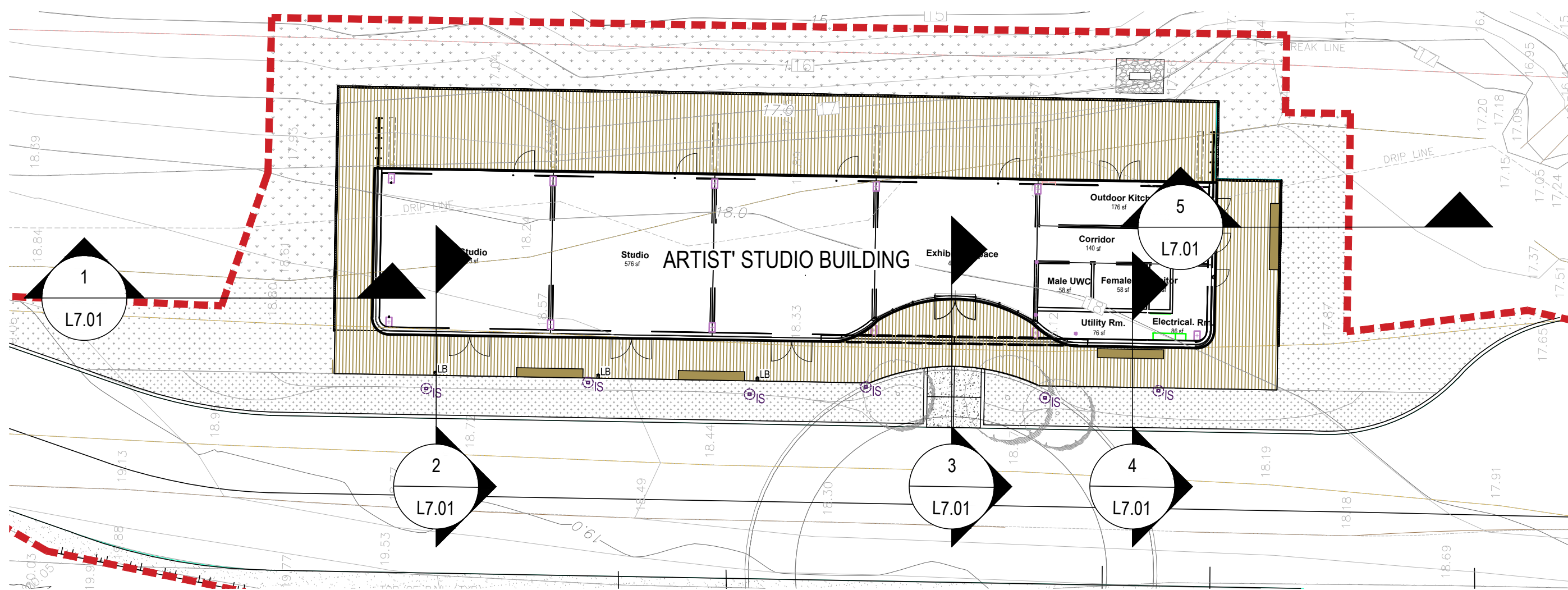


3 SECTION C
SCALE: 3/8"=1'-0"



5 SECTION E
SCALE: 3/8"=1'-0"

4 SECTION D
SCALE: 3/8"=1'-0"



6 KEY PLAN
SCALE: 1/16"=1'-0"

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PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

SECTIONS

PFS PROJECT NUMBER:
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DATE:
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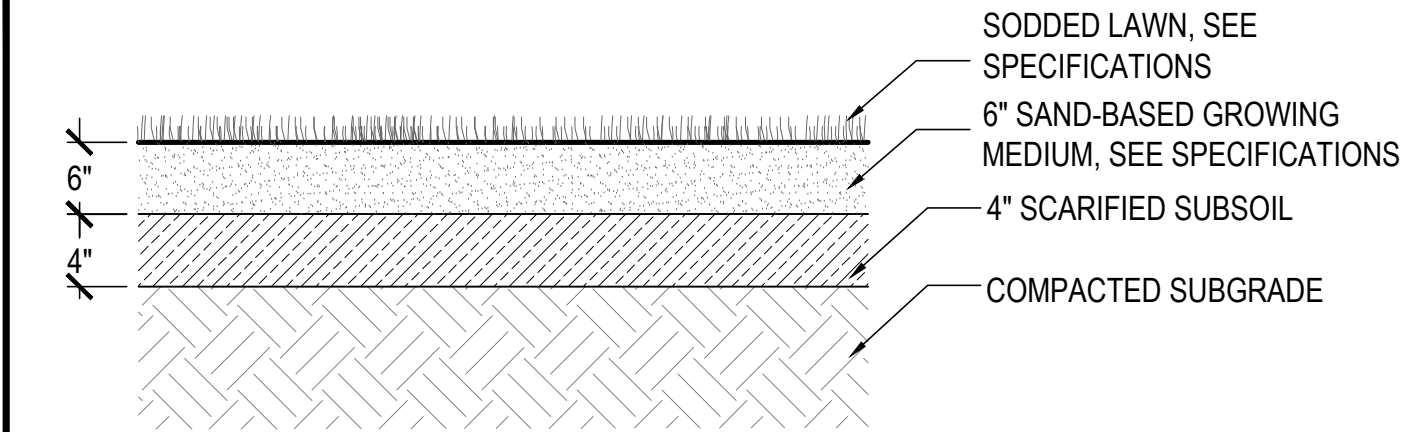
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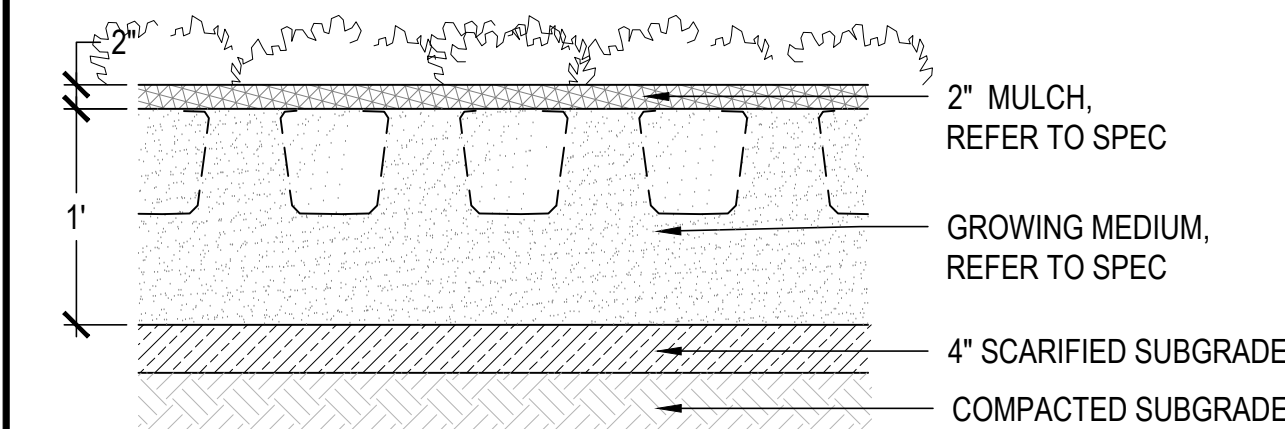
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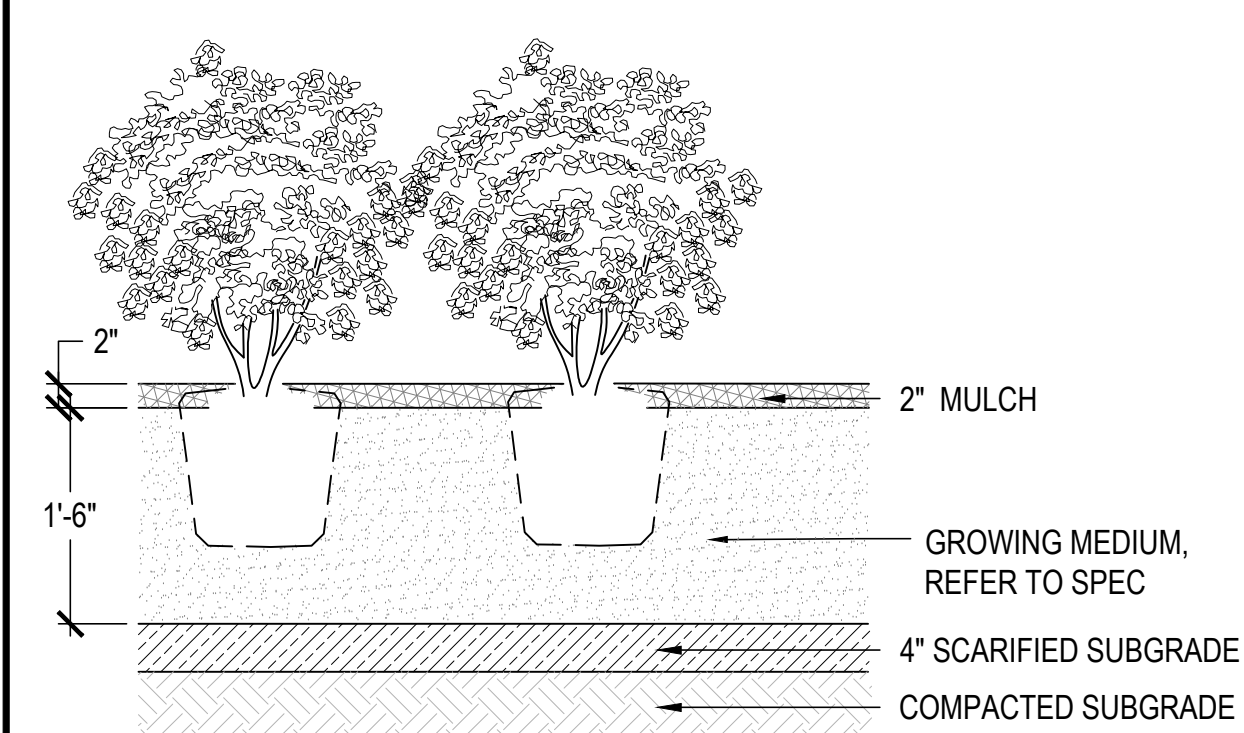
OF:



LAWN TYP. ON GRADE



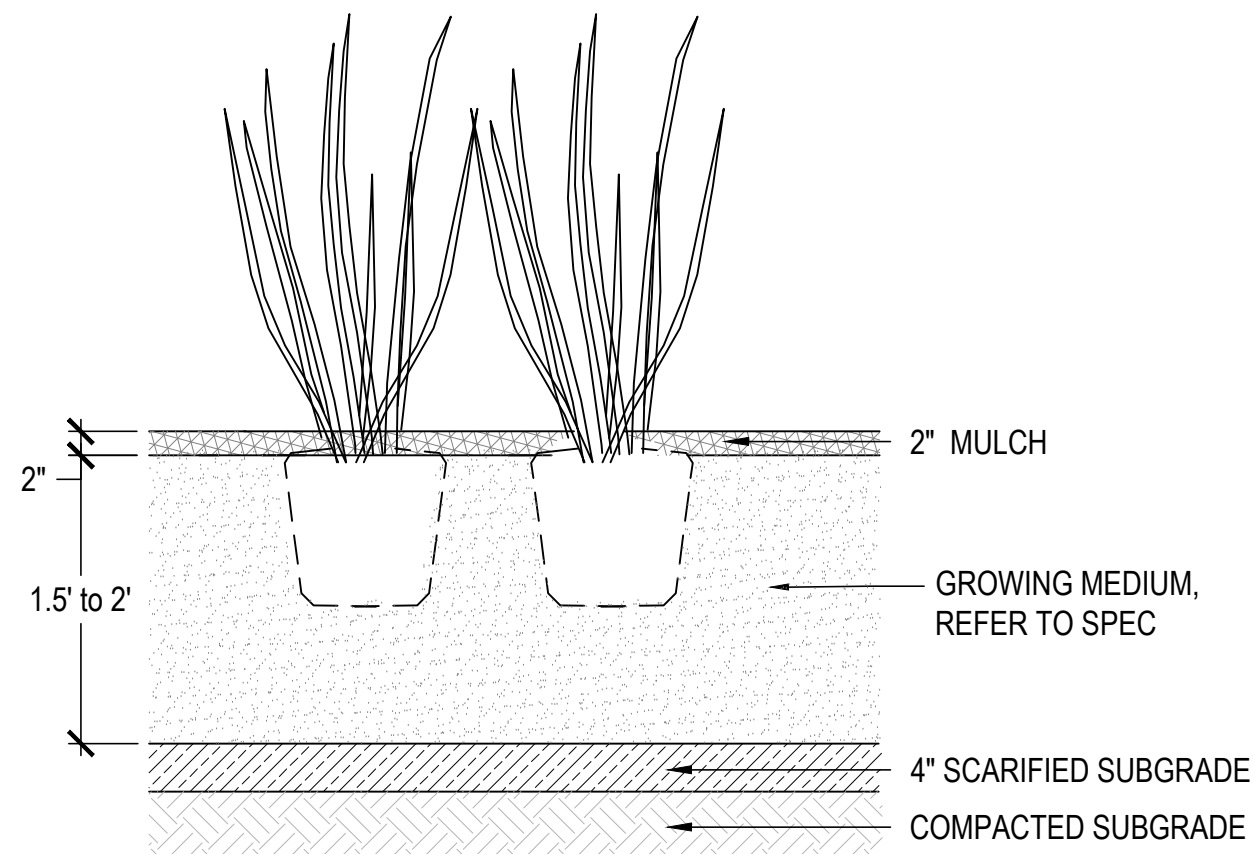
GROUNDCOVER SOIL DEPTH ON GRADE



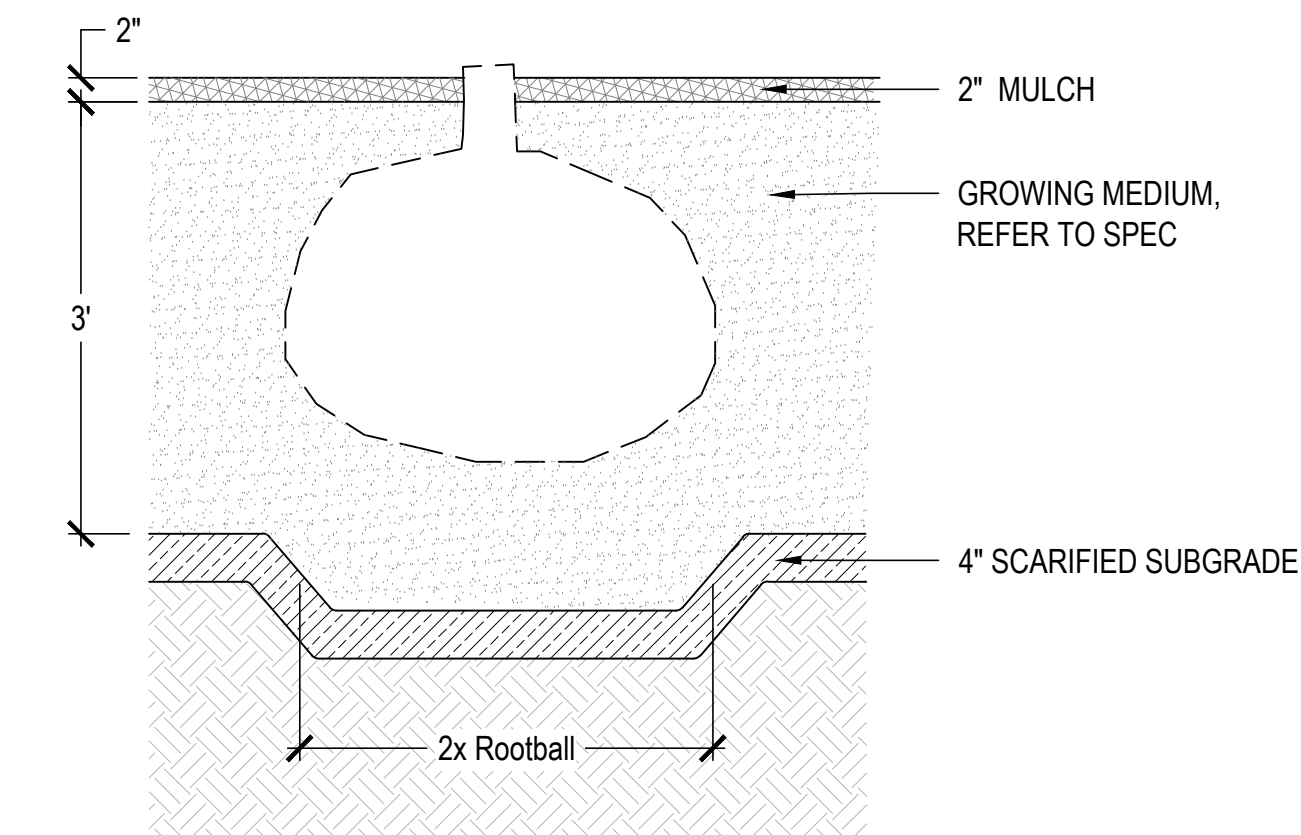
SHRUB SOIL DEPTH ON GRADE

1 SOIL PROFILES, TYP.

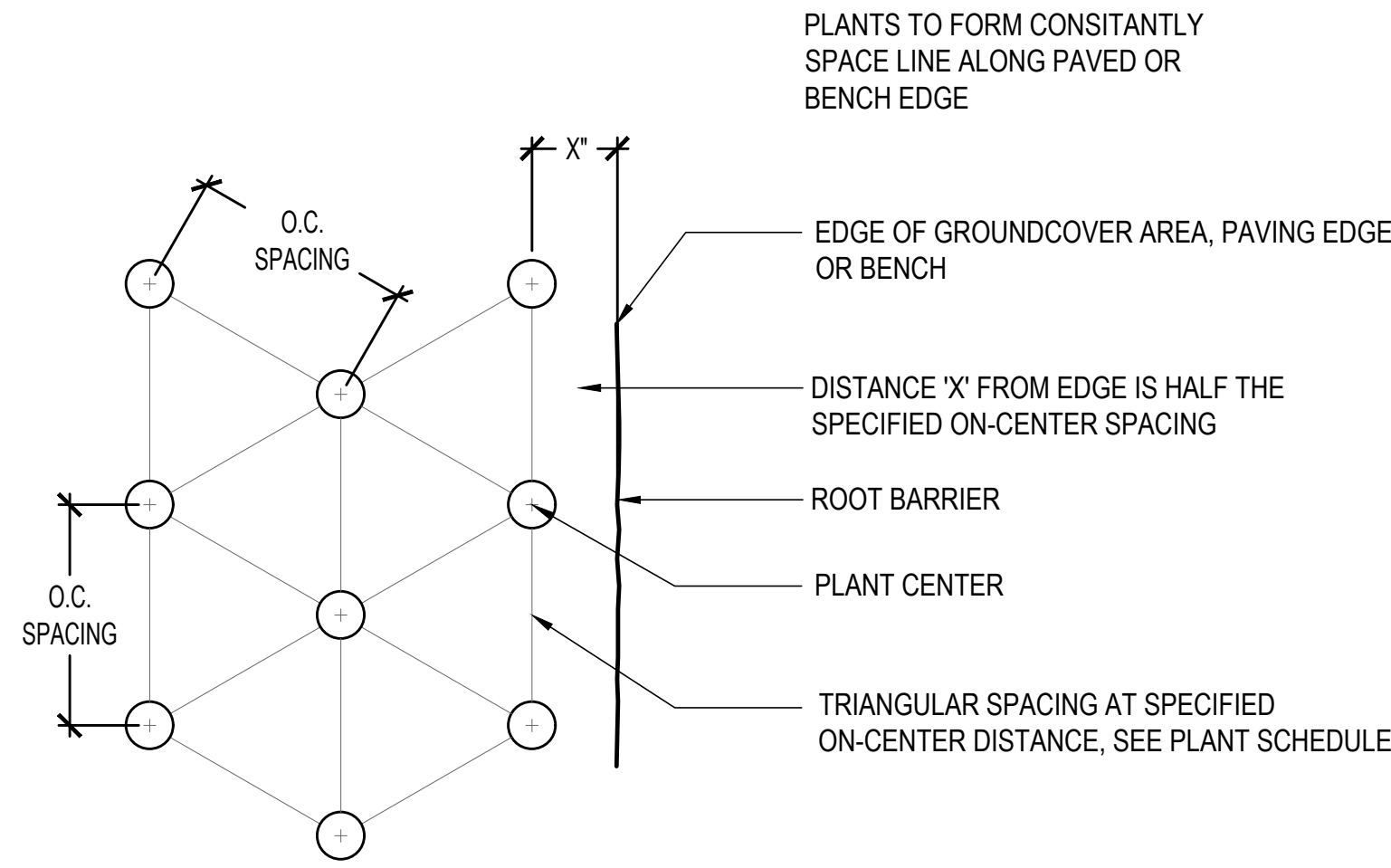
SCALE: 3/4"=1'0"



GRASS PLANTING ON GRADE



TREE SOIL DEPTH ON GRADE



2 PLANTING LAYOUT

SCALE: 1'-0"=1'0"

2" (MIN.) WIDE "ARBOUR TIE" BANDING SECURE TO WOOD STAKE WITH 1" GALVANIZED ROOFING NAILS (OR APPROVED EQUAL)

2 - 2" x 2" x 8'-0" (50mm x 50mm x 2400mm) LONG PRESSURE TREATED WOOD STAKES EXTENDING 6" PAST ROOTBALL KEEP CLEAR OF ROOTBALL

SET CROWN OF ROOTBALL 1" ABOVE FINISH GRADE AND REMOVE BURLAP AND TWINE FROM TOP THIRD OF ROOTBALL. SET TREE AT 2" (MIN) TO 4" (MAX) ABOVE ORIGINAL NURSERY GRADE AND SURROUNDING GRADE TO ALLOW FOR SETTLEMENT

MULCH - SEE SPECIFICATIONS. KEEP MULCH AWAY FROM TREE TRUNK.

FINISHED GRADE

PLANTING MEDIUM TYP., SEE SPEC. COMPACT UNDER ROOTBALL FOR FIRM STABLE BASE

SCARIFY TREE PIT SIDES AND BOTTOM (DON'T DIG TREE PIT DEEPER THAN ROOTBALL

PLACE TREE ROOTBALL ON COMPACTED GROWING MEDIUM TO 85% SPD

NOTES:

- TREE STAKES TO BE REMOVED AFTER ONE FULL YEAR FROM TIME OF SUBSTANTIAL COMPLETION.
- REMOVE TREE WRAP, PACKAGING AND TAGS AT TIME OF STAKING.
- REMOVE ONLY DEAD OR BROKEN BRANCHES.
- DO NOT CUT LEADER.
- WATER TO SATURATION. REMOVE AIR SPACE WITH SOIL PORES.
- ALL TREES TO BE NATURAL FORM, NO TIPPING, SHEARING ALLOWED.

3 TREE PLANTING ON GRADE, TYP.

SCALE: 1'-0"=1'0"

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PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

LANDSCAPE DETAILS
PLANTING

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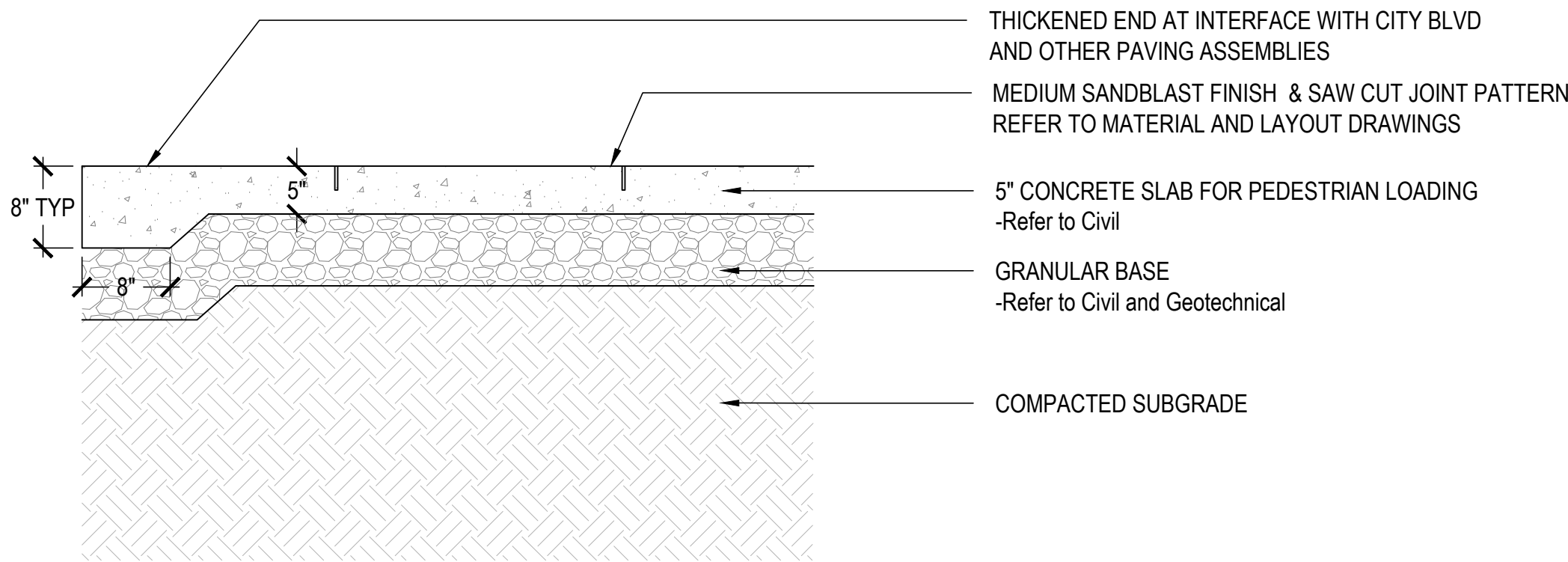
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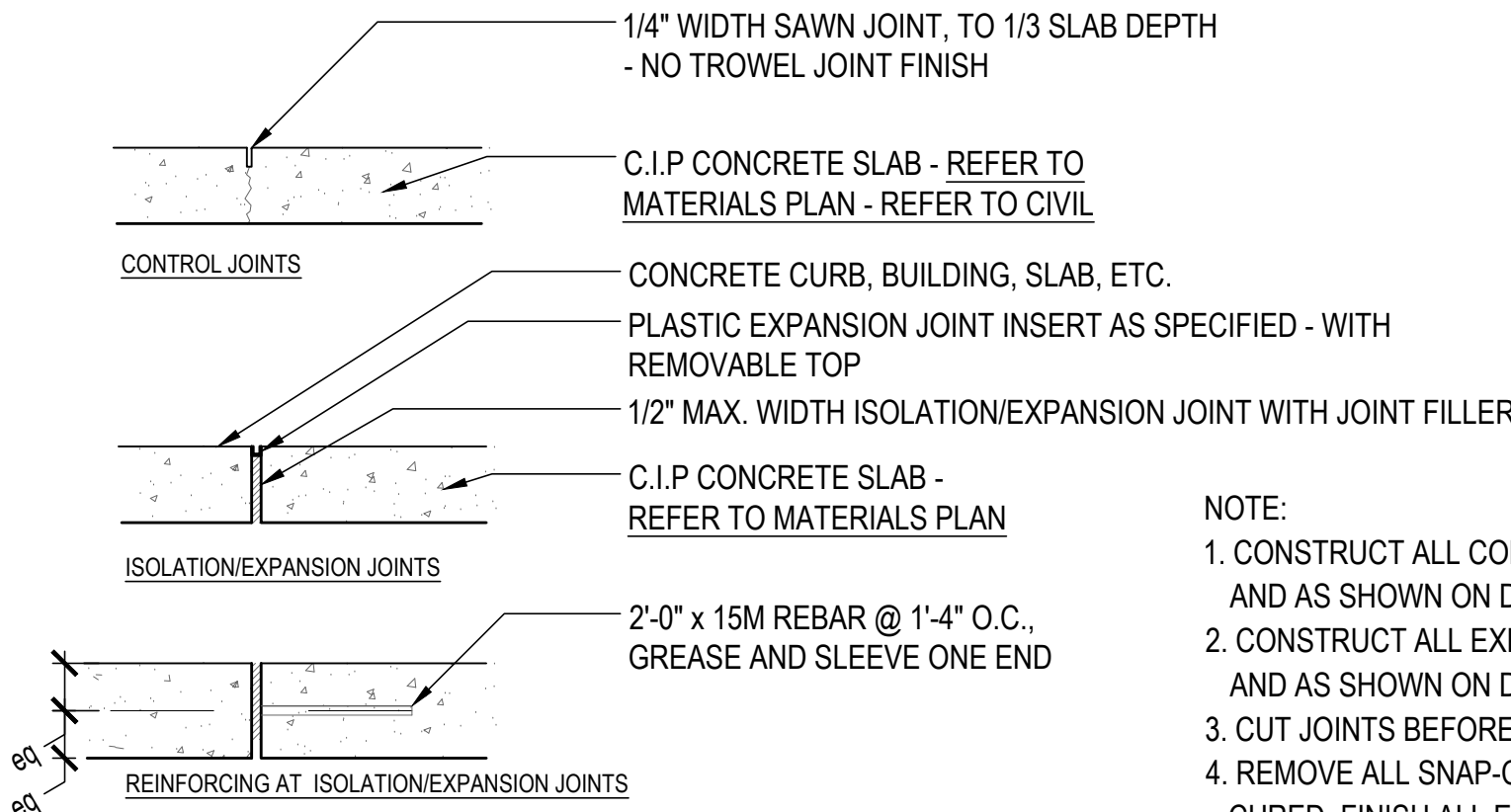
L9.01

OF:



1 CIP CONCRETE PAVING

SCALE: 1'-0"=1'-0"



- NOTE:
1. CONSTRUCT ALL CONTROL JOINTS MIN. 5' O.C., AND AS SHOWN ON DRAWINGS
 2. CONSTRUCT ALL EXPANSION JOINTS MIN. 10' O.C., AND AS SHOWN ON DRAWINGS.
 3. CUT JOINTS BEFORE RANDOM CRACKING OCCURS
 4. REMOVE ALL SNAP-CAPS AFTER CONCRETE HAS CURED, FINISH ALL EXPOSED EX. JOINTS WITH CONTIN. BEAD CAULK ON TOP.
 5. STEEL DOWELS TO BE EPOXY COATED.
 6. REFER TO THE TOWN OF LADYSMITH STANDARD DRAWING C4 - CONCRETE FINISH AS PER LANDSCAPE

2 CIP CONCRETE JOINTS

SCALE: 1'-0"=1'-0"

CLIENT:

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PHASE 1 - LADYSMITH, BC

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LANDSCAPE DETAILS
PAVING

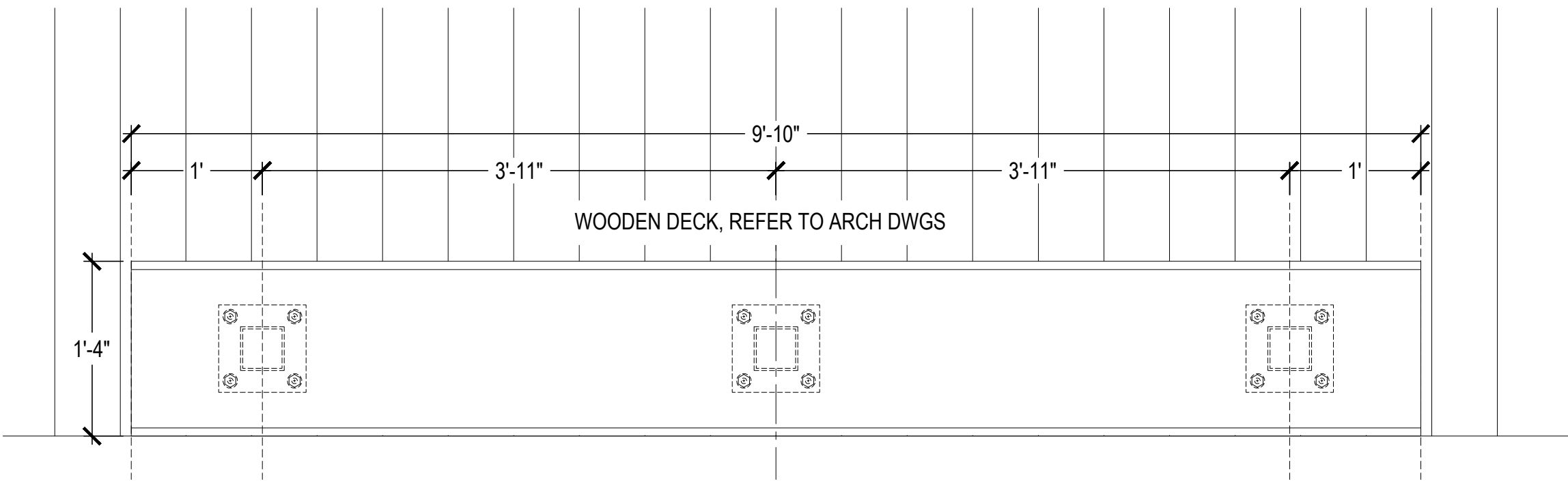
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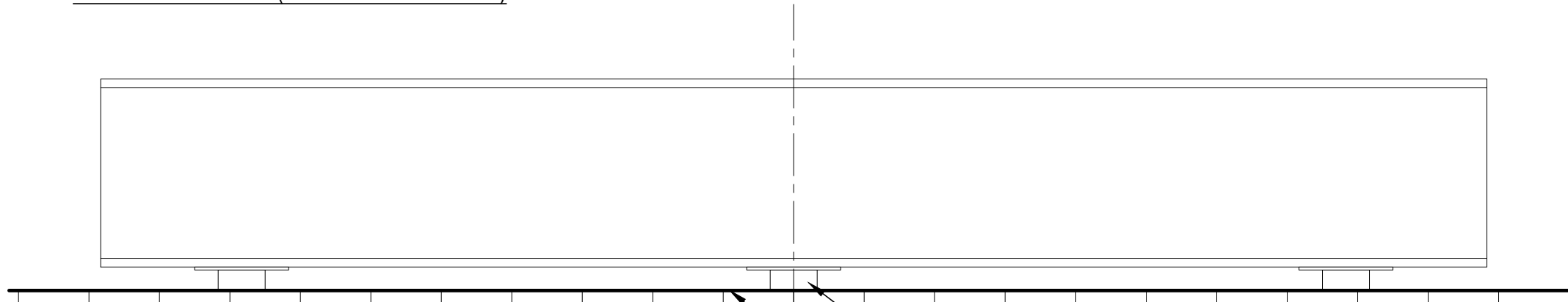
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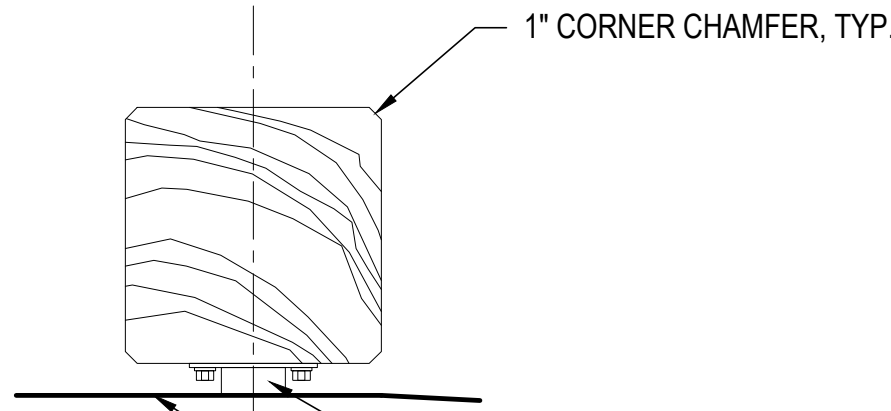
BENCH - PLAN VIEW (METAL LEGS DASHED)



BENCH - ELEVATION

METAL LEG, TYP.

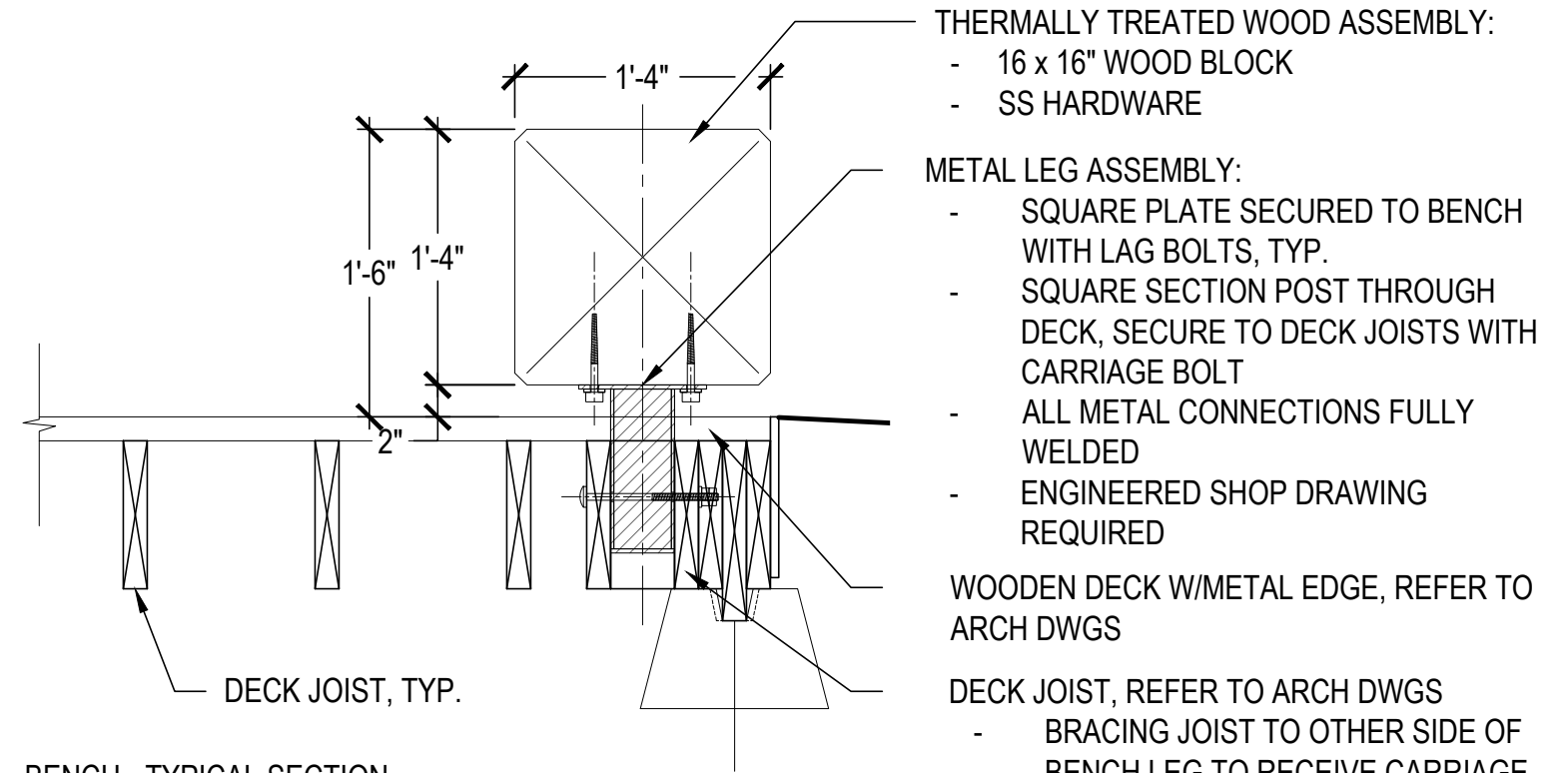
FINISHED GRADE



BENCH - END ELEVATION

METAL LEG, TYP.

FINISHED GRADE



BENCH - TYPICAL SECTION

1 WOODEN BENCH

SCALE: 1-0"=1'0"

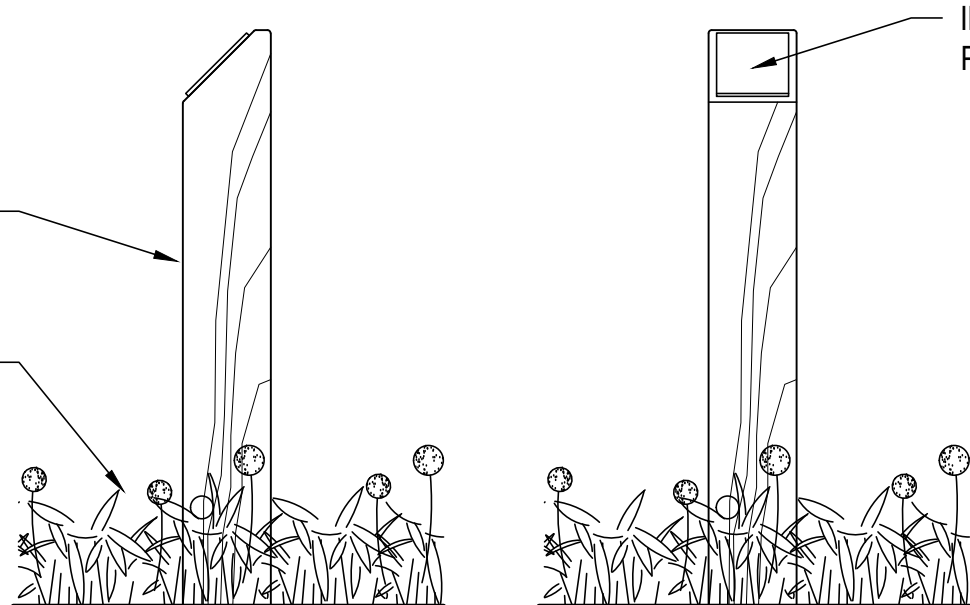


INTERPRETIVE SIGNAGE NOTES:

1. (6) 6 x 6" PT POSTS
2. FINISHED HEIGHT 3' ABOVE GRADE
3. PLACED IN GRAVEL FOOTING, TYP.
4. ANGLE TOP TO PROVIDE SURFACE FOR INTERPRETATIVE PANEL
5. SHOP DRAWING REQUIRED FOR APPROVAL INTERPRETATIVE PANEL CONTENTS/GRAPHIC TO BE CONFIRMED
- 6.

SIDE FACING WOOD DECK

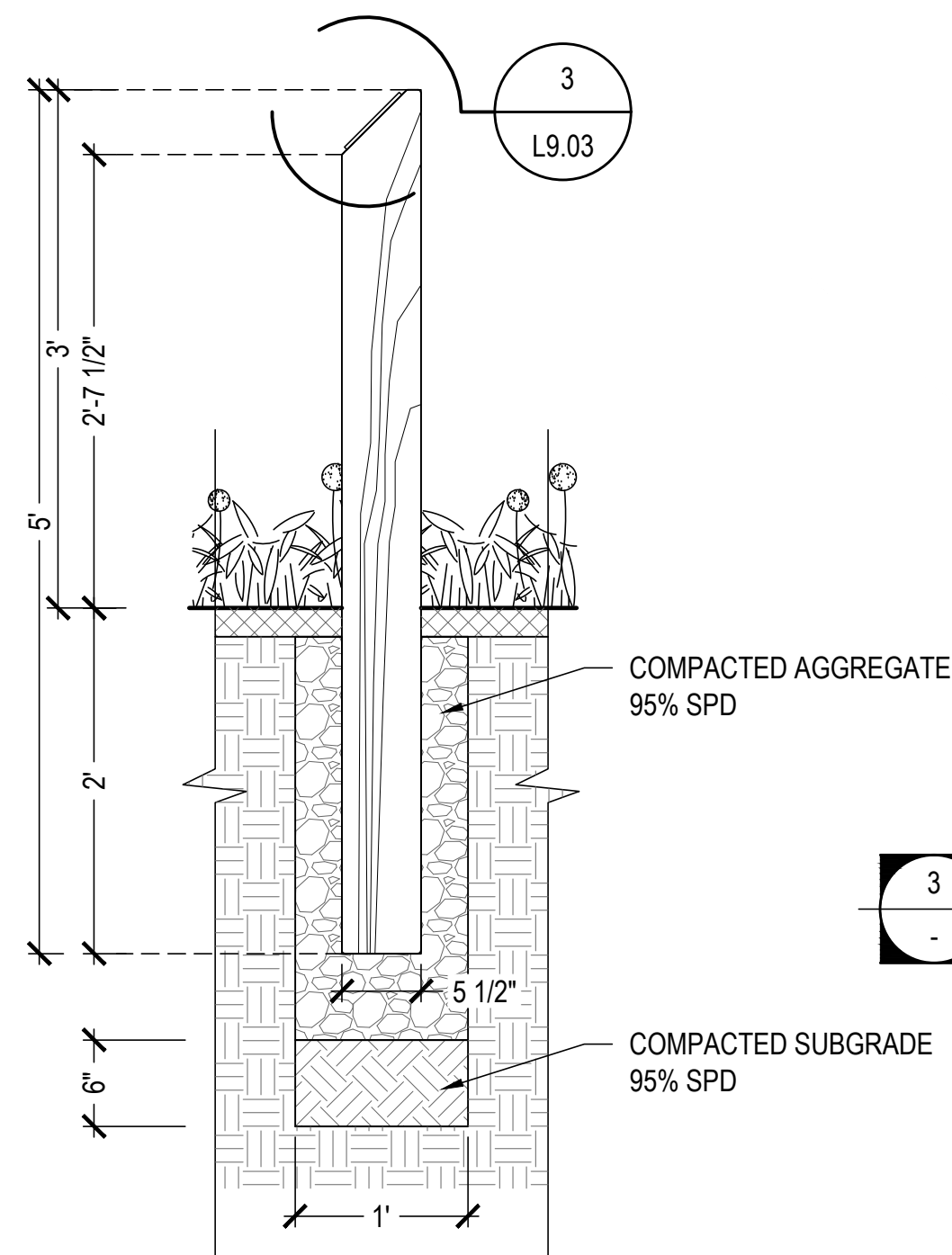
PLANTING: HEIGHT VARIES



SIDE

FRONT

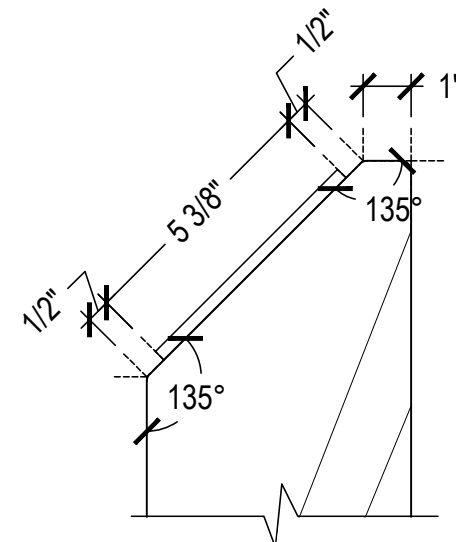
INTERPRETATIVE SIGN - ELEVATIONS



INTERPRETATIVE SIGN - TYPICAL SECTION

3 INTERPRETATIVE SIGNAGE - TOP DETAIL

SCALE: 3-0" = 1'0"



2 INTERPRETATIVE SIGNAGE

SCALE: 1-0"=1'0"

NOTES

1. REFER TO LG0.01 FOR GENERAL NOTES
2. CONTRACTOR MUST SUBMIT FULLY ENGINEERED SHOP DRAWINGS OF THE FURNITURE ELEMENTS, INCLUDING WOOD AND STEEL FOR REVIEW BY THE LANDSCAPE ARCHITECT + ENGINEER PRIOR TO FABRICATION COMMENCING.
3. ALL STEEL TO BE STAINLESS STEEL
4. ALL FIXINGS AND CONNECTIONS ARE TO BE FIT FOR PURPOSE AND CONCEALED
5. ALL EXTERNAL STEEL TO BE FINISHED AS PER SPECIFICATION

CLIENT:

PROJECT TEAM:

LANDSCAPE ARCHITECT
PFS Studio
1777 West 3rd Avenue
Vancouver, BC V6J 1K7

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ISSUANCE:

No	Date	Details	By
1	2022-08-03	ISSUED FOR COSTING	SMC
2	2023-02-02	PHASE 1 - ISSUED FOR 75% CD	SMC
3	2023-02-21	PHASE 1 - ISSUED FOR 90% CD	SMC
4	2023-03-31	PHASE 1 - IFT & BP	SMC

PFS STUDIO
PLANNING • URBAN DESIGN • LANDSCAPE ARCHITECTURE
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www.pfs.bc.ca

STAMP:



PROJECT NAME:

ARTS AND HERITAGE HUB
PHASE 1 - LADYSMITH, BC

DRAWING TITLE:

LANDSCAPE DETAILS
SITE FURNISHING

PFS PROJECT NUMBER:
20042

DATE:
JUNE 2022

DRAWN BY:
SMC/SD

CHECKED BY:
KM

SCALE:
1" = 1' - 0"

DWG. NO.:

L9.03

OF:

1 General

1.1 **SUMMARY**

- .1 Section addresses the protection and care of existing trees and shrubs that have been designated for retention and protection. Identify specified trees and protect from damage and maintain throughout the course of construction. Work includes all labour, materials, equipment and services required.
- .2 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- .3 Related Work:
 - .1 Landscape Finished Grading Section 32 91 19
 - .2 Growing Medium Section 32 91 13
 - .3 Plant Material Section 32 93 00

1.2 **REFERENCE STANDARDS**

- .1 Town of Ladysmith Tree Protection Bylaw.

1.3 **APPROVALS, INSPECTIONS AND SITE SUPERVISION:**

- .1 Meet with the Contractor's Certified and the Town's Arborist to review tree preservation measures. The Contractor is responsible for the hire of a (Contractor's) Certified Arborist.
- .2 Tree Protection Fencing must be approved by the Contractor's Arborist prior to the commencement of site work.
- .3 The Contractor's Arborist must be consulted beforehand, if access is required within any of the Tree Protection Areas. All Tree Protection Areas must remain fenced at all times.
- .4 Do not remove any trees or any part of a tree without prior approval of the Contractor's Arborist. Any modification to a protected tree must be made under the supervision of the Town Arborist. This includes excavation activity that may impact tree roots.
- .5 Establish a schedule of periodic site inspections with the Contractor's and Town's Arborist to monitor quality and compliance with the Tree Protection Measures detailed herein.

1.4 **QUALIFICATIONS:**

- .1 All tree care and supervision shall be conducted by an I.S.A. certified personnel hired by the Contractor.

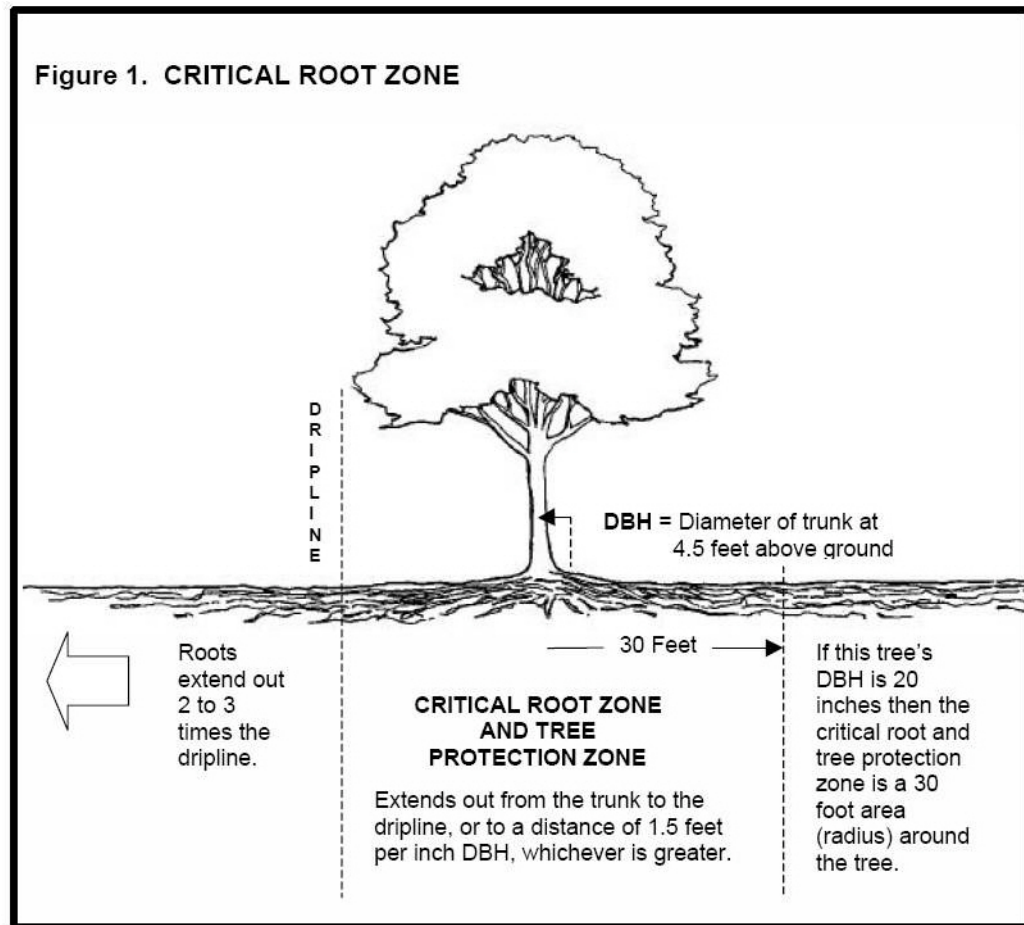
2 Products

2.1 **TREE PROTECTION FENCING**

- .1 Tree protection fencing must be erected before the onset of construction in relationship to each tree's Critical Root Zone. Refer to Tree Management Plan Drawing and Figure1 below. To be as follows:
 - .1 Tree protection fencing will be snow-fencing firmly attached to the ground with metal stakes or a 2" x 4" wood frame with uprights driven into the ground.

- .2 Fencing will be a minimum of 42" in height and extend to at least the dripline, or to a distance of 1.5' per inch of DBH (diameter breast height) radius for every 1" of trunk diameter at DBH, whichever is the greater.

Figure 1



- .2 Tree protection fencing for woodlots or groups of plantings, shall be placed at least 1m beyond dripline of outer canopies.
- .3 If site constraints or tree characteristics make the above specifications impractical or impossible, either site design or building layout must be revised, or an alternative fencing layout and/or trunk –root protection strategy must be developed and approved in consultation with the Contractor's Certified Arborist prior to initiation of construction and hoarding activities.

2.2 TREE PROTECTION SIGNAGE:

- .1 Tree protection signage shall be weather proof, i.e. Coroplast, and be a minimum size of 1m across by 750mm in height. Signage will be perforated at each corner to facilitate mounting. Use plastic lock ties for mounting.

2.3 ROOT PROTECTION CLOTH:

- .1 Landscape fabric shall be used to cover exposed roots along the cut face of excavations made adjacent to tree protection areas. The fabric is intended to conserve moisture within the soils and roots.

2.4 TREE MULCH:

- .1 Tree mulch shall be complete tree chip mulch, including parts of the leaf, twig, bark and stem wood. This product may be obtained from local tree contractors, generally free of charge. The mulch should be free of pests or diseases and should not contain Western Red Cedar or Black Walnut.
- .2 Provide a sample of the proposed tree mulch and its source for approval by the Consultant and Project Arborist,

3 Execution

3.1 TREES - PROTECTION FENCING AND SIGNAGE:

- .1 Tree protection fencing will be erected prior to the commencement of any other site work. Area of tree protection fencing is limited to:
 - .1 Trees as identified on drawings.

Grubbing or cutting of vegetation to facilitate the erection of the fence should be performed by hand (Small power tools are permitted.) and limited to the minimum scope necessary to accomplish the task. Do not prune or remove any large branches from trees designated as "protected" on the Tree Preservation Relocation and Removal Plan without prior approval from the Consultant and Contractor's Certified Arborist.
- .2 Clearly visible, all-weather signage shall be attached to all sides of the fencing at a maximum interval of 15 meters. Tree protection signage will be mounted on the outside of the tree protection fencing at eye level (42"). Signage will identify the area within as follows: **"Tree Protection Area - Keep out. No access, hoarding or storage of materials permitted. Penalties in effect for fence removal or damage to trees."**

3.2 SITE CLEARING -TREE AND SHRUB REMOVAL:

- .1 Trees designated for removal will be flagged and approved by the Consultant and Contractor's Certified Arborist prior to felling. Do not disturb trees, shrubs or soils within the tree protection areas. Maintain a setback of two meters from all tree protection fencing.

3.3 MULCHING OF EXISTING TREES:

- .1 Tree-chip mulch will be placed by hand to a depth of 4" - 6" throughout the extent of all tree protection areas. No machinery is permitted within the tree protection areas. It is permitted to temporarily remove fence panels as required to facilitate the distribution of the mulch. Fence panels must be replaced upon completion or temporary cessation of mulching.

3.4 TREE CANOPY PROTECTION AND OVERHEAD PRUNING:

- .1 The Contractor shall take every precaution to ensure that cranes or other construction equipment do not damage the aerial portions of protected trees. Where necessary, caution flagging should be attached to the ends of branches in close proximity to construction.
- .2 In the event that the branches of a protected tree encroach within the construction envelope and conflict with the structure, the Contractor will notify the Project Arborist immediately. The Contractor's Arborist will review the situation with the Contractor and carry out all required pruning.

3.5 EXCAVATION ADJACENT TO TREE PROTECTION FENCING:

- .1 The Project Arborist must be in attendance for all excavation within 5 meters of a tree protection area [measured from the closer of either the fence line or the nearest branch tip]. The Project Arborist is responsible for monitoring and/or remediating possible root and branch impacts to protected trees.
- .2 The Contractor will maintain a setback of two meters from all Tree Protection Fencing free of ground disturbance.
- .3 The Project Arborist will be consulted beforehand if the project absolutely requires an encroachment within this setback.
- .4 Where necessary, vertical shoring or other soil stabilization procedures will be used to ensure that no encroachment into the tree protection area occurs.
- .5 No overburden from the excavation shall be placed within the tree protection areas.
- .6 Any live woody roots impacted by the excavation shall be pruned back to undamaged tissue by the Project Arborist.
- .7 Where significant tree root mats are exposed during excavation, root protection fabric will be fixed in place by the Project Arborist to protect the exposed root mats from drying out.

3.6 UNDERGROUND SERVICES AND/OR UTILITY LINES:

- .1 Route all underground services and/or utility lines around the tree protection areas.
- .2 Notify the Project Arborist of any underground utility lines that encroach within the Tree Protection Areas. The Sub-Contractor is responsible for ensuring that all off-site utility Contractors (e.g. B.C. Gas, B.C. Tel etc.) are in compliance with the above.
- .3 Where an encroachment is absolutely required within one or more tree protection areas, the Project Arborist must be consulted beforehand, and efforts made to minimize impacts to the protected trees to the satisfaction of the Project Arborist.

3.7 PRUNING OF PROTECTED TREES:

- .1 Removal of hazardous deadwood and other required crown pruning should be performed before construction commences.

3.8 ROOT PRUNING OF PROTECTED TREES:

- .1 Tree roots greater than 2.5cm in diameter that are exposed or damaged from excavation activity must be pruned cleanly back to undamaged tissue.
- .2 The Contractor's Arborist will conduct all root pruning.
- .3 Root pruning tools must be clean and sharp.
- .4 Permissible root pruning tools pruning loppers and tri-faceted pruning saws.

3.9 IRRIGATION AND DUST MANAGEMENT OF EXISTING TREES:

- .1 Irrigate protected trees once a week during the dry season [June - October] to an effective soil depth of 8".
- .2 During dry periods dust that is generated by onsite vehicular and excavation activity will collect on the leaf surface of protected trees, thereby reducing the effective photosynthetic potential of the tree.
- .3 Apply an aerial spray of clean water to the canopy of all protected trees once every two weeks in order to mitigate dust impacts.
- .4 Aerial water sprays must be completed prior to 10:00 am and the onset of hot sun on the tree canopies.

3.10 DISPOSAL OF WASTE:

- .1 Do not bury rubbish and waste material onsite.
- .2 Do not dispose of waste or volatile materials such as mineral spirits, oil, and paint thinner or concrete tailings onsite. In particular, waste products must be kept clear of all tree protection areas, waterways, storm or sanitary sewers and undisturbed soils.

3.11 STORAGE OF CONSTRUCTION MATERIALS:

- .1 All traffic, dumping and storage of materials is strictly prohibited within protection areas without prior written authorization by the Project Arborist.

END OF SECTION

1. General

1.1 SUMMARY

- .1 General Requirements: Conform with requirements of General and Supplementary Conditions and all Sections of Division 01, General Requirements, as it applies to the work of this Section.
- .2 Scope: This section specifies all materials and installation of standard manufactured catalogue items including all labour, equipment, miscellaneous attachments and other services necessary to the supply and install of exterior site furnishing.
- .3 Cooperate and coordinate with the requirements of other units of work specified in other Sections
- .4 The work shall include, but shall not necessarily be limited to, the following:
 - .1 Wooden Bench(es)
 - .2 Interpretive signage
- .5 Related Sections:
 - .1 Landscape Finished Grading Section 32 91 19

1.2 ACTION SUBMITTALS

- .1 All products listed to be submitted in accordance with Section 01 33 00.
- .2 Shop Drawings: Include the following:
 - .1 Include installation details, material descriptions, finishes and dimensions
 - .2 Shop drawings for supporting framework, anchorage and loading requirements for each of the furnishings specified to be prepared by a qualified Professional Engineer and bear the stamp and signature of a qualified Professional Engineer registered in the British Columbia.
- .3 Samples for Verification:
 - .1 Submit product colour samples for all items listed and to be confirmed prior to ordering of material.
 - .2 Submit a mock-up of (1) plastic interpretative panel placed on interpretative signage

1.3 INFORMATION SUBMITTALS

- .1 Provide data for maintenance for the care and cleaning of site furnishings for incorporation into manual specified in Closeout Submittals.

2. PRODUCTS

2.1 MANUFACTURER

- .1 Substitutions: Consultant may consider additional manufacturers having similar products to Acceptable Materials Manufacturers listed above during the construction period, provided they meet the performance requirements established by the named products and provided they submit

requests for substitution in accordance with 01 25 00 .00 – Substitution Procedures before starting any work of this Section:

- .1 Do not use substitute materials to establish Bid Price.
- .2 Substitutions that appear as a part of the project without review and acceptance by the Consultant will be rejected, and replaced with one of the specified materials.

2.2 MATERIALS

.1 WOODEN BENCH(ES)

- .1 Manufacturer: Custom - Per IFT drawings, requires shop drawing approval
- .2 Description/Colour: Thermally treated wood w/ss legs, colour: natural
- .3 Installation: Mounted into deck structure (below finished surface)
- .4 Quantity: As shown in drawings

.2 INTERPRETIVE SIGNAGE

- .1 Manufacturer: Custom - Per IFT drawings, requires shop drawing approval
- .2 Description/Colour: Pressure treated 6 x 6" nominal wooden post w/plastic graphic panel, colour: natural wood finish
- .3 Installation: Placed in gravel footing, typ.
- .4 Quantity: 6

3. Execution

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- .2 Examine roughing-in for embedded and built-in anchors to verify actual locations before furnishing installation.
- .3 All furnishing locations to be laid out on site for review by Owner's Representative prior to installation.
- .4 Provide Owner's Representative 24 hours' notice of installation.
- .5 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- .1 Assemble furnishings in accordance with manufacturer's instructions.
- .2 Install furnishing true, plumb, anchored firmly supported, as indicated and as directed by Owner's Representative.
- .3 Touch up damaged finishes to approval of Owner's Representative.

END OF SECTION

1. General

1.1 SUMMARY

- .1 General Requirements: Conform With Requirements of General And Supplementary Conditions And All Sections Of Division 01, General Requirements, As It Applies To The Work Of This Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections
- .3 Scope: Furnish all labour, materials, equipment and services necessary to provide a complete and properly operating irrigation design build system, specified herein. The irrigation system must be Toro per Town of Ladysmith standards.
- .4 Related Sections:
 - .1 Landscape Finished Grading Section 32 91 19
 - .2 Growing Medium Section 32 91 13
 - .3 Plant Material Section 32 93 00

1.2 REFERENCE AND REGULATORY STANDARDS

- .1 Canadian Standards Association (CSA)
- .2 British Columbia Irrigation Association.

1.3 SYSTEM DESCRIPTION

- .1 The system is schematic and shall be adjusted to site conditions
- .2 It is the responsibility of the irrigation contractor to inform the Owner of any and all discrepancies, errors or conflicts that may be found prior to and during installation
- .3 Any changes to the specifications or drawing are subject to written approval by the Owner. Any and all changes made by the Contractor without written permission shall be the Contractor's responsibility. The Contractor will be solely responsible for all costs to reinstall such changes to conform to these specifications.
- .4 Pay all costs as required for such permits and inspections at no extra cost to the Owner.

1.4 QUALITY ASSURANCE

- .1 All irrigation work shall be completed by an experienced and competent irrigation contractor having the required facilities, equipment and personnel for all phases of the work specified.
- .2 The irrigation contractor shall be a member in good standing with The Irrigation Industry Association of British Columbia.
- .3 A manufacturer's warranty is required for all irrigation equipment outlined in this specification.
- .4 Deliver material and equipment in new unopened containers. Advise Consultant when material arrives on site and do not unpack until Consultant has received documents identifying the products
- .5 All re-establishment planting to have hose bibs and watered during establishment.
- .6 Irrigation system to include weather sensor, soil moisture sensor, and high efficiency sprinkler heads and/or drip system.
- .7 Irrigation system to be designed by the Contractor, using qualified irrigation specialist and suppliers. Shop Drawings required for approval by Owner's representative before finalizing and installation.

1.5

SITE CONDITIONS

- .1 Verify the existence and location of all on site utilities and cooperate with the Contractor and utility companies in keeping their respective utilities in operation. Notify the Consultant immediately for direction, as to procedure, should any piping or utilities be encountered during excavation.
- .2 Prior to the work of this section, carefully inspect the installed work of other trades or contractors and verify that all such work is complete to the extent that this work may commence properly.
- .3 Field Measurements: Make all measurements in the field and adjust the design to meet the on-site conditions. In the event of major discrepancies between the drawings and the actual site conditions notify the Consultant before proceeding with the work.
- .4 Verify the locations of underground services by hand digging or by use of an M-scope.
- .5 Repair all damage to underground services. Damage to services that are shown on the drawings or have been brought to the Contractor's attention in the field shall be repaired at the Contractor's expense. Damage to unforeseen services (provided that all reasonable steps were made by the Contractor to ascertain all information regarding existing services) shall be repaired and the Owner will pay for the repairs in accordance with the General Condition titled 'Changes'. The Owner must be notified immediately of any such damage.

1.6

PROTECTION

- .1 Protect existing buildings, equipment, sidewalks, landscape reference points, monuments, markers and other completed work. Make good all damage resulting from work of this contract at no expense to the Owner.
- .2 Do not park vehicles on the site except those that are essential for the construction of the system. The Contractor shall repair all damage caused by his performance of the contract.
- .3 Trenches and other excavations cannot be left open overnight unless they are protected to WCB Standards. In all areas excavated trenches must be covered and barricaded to ensure public safety.

1.7

GUARANTEE

- .1 Provide a written guarantee for all workmanship and materials for one year from the date of Substantial Performance of the Contract.

1.8

EQUALS

- .1 Alternative equipment will be considered for inclusion in this project. The proposed equipment shall equal or exceed the specifications of equipment specified. It shall be of good quality construction and shall have a proven record of low maintenance, trouble- free performance wherever it has been used in projects that have the same site conditions.
- .2 The proposed equipment shall have a comparable warranty and a local, well stocked distributor.

1.9

SEQUENCING

- .1 Ensure the installation of sleeves and irrigation pipe under paved surfaces, and through planter walls as required.
- .2 Verify the location of the water supply for the irrigation system.
- .3 Verify the location of the electrical conduit for the low voltage wire from the irrigation controller to the landscape.

1.10

INSPECTION

- .1 All work must remain uncovered for inspection of workmanship and materials. Notify the Owner's representative a minimum of forty-eight (48) hours prior to required inspections.

2. Products

2.1 PIPE AND FITTINGS

- .1 Plastic pipe to be extruded, virgin, high impact polyvinylchloride (PVC) pipe that is continuously and permanently marked showing manufacturer's name or trademark, type of material, pipe size and pressure rating.
- .2 All piping to be Class 200 except for piping under hard surfaces that cannot be sleeved, then to be Schedule 40 PVC.
- .3 Plastic pipe fittings to be Schedule 40 PVC designed for solvent welding to PVC pipe except where valves, risers, etc. require threaded joints.
- .4 Pipe sleeves under hard surfaces to be Class 160 PVC pipe.

2.2 SOLENOID VALVES

- .1 First quality Toro valves.

2.3 SPRINKLER HEADS

- .1 First quality Toro sprinkler heads.

2.4 AUTOMATIC CONTROLLER

- .1 First quality Toro controller.

2.5 CONTROL AND COMMON WIRING

- .1 Insulated single strand copper wire TWU-40 #14 gauge to be used where directly buried in the landscape. White to be used as the common.
- .2 Wiring from the controller to the landscape may be a minimum of #18 solid wire run in conduit.
- .3 All electrical connections to be made with CSA watertight connectors.

3. Execution

3.1 LAYOUT OF SPRINKLER SYSTEM

- .1 Co-ordinate exact locations of lines, valves and heads, with planting locations to avoid conflicts and damage to plants during installation. Stake locations and check grades of all components

3.2 EXCAVATION AND BACKFILLING

- .1 The excavation depths for piping shall be:
 - .1 In landscape areas a minimum cover of 12" (300 mm).
 - .2 Under paving a minimum cover of 18" (450 mm).
 - .3 On slab place pipe on filter fabric above drain rock if 12" (300 mm) cover cannot be met.
- .2 Trenches shall be straight with uniform slopes to the bottom of the trenches
- .3 Place pipe on firm soil at all points of the trench
- .4 Backfill trenches in 6" (150 mm) layers, tamping to ensure compaction of trench is equal to surrounding undisturbed area

- .5 Backfill material shall be free from rocks and other unsuitable materials which could damage the pipe or create unusual settling problems.

3.3 **INSTALLATION OF PIPING**

- .1 Install the piping in accordance with the drawings and with manufacturer's recommendations
- .2 Where possible, main and lateral lines may occupy the same trench provided a minimum 2" (50 mm) horizontal clearance can be maintained.
- .3 No line may be installed parallel to and directly over another line.
- .4 All piping to run as straight as possible between fittings.
- .5 Remove all excess PVC solvent cement from all solvent weld joints.
- .6 The entire irrigation system shall be thoroughly flushed with water to remove dirt, scale and foreign matter before sprinkler heads are installed.

3.4 **INSTALLATION OF SPRINKLERS**

- .1 Pop-up sprinklers shall have an adjustable riser assembly (triple swing joint) assembled by using at least three standard PVC street elbows. (NOTE the use of marlex street elbows are prohibited.)
- .2 Triple swing joint risers shall be of schedule 80 PVC and fittings of schedule 40 PVC unless otherwise designated on the drawings.
- .3 The bottom street elbow shall be connected to the side outlet on the lateral line.
- .4 The PVC nipple on a pop-up sprinkler shall be installed at 45 degree to the lateral line.
- .5 All stationary spray sprinklers shall be installed with two PVC street elbows to connect to the lateral line and a schedule 80 PVC nipple that is long enough to be 4" (100 mm) above finished grade.
- .6 All sprinklers to be installed a minimum of 1" (25 mm) away from any hard surface.

3.5 **INSTALLATION OF VALVES AND VALVE BOXES**

- .1 All valve boxes to be installed flush with finish grade.
- .2 All valves to be installed vertically and centred in the valve box for ease of accessibility for servicing.
- .3 All valve boxes to be blocked so that the valve box does not rest on the piping below.
- .4 Minimum valve box sizes:
 - .1 910 - one 1 1/2" valve or two 1" valves
 - .2 141- two 1 1/2" valves or three 1" valves
 - .3 1320 - three 1 1/2" valves or four valves
- .5 All wiring connection in valve boxes to be of sufficient length to permit removal of the top of the valve from the valve box
- .6 Bottom of valve boxes to be filled with 2" (50mm) layer of 19mm clear crush drain rock complete with a filler fabric separation from the subgrade.

3.6 **INSTALLATION OF WIRE**

- .1 Protect low-voltage wiring by installing and taping them beneath main and lateral irrigation lines at a minimum 3' (900mm) o.c..
- .2 All electrical connection to be made in an accessible valve box.
- .3 Provide electrical connection between controller location and antenna locations per manufacturer's instructions.

3.7 **CLEANUP**

- .1 Any damage to paving, planting or any other structure due to settlement of improperly compacted trenches shall be promptly repaired at the contractor's expense to the satisfaction of the Consultant.
- .2 Surplus material shall become property of the contractor and removed from the site.

3.8 **OPERATION INSPECTION**

- .1 Upon completion of the irrigation system, the entire system shall be tested for proper operation.
- .2 The contractor shall balance and adjust the various components of the irrigation system to ensure the efficient operation of the system. This includes the adjustment of pressure regulators, part circle sprinklers and individual adjustments of the controllers. Also make minor changes in sprinkler head locations to provide full coverage as part of the work.
- .3 Coverage Test: When the irrigation system has been completed, a coverage test shall be performed in the presence of the Consultant to determine if coverage of water to planting and lawn areas is complete and if any necessary adjustments are required.
- .4 Controller Test: Prior to final acceptance of the irrigation system the automatic controllers shall be set in sequence and tested through all zones and any necessary adjustments made.

END OF SECTION

1. General

1.1 SUMMARY

- .1 General Requirements: Conform With Requirements of General And Supplementary Conditions And All Sections Of Division 01, General Requirements, As It Applies To The Work Of This Section
- .2 Cooperate and coordinate with the requirements of other scopes of work specified in other Sections.
- .3 Scope: This section specifies the supply and installation of planting soil (growing medium), including all labour, equipment, products and services necessary to perform work.
- .4 Related Work Specified In Other Sections
 - .1 Automatic Irrigation Section 32 84 10
 - .2 Plant Material Section 32 93 00
- .5 Reference Standards
 - .1 CNLA and BC Landscape Standards

1.2 DEFINITIONS

- .1 Growing Medium: 'Topsoil' which shall mean a mixture of mineral particulates, micro organisms and organic matter providing suitable medium for supporting intended plant growth.

1.3 TESTING

- .1 Contractor will arrange and pay for services of accredited testing laboratory within Vancouver Island to perform complete soil quality analysis on topsoil(s).
- .2 Samples to be taken within three weeks of proposed install. Provide adequate tests from all sources of topsoil.
- .3 Soil analysis shall include results for: existing soil nutrients; soil salinity expressed as electrical conductivity; pH value; organic matter; soil texture; sand/fines/organic matter; total nitrogen, available phosphorus, potassium, calcium and magnesium; fertility recommendations; and recommended soil conditioning amendments.
- .4 Submit original copy of analysis to the Landscape Architect. Test results shall include written summary of analysis from testing agency including: confirmation or denial of conformance to specifications and Town of Ladysmith's requirements; suitability of topsoil for proposed use and general quality of topsoil; recommendation for type and application rate of fertilizer, and any required amendments.
- .5 The Contractor will pay all analytical costs prior to the analysis being performed. All submitted analysis reports must be dated and have the project name clearly indicated on the analysis. Prior to commencement of any work, the soil analysis reports must be forwarded to the Consultant for approval.
- .6 Failure to follow required procedures may result in the removal of all imported soils from the site at the Contractors expense. Note that cost(s) of additional testing, at Consultants discretion, to be incurred by Contractor.

1.4 INSPECTION:

- .1 Verify the size, location and depth of all existing site services and sub-surface utilities prior to commencement of the work. Repair all damage as result of failure to perform adequate inspection at no cost to the Owner.
- .2 Notify Consultant when the site is prepared for growing medium placement. Do not place growing medium until subgrades have been reviewed.

- .3 Provide at least two days (48 hours) notice in advance of each required inspection.

1.5 **SUBMITTALS:**

- .1 Submit to the Consultant a copy of an analysis by an approved independent soil testing laboratory. Refer to Section 1.3 Testing.
 - .1 The analysis shall include a breakdown of the following components: total nitrogen by weight, available levels of phosphorous, potassium, calcium, magnesium, soluble salt content, organic matter by weight, % sand, % fines (silt and clay) and pH value. In addition, the analysis shall clearly indicate the Project Name, Date Tested and Contractor's Name.
- .2 Submit to the Project Manager one composite sample of each type of proposed growing medium for each different application within the project (e.g. seeded lawns, restoration plantings). Each sample shall be a composite of at least three samples from the proposed source and shall be at least one (1) litre in volume.
- .3 At the discretion of the Consultant, submit up to two (2) additional samples, including samples of proposed additives to the growing medium from material delivered to the site as required to ascertain compliance with this specification. Results of these tests shall be submitted to the Consultant for approval.

1.6 **QUALITY ASSURANCE:**

- .1 All landscape work shall be completed by an experienced and competent Landscape Contractor, having the capabilities and personnel necessary for all phases of the work specified. The execution and maintenance of the work in this section must be supervised by a Landscape Industry Certified Technician or a Landscape Industry Certified Manager.
- .2 The Landscape Contractor must be an Active Member of the British Columbia Landscape & Nursery Association (BCLNA) and have met the qualification standards currently applied to contractors by that organization. The Contractor must provide proof of membership, proof of having worked in the industry for a minimum of five (5) years and a list of clients for whom similar sized landscape projects have been satisfactorily completed. The acceptance of the Contractor's experience and work history will be at the discretion of the Town of Ladysmith.
- .3 Contractors must ensure that all work performed is done according to the latest edition of the BC Landscape Standards.
- .4 Advise Consultant of sources of growing medium to be utilized on this Project a minimum of thirty days (30) prior to starting work of this Section.
- .5 Carry out growing medium preparation and placement such that the final product matches the standard set by the samples submitted, within a range of variation that may reasonably be expected with good quality control.
- .6 The Consultant may appoint an independent testing laboratory to ascertain compliance with this specification and to recommend modifications to make the growing medium meet the requirements of this specification.

1.7 **PRODUCT HANDLING:**

- .1 DO NOT MOVE OR WORK GROWING MEDIUM OR ADDITIVES WHEN THEY ARE EXCESSIVELY WET, EXTREMELY DRY, OR FROZEN OR IN ANY MANNER WHICH WILL ADVERSELY AFFECT GROWING MEDIUM STRUCTURE. Growing medium whose structure has been destroyed by handling under these conditions will be rejected.
- .2 Protect growing medium and additives against extreme wetting by rain or other agents, and against contamination by weeds and insects.

- .3 Stockpile materials in bulk form in paved areas and provide protection by storing under roof or tarpaulins. Take all necessary precautions to prevent contamination of component materials from windblown soils, weed seeds and insects. Contamination of individual components may result in rejection, if used.
- .4 Deliver and store fertilizers and other chemical ingredients in the manufacturer's original containers. Protect against damage and moisture until incorporated into the work.

2. Products

2.1 GROWING MEDIUM MATERIALS

- .1 Imported Topsoil: screened natural, fertile, friable, agricultural soil with organic matter content and pH value range as indicated in Table 1. Soil free from subsoil, slag, clay, stone, lumps, live plants, roots, sticks, quack grass, noxious weeds and foreign matter.
- .2 Peat moss: Decomposed fibrous or cellular stems and leaves of species of Sphagnum Mosses consisting of a minimum of 90% organic matter by dry weight basis, finely ground to enable mixing with other components; 100% by volume of the particle sizes to pass a #4 sieve with a minimum of 97.5% passing a #8 sieve.
- .3 Pumice: A ground, porous volcanic rock, dark brown to black in colour.
- .4 Commercial Compost: Provide sample to a Certified Soil Analysis laboratory servicing Vancouver Island for inspection and approval. Approved sample shall be standard throughout.
- .5 Sand: Sand to be used in landscape soil preparations maybe either river pump or pit sourced but will have no more than 55% of its dry weight being gravel. The addition of sand must meet the requirements for % sand % Fines as outlined in the CSLA Landscape Standard, current edition. Provide sample to a Certified Soil Analysis laboratory for inspection and approval. Approved sample shall be standard throughout.
- .6 Fertilizer and lime applications will be as detailed in the Certified Soil Analysis laboratory report. The application of chemicals (fertilizer and lime) will be as detailed for the following:
 - .1 formulations and trade names
 - .2 rates of application
 - .3 date of application
- .7 In situations of soils offering excessive levels of water soluble salts (3.0ms/cm or more); application of fresh water followed by drainage maybe required prior to any plant material installation.

2.2 GROWING MEDIUM MIX BY PLANTING AREAS:

- .1 Growing Medium shall vary according to planting areas (Refer to Table 1), and according to Soil Analysis recommendations. Approximate volumes only.
- .2 Growing Medium shall be predominantly sand based and screened with additives and fertilizers as required to make it meet the following specifications:
- .3 Substantially free from roots, sticks, building materials, wood chips, chemical pollutants and other extraneous materials.
- .4 Population of plant pathogenic nematodes: maximum 1000 per litre for any single species.
- .5 Maximum requirement of dolomite lime to required pH: 0.5kg/m².
- .6 Salinity: maximum saturation extract conductivity of 3.0 mmho/cm @25 deg. C

- .7 Fertility:
 - .1 Total Nitrogen 0.2-0.6% by weight
 - .2 Available Phosphorous 20-250 ppm
 - .3 Available Potassium 50-1000ppm
 - .4 Carbon to Nitrogen Ratio: max. 40:1
- .8 pH: Refer to Table 1
- .9 Boron: the concentration in the saturation extract shall not exceed 1.0 ppm
- .10 Sodium: the sodium absorption ratio(SAR) as calculated from analysis of the saturation extract shall not exceed 8.0
- .11 The textural properties and organic content shall be have the following composition AFTER MIXING (BY DRY WEIGHT):

Table 1. Properties of Growing Media for Level 1 “Well-Groomed” Areas - Modified Level 1

Growing Medium Types	1L	1H	1P
Applications:	Low Traffic Lawn Areas, Trees & Large Shrubs	High Traffic Lawn Areas	Planting Areas
Texture:	Percent of Dry Weight of Total Growing Medium		
Coarse Gravel - larger than 19mm - smaller than 40mm	0 – 1%	0 – 1%	0 – 1%
All Gravel - larger than 2mm - smaller than 40mm	0 – 5%	0 – 5%	0 – 5%
	Percent of dry Weight of Growing Medium excluding Gravel		
Sand: - larger than 0.05mm - smaller than 2mm	50 – 70%	80 – 90%	50 – 70%
Silt: - larger than 0.002mm - smaller than 0.05mm	10 – 25%	5 – 15%	10 – 25%
Clay: - smaller than 0.002mm	0 – 20%	0 – 20%	0 – 20%
Clay & Silt Combined	Maximum 25%	Maximum 25%	Maximum 25%
Organic Content (by weight)	3 – 10%	3 – 5%	10 – 20%
Acidity (pH):	5.5 – 7.0	6.0 – 7.0	5.5 – 7
Drainage:	Percolation shall be such that no standing water is visible 60 minutes after at least 10 minutes of moderate to heavy rain or irrigation.		

2.3 DRAINAGE AND FILTER:

- .1 Drain rock: 3/4" - 1" diameter round rock washed free of all fines and organic materials.
- .2 Filter Fabric: heat bonded, rot-proof, non-woven geotextile fabric, or approved equal.
- .3 Provide a sample of both the round rock and the filter fabric for approval prior to delivery and installation onsite.

- 2.4 **CLEANOUTS:**
 - .1 6" diameter PVC pipe, lengths as required.
 - .2 6" diameter PVC caps, black in colour.
- 2.5 **FEEDER TUBES:**
 - .1 4" diameter PVC pipe, lengths as shown on drawings.
- 2.6 **COMPOSTED BARK MULCH:**
 - .1 Refer to Section 32 93 00: Plant Material
- 3. Execution
- 3.1 **GENERAL WORKMANSHIP**
 - .1 Contractor to review site conditions first hand prior to execution of work of this section.
 - .2 Prevent damage to fencing, landscaping, natural features, benchmarks, existing buildings, existing pavement, and utility lines which are to remain. Make good any damage.
 - .3 Do not bury foreign material beneath areas to be landscaped.
- 3.2 **PREPARATION OF SUBGRADE**
 - .1 Subgrade shall be reviewed by Consultant before placing topsoil.
 - .2 Locate runs of utility lines before commencement of work. Protect active lines from damage.
 - .3 Remove all foreign material, undesirable plants, roots, stones in excess of 25 mm, debris and soil contaminated with salt, oil or gasoline. Dispose off-site.
 - .4 Grade subgrade to eliminate uneven areas, low spots and ensure positive drainage.
 - .5 Cultivate subsoil to depth of 150 mm.
 - .6 Re-cultivate subsoil compacted during hauling or spreading.
- 3.3 **TEMPORARY EROSION AND SEDIMENTATION CONTROL:**
 - .1 If required, provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties. Refer to sediment and erosion control plan, specific to site, and comply with local requirements.
- 3.4 **TOPSOIL PLACEMENT**
 - .1 Place topsoil in dry weather on dry, unfrozen grade.
 - .2 Manually spread topsoil around trees and plants to prevent damage by grading equipment.
 - .3 Do not cover catch basins, valve covers or inspection pits.

- .4 Fine grade to ensure positive drainage away from paved areas.
- .5 Leave surface smooth, uniform and sufficiently firm to prevent sinkage pockets when watered.
- .6 Achieve a uniform topsoil depth of 150 mm for all areas to receive sod.
- .7 Place planting mix for shrub planting beds to a depth of 450 mm.
- .8 Place planting mix for grass planting on grades in beds between a depth of 450 mm and 610mm.
- .9 Place planting mix for tree beds to a depth of 900mm.

3.5 **FINISH GRADING**

- .1 All growing medium shall be fine graded after placing to the finished elevations and contours as detailed and specified herein. Surfaces shall be true to intended grades, smooth, uniform, and firm against deep foot printing, with a fine loose surface texture. Ensure all rough spots and low areas are eliminated to ensure positive surface drainage. Tolerance for finish grading to be 5mm.

3.6 **MULCHING**

- .1 Place mulch as indicated in Section 32 93 00.
- .2 Ensure soil settlement has been corrected prior to mulching.

3.7 **CLEAN-OUTS:**

- .1 Cut v-shaped notches at one end of 6" diameter P.V.C. pipe. Place notched end over roof drain, surround with 2" depth drain rock and run filter fabric 8" up around pipe.
- .2 Ensure top of pipe is flush with finish grade and cover with P.V.C. cap. Black in colour.

3.8 **ACCEPTANCE**

- .1 Consultant will inspect growing medium in place and determine acceptance of depth of growing medium and finish grading, prior to plant installation.
 - .1 Approval of growing medium may be subject to soil testing and analysis if any doubt exists concerning its conformity to the requirements
 - .2 Contractor shall pay for cost of additional testing of installed growing medium if testing required by Consultant.
- .2 Surplus Material:
 - .1 Dispose of materials not required by Consultant off site, at no cost to Owner.

3.9 **CLEAN UP**

- .1 Immediately clean up any soil or debris spilled onto pavement or concrete.
- .2 Dispose of surplus topsoil not required for fine grading and landscaping as directed by the Owner's Representative.

END OF SECTION

1. General

1.1 SUMMARY

- .1 General Requirements: Conform With Requirements of General And Supplementary Conditions And All Sections Of Division 01, General Requirements, As It Applies To The Work Of This Section.
- .2 Cooperate and coordinate with the requirements of other units of work specified in other Sections
- .3 Scope: Furnish all labour, materials, equipment and services necessary to perform the finished grading of the following:
 - .1 Cast-in-place concrete paving, site furnishings and planting.
 - .2 Removal of any base material, which is unacceptable for required bearing capacities or Corrected Maximum Dry Density, or as directed by the Geotechnical Engineer
- .4 Related Sections:
 - .1 Exterior Site Furnishings Section 32 37 00
 - .2 Automatic Irrigation Section 32 84 10
 - .3 Growing Medium Section 32 91 13

1.2 REFERENCES AND REGULATORY REQUIREMENTS

- .1 ASTM D1557-78 MPD "Tests for Moisture-Density Relations of Soils Using 5.5 lb (2.5kg.) Rammer and 12" (300mm) Drop".
- .2 Codes and Standards: Perform backfill operations working in compliance with applicable requirements of governing authorities having jurisdiction
- .3 Project Geotechnical Soils Report and Recommendations

1.3 SITE CONDITIONS

- .1 Visit the site and be satisfied as to the nature of work to be encountered.
- .2 Start of work shall signify acceptance of the site as satisfactory and no claim will be recognized for extra work or no allowance made for defective work due to site conditions.
- .3 The Contractor shall notify an independent testing agency to carry out testing of compaction at least 48 hours in advance of time required.

1.4 PROTECTION

- .1 Protect all existing items to remain. If damaged, restore to original condition unless specified otherwise. Notify the Consultant immediately if any damage occurs.
- .2 Maintain access routes to prevent accumulation of mud on roads.
- .3 Use all means necessary to control dust on and near the work caused by these operations.

1.5 INSPECTION

- .1 The Consultant or the Consultant's representative is to review all stages of the work. Provide 48 hours notice to the Consultant when inspections are required.

1.6 **TESTING**

- .1 The Contractor to notify the testing agency to carry out testing of compaction at least 48 hours in advance of time required.
- .2 Submit testing procedure, frequency of tests, testing laboratory as designated by certified testing personnel to Consultant for approval.

2. Products

2.1 **FILL MATERIAL**

- .1 Refer to Geotechnical Soils Report

3. Execution

3.1 **PREPARATION**

- .1 Remove trees within site boundaries unless designated to remain.
- .2 Stake location of existing utilities.

3.2 **DRAINAGE**

- .1 Drain all areas to be re-graded using methods acceptable to the Consultant.
- .2 Compact filled and disturbed areas to Standard Procter Density to ASTM D698, as follows:
 - .1 85% under landscaped areas.
 - .2 Base to 95% under walks, pavement and miscellaneous hard landscape elements.
 - .3 Prior to placing fill over existing ground scarify surface depth to 4" (100mm). Maintain base material and existing surface at approximately the same moisture content to facilitate bonding.

3.3 **FINISHED GRADING**

- .1 Uniformly grade areas within limits of grading under this section. Smooth finished surface within specified tolerances, compact with levels or slopes between elevations as shown, or between such points and existing grades.
- .2 Grade areas to drain away from structures and to prevent ponding. Finish surfaces to be free from irregular surface changes.
- .3 Ensure positive drainage.

3.4 **TOLERANCES**

- .1 Grading Surface of Fill under Pavers and Walks: Grade smooth and even, free of voids, compacted as specified and to required subgrade elevations as shown. Provide final grades within a tolerance of 6mm (1/4") under 3.0m (10') straightedge

3.5 **FIELD QUALITY CONTROL**

- .1 Compacted fills will be tested as indicated in Clause 1.7 above.

.2 **Enforcement:**

- .1 Approval of test results may be verbal if required to expedite the work, but will subsequently be confirmed in writing.
- .2 Materials, workmanship failing tests will be rejected and defective materials/workmanship replaced at the Contractor's expense.
- .3 Re-testing of any rejected work shall be done at the Contractor's expense.

3.6 **MAINTENANCE**

- .1 Protect newly graded areas from traffic and erosion, trash, and debris.
- .2 The site surface (cut and fill areas) must at all times be contoured to direct precipitation and run-off to drainage ditches or slopes leading away from the work area. Surfaces must always be left graded smooth and rolled with a smooth drum roller to minimize infiltration of water and subsequent deterioration of material due to excessive moisture content. Surfaces must never be left with undrained depressions or with a rough texture.
- .3 If any damage occurs prior to substantial completion, repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances at the Contractor's expense.
- .4 Repair and make good and clean up any damage and/or debris.

3.7 **SURPLUS MATERIAL**

- .1 Remove all surplus material not required for backfill, grading or landscaping from the site as directed by the Consultant.
- .2 Stockpile areas and job site to be left completely clean and raked.

END OF SECTION

1. General

1.1 **SUMMARY**

- .1 General Requirements: Conform with Requirements of General and Supplementary Conditions And All Sections Of Division 01, General Requirements, As It Applies To The Work Of This Section
- .2 Cooperate and coordinate with the requirements of other scopes of work specified in other Sections.
- .3 Scope: Furnish all labour, materials, equipment and services necessary to provide the installation of plant material and other associated materials including, but limited to, mulch, filter fabric, tree guys and support posts, and root barrier

1.2 **RELATED WORK SPECIFIED IN OTHER SECTIONS**

- .1 Automatic Irrigation Section 32 84 10
- .2 Growing Medium Section 32 91 13

1.3 **REFERENCE STANDARDS**

- .1 Town of Ladysmith Engineering Standards and Specifications (Section 12 – Landscaping), current edition.
- .2 BC and Canadian Landscape Standards, current edition.
- .3 Metric Guide Specifications for Nursery Stock, latest edition, by Landscape Canada.

1.4 **DELIVERY, STORAGE AND HANDLING**

- .1 Review of plant material by owner's representative: Submit a schedule for review and submittal of substitutes prior to delivery.
- .2 Handle plants with reasonable care and skill to prevent injuries to trunk, branches, roots, rootballs and containers.
- .3 Protect plants during shipment and until planted on site with tarpaulin or other suitable covering to prevent excessive drying from sun and wind, and breakage from wind and equipment.
- .4 Do not install plants whose soil balls have been cracked or broken prior to or during planting or when burlap ropes required in connection with their transplanting have been removed.
- .5 Adhere to Supplier / Manufacturer's handling instruction.
- .6 Replace damaged or rejected plants at no cost to Owner.

1.5 **PROJECT CONDITION**

- .1 Focus planting times during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
 - .1 Spring Planting: March 1 to June 15.
 - .2 Fall Planting: September 1 to October 30.
- .2 Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements.

- .3 Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Landscape Consultant.
 - .1 When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.6 **SUBSTITUTIONS**

- .1 No substitutions of specified plant material permitted unless approved by Landscape Consultant.
- .2 All proposed substitution must provide proof of equal in size, colour, hardiness, bloom time or other characteristic required by the Landscape Architect.

1.7 **STAGES OF REVIEW**

- .1 Notify Town's Representative, and Landscape Consultant to obtain reviews at following stages of project:
 - .1 Bed excavation: planting bed layout approved prior to excavation.
 - .2 Site delivery: have trees, shrubs, and perennials inspected at Nursery prior to site delivery.
 - .3 Tree staking: stake tree locations for approval prior to installation.
 - .4 Tree planting: installation of first tree to be approved prior to installing remaining trees.
 - .5 Shrub and groundcover planting: lay out shrubs and groundcover in planting beds for approval prior to installation.
 - .6 Construction Completion Inspection: have all installed plant material inspected prior to commencement of maintenance period.
 - .7 Final Acceptance Inspection: at end of maintenance period arrange for final acceptance of plants

2. **Products**

2.1 **PLANTS - GENERAL**

- .1 Supply Pacific Northwest and Alberta nursery grown plants.
- .2 Supply plants conforming to federal and provincial regulations.
- .3 Nursery Grown Plants:
 - .1 Plants true to type, structurally sound, well balanced, healthy, vigorous, of normal growth habits, densely foliated with healthy well developed root system, exhibiting the best characteristics of the species.
 - .2 Plants free of disease, insect infestations, insect eggs, rodent damage, sun scald, frost cracks and other abrasions or scars to bark.

2.2 **PLANTS - CHARACTERISTICS**

- .1 Trees: straight bodied specimen quality trees. Double/multiple leaders not acceptable, unless indicated on plant schedule.
- .2 Shrubs: natural form, typical of genus, species and variety
- .3 Groundcover: natural form, typical of genus, species, and variety.

2.3 **PLANT MEASUREMENT**

- .1 Measure trees and shrubs with branches in their normal positions.
- .2 Height and spread dimensions specified refer to main body of plant.
- .3 Caliper size takes precedence over height. Take caliper measurement 30 cm above ground.

2.4

PLANTS – SOIL BALLS

- .1 Container grown plants:
 - .1 Grown in containers for minimum of three months.
 - .2 Established root system which will "hold" soil when removed from container.
 - .3 Container sized in proportion to plant size.
 - .4 Root-bound plants are not acceptable.
- .2 Balled and burlapped plants:
 - .1 Soil balls tightly secured with burlap, heavy twine and rope, or burlap wire baskets and rope. Plant trunks shall be in centre of the root ball.
 - .2 Protect balls against exposure to elements.
 - .3 Deliver with firm natural ball of soil and free from pernicious perennial plants and their roots.
- .3 Ball size for nursery trees:
 - .1 Supply nursery grown plants with minimum size balls as follows:
 - .2

Deciduous	Caliper (mm)	Ball Diameter (cm)
	40	70
	50	70
	60	80
	70	90
	80	90
	90	100
	100	120
 - .3

Coniferous	Height (cm)	Ball Diameter (cm)
	200	80
	250	80
	300	90
	350	100
	400	110
 - .4 Adjust ball size according to growing habits of plants.
 - .5 Ball size shall be sufficiently large to contain at least 75% of fibrous root system with a ball depth not less than 50% of ball diameter.

2.5

GROWING MEDIUM

- .1 Growing Medium for all Planting Areas, Refer to Section 32 91 13

2.6

WATER

- .1 Water: potable.

2.7

PLANT ACCESSORIES

- .1 Tree guys and support posts: as detailed, if necessary.
- .2 Filter Fabric: black horticultural nonwoven geotextile fabric with a minimum tensile strength of 0.530 kN, apparent opening size of 0.15 to 0.21 mm and as approved by Town's representative. Submit sample for approval prior to installation.

2.8 **MULCH**

- .1 Decomposed premium fine to medium texture wood or bark chips. 25mm size, per CSLA landscape standards. No colour or additives. Submit sample for approval prior to installation.

3. Execution

3.1 **PREPARATION**

- .1 Locate and stake locations of electrical services, utility lines and other underground obstructions.
- .2 If underground services interfere with planting plan, notify Town's Representative, stop work in area and await further instructions.
- .3 Stake out locations of trees, shrubs and planting beds. Obtain approval of locations from Town's Representative.
- .4 Protect benchmarks and hubs that form part of legal site survey.
- .5 Excavate tree pits and planting beds after approval of location by Town's Representative.

3.2 **PREPARATION OF PLANT BEDS AND TREE PITS**

- .1 Shrub Beds: excavate plant beds minimum of 450 mm (2') depth. All non-cementitious excavated material may be reused as fill material for landscaped areas. Unsuitable or excess material to be removed for disposal off-site.
- .2 Trees and Specimen Shrubs: excavate plant pits large enough for soil ball and 450 mm around and beneath soil ball. All non-cementitious excavated material may be reused as fill material for landscaped areas. Unsuitable or excess material to be removed for disposal off-site.
- .3 Place growing medium in planting beds to required elevations as detailed, allowing for settlement.

3.3 **PLANTING**

- .1 Scarify and loosen soil at bottom of tree pits and planting beds prior to placing growing medium. Cover bottom of each excavation with minimum of 150mm of growing medium as required to bring root crown to finished grade of soil and tamp firmly.
- .2 Place plants at same depth they were originally grown. Face for best appearance.
- .3 Measure minimum depth of plant pit from downward side of slope when planting on incline.
- .4 Container plants: remove containers and keep soil ball intact while placing plant in pit.
- .5 Balled and burlapped plants:
 - .1 Keep burlap and twine intact while placing plant in pit.
 - .2 Tamp growing medium around ball in layers of 150 mm eliminating air voids.
 - .3 When 75% of growing medium has been placed fill hole with water.
 - .4 After water has completely penetrated soil, cut and fold burlap from top third of root ball before placing final layer of growing medium.
 - .5 Complete backfilling, fill with water and allow it to be absorbed.
- .6 Ensure smooth and even soil surface remains. No soil humps or clods to remain from planting activities.
- .7 Apply Bark Mulch to consistent depth in all locations. Keep material 50mm away from trunks and stems of plants.

3.4 **SUPPORTING TREES**

- .1 Support trees immediately after installation as detailed.

3.5 **PRUNING**

- .1 Obtain approval prior to commencing pruning.
- .2 Limit pruning to removal of dead or injured branches, stray branches, double leaders, and to compensate for loss of roots as a result of transplanting.

3.6 **MAINTENANCE**

- .1 Refer to Section 32 94 00 - Landscape Maintenance.

3.7 **CLEAN-UP**

- .1 On a daily basis during installation:
 - .1 Broom clean pavement and pathways.
 - .2 Remove excess materials from site.
 - .3 Protect newly planted trees or shrubs from other trades, as necessary
 - .4 Leave site in neat and clean condition.

END OF SECTION

1. General

1.1 **SUMMARY**

- .1 General Requirements: Conform With Requirements of General And Supplementary Conditions And All Sections Of Division 01, General Requirements, As It Applies To The Work Of This Section
- .2 Scope: Furnish all equipment, materials, labour and services necessary for the complete maintenance of all landscape areas. This includes, but is not limited to:
 - .1 Turf management, mowing, fertilizing, weed eradication, removal of clippings, aerating, top dressing, watering.
 - .2 Management of trees, shrubs, groundcover, aquatics, pest and disease control, growth control, fertilizing, weeding, watering and cultivation, mulching.
 - .3 Maintenance of the irrigation system throughout the term of the contract. This will include complete blow out and drainage of the system prior to winter and the complete reinstatement of system operations in the spring.
- .3 Cooperate and coordinate with the requirements of other scopes of work specified in other Sections.
- .4 Use Integrated Pest Control (IPC) as primary method of maintenance.
- .5 Provide Owner's Rep with copies of permits and licenses required by regulatory authorities, including applicator's current chemical license.

1.2 **REFERENCE STANDARDS**

- .1 BCNLA Standards, current addition
- .2 BCNLA Integrated Pest Management Plan, current edition.
- .3 BC Landscape Standards, current edition.

1.3 **MAINTENANCE/ GUARANTEE**

- .1 Maintain landscape works for a period of 2 years OR 24 calendar months from the date of issuance of Substantial Completion until Final Acceptance.

1.4 **DAMAGE TO PROPERTY**

- .1 The Contractor shall repair and pay for damages caused by Contractor's personnel and equipment during the term of the maintenance period.
- .2 Third Party damage is the responsibility of the contractor prior to issuance of the Construction Completion Certificate.
- .3 The Contractor shall report damages immediately to Owner.
- .4 Obtain approval of the Consultant for repairs and replacements. Return grass areas, plant materials, equipment and buildings to their original condition prior to damage. Scalping of turf and mechanical damage to trees including tearing of bark shall be considered as damage.
- .5 Complete repairs and replacements within seven days from date of approval given for repair or replacement.

1.5 **NOTICE TO THE TOWN**

- .1 The Contractor shall provide the Town with at least two days' advance notification of intent of spray for weed and insect control.

1.6 **MAINTENANCE LOG**

- .1 Keep regular Maintenance Log throughout contract.
- .2 Include in Log: detail activities, areas in which activities were carried out, and approximate time for start-up and completion of each activity.
- .3 Detail applications of chemicals in Log. Include target weed or insect, mode, type, and rate of application of chemical, date, time, weather conditions and results of application.
- .4 For all pesticide applications, adhere to District's requirements on Integrated Pest Management Plan (current edition) forms.
- .5 Test soil moisture and record in Log.

2. Products

2.1 **MATERIALS**

- .1 Fertilizer:
 - 11-51-0 at 3 kg/100 m2
 - 27-14-0 at 3 kg/100 m2
 - 16-20-0 at 3 kg/100 m2
 - 10-6-4 at 5 kg/100 m2
 - 10-6-4 at 18 g/ mm of caliper per tree
- .2 Topsoil: Imported topsoil: natural, fertile, friable, agricultural soil containing no less than 6% organic material with pH value ranging from 5.9 to 7.0.
- .3 Weed Control: Chemicals as required by site conditions and in accordance with current regulations.
- .4 Pest and Disease Control: Chemicals as required by site conditions and in accordance with current regulations.

3. Execution

3.1 **MAINTENANCE CLASSIFICATION**

- .1 BC Landscape Standards Level 1: Well Groomed
 - .1 Main objective is first-class appearance, always impeccably clean and well groomed.
 - .2 This level requires consistent, frequent attention to many details that affect the health and appearance of the garden. Maintenance may include extensive work to upgrade conditions that would be acceptable in most other landscapes.

3.2 **GENERAL WORKMANSHIP**

- .1 Schedule timing of operations to plant growth, weather conditions and use of site. Provide copy of schedule for approval by Owner / Owner's Rep.
- .2 Do each operation continuously and complete within reasonable time period.
- .3 Provide equipment and material necessary for maintenance to acceptable horticultural standards.

- .4 Collect and dispose of excess material and debris daily.

3.3 **SPRING CLEAN-UP**

- .1 Complete spring clean-up as soon as working conditions are favorable and no later than March 15.
- .2 Remove and dispose of protective coverings and mulch used in winter protection.
- .3 Sweep and hose with water all hard surfaces, sidewalks, paved areas and curbs.
- .4 Collect and dispose off-site any sand, gravel, salt and debris, accumulated during winter months.
- .5 Planting Beds: Clean plant beds of debris and dead plant material. Re-edge deep 'v' bed edges.
 - .1 Cut down grasses that remained over the winter.

3.4 **IRRIGATION**

- .1 Contractor to ensure automated irrigation system is in full operation as part of start-up during the maintenance period.

3.5 **TURF MAINTENANCE**

- .1 Topdressing and Reseeding:
 - .1 Mow grass to height of 50 mm.
 - .2 After mowing, rake thoroughly, removing loose and dead grass, stones and debris.
 - .3 Spread topsoil to maximum thickness of 15 mm, filling in low areas and bare spots.
 - .4 Overseed areas with seed mixture equivalent to existing grasses. Seed at rate of 3 kg/100 m².
 - .5 Rake seed into topsoil. Roll lightly.
 - .6 Water to ensure penetration of 80 mm and at frequent intervals to maintain vigorous growth.
- .2 Fertilizing:
 - .1 Use only mechanical equipment. Check calibration of spreader to ensure that specified rate is used.
 - .2 Spread 50% of fertilizer in one direction, then 50% at right angles.
 - .3 Apply 11-51-0 fertilizer at rate of 3 kg/100 m², in early spring as soon as frost is out of ground prior to May 15.
 - .4 Apply 27-14-0 fertilizer at rate of 3 kg/100 m² during the last two weeks of July.
 - .5 Apply 16-20-0 fertilizer at rate of 3 kg/100 m² during the last two weeks of August.
 - .6 Water, immediately after fertilizing. Obtain moisture penetration of 50 mm minimum.
- .3 Watering:
 - .1 Areas with underground irrigation systems: operate systems as per manufacturer's manuals and design.
 - .2 Areas where water is supplied by Contractor: supply labour, water truck, pumps, portable sprinkler systems and water necessary to provide adequate watering.
 - .3 Apply water as required throughout growing season as required.
- .4 Mowing - Maintained Areas:
 - .1 Maintain turf with sharp mowers at 50-75mm during growing season.
 - .2 Remove papers, rocks, and other foreign material prior to cutting.
 - .3 Change direction of cut with each mowing where practical.
 - .4 Do not remove grass clippings from turf areas unless volume is such as to be harmful to turf areas or unsightly.
 - .5 Remove clippings from sidewalks and roads during the same mowing.
 - .6 Adjust mower blades so that not more than 30% of grass blade will be cut at one time. Remove clippings after each cut.

3.6

TREE AND SHRUB MAINTENANCE

- .1 Maintenance of Plant Beds:
 - .1 Maintain deep "v" spaded bed edge to even depth of 100 mm in line with original layout.
 - .2 Maintain mulch type, depth and layout as per drawings and specifications.
 - .3 Remove weeds monthly, including roots.
 - .4 Do not damage roots of plants.
 - .5 Collect and dispose of paper, refuse, and dead plants.
- .2 Staking:
 - .1 Keep stakes and guy wires taut and plants plumb for duration of maintenance period.
- .3 Pruning:
 - .1 Prune, when required or directed, in accordance with current industry standards.
- .4 Fertilization Requirements in Early Spring:
 - .1 Apply 10-6-4 fertilizer at rate of 18 g/mm of caliper per tree at dripline of tree.
 - .2 Apply 10-6-4 fertilizer at rate of 5 kg/100 m2 into upper surface of plant beds.
 - .3 Apply water after fertilizing sufficient to ensure penetration of fertilizer.
- .5 Watering:
 - .1 Test moisture levels of individual plant species and provide adequate water supply by hand if necessary to augment irrigation system.

3.7

WEED, INSECT, AND DISEASE CONTROL

- .1 General Considerations:
 - .1 Ensure proper, positive identification of infestations and consult with Town's Representative, Owner and adjacent land owners before taking corrective action.
 - .2 Take every measure to correct infestation using an Integrated Pest Control (IPC) methods prior to the use of chemicals – using prevention, monitoring and control.
 - .3 Prior to chemical applications, obtain written approval from Town or Governing Body. This is especially critical for all planting in the foreshore.
 - .4 Determine susceptibility of plant species to chemical damage prior to any chemical application.
 - .5 Use equipment and containers free of harmful residues unrelated to specific control measures applicable to situation.
 - .6 Perform disease, weed and insect control, in accordance with Federal, Provincial, or Municipal chemical application regulations. Notify The Town and Town's Representative of intent at least three days prior to any chemical application.
 - .7 Prepare and apply chemical according to manufacturer's specification. Minimize drift at all times.
 - .8 Carry out treatment with due regard to climatic conditions' effect on surroundings and occupants of buildings.
- .2 Weed Control:
 - .1 Remove weeds and their root systems by hand weekly.
 - .2 Remove all related dead weed material.
 - .3 Repair and pay for damage caused by application of herbicides.
 - .4 Effectiveness of treatment program to be determined by inspection by Engineer. Repeat as required.
- .3 Insect and Disease Control:
 - .1 Make minimum weekly inspection of lawns and plants for insect and disease infestations. Apply chemicals based on development stage of insects' life cycles.
 - .2 Repair and pay for damages caused by application of chemicals.

3.8

AUTUMN PREPARATION

- .1 Rake leaves minimum weekly and remove from site.
- .2 Protect plants from rodent damage.
- .3 Protect coniferous plants with burlap wrap during winter months, if warranted.
- .4 Protect tree trunks with tree wrap, if warranted.
- .5 Do not cut down grasses, or dead head perennials with winter interest

3.9

CLEANLINESS OF GROUNDS

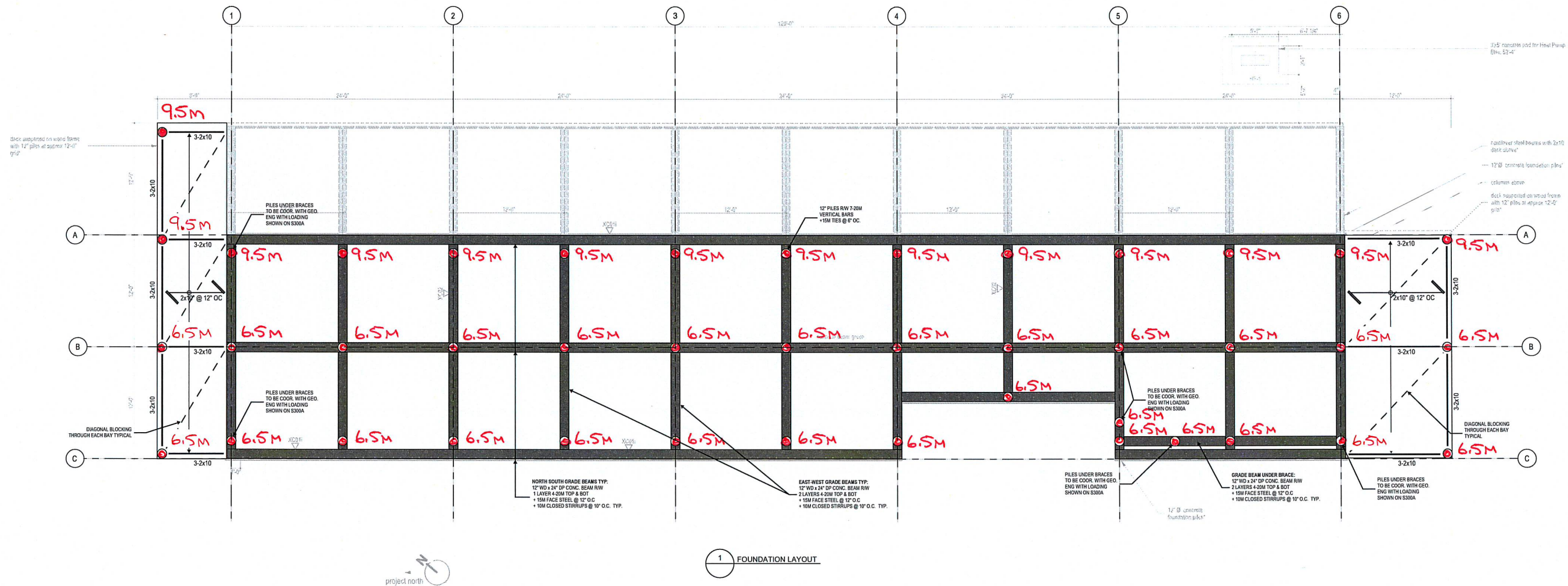
- .1 Keep site area clean and tidy on a minimum weekly basis.
- .2 Clean hard surface areas of landscape debris on a weekly basis.
- .3 Maintenance standards shall be upheld up to and following Substantial Completion approval to Final Acceptance.

END OF SECTION

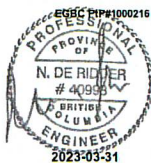
APPENDIX G

Geotechnical

LEA Markup : 2023-04-06
XXM = Estimated pile depth below existing grade



1 FOUNDATION LAYOUT



CHECKWITH
POIRON
ARCHITECTS
INC.

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Arts and Heritage Hub

Page 035 of 076 building

Client	Town of Ladysmith	Drawn By	NDR	Reviewed By		Sheet Number	S200
Project Number	2729	Sheet Name	Foundation Design	Issue No.	71	Issued For	BP AND TENDER SET
Scale	n/a	Date	2023.02.28	Revision			



GEOTECHNICAL ASSESSMENT

**Town of Ladysmith
Ladysmith Arts and Heritage Hub (LAHH)
Proposed Building Relocation – Artist's
Studio
Oyster Bay Drive, Ladysmith, BC**

Prepared For:
Checkwitch Poiron Architects Inc.
9-93 Commercial Street
Nanaimo, BC, V9R 5G3

Attention:
Mr. Brett MacIntyre, Architect
brett@cparch.ca

July 19, 2021

File No.: F9198.01
Revision No.: 00
Prepared by:
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Reviewed by:
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LEA Lewkowich
Engineering
Associates Ltd.

DISCLAIMER

1. Lewkowich Engineering Associates Ltd. (LEA) acknowledges that this report, from this point forward referred to as “the Report,” may be used by the Town of Ladysmith (ToL) and/or the Authority Having Jurisdiction (AHJ) as a precondition to the issuance of a development and/or building permit and that this Report and any conditions contained in the Report may be included in a restrictive covenant under Section 56 of the Community Charter and registered against the title of the properties at the discretion of the ToL.
2. This Report has been prepared in accordance with standard geotechnical engineering practice solely for and at the expense of Checkwitch Poiron Architects Inc. (CPA). We have not acted for or as an agent of the ToL in the preparation of this Report.
3. The conclusions and recommendations submitted in this Report are based upon information from relevant publications, a visual site-assessment of the properties, anticipated and encountered subsurface soil conditions, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. If unanticipated conditions become known during construction or other information pertinent to the structure(s) becomes available, the recommendations may be altered or modified in writing by the undersigned.
4. This Report was authored, to the best of our knowledge at the time of issuance, with considerations for local requirements specific to the AHJ and their standards for the preparation of such reports, the 2018 British Columbia Building Code (BCBC), and current engineering standards. Updates to municipal bylaws, policies, or requirements of the AHJ, or updates to the BCBC and/or professional practice guidelines may impact the validity of this Report.
5. This Report has been prepared by Mr. Stuart Crossfield, P.Geo., P.L.Eng., and reviewed by Mr. Jeff Scott, P.Eng. Messrs. Crossfield and Scott are both adequately experienced and are also members in good standing with the Engineers and Geoscientists of British Columbia (EGBC).

EXECUTIVE SUMMARY

1. The following is a brief synopsis of the properties, assessment methods, and findings presented in the Report. The reader must read the Report in its entirety; the reader shall not rely solely on the information provided in this summary.
2. The subject properties, 610, 612, 614, and 616 Oyster Bay Drive, Ladysmith, BC, from this point forward referred to as “the Properties,” are located on the east coast of Vancouver Island within the jurisdictional boundaries of the ToL. At the time of this Report, we understand the proposed development consists of relocating the Artist’s Studio to the north side of Oyster Bay Drive, from the location originally proposed along the south side of Oyster Bay Drive. We understand the building will be a maximum of one-storey in height, and of conventional construction methods. The building as proposed would include a cantilevered foundation system fully supported by drilled piers or piles in proximity to an existing ocean-facing slope.
3. A site-specific assessment was conducted to identify potential geotechnical hazards for the Properties and the proposed commercial development. Our assessment determined that slope stability and poor fill soils are areas of concern for the development.
4. The findings confirm the development is considered safe as proposed, provided the recommendations in this Report are followed.

List of Abbreviations Used in the Report

Abbreviation	Title
AHJ	Authority Having Jurisdiction
BCBC	British Columbia Building Code
BH	Borehole
CPA	Checkwitch Poiron Architects Inc.
DPA	Development Permit Area
DCPT	Dynamic Cone Penetration Testing
EGBC	Engineers and Geoscientists of British Columbia
FCL	Flood Construction Level
FoS	Factor of Safety
GSI	Geological Strength Index
LEA	Lewkowich Engineering Associates Ltd.
MNC	Municipality of North Cowichan
PGA	Peak Ground Acceleration
RMR	Rock Mass Rating
RQD	Rock Quality Designation
SLS	Service Limit State
SPT	Standard Penetration Testing
UCS	Unconfined Compressive Strength
ULS	Ultimate Limit State

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1.0 INTRODUCTION

1.1 General

- a. As requested, LEA has carried out a geotechnical assessment with respect to the above noted LAHH Artist's Studio building development. This Report provides a summary of our findings and recommendations.

1.2 Background

- a. At the time of our field review reviews and investigation, the proposed building location was vacant and undeveloped. The area includes gravel surface/level vehicle parking adjacent to Oyster Bay Drive, and localized vegetation/ground cover (blackberry vines, maples, tall grasses, bracken fern) closer to the crest of the ocean-facing slope.
- b. The building site is located on the north/east side of Oyster Bay Drive, approximately 475m north of the Transfer Beach Boulevard/Oyster Bay Drive intersection, and approximately 620m south/southeast of the Ludlow Road Oyster Bay Drive intersection.
- c. We understand the Artist's Studio will be a maximum of one-storey in height, with a wood-framed superstructure of conventional construction methods. The building as proposed includes a cantilevered foundation system partially supported by drilled piers or piles in proximity to an existing ocean-facing slope.
- d. We assume the proposed development will include the installation of associated on and off-site civil works and services. At the time of this Report, we understand the Artist's Studio would be ground level access, at or close to existing elevations along the Oyster Bay Drive frontage.
- e. Reference the attached plan prepared by the project architect, CPA.

1.3 Assessment Methodology

- a. A subsurface geotechnical investigation was carried out in proximity to the proposed Artist's Studio location on April 7 and 8, 2021, utilizing drilling equipment provided by Drillwell Enterprises Inc. The April 7th investigation included BHs 21-01 and 21-02, advanced through bedrock utilizing HQ3 coring to maximize sample recovery, visually classify rock conditions, and retrieve samples for testing of the encountered conditions. The April 8th investigation included BHs 20-05 and 20-06 advanced with a solid stem drill and included SPT and DCPT in-situ testing, as well as grab samples and field classification of the encountered conditions.
- b. All BHs were infilled with bentonite upon completion of our investigation each day. The drill cuttings were stored in steel barrels and left on site for coordination by the ToL environmental consultant, Mr. Gordon Guy of Golder Associates.

- c. A site plan showing the location of the BHs (Drawing F9198-01) is attached, following the text of this Report.
- d. The BH locations were sited to provide good general coverage of the proposed building site and surrounding areas given the available information regarding future building location, general access with respect to existing structures and/or treed areas, as well as the locations of underground utilities.

2.0 SITE CONDITIONS

2.1 Physical Setting

- a. The Properties are located in the northeast region and jurisdictional limits of the ToL. Based on our desktop review, the Properties are identified under a single title, with the following civic and legal address:
 - i. 610 Oyster Bay Drive; Lot 4, District Lots 8G, 11G, 24 and 56, Oyster District, Plan 45800, Except Plans VIP64405, VIP71943, VIP72131 and EPP100456, PID: 010-208-828.
- b. We recognize the above noted civic and legal addresses are associated with the parent parcel and the existing buildings at the proposed original location of the Artist's Studio on the opposite side of Oyster Bay Drive. At the time of this Report, we are unclear if a separate civic address is applicable for the proposed building area, or if the property is simply affiliated with the civic and legal addresses referenced above.
- c. A location plan of the Properties is shown below in Figure 2.1.1.



Figure 2.1.1 – Location Plan of Subject Properties and Building Location¹

- d. The Properties and proposed development area are zoned for Waterfront Area Plan Development, and are bound in all immediately directions by properties with the same zoning.
- e. Zoning for the Properties and surrounding areas is shown below in Figure 2.1.2.

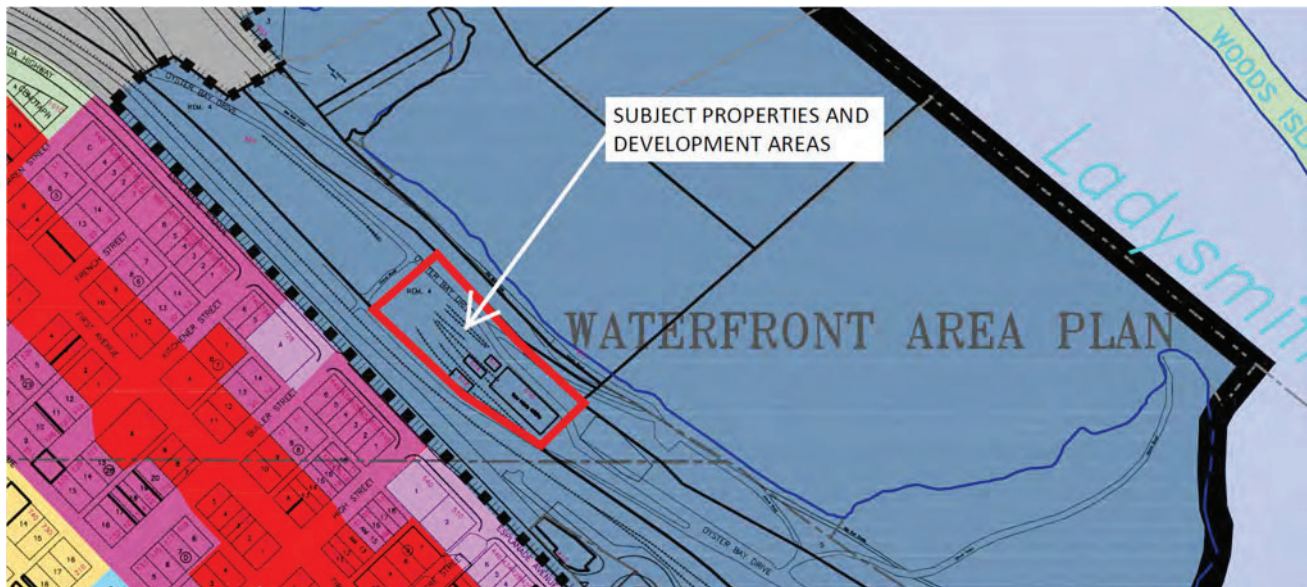


Figure 2.1.2 – Location Plan of Properties and Zoning²

- f. Based on our desktop review, the properties and development area fall within DPA 7 for Hazard Lands, however the DPA zone is not color-coded on the referenced mapping, and states “Refer to the Waterfront Area Plan³.”
- g. Based on our cursory review of the Waterfront Area Plan³, the language and intent of the document are form and character related, and not driven by development requirements in hazard land areas.

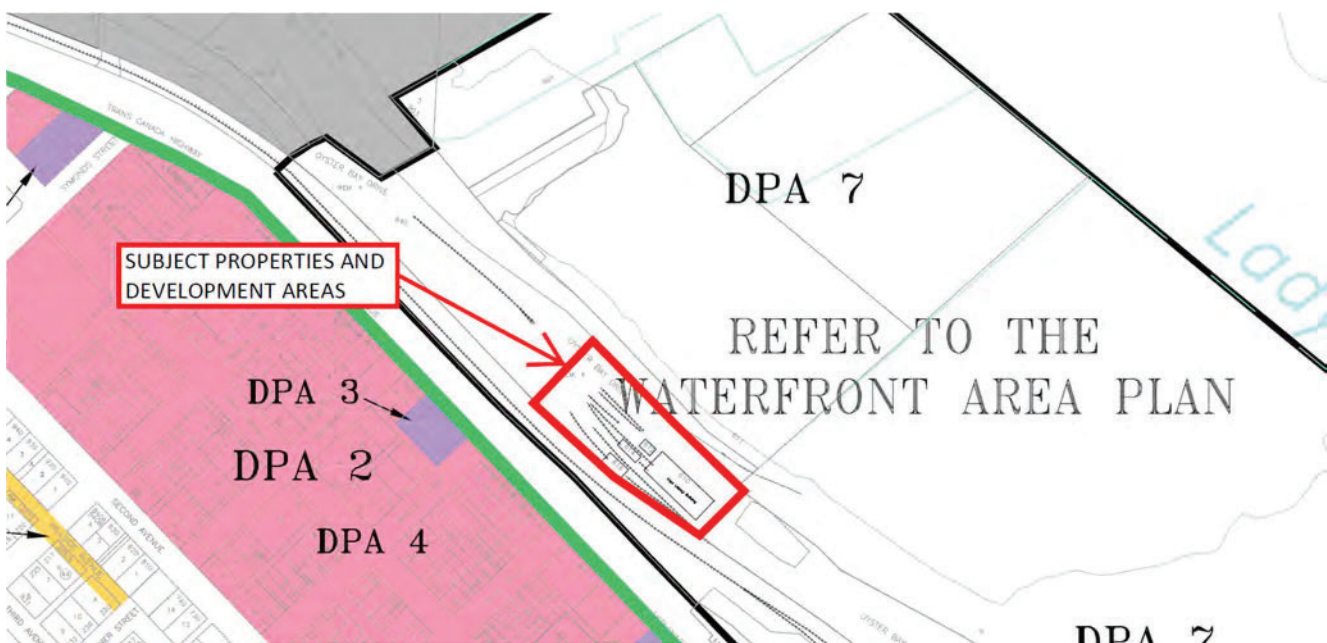


Figure 2.1.3 – Location Plan of Properties and DPAs³

2.2 Terrain and Features

- a. The Artist's Studio location is generally level and consistent with the existing Oyster Bay Drive frontage, but abruptly steepens towards a defined ocean-facing slope to the north/northeast. The slope is the prominent feature of the building area, measuring approximately 12m in total height over the proposed building location, and configured at approximately 40°, with localized over-steepened areas up to approximately 65°. The slope is separated by a bench approximately 3m to 4m in width. The slope height is based on measurements taken in the field, and survey data provided on the attached architectural rendering.
- b. Bedrock exposures are visible at a few locations on the slope with a thin veneer of unconsolidated soil cover as typical. The toe of the bedrock slope includes a defined swale (excavated into bedrock), adjacent to the existing rail/pedestrian corridor below.
- c. The slope includes sporadic immature to juvenile tree cover with minor "pistol butt"/bent growth pattern, primarily consisting of Maples, with lesser numbers of Fir and Cedars, including sparse low-lying brush, vines, and grasses. The typical slope condition is shown below in Image 2.2.



Image 2.2 – Typical Vegetation and Slope Angle, View from Rail Trail Looking Northwest

2.3 Regional Geology

- a. Surficial geology for the area⁵ is classified as part of the Quamichan formation, commonly comprised of fluvial deposits, and includes marine/fluvioglacial deposits. The soils are classified as very gravelly loam and sand, and rapidly drained, defined as soils that hold little moist after rain.
- b. Bedrock geology for the area⁶ is classified as the Nanaimo Group formation, and is typically comprised of boulder, cobble, and pebble conglomerate, coarse to fine sandstone, siltstone, shale, and coal. The conditions encountered during our field investigation consisted of siltstone commonly found in the general geographic area, and consistent with the Nanaimo Group.

2.4 Soil and Bedrock Conditions

- a. Consistent soil strata were encountered during the BH investigation. Generally, these strata consisted of miscellaneous fills consisting of loose, brown to black, moist, silty sand with some gravel, cobbles, organics, and coal debris, underlain by a compact, grey/brown, moist to wet, sand and gravel, with trace to some silt and cobble, underlain by a dense to very dense, grey, moist, sandy gravel with some silt, underlain by a dense to hard, grey-brown, sedimentary bedrock (siltstone/claystone).
- b. Detailed descriptions of the subsurface conditions are provided on the attached borehole logs (BH 21-01, BH 21-02, BH 21-05, and BH 21-06). The main strata are discussed in Tables 2.4.1 and 2.4.2 below.

Soil Stratum No.	Soil Description	Depths	
		From	To
1	Miscellaneous fills; silty sand, some gravel, cobble, organics, coal debris, loose to compact, brown to black, moist	0.00	3.35
2	Sand, with varying amounts of silt and gravels, compact to dense, grey/brown, moist to wet	1.52	4.55
3	Siltstone/claystone bedrock	3.04	4.27

Table 2.4.1 – Summary of Encountered Soil Strata

Soil Stratum No.	BH No., Maximum Encountered Depth (m) per Stratum			
	21-01	21-02	21-05	21-06
1	3.35	2.74	1.68	1.52
2	4.55	4.27	3.51	1.98
3	4.55	4.27	NE	3.04
*NE denotes Not Encountered				

Table 2.4.2 – Summary of Maximum Encountered Depths per Stratum per BH

- c. Fill materials were encountered in each BH at depths from 1.52m to 3.35m, while bedrock was encountered in each of the BHs, with the exception of BH 21-03, at depths from 3.04m to 4.55m, and to a mean depth of 3.95m.
- d. The coring rig was able to drill through and recover samples of the bedrock. The following is a general description of the rock samples from the drill core and outcrops on surface:
 - i. Weak to moderately strong, dark grey, fine grained, slightly weathered, siltstone/claystone. Seams of moderately weathered and fractured rock, trace clay.
 - ii. Rock Quality Designation (RQD) was measured as typically poor at 25%, while in the more competent core to range from 50% to 75%.
 - iii. Joint conditions appeared to be persistent, less than 0.1mm separation, slightly rough, soft infilling, slight to moderately weathered, however seams of disintegrated rock and clay were noted.
 - iv. Bedding laminations in the outcrops along the trail appear to be steeply dipping toward the southwest.
- e. Bedrock exposures in proximity to the Properties, as well as the core samples collected during the drilling investigation, are shown below in Photos 2.6.1 through 2.6.4.
- f. The intact rock Unconfined Compressive Strength was estimated using field hardness methods and laboratory testing. The average field hardness was estimated at R2 to R3, or weak (5-25MPa) to medium weak (25-50MPa). The conducted laboratory UCS test resulted in a strength of 60MPa. We note the strength of the rock is anisotropic along bedding fabric.
- g. The core was logged to classify the rock using accepted classification systems. The Rock Mass Rating (RMR, 1976)⁷ average conditions were typically found to be around 35, or the upper end of "Poor Rock".
- h. The Geological Strength Index (GSI)⁸ is taken as equivalent to the RMR value.



Photo 2.4.1 – Rock Exposure Adjacent to Toe of Slope, Near Storm Outlet NW along Trail.



Photo 2.4.2 – Bedrock Exposure on Slope Face in Proximity to Building Area



Photo 2.4.3 – Rock Core Samples, BH21-01 from 4.54m to 12.65m



Photo 2.4.4 – Rock Core Samples, BH21-02 from 4.27m to 12.65m

- i. Soil and rock classification terminology is based on the Modified Unified Soil Classification System and the International Society of Rock Mechanics suggested methods. The relative proportions of the major and minor soil constituents are indicated by the use of appropriate Group Names as provided in ASTM D2488-93 and/or D2487 Figures 1a, 1b, and 2. Other descriptive terms generally follow conventions of the Canadian Foundation Engineering Manual.
- j. Borehole logs and laboratory test results for both soil and rock can be found attached to this Report.

2.5 Groundwater Conditions

- a. A standpipe piezometer was installed in BH 21-01 with a 3.0m slotted PVC placed at the base of the hole with the remaining solid PVC and backfilled with bentonite. The measured depth to groundwater after one day of installation was 3.35m from ground surface. Additionally, groundwater was encountered during drilling within BH 21-05 and BH 21-06 at a depth of 1.52m and 0.91m from ground surface.

- b. The results of our investigation within the remaining portions of the site suggest the groundwater levels are relatively near surface at approximately 2.0m depth.
- c. We note that groundwater movement in rock is primarily dominated by higher permeability and interconnected fracture zones, and that our piezometer indicates the rock to be submerged.
- d. Groundwater levels can be expected to fluctuate seasonally with cycles of precipitation. Conditions at other times and locations can differ from those observed within the BHs at the time of our assessment.

2.6 Watercourses, Ocean Flooding

- a. We have reviewed the Properties and proposed building development with respect to its proximity to any watercourses, including the Strait of Georgia.
- b. There are no mapped watercourses or riverine systems in proximity to the Properties and proposed development area. However, the Strait of Georgia is located almost adjacent to the north/northeast limits of the Properties.
- c. Site specific topographical survey data was not available at the time of this Report. However, based on available online mapping tools and available elevation data, we believe the pedestrian rail/trail located at the toe of the defined slope to be at an elevation of approximately 6m geodetic (CGVD 2013). The available terrain mapping shown on the attached architectural plan shows the slope height to be approximately 12m, which places the building construction at an elevation of approximately 18m geodetic.
- d. Local coastal Flood Construction Levels, with allowances for current best practices including climate change, generally yield FCLs of ± 5.5 m geodetic.

2.7 Covenant Review

- a. As part of our assessment, we have reviewed the titles of the Properties relative to any restrictive covenants that may be registered.
- b. At the time of this Report, there were no restrictive covenants registered against the titles of the Properties that impact the comments, conclusions, and recommendations in this Report.

3.0 SLOPE STABILITY ANALYSIS

- a. A pseudo-static limit equilibrium analysis was carried out using Slope/W version 10.2.1 software by GeoStudio 2020, employing the Morgenstern-Price method. The outputs are appended to this Report.
- b. The software was used to evaluate the slope's resistance to slope failure over a range of potential slip surfaces, determining the critical FoS and the probable extent of failure. A FoS of less than 1.0 represents an unstable condition while a FoS greater than 1.0 indicates a stable condition. Analyses were performed for both static and seismic conditions.

- c. The slope geometry was modeled using the project survey data and represents a section taken through the proposed building at BH 21-01, considered representative of the overall slope conditions. The modelled Section A-A' is shown in Figure 3.1 below. The slope measures a total of 12m in height at an overall inclination of 47°.

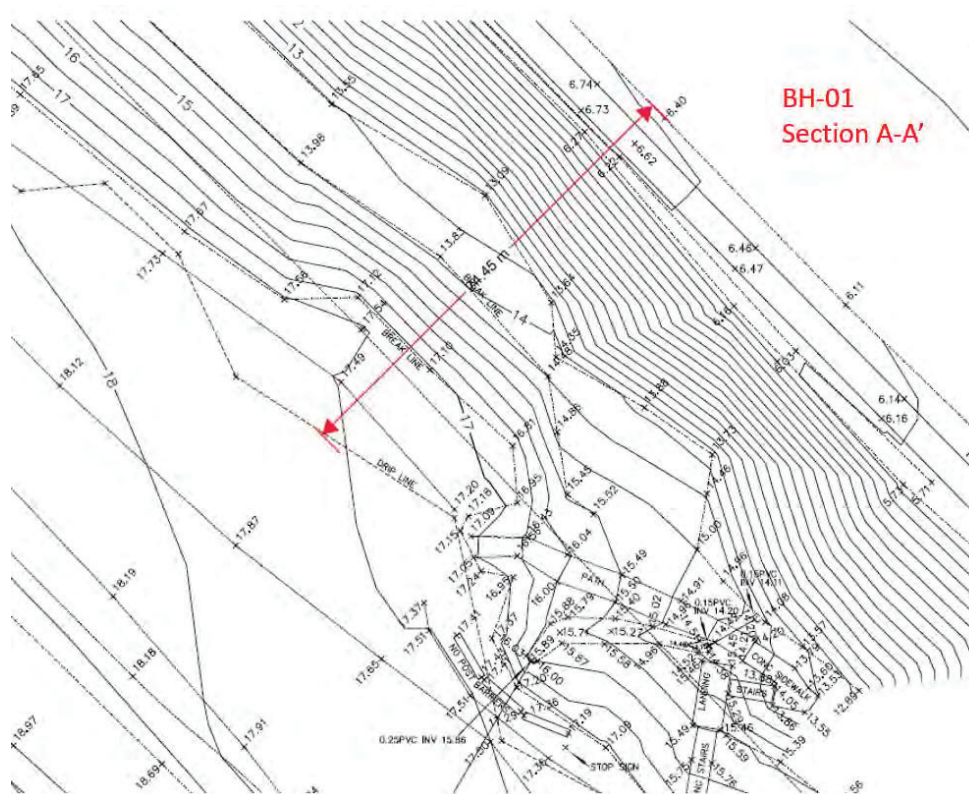


Figure 3.1: SlopeW Section A-A'

- d. Stability analysis for weak rock is based on the strength of the fractured rock mass defined by the non-linear generalized Hoek-Brown failure criterion⁷. This criterion treats the rock mass as an isotropic material through an estimation of main properties gathered from our field investigation of surface and subsurface information.
- Uniaxial compressive strength of intact rock based on field hardness estimates of 15 MPa.
 - An estimate of the GSI⁷ was based on the RMR and on charts for a value of 35.
 - A value of the intact material constant m_i of 5 for siltstone.
 - Disturbance factor of 0 for a natural undisturbed slope.
- e. RocData software from Rocscience® was used to establish the Hoek-Brown failure envelope of the rock mass and to determine the equivalent Mohr-Coulomb strength parameters of cohesion and angle of internal friction (attached). The strength parameters are summarized in Table 3.2 below.

Soil Layer	Unit Weight (kN/m ³)	Effective Friction Angle (Degrees)	Effective Cohesion (kPa)
Sand and Silt (Loose)	18	27	0
Siltstone/Claystone (GSI 35)	25	40	100

Table 3.1: Mohr-Coulomb Soil Parameters used in Analysis

- f. Piezometric conditions were based on the installed standpipe with a measured depth to water of 3.3m.
- g. Our analysis for the seismic condition conservatively includes a horizontal acceleration coefficient of 0.479g, equivalent to the full Peak Ground Acceleration (PGA) of the site.
- h. The results of the slope stability analysis have been summarized in Table 3.5 below.

Section	Description of Failure	Factor of Safety (given conditions)	
		Static	Pseudo-static
Section A-A'	Slip surface 5m behind crest	1.8	3.6

Table 3.2: Summary of Slope Stability Analysis

- i. The analysis conducted through Section A-A' indicates that no potential deep-seated slip surfaces are developed with a FoS less than 1.0. As discussed, a pseudo-static FoS greater than 1.0, and a static FoS greater than 1.5, results in an acceptable level of safety from a deep-seated failure and no further analysis is required.

4.0 DESIGN PHASE

4.1 Slope Stability and Building Setback

- a. Our investigation shows the upper slope is comprised of up to 4.5m of loose to compact, sands, silts, gravels and fills coincident with the elevation of the 3m wide mid-slope bench. Followed by a steeply inclined slope primarily comprised of weak sedimentary siltstone/claystone bedrock overlain by a veneer of loose, unconsolidated sands, silts and gravels. Our borehole investigation has shown the rock mass conditions can be described as typically poor, with an improvement in its quality beyond approximately 9 metres of surface.
- b. As a result of the slope conditions, we have assessed the stability to be controlled by the weak rock mass strength conditions. We have concluded through our pseudo-static slope stability assessment the slope is considered safe from potential deep-seated instabilities both in the static and seismic conditions given the conservative assumptions. Periodic and localized sloughing of the thin veneer of overburden should be

best managed by normal slope maintenance (refer to Section 4.2 below).

- c. We consider erosion at the toe of slope to be a low-probability concern over the design life of the development given the presence of resistant bedrock exposed along the slope and at the toe.
- d. In addition, there were no visual signs of potential global / full slope height instability (tension cracks, toe erosion, ponding water, seepage, evidence of past failures, etc.) within the slope beneath the proposed building. Evidence of localized instability would also include accumulations of talus or boulders at the base of the slope. The relative lack of materials would indicate that rock fall hazard is of low frequency.
- e. Notwithstanding the above, given the proposed building development, LEA recommends the following (as illustrated in Figure 4.1):
 - i. Regrading the upper 4m of sands/mixed fill materials to a slope no greater than 2 Horizontal to 1 Vertical (2H:1V).
 - ii. Implement a 3.0m foundation setback from the defined crest of the lower rock slope as measured by a qualified survey professional. Note the setback relates to foundation connections and allows for cantilevered building design.

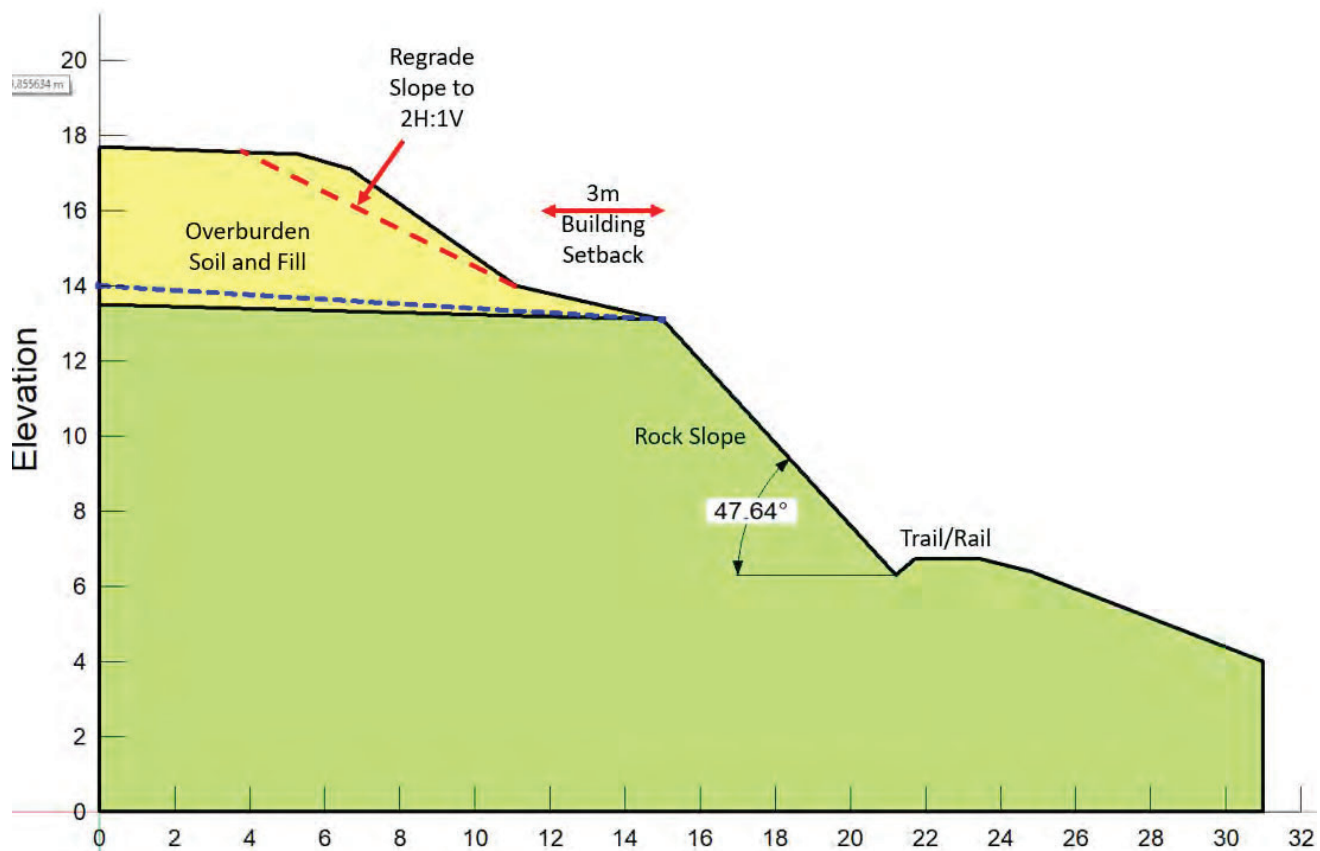


Figure 4.1 – Recommendations for Slope

4.2 Slope Maintenance

- a. In order to ensure long-term stability, the following should be considered as basic, minimum requirements for maintaining slope stability.
 - i. Do not direct surface water flows toward the crest of slope. All surface water drainage should be carefully controlled and discharged to suitable areas.
 - ii. Any collected stormwater or pipe drainage measures shall be directed to a suitable discharge area at the toe of slope. Water shall not be discharged near the slope crest, or on the slope for any reason.
 - iii. Do not remove natural vegetation from the slope and maintain a dense vegetation cover.
 - iv. Replace or revegetate any areas that show signs of erosion or soil loss from natural (or other) processes.
 - v. Pressurized irrigation systems or pressurized piping of any kind should be inspected and maintained on a regular basis. Damage / leakage of pressurized irrigation systems or similar could impact the stability of the slope.
 - vi. Do not dump refuse, debris, landscaping waste (leaves, lawn clippings, etc.) on the slope or over the slope crest.
 - vii. Spiraling of any trees is preferred for tree removal; stumps of any trees should be left in place.
- b. It should be noted that landslides can also occur due to human activity or by failure of infrastructure (i.e. underground civil servicing including water mains and or storm/sanitary sewer systems) in the vicinity of the Properties.

4.3 Foundation Design

- a. We understand the proposed Artist's Studio will be a maximum of one-storey in height, with a superstructure of conventional construction methods which will be located adjacent to the crest of the slope. Our investigation has shown at least 3.5m of loose to compact sands with varying amounts of silt, gravel fill and organic materials. As such we consider these soils not suitable for conventional shallow foundation support. Suitable bearing conditions are considered 4.5m in depth below the top of the siltstone/claystone bedrock. In consideration of the development plan and proximity to the slope crest we recommend a foundation system fully supported by drilled piers or piles socketed into bedrock.
- b. The benefit of this foundation solution will be to provide assurance in regards to placing the structural loads of the building at a depth which will not impact the stability of the slope. Furthermore, it will allow the loads of the building to be founded on similar bedrock conditions across the building footprint through the use of piles, eliminating uncertainties around differential settlements between the various building areas.

- c. Based on the results of our investigation and the conditions encountered, we recommend that the front row (northeast row) of drilled piers, located at a minimum setback of 3.0m from crest of slope, should be socketed a minimum of 5.0m embedment depth into rock. Subsequent rows of drilled piers can be socketed a minimum of 2m into rock.
- d. We assume the capacity of the drilled pier will be derived from base resistance only. Turner and Ramey⁹ (2010) show that the GSI and associated Hoek-Brown strength parameters can be used in a bearing capacity analysis, providing the means to determine the nominal base resistance of rock socketed drilled piers. Using the parameters discussed in Section 3.0 (d), we recommend a nominal base resistance at ULS of 775 kPa, and a nominal base resistance at SLS of 310kPa (considering a geotechnical resistance factor of 0.4).
- e. Note that the resistance at the base of the rock socketed pier could be governed by either the geotechnical strength of the rock mass beneath the tip as outlined above, or by the structural strength of the concrete in bearing.
- f. We understand the development is at a preliminary stage of design. Once additional information on loading, dimensions and spacing of socketed piers becomes available further coordination between the Geotechnical and Structural Engineer(s) will be required to finalize the design parameters. Lateral loading on the drilled piers and any future retaining wall construction within the Properties shall be reviewed by the Geotechnical and/or Structural Engineer(s).

4.4 Ocean Flooding, Potential Erosion

- a. As outlined in Section 2.7 of this Report, the Artist's Studio is proposed to be sited at an elevation of approximately 18m. This is roughly 12.5m above typical FCLs for the area.
- b. Therefore, we conclude the proposed building will not be impacted by ocean flooding.
- c. We have given further consideration to potential erosion of the slope due to low-frequency storm events, sea level rise, and climate change.
- d. Given that the slope consists almost exclusively of bedrock, and is protected by a large soil mass supporting the pedestrian rail/trail, assumed to be underlain by bedrock at shallow depths, we conclude toe erosion of the supporting slope will not impact the structure over the design life of the building.

4.5 Seismic Criteria

- a. Based on the 2018 British Columbia Building Code, Division B, Part 4, Table 4.1.8.4.A, "Site Classification for Seismic Site Response," the soils and strata encountered during the subsurface investigation would be "Site Class C" (Very Dense Soil or Soft Rock).

4.6 Foundation Drainage

- a. Conventional requirements of the 2018 BCBC pertaining to building drainage are considered suitable at this site.
- b. Given our understanding of proposed construction elevations, we expect the foundation drains and roof water collection systems can be directed to existing or future storm sewer mains along the Oyster Bay Drive frontage.

5.0 CONSTRUCTION PHASE

5.1 General Excavation – Socketed Piers

- a. The pier construction methods must consider the site-specific soil, bedrock and groundwater conditions, as well as the design requirement of base resistance only.
- b. From our investigation, we have determined the rock to be of poor condition, and in some cases of a highly fractured nature. The effects during construction and drilling will potentially require casing or drilling muds to help stabilize the borehole walls from collapse. However, the borehole did remain open in rock during the drilling investigation. It is expected the cohesionless overburden materials will require casing support to prevent collapse.
- c. The groundwater well installed in BH 21-01 shows a water level at 3.35m below existing ground surface with the general upslope site having a shallow depth to water of around 2m.
- d. The design assumes that load is carried in base resistance only, and as such it is essential that the end of the socket be thoroughly cleaned of all drill cuttings and loose rock. Where it is not possible to clean and inspect the end of the socket, it may be necessary to assume that there is no end bearing and that the full load will be carried in side wall resistance. The Geotechnical Engineer should review the pile design prior to construction.
- e. Further constructability issues will need to be worked out through the final design process and with input from an experienced contractor, which may include accessibility on sloping ground conditions.

5.2 Structural Fill

- a. Where fill is required to raise areas that will support buildings, slabs, or pavements, structural fill should be used. The Geotechnical Engineer should first approve the exposed subgrade in fill areas, to confirm the removal of all unsuitable materials.
- b. Structural fill should be inorganic sand and gravel. If structural fill placement is to be carried out in the wet season, material with a fines content limited to 5% passing the 75µm sieve should be used, as such a

material will not be overly sensitive to moisture, allowing compaction during rainy periods of weather.

- c. Structural fill should be compacted to a minimum of 95% of Modified Proctor maximum dry density (ASTM D1557) in foundation and floor slab areas, as well as in paved roadway and parking areas.
- d. Structural fills under foundations, roadways, and pavements should include the zone defined by a plane extending down and outward a minimum 0.5m from the outer edge of the foundation at an angle of 45 degrees from horizontal to ensure adequate subjacent support. This support zone is shown below in Figure 5.2.

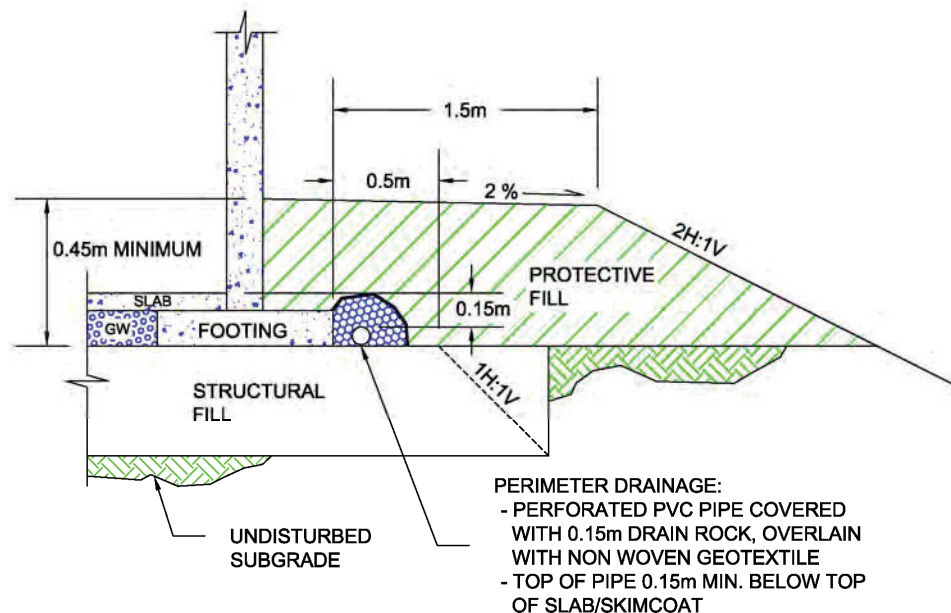


Figure 5.2 – Typical Section, Structural Fill

- e. Compaction of fill should include moisture conditioning as needed to bring the soils to the optimum moisture content and compacted using vibratory compaction equipment in lift thicknesses appropriate for the size and type of compaction equipment used.
- f. A general guideline for maximum lift thickness is no more than 100mm for light hand equipment such as a “jumping-jack,” 200mm for a small roller and 300mm for a large roller or heavy (>500 kg) vibratory plate compactor or a backhoe mounted hoe-pac or a large excavator mounted hoe-pac, as measured loose.
- g. It should be emphasized that the long-term performance of buildings, slabs, and pavements is highly dependent on the correct placement and compaction of underlying structural fills. Consequently, we recommend that structural fills be observed and approved by the Geotechnical Engineer. This would include approval of the proposed fill materials and performing a suitable program of compaction testing during construction.

5.3 Stormwater Management

- a. As part of the geotechnical investigation, field observations of the subgrade soil conditions with respect to the on-site infiltration and disposal of stormwater were carried out.
- b. Subgrade soil conditions consist of a thin layer of disturbed soils and fill materials overlying fine-grained soils and sedimentary bedrock at shallow depths.
- c. Based on the subgrade soil conditions encountered during the BH investigation, it is the opinion of LEA that site conditions (fill soils over shallow bedrock) are not conducive to the installation of on-site stormwater infiltration measures.
- d. Site conditions may be conducive to the installation of storm water detention measures. The location(s) of any proposed detention measures shall be reviewed by the Geotechnical Engineer to determine if the design method(s) and/or location(s) pose a hazard to the Properties or any adjacent or adjoining properties.

5.4 Pavement Design – Private Works

- a. Any organic or deleterious material should be removed from beneath the designated roadway, driveway, or parking areas prior to subgrade preparation. If fill is required to bring the subgrade up to the desired elevation, structural fill should be used.
- b. The subgrade should be proof rolled after final compaction and any areas showing visible deflections should be inspected and repaired. The Geotechnical Engineer shall review the parking lot and roadway subgrade conditions during the course of excavation.
- c. The parking lot subgrade and pavement should be sloped to provide adequate drainage as per the design and direction of the civil consultant.
- d. An estimated soaked California bearing ratio of 30% and a 20-year design life have been used in the calculating pavement designs. See Tables 5.4.1 and 5.4.2 below.

Areas Subject to Cars and Small Trucks	
Estimated Equivalent Single-Axle Load: 2×10^4	
Asphaltic Concrete Pavement	50mm
19mm Well-Graded Granular Base Course	100mm
75mm Select Granular Subbase (SGSB)	250mm

Table 5.4.1 – Pavement Design Recommendations for Light Traffic/Low Volume Areas

Areas Subject to Large Trucks	
Estimated Equivalent Single-Axle Load: 2×10^5	
Asphaltic Concrete Pavement	75mm
19mm Well-Graded Granular Base Course	150mm
75mm Select Granular Subbase (SGSB)	300mm

Table 5.4.2 – Pavement Design Recommendations for Heavy Traffic/High Volume Areas

- e. It is recommended that a reinforced concrete slab be utilized where garbage dumpsters are located. The slab should be large enough to contain the disposal unit and front tires of the garbage truck during disposal operations.
- f. The above recommendations for general stripping, granular and pavement structure are in accordance with current best-practices. If the recommendations provided here prove cost-prohibitive or restrictive, alternative options may be considered through a balance of reduced preparation efforts, with a corresponding reduction in pavement design life.

6.0 CONCLUSIONS

6.1 Local Government Conformance Statement

- a. From a geotechnical point of view, and provided the recommendations in this Report are followed, the land is considered safe for the use intended (defined for the purposes of this Report as a single-storey commercial building of conventional construction methods), with the probability of a geotechnical failure resulting in property damage of less than:
 - i. 2% in 50 years for geotechnical hazards due to seismic events, including slope stability; and,
 - ii. 10% in 50 years for all other geotechnical hazards.

6.2 Geotechnical and Quality Assurance Statement

- a. The 2018 BCBC requires that a geotechnical engineer be retained to provide Geotechnical Assurance services for the construction of buildings that are outside of Part 9 of the BCBC. Geotechnical Assurance services include review of the geotechnical components of the plans and supporting documents, and responsibility for field reviews of these components during construction.

6.3 Acknowledgements

- a. LEA acknowledges that this Report may be requested by the building inspector (or equivalent) of the ToL as a precondition to the issuance of a building or development permit. It is acknowledged that the Approving Officers and Building Officials may rely on this Report when making a decision on application for

development of the land. We acknowledge that this Report has been prepared solely for, and at the expense of Checkwitch Poiron Architects Inc.

- b. We have not acted for or as an agent of the ToL in the preparation of this Report. We acknowledge the ToL and the Approving Officer(s) are authorized users of this Report. We acknowledge that this Report may be registered against the titles of the Properties as a restrictive covenant.

6.4 Limitations

- a. The conclusions and recommendations submitted in this Report are based upon the data obtained from a limited number of widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction or further investigation. The recommendations given are based on the subsurface soil conditions encountered during the BH program, current construction techniques, and generally accepted engineering practices. No other warrantee, expressed or implied, is made. Subgrade conditions are known only at the BH locations and have been used to infer conditions throughout the site in preparation of this Report. If unanticipated conditions become known during construction or other information pertinent to the development become available, the recommendations may be altered or modified in writing by the undersigned.

7.0 CLOSURE

- a. Lewkowich Engineering Associates Ltd. appreciates the opportunity to be of service on this project. If you have any comments, or additional requirements at this time, please contact us at your convenience.

Respectfully Submitted,
Lewkowich Engineering Associates Ltd.



Stuart Crossfield, P.Geo., P.L.Eng.
Engineering Geologist



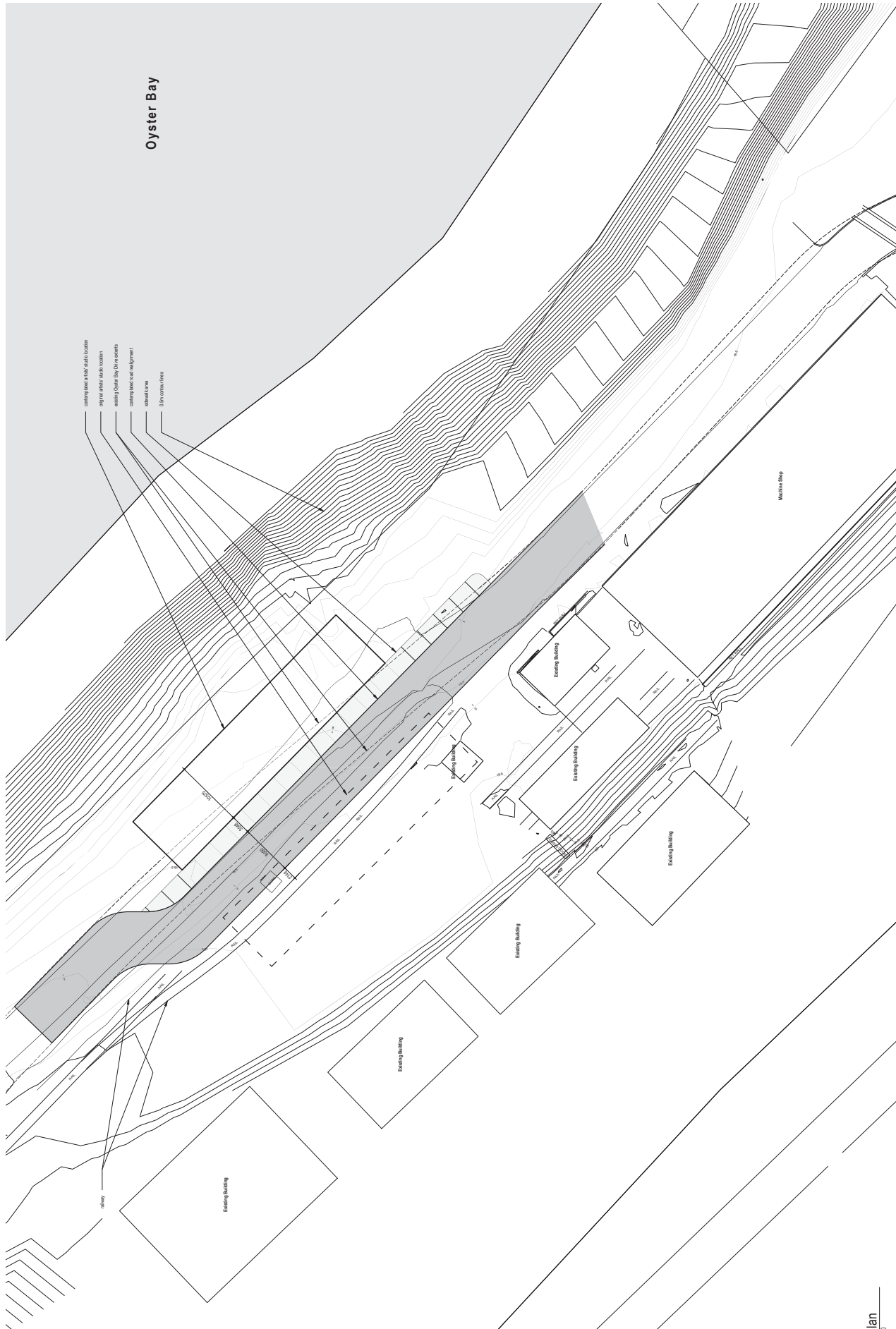
Jeff Scott, P.Eng.
Geotechnical Engineer

8.0 ATTACHMENTS

1. Checkwitch Poiron Architects Inc. drawing titled "Ladysmith Arts and Heritage Hub – Artist's Studio, Ladysmith, BC, Site Plan," File No. 2032, Drawing No. A111, Dated January 13, 2021.
2. BH Site Plan, LEA Drawing No. F9198-01.
3. BH Soil Logs, BH 21-01, BH 21-02, BH 21-05, and BH 21-06
4. BH Rock Logs, BH21-01 and BH21-02.
5. RMR and RQD Plots
6. Laboratory Test Results
7. Hoek-Brown Rock Strength from RocData
8. 2015 National Building Code Seismic Hazard Calculation, Accessed June 2021.
9. Slope Analysis Results (Static and Seismic)

9.0 REFERENCES

1. Google Earth® Online Mapping System, Accessed June 2021.
2. Town of Ladysmith drawing titled "Official Community Plan, Map 1 – Land Use," Dated September 18, 2018.
3. Town of Ladysmith drawing titled "OCP Map 2 – Development Permit Areas," Dated September 18, 2018.
4. Town of Ladysmith document titled "Waterfront Area Plan," Dated February 2018.
5. Soils of South Vancouver Island, British Columbia, Soil Survey Report No. 44, Sheet 3.
6. iMap BC Online GIS Mapping, Accessed June 2021.
7. Bieniawski, Z.T. 1976. Rock mass classification in rock engineering. In Exploration for rock engineering, proc. of the symp., Vol 1, 97-106. Cape Town: Balkema.
8. E. Hoek, E.T. Brown, 2018. "The Hoek-Brown Failure Criterion and GSI – 2018 Edition", Journal of Rock Mechanics and Geotechnical Engineering.
9. Turner, J.P. and Ramey, S.B., 2010, "Base Resistance of Drilled Shafts in Fractured Rock" Geotechnical Special Publication No. 198; The Art of Foundation Engineering Practice, ASCE, Reston, BA, March, pp. 687-701.



BOREHOLE LOG

File Number: F9198

BH21-01

Client: Checkwitch Poiron Architects

Project: Ladysmith Arts and Heritage Hub (LAHH)

Location: Ladysmith, BC

Water Level	Depth (m)	Soil Symbol	Description
	0.0		Ground Surface
	0.0-1.2m		Silty sand, some gravel, trace to some cobble, trace organics (roots, rootlets, matter), trace coal debris, loose, dark brown, damp (fill)
	1.0		
	1.2-1.65m		Sandy silt, trace to some gravel, trace construction debris (brick), firm, light grey/ brown, moist (fill)
	1.65-3.35m		Silty sand, some gravel, trace to some cobble, trace organics (roots, rootlets, matter), trace coal debris, loose, dark brown, damp (fill)
	2.0		
	3.0		
	3.35-4.55m		Sand, some silt and gravel, trace evidence of cobble, compact, medium brown/grey with rust staining, wet
	4.0		
	5.0		Fill material encountered to 3.35m Auger stem/ sample wet at 3.35m (inferred groundwater) Bedrock encountered at 4.55m End of borehole at 4.55m (effective refusal)
	6.0		
	7.0		
	8.0		

Logged By: Tennes Hamre, GIT

Date: April 7, 2021

Reviewed By: Stuart Crossfield, P.Geo., P.L.Eng. Page 1 of 1

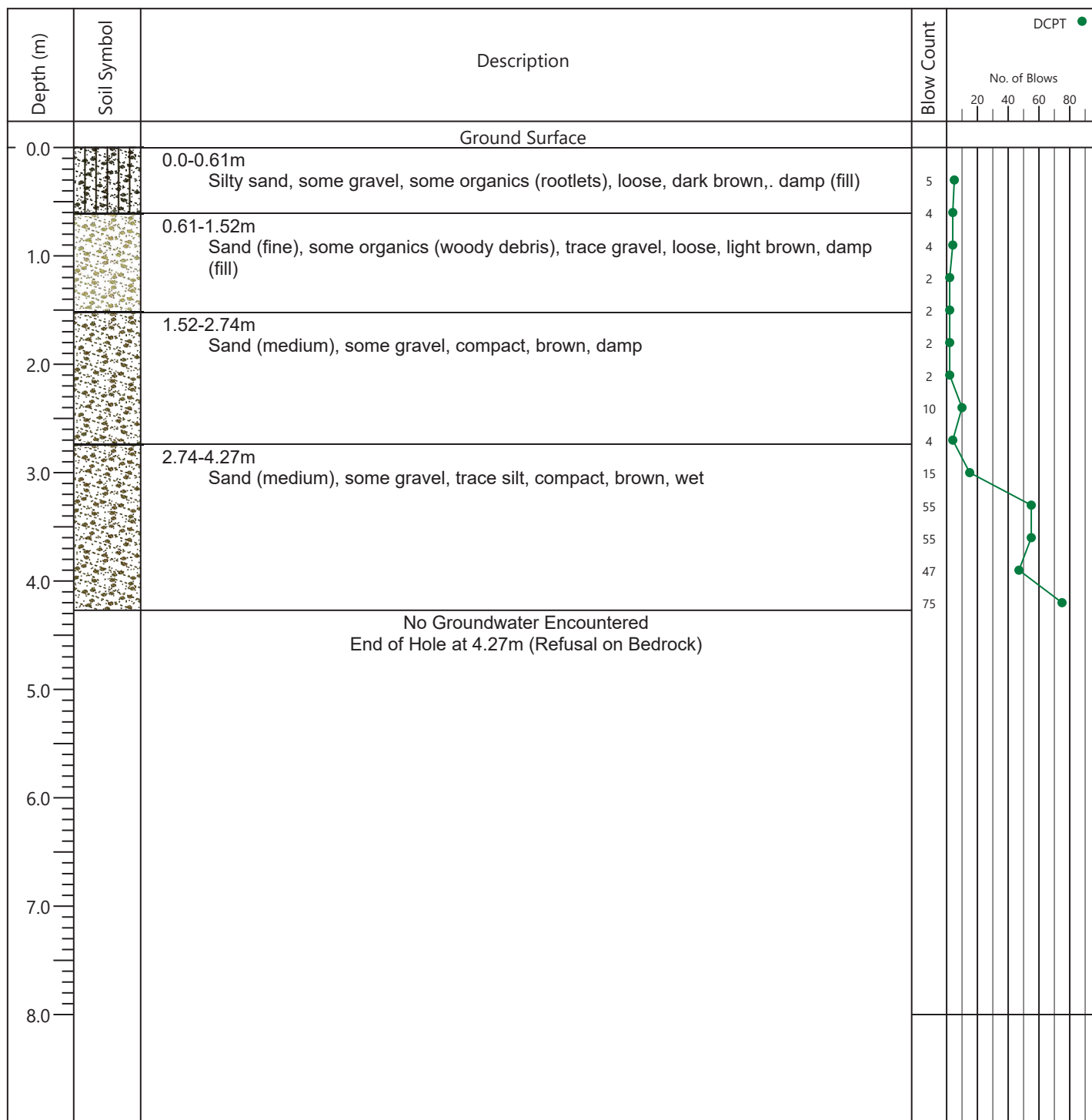
Digging Method: Solid Stem Auger

1900 Boxwood Road
Nanaimo, British Columbia, V9S 5Y2
Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

BOREHOLE LOG

File Number: F9198
Client: Checkwitch Poiron Architects
Project: Ladysmith Arts and Heritage Hub (LAHH)
Location: Ladysmith, BC

BH21-02



Logged By: Tennes Hamre, GIT
Reviewed By: Stuart Crossfield, P.Geo., P.L.Eng.
Digging Method: Solid Stem Auger

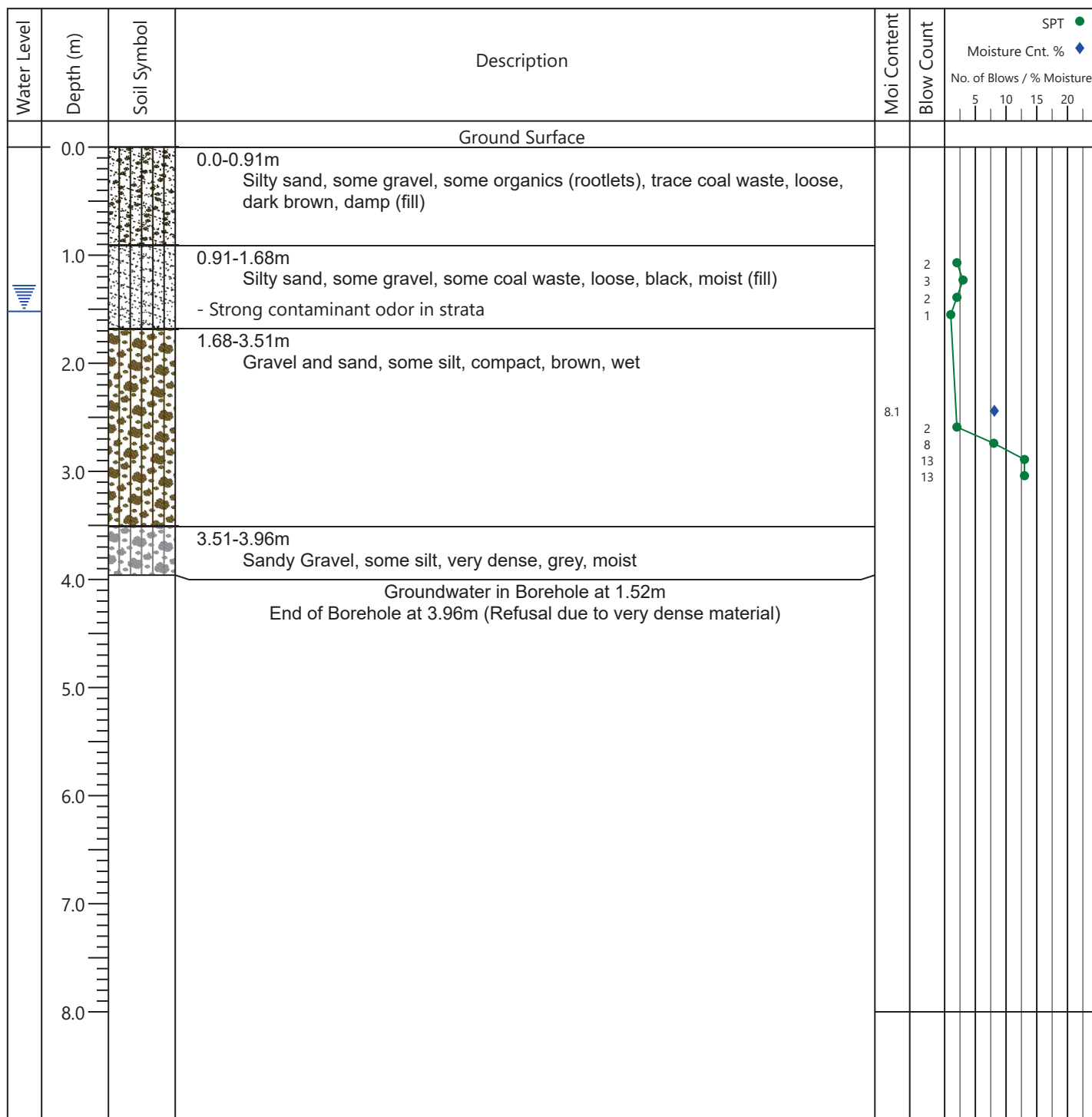
Date: April 7, 2021
Page 1 of 1

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BOREHOLE LOG

File Number: F9198
Client: Checkwitch Poiron Architects
Project: Ladysmith Arts and Heritage Hub (LAHH)
Location: Ladysmith, BC

BH21-05



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Reviewed By: Stuart Crossfield, P.Geo., P.L.Eng.
Digging Method: Solid Stem Auger

Date: April 7, 2021
Page 1 of 1

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BOREHOLE LOG

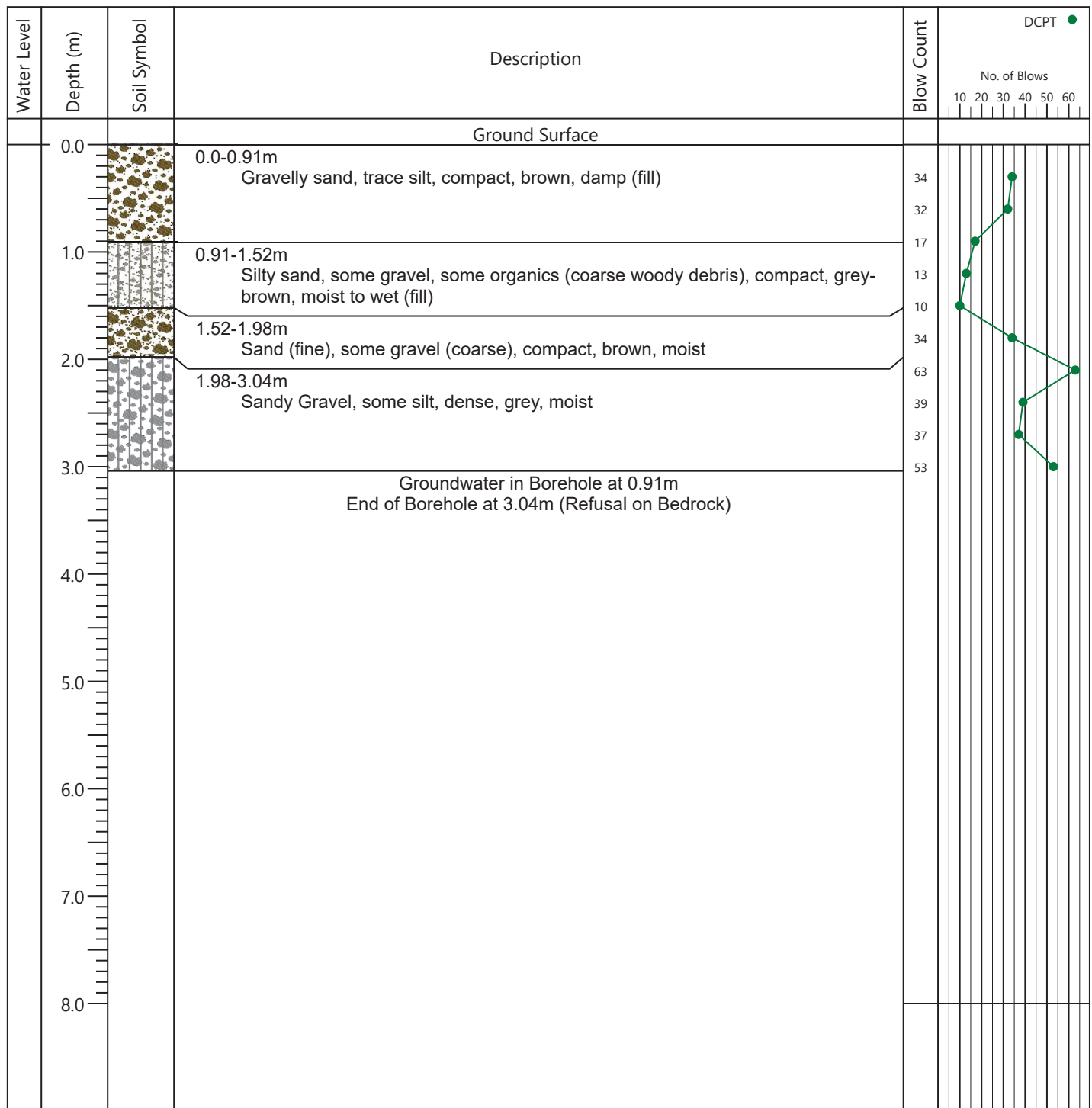
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Client: Checkwitch Poiron Architects

Project: Ladysmith Arts and Heritage Hub (LAHH)

Location: Ladysmith, BC

BH21-06



Logged By: Tennes Hamre, GIT

Date: April 7, 2021

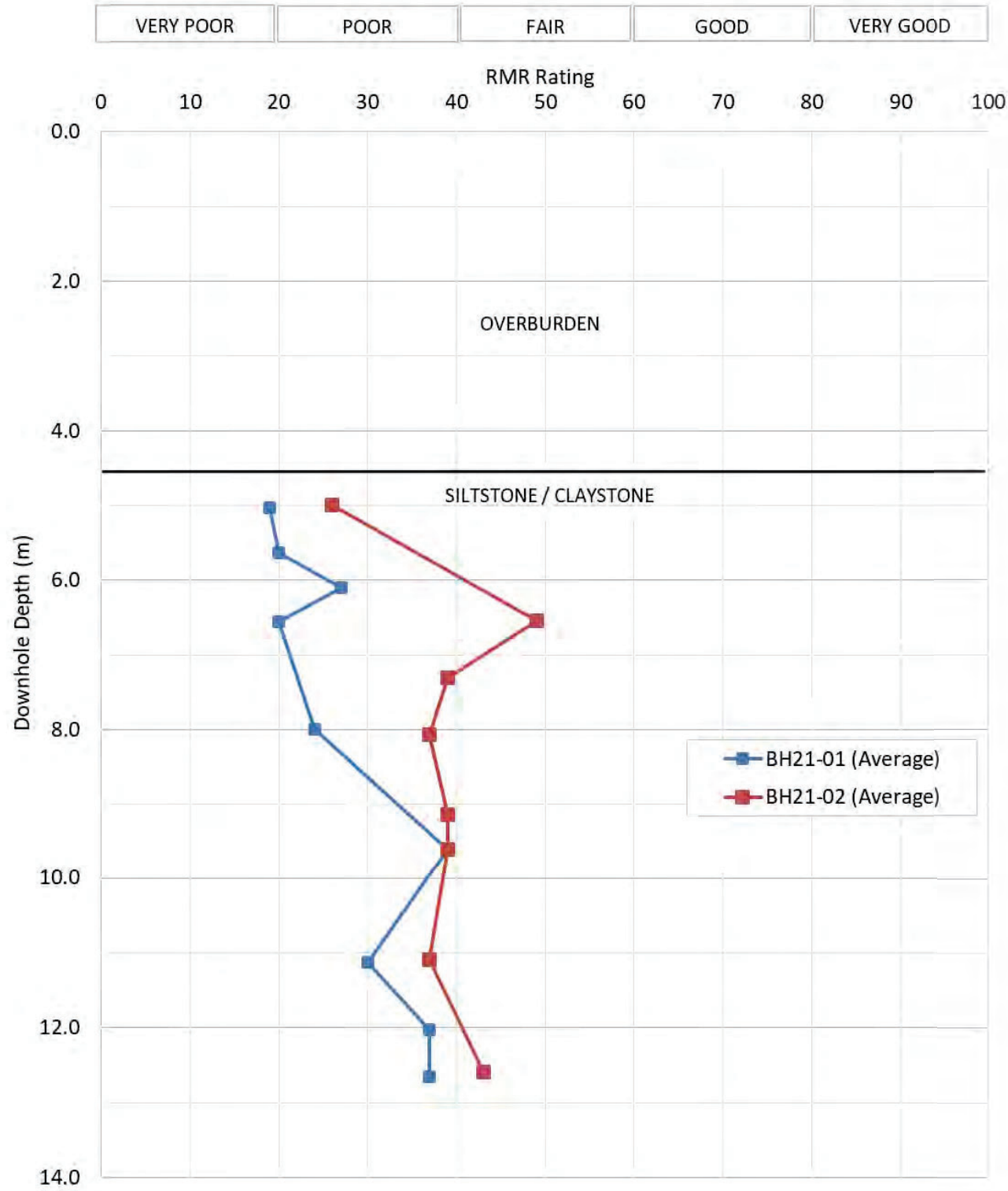
Reviewed By: Stuart Crossfield, P.Geo., P.L.Eng. Page 1 of 1

Digging Method: Solid Stem Auger

1900 Boxwood Road
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Phone: 250-756-0355
Fax: 250-756-3831
Email: geotech@lewkowich.com

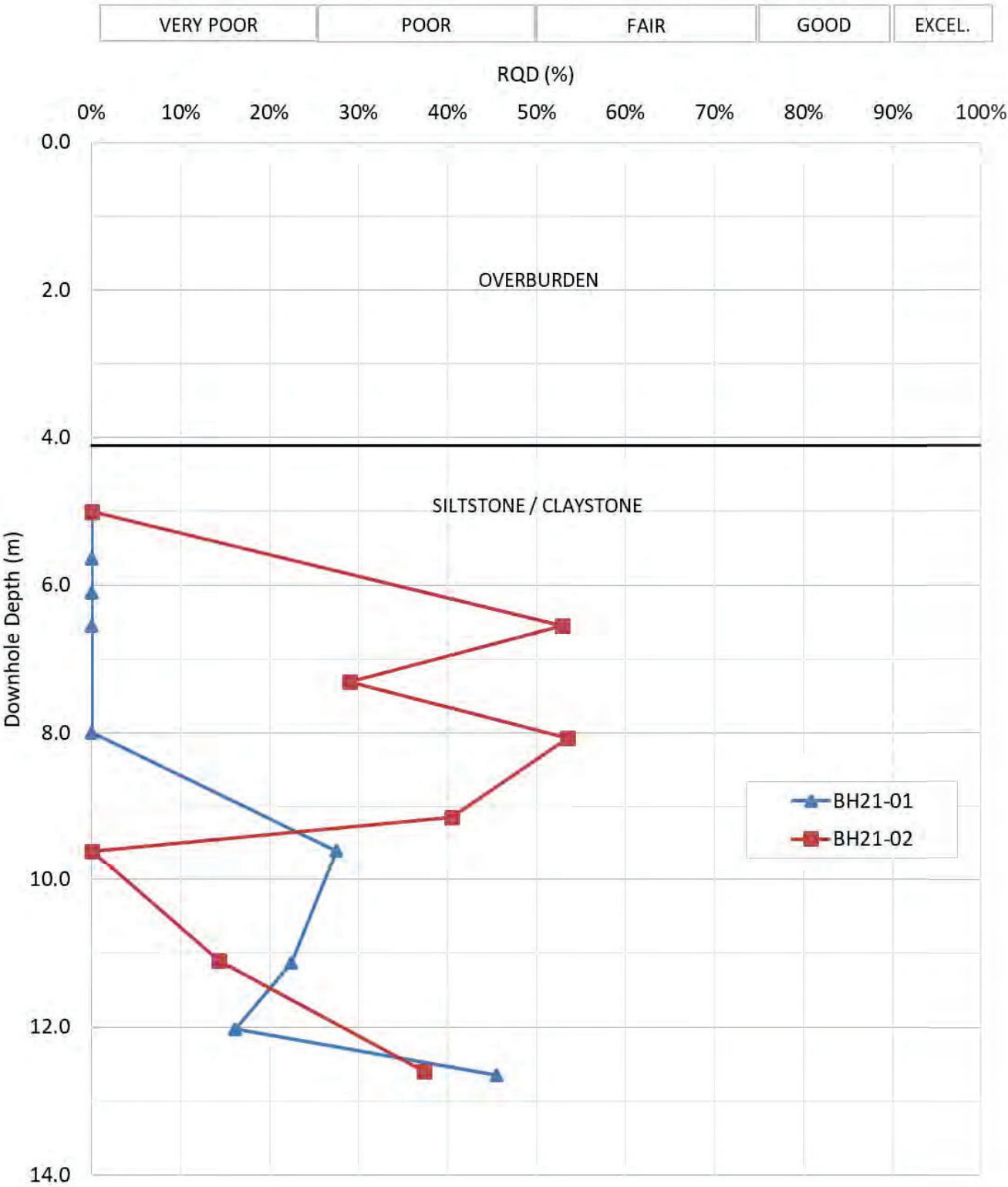


Rock Mass Rating System (RMR76) Vs. Depth





Rock Quality Designation (RQD) Vs. Depth



COMPRESSIVE STRENGTH OF ROCK CORES

Client: Checkswitch Poiron Architects

Project Name: Ladysmith Arts and Heritage Hub (LAHH)

Site Location: Ladysmith, BC

Test Location: BH21-02 from 5.1m to 5.45m

Job No: F9198

Lab No. L5195

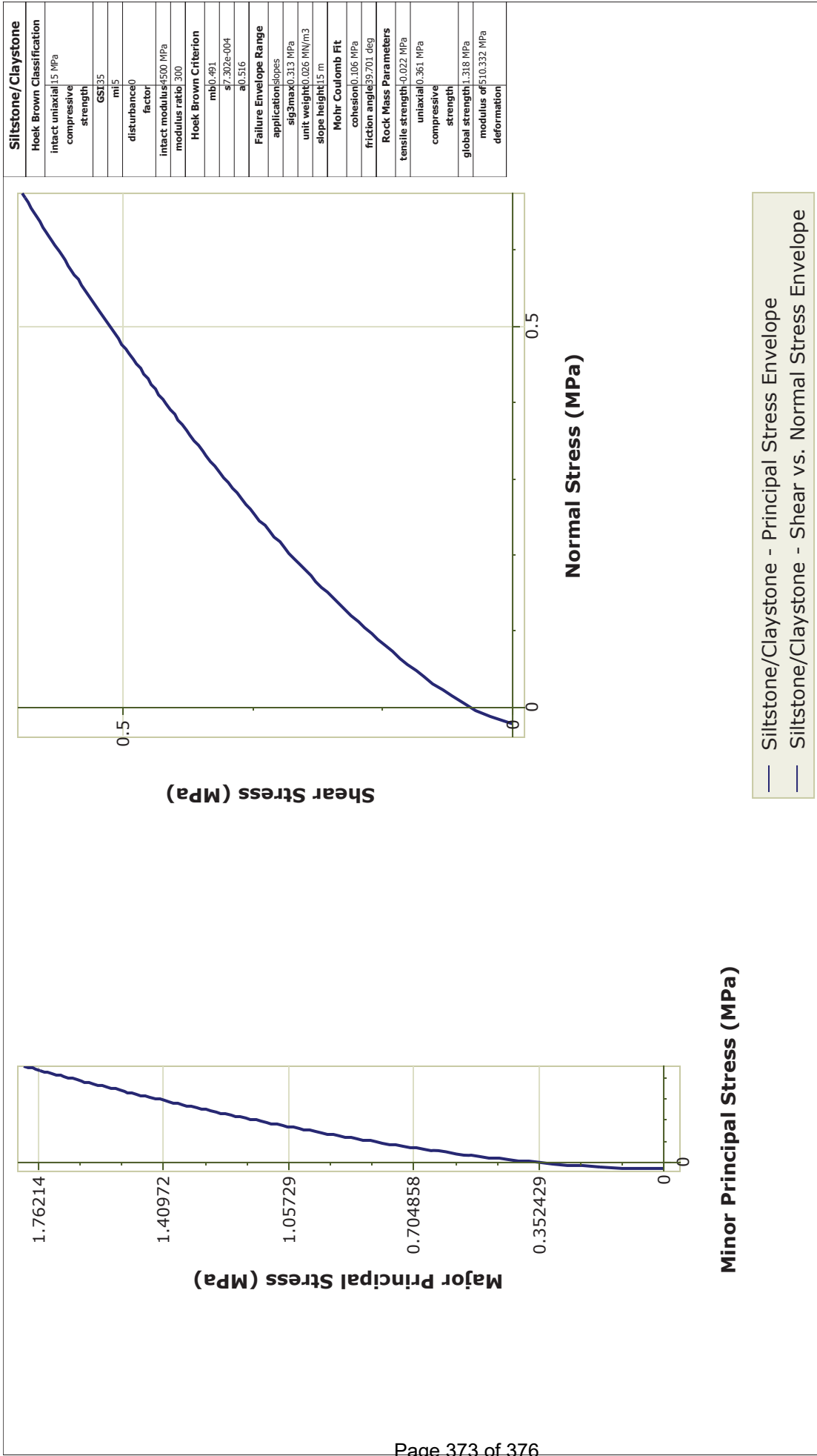
Date Cored: April 7, 2021


Date Tested: April 21, 2021

Cored By: SC

[illegible]¹ Compressive Strengths corrected for L/D ratio less than 2.0

5/2



	Project	Analysis of Rock/Soil Strength	
	Analysis Description		
	Drawn By	Company	
	Date	File Name	
ROCDATA 5.013	2021-04-29, 11:43:18 AM		RocData1.roc5

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 48.996N 123.816W

User File Reference: LAHH Artist' Studio

2021-06-24 21:40 UT

Requested by: Steve Stacey, Lewkowich Engineering Associates Ltd.

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.576	0.416	0.305	0.135
Sa (0.1)	0.883	0.640	0.467	0.206
Sa (0.2)	1.097	0.795	0.583	0.255
Sa (0.3)	1.127	0.816	0.598	0.256
Sa (0.5)	1.018	0.725	0.519	0.211
Sa (1.0)	0.585	0.396	0.272	0.101
Sa (2.0)	0.350	0.230	0.152	0.053
Sa (5.0)	0.109	0.063	0.034	0.011
Sa (10.0)	0.039	0.022	0.012	0.004
PGA (g)	0.479	0.346	0.254	0.110
PGV (m/s)	0.740	0.504	0.349	0.128

Notes: Spectral ($S_a(T)$, where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s . Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

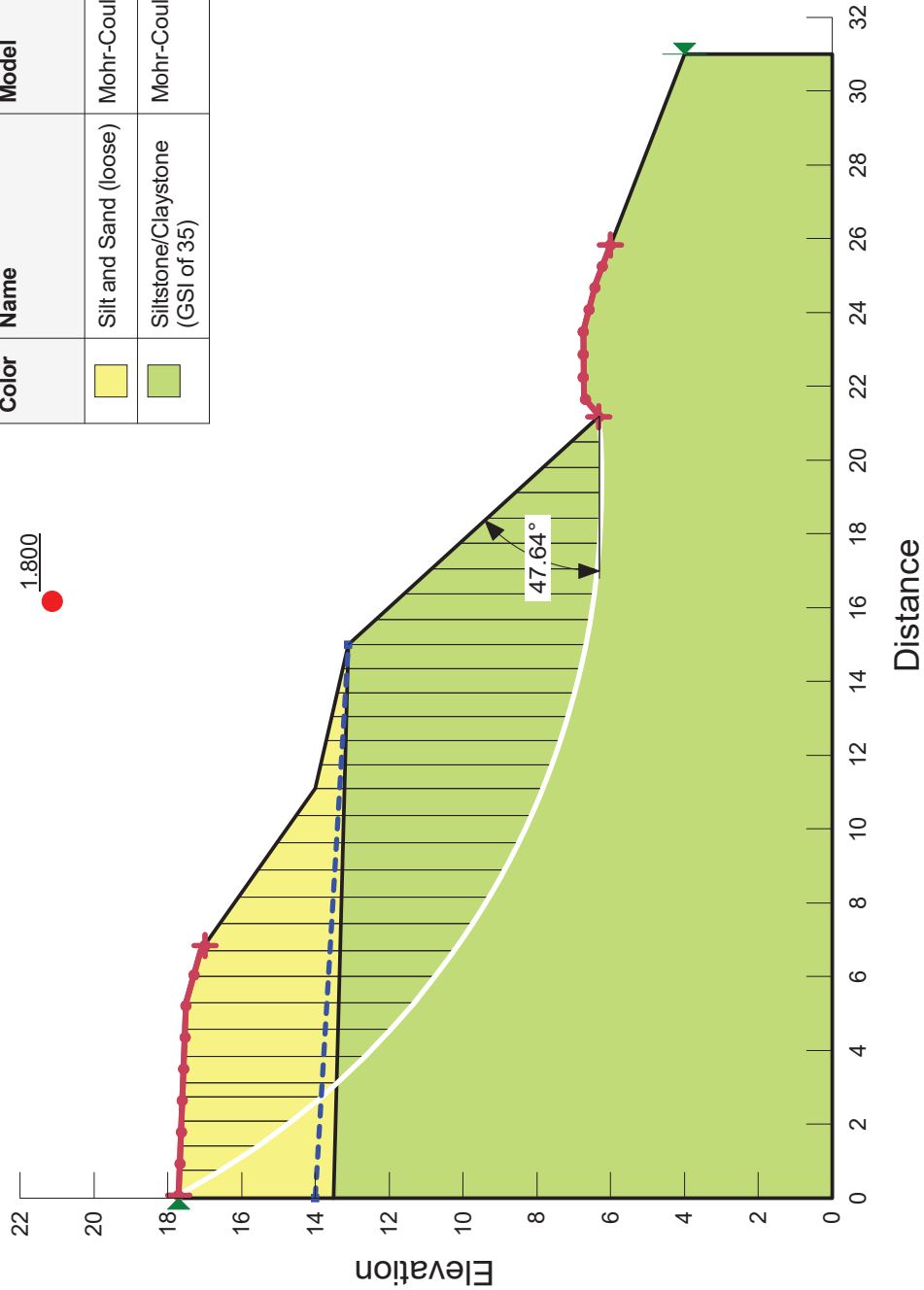


Natural Resources
Canada

Ressources naturelles
Canada



Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
<div></div>	Silt and Sand (loose)	Mohr-Coulomb	18	0	27	1
<div></div>	Siltstone/Claystone (GSI of 35)	Mohr-Coulomb	25	100	40	1



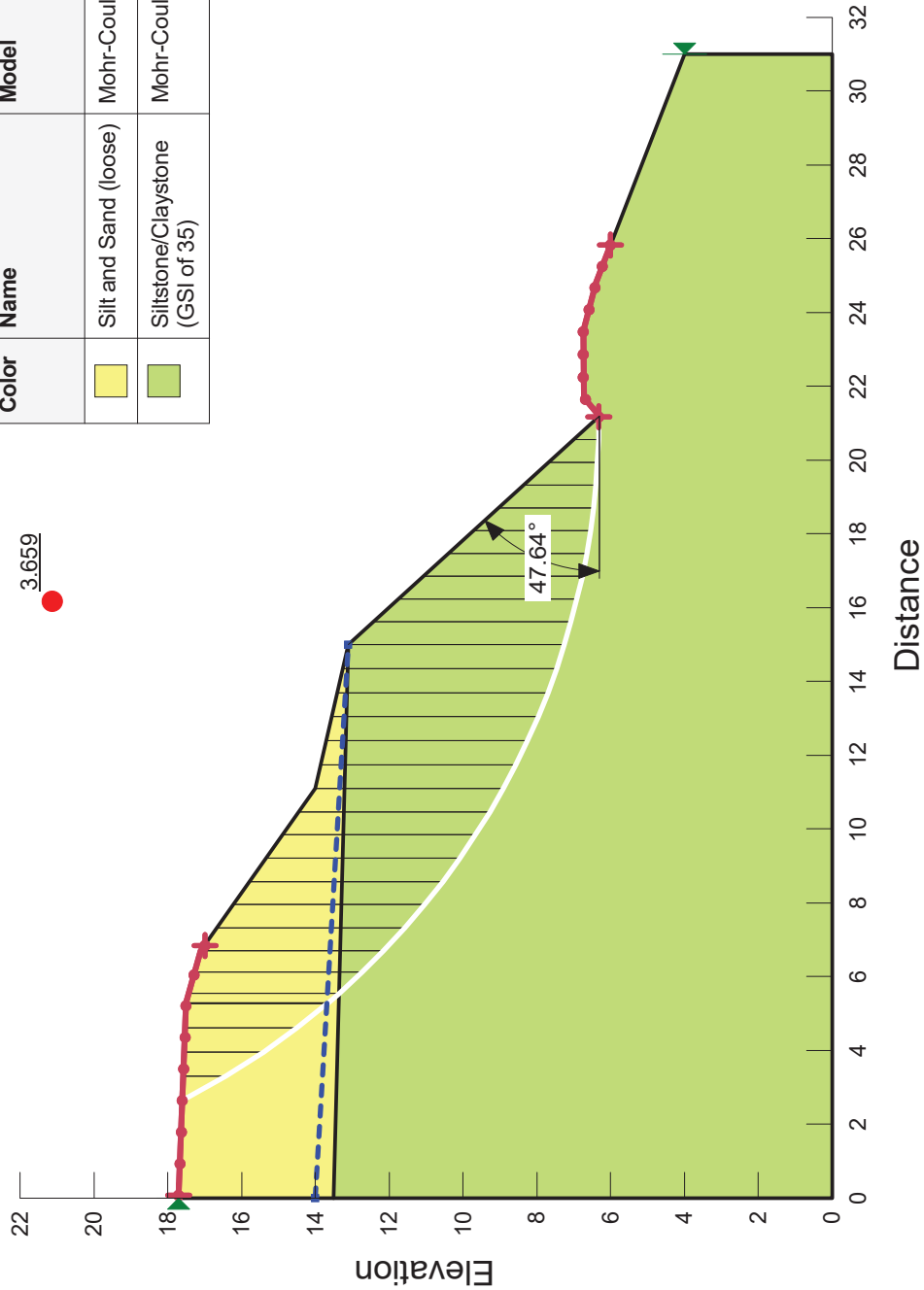
Slope Stability

F9198 - LAHH - A-A' Seismic.gsz

2021-07-15

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Color	Name	Model	Unit Weight (kN/m³)	Cohesion' (kPa)	Phi' (°)	Piezometric Line
<div></div>	Silt and Sand (loose)	Mohr-Coulomb	18	0	27	1
<div></div>	Siltstone/Claystone (GSI of 35)	Mohr-Coulomb	25	100	40	1



Slope Stability

F9198 - LAHH - A-A' Static.gsz

2021-07-15

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