

A Reality-based Cost-benefit Analysis of High Performance Residences in Victoria, BC

by

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B.Eng, University of Victoria, 2015

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## ABSTRACT

This research initiative attempts to empirically determine, with reality-based evidence from un-biased sources, the cost challenge, energy advantage, and expected pay-back period associated with building an above-code residence in Victoria, BC. In addition, this initiative created a much-needed benchmark for contractors to gain a firm understanding of the construction details required to achieve the various levels of the “Step-Code” in the newest edition of the BCBC. It was important to gain this information specific to Victoria B.C. to make an appropriate estimation of the actual “cost challenge” for building above code in the local housing market. This was accomplished through: a simulated tendering process with local contractors, an energy analysis of a case-study residence with the same floor plan, and an in-depth study into the variables governing time-to-amortization. The contractors provided quotes for an “above code” residence (ACR), and a minimum-code residence (MCR) with the same floor plan. The results were then compared to the as-built construction costs of the residence. When compared to the MCR, it was found that the ACR has a cost-challenge of approximately 22.5% (\$74,400), an energy advantage of 22.5 kWh/m<sup>2</sup>/yr, and a payback period of over 79 years when a fuel inflation rate of 2% is considered. However, many of the components in the ACR assemblies were either for aesthetic appeal (metal-roofing), or comfort (floor-cavity insulation), and therefore it was possible to reduce the cost-challenge to just 2.1% (\$7,759), while maintaining an energy advantage of 15kWh/m<sup>2</sup>/yr and step-level 3 designation. This was dubbed the hybrid-residence (HR) as it employed a combination of above-code and minimum-code construction assemblies. The HR has a pay-back period of approximately 16 years when the same inflation rate is expected in the price of fuel.

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# 1. INTRODUCTION

In the early 1970's a group of researchers from the National Research Council of Canada (NRC) and several research institutions in Saskatchewan undertook an initiative to change the way homes were designed and built in Canada [1]. The result was the "Saskatchewan Conservation House", a precursor to both the Passivehaus (developed by Dr. Wolfgang Feist in Germany) and the Canadian R2000 program (developed by NRCan). The Saskatchewan house was, at its time, the most airtight building in the world with a blower door test result of 0.5 air changes per hour (ach) at 50 Pa [1]. Although the Saskatchewan house gained attention world-wide, the design and construction principals were not adopted by the construction sector due to the step-forward it required in the accepted building codes of the time.

Designing high performance homes is not a new concept, however with issues of climate change and global warming at the forefront of collective global consciousness, these concepts are once again attracting attention in an effort to reduce GHG production and energy consumption. Research shows that focusing on reducing residential building energy consumption would be an effective means to accomplish GHG emissions targets. In the United States 40% of all energy use is for buildings, with 22% being used for residential buildings [2]. This shows that residences use more energy than commercial buildings. In fact, about 75% of global energy use in buildings is from residential sources [2]. In 2005, residential buildings were responsible for 29% of global energy consumption, and 21% of the global CO<sub>2</sub> emissions (see Figure 1 below) [2]. Surprisingly, global CO<sub>2</sub> emissions from household energy use is comparable to that of the transport industry.

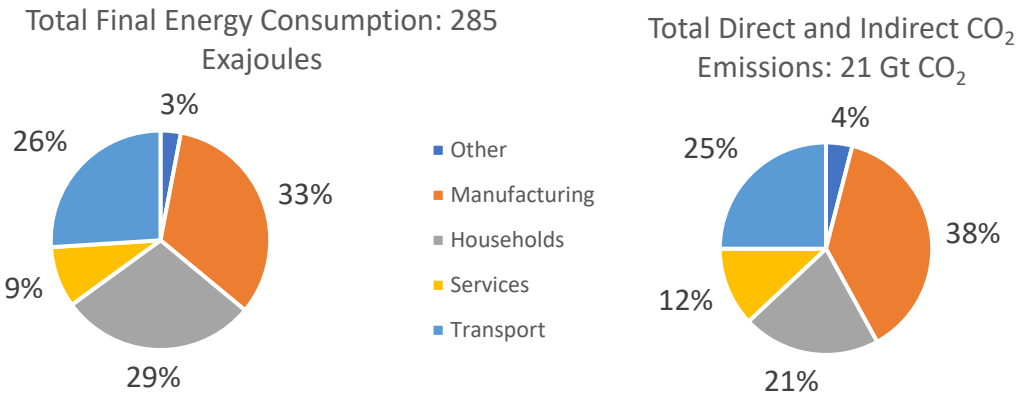


FIGURE 1 - 2005 GLOBAL ENERGY USE AND CO<sub>2</sub> EMISSIONS [2]

Attention is now being turned to the residential-construction industry, and legislation is being implemented in countries around the world in an effort to make “above-code” residential buildings easier and more economical to build. In British Columbia, the 2016 version of the BC Building Code (BCBC) incorporates “Energy Step Codes” which allow municipalities to adopt a “beyond-code” option to ensure higher building performance.

The experiences of countries currently adopting similar legislation to the “step-code” show that these codes may be difficult to implement due, in part, to resistance from mainstream home builders. An article from the “Canadian Building Energy End-Use Data and Analysis Center” at the University of Alberta stated that most mainstream builders can be deterred from building these homes because of the specialized building techniques, materials needed, and the numerous real or perceived technical and cost-related obstacles [3]. The Department of Civil and Building Engineering at Loughborough University conducted a feasibility study of zero-carbon homes from a home builders’ perspective. In their research they conducted a survey polling the top 41 home-building companies in England and asked them to comment on the most influential barriers to the implementation of high performance housing developments. The respondents stated that technical barriers are one of the main considerations [4]. Another barrier is the fact that volume home builders, or spec home builders, tend to use a set of standard construction packages in their developments to achieve an economy of scale and reduce construction defects [4]. Building scientists and building envelope designers are rarely employed in the residential housing sector as it is not mandatory and may negatively affect the bottom line of home builders. A lack of confidence in emerging green technologies was a recurring theme in the study with 76% of respondents commenting that it is a significant-to-major barrier. This study also showed that only 5% of respondents commonly use high efficiency glazing, and just 12% said they always integrate renewable energy features in their housing projects [4]. However, innovation within the supply chain was also rated as a significant *driver* by 85% of respondents, implying that home builders *will* implement energy efficient technology, provided that it is incorporated into materials they are *already* comfortable using. 88% of respondents stated that proper legislation for high performance homes would be a major driver for adoption in the industry, stating that “making [high performance] standards mandatory would be the most effective way of driving the industry to build [high performance] homes. The caveat to this is that 73% of respondents also stated that the definition of zero-carbon homes is a *significant barrier* to the implementation of high performance housing due to its ambiguity [4].

A document entitled “Energy Step Code Implementation Recommendations” produced by the Stretch Code Implementation Working Group stated that “the development industry also has some specific concerns that some local governments may implement the Step Code too quickly, beyond market acceptance and the capacity of local industry” [5]. Due to these facts, the implementation of step codes in BC may create a disparity between the level of performance that the municipalities adopting the step codes will require of homes, and the product that home builders (particularly volume home developers) are used to producing. This new legislation could pose a significant burden on the residential construction sector who will have very little time to adapt to the change in expectations.

There has been little research into the implementation of energy step-codes in British Columbia, primarily because of how recently they have been implemented. Furthermore, construction methods and details have not been provided to the home builders in regards to meeting each step level. This leaves room for costly errors to occur during construction. If a smooth transition from prescriptive Part-9 building (as found in 2012 BC codes) to more ambiguous energy step-levels is desired, the builder would benefit from a “benchmark” to determine what level of detail is needed to meet specific step-levels. There needs to be some context in regards to the construction requirements and procedures necessary to meet higher step levels. There is no such context currently available to home-builders to reference. The main unanswered questions to date are: what can be done to assist builders in their decisions of which green technologies to adopt to meet the specified step levels? Which technologies and details can be easily implemented in the field? What can be done to help the builder meet new energy performance requirements using familiar construction practices? What can be done to assist builders in creating a product that will meet step code regulations?

This study used a high-performance residence, constructed in Victoria, BC during 2015, as a case study to develop a “real-world” cost and energy comparison between an above-code home and a minimum-code home. The high-performance residence was then compared to the BC Step-code to determine which step level was achieved. The time-to-amortization was also determined for the above-code residence.

## 2. LITERATURE REVIEW

There are several alternatives to building a typical “minimum-code” part-9 residence, Passivehouse being a well-established example. There is no denying that “above-code” construction practices produce energy savings. For instance, for a residence to be a certified Passivehouse the heating energy consumption must not exceed 15 kWh/m<sup>2</sup>a, which is a major improvement over the 70 - 80 kWh/m<sup>2</sup> of a minimum-code building [5] [6]. However, this also represents a major leap above typical construction practices, requiring builders to receive specialized training in order to become a passivehouse builder. The upside to building an above-code residence (ACR) is that it reduces energy demand and saves money in the long term. The downside is that they can be more expensive to build than a minimum-code residence (MCR) and the payback period can be significant.

For clarification, Part 9 of the BC building code is the building standard used in the province of British Columbia for residential home building [7]. It represents a “bare-minimum” construction model to meet structural and energy performance targets specified in the National Building Code [8], with some variations specific to the various climate zones within the Province. The National Building Code is a “model” building code for all jurisdictions in Canada. As a model code, the National Building Code has no legal status until it is adopted by a specific jurisdiction, however, it forms the basis of all of the provincial building codes.

There have been many research initiatives to provide insights to the economic viability of above-code standards such as Passivehouse. Ray Galvin provides a “reality-based” (instead of modelled) approach to conduct a cost-benefit analysis of Passivehouses (PH) compared to conventionally built houses (CH) [6]. It showed how a number of variables affect the energy consumption advantage of a PH. It also showed that the amortisation time is *very sensitive to variations in the estimates of the building cost*, however, this study does not compare residences with identical floor-plans and does not provide an in-depth construction cost comparison of a PH and CH with identical floor plans. Instead it uses accepted construction *averages* from across the EU to give a more general view. In the authors concluding remarks he suggested that “an investor-household would have to believe a PH would out-perform a CH by about 50 kWh/m<sup>2</sup> a to think it would amortise in 25 years or less” assuming modest fuel price increases and discount rates of 5% and 8% respectively. The author states that construction costs for building a PH rather than a CH in various European countries range from 0% to 17% with a mean of 8%, however, these values are not appropriate to use for our study as they assume a *PH construction in Europe*, while the study at the forefront of this report was with respect to some arbitrary level “above-code” as achieved by a case-study high-

performance residence in the Victoria, BC housing market. That is to say that the high-performance residence studied in this research initiative was not built to the PH standard using PH approved components. In addition, PH components are more readily available in EU countries due to the close proximity to the manufacturing plants, which makes the standard more affordable in the EU.

In contrast to the important work Ray Galvin produced, Audenaert et al. compare cost-challenge, energy consumption, and amortisation periods for PH and low-energy houses (LEH) with respect to CH with the *same floor plan* [9]. For clarification, Passivehouse (PH) refers to a residence built to the “Passivehouse building standard”, where a low-energy house (LEH) is a residence designed with the goal of reducing energy consumption, but *not* specifically built to meet the metrics of the Passivehouse standard. This article summarizes that construction cost increases for PH and LEH compared to CH are 16% and 4% respectively. Using modelled energy data, they conclude that the LEH break even earlier than the PH when considering cost challenge. They determined that the economy of building high-performance buildings is very depended on the predicted cost growth rate of energy supply. However, it is unclear what the *actual* (not modeled) energy consumption of these buildings would be, and how it would affect the results of the study. This same study shows how different modelled and actual energy performance can be, which will greatly impact amortization time. In addition, the construction cost data is not representative of the Victoria, BC housing market.

A study by Osmani and O’Reilly in 2009 gathered the opinions of major house builders in the UK on the feasibility of zero carbon homes in England by 2016. They showed that re-occurring comments among interviewees was that “*nobody knows exactly how much it is going to cost to build in accordance with the [Code for Sustainable Homes]*” [4]. The Code for Sustainable Homes (CSH) is a code similar to the Step-code introduced in BC, Canada. It can be assumed that home-builders in Victoria would have similar comments regarding the step-code.

In 2015, Heffernan et al. conducted a very similar study in the UK to explore why the take-up on voluntary energy efficiency standards (similar to the Step-Code introduced in British Columbia) has been limited [10]. They site that one of the main barriers to the mass development of zero-carbon homes in the UK is still the *perceived* and real increased cost of building energy efficient. Implying that builders still have preconceived opinions on how much a high-performance residence will cost. This article concluded that while drivers for low energy homes exist, home builders still perceive the barriers to *outweigh* the drivers. The conclusion that can be made from this literature review is that there is a lack of “real-world” cost comparisons between “above-code” residences, and “conventional” residences for home-builders to rely on.

## 2.1. ENERGY STEP CODE SUMMARY

The energy step-code is a voluntary performance standard that provides an incremental approach to achieving higher energy performance in both commercial and residential buildings. Step levels are assigned to a building based on compliance to specific performance metrics: *Mechanical Energy Use Intensity, Thermal Energy Demand Intensity, Peak Thermal Load, and Air-tightness*.

For part 9 buildings there are five step-levels, with Step 5 associated with “net-zero-ready” performance. The performance is compared to a modeled minimum-code “reference building”.

### 2.1.1. REFERENCE BUILDING APPROACH

The Reference Building Approach focuses on the buildings modelled performance. This method requires a “minimum-code-reference building” to be developed to which the high-performance residence is compared.

By comparing the reference model and the above code-model, it can be shown that the designed building will exceed the energy performance of the reference building of the same geometry and orientation. It can then be stated that the building design will meet a specific step-level in the code by comparing it to each of the performance targets as outlined below [5].

### 2.1.2. MECHANICAL ENERGY USE INTENSITY

The Mechanical Energy Use Intensity (MEUI) is a metric that quantifies energy used by space heating, cooling, ventilation, and domestic hot water over one year, per square metre of useable floor area. It is given in units of kWh/m<sup>2</sup>/yr. This metric does not include plug loads, lighting, or appliances (base-loads). The MEUI is intended to encourage well-designed building envelopes to reduce energy use [5].

### 2.1.3. THERMAL ENERGY DEMAND INTENSITY

Thermal Energy Demand Intensity (TEDI) is a metric of building envelope performance measured in kWh/m<sup>2</sup>/yr. This metric shows the required energy to keep the interior at a specific design temperature. It accounts for passive gains and envelope heat losses. The TEDI is intended to encourage well-designed building envelopes and optimized thermal gains from passive sources [5].

#### 2.1.4. PEAK THERMAL LOAD

Peak Thermal Load (PTL) is a metric for the energy required to condition the air in a building on a specific design day (the hottest or coolest day of the year). It measures the amount of energy (in W) needed to keep a space at a specified design temperature, per floor area of the building ( $m^2$ ). It is meant to encourage air-tight, well insulated building envelopes that optimize the use of shading and solar-gains. It also promotes the use of high performing windows and doors [5].

#### 2.1.5. AIRTIGHTNESS

Airtightness is the metric, given in air changes per hour at 50 Pa ( $ACH_{50}$ ), for a building's resistance to air leakage through the building envelope. Airtightness can also be defined as equivalent leakage area (ELA) and normalized leakage area (NLA). ELA is defined as a hole of equivalent area in the building envelope that would produce the same leakage rate as the  $ACH_{50}$  test. The NLA is the size of the ELA divided by the area of the entire envelope. The ELA and the NLA are used to define the air leakage of smaller buildings [5].

#### 2.1.6. BUILDING PERFORMANCE TIERS

The building performance tiers are divided into five sections that progress from BCBC minimum requirements, to Net Zero ready performance. The structure for climate zone 4 is shown in the table below.

Step Level	Energy Modelling	Airtightness	Mechanical Energy Use	Envelope
<b>Step 1 Enhanced Compliance (BC Building Code Performance)</b>	Required	3.5 $ACH_{50}$	BCBC using 9.36.5. or ERS v15 ref. house (MEUI of 80 $kWh/m^2/year$ is likely, but not required)	Report on TEDI and PTL (Peak Thermal Load) (TEDI 50 $kWh/m^2/year$ is likely, but not required)
<b>Step 2 10% Beyond Code</b>	Required	3.0 $ACH_{50}$	10% better than ERS v15 ref. house OR MEUI – 60 $kWh/m^2/year$	TEDI – 45 $kWh/m^2/year$ OR PTL – 35 $W/m^2$
<b>Step 3 20% Beyond Code</b>	Required	2.5 $ACH_{50}$	20% better than ERS v15 ref. house OR MEUI – 45 $kWh/m^2/year$	TEDI – 40 $kWh/m^2/year$ OR PTL – 30 $W/m^2$
<b>Step 4 40% Beyond Code</b>	Required	1.5 $ACH_{50}$	40% better than ERS v15 ref. house OR MEUI – 35 $kWh/m^2/year$	TEDI – 25 $kWh/m^2/year$ OR PTL – 25 $W/m^2$
<b>Step 5</b>	Required	1.0 $ACH_{50}$	MEUI – 25 $kWh/m^2/year$ (no ERS option)	TEDI – 15 $kWh/m^2/year$ OR PTL – 10 $W/m^2$

FIGURE 2 - STEP CODE REQUIREMENTS [5]

### **Step 1: Enhanced Compliance**

The first step requires a pre-construction thermal model and post-construction airtightness test. Currently, the BCBC does not require a target airtightness performance level to be achieved by the builder, however it does assume that it falls within the range of 2.5 to 3.2 ACH<sub>50</sub> [5].

### **Step 2 - 4: Performance Tiers**

These steps are intended to improve the airtightness and energy performance above the BCBC minimum requirements [5].

### **Step 5: High Performance**

This tier represents the highest level of performance being achieved in BC today. This step has similar TEDI and PTL requirements to passive-house standards, however the passive house standard for airtightness is 0.6 ACH<sub>50</sub> [1] [6] [5].

## **2.2. GAPS IN KNOWLEDGE**

Although there have been many research projects into the economic feasibility of passive-homes, there has been little research into the implementation of energy step-codes in British Columbia, primarily because of how recently they have been implemented. In addition, the new step codes are not prescriptive, meaning they do not provide the home builder with methods and details to meet each step level. This leaves room for costly errors to occur during construction, particularly in the early stages of adopting new step-levels. The builder needs some sort of benchmark to determine what level of detail is required to meet specific step-levels if a smooth transition to the step-code is desired. There needs to be some context to the construction requirements and procedures needed to meet a higher step level. The main unanswered questions to date are:

- What is the actual cost-challenge of constructing a residence to meet a higher step level in Victoria, BC?
- What can be done to assist builders with the implementation high-performance construction details that can be easily implemented in the field?
- Can the builder meet new energy performance requirements using familiar construction practices?
- What are the actual energy savings associated with a higher step-level when compared to a minimum-code building?
- What is the pay-back period that can be expected from building to a higher step-level?

### 2.3. RESEARCH OBJECTIVES

The objectives at the forefront of this study were as follows:

- Empirically determine the cost challenge for building “above-code” in the Victoria, BC housing market.
- Create a calibrated energy model of the as-built “above-code” residence using actual energy data obtained from BC Hydro (electricity provider) and Fortis BC (natural gas provider).
- Create an energy model of a “reference building” of the same floor-plan and building orientation.
- Compare the modeled and actual performance for the residence.
- Determine which step-level is achieved by the as-built residence.
- Determine the “time to amortization” associated with the cost-challenge of building an above-code residence in Victoria, BC.

It is worthwhile to note that this approach can be adapted for use in any climate zone to answer these questions.

### 3. METHODOLOGY

In order to meet the objectives of this research initiative, this study saw the creation of two construction detail packages for an identical floor plan, one above-code and the other designed to minimum-code. The construction drawings were adapted from design drawings created by RJC for a high-performance residence which was constructed in 2015. This will be the case study residence for this report. Cost data was then obtained through the implementation of a simulated tendering process with two (2) reputable contractors in the Victoria area who were familiar with both Part 9 and “above-code” construction practices. This was done to create a relevant cost comparison between the high-performance residence and the conventional residence specific to the Victoria, BC housing market. Ideally, there would have been more participants willing to provide quotes, but due to the construction boom occurring in the area, contractors willing to participate were few. However, the quotes that were obtained were a close match to the actual construction costs of the residence.

Next, actual energy performance data of the high-performance residence was obtained from BC Hydro and Fortis BC and a calibrated energy model of the residence was created. After the electrical consumption and natural gas consumption of the residence were accurately predicted by the energy-model, a reference building was then reverse engineered from this calibrated model by changing the building assemblies to what would be representative of BCBC minimum standards. In order to ensure the model was predicting the consumption of a minimum-code building, it was important to ensure that environmental conditions within the building (such as temperature, and relative humidity) were kept consistent between the two models. It was also important to compare the predicted thermal resistances of the wall-assemblies to calculated values.

#### 3.1. CONSTRUCTION DOCUMENT CREATION

Two construction-detail packages were created for a residence, one package with “above-code” wall, roof, and floor assemblies, as well as high performance detailing and construction components. This residence will be referred to the “above-code-residence” (ACR). The other package used typical “minimum-code” assemblies and details, this residence will be referred to as the “minimum-code-residence” (MCR). Construction drawings were adapted from construction drawings made by RJC, the partnering organisation in this research initiative. The floor plan of the home was identical for the two residences to limit variables in construction costs associated with items such as lineal feet of interior walls. All of the plumbing fixtures, light fixtures, interior finishes, and cabinetry were held constant to limit construction variables. It was

assumed that they would be built on the same plot of land. Construction documents can be found in Appendix A.

### *3.1.1. ABOVE-CODE DESIGN DETAILS*

Design details of a high performance residential building were adapted from original construction documents provided by RJC in order to organize an above-code construction package to distribute to the chosen contractors. High-performance building envelope details were designed to reduce thermal bridging through wall studs using continuous exterior insulation. A continuous air barrier was applied to the exterior to limit air-changes. High-performance – triple-glazed windows were installed to limit losses through the glazing. Thermal mass was added to interior floors by adding a 1-1/2” concrete topping. The R-values of the assemblies were calculated to ensure that they were all above BC-building code minimums. The foundation walls were insulated with 4-1/2” of mineral-fiber insulation extending to the bottom of the footing. The standing seam metal roof was designed to incorporate 8” of continuous exterior mineral-fiber insulation over traditional roofing plywood.

The home was built using 2x4 studs at 16” on-center in order to increase the interior floor area and reduce the amount of lumber used in the exterior walls. Due to the 1-1/2” concrete topping added to the interior floors, the floor joists had to be 2-2x8 in order to take the additional load. 2x4 engineered trusses were used in the roof assembly, although 2x12 roof joists were used in the location of the cathedral ceiling.

Some of the above code details are provided below in order to provide an example of the design considerations.

### 3.1.1.1. Above-Code Base of Wall at Foundation

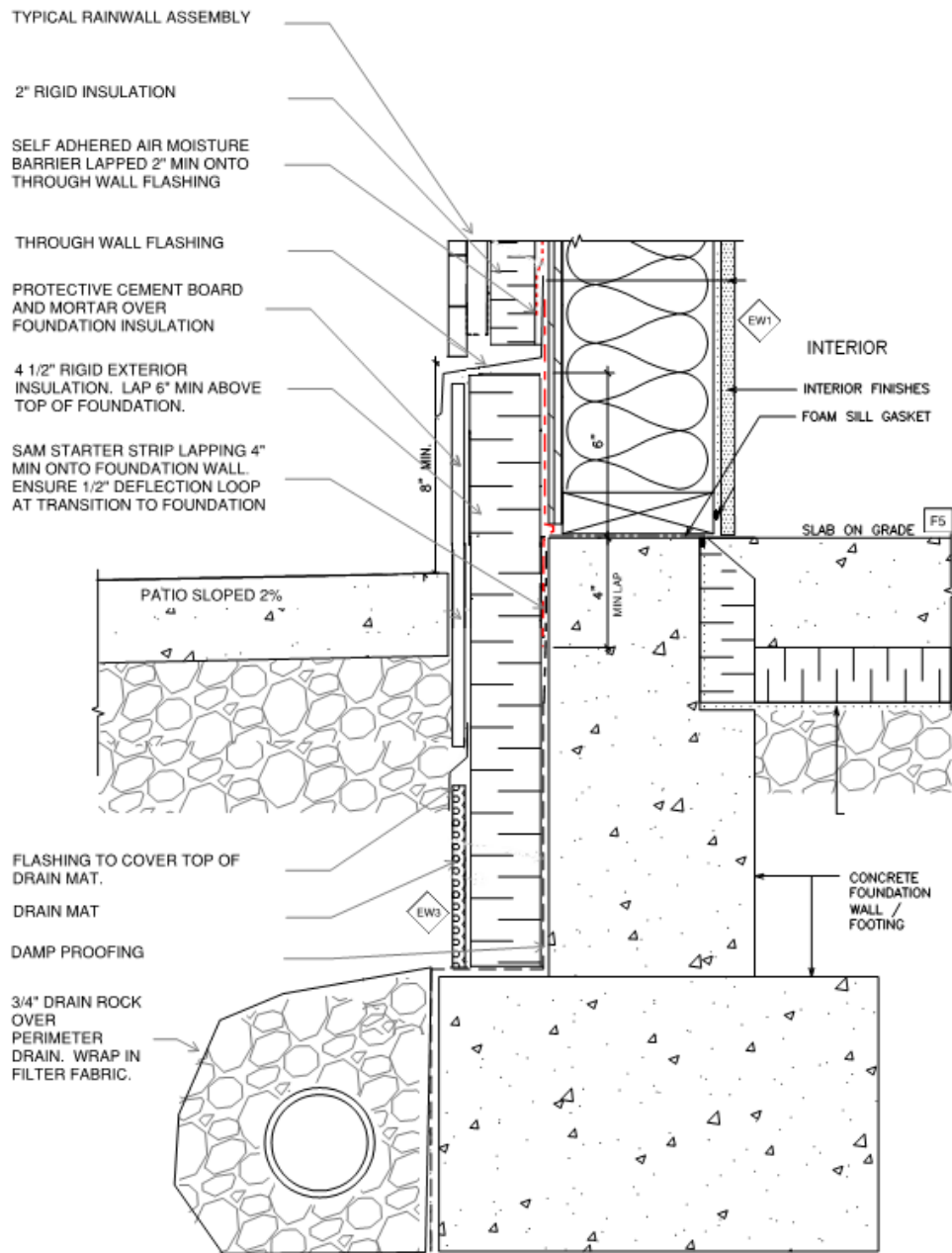


FIGURE 3 - ABOVE CODE BASE OF WALL AT FOUNDATION

### 3.1.1.2. Above-Code Exterior Wall

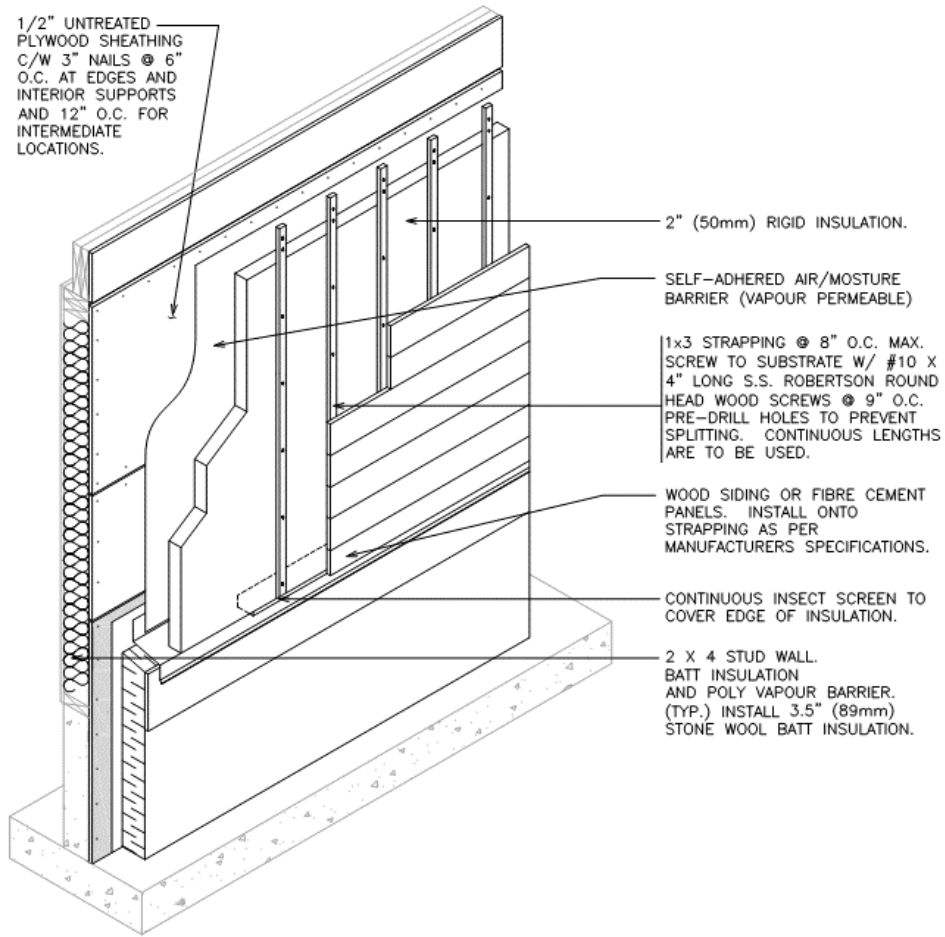


FIGURE 4 - ABOVE CODE EXTERIOR WALL [11]

This exterior wall assembly does not include a vapor barrier as the partnering company in this research initiative, RJC, determined through hygrothermal simulation (WUFI) that there is no chance of condensation within the wall for the climate of Victoria, BC. This is because the balance of the insulation is on the exterior and therefore the surfaces within the wall cavity never drop below the dew point of the air inside the residence. This is beneficial as it allows the assembly to dry to the interior and the exterior. This assembly was calculated to have a thermal resistance of R-21.6, which is 37% higher than BCBC code minimum.

### 3.1.1.3. Above-Code Roof Assembly

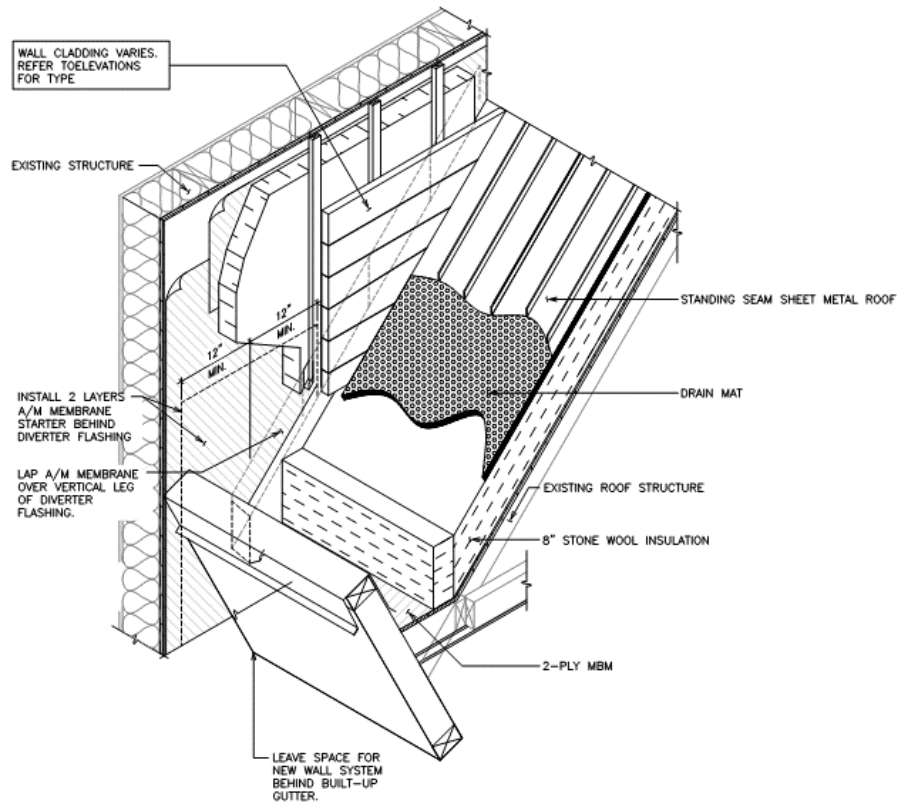


FIGURE 5 - ABOVE CODE ROOF ASSEMBLY [11]

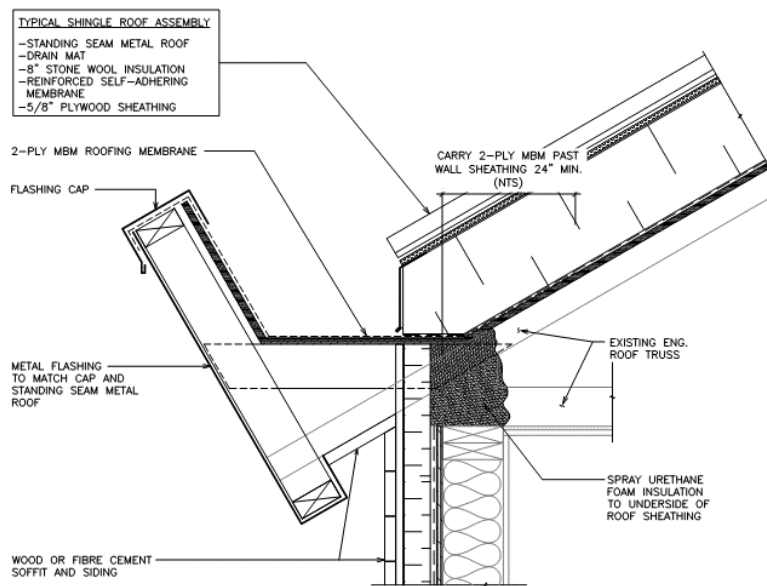


FIGURE 6 - ABOVE CODE ROOF CROSS SECTION [11]

A major consideration during the development of the roof detail was to maintain air barrier continuity at the transition from the wall to the roof. This is accomplished with closed cell spray urethane insulation between the double top-plate of the exterior walls and the underside of the roof sheathing. This effectively connects the membrane on the walls to the membrane on the exterior of the roof sheathing. The roof assembly is insulated with 8" of exterior mineral-fiber insulation and a layer of drain mat provides a drainage plane and ventilation path. The entire assembly is fastened to the roof trusses with 12" long screws with rubber gaskets to seal penetrations.

### *3.1.2. MINIMUM-CODE DESIGN DETAILS*

The design details for the given floor plan were then re-designed as if the home were being built to minimum requirements of Part-9 of the BC-building code. The R-values of the assemblies were calculated to ensure compliance to BC-building code minimums.

In this case, the walls were framed with 2x6 SPF #2 wood studs, and the floor joists are 2x10 SPF #2 as is typical in part-9 construction.

As with the above-code design, some of the part-9 details are provided and described below in order to provide an example of the design considerations. The full detail set for this residence can be found appended to this report.

### 3.1.2.1. MCR Base of Wall at Foundation

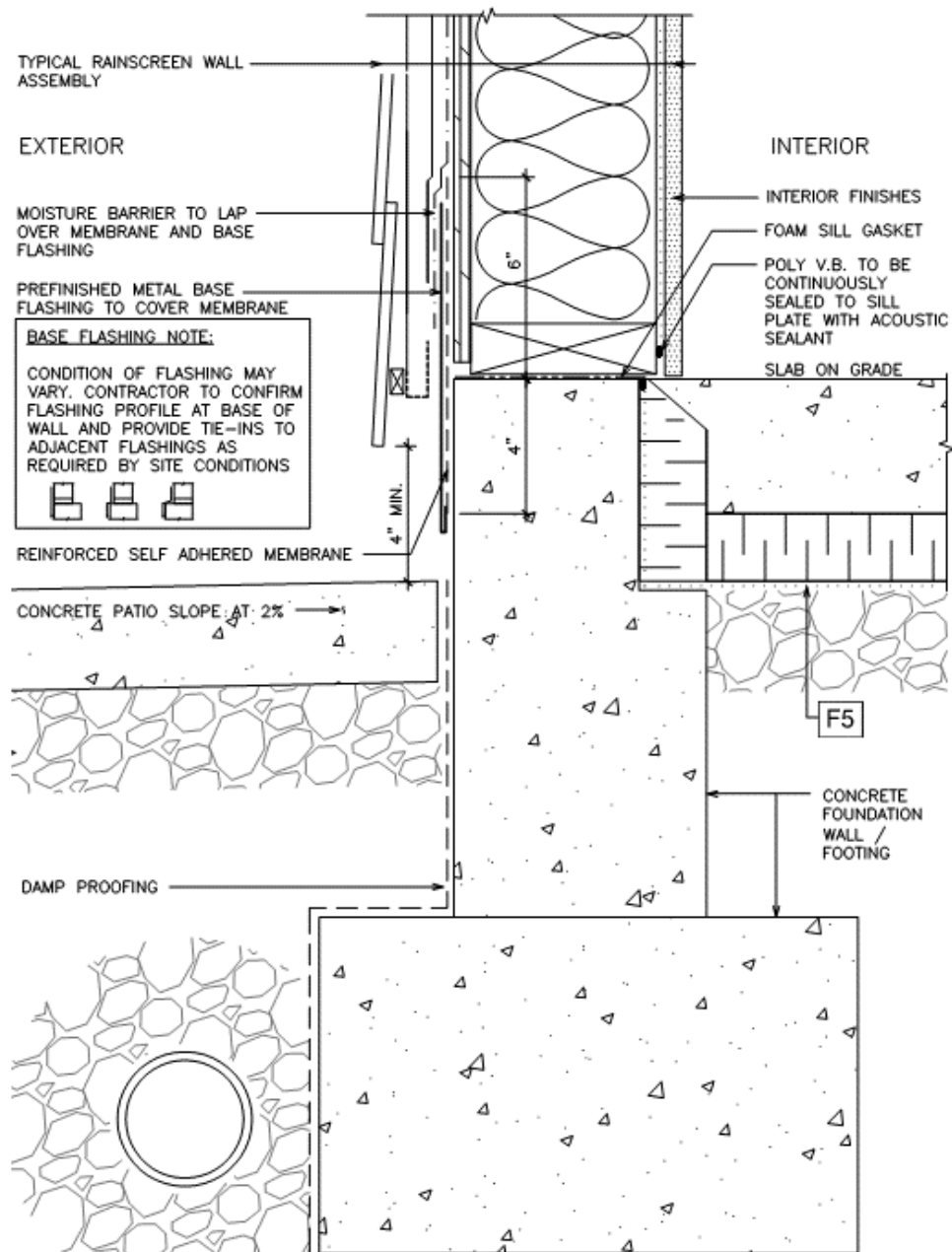


FIGURE 7 – MCR BASE OF WALL AT FOUNDATION

### 3.1.2.2. MCR Exterior Wall

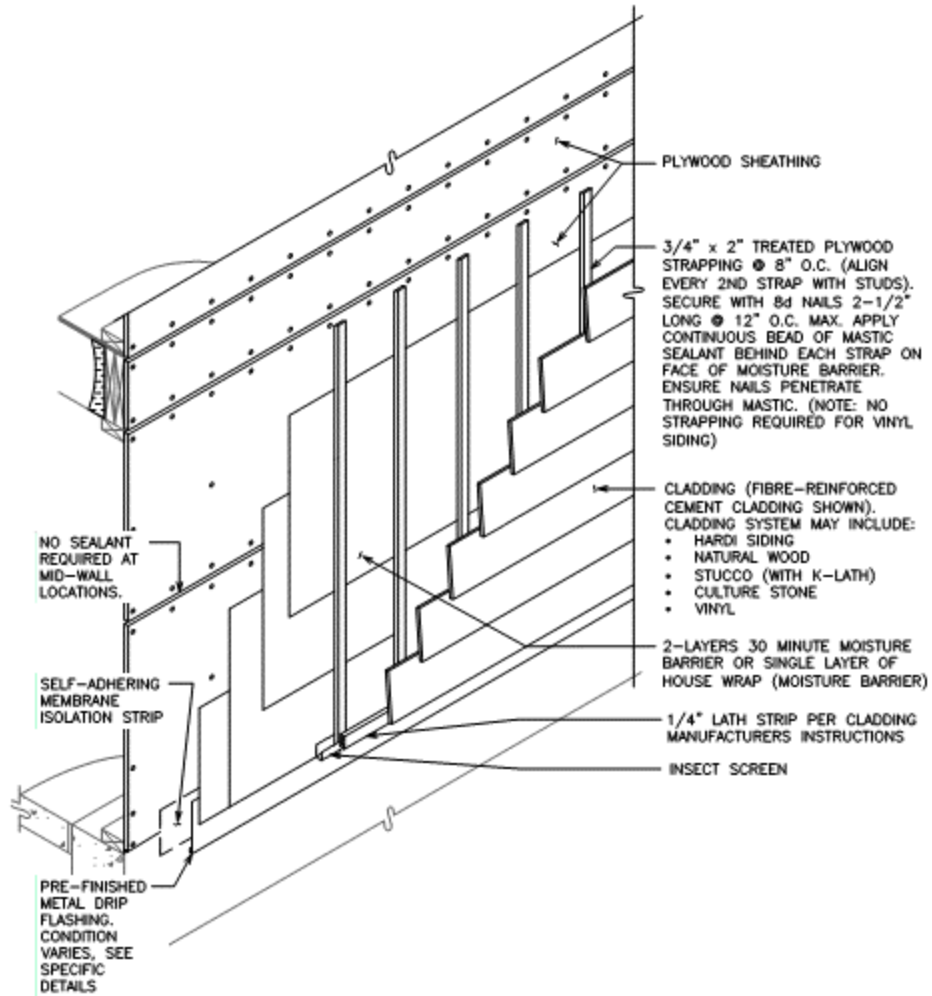


FIGURE 8 - MCR EXTERIOR WALL [11]

### 3.1.2.3. MCR Insulated Basement Wall

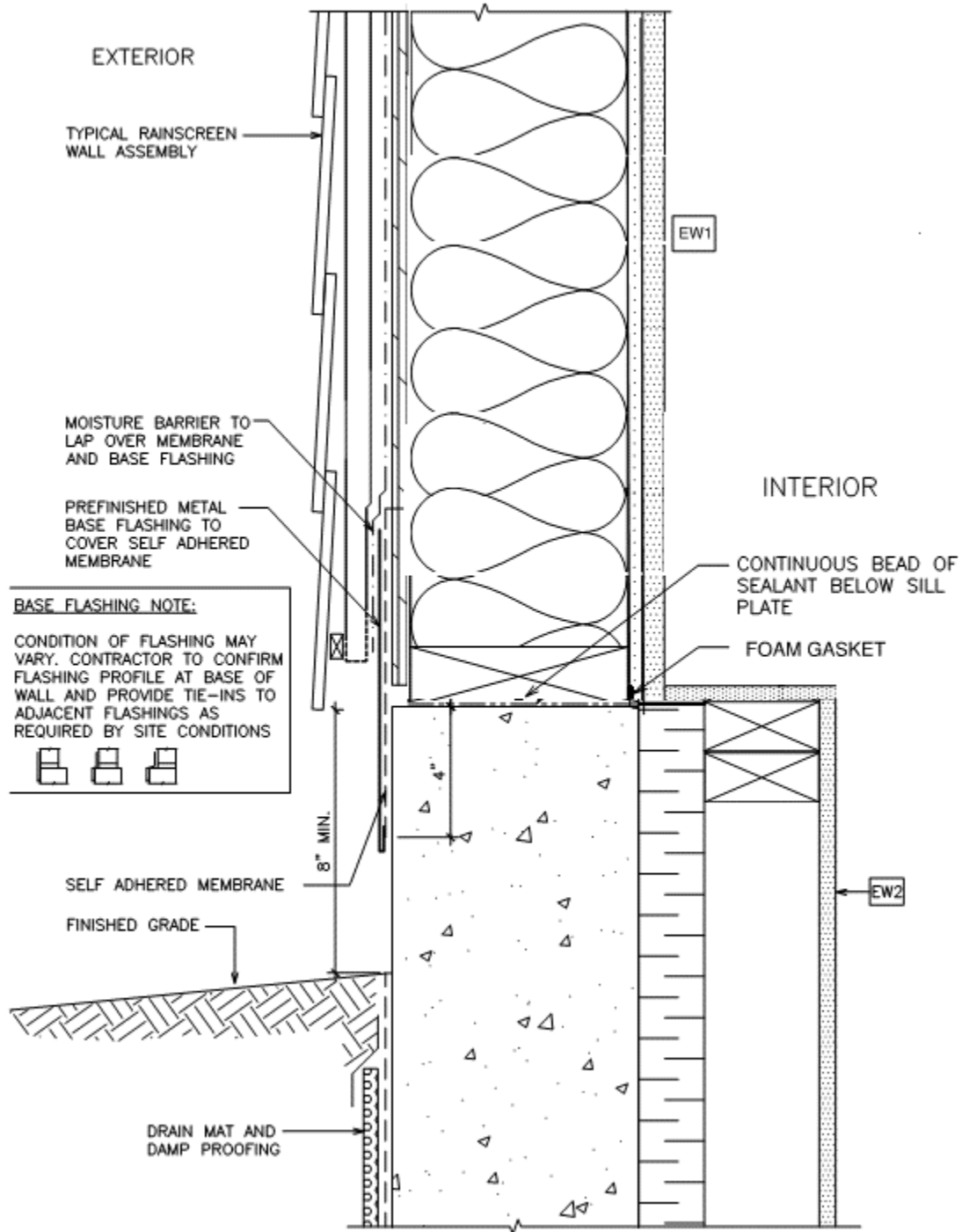


FIGURE 9 - MCR INSULATED BASEMENT WALL

### 3.1.2.4. MCR Cathedral Roof Assembly

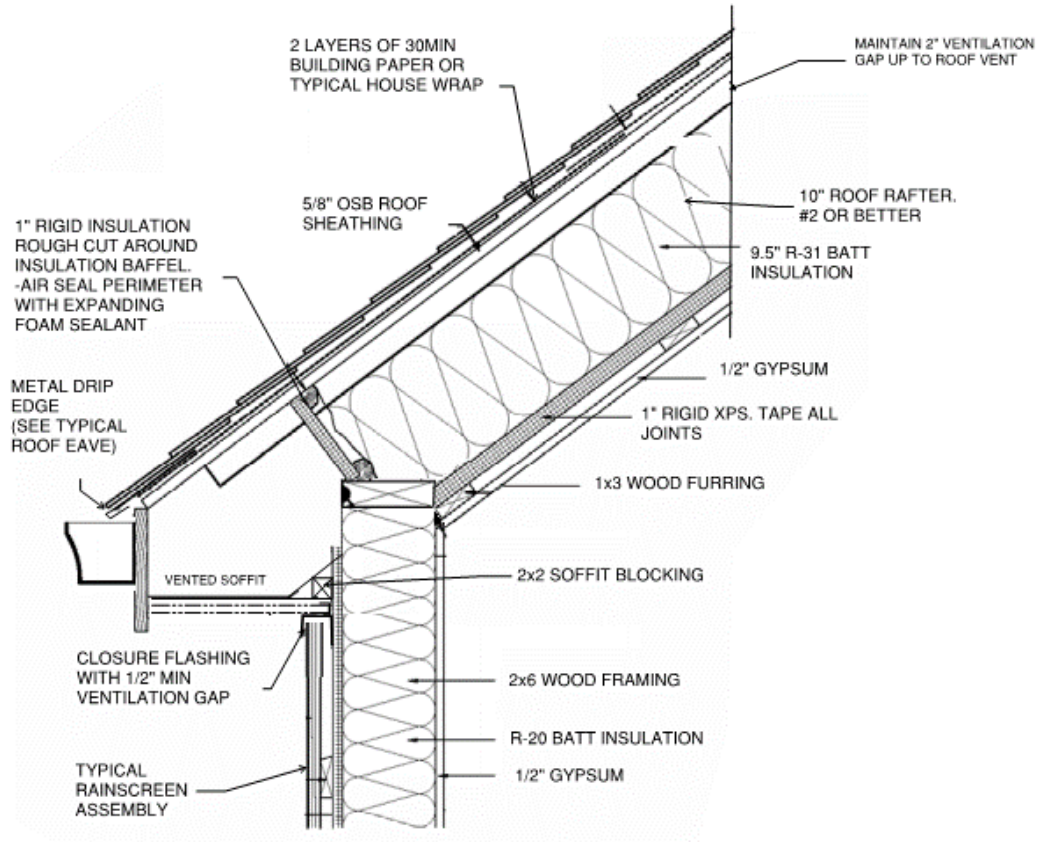


FIGURE 10 - MCR CATHEDRAL ROOF

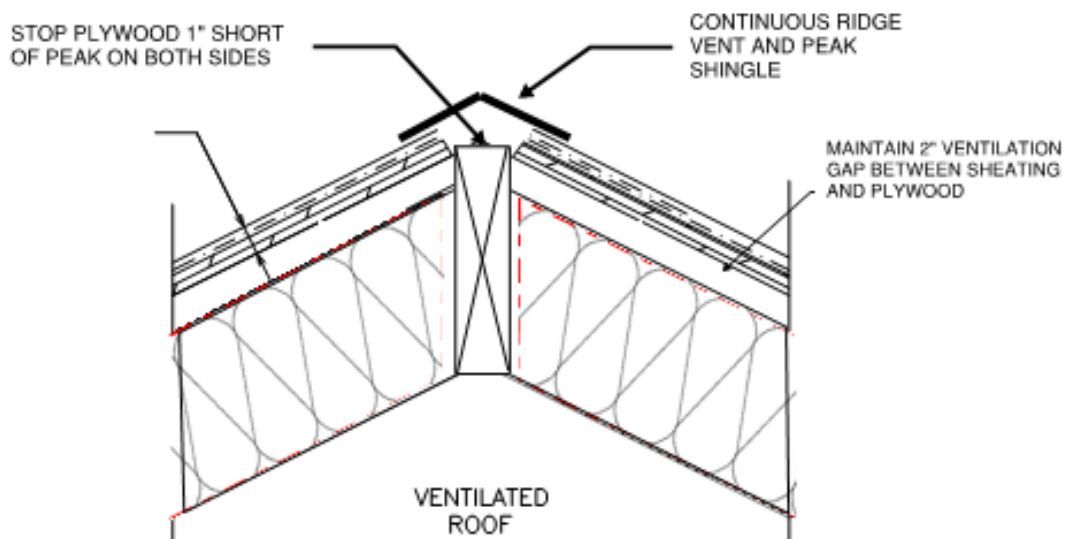


FIGURE 11 - MCR ROOF VENT DETAIL

### 3.1.2.5. MCR Trussed Roof Assembly

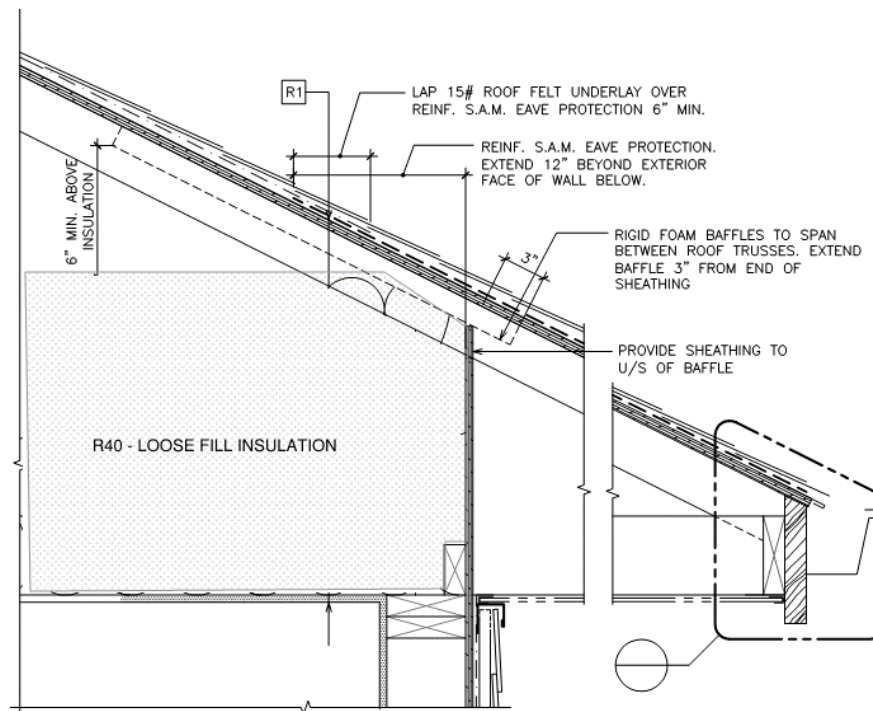


FIGURE 12 - MCR TRUSSED ROOF [11]

## 3.2. SIMULATED TENDERING PROCESS METHODOLOGY

A simulated tendering process was undertaken with two (2) reputable contractors in the area. These contractors were all familiar with both code and above-code construction. The same information was provided to all contractors, namely:

- Above-code design detail package:
  - Foundation plan, floor plan, design details, general framing details, etc....
  - Assembly specifications.
  - List of “pull out costs” (items that do not change from AC to P-9).
- Minimum-code detail package:
  - Foundation plan, floor plan, design details, general framing details, etc....
  - Assembly specifications.
  - List of “pull out costs” (items that do not change from ACR to MCR) .

From this information, each contractor provided a cost estimate for the construction of both designs and the results were compared and averaged.

### 3.3. ENERGY MODELING METHODOLOGY

Energy simulation is an important tool used when designing and building a high-performance residence. A well-prepared energy model takes the variables such as environmental conditions of the building site, building orientation, construction materials, thermal bridging, etc... and generates an estimate of the energy consumption of the structure. The software tools are vital in the effort to reduce the energy costs of buildings. In order to meet the requirements of the BC Energy Step code, it is necessary to perform a “whole-building” energy model of the proposed design prior to construction in order to demonstrate to local governing bodies that the building is capable of meeting or exceeding the energy performance requirements of the adopted step-level.

There are many energy simulation tools available to designers, all with advantages and challenges. EnergyPlus was chosen for this research initiative due to the authors previous experience with the software. EnergyPlus is one of the most widely known energy simulation software tools. It is the DOE’s (Department of Energy) open-source, whole-building energy simulation engine. EnergyPlus can be difficult to use, however, it is very powerful. It does not have a visual user interface that allows users to conceptualize the building. When paired with a graphical user interface (GUI) such as OpenStudio, it becomes much easier to use [12].

Based on the research mentioned above comparing several energy modelling software programs, it was decided that the energy models in this research project would be created using EnergyPlus in combination with the OpenStudio GUI.

### 3.3.1. CALIBRATED ENERGY MODEL GENERATION

#### Building Geometry and Orientation

Using the design drawings for the above-code residence, the building geometry was created using “Google Sketch-up”. Google Sketch-up has an OpenStudio plug-in that allows sketch-up building geometry to be used by EnergyPlus.

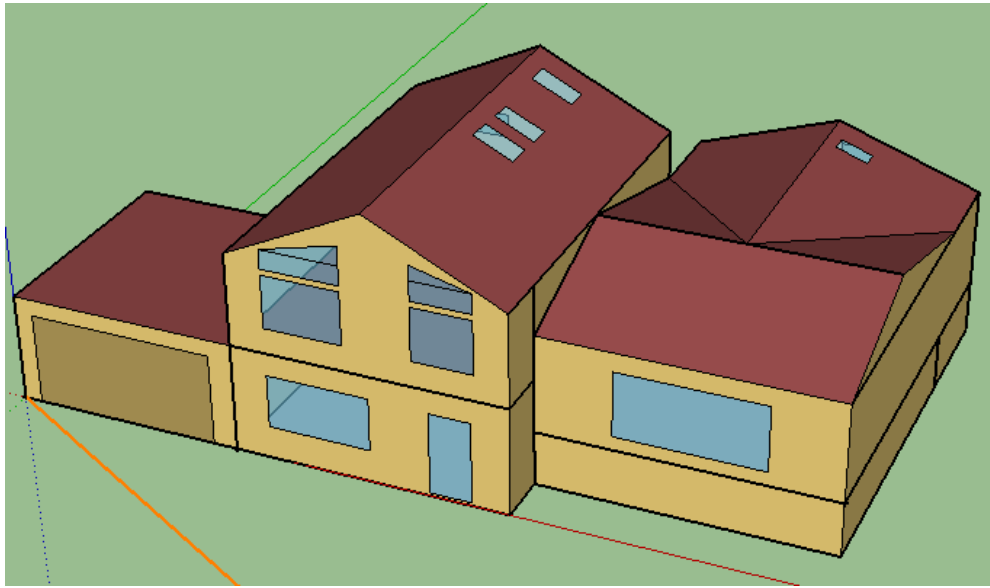


FIGURE 13 - RESIDENCE GEOMETRY

#### Construction Sets

Using published values for the material specifications from the “assembly-descriptions” within the design drawings, “constructions” were modeled in OpenStudio for each of the sub-assemblies within the residence. “Constructions” are a build-up of materials specifications within OpenStudio that are then applied to the various surfaces of the Google Sketch-up generated geometric model. For example, the assembly for “Exterior Wall 1” (EW1) is shown in Figure 14, below. The thermal resistance of the components are listed in the right-hand column in both RSI [ $\text{K}^2/\text{W}$ ], and R-value [ $\text{ft}^2 \cdot \text{F} \cdot \text{h}/\text{Btu}$ ].

EW1	EXTERIOR WALL - 2X4	RSI	R
1	FINISH TO OWNERS SPECIFICATION	0.00	0.00
2	1/2" GYPSUM WALL BOARD	0.08	0.45
3	2X4 STUDS	0.00	0.00
4	3.5" ROXUL COMFORTBATT INSULATION	1.93	10.9
5	1/2" PLYWOOD SHEATHING	0.11	0.62
6	SOPRASEAL STICK V.P. A/M BARRIER	0.00	0.00
7	2" ROXUL COMFORTBATT IS	1.41	8.01
8	1/2" RAINSCREEN/CAPILLARY BREAK	0.17	0.97
9	WOOD SIDING OR FIBRE CEMENT CLADDING	0.10	0.57
EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY		3.80	21.6

FIGURE 14 - ASSEMBLY DESCRIPTION FOR EXTERIOR WALL 1

The materials listed above were created within the software using material properties (specific heat capacity, thermal conductivity, density, etc.) and thicknesses and incorporated into a “construction: for EW1. **Note, only the materials that effect thermal performance were included in this construction.**

### ACR R-Value Comparisons

BC building code has minimum-values for construction assembly R-values, therefore the theoretical R-values of the building envelope were calculated using the “series-sum method” to ensure that they meet BCBC code minimum standards. The “series sum method” states that the thermal resistance of an assembly is the sum of all the thermal resistance in a heat-flow path [13]. For the section of the wall that is non-homogeneous (the insulated wall-study-cavity) an equivalent resistance  $R_{eq}$  was calculated using the “parallel-flow method” where  $R_{eq} = \frac{1}{R_{stud}} + \frac{1}{R_{stud}}$  and R is defined as described below.

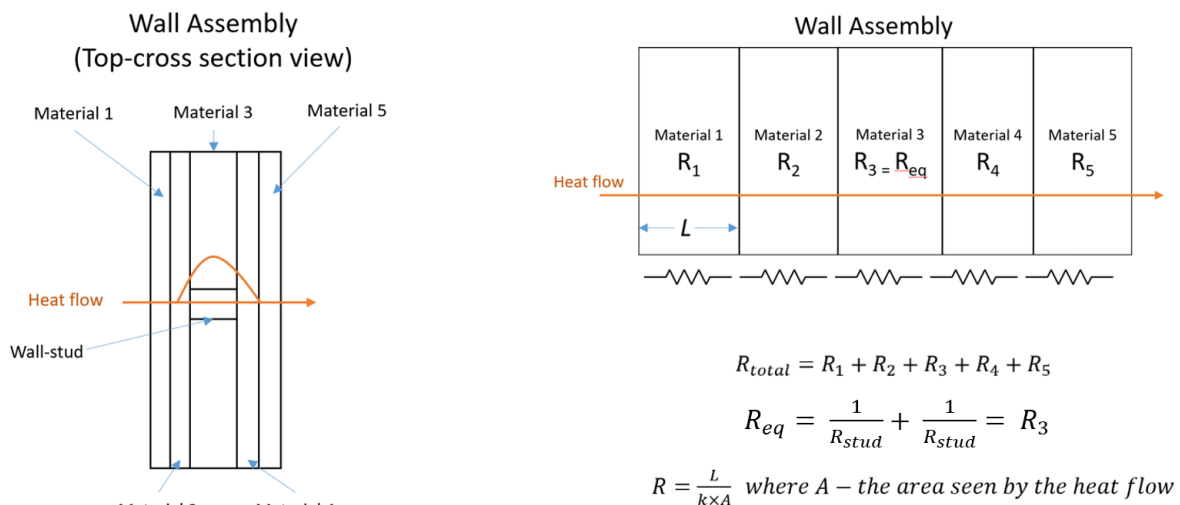


FIGURE 15 - RESISTIVE CIRCUIT THEORY – SERIES SUM AND PARALLEL FLOW METHODS [13]

The modeled thermal-resistance for the assemblies were then compared to the calculated values in the design drawings to ensure the model was representative of real-world parameters. The largest percent difference in modeled vs calculated R-value was found to be 2.75%, which is acceptable for the purposes of this study. The comparisons are shown in Table 1.

TABLE 1 – ABOVE-CODE THERMAL RESISTANCE COMPARISON

Assembly	RSI - Modelled	RSI - Calculated	% Diff
EW1	3.82	3.8	-0.52
EW2	3.63	3.73	2.75
R1	6.44	6.32	-1.86
R2	5.85	5.84	-0.17

\*Note: Window U-values were specified within OpenStudio

### Load Definitions

For single family residential buildings, typical equipment load definitions for interior electrical equipment and lighting were both found to be 5 W/m<sup>2</sup> [14].

### Schedule Sets

Schedule sets create “operation schedules” for a number of parameters in the energy model such as: building occupancy, occupant activity level, house-equipment use, interior light use, hot-water use, and heating set point. The schedule sets can be thought of an outline of user behavior within the residence. Schedules were created for both summer and winter occupant and equipment behaviors. The schedule sets are often created using a *fractional schedule*, meaning a *percentage-use* is on the vertical axis, and *time-of-day* is on the horizontal axis.

### House Electrical Equipment

The “house equipment” schedule, which determines the use of electrical equipment within the house, was defined during the winter using a fractional schedule as follows:

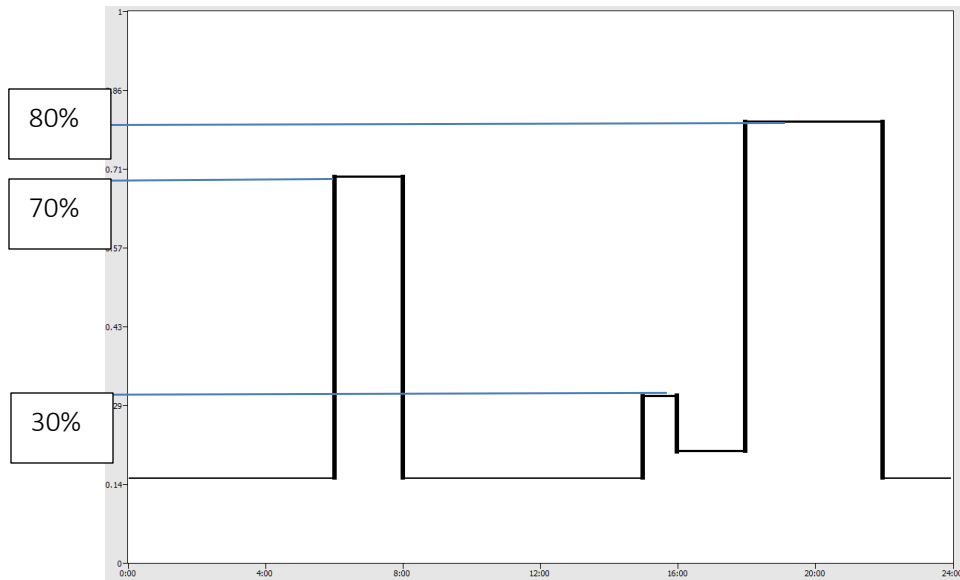
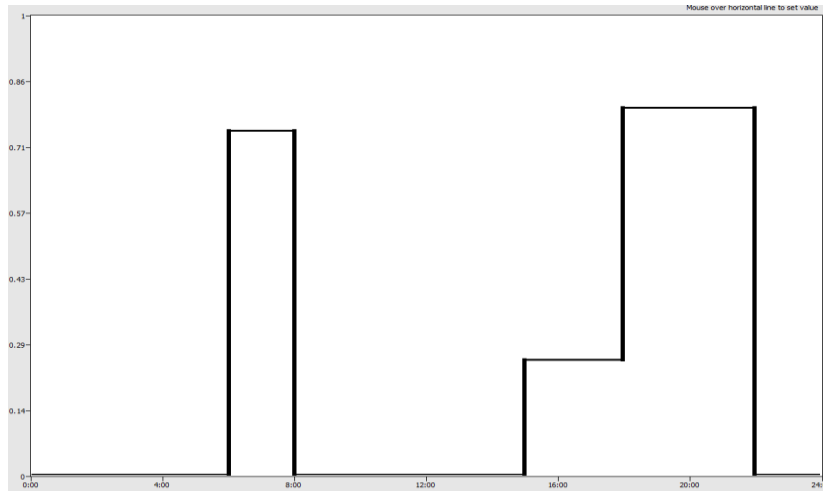


FIGURE 16 - WINTER HOUSE EQUIPMENT SCHEDULE

A spike to 70% of maximum electrical consumption between the hours of 6:00 am – 8:00 am was assumed as occupants get ready for the day, followed by an additional major spike between 6:00pm and 10:00pm as occupants come home, cook dinner, watch TV, and use other equipment around the house. In the summer, it was assumed that the electrical consumption between 6:00pm and 10:00pm would be reduced significantly as the occupants spend more time outside enjoying the warm weather, and are less likely to cook or dry clothing indoors.

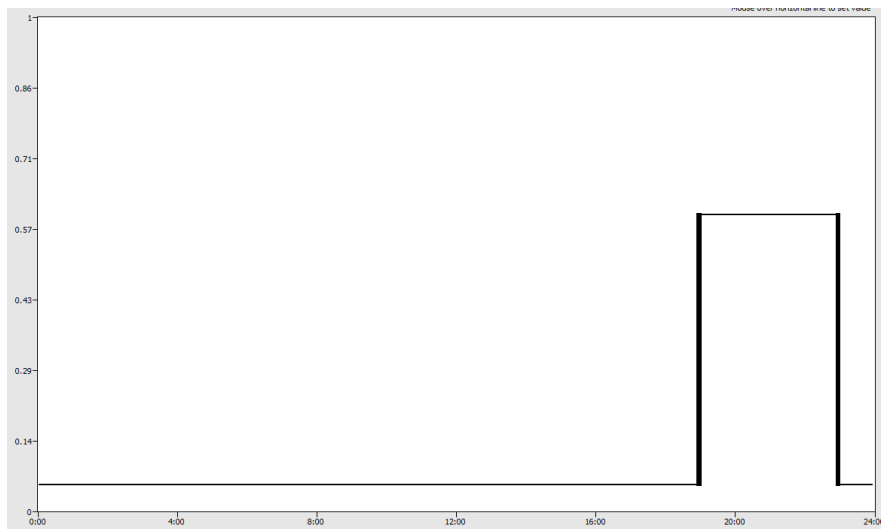
### ***Lighting***

A similar definition was applied to the interior lighting. In the winter, it was assumed that 70% of the interior lights are being used in the morning between 6:00am and 8:00am, 30% are being used between 3:00pm and 6:00pm, and 75% are being used between 6:00pm and 10:00pm. Therefore, the interior lighting takes on a step function as shown below:



**FIGURE 17 - WINTER LIGHTING SCHEDULE**

During the summer, lighting is not required during the majority of the day. However, the schedule was defined to allow a draw of 50% maximum electrical definition ( $5W/m^2$ ) between the hours of 6:00pm and 11:00pm, as shown in the figure below.



**FIGURE 18 - SUMMER LIGHTING SCHEDULE**

## Heating System

The as-built-residence uses a natural gas heating system. For this model two heating loops were created. The first loop serviced the main living areas, while the second loop serviced the garage and the heated-crawlspace.

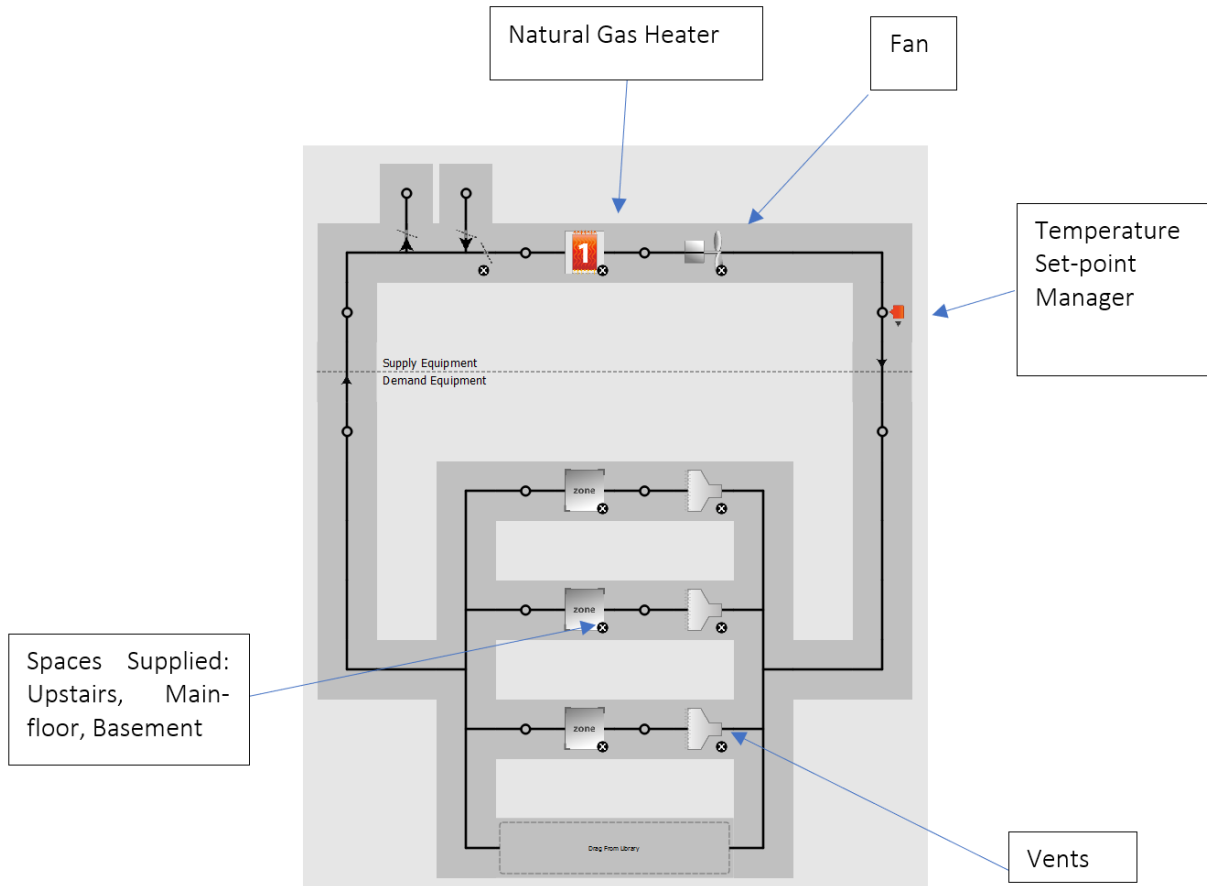


FIGURE 19 - HEATING SYSTEM FOR MAIN LIVING AREAS

## Service Water System

A service water system with an electrical hot-water heater was created to supply the fixtures on each floor with hot water. An average water use definition of 0.001L/s was applied to each water-use connection [15]. In the figure below, we can see three water-use-connections that supply the upper-floor, kitchen, and basement. As can be seen from the exploded view, the upper floor water-use-connection supplies a main bathroom and a master bathroom.

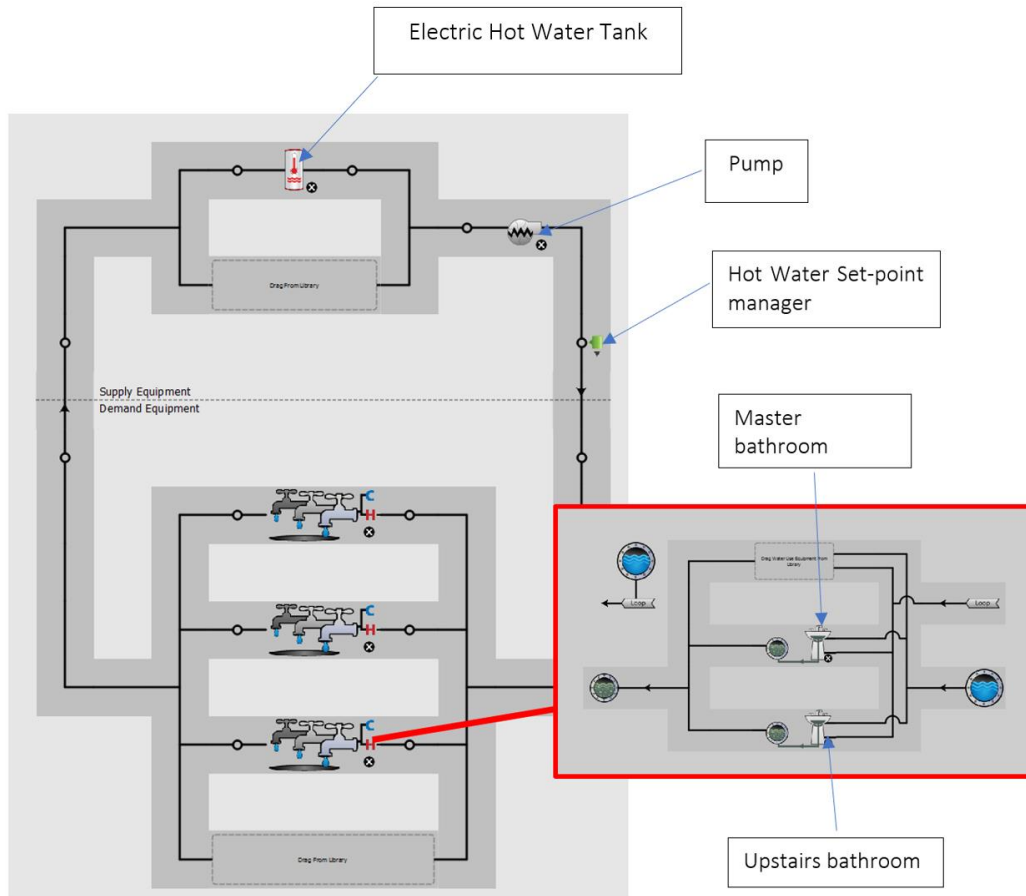


FIGURE 20 - SERVICE WATER SYSTEM

## ACR Air-leakage Rate



n-Factor Table

Zone	# of stories →	1	1.5	2	3
1	Well-shielded	18.6	16.7	14.9	13.0
	Normal	15.5	14.0	12.4	10.9
	Exposed	14.0	12.6	11.2	9.8
2	Well-shielded	22.2	20.0	17.8	15.5
	Normal	18.5	16.7	14.8	13.0
	Exposed	16.7	15.0	13.3	11.7
3	Well-shielded	25.8	23.2	20.6	18.1
	Normal	21.5	19.4	17.2	15.1
	Exposed	19.4	17.4	15.5	13.5
4	Well-shielded	29.4	26.5	23.5	20.6
	Normal	24.5	22.1	19.6	17.2
	Exposed	22.1	19.8	17.6	15.4

FIGURE 21 - LBL N-FACTOR CHART [16]

The as-built residence was tested to have a blower-door test of  $1.58 \text{ ACH}_{50}$ . The residence is 1.5 levels near the ocean (exposed), therefore the Lawrence-Berkeley Laboratories N-factor for the residence was found to be 15. Therefore, the residence has an infiltration rate of  $0.105 \text{ ACH}_{\text{natural}}$  (how much air-leakage can be expected from the envelope under the normal operating pressure of 4Pa) [16].

### 3.3.2. CALIBRATED ENERGY CONSUMPTION

Using the *actual energy data* for the case-study residence (obtained from BC Hydro and Fortis BC) the electrical consumption and natural gas-use of the model were verified and calibrated. The various lighting schedules and heating set points were then adjusted until the monthly natural-gas, and electrical energy consumption of the ACR energy model closely matched the actual consumption of the residence reported by Fortis BC, and BC Hydro. The final percent difference between modeled and reported energy consumption was 1.09% for the year. The largest difference in electricity consumption of 56kWh occurred in June, while the largest difference in heating energy, 146kWh, occurred in October. A monthly energy-use comparison can be found in Figure 22, Figure 23 and Figure 24.

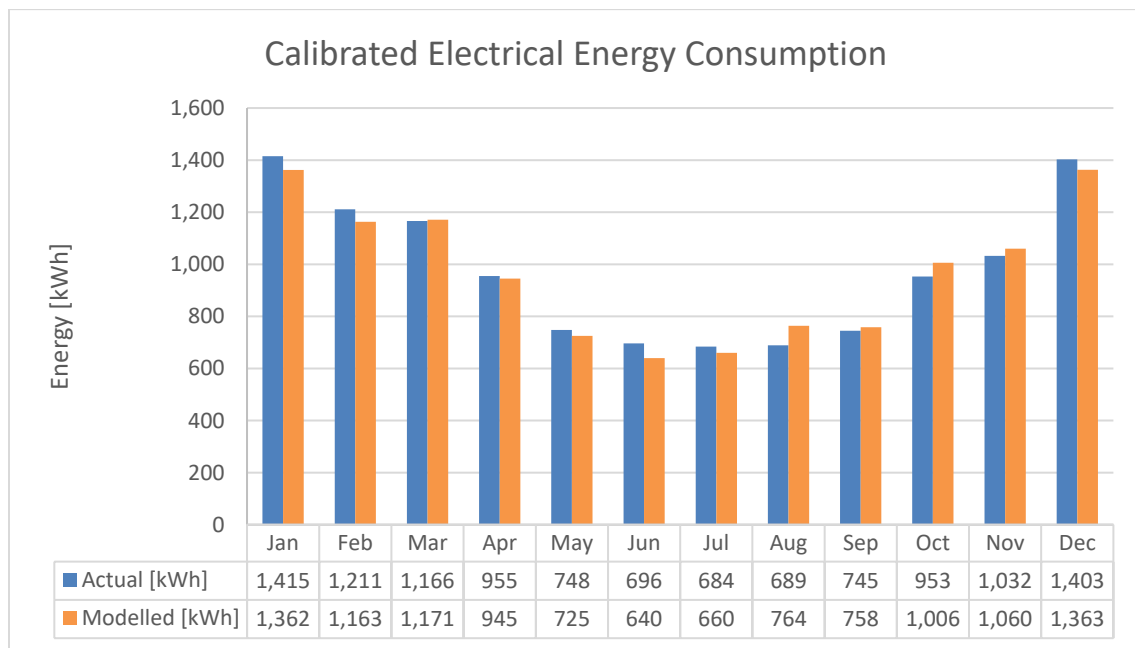
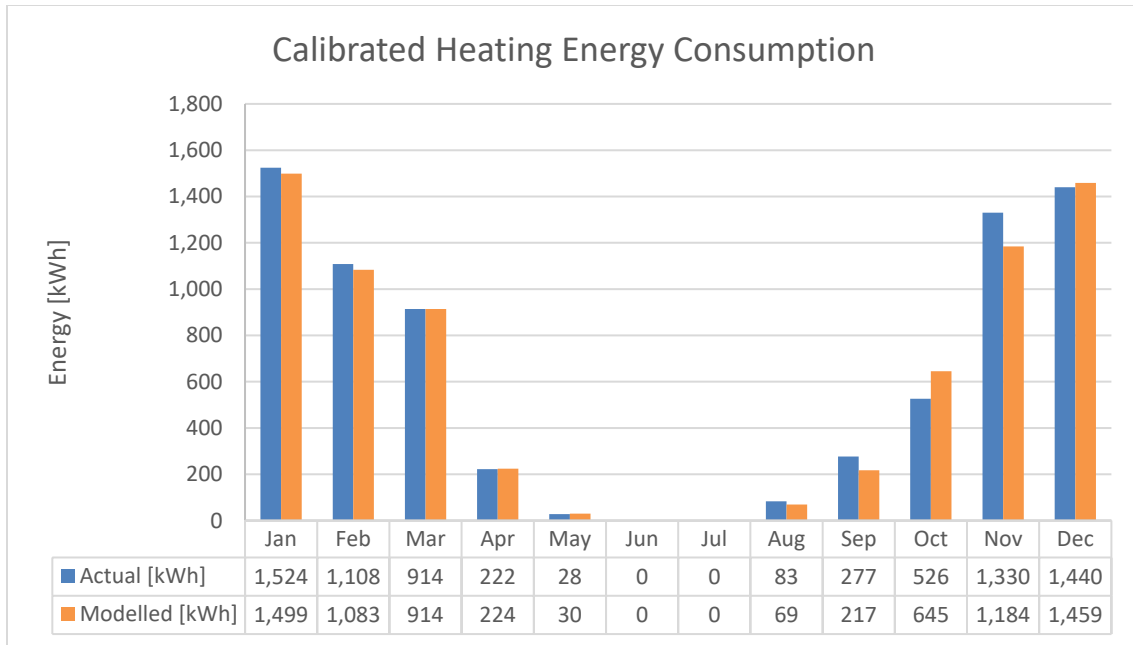
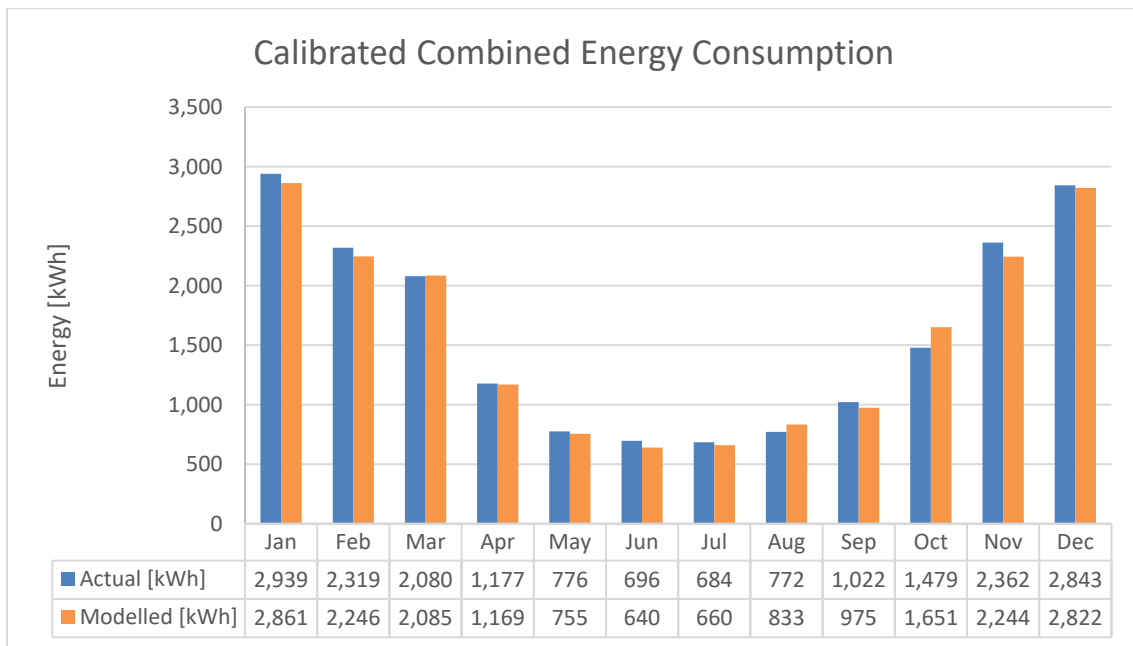


FIGURE 22 - CALIBRATED ELECTRICAL ENERGY CONSUMPTION



**FIGURE 23 - CALIBRATED HEATING ENERGY CONSUMPTION**



**FIGURE 24 - CALIBRATED WHOLE-BUILDING ENERGY CONSUMPTION**

### 3.3.3. MCR REFERENCE MODEL GENERATION

In order to contrast the performance of the ACR to a residence with typical Part-9 construction, a second model was generated using the MCR design drawings. Schedule sets and electric loads were held constant between the two models. It was assumed that the occupant's behavior did not change between the two

models. It should be noted, however, in an interview with the occupants it was stated that living in a high-performance residence does in fact make them more aware of their energy consumption, which has led to a change in occupant behavior. It has been shown that occupant behavior plays a significant role in reducing overall energy consumption in a building. Therefore, it is possible that the *energy advantage* between the ACR and MCR may be even more drastic than model predicts.

### MCR R-Value Comparisons

A code-minimum reference model was reverse engineered using the calibrated energy model and the minimum code construction details. The construction assemblies of the above-code energy model were altered to represent those found in the minimum-code construction details. The calculated and modeled R-values are compared in the table below. The largest percent difference in the modelled and calculated RSI values was found to be 4.19%, which was considered to be an acceptable error.

TABLE 2 - REFERENCE BUILDING THERMAL RESISTANCE COMPARISON

Assembly	RSI - Modelled	RSI - Calculated	% Diff
<b>EW1 - Typical exterior walls</b>	2.76	2.78	-0.72
<b>EW2 - Insulated foundation walls</b>	1.91	1.99	-4.19
<b>R1 - Cathedral roof and garage roof</b>	4.7	4.67	0.64
<b>R2 - Typical trussed roof</b>	6.94	6.91	0.43

### MCR Air-leakage Rate

The ACH<sub>50</sub> value of the residence was set as the minimum value for step-level 1 compliance, 3.5 ACH<sub>50</sub>. Using the same technique as described in determining the ACR air-leakage-rate, the MCR was calculated to have a natural air-leakage rate of 0.23 ACH<sub>natural</sub>.

## 4. COST COMPARISON RESULTS

### 4.1. INITIAL COST COMPARISON

The following cost table was generated based on the quotes provided by the contractors, and the as-built costs of the building.

TABLE 3 - CONSTRUCTION COST COMPARISON

	Contractor 1		Contractor 2		As Built (2015)	As Built (2017)
	Above Code	Code	Above Code	Code	2015 Cost	2017 Cost
<b>Total Cost</b>	\$443,906	\$369,507	\$482,660	\$386,502	\$455,850	\$467,318
<b>Cost / sqft</b>	\$204	\$170	\$222	\$178	\$210	\$215

*2017 Costs have been adjusted for inflation\* [17]*

Although the quotes provided by the respondents were similar, Contractor-1 has lower construction costs in both the ACR, and MCR. This is due to the fact that Contractor 1 is a larger construction company and is therefore is able to keep material and labor costs lower due to the economy of scale. It should be noted that both the respondents gave quotes similar to the actual cost of building, recorded in 2015. As expected, there was a cost challenge associated with building above-code. Based on the information acquired, the average percent increase in construction costs was 22.5% (\$85,279). Contractor-1 had the lower cost-challenge of \$74,400. The following figure shows where the cost increases occurred, the fixed cost of \$183,340 consistent between both buildings has been omitted to give a clearer depiction of cost differences between the two residences.

### Construction Cost Comparison

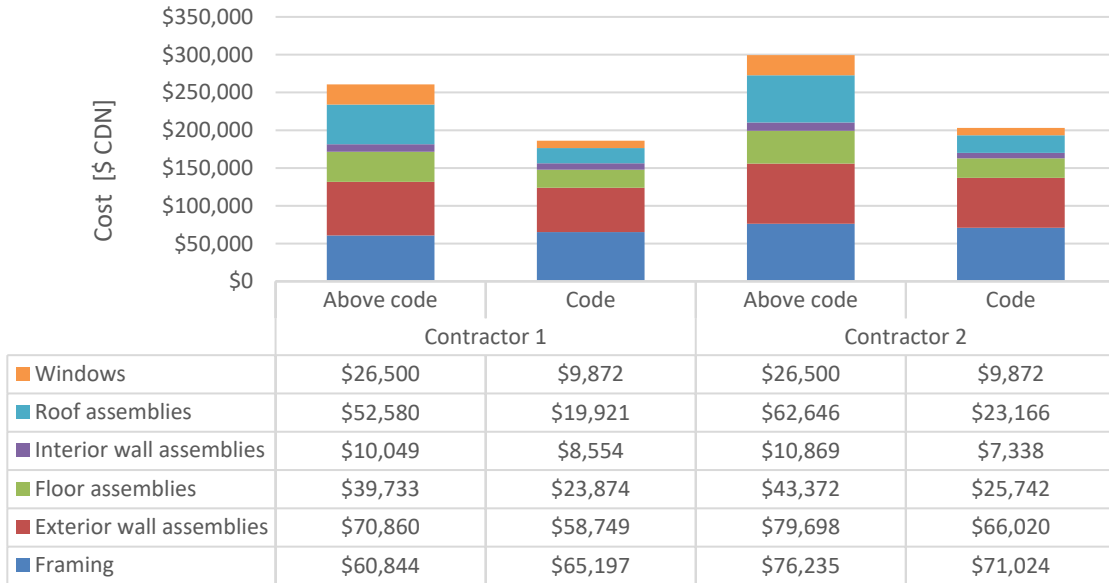


FIGURE 25 –CONSTRUCTION COST COMPARISON EXCLUDING \$183,340 IN FIXED COSTS

### Construction Cost Comparison

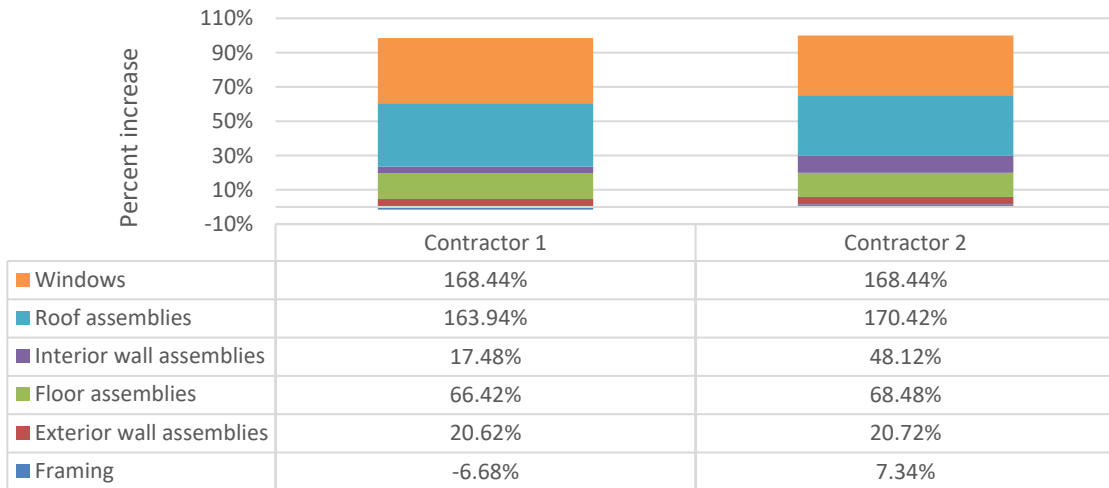
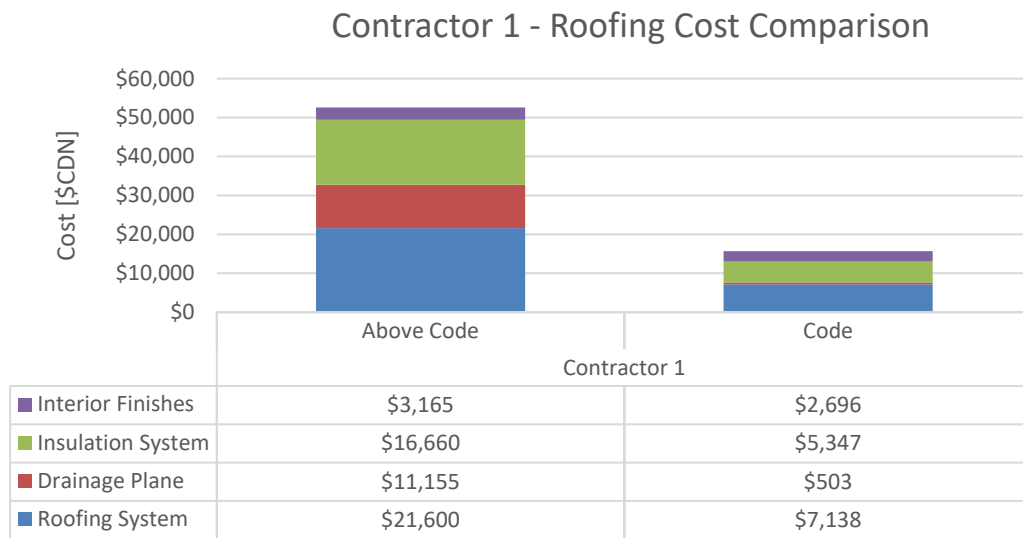


FIGURE 26 - INCREASE IN CONSTRUCTION COST BY PERCENTAGE

As can be seen in the figures above, the majority of the cost increase in the above code residence can be attributed to the roof, floor, and external wall assemblies. This is to be expected as the entire building envelope has been improved for energy efficiency. These assemblies were explored in further detail to show which sub-assemblies were responsible for the largest increase in cost.

#### 4.1.1. ROOF ASSEMBLIES

Figure 27 illustrates how the roofing costs differ between the two structures. It can be seen that the roofing type, drainage plane, and insulation system all contribute significantly to the cost difference. The roofing system of the above code residence is of much higher quality, having been engineered by building science professionals to ensure proper drainage, and superior insulating properties. Design details for the two roofing systems can be found in sections 3.1.1.3 and 3.1.2.4 for reference. Assembly components can be found in the Appendix A and B. Framing costs have been omitted for clarity.

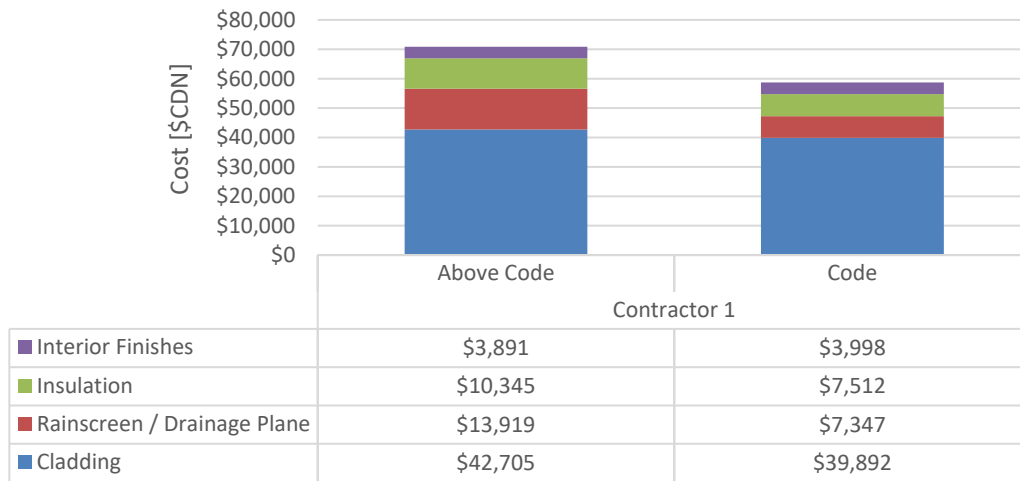


**FIGURE 27 – ROOFING ASSEMBLY COST COMPARISON**

#### 4.1.2. EXTERIOR WALL ASSEMBLIES

Framing costs were provided by the contractors as bulk values for the entire residence, not broken down for sub-assemblies. As such, the framing was ignored, and the other components in the wall assembly were studied in greater detail.

### Contractor 1 - Exterior Wall Cost Comparison



**FIGURE 28 - EXTERIOR WALL ASSEMBLY COST COMPARISON**

*Note: Framing costs have been omitted as they were provided as a bulk value for the entire residence, not broken down for sub-assemblies.*

Figure 28 shows that the primary cost differences in the exterior wall assemblies comes from the rainscreen/drainage plane and insulation. In the above code residence, the air/moisture barrier is provided by a self-adhered product which is more expensive than traditional building paper, or traditional house-wrap. In addition to this, the exterior of the building is covered with 2” to 3.5” of continuous insulation.

#### 4.1.3. FLOOR ASSEMBLIES

It is immediately apparent that the primary cost difference in the floor assemblies comes from the addition of thermal massing on the main floors of the above code residence, and from the use of sound proof insulation within the floor cavity. The code residence has no additional thermal massing on the main floors. The above-code residence employs mineral-wool batt insulation in the floor-joint cavities for the purposes of soundproofing and fire-proofing.

### Contractor 1 - Floor Assembly Cost Comparison

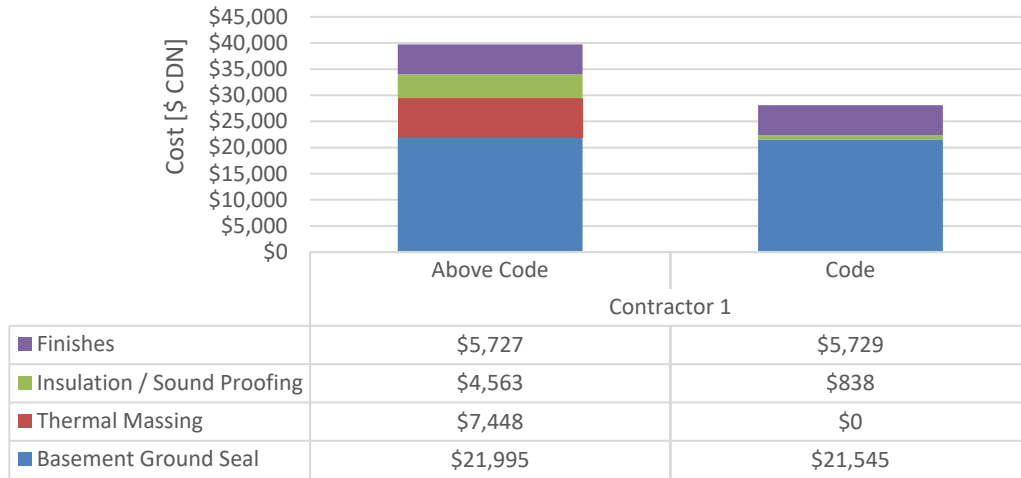


FIGURE 29 - FLOOR ASSEMBLY COST COMPARISON

#### 4.1.4. WINDOW COST COMPARISON

Window quotes for were obtained from two reputable glazing manufacturers serving the local housing market. The Above code residence uses a triple glazed, low-e casement-windows with a multi-point locking mechanism to ensure air-tightness. While the minimum-code residence employs standard Part-9 casement windows. As can be seen in the figure below, there is a cost difference of more than \$16,000 between the two window packages.

### Window Cost Comparison



FIGURE 30 - WINDOW COST COMPARISON

#### 4.1.5. OVERALL COST CHALLENGE

Table 4 and Table 5 below compare the costs of the wall assemblies for the ACR and MCR provided by the two contractors. The cost-challenge is defined as the increase in construction costs of the ACR when compared to the MCR with the same floor plan. From Table 6 above, the average cost-challenge of above code residence is between \$74,399 and \$96,158, which corresponds to an average of \$39/sqft. This represents an average increase of 22.5%. This is higher than the values found during the initial literature review.

TABLE 4 – ACR ASSEMBLY COST COMPARISONS INCLUDING FRAMING COSTS

<b>Above-Code Construction Costs</b>			
		<b>Contractor 1</b>	<b>Contractor 2</b>
<b>Assembly Name</b>	Assembly Description	Assembly Cost	Assembly Costs
<b>EW1*</b>	Exterior Wall	\$122,508	\$146,045
<b>EW2*</b>	Exterior Wall	\$3,139	\$3,346
<b>EW3</b>	Exterior Insulated Foundation Wall	\$6,058	\$6,542
<b>F1</b>	Floor - Garage Slab	\$6,428	\$5,681
<b>F2</b>	Floor - Crawlspace ground seal	\$6,581	\$9,137
<b>F3*</b>	Floor- Over unconditioned space	\$5,471	\$6,212
<b>F4</b>	Floor- Typical floor assembly	\$12,267	\$13,356
<b>F5</b>	Floor - Main floor SOG	\$8,986	\$8,986
<b>IW1*</b>	Interior Wall - Bedroom and bathroom walls	\$6,989	\$7,732
<b>IW2*</b>	Interior walls	\$3,060	\$3,137
<b>R1 *</b>	Roof- Sloped metal	\$36,550	\$43,525
<b>R1*</b>	Roof-Sloped metal at cathedral	\$7,350	\$8,705
<b>R2</b>	Roof- Over garage	\$8,680	\$10,416
<b>W</b>	Windows	\$26,500	\$26,500

<b>Total Assembly Costs</b>		\$260,566	\$299,320
<b>Fixed Costs</b>		\$183,340	\$183,340
<b>Above-Code Cost Estimate</b>		<b>\$443,906</b>	<b>\$482,660</b>
<b>Floor Area (sqft)</b>		2173	2173
<b>Cost / Unit Area</b>		<b>\$204</b>	<b>\$222</b>

Note: The cost of the external wall assembly includes framing for the entire residence. \* indicates that framing costs are included in EW1.

TABLE 5 - MCR ASSEMBLY COST COMPARISON INCLUDING FRAMING COSTS

<b>Minimum-Code Construction Costs</b>			
		<b>Contractor 1</b>	<b>Contractor 2</b>
<b>Assembly Name</b>	<b>Assembly Description</b>	<b>Assembly Cost</b>	<b>Assembly Cost</b>
<b>EW1*</b>	Typical exterior wall	\$118,348	\$131,066
<b>EW2*</b>	Exterior-insulated foundation wall	\$3,666	\$3,947
<b>EW3*</b>	Exterior-2x4 stone veneer wall	\$1,932	\$2,031
<b>F1</b>	Floor- Garage slab	\$4,553	\$5,056
<b>F2*</b>	Floor- Crawlspace ground seal	\$8,455	\$8,712
<b>F3*</b>	Floor-Above conditioned space	\$4,237	\$6,086
<b>F4</b>	Floor- Main floor assembly	\$2,330	\$2,562
<b>F5</b>	Floor- Basement Slab	\$8,537	\$9,413
<b>IW1*</b>	Interior Walls	\$8,554	\$7,338
<b>R1*</b>	Roof - Typical trussed roof	\$12,490	\$13,547
<b>R2*</b>	Roof- Cathedral roof	\$3,194	\$3,534
<b>W</b>	Windows	\$9,872	\$9,872
<b>Total Assembly Costs</b>		\$186,167	\$203,162

<b>Fixed Costs</b>		\$183,340	\$183,340
<b>Minimum-Code Cost Estimate</b>		<b>\$369,507</b>	<b>\$386,502</b>
<b>Floor Area (sqft)</b>		2173	2173
<b>Cost / Unit Area</b>		<b>\$170</b>	<b>\$178</b>

Note: The cost of the external wall assembly includes framing for the entire residence. \* indicates that framing costs are included in EW1.

TABLE 6 – COST SUMMARY TABLE

	<b>Contractor 1</b>		<b>Contractor 2</b>	
	Above Code	Code	Above Code	Code
<b>Total Cost</b>	\$443,906	\$369,507	\$482,660	\$386,502
<b>Cost Challenge</b>	\$74,399		\$96,158	
<b>Cost Challenge / sqft</b>	\$34		\$44	
<b>Percent Increase</b>	20.1		24.9	
<b>As Built Cost (2015)</b>	\$455,850			
<b>As Built Cost (2017)</b>	\$467,318			

TABLE 7 - PERCENTAGE OF TOTAL COST CHALLENGE BY ASSEMBLY

	<b>C1</b>	<b>C2</b>	<b>Average</b>
	<b>Percentage of Total Cost Challenge [%]</b>		<b>[%]</b>
<b>External Walls</b>	10.4	19.6	15.0
<b>Floor</b>	21.3	18.3	19.8
<b>Interior Walls</b>	2.0	3.7	2.8
<b>Roof</b>	43.9	41.1	42.5
<b>Windows</b>	22.3	17.3	19.8

Some of these components are either for aesthetic appeal (metal-roofing), or comfort (floor-cavity insulation), and therefore it may be possible to reduce the cost-challenge significantly while maintaining high-energy performance simply by choosing to use combination of above-code and minimum-code assemblies instead. However, a sacrifice in air-tightness will likely result from omitting some of the high-performance components.

## 5. ENERGY COMPARISON RESULTS

Using the calibrated energy models, a comparison of the building energy consumption was conducted and can be found in Figure 31 - Figure 33. It was found that the ACR had a 6.3% reduction in electrical energy consumption and a 22.5% reduction in overall energy consumption. What was very exciting was the 40.2% reduction in heating energy consumption. When put into a metric of “energy-advantage” this represents a decrease in yearly energy consumption of 22.6kWh/m<sup>2</sup>/yr (5,530 kWh/yr). It is evident from this comparison that the improved building envelope is extremely effective in reducing heat lost through thermal bridging and air-leakage. The percentage reductions in energy consumption can be found in Table 8.

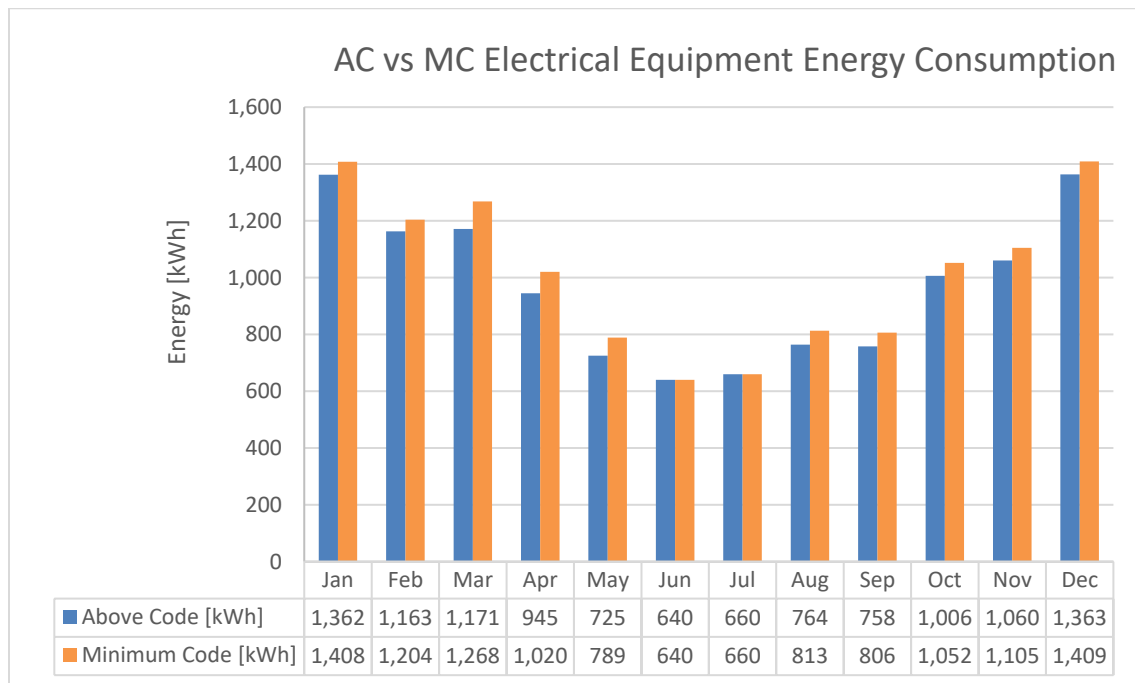


FIGURE 31 - ELECTRICAL ENERGY COMPARISON BETWEEN THE ACR AND MCR

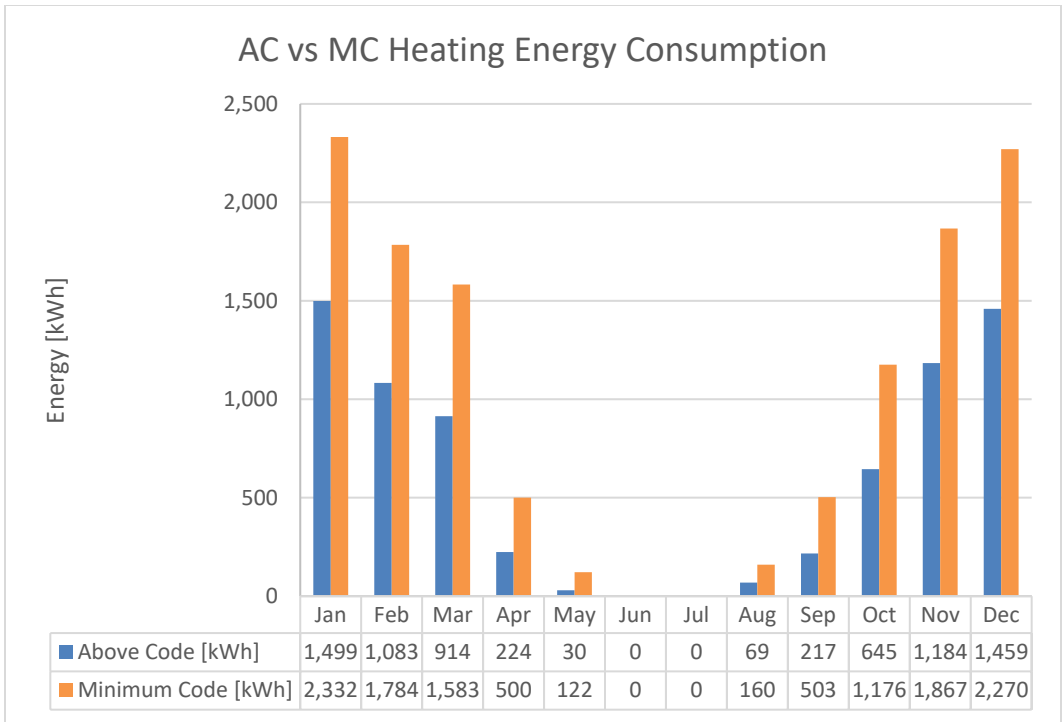


FIGURE 32 - HEATING ENERGY COMPARISON OF THE ACR AND MCR

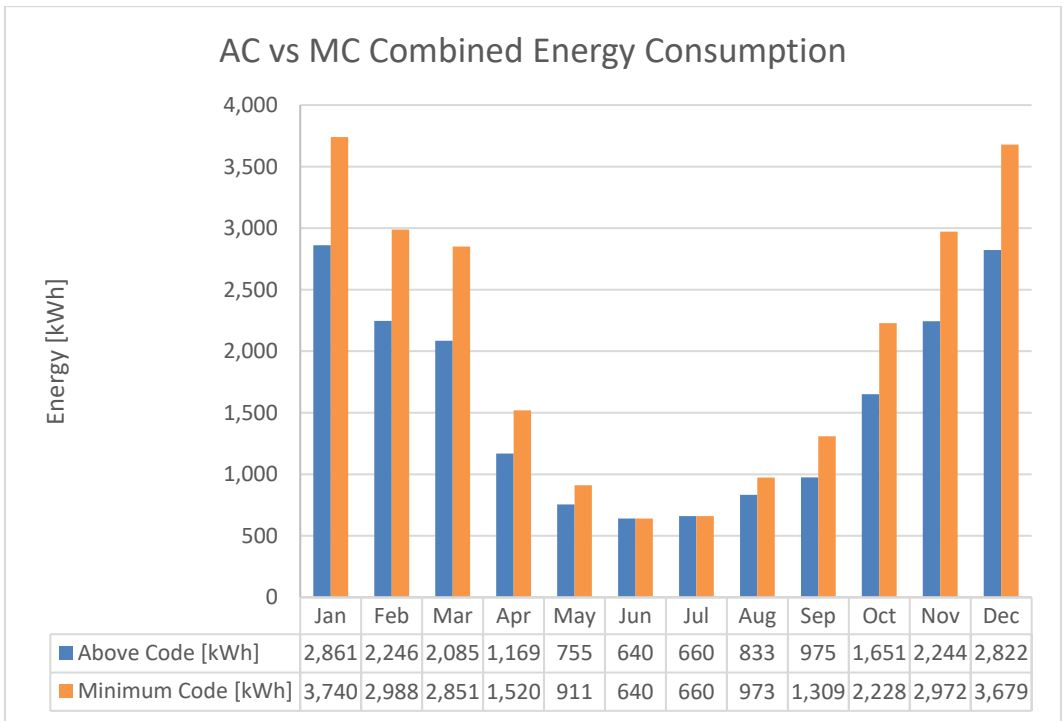


FIGURE 33 - COMBINED ENERGY COMPARISON OF THE ACR AND MCR

TABLE 8 - PERCENT REDUCTIONS IN ENERGY USE

	<b>Above Code [kWh]</b>	<b>Minimum Code [kWh]</b>	<b>% Reduction</b>
<b>Yearly Electrical Energy</b>	8,239	8,794	6.3
<b>Yearly Heating Energy</b>	7,352	12,297	40.2
<b>Total Yearly Energy Consumption</b>	18,972	24,472	22.5

## 5.1. HYBRID CONSTRUCTION MODEL

### 5.1.1. HYBRID-MODEL COST ANALYSIS

If the ACR design details are studied closely, it can be observed that there are many components that are included that would not be required for increased energy performance. An example of this is the floor-cavity insulation, which is meant to act as an acoustic barrier. It is a reasonable assumption that the floors in the residence act as adiabatic boundaries, and therefore, the amount of insulation within the floor cavity doesn't have an effect on thermal performance. If the roofing-system is considered, it can be noticed that a typical Part-9 attic-style roof has a similar thermal performance to the cathedral roof-systems of the ACR and would be much simpler to construct.

A model was analyzed that attempted to preserve the *necessary* energy-performance details of the ACR, while trimming away over-designed, or un-necessarily expensive construction components un-related to improving energy performance. It was thought that a model which employs the *above-code exterior walls, minimum-code roof, minimum-code floors, and minimum code windows* is likely to achieve similar energy performance to the ACR. This model will be referred to as the "hybrid-residence" (HR) for the remainder of this report.

By creating a model employing the *above-code exterior walls, minimum-code roof, minimum-code floors, and minimum code windows*, the cost-challenge was *reduced* by approximately \$66,640, meaning that similar energy-performance to the ACR was thought to be possible at a cost challenge of only 2.1%, or \$7,759 (based on the construction cost estimates provided by Contractor-1).

### 5.1.2. HYBRID-MODEL ENERGY ANALYSIS

The HR was created in Energyplus / OpenStudio and compared to the ACR. Recall that the airtightness value of the ACR was found through testing of the as-built residence to be 1.58 ACH<sub>50</sub>. Airtightness in the

HR was reduced to the minimum value of 2.5 ACH<sub>50</sub> required for conformance to step-level 3. This means the HR was modeled to have a natural air-leakage rate of 0.167 ACH<sub>natural</sub>. It is likely that this level of airtightness could be maintained considering that the high-performance exterior wall assembly this model employs uses a self-adhered continuous exterior air/moisture barrier. Combine this with a traditional caulk-and-seal polyurethane vapour barrier and airtight-drywall technique and it is likely that this residence could out-perform the minimum 2.5 ACH<sub>50</sub> required for step-3 compliance.

The energy-advantage of the HR was found to be 15.14kWh/m<sup>2</sup>/yr (3,709 kWh/yr) and the energy required to heat the HR was reduced by 26% when compared to the MCR. The following figures depict a comparison in energy requirements between the ACR, HR, and MCR.

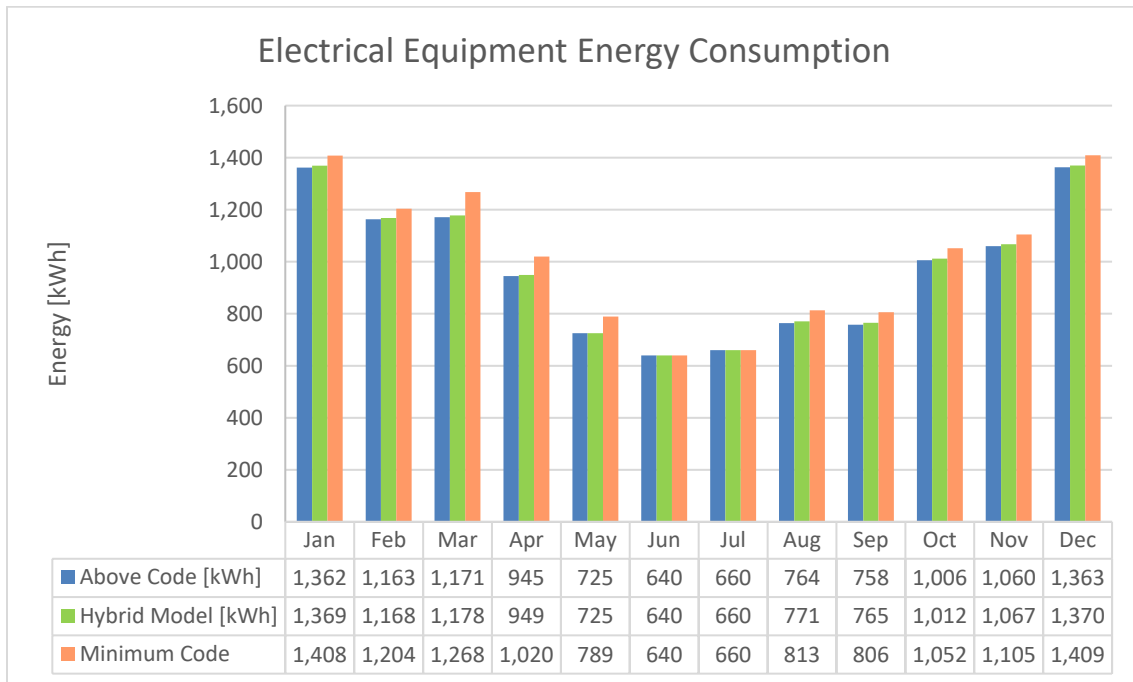


FIGURE 34 - ELECTRICAL ENERGY CONSUMPTION COMPARISON BETWEEN ACR, HR, AND MCR

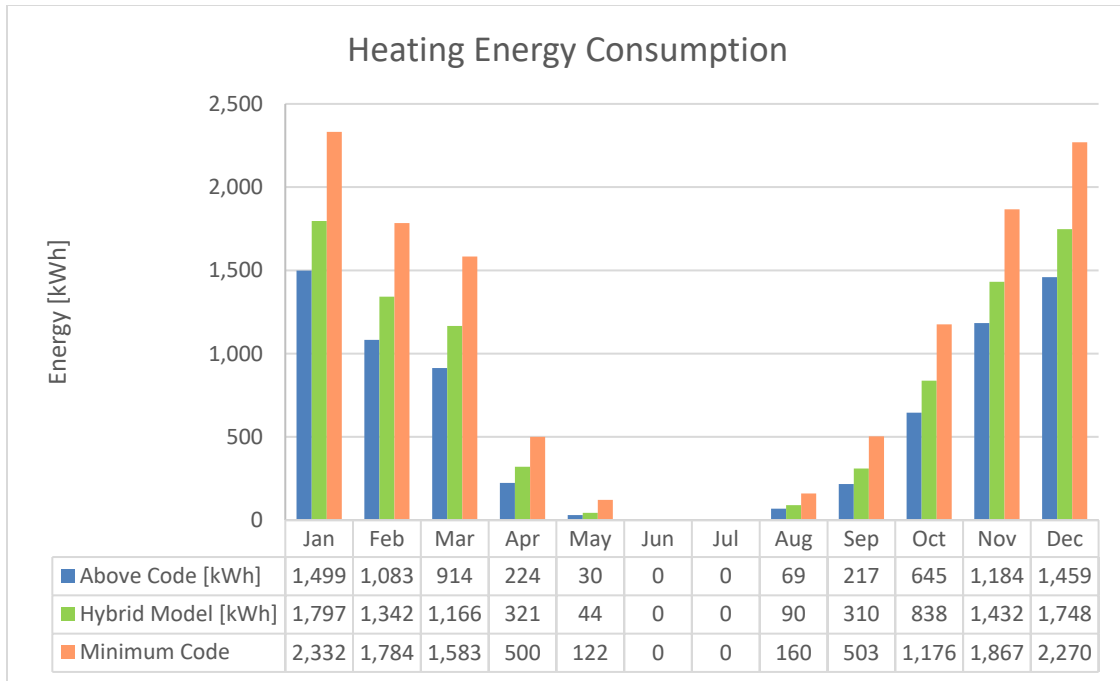


FIGURE 35 – HEATING ENERGY COMPARISON BETWEEN THE ACR, HR, AND MCR

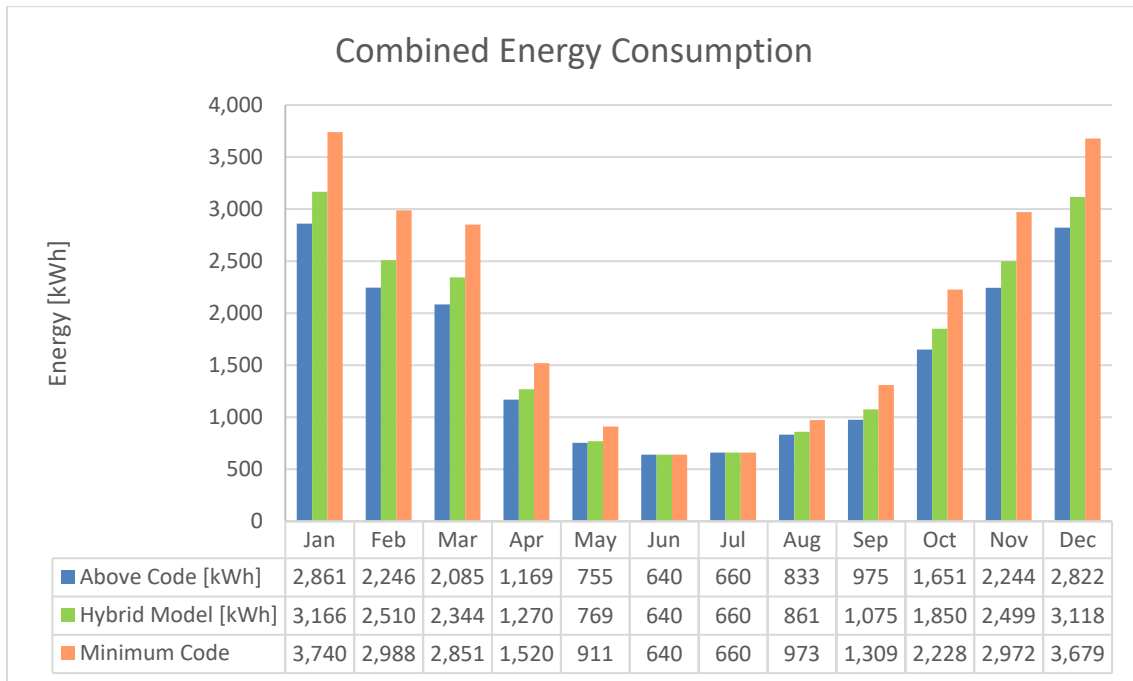
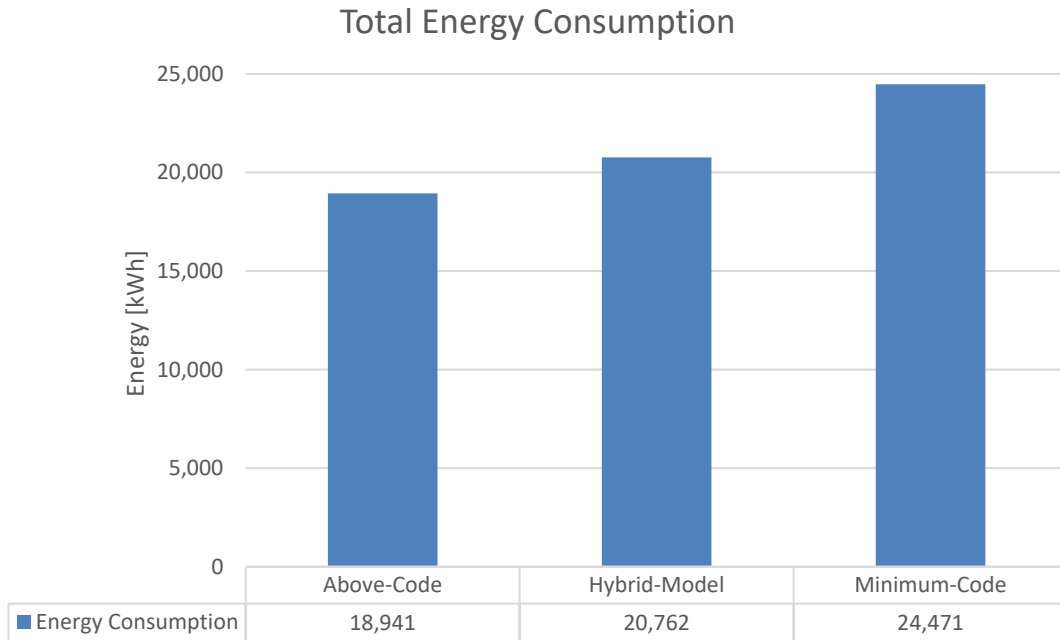


FIGURE 36 - COMBINED ENERGY COMPARISON BETWEEN ACR, HR, AND MCR



**FIGURE 37 - TOTAL YEARLY ENERGY COMPARISON BETWEEN THE ACR, HR, AND MCR**

## 5.2.STEP-CODE COMPARISON

Both the ACR and HR best the minimum-code MEUI by greater than 20%, and therefore both meet the requirement for step-3 compliance, thereby confirming that similar energy performance can be expected from the HR and the ACR. The three models are compared to the energy-step code in Table 9 and Figure 38. From the comparison shown in Table 10 it can be seen that the HR represents a 15.2% reduction in total energy consumption for the year while the ACR represents a 26.2% reduction.

**TABLE 9 - STEP-CODE COMPARISON TABLE**

	<b>Above Code</b>	<b>Minimum Code</b>	<b>Hybrid Code</b>
<b>Energy Model</b>	✓	✓	✓
<b>Airtightness</b>	1.58	3.5	2.5
<b>MEUI [kWh/m2/yr]</b>	52	74	59
<b>TEDI [kWh/m2/yr]</b>	30	50	37
<b>Step Level Achieved</b>	3	1	3

	Step Level	Energy Modelling	Airtightness	Mechanical Energy Use	Envelope
Minimum code	<b>Step 1 Enhanced Compliance</b> (BC Building Code Performance)	Required	3.5 ACH <sub>50</sub>	BCBC using 9.36.5. or ERS v15 ref. house (MEUI of 80 kWh/m <sup>2</sup> /year is likely, but not required)	Report on TEDI and PTL (Peak Thermal Load) (TEDI 50 kWh/m <sup>2</sup> /year is likely, but not required)
	<b>Step 2 10% Beyond Code</b>	Required	3.0 ACH <sub>50</sub>	10% better than ERS v15 ref. house OR MEUI – 60 kWh/m <sup>2</sup> /year	TEDI – 45 kWh/m <sup>2</sup> /year OR PTL – 35 W/m <sup>2</sup>
Hybrid Model	<b>Step 3 20% Beyond Code</b>	Required	2.5 ACH <sub>50</sub>	20% better than ERS v15 ref. house OR MEUI – 45 kWh/m <sup>2</sup> /year	TEDI – 40 kWh/m <sup>2</sup> /year OR PTL – 30 W/m <sup>2</sup>
Above code	<b>Step 4 40% Beyond Code</b>	Required	1.5 ACH <sub>50</sub>	40% better than ERS v15 ref. house OR MEUI – 35 kWh/m <sup>2</sup> /year	TEDI – 25 kWh/m <sup>2</sup> /year OR PTL – 25 W/m <sup>2</sup>
	<b>Step 5</b>	Required	1.0 ACH <sub>50</sub>	MEUI – 25 kWh/m <sup>2</sup> /year (no ERS option)	TEDI – 15 kWh/m <sup>2</sup> /year OR PTL – 10 W/m <sup>2</sup>

FIGURE 38 - FINAL STEP-CODE COMPARISON FOR THE ACR, HR, AND MCR

TABLE 10 - CONSUMPTION COMPARISON

Consumption Comparison			
Electrical Energy Consumption		Electrical Energy Consumption	
Above Code [kWh]	11,620	Hybrid Code [kWh]	11,672
Minimum Code [kWh]	12,175	Minimum Code [kWh]	12,175
<b>% Reduction</b>	<b>4.6</b>	<b>% Reduction</b>	<b>4.1</b>
Heating Energy Consumption		Heating Energy Consumption	
Above Code [kWh]	7,352	Hybrid Code [kWh]	9,089
Minimum Code [kWh]	12,297	Minimum Code [kWh]	12,297
<b>% Reduction</b>	<b>40.2</b>	<b>% Reduction</b>	<b>26.1</b>
Total Consumption		Total Consumption	
Above Code [kWh]	18,972	Hybrid Code [kWh]	20,761
Minimum Code [kWh]	24,472	Minimum Code [kWh]	24,472
<b>% Reduction</b>	<b>22.5</b>	<b>% Reduction</b>	<b>15.2</b>

## 6. TIME TO AMORTIZATION

As it was determined that the ACR and HR achieve the same step-level classification, the cost-challenge used in the time-to-amortization study will be that of the HR, \$7,759. It is more likely that an individual building a new home would desire to save the additional \$66,600 if similar results can be achieved for significantly less.

### 6.1. BASIC COST COMPARISON

The basic cost-benefit analysis of the HR compared to a MCR can be defined by the following logic: There is an associated cost-challenge to build the HR when compared to the MCR. To make it economically viable for the investor, the HR would need to be able to recoup the additional building costs through increased energy savings within a reasonable pay-back period, taken as 25 years. The return-on-investment, or amortization period is the time at which the additional building costs are equal to the fuel savings of the residence.

In the simplest case, this means:

$$C_D = \Delta E \times P_f \times t_N \quad (1)$$

Where:

$C_D$  is the cost-challenge of building the HR [\$CDN],  $\Delta E$  is the difference in yearly fuel consumption [kWh/yr] between the HR and the MCR,  $P_f$  is the fuel price [\$CDN/kWh] and  $t_N$  is the number of years to pay-back.

Re-arranging we have:

$$t_N = \frac{C_D}{\Delta E \times P_f} \quad (2)$$

Knowing the initial cost challenge of \$7,759, and the yearly energy savings of 3,709 kWh/yr, the equation then becomes:

$$t_N = \frac{C_D}{\Delta E \times P_f} = \frac{\$7759}{3709 \frac{kWh}{yr} \times P_f} = \frac{2.09}{P_f}$$

Which, when plotted, appears as follows:

## Time to Amortisation

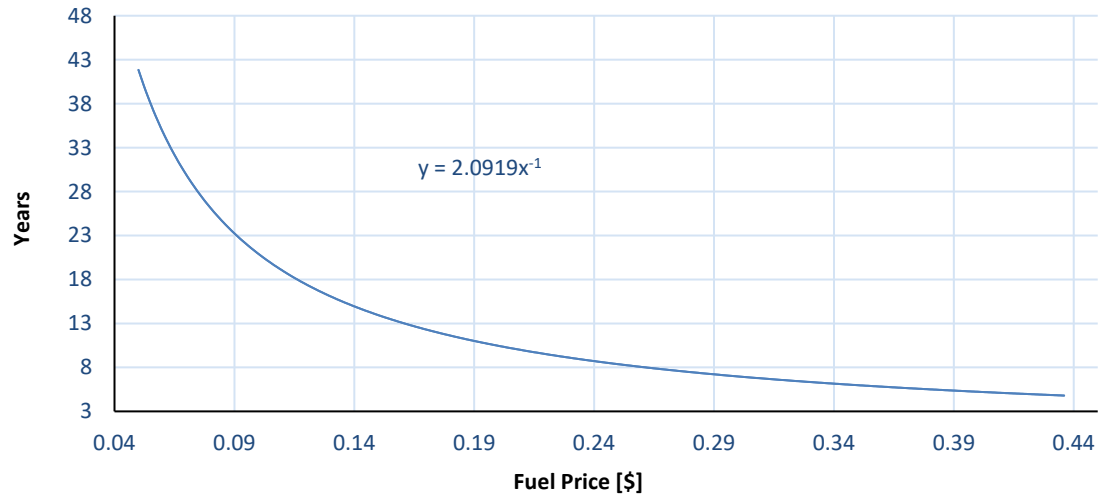


FIGURE 39 - RELATIONSHIP BETWEEN ROI AND FUEL COST

As can be seen from this simple example, the time to amortization is very sensitive to the price of fuel. Natural gas is significantly cheaper than electricity, therefore, if the residence employs natural gas as a means of heating, the payback period will be longer. For example, the average cost of electricity for the case where the energy demands of the residence are supplied entirely by hydro-electricity, the average cost / kWh is approximately \$0.11/kWh. Based on the graph above, the initial investment of \$7,759 will be recouped after 19 years. If the residence employs natural gas as a means of heating, the average energy cost was calculated to be approximately \$0.07/kWh. Meaning the initial investment will be repaid after 29.8 years.

### 6.2. EXPECTED INCREASE IN ENERGY COSTS

In reality the cost of energy will not be consistent over the pay-back period. It is likely that the price of energy will rise, reducing the time-to-amortization. In fact, in Canada over the last decade, energy costs have increased faster than the 1.6% average rate of inflation [18].

More realistically, the relationship between energy savings and fuel price should be thought of in the following terms:

$$C_R = \int E_A \times P_{f(t)} dt$$

Where:

$C_R$  is the recouped cost [\$],  $E_A$  is the energy advantage of the HR, and  $P_{f(t)}$  is the fuel price as a function of time. Assuming that the fuel price rises at some rate per year,  $r$ ,  $P_{f(t)}$  becomes a growth rate equation, taking the form:

$$P_{f(t)} = P_{f(0)}(1 + r)^t$$

Therefore,

$$C_R = \int E_A P_{f(0)}(1 + r)^t dt$$

Writing in terms of an exponential for future clarity, this becomes:

$$C_R = E_A P_{f(0)} \int e^{\ln(1+r)t} dt$$

Integrating yields:

$$C_R = \frac{E_A P_{f(0)}}{\ln(1 + r)} e^{\ln(1+r)t} + C$$

Applying the boundary conditions of  $t = 0, C_R = 0$

$$C = -\frac{E_A P_{f(0)}}{\ln(1 + r)}$$

Therefore,

$$C_R = \frac{E_A P_{f(0)}}{\ln(1 + r)} e^{\ln(1+r)t} - \frac{E_A P_{f(0)}}{\ln(1 + r)}$$

$$C_R = \frac{E_A P_{f(0)}}{\ln(1 + r)} [e^{\ln(1+r)t} - 1]$$

(3)

The above is a general equation to determine the amount that has been recouped after a specified number of years. Knowing that the recouped costs are equal to the cost challenge at some time in the future, the equation can be re-written in terms of the amortization time,  $t_N$  as:

$$t_N = \frac{\ln \left[ \frac{C_D \ln(1+r)}{E_A P_{f(0)}} + 1 \right]}{\ln(1+r)} \quad (4)$$

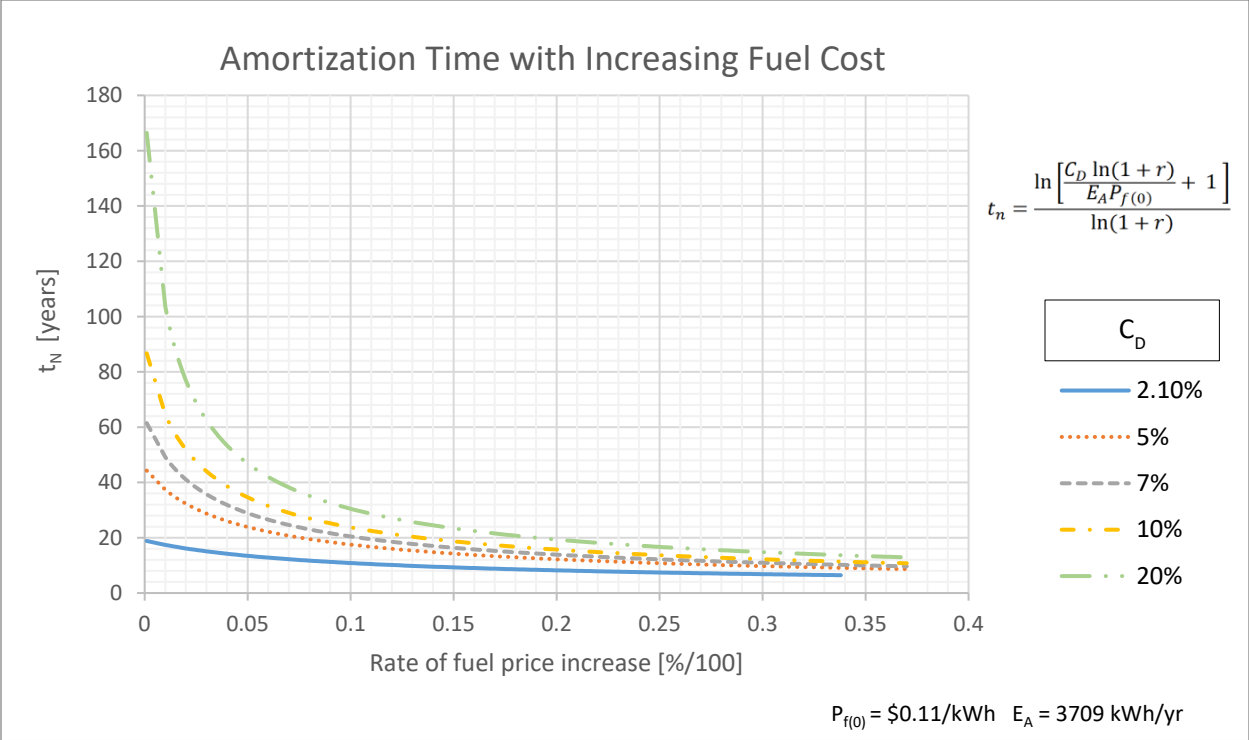
As an example, knowing that  $C_D = \$7759$ ,  $E_A = 3709 \text{ kWh}$ ,  $P_{f(0)} = \$0.11/\text{kWh}$  ( the average cost of electrical energy in the previous example), and a yearly growth rate in energy costs of 4%,  $t_N$  is calculated to be 14.2 years.

Using this equation, we can explore the relationship between amortization time, cost challenge, energy advantage, and fuel price growth rate in depth.

### 6.3. AMORTIZATION TIME WITH INCREASING ELECTRICITY COST AND COST-CHALLENGE

The charts below show amortization time plotted against the rate,  $r$ , at which electrical energy costs are expected to rise. A conservative estimate for  $r$  is taken to be 2%, which is slightly higher than the average national rate of inflation of 1.8% over the last 20 years [19].

The plotted levels of cost dis-advantage vary from 2.1% (that given by contractor-1) to 20%. In this scenario, the initial fuel-price is  $\$0.11/\text{kWh}$  (the average cost of electricity for the residence), and the energy advantage of the HR is  $3709 \text{ kWh/yr}$ , or  $15\text{kWh}/\text{m}^2/\text{yr}$ .



**FIGURE 40 - AMORTIZATION TIME WITH INCREASING FUEL COST FOR VARIOUS LEVELS OF COST-CHALLENGE #1**

This chart would be useful to determine the estimated payback period of the residence based on real-world construction quotes given by the contractor and the expected rise in fuel costs.

**6.4. VARIATIONS IN ENERGY ADVANTAGE**

The charts below show amortization time for the high-performance residence plotted against energy advantage for various levels of cost challenge, and rates of fuel price increase. The energy advantage has been normalized using the footprint of the house in m<sup>2</sup>. This allows the graphs to be general enough to be applicable to various residences of varying floorplans.

As can be seen in Figure 41, if the cost challenge is 2.1% (as expected in the HR from contractor - 1), the energy advantage is 15kWh/m<sup>2</sup>/yr (3709 kWh/yr for the floor plan used in this study), and the rate of fuel price increase is 2%/yr, the time to amortization is approximately 16 years (16.26 years when the equation is used). For the above-code residence (as outlined earlier) with a cost-challenge of 20% and an energy advantage of 22.5 kWh/m<sup>2</sup>/yr (as calculated), amortization will occur after 60 years (58.29 years when the equation is used). Amortization time with increasing energy advantage, E<sub>A</sub>, and fuel price increases of 4% and 10% are shown in Figure 41, Figure 42 and Figure 43 respectively.

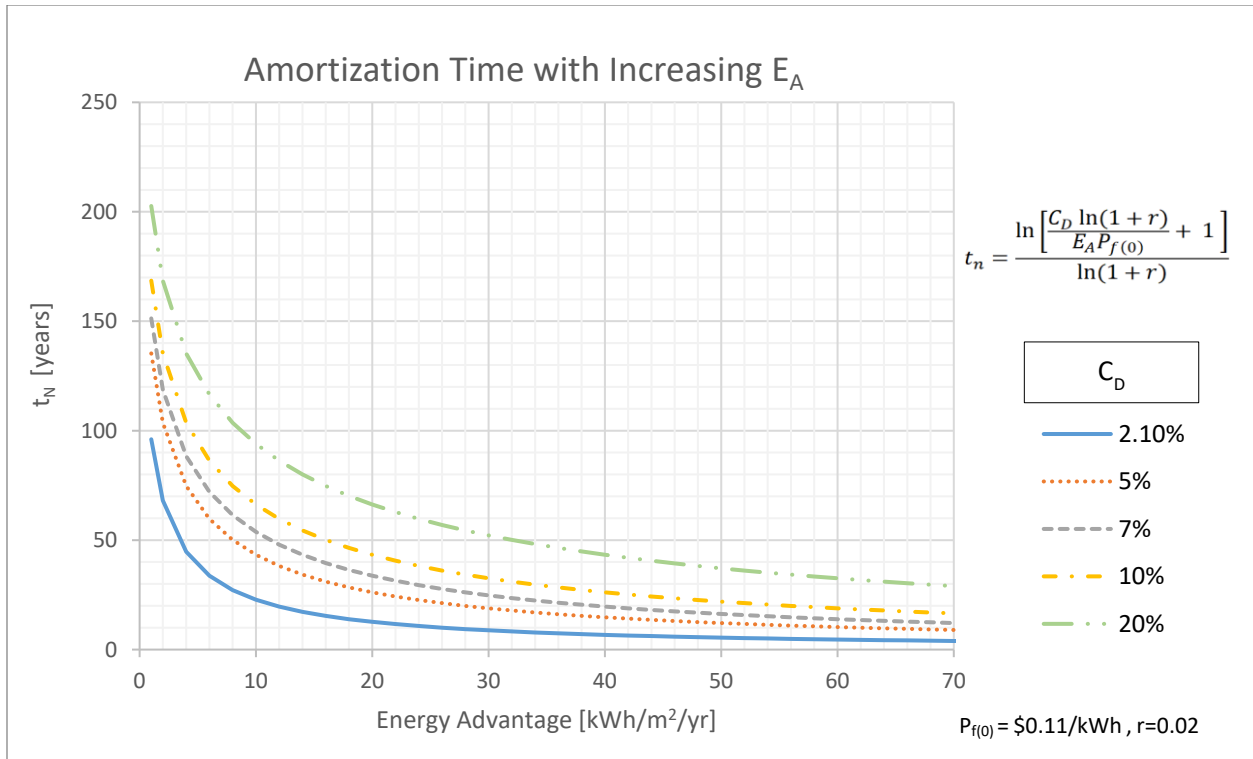


FIGURE 41 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #2.

$P_{f(0)} = \$0.11/\text{kWh}, R = 0.02$

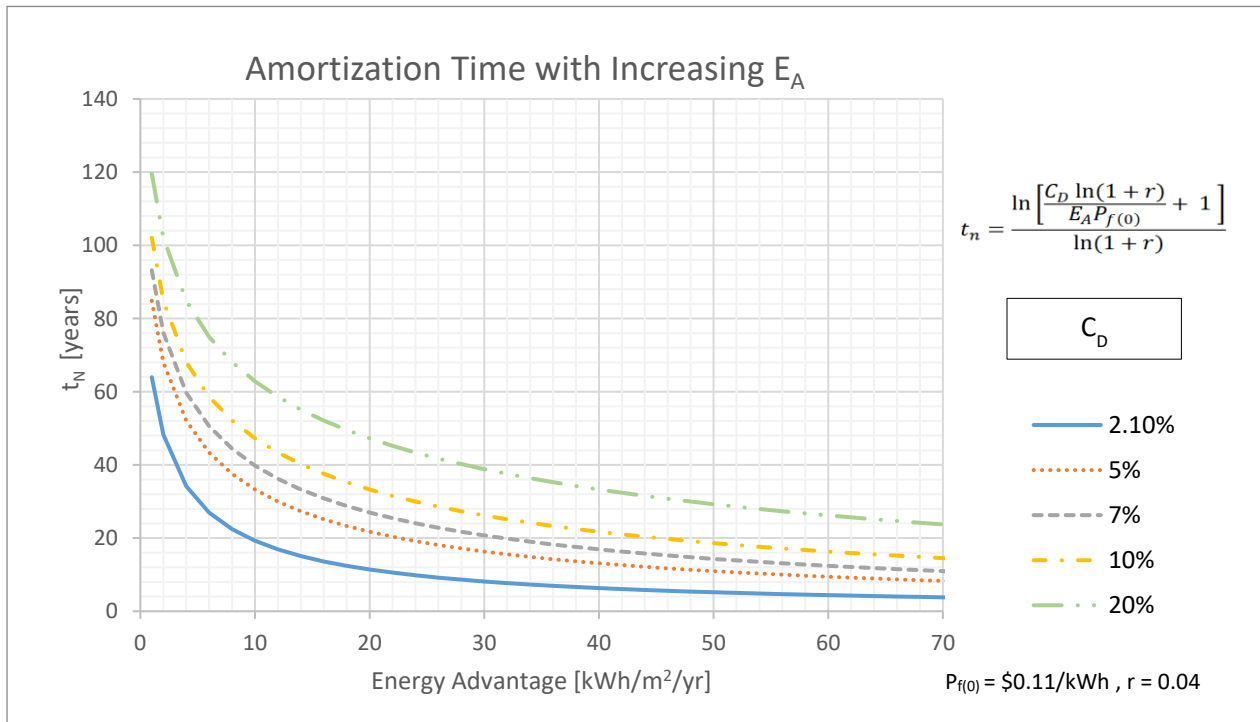


FIGURE 42 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #3.

$P_{f(0)} = \$0.11/\text{kWh}, R = 0.04$

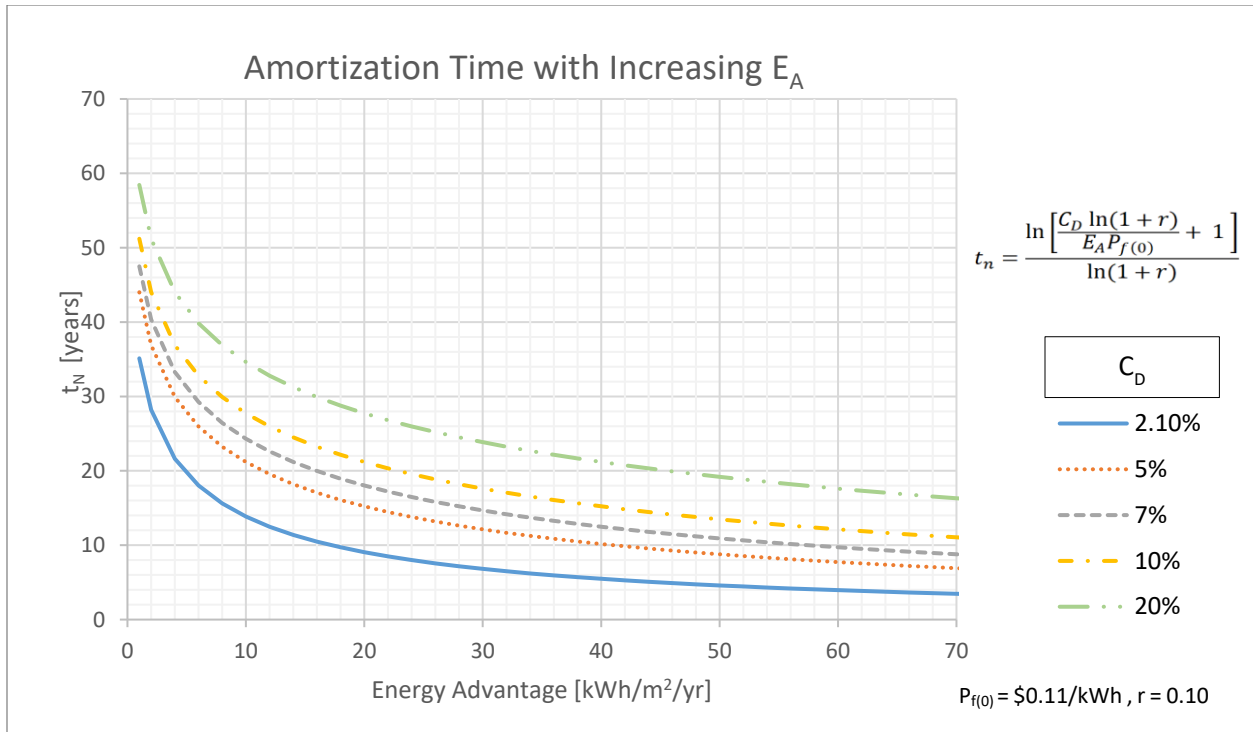


FIGURE 43 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #4.

$$P_{f(0)} = \$0.11/\text{kWh}, r = 0.10$$

### 6.5. EFFECT OF INITIAL FUEL PRICE

If the residence employs natural gas as a means of heating, the average energy cost is approximately \$0.07/kWh, compared with the \$0.11/kWh using only electricity. This is because of how inexpensive natural gas is relative to electricity. This will change the time-to-amortization of the residence as the initial price of fuel,  $P_{f(0)}$ , is a variable in the amortization equation.

The charts below show the change in amortization time when  $P_{f(0)}$  is set to \$0.07/kWh. The amortization time is plotted against energy advantage for various levels of cost challenge, and rates of fuel price increase. As above, the energy advantage has been normalized using the footprint of the house in  $\text{m}^2$ .

As can be seen from Figure 44, if the cost challenge is 2.1%, the energy advantage is  $15\text{kWh}/\text{m}^2/\text{yr}$ , and the rate of fuel price increase is 2%/yr, the time to amortization is approximately 25 years (23.6 years when the equation is used). Decreasing the initial fuel-price from \$0.11/kWh to \$0.07/kWh increased the time to amortization by approximately 7 years using a cost-challenge of just 2.1%.

For a cost-challenge of 5% (provided by Contractor-2), pay-back occurs after 45 years (44.4 using the equation). For the above-code residence with a cost-challenge of greater than 20% and a calculated energy advantage of 22.5 kWh/m<sup>2</sup>/yr, amortization will occur after 80 years (79 years when the equation is used), which is an increase of 20 years compared to the case of an initial fuel price of \$0.11/kWh.

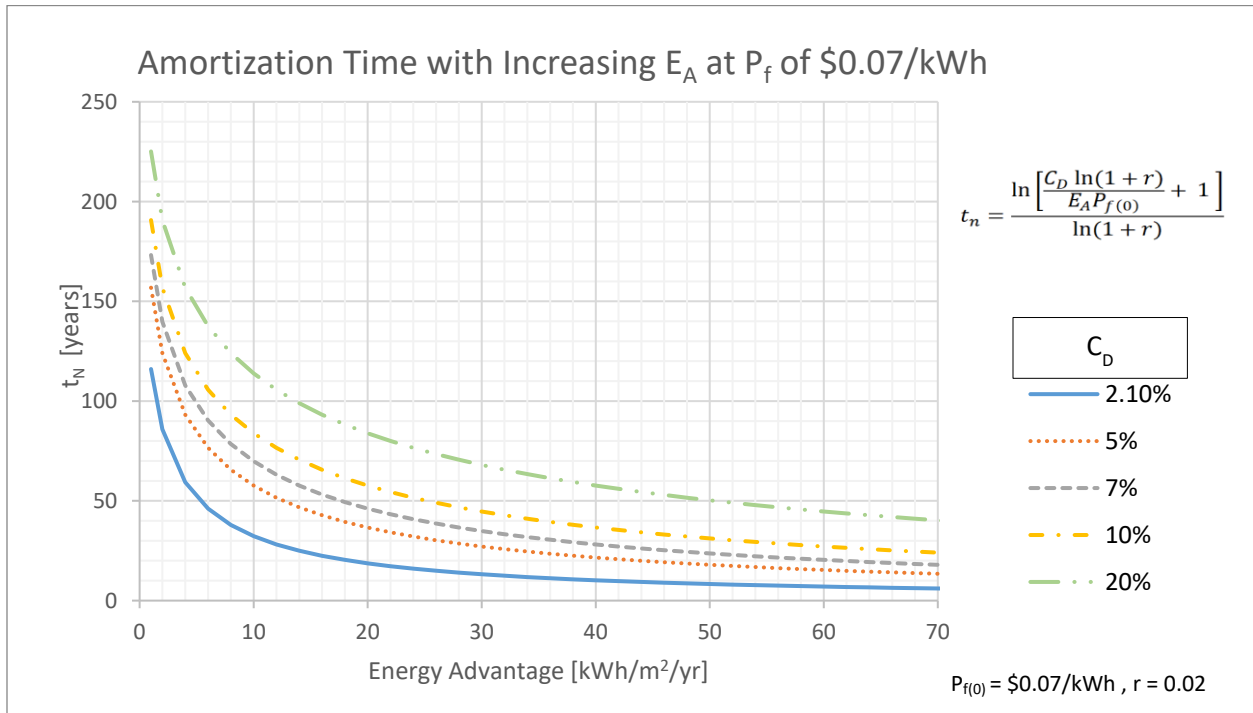


FIGURE 44 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #5.

$P_{f(0)} = \$0.07/\text{kWh}, R = 0.02$

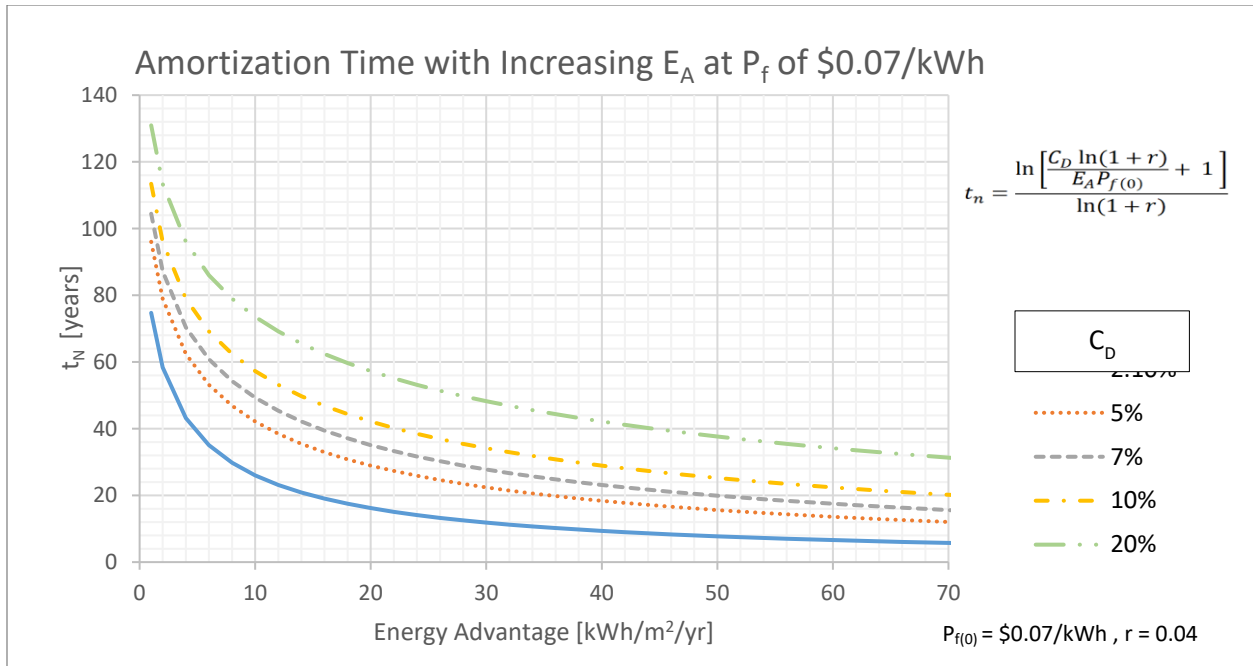


FIGURE 45 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #6.

$P_{f(0)} = \$0.07/\text{kWh}, R = 0.04$

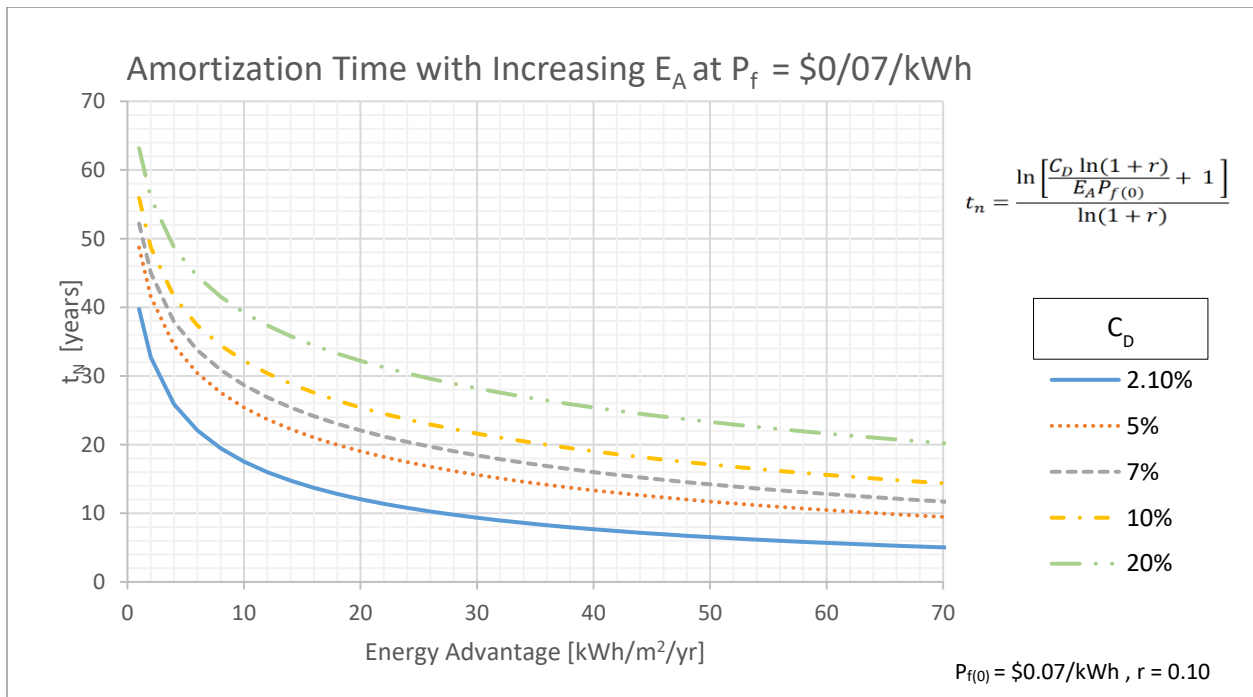


FIGURE 46 - AMORTIZATION TIME WITH VARYING ENERGY ADVANTAGE AND COST CHALLENGE #7.

$P_{f(0)} = \$0.07/\text{kWh}, R = 0.10$

## 6.6. CASH-FLOW CHARTS

Using equation (3) the cashflow for various energy inflation rates were plotted against time to produce Figure 47 and Figure 48. These charts are useful to determine recouped costs of the HR after a specified number of years for a given initial cost of fuel.

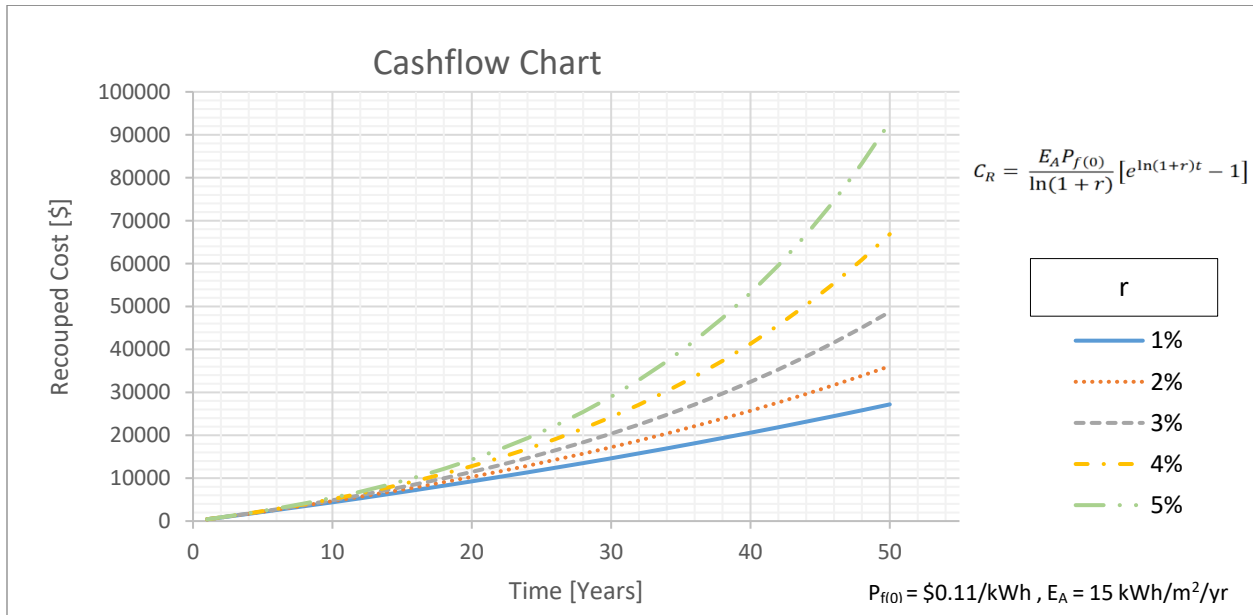


FIGURE 47 - CASHFLOW CHART FOR VARIOUS ENERGY INFLATION RATES, R #1

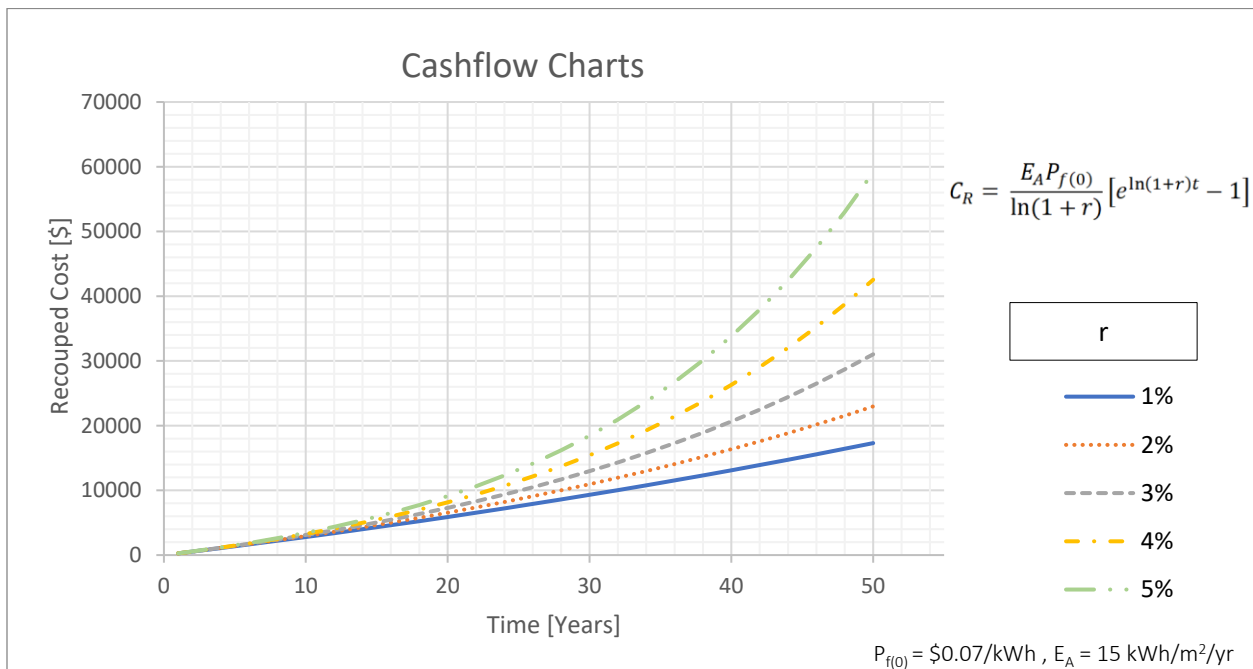


FIGURE 48 - CASHFLOW CHART FOR VARIOUS ENERGY INFLATION RATES, R #2

## 7. DISCUSSION: IS IT ECONOMICALLY VIABLE TO BUILD ABOVE CODE MINIMUMS?

Simply put, the answer to this question is: it depends. As shown, the answer is dependent on many factors, most notably the cost-challenge associated with building above code-minimums, the expected energy-advantage, the initial price of fuel used in the residence, and the expected rise in energy prices. As outlined in the literature review, one of the main barriers to the mass development of higher performance homes is the *perceived* and real increase in construction costs. However, as found in this report, it doesn't take a huge additional investment to achieve step-3 compliance (20% better than code-minimums) and it doesn't represent as large a leap in construction practices as many home builders perceive. In-fact, it can be done using construction methods and practices very common in the industry today. In the example shown in this report, a 2.1% increase in construction costs (created by adding an exterior air/moisture barrier, 2" of exterior insulation, and 4" of foundation insulation), resulted in a 26.1% decrease in yearly heating costs, a 15.2% reduction in *total* energy consumption, and an energy advantage of 15kWh/m<sup>2</sup>/yr (3709 kWh/yr). As shown in this report, simply reducing the air-leakage through the use of a self-adhered air/moisture barrier on the exterior, and adding a layer of continuous exterior insulation can have a big impact on energy savings. It seems that the industry has a resistance to accept high-performance energy targets based on a pre-conceived notion that it will be too different than what is currently being done, or that it will be too expensive. In Victoria, if an investor is not concerned with a conservative pay-back period around 16 – 25 years, then building above code minimums will save money in the long term, so long as the cost disadvantage is not more than 7%. The return-on-investment will be even shorter if the energy sector experiences high rates of inflation, or the initial cost of energy is high. In locations where energy cost is high, such as in many parts of the EU and US, investing into above-code construction practices will pay for themselves relatively quickly, assuming the cost challenge can be maintained around 2% - 10%. For example, the average cost of electricity in San Francisco is \$0.27kWh [20]. Assume: a 7% cost challenge (\$26,000) in the construction cost of the single-family home outlined in this study, an annual increase in the cost of energy of 1%, and an energy advantage of 15kWh/m<sup>2</sup>/yr. With these parameters the additional cost of \$26,000 will be recouped after 23 years. Using the same parameters and a 2.1% cost-challenge (as found in this report), the additional costs will be recouped in 7.5 years. After 25 years, a residence with a 15kWh/m<sup>2</sup>/yr, an initial energy cost of \$0.27/kWh, and a yearly energy increase rate of 1% will have accumulate a total of \$29,147 in energy savings. Even with an energy increase of 0%, this home would

accumulate \$25,500 in energy savings after 25 years. As fuel prices increase, the question of economic viability of implanting high-performance construction details becomes a no-brainer.

The method outlined in this report, and summarized below, can be easily applied to any geographical location to determine if additional investments into energy-saving building details will pay-back in an acceptable period of time. This can be applied to new construction projects, and energy retrofits.

- 1.) Create two construction detail packages and ask contractors to give quotes on both to get a very clear estimate of construction costs. The difference between the quotes for the ACR and MCR becomes the “cost-challenge”, CD. If this is an energy-retrofit, include the cost of demolition, and disposal.
- 2.) Have an energy comparison done through energy modeling of the two proposed designs. If possible, ensure that the model is calibrated using actual energy data from the energy supplier. The difference in modeled yearly energy consumption between the ACR and MCR becomes the “energy advantage” EA
- 3.) Determine what method of energy will be employed in the building. Use the energy models to determine the yearly cost of energy for the building. Use this to calculate the average initial energy cost,  $PF(0)$ . If the building uses a different energy source, such as natural gas, for heating, cooking, etc, this initial energy cost must be a weighted average cost of all energy-types employed.
- 4.) Determine a reasonable average rate for the increase in energy costs,  $r$ . In Canada, a conservative value is 2% as the increase in energy costs has been greater than the national rate of inflation over the last 10 years.
- 5.) Use the amortization equation, equation (4) to determine what the estimated pay-back period will be.

## 8. CONCLUSIONS

This research initiative attempted to empirically determine, with reality-based evidence from un-biased sources, the cost challenge, energy advantage, and expected pay-back period associated with building an above-code residence in Victoria, BC. In addition, this initiative created a much-needed benchmark for contractors to gain a firm understanding of the construction details required to achieve the various levels of the “Step-Code” in the newest edition of the BCBC (British Columbia Building Code). It is important to gain this information specific to Victoria B.C. to make an appropriate estimation of the actual “cost challenge” for building above code in the local housing market.

This was accomplished by creating two construction detail packages, one for an above-code residence (ACR), the other for a minimum-code residence (MCR) and undertaking a simulated tendering process with two reputable contractors in the area. The energy data for the as-built, ACR (constructed in 2015) was then gathered and used to create a calibrated energy models of the buildings. The energy performance metrics were then calculated and to determine which “Step-Level” in the BCBC step-code was achieved.

Overall, the results of the study showed that there is an average cost increase of approximately 22.5% for building the ACR detail package in the Victoria, BC area. The quotes provided by the contractors indicated that it would cost approximately \$213/sqft to build the ACR, and approximately \$174/ sqft to build the MCR. This corresponds to an average increase of \$39/sqft for the ACR. Ideally, there would have been more participants willing to provide quotes but based on the actual construction costs for the ACR of \$215.06/sqft, the quotes obtained seem sufficient.

On average, 42.5% of this cost increase of the ACR can be attributed to the design of the roofing system, 19.8% to the floor assemblies, 19.8% to the windows, and 15% to the exterior wall assembly. The above-code residence was found to reduce the yearly heating energy consumption of the home by 40.2% when compared to the minimum-code residence. In total, the ACR was calculated to have an energy-advantage of 22.6kWh/m<sup>2</sup>/yr in total energy consumption and met all the requirements to achieve a step-level 3 classification.

It was noticed that many of the components in the ACR assemblies are either for aesthetic appeal (metal-roofing), or comfort (floor-cavity insulation), and therefore it was possible to reduce the cost-challenge by approximately \$66,640 while maintaining high-energy performance simply by choosing to use combination of above-code and minimum-code assemblies. This combination of above-code and minimum-code

assemblies was referred to as the “Hybrid Residence” (HR), and had a cost-challenge of just 2.1%, or \$7,759 while maintaining a step-level 3 designation. When compared to the MCR, the HR reduced yearly heating demand by 26.1% and had a total energy advantage of 15.14kWh/m<sup>2</sup>/yr. The pay-back period of the HR was much more realistic than that of the ACR. If the residence relies solely on electricity for heating and running electrical equipment, the HR will amortize in approximately 16 years when a 2.1%/yr inflation rate is expected in the price of fuel. If the home employs natural gas for heating, the expected amortization period is 23.47 years for the same rise in fuel prices. These numbers decrease to 14.2 years, and 19.7 years respectively for a fuel-price inflation rate of 4%/yr.

By defining an equation for amortization-time, it was determined that pay-back period is very sensitive to the variables of energy-advantage, cost challenge, inflation rate, and initial fuel price. Energy-analysis and cost-analysis of the as-built structure revealed that the largest contributor to energy-performance is the “air-tightness” of the building envelope. This means that high-performing residences can be designed and built with a minimal increase to building cost. If fuel prices are expected to rise at a rate of 2% / yr or greater, the investment can be recouped in a very reasonable amount of time. This report can serve as a benchmark for home-builders to gain a firm understanding of the level of detail required to achieve step-level 3 performance while homeowners can use this report when designing a home, along with an energy-model, to estimate the pay-back period of investments into energy-saving technology.

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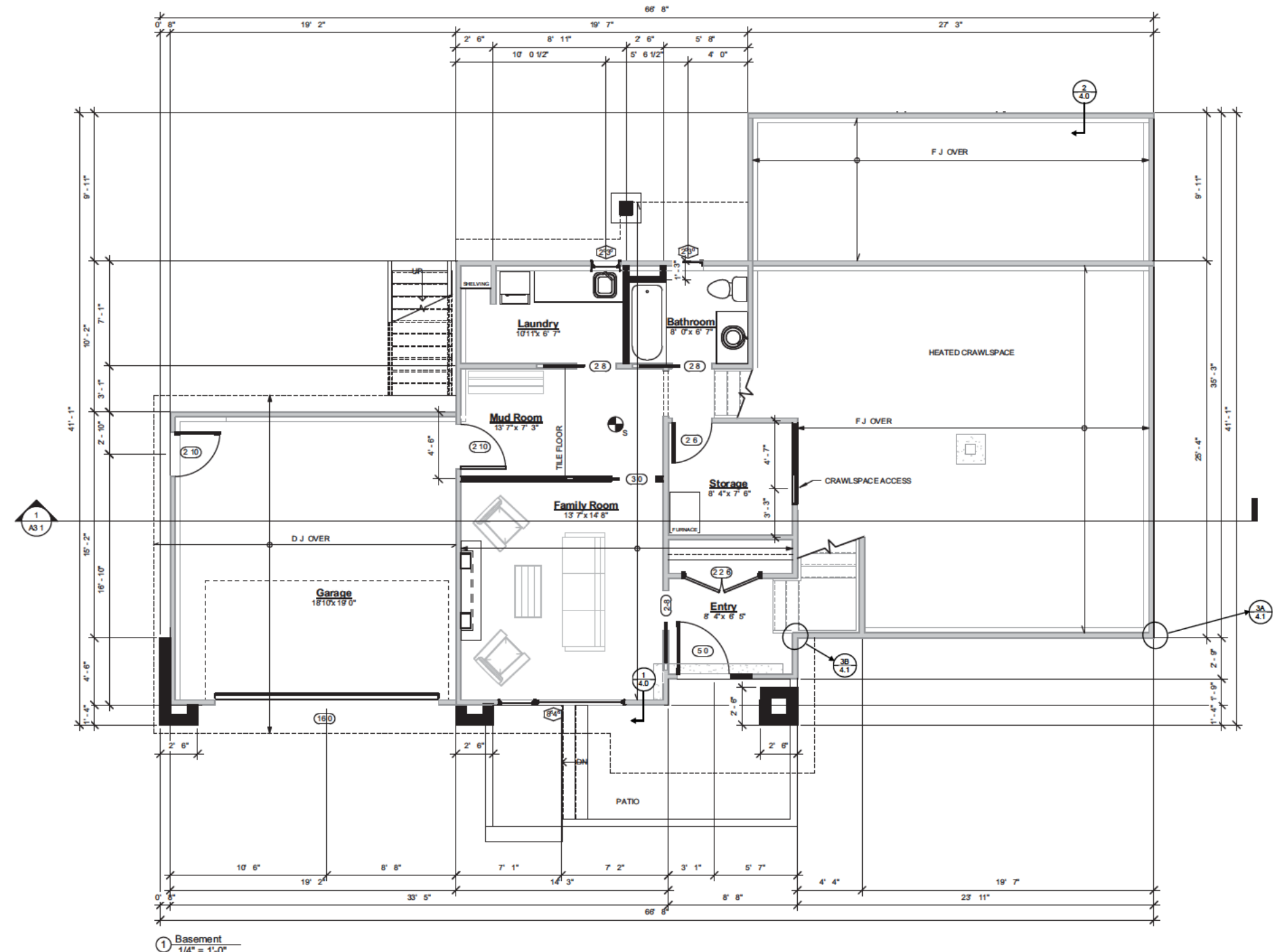
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## APPENDIX A – ABOVE CODE DESIGN DRAWINGS:

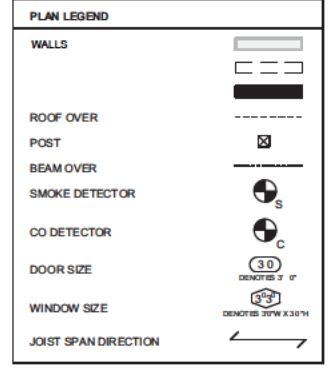
The design drawings in this Appendix were adapted from those created by RJC for the construction of the high-performance residence that is the subject of this research initiative [11].







- FRAMING NOTES:**
- ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  - ALL LUMBER TO BE SPF#2 OR BETTER UNLESS NOTED OTHERWISE
  - ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  - ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN
  - ALL LINTELS TO BE 2 PLY 2X10 U N O
  - ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  - ALL INTERIOR DOORS TO BE 68" TALL UNLESS NOTED OTHERWISE, PROVIDE MIN 2 STUDS ES AT JAMB FRAMING
  - ALL EXTERIOR DOORS TO BE 70" TALL UNLESS NOTED OTHERWISE
  - ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
  - DESIGN LOADS  
 SAANICH            So 2.1kPa  
                           Sr 0.3kPa



**GENERAL NOTES:**

- All drawings shall conform to the specifications and standards of the BC Building Code and other documents prepared by the Design (R/S) and used in connection with this project as indicated on drawings for the work shown in them ("as Work") and as such are and remain the property of R/S. All drawings shall be accurate and R/S shall not be held responsible for any errors or omissions in the drawings or project.
- Use of drawings shall be limited to that described in the drawings and shall not be used for any other project.
- Do not construct any framed drawings unless marked "Final" or "Construction" in the lower right hand corner, and then only for the particular project.
- The drawings shall not be used for "copying" or "reproduction" unless authorized in writing by the Design (R/S) or "Construction" drawings are not complete and any project based on such drawings must allow for this.
- It is the responsibility of the Contractor to verify all dimensions and conditions relating to existing buildings or site conditions as applicable to the project. The Contractor shall notify the Designer of any errors, omissions or discrepancies as identified in the drawings or to the commencement of the work. Commencement of construction or any part thereof constitutes acceptance of the drawings, except where the drawings indicate otherwise, and means dimensions and materials shall be as shown and shall not be considered voided and no responsibility shall be assumed for any work.
- The use of drawings generally describes the completed project. It does not include requirements that may be necessary for construction or safety. The Contractor is responsible for safety and about the jobsite during construction and the design and construction of all temporary structures, formwork, shoring, bracing etc., required to complete the work.

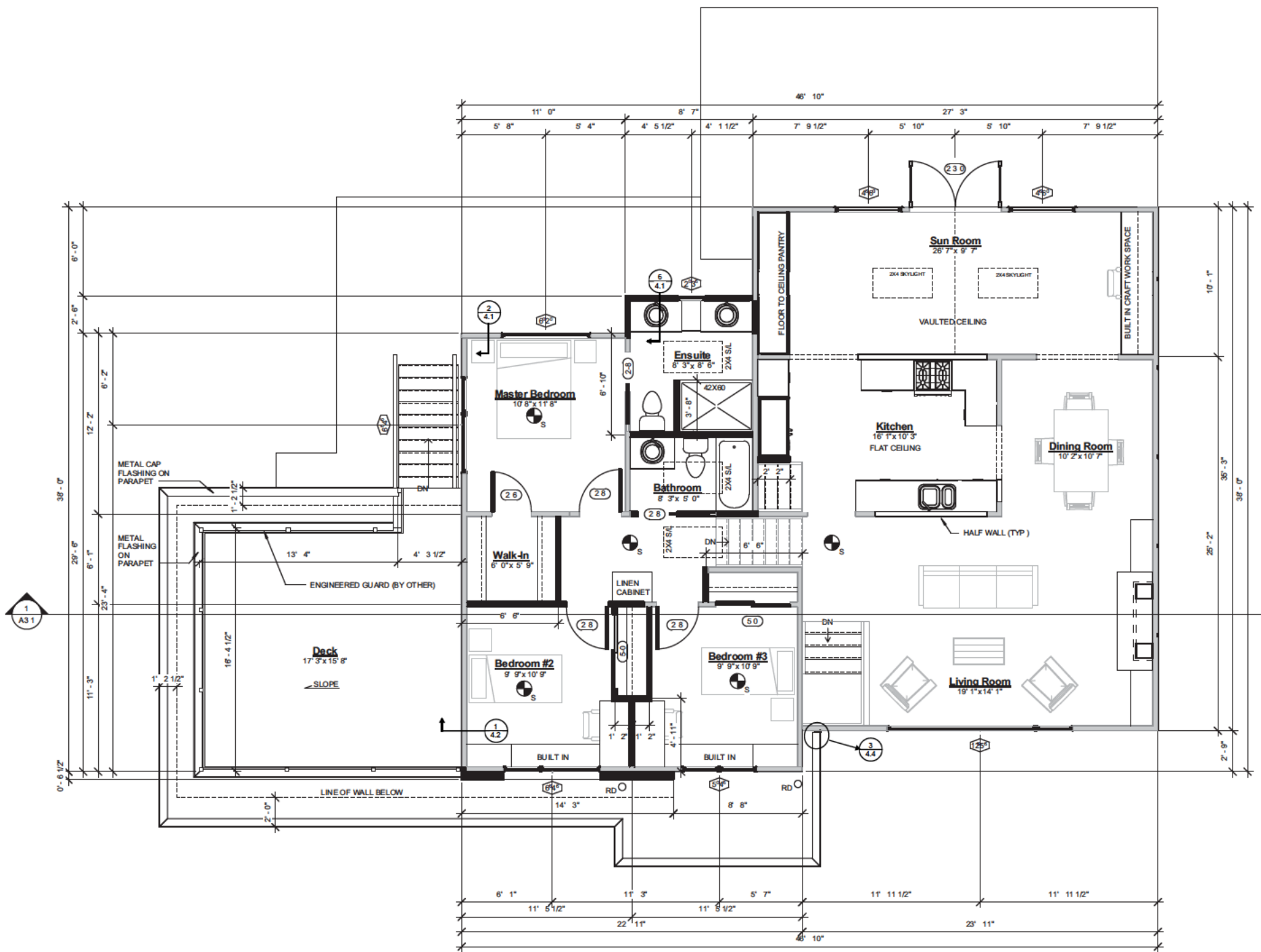
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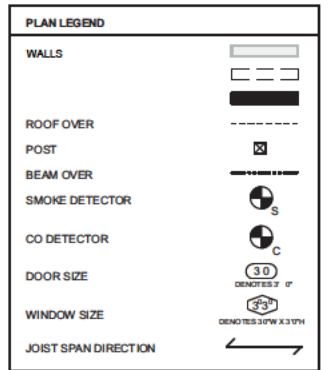
Project No  
 1494

Sheet  
**A2.2**



1 Main & Upper

- FRAMING NOTES:**
- 1 ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  - 2 ALL LUMBER TO BE SPP#2 OR BETTER UNLESS NOTED OTHERWISE
  - 3 ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  - 4 ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN
  - 5 ALL LINTELS TO BE 2 PLY 2X10 UN O
  - 6 ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  - 7 ALL INTERIOR DOORS TO BE 6'8" TALL UNLESS NOTED OTHERWISE; PROVIDE MIN 2 STUDS E/S AT JAMB FRAMING
  - 8 ALL EXTERIOR DOORS TO BE 7'0" TALL UNLESS NOTED OTHERWISE
  - 9 TYPICAL DOOR / WINDOW HEAD HEIGHT  
MAIN FLOOR 7'  
BASEMENT 6'8"
  - 10 ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
  - 11 DESIGN LOADS  
SAANICH Ss 2.1kPa  
Sr 0.3kPa



**GENERAL NOTES**

- 1 All drawings shall be in accordance with the design specifications and other documents prepared by the Designer (R/S) and used in connection with this project as indicated on drawings for the work shown in them (R/W) and as such are and remain the property of R/S. All work to be executed shall be in accordance with the R/S drawings and shall not be used on any other work or project.
- 2 Use of drawings shall not be construed to be a guarantee or warranty of any kind.
- 3 Do not construct any items (drawings) unless marked "To Construct" by R/S in the issued drawings or unless otherwise indicated.
- 4 The drawings shall not be construed as a "Contract" or "Contract Documents" unless and until they are incorporated into the Contract Documents.
- 5 It is the responsibility of the Contractor to verify all dimensions and conditions relating to existing buildings or structures as applicable to the project. The Contractor shall notify the Designer of any errors, omissions or discrepancies as identified in the drawings or to be corrected at the start of the work. Commencement of construction or any part thereof shall constitute acceptance of the drawings and conditions of the drawings and shall constitute a binding contract. All dimensions and materials shall be as shown on drawings unless otherwise indicated.
- 6 The use of drawings generally describes the completed project. It does not include requirements that may be necessary for construction or safety. The Contractor is responsible for verifying and about the job site during construction and the design and construction of all temporary structures, formwork, shoring, bracing, etc., required for completion of the work.

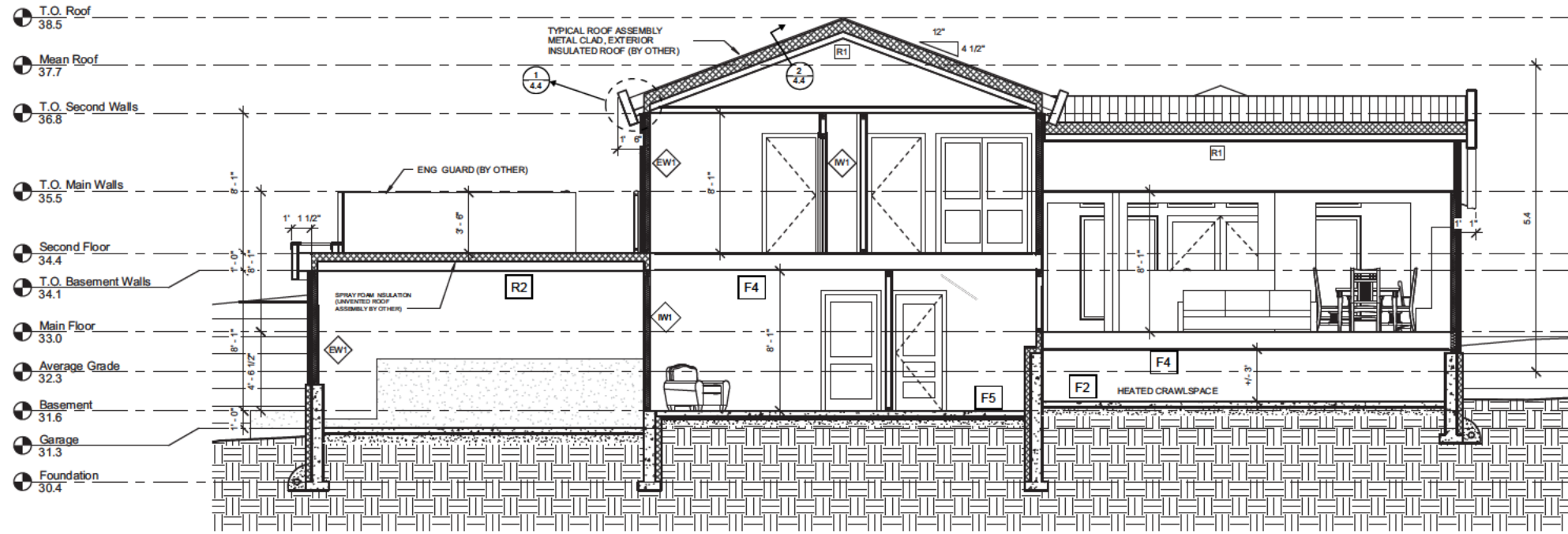
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Sheet Title  
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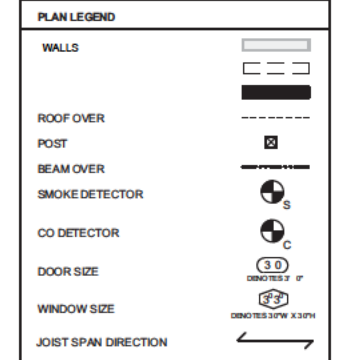
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**A2.3**



**FRAMING NOTES:**

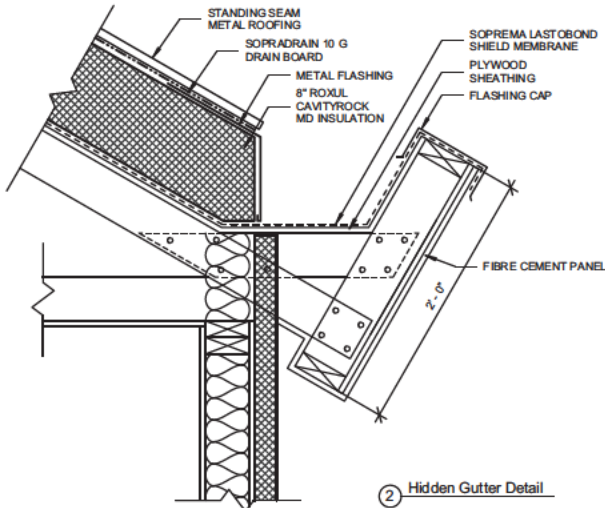
- ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
- ALL LUMBER TO BE SPF#2 OR BETTER UNLESS NOTED OTHERWISE
- ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
- ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN ALL UNTELS TO BE 2 PLY 2X10 U N O
- ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
- ALL INTERIOR DOORS TO BE 6" TALL UNLESS NOTED OTHERWISE; PROVIDE MIN 2 STUDS AT JAMB FRAMING
- ALL EXTERIOR DOORS TO BE 70" TALL UNLESS NOTED OTHERWISE
- TYPICAL DOOR / WINDOW HEAD HEIGHT
- BASEMENT 8"
- ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
- DESIGN LOADS  
SAVANICH S<sub>s</sub> 2.1kPa  
S<sub>r</sub> 0.3kPa



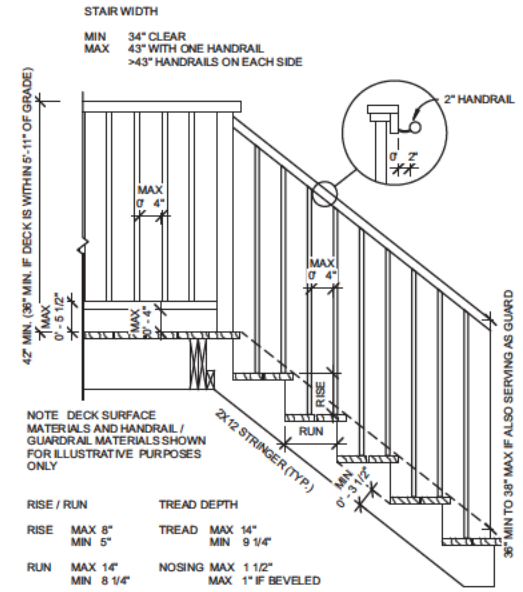
**GENERAL NOTES:**

- All drawings shall comply with the British Columbia Building Code (BCBC) and all other applicable codes and standards. It is the responsibility of the Contractor to verify the accuracy of all dimensions and specifications shown on these drawings.
- Use of fasteners shall be in accordance with the manufacturer's specifications.
- Do not construct any frame or structure unless approved by the Designer. The Contractor shall notify the Designer of any errors, omissions or discrepancies as they occur in the drawings or on or to the construction of the work.
- The Designer shall not be liable for "printing" or "copying" or "reproduction" of these drawings without the written consent of the Designer. The Designer shall not be responsible for any errors, omissions or discrepancies in the drawings or on or to the construction of the work.
- The use of a design generally describes the completed project. It does not include requirements that may be necessary for construction during construction and the design and construction of all temporary structures, formwork, scaffolding, etc., required for completion of the work.

Section A



Hidden Gutter Detail



Typical Residential Deck Stair Configuration

**HEATING SYSTEM**

FORCED AIR FURNACE

**VENTILATION REQUIREMENTS**

KITCHEN AND BATHROOM FANS IN ACCORDANCE WITH 9.32.3.6

	INTERMITTENT	CONTINUOUS
KITCHEN	47LS	N/A
BATHROOM	23LS	9LS

**PRINCIPAL VENTILATION SYSTEM SUPPLY AIR (9.32.3.4)**  
DUCTED FORCED AIR SYSTEM WITH HRV  
PROVIDE SUPPLY AIR TO EACH BEDROOM AND EACH FLOOR LEVEL WITHOUT A BEDROOM

**PRINCIPAL VENTILATION SYSTEM EXHAUST FAN (9.32.3.5)**

TOTAL FLOOR AREA	204 m <sup>2</sup>
NUMBER OF BEDROOMS	3
PRINCIPAL EXHAUST FAN MINIMUM AIR FLOW RATE PER 9.32.3.4	28LS

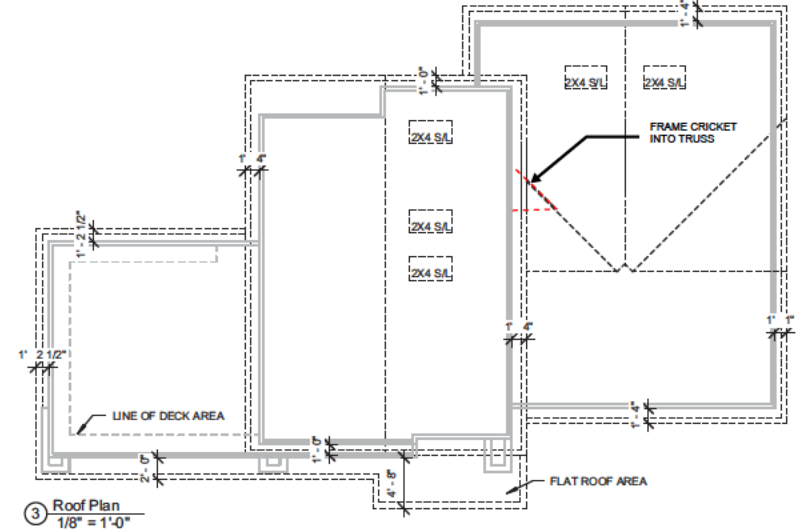
**HEATED CRAWLSPACE VENTILATION (9.32.3.7)**

CRAWLSPACE HEAT SOURCE  
DUCTED FORCED AIR SYSTEM  
TOTAL CRAWLSPACE AREA 64 m<sup>2</sup>  
PROVIDE 1 AIR TRANSFER GRILLE TO FLOOR AREA ABOVE FOR EACH 30m<sup>2</sup> OF CRAWLSPACE AREA

Description	Date

**ASSEMBLY DESCRIPTIONS**

EXTERIOR WALLS		INTERIOR WALLS		FLOOR SYSTEMS		ROOF SYSTEMS		WINDOWS, DOORS & SKYLIGHTS	
EW1 EXTERIOR WALL 2X4	RSI R	IW1 BEDROOM AND BATHROOM WALLS	RSI R	F3 FLOOR OVER UNHEATED SPACE	RSI R	R1 ROOF SLOPED METAL	RSI R	W1 WINDOWS AND DOORS	USI U
1 FINISH TO OWNERS SPECIFICATION	0.00 0.00	1 1/2" GYPSUM WALL BOARD AND FINISH	0.00 0.00	1 1.5" CONCRETE TOPPING - POWER TROWEL	0.00 0.00	1 FINISH TO OWNERS SPECIFICATION	0.00 0.00	1 INNO NOVA 70 MS	1.08 0.19
2 1/2" GYPSUM WALL BOARD	0.08 0.45	2 2X4 STUDS AT 16" O.C.	0.00 0.00	2 1/2" PLYWOOD SHEATHING	0.11 0.62	2 1/2" GYPSUM CD WALL BOARD	0.08 0.45	434 GLAZING (MIN THICKNESS) CLEAR	0.00 0.00
3 2X4 STUDS	0.00 0.00	3 ROXUL SAFE NSOUND BATT INSULATION	0.00 0.00	3 2X6 FLOOR JOISTS	0.00 0.00	3 2X4 ENG. TRUSSES	0.00 0.00	LOW E SURFACE 2 AND 5	0.00 0.00
4 3.5" ROXUL COMFORTBATT INSULATION	1.93 10.9	4 1/2" GYPSUM WALL BOARD AND FINISH	0.00 0.00	4 8" DEMILEC POLARFOAM PF 7300 INS	5.58 31.7	4 5/8" PLYWOOD SHEATHING	0.11 0.62	ARGON FILL	0.00 0.00
5 1/2" PLYWOOD SHEATHING	0.11 0.62	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>N/A N/A</b>	5 SOPREMA LASTOBOND SHIELD MEMBRANE	0.00 0.00	5 SOPREMA LASTOBOND SHIELD MEMBRANE	0.00 0.00	WARM EDGE, HARD BAR SPACER	0.00 0.00
6 SOPRASEAL STICK V P AM BARRIER	0.00 0.00	IW2 INTERIOR WALLS	RSI R	6 8" ROXUL CAVITYROCK MD INSULATION	5.91 33.6	6 8" ROXUL CAVITYROCK MD INSULATION	5.91 33.6	<b>EFFECTIVE RSI / R VALUE (INV NFRC U FACTOR)</b>	<b>0.93 5.25</b>
7 2" ROXUL COMFORTBATT IS	1.41 8.01	1 1/2" GYPSUM WALL BOARD AND FINISH	0.00 0.00	7 SOPREMA 0.4" SOPRADRAIN 10 G DRAIN BOARD	0.05 0.28	7 SOPREMA 0.4" SOPRADRAIN 10 G DRAIN BOARD	0.05 0.28	S1 SKYLIGHTS	USI U
8 1/2" RAINSCREEN/CAPILLARY BREAK	0.17 0.97	2 2X4 STUDS AT 16" O.C.	0.00 0.00	8 1/2" DRAINAGE CAVITY	0.17 0.97	8 1/2" DRAINAGE CAVITY	0.17 0.97	1 ALUMICOR SKYVIEW 2300	2.40 0.42
9 WOOD SIDING OR FIBRE CEMENT CLADDING	0.10 0.57	3 1/2" GYPSUM WALL BOARD AND FINISH	0.00 0.00	9 STANDING SEAM METAL ROOF	0.00 0.00	9 STANDING SEAM METAL ROOF	0.00 0.00	66 GLAZING, GREY	0.00 0.00
<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>3.80 21.6</b>	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>N/A N/A</b>	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>6.32 35.9</b>	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>6.32 35.9</b>	LOW E SURFACE 2	0.00 0.00
EW2 EXTERIOR WALL 2X4	RSI R	F1 FLOOR - GARAGE SLAB	RSI R	R2 ROOF GARAGE DECK	RSI R	R2 ROOF GARAGE DECK	RSI R	ARGON FILL	0.00 0.00
1 FINISH TO OWNERS SPECIFICATION	0.00 0.00	1 COMPACTER SUB BASE	0.00 0.00	1 COMPACTER SUB BASE	0.00 0.00	1 COMPACTER SUB BASE	0.00 0.00	STAINLESS STEEL SPACER BAR BLACK	0.00 0.00
2 1/2" GYPSUM WALL BOARD	0.08 0.45	2 10MIL POLY AVV BARRIER	0.00 0.00	2 10MIL POLY AVV BARRIER	0.00 0.00	2 10MIL POLY AVV BARRIER	0.00 0.00	<b>EFFECTIVE RSI / R VALUE (INV NFRC U FACTOR)</b>	<b>0.42 2.37</b>
3 2X4 STUDS	0.00 0.00	3 4" CONCRETE SOG (32MPa) RW 10M E/W @ 24"	0.00 0.00	3 2" DEMILEC POLARFOAM PF 7300 INS	5.58 31.7	3 2" DEMILEC POLARFOAM PF 7300 INS	5.58 31.7	FLAT ROOF AREA	
4 3.5" ROXUL COMFORTBATT INSULATION	1.93 10.9	4 SLOPED FINISH	0.00 0.00	4 3.5" CONCRETE S O G HAND TROWEL FINISH	0.07 0.40	4 3.5" CONCRETE S O G HAND TROWEL FINISH	0.07 0.40		
5 1/2" PLYWOOD SHEATHING	0.11 0.62	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>N/A N/A</b>	5 FINISH FLOOR TO OWNERS SPECIFICATION	0.00 0.00	5 FINISH FLOOR TO OWNERS SPECIFICATION	0.00 0.00		
6 SOPRASEAL STICK V P AM BARRIER	0.00 0.00	F2 FLOOR - CRAWLSPACE GROUND SEAL	RSI R	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>N/A N/A</b>	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>5.94 33.2</b>		
7 2" ROXUL COMFORTBATT IS	1.41 8.01	1 COMPACTER SUB BASE	0.00 0.00						
8 1/2" RAINSCREEN/CAPILLARY BREAK	0.17 0.97	2 10MIL POLY AVV BARRIER	0.00 0.00						
9 GALV METAL LATH AND 1/2" MORTAR BED	0.02 0.11	3 2" CONCRETE SOG (32MPa) RW 10M E/W @ 24"	0.00 0.00						
10 THINSTONE VENEER	0.01 0.06	4 SLOPED FINISH	0.00 0.00						
<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>3.73 21.2</b>	<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>N/A N/A</b>						
EW3 EXT. WALL - 6" CONC. WALL	RSI R								
1 DUROCK CEMENT BOARD	0.07 0.39								
2 DORKEN "DELTA-DRAIN" DRAINBOARD	0.05 0.28								
3 4.5" ROXUL COMFORTBOARD 80 INS.	3.17 18.0								
4 SOPREMA COLPHENE LM 300 MEMBRANE	0.00 0.00								
5 8" CONCRETE FOUNDATION WALL	0.20 1.15								
<b>EFFECTIVE RSI / R VALUE OF ENTIRE ASSEMBLY</b>	<b>3.49 19.8</b>								



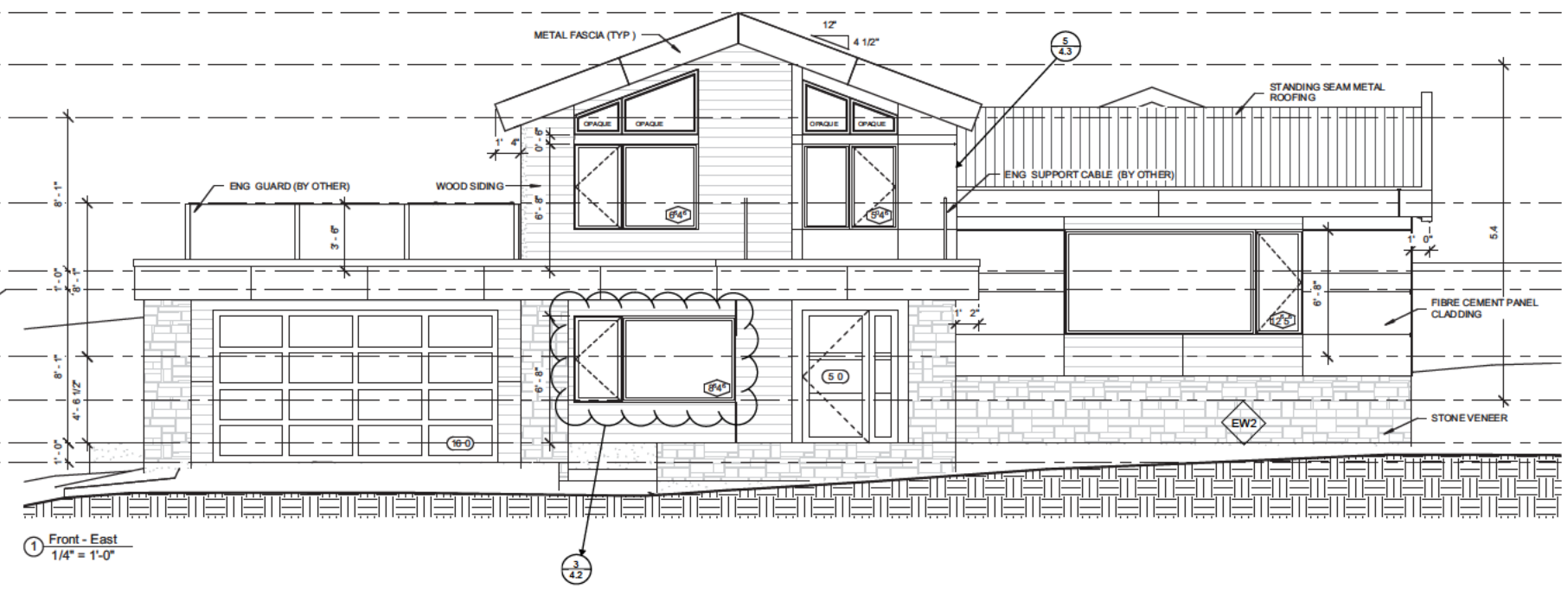
Roof Plan 1/8" = 1'-0"

Project No 1494

Sheet A3.1

Section & Roof Plan

- T.O. Roof 38.5
- Mean Roof 37.7
- T.O. Second Walls 36.8
- T.O. Main Walls 35.5
- Second Floor 34.4
- T.O. Basement Walls 34.1
- Main Floor 33.0
- Average Grade 32.3
- Basement 31.3

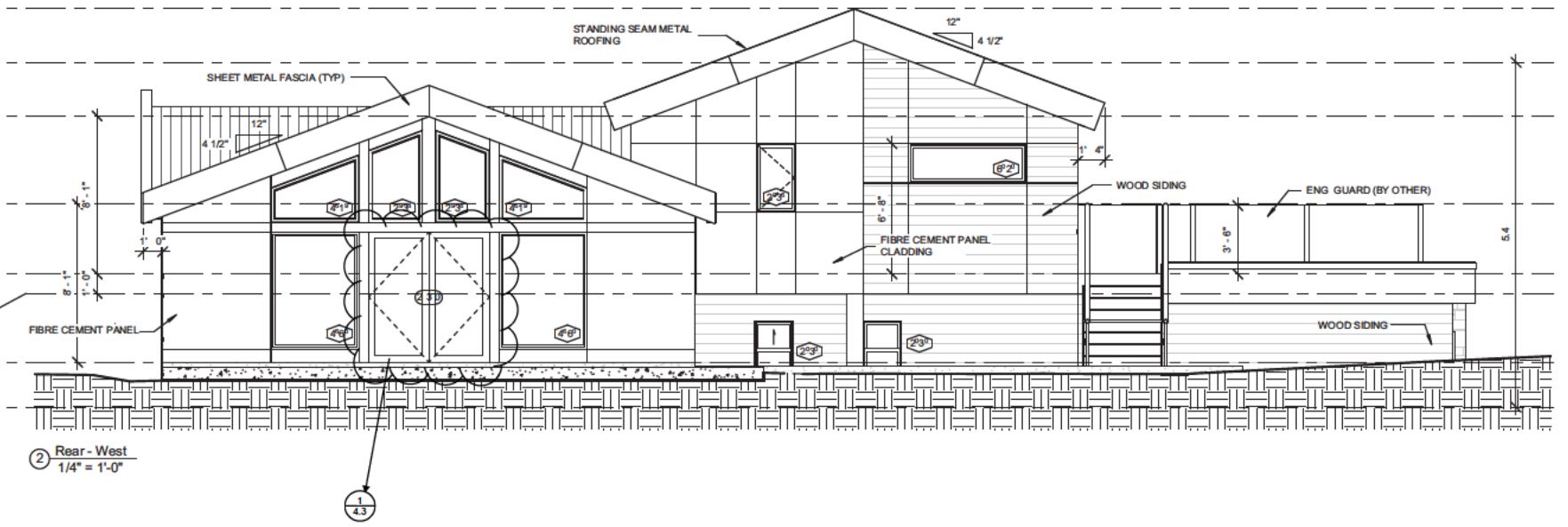


1 Front - East  
1/4" = 1'-0"

**EXTERIOR FINISH NOTES**

SOFFIT	TYPICAL EAVE GABLE EAVE U/S OF DECK U/S OF ENTRY CANOPY	SHEET METAL TO MATCH ROOF SHEET METAL TO MATCH ROOF STAINED FINELINE WOOD STAINED FINELINE WOOD
GLITTERS	4" ROUND PAINTED PVC	
FASCIA	SHEET METAL TO MATCH ROOF	
WINDOW TRIM	SHEET METAL CLOSURE (TYP)	
DOOR TRIMS	SHEET METAL CLOSURE (TYP)	

- T.O. Roof 38.5
- Mean Roof 37.7
- T.O. Second Walls 36.8
- T.O. Main Walls 35.5
- Second Floor 34.4
- T.O. Basement Walls 34.1
- Main Floor 33.0
- Average Grade 32.3



2 Rear - West  
1/4" = 1'-0"

**GENERAL NOTES**

- 1 All design items, including design specifications and other documents prepared by the Designer (P/E) and used in connection with this project are instruments of service for the work shown in them. They are not to be used for any other project or purpose without the written consent of the Designer. The Designer shall not be held responsible for any errors or omissions in the design or construction of any structure or project.
- 2 Use of these drawings is limited to that described in the contract documents.
- 3 Do not construct any items shown on these drawings unless they are specifically noted as being to be constructed in the contract documents.
- 4 The drawings shall not be used for "printing" or "copying" or "reproduction" of any kind without the written consent of the Designer. The Designer shall not be held responsible for any errors or omissions in the design or construction of any structure or project.
- 5 It is the responsibility of the Contractor to verify all dimensions and specifications relating to existing conditions or to be constructed on site. The Contractor shall notify the Designer of any errors, omissions or discrepancies as identified in the drawings or or to commencement of the work. Commencement of construction or any part thereof shall be acceptance of the drawings, which shall constitute the Contractor's acknowledgment and agreement to the same, and shall constitute the Contractor's agreement to construct the same as shown on the drawings and as approved by the Designer.
- 6 The use of any design generally describes the completed project. It does not include requirements that may be necessary for construction or safety. The Contractor is responsible for verifying and about the jobsite during construction and the design and construction of all temporary structures, formwork, shoring, etc., required for completion of the work.

Comments

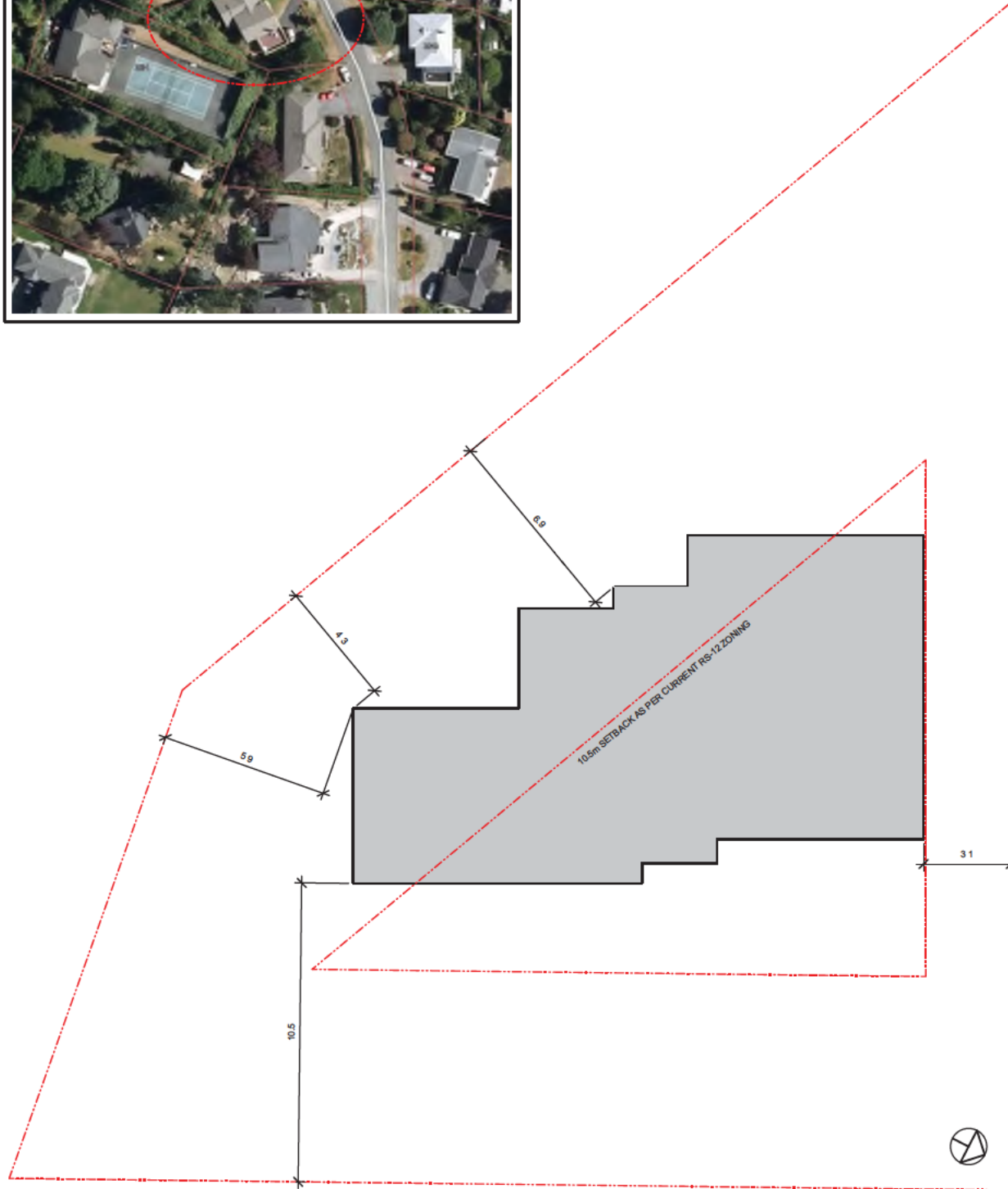
Sheet Title  
**Elevations**

Project No  
**1494**

Sheet  
**A4.1**



**KEY PLAN:**



**SITE PLAN**  
NTS

**GENERAL NOTES**

- THIS SET OF DRAWINGS SHOWS THE COMPLETED PROJECT. THE DRAWINGS DO NOT SHOW COMPONENTS THAT MAY BE NECESSARY FOR CONSTRUCTION SAFETY. THE CONTRACTOR IS RESPONSIBLE FOR SAFETY IN AND ABOUT THE JOB SITE DURING CONSTRUCTION AND THE DESIGN AND ERECTION OF ALL TEMPORARY STRUCTURES, FORMWORK, FALSE WORK, SHORING, ETC. REQUIRED TO COMPLETE THE WORK.
- THE USE OF THESE DRAWINGS IS LIMITED TO THAT IDENTIFIED IN THE REVISIONS COLUMN. DO NOT CONSTRUCT FROM THESE DRAWINGS UNLESS MARKED "ISSUED FOR CONSTRUCTION" IN THE REVISIONS COLUMN, AND SIGNED BY AN ENGINEER OF READ JONES CHRISTOFFERSEN LTD. THE DRAWINGS SHALL NOT BE USED FOR PRICING OR TENDER UNLESS SO INDICATED IN THE REVISION COLUMN.
- DESIGN**  
THE COMPLETED BUILDING ENVELOPE SHOWN ON THE DRAWINGS HAS BEEN DESIGNED IN SUBSTANTIAL ACCORDANCE WITH THE 1998 B.C. BUILDING CODE OR THE VICTORIA BUILDING BY-LAWS AS REQUIRED.
- SECTION MARK SHOWN THIS MEANS SECTION #4 ON DRAWING R-2.
- DO NOT CUT OR DRILL ANY OPENINGS IN STRUCTURAL MEMBERS WITHOUT WRITTEN PERMISSION OF R.J.C.
- ALL MECHANICAL, ELECTRICAL, ARCHITECTURAL AND OTHER ITEMS THAT ARE AFFECTED BY RESTORATION MUST BE REPLACED IN ACCORDANCE WITH CURRENT APPLICABLE CODES AND USING GOOD PRACTICE. MODIFY AS REQUIRED.
- SHOP DRAWINGS**  
RJC'S DRAWINGS, WHETHER IN ELECTRONIC FORMAT OR HARDCOPY, MAY NOT BE USED AS OR MODIFIED TO PROVIDE SHOP DRAWINGS UNLESS:  
- RJC IS REIMBURSED FOR THE DRAWINGS AND  
- THE CONTRACTOR RESPONSIBLE FOR THE SHOP DRAWINGS SIGNS STANDARD AUTHORIZATION AND WAIVER FORM.

**DESIGN PARAMETERS**

- THIS BUILDING ENVELOPE RESTORATION HAS BEEN DESIGNED USING "RAINSCREEN PRINCIPLES". THIS ASSEMBLY RELOCATES THE VAPOUR BARRIER AND INSULATION TO THE OUTSIDE OF EXTERIOR SHEATHING TO BETTER CONTROL VAPOUR TRANSFER AND AIR LEAKAGE, AND ENHANCE THE THERMAL PROPERTIES OF THE WALL.
- READ JONES CHRISTOFFERSEN PROVIDES FIELD REVIEW ONLY FOR THE WORK SHOWN ON THESE DRAWINGS. THIS REVIEW IS NOT A "FULL TIME" REVIEW BUT IS A PERIODIC REVIEW AT THE SOLE DISCRETION OF READ JONES CHRISTOFFERSEN'S ENGINEERS IN ORDER TO ASCERTAIN THAT THE WORK IS IN GENERAL CONFORMANCE WITH THE PLANS AND SUPPORTING DOCUMENTS PREPARED BY READ JONES CHRISTOFFERSEN. FIELD REVIEW BY READ JONES CHRISTOFFERSEN IS NOT CARRIED OUT FOR THE CONTRACTOR'S BENEFIT, NOR DOES IT MAKE READ JONES CHRISTOFFERSEN GUARANTORS OF THE CONTRACTOR'S WORK. IT REMAINS THE CONTRACTOR'S RESPONSIBILITY TO BUILD THE WORK IN CONFORMANCE WITH THE DOCUMENTS. RJC SHALL NOT BE RESPONSIBLE FOR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUB-CONTRACTOR, OR ANY OTHER PERSONS PERFORMING ANY OF THE WORK OR FOR THE FAILURE OF ANY OF THEM TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.  
  
RJC WILL REVIEW SHOP DRAWINGS PERTAINING TO WORK SHOWN ON RJC'S DRAWINGS. THE EXTENT OF THIS REVIEW IS AT THE SOLE DISCRETION OF RJC'S ENGINEER AND IS FOR THE SOLE PURPOSE OF ASCERTAINING GENERAL CONFORMANCE WITH THE BUILDING ENVELOPE DESIGN CONCEPT. THE REVIEW IS NOT AN APPROVAL OF THE DETAILS, AND DIMENSIONS INHERENT IN THE SHOP DRAWINGS, RESPONSIBILITY FOR WHICH SHALL REMAIN WITH THE CONTRACTOR SUBMITTING THEM. SUCH REVIEW SHALL NOT RELIEVE THE CONTRACTOR OF HIS OR HER RESPONSIBILITY FOR ERRORS AND OMISSIONS IN THE SHOP DRAWINGS OR FOR MEETING ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS.
  - PROVIDE 24 HOURS ADVANCE NOTICE OF EACH REQUIRED FIELD REVIEW. FIELD REVIEWS SHALL BE SCHEDULED TO BE CARRIED OUT DURING NORMAL BUSINESS HOURS UNLESS SPECIAL ARRANGEMENTS ARE MADE WITH RJC.
  - THE WORK TO BE REVIEWED SHALL BE GENERALLY COMPLETE.

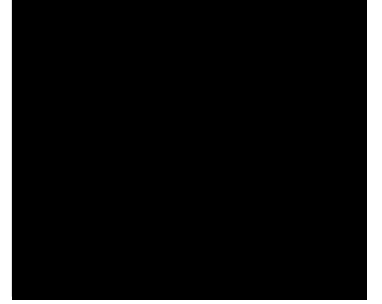
**GENERAL**

- ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:  
-BRITISH COLUMBIA BUILDING CODE PART 4 OR VICTORIA BUILDING BY-LAWS  
-CAN/CSA-086 ENGINEERING DESIGN IN WOOD  
-CAN/CSA-0121 DOUGLAS FIR PLYWOOD  
-CAN/CSA-0437 STRAND BOARD AND WATERBOARD  
-CAN/CSA-B111 WIRE NAILS, SPIKES AND STAPLES  
-CAN/CSA-B24 MISCELLANEOUS BOLTS AND SCREWS  
-CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC  
-WOOD DESIGN MANUAL - CANADIAN WOOD COUNCIL  
-WOOD BUILDING TECHNOLOGY - CANADIAN WOOD COUNCIL
- ANY CHANGES TO THE EXISTING FRAMING SHALL HAVE PRIOR WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED IF NOT COMPLETED CORRECTLY.
- ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
- FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
- DO NOT COVER WOOD FRAMING WITH FINISHES UNTIL THE STRUCTURAL ENGINEER'S FRAMING REVIEW IS COMPLETE. PROVIDE 24 HOURS ADVANCE NOTIFICATION WHEN FRAMING REVIEWS ARE REQUIRED.
- NOTCHING AND DRILLING OF STRUCTURAL ELEMENTS SHALL FOLLOW THE GUIDELINES SET FORTH IN THE BRITISH COLUMBIA BUILDING CODE OF CANADA PART 9, UNLESS OTHERWISE APPROVED IN WRITING BY READ JONES CHRISTOFFERSEN.
- ALL NEW TIMBER AND SHEATHING TO BE PRESSURE TREATED WHERE SPECIFIED, FIELD TREAT ALL CUT ENDS.

**MATERIALS**

- STUDS & BUILT-UP POSIES TO BE S-P-F # 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED.
- JOISTS TO BE SPF # 2 GRADE OR BETTER.
- BUILT-UP BEAMS AND HEADERS TO BE SPF # 2 GRADE OR BETTER.
- WALL PLATES TO BE S-P-F STUD GRADE OR BETTER. WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED.
- POSTS AND BEAMS TO BE SPF # 2 GRADE OR BETTER.
- ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S") AND S-DRY
- SHEATHING TO BE O.S.B
- TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, CANADA SCAFFOLD SUPPLY, WGA CONNECTORS OR APPROVED EQUAL.
- NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS OR COMMON SPIRAL NAILS. ALL NAILS IN CONTACT WITH PRESSURE TREATED MATERIALS OR OUTSIDE OF MOISTURE BARRIER TO BE HOT-DIPPED GALVANIZED OR STAINLESS STEEL.
- MISCELLANEOUS STEEL TO BE G40.21 OR APPROVED EQUAL.
- ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
- BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
- ALL FASTENERS AND CONNECTION HARDWARE THROUGH P/T MATERIALS TO BE HOT DIPPED GALVANIZED OR STAINLESS STEEL.

Drawing Notes



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Project Name



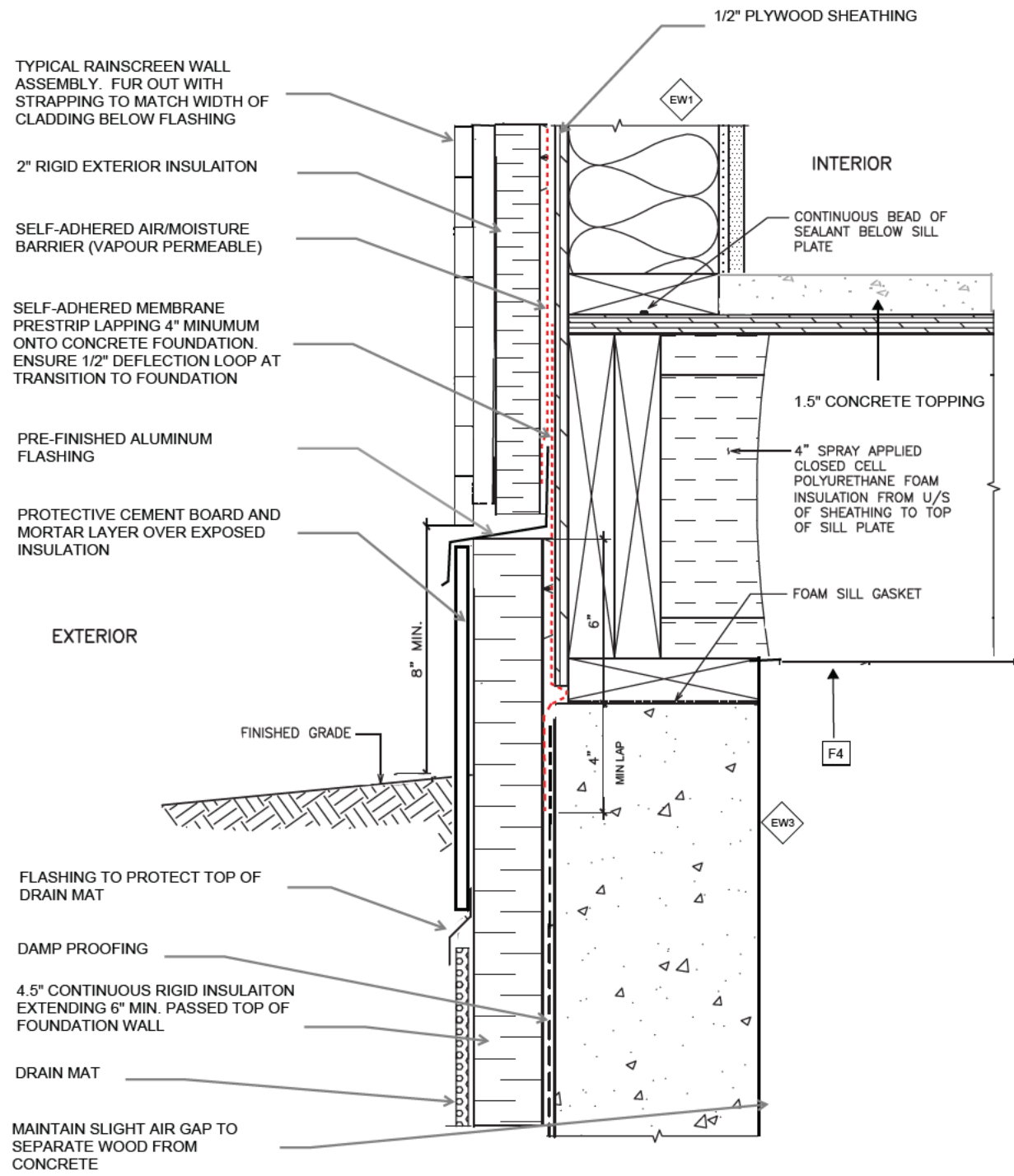
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**GENERAL NOTES AND SITE PLAN**

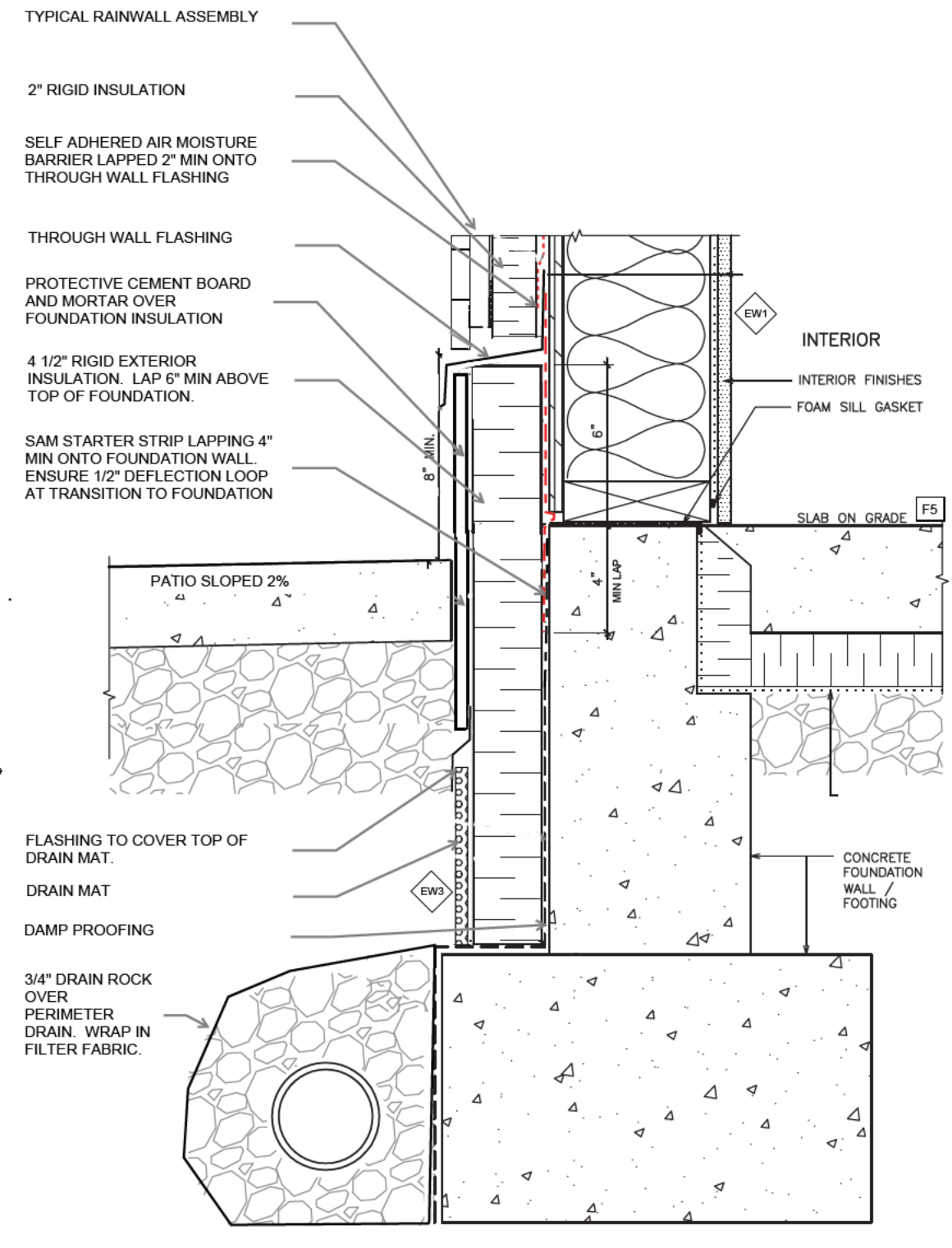


R-1.1

Drawing Notes



2  
4.0 TYPICAL BASE OF WALL AT FOUNDATION



1  
4.0 TYPICAL BASE OF WALL AT FOUNDATION

No	Revision	Date	By

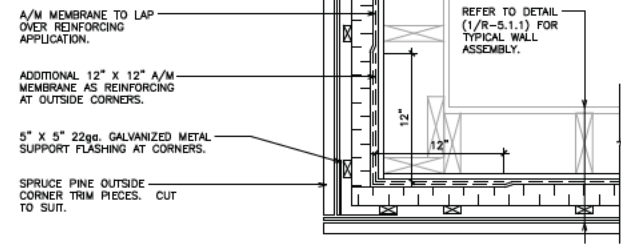
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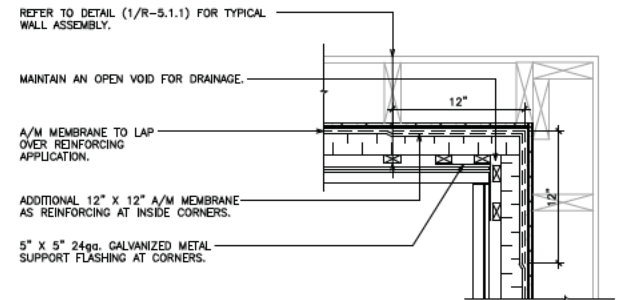
DETAILS

R-4.0

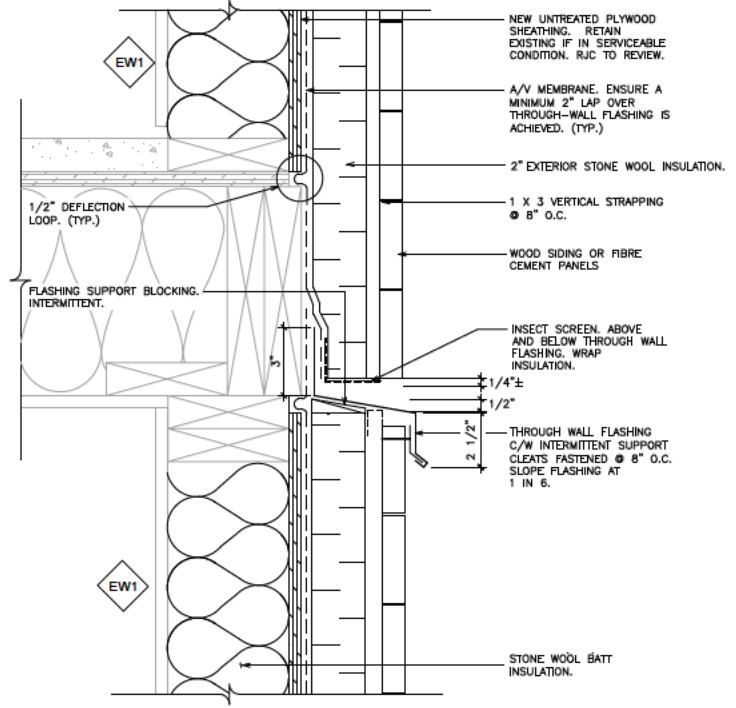
**NOTE**  
REFER TO THE NOTES AND LEGEND ON THIS SHEET FOR FURTHER DETAILS.



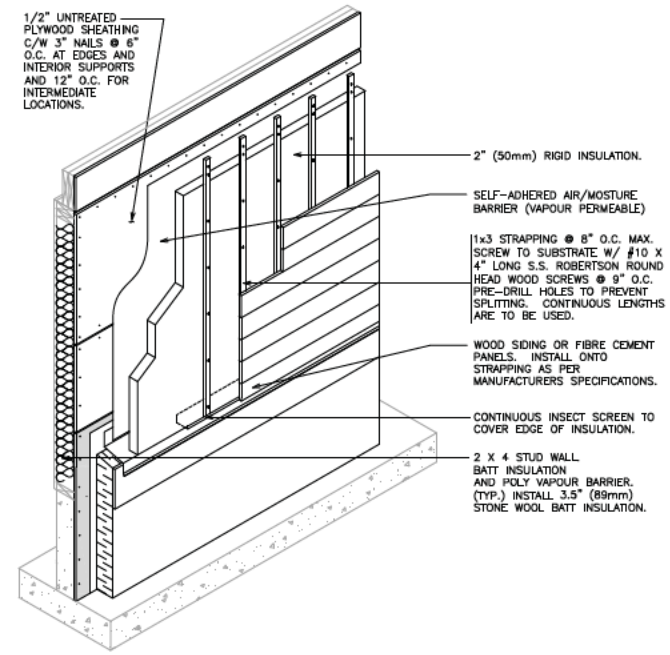
**3A TYPICAL OUTSIDE CORNER**  
4.1 1 1/2" = 1'-0"



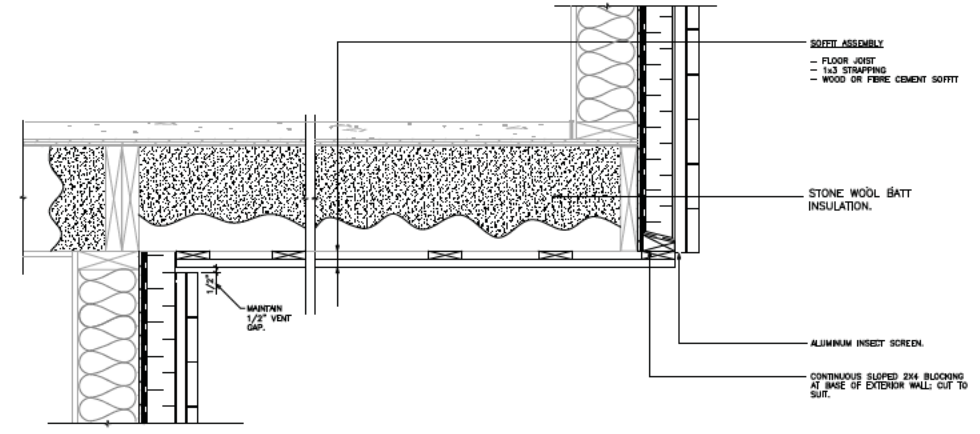
**3B TYPICAL INSIDE CORNER**  
4.1



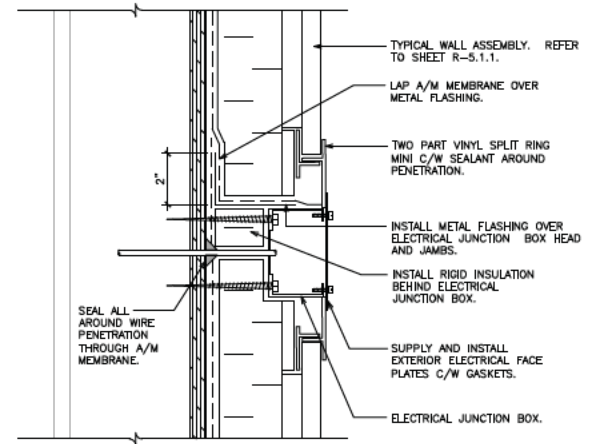
**2 TYPICAL THROUGH WALL FLASHING**  
4.1



**1 TYPICAL WALL ASSEMBLY**  
4.1

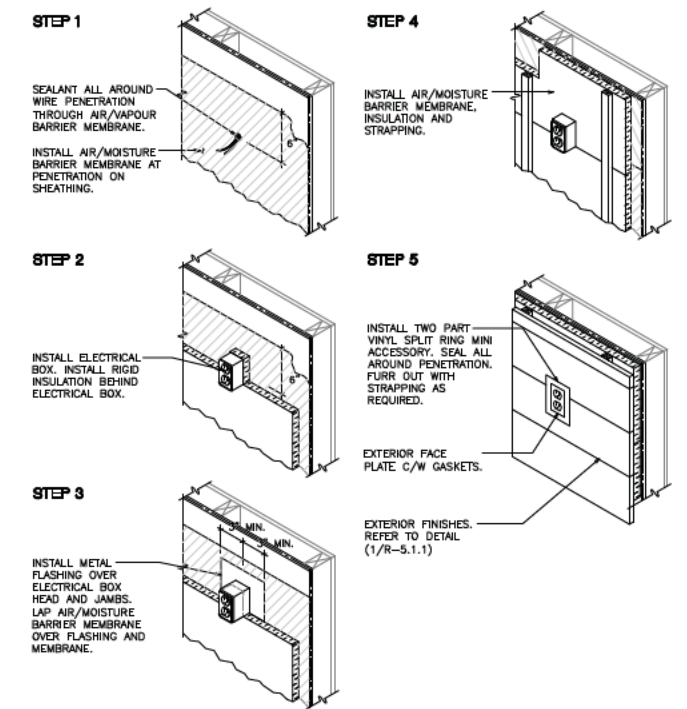


**6 OVERHANG AND SOFFIT DETAIL AT BEAM LOCATION**  
4.1

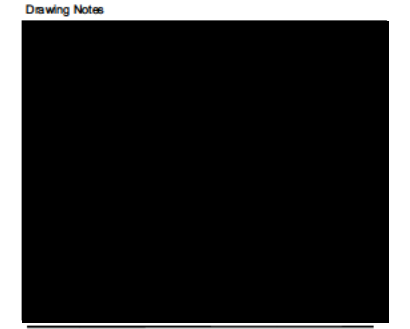


- ELECTRICAL RECEPTICAL NOTES**
1. INSTALL NEW GFCI ELECTRICAL RECEPTACLE. INCLUDE ALL WIRING AND TESTING.
  2. EXTEND AND TEST ELECTRICAL JUNCTION BOXES TO ACCOMMODATE NEW WALL ASSEMBLY.
  3. CONTRACTOR TO VERIFY QUANTITY AND LOCATION OF ELECTRICAL BOXES.
  4. ELECTRICAL BOXES TO BE INSTALLED BETWEEN 8" MAX. SPACED STRAPPING. STRAPPING TO REMAIN CONTINUOUS IN ACCORDANCE WITH TYPICAL WALL ASSEMBLY.

**5 ELECTRICAL RECEPTICAL INSTALLATION**  
4.1



**4 ELECTRICAL RECEPTICAL INSTALLATION**  
4.1



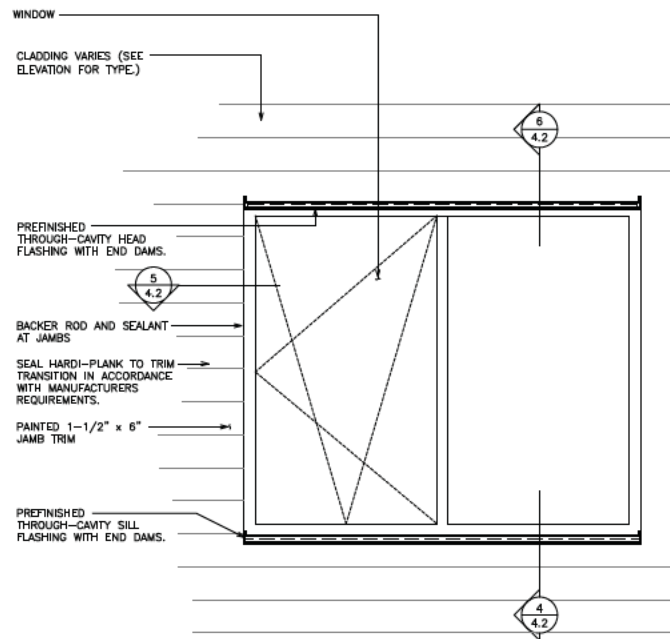
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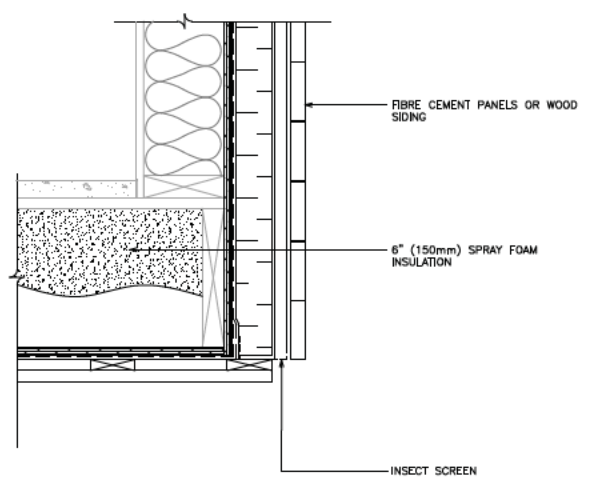
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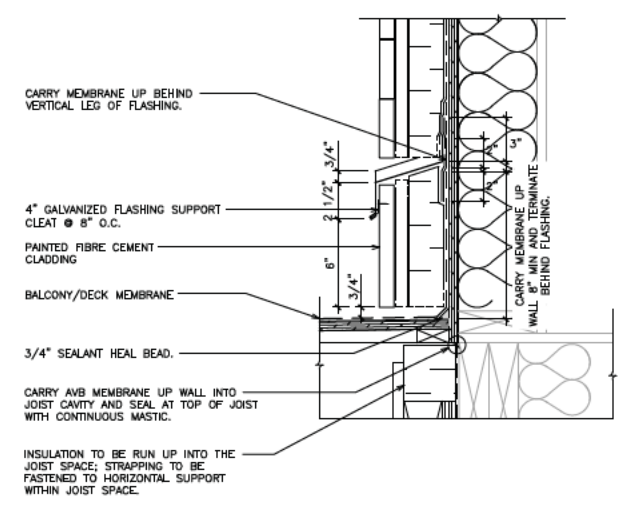
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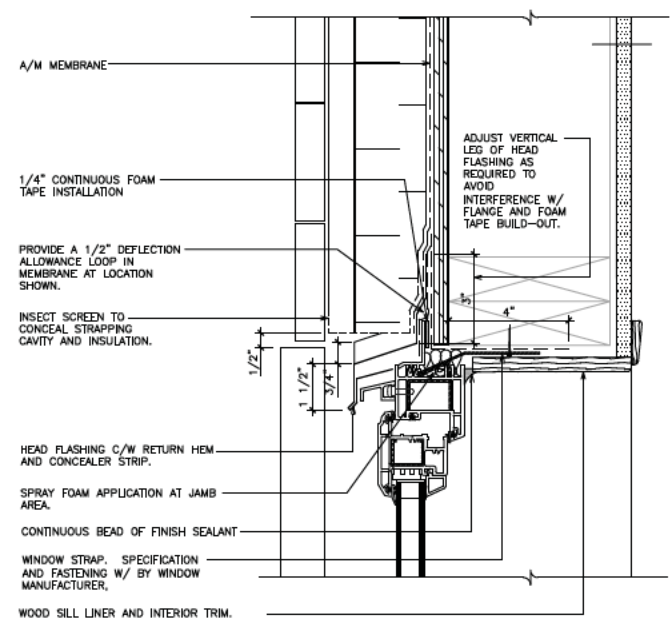
3 SCHEMATIC WINDOW ELEVATION  
4.2



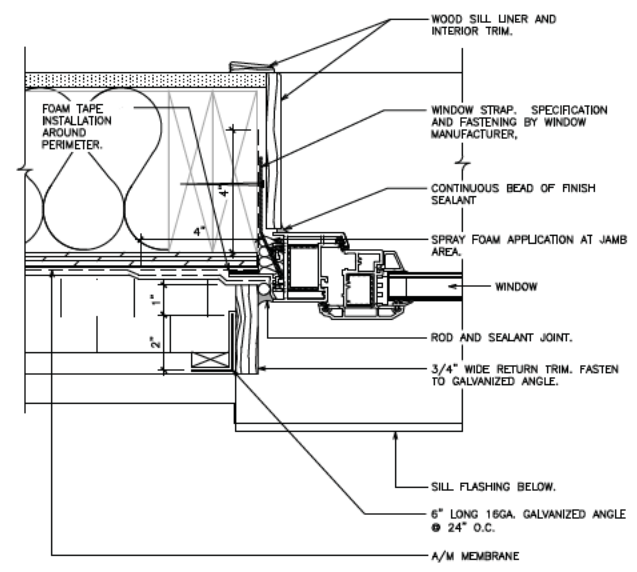
2 OVERHANG DETAIL  
4.2



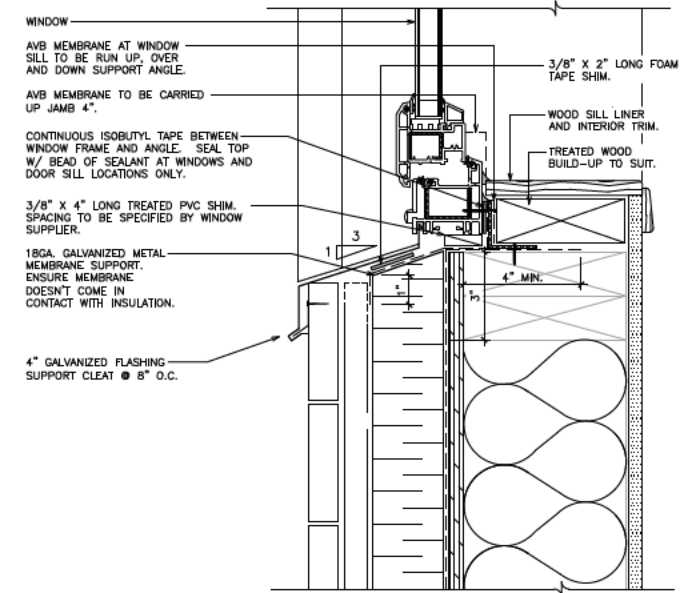
1 BASE OF WALL DETAIL  
4.2



6 TYPICAL WINDOW HEAD  
4.2



5 TYPICAL WINDOW JAMB  
4.2



4 TYPICAL WINDOW SILL  
4.2

Drawing Notes

No	Revision	Date	By

Project Name

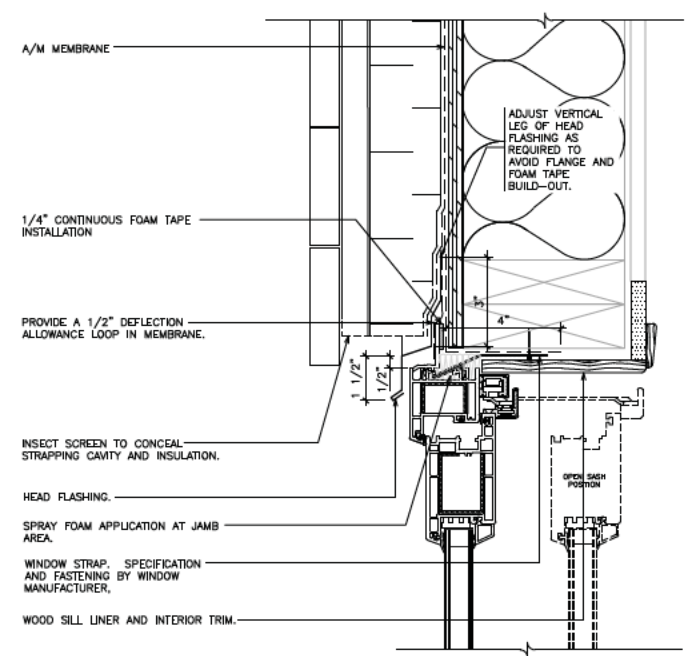
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Drawn By

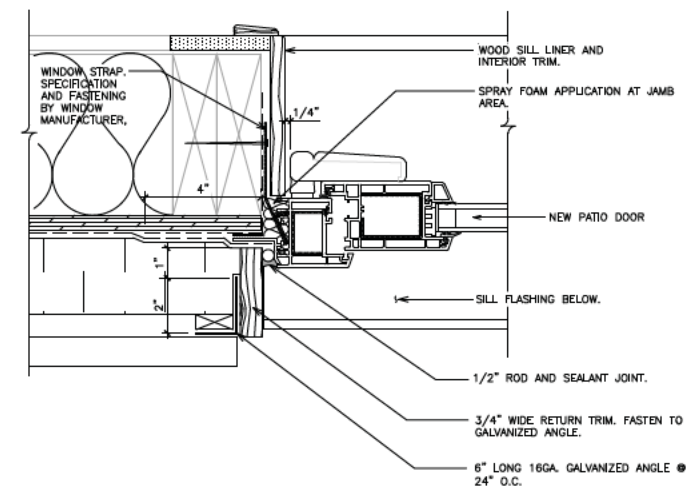
Designed By

R-4.2

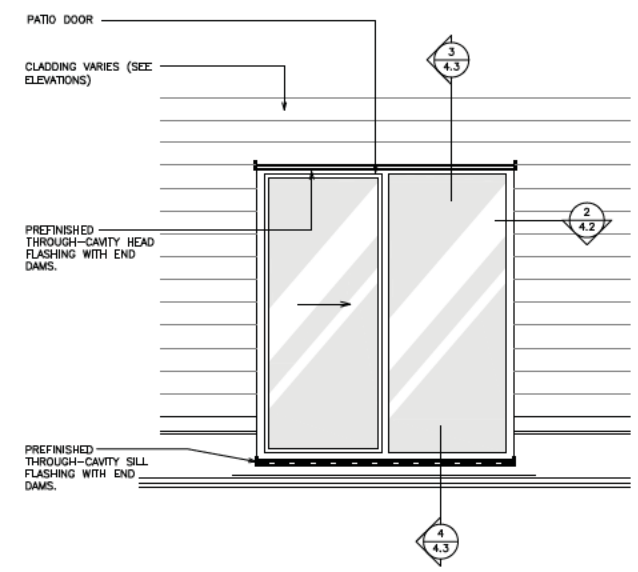
Drawing Notes



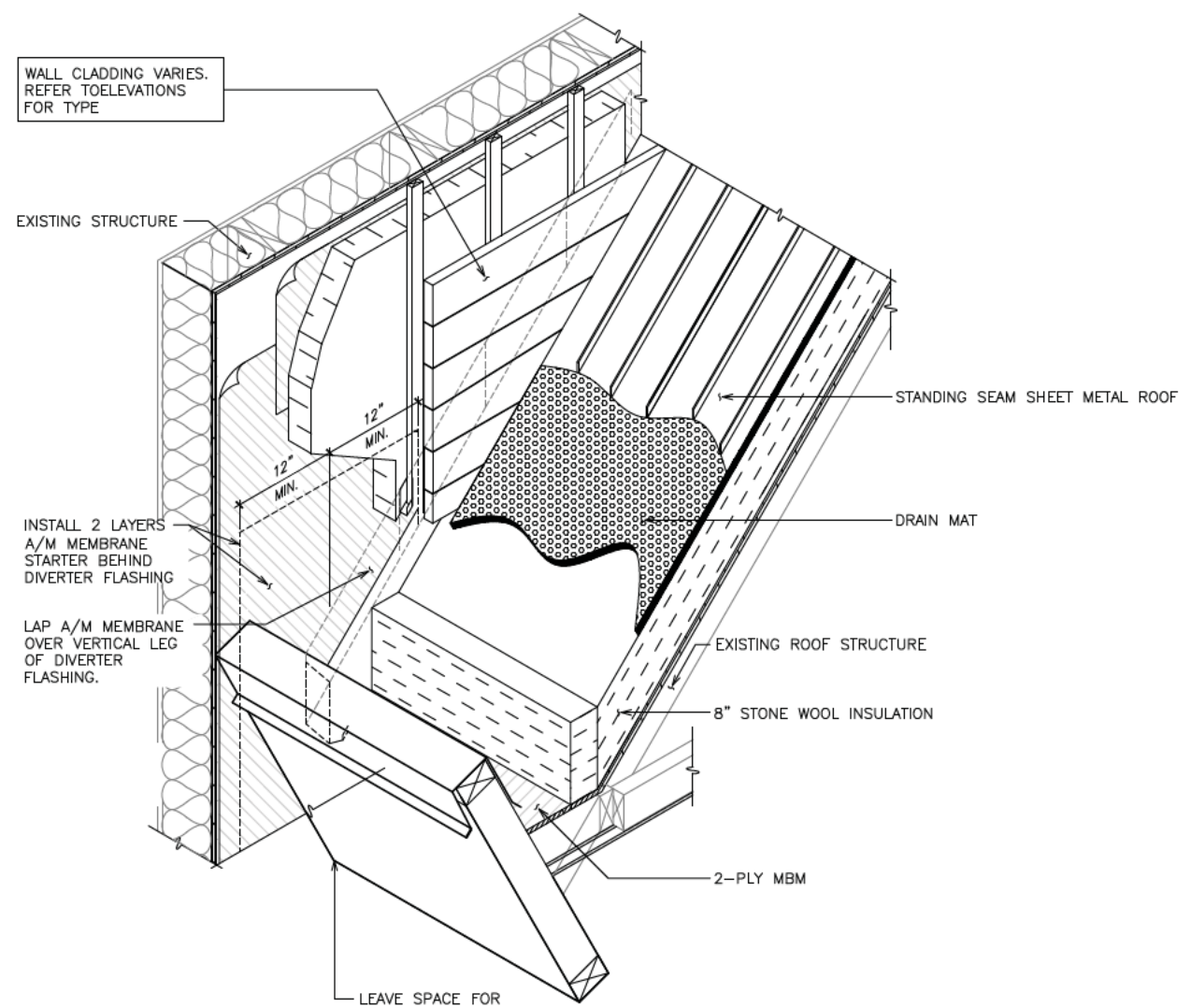
3 TYPICAL PATIO DOOR HEAD  
4.3



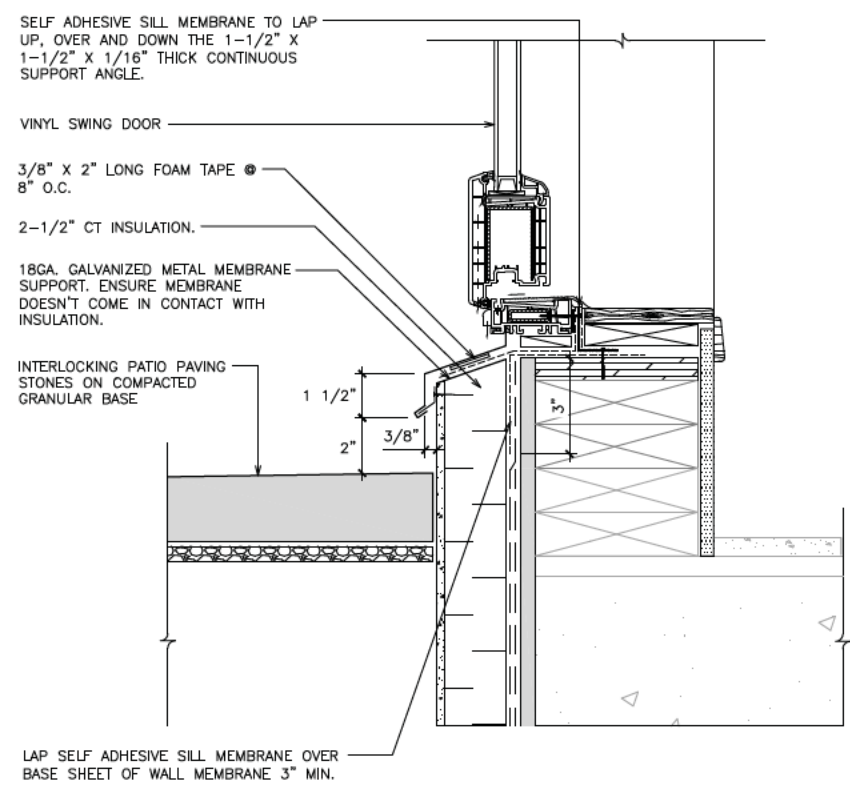
2 TYPICAL PATIO DOOR JAMB  
4.3



1 SCHEMATIC PATIO DOOR ELEVATION  
4.3



5 TYPICAL ROOF TO WALL INTERFACE  
4.3



4 TYPICAL PATIO DOOR SILL  
4.3

No	Revision	Date	By

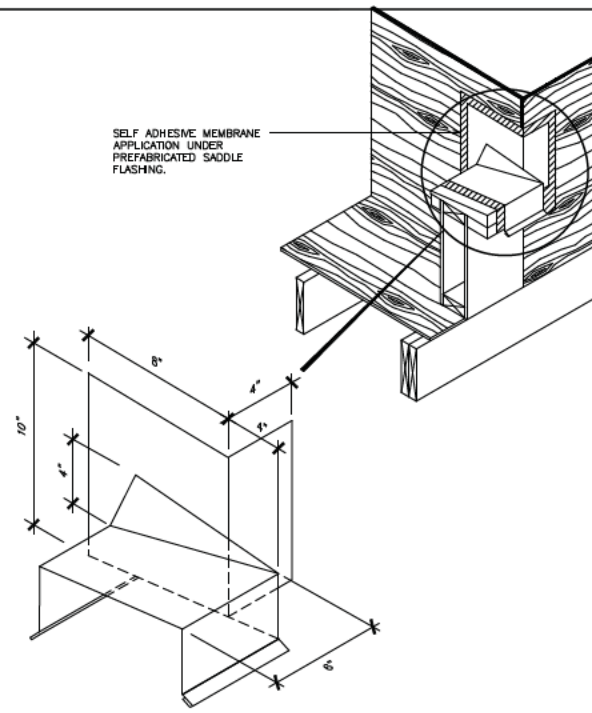
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Sheet Title  
**DETAILS**

Drawn By

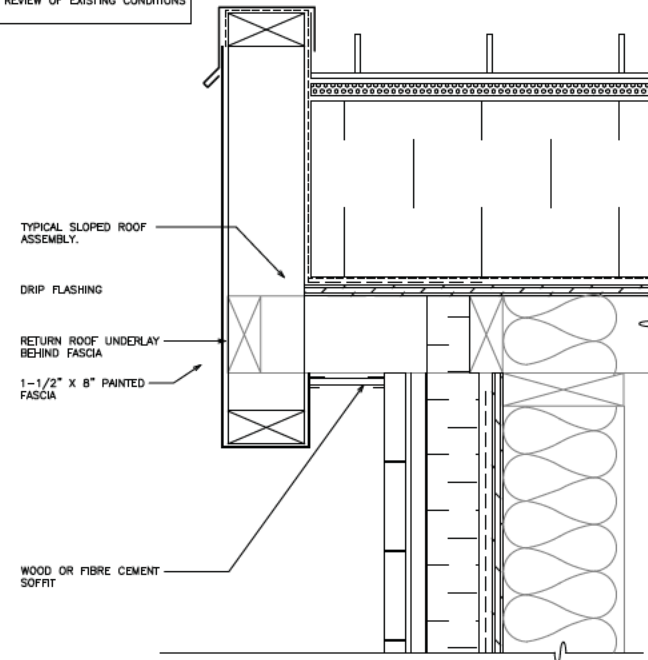


SELF ADHESIVE MEMBRANE APPLICATION UNDER PREFABRICATED SADDLE FLASHING.



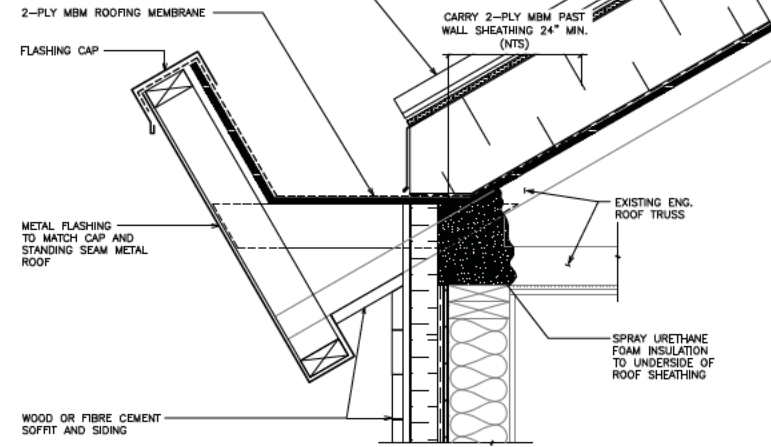
3  
4.4 NTS  
**TYPICAL SADDLE FLASHING ISOMETRIC AT ALL WALL TRANSITIONS**

**STRUCTURAL GABLE EXTENSION NOTES**  
STRUCTURAL FRAMING REQUIREMENTS TO BE DEVELOPED UPON REVIEW OF EXISTING CONDITIONS ON SITE.



2  
4.4  
**GABLE ROOF EXTENSION**

**TYPICAL SHINGLE ROOF ASSEMBLY**  
-STANDING SEAM METAL ROOF  
-DRAIN MAT  
-8\"/>



1  
4.4  
**TYPICAL SLOPED ROOF**

No	Revision	Date	By

Project Name  
[Redacted]

Sheet Title  
**DETAILS**

Drawn By  
[Redacted]

R-4.4

CONCRETE

- 1. CONCRETE IS SPECIFIED AS PER THE "PERFORMANCE" ALTERNATE AS OUTLINED IN TABLE 5 OF CAN/CSA-A23.1.
2. THE GENERAL CONTRACTOR IS RESPONSIBLE FOR WORKING WITH THE CONCRETE SUPPLIER TO ENSURE THAT THE PLASTIC AND HARDENED MIX PROPERTIES MEET SITE REQUIREMENTS FOR PLACING, FINISHING, AND THE OWNERS' SPECIFIED PERFORMANCE REQUIREMENTS.
3. THE SUPPLIER SHALL MEET ALL CERTIFICATION AND DOCUMENTATION REQUIREMENTS AS OUTLINED UNDER THE "PERFORMANCE" ALTERNATE OF TABLE 5 OF CAN/CSA-A23.1.
4. PORTLAND CEMENT SHALL BE TYPE GU UNLESS NOTED OTHERWISE.
5. CONCRETE SHALL HAVE A UNIT WEIGHT OF 23±1 kN/m³ (145±5 PCF) UNLESS NOTED OTHERWISE.
6. CONCRETE PROPERTIES:

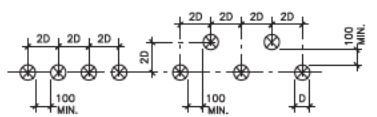
Table with 4 columns: ELEMENT, COMPRESSIVE STRENGTH (MPa) 28 DAYS U.N.G., EXPOSURE CLASS, COMMENTS. Rows include FOOTINGS, SLAB ON GRADE (INTERIOR), SLAB ON GRADE (EXTERIOR), and RETAINING WALLS.

- 7. SLUMP AND AGGREGATE SIZE TO BE DETERMINED BY THE GENERAL CONTRACTOR AND SUPPLIER TO MEET PLACEMENT AND FINISHING REQUIREMENTS WITHOUT SEGREGATION WHILE MEETING ALL OWNER SPECIFICATIONS.
8. MAXIMUM WATER/CEMENT RATIO AND AIR CONTENT TO MEET THE REQUIREMENTS FOR THE EXPOSURE CLASS AS OUTLINED IN TABLE 2, 4 AND 20 OF CAN/CSA-A23.1.
9. AT THE REQUEST OF THE OWNER, THE SUPPLIER WILL FURNISH TEST DATA RESULTS FOR EACH PROPOSED MIX DESIGN DEMONSTRATING THAT THEY MEET THE STRENGTH, DURABILITY, AND SHRINKAGE REQUIREMENTS SPECIFIED.
10. CURING OF CONCRETE TO MEET THE REQUIREMENTS FOR THE EXPOSURE CLASS AS OUTLINED IN CLAUSE 7.4.1.7 AS WELL AS TABLES 2 AND 20 OF CAN/CSA-A23.1.
11. ALL BOTTOM EDGES OF EXPOSED SLABS AND BEAMS, AS WELL AS EDGES OF WALLS AND COLUMNS, TO BE CHAMFERED 20 mm X 20 mm.
12. NO CALCIUM CHLORIDE IS PERMITTED, IN ANY FORM, IN ANY CONCRETE MIX WITHOUT THE EXPRESS WRITTEN CONSENT OF READ JONES CHRISTOFFERSEN LTD.
13. CURING AND PROTECTION OF CONCRETE FOR HOT, COLD OR DRY WEATHER IS TO BE AS PER CLAUSES 7.4.1.B AND 7.4.2 OF CAN/CSA-A23.1 AS A MINIMUM. SEE ALSO "COLD WEATHER REQUIREMENTS" IN THE STRUCTURAL DRAWINGS.

CONDUITS, PIPES AND SLEEVES EMBEDDED IN CONCRETE

EXCEPT WHEN APPROVED BY RJC, PIPES, CONDUITS, AND SLEEVES EMBEDDED IN CONCRETE SHALL BE INSTALLED IN ACCORDANCE WITH CSA STANDARD A23.1 CLAUSE 8.7.5 AND THE FOLLOWING GUIDELINES:

- 1. GENERAL
A. NOT WITHSTANDING THE SATISFYING OF THESE GUIDELINES, THE CONDUIT, SLEEVES, PIPES, ETC. SHALL NOT IMPAIR THE STRUCTURAL STRENGTH AND SHALL BE MOVED IF SO DIRECTED BY RJC.
B. CENTRELINE SPACING TO BE NOT LESS THAN 3 DIAMETERS, UNLESS NOTED OTHERWISE.
C. CENTRELINE SPACING BETWEEN PARALLEL CONDUIT AND REINFORCING BARS TO BE 3 BAR DIAMETERS, UNLESS NOTED OTHERWISE.
D. ADD REINFORCING AT POINTS OF CONGESTION AS DIRECTED BY THE STRUCTURAL ENGINEER.
2. FOR NON-SHEAR WALLS - CONDUIT, SLEEVES OR EMBEDDED PIPES:
- MAXIMUM DIAMETER = 1/4 WALL THICKNESS
- NO HORIZONTAL RUNS PERMITTED
- VERTICAL RUNS TO HAVE MINIMUM 50 mm CONCRETE COVER AND SHALL HAVE A MINIMUM CLEAR SPACING OF 4 DIAMETERS.
7. SPACING OF SLEEVES THROUGH SLABS TO BE NOT LESS THAN THE FOLLOWING:



CONCRETE FORMWORK STRIPPING

- 1. THE DESIGN AND FIELD REVIEW OF FORMWORK, SHORING AND RESHORING IS THE RESPONSIBILITY OF THE CONTRACTOR. RESHORING DRAWINGS SHALL BE SUBMITTED TO RJC FOR THE EFFECT ON THE BASE BUILDING STRUCTURE ONLY.
2. NO COLUMN OR WALL FORMS SHALL BE REMOVED BEFORE CONCRETE HAS REACHED 10 MPa FOR ARCHITECTURAL CONCRETE OR 8 MPa FOR OTHER COLUMNS OR WALLS.
3. NO SLABFORMS OR BEAMFORMS SHALL BE REMOVED BEFORE CONCRETE HAS REACHED 17 MPa. FOR PARKING SLABS THE CONCRETE SHALL REACH 75% OF THE 28 DAY STRENGTH BEFORE STRIPPING.
4. STRENGTH OF CONCRETE FOR STRIPPING TO BE DETERMINED USING CYLINDERS STORED ON SITE IN A PROTECTED ENCLOSURE THAT MAINTAINS A SIMILAR TEMPERATURE AND HUMIDITY AS THE STRUCTURAL ELEMENTS REPRESENTED. ALTERNATE METHODS, IF ACCEPTABLE TO RJC, MAY BE USED.
5. ALL SLABS, BEAMS, ORDERS ETC. TO BE SHORED UNTIL CONCRETE REACHES DESIGN STRENGTH.

STRUCTURAL MOVEMENTS

THIS STRUCTURE WILL UNDERGO NORMAL TYPES OF MOVEMENT AND DEFLECTION, AND THE FOLLOWING ARE ESTIMATES FOR THIS STRUCTURE. NON-STRUCTURAL COMPONENTS MUST BE DETAILED TO ACCOMMODATE THIS DESIGN, DETAILING, AND FIELD REVIEW OF THESE NON-STRUCTURAL ELEMENTS IS BY OTHERS, AND NOT READ JONES CHRISTOFFERSEN LTD.

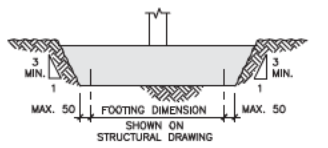
- 1. DIFFERENTIAL VERTICAL MOVEMENTS BETWEEN ADJACENT COLUMNS AND BETWEEN ADJACENT COLUMNS AND WALLS = APPROXIMATELY 20 mm.
2. VERTICAL DEFLECTION OF COLUMNS AND WALLS DUE TO SHRINKAGE AND CREEP = APPROXIMATELY 3.5 mm PER 3600 mm OF HEIGHT.
3. VERTICAL DEFLECTIONS OF EDGE BEAMS AND EDGES OF SLABS = APPROXIMATELY 25 mm.
4. VERTICAL DEFLECTIONS AT INTERIOR OF FLOORS = APPROXIMATELY 25 mm.
5. HORIZONTAL DRIFT DURING WIND AND EARTHQUAKE BETWEEN FLOORS:
A. ± 13 mm DRIFT WITHOUT DAMAGE TO NON-STRUCTURAL COMPONENTS.
B. ± 50 mm DRIFT WITHOUT COLLAPSE OF NON-STRUCTURAL COMPONENTS.
ALL STRUCTURES ARE ALSO SUBJECT TO CONSTRUCTION TOLERANCES. THIS SHOULD BE ALLOWED FOR IN DETAILING NON-STRUCTURAL COMPONENTS IN ADDITION TO THE ABOVE MOVEMENTS.

EXCAVATIONS

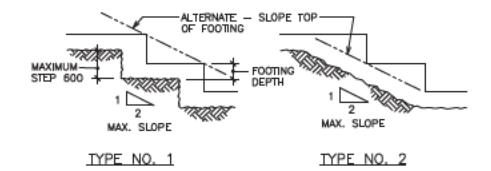
- 1. DESIGN AND FIELD REVIEW OF EXCAVATION, SHORING, AND BACKFILL IS NOT DONE BY READ JONES CHRISTOFFERSEN.

FOUNDATIONS

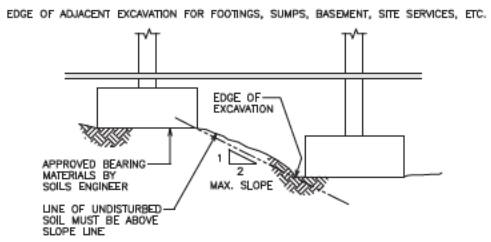
- 1. FOOTINGS HAVE BEEN DESIGNED FOR THE FOLLOWING ASSUMED ALLOWABLE BEARING RESISTANCE. TO BE CONFIRMED BY GEOTECHNICAL ENGINEER ON-SITE.
A. STRIP FOOTINGS: 145 kPa
B. SPREAD FOOTINGS: 170 kPa
2. BEARING SURFACES MUST BE APPROVED BY THE SOILS ENGINEER IMMEDIATELY BEFORE FOOTING CONCRETE IS PLACED. RJC IS NOT RESPONSIBLE FOR CONFIRMING BEARING CAPACITIES OF SOILS.
3. REFER TO SOILS REPORT FOR OTHER SPECIFIC DESIGN REQUIREMENTS FOR FOOTINGS, SOIL SLOPES, FROST PROTECTION, MINIMUM COVER, ETC.
4. UNLESS OTHERWISE SHOWN, CENTER FOOTINGS UNDER COLUMNS AND WALLS.
5. DOWELS SHALL BE PLACED BEFORE CONCRETE IS PLACED. TEMPLATES SHALL BE USED TO ENSURE CORRECT PLACEMENT OF DOWELS.
6. PROVIDE 50 mm GROUND SEAL UNDER FOOTINGS AS REQUIRED BY SOIL CONDITIONS.
7. FOR GROUND ELEVATIONS AND DRAINAGE SLOPES, SEE ARCHITECT'S DRAWINGS.
8. VARY FOOTING ELEVATIONS WHERE REQUIRED IN ACCORDANCE WITH DETAIL FOR "TYPICAL STEPPED FOOTING", SHOWN ON STRUCTURAL DRAWINGS.
9. FOOTINGS MAY HAVE TO BE LOWERED TO ACCOMMODATE MECHANICAL OR ELECTRICAL SERVICES. SEE MECHANICAL AND ELECTRICAL DRAWINGS FOR ELEVATIONS OF SAME. FOOTINGS ARE NOT TO BE UNDERMINED BY EXCAVATIONS FOR SERVICES, PITS, ETC.
10. FOOTING ELEVATIONS, IF SHOWN, ARE FOR BIDDING PURPOSES ONLY, ARE NOT FINAL, AND MAY VARY ACCORDING TO SITE CONDITIONS OR AS REQUIRED BY SERVICES. ALL FOOTINGS MUST BE TAKEN TO A BEARING LAYER APPROVED BY THE SOILS ENGINEER.
11. BEARING SURFACES MUST BE PROTECTED FROM FREEZING BEFORE AND AFTER FOOTINGS ARE POURED.
12. SUB-BASE DESIGN OF SOIL UNDER THE SLAB ON GRADE SHALL BE IN ACCORDANCE WITH THE SOIL REPORT.
13. CONCRETE PLACED UNDER WATER SHALL CONFORM TO CAN/CSA-A23.1.
14. FOOTINGS CAST DIRECTLY INTO EXCAVATIONS (WITHOUT SIDE FORMS) SHALL NOT BE LARGER THAN SHOWN BELOW:



TYPICAL STEPPED FOOTINGS (WALLS)



TYPICAL FOOTING ADJACENT TO EXCAVATION



GENERAL cont.

- 11. DEFINITIONS:
A. RJC: READ JONES CHRISTOFFERSEN OR ITS REPRESENTATIVE.
B. SPECIALTY STRUCTURAL ENGINEER: A STRUCTURAL ENGINEER REGISTERED AND LICENSED TO PRACTICE BY THE PROFESSIONAL ENGINEERING ASSOCIATION HAVING JURISDICTION IN THE AREA WHERE THE STRUCTURE IS TO BE BUILT AND WHO IS RESPONSIBLE FOR THE DESIGN AND FIELD REVIEW OF:
- STRUCTURAL ELEMENTS DESIGNED BY THE CONTRACTOR OR SUBCONTRACTORS, SUCH AS OPEN WEB STEEL JOISTS, PRECAST DOUBLE TEES, PRECAST PLANKS, STRUCTURAL STEEL CONNECTIONS, LIGHT WOOD FRAME ROOF TRUSSES, ETC.
- SECONDARY STRUCTURAL ELEMENTS AND NON-STRUCTURAL ELEMENTS. SEE ALSO "NON-STRUCTURAL ELEMENTS" GENERAL NOTES.
C. CONTINUOUS: FULL TENSION SPLICE AND TENSION DEVELOPMENT LENGTH.
D. EMBEDMENT: UNLESS NOTED OTHERWISE EMBEDMENT MEANS A COMPRESSION DEVELOPMENT LENGTH AND TENSION EMBEDMENT MEANS A TENSION DEVELOPMENT LENGTH AS PER CAN/CSA-A23.3 AND AS SHOWN ON THESE GENERAL NOTES DRAWINGS.
E. GENERAL CONTRACTOR: FOR THE PURPOSES OF THESE DRAWINGS, THE USE OF THE TERM "CONTRACTOR" OR "GENERAL CONTRACTOR" SHALL REFER TO THE PRIME PERSON OR COMPANY RESPONSIBLE FOR CONSTRUCTION OF THE PROJECT AND THE COORDINATION OF TRADES AND SUBCONTRACTORS. THIS MAY BE THE GENERAL CONTRACTOR, OR A CONSTRUCTION MANAGER.

DESIGN CODE

- 1. THE COMPLETED BASE BUILDING STRUCTURE SHOWN ON THE STRUCTURAL DRAWINGS HAS BEEN DESIGNED IN SUBSTANTIAL ACCORDANCE WITH THE BRITISH COLUMBIA BUILDING CODE 2012 WHICH IS BASED ON THE NATIONAL BUILDING CODE OF CANADA 2010.

DESIGN LOADS

- 1. SPECIFIED UNIFORM LOADS kPa (SEE ALSO PLANS) LIVE SUPERIMPOSED LOAD DEAD LOAD (S.D.L.)
A. ROOF - BASED ON A GROUND SNOW LOAD OF - 2.1 } 0.5 PLUS A RAIN LOAD OF 0.3 AND AN IMPORTANCE FACTOR Ia = 1.0 ULS, 0.9 SLS
B. RESIDENTIAL FLOORS 1.9 } 0.75
C. STAIRS AND CORRIDORS 4.8
CONTRACTORS CONSTRUCTION LOADS MUST NOT EXCEED THE ABOVE DESIGN LOADS. DESIGN LOADS MAY ONLY BE APPLIED AFTER CONCRETE REACHES ITS DESIGN STRENGTH.
SUPERIMPOSED DEAD LOADS (S.D.L.) ARE NON-STRUCTURE DEAD LOADS DUE TO ARCHITECTURAL TOPPING, FINISHES, PARTITIONS, ROOFING MATERIALS, PAVERS, SOIL, ETC.
STRUCTURAL DEAD LOADS (D.L.) ARE DUE TO THE WEIGHT OF THE STRUCTURE ITSELF. THEY VARY WITH THE STRUCTURAL SYSTEM AND INCLUDE CONCRETE TOPPING ON STEEL DECK.
2. WIND UPLIFT LOADS ON STEEL OR WOOD ROOFS SHALL BE 1 kPa NET FACTORED DIMENSIONS NOTED OTHERWISE.
3. SEISMIC AND WIND DESIGN:
THE LATERAL SYSTEM FOR THIS PROJECT CONSISTS OF SHEAR WALLS AND IS DESIGNED FOR THE FOLLOWING EARTHQUAKE FACTORS:
Sa (0.2) = 1.2 SITE CLASSIFICATION: SITE CLASS C (T.B.C.)
Sa (0.5) = 0.82 Ie = 1.0
Sa (1.0) = 0.38 Rd = 3.0
Sa (2.0) = 0.19 Ro = 1.7
AND THE FOLLOWING WIND LOADS AND FACTORS:
q50 = 0.63 kPa, Iw = 1.0 ULS, 0.75 SLS

- 1. READ JONES CHRISTOFFERSEN PROVIDES FIELD REVIEW ONLY FOR THE WORK SHOWN ON THESE STRUCTURAL DRAWINGS. THIS REVIEW IS NOT A "FULL TIME" REVIEW BUT IS CONDUCTED WITH SUCH FREQUENCY AS RJC DEEMS APPROPRIATE TO OBSERVE VARIOUS STAGES OF THE WORK AND TO ASCERTAIN THAT THE WORK IS IN GENERAL CONFORMANCE WITH THE PLANS AND SUPPORTING DOCUMENTS PREPARED BY READ JONES CHRISTOFFERSEN. FIELD REVIEW BY READ JONES CHRISTOFFERSEN IS NOT CARRIED OUT FOR THE CONTRACTOR'S BENEFIT, NOR DOES IT MAKE READ JONES CHRISTOFFERSEN GUARANTORS OF THE CONTRACTOR'S WORK. IT REMAINS THE CONTRACTOR'S RESPONSIBILITY TO BUILD THE WORK IN CONFORMANCE WITH THE CONTRACT DOCUMENTS. RJC SHALL NOT BE RESPONSIBLE FOR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUB-CONTRACTOR, OR ANY OTHER PERSONS PERFORMING ANY OF THE WORK OR FOR THE FAILURE OF ANY OF THEM TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.
RJC WILL REVIEW SHOP DRAWINGS PERTAINING TO WORK SHOWN ON RJC'S DRAWINGS. THE EXTENT OF THIS REVIEW IS AT THE SOLE DISCRETION OF RJC'S ENGINEER AND IS FOR THE SOLE PURPOSE OF ASCERTAINING GENERAL CONFORMANCE WITH THE STRUCTURAL DESIGN CONCEPT. THE REVIEW IS NOT AN APPROVAL OF THE DESIGN, DETAILS, AND DIMENSIONS INHERENT IN THE SHOP DRAWINGS, RESPONSIBILITY FOR WHICH SHALL REMAIN WITH THE CONTRACTOR OR SUBCONTRACTOR SUBMITTING THEM. SUCH REVIEW SHALL NOT RELIEVE THE CONTRACTOR OR SUBCONTRACTOR OF HIS OR HER RESPONSIBILITY FOR ERRORS AND OMISSIONS IN THE SHOP DRAWINGS OR FOR MEETING ALL REQUIREMENTS OF THE CONTRACT DOCUMENTS.
2. PROVIDE 24 HOURS ADVANCE NOTICE OF EACH REQUIRED FIELD REVIEW. FIELD REVIEWS SHALL BE SCHEDULED TO BE CARRIED OUT DURING NORMAL BUSINESS HOURS UNLESS SPECIAL ARRANGEMENTS ARE MADE WITH RJC.
3. THE WORK TO BE REVIEWED SHALL BE GENERALLY COMPLETE.

NON-STRUCTURAL ELEMENTS

- 1. "NON-STRUCTURAL" OR "SECONDARY STRUCTURAL" ELEMENTS ARE NOT PART OF THE STRUCTURAL DESIGN SHOWN ON THESE DRAWINGS. SUCH ELEMENTS ARE DESIGNED, DETAILED AND REVIEWED IN THE FIELD BY OTHERS. THEY APPEAR ON DRAWINGS OTHER THAN THESE DRAWINGS OF READ JONES CHRISTOFFERSEN LTD., WHERE STRUCTURAL ENGINEERING RESPONSIBILITY IS REQUIRED FOR THESE ELEMENTS. THIS SHALL BE PROVIDED BY SPECIALTY STRUCTURAL ENGINEERS, WHO SHALL ALSO PROVIDE ANY LETTERS REQUIRED BY BUILDING PERMIT AUTHORITIES.
2. EXAMPLES OF NON-STRUCTURAL ELEMENTS INCLUDE, BUT ARE NOT LIMITED TO:
A. ARCHITECTURAL COMPONENTS SUCH AS GUARDRAILS, HANDRAILS, FLAG POSTS, CANOPIES, CELINGS, MILLWORK, ETC.
B. LANDSCAPE ELEMENTS SUCH AS BENCHES, LIGHT POSTS, PLANTERS, ETC.
C. CLADDING, GLAZING, WINDOW MULLIONS, INTERIOR STUD WALLS AND EXTERIOR STUD WALLS.
D. ARCHITECTURAL PRECAST, PRECAST CLADDING.
E. SKYLIGHTS.
F. MECHANICAL AND ELECTRICAL EQUIPMENT, COMPONENTS, AND THEIR ATTACHMENT DETAILS.
G. WINDOW WASHING EQUIPMENT AND ITS ATTACHMENTS.
H. ESCALATORS, ELEVATORS, AND CONVEYING SYSTEMS.
I. GLASS BLOCK AND ITS ATTACHMENTS.
J. BRICK OR BLOCK VENEERS AND THEIR ATTACHMENTS.
K. NON-LOAD BEARING MASONRY.
L. NON-STRUCTURAL CONCRETE TOPPING.
3. SHOP DRAWINGS FOR NON-STRUCTURAL ELEMENTS WHICH MAY AFFECT THE PRIMARY STRUCTURAL SYSTEM SHALL BE SUBMITTED TO READ JONES CHRISTOFFERSEN LTD. THESE DRAWINGS WILL BE REVIEWED ONLY FOR THE EFFECT OF THE ELEMENT ON THE PRIMARY STRUCTURAL SYSTEM.

LIST OF STRUCTURAL DRAWINGS

- S1.01 GENERAL NOTES AND TYPICAL DETAILS
S1.02 GENERAL NOTES AND TYPICAL DETAILS
S1.03 GENERAL NOTES AND TYPICAL DETAILS
S1.04 GENERAL NOTES AND TYPICAL DETAILS
S2.01 FOUNDATION PLAN WITH MAIN LEVEL FRAMING ABOVE AND MAIN LEVEL PLAN SHOWING UPPER LEVEL FRAMING ABOVE
S2.02 UPPER LEVEL PLAN SHOWING ROOF FRAMING OVER AND SCHEDULES
S3.01 SECTIONS AND DETAILS

DRAWINGS

- 1. THIS SET OF DRAWINGS SHOWS THE COMPLETED PROJECT. THE DRAWINGS DO NOT SHOW COMPONENTS THAT MAY BE NECESSARY FOR CONSTRUCTION SAFETY. THE GENERAL CONTRACTOR IS RESPONSIBLE FOR SAFETY IN AND ABOUT THE JOB SITE DURING CONSTRUCTION, AND THE DESIGN AND ERECTION OF ALL TEMPORARY STRUCTURES, FORMWORK, FALSE WORK, SHORING, ETC. REQUIRED TO COMPLETE THE WORK.
2. THE USE OF THESE DRAWINGS IS LIMITED TO THAT IDENTIFIED IN THE REVISIONS COLUMN. DO NOT CONSTRUCT FROM THESE DRAWINGS UNLESS MARKED "ISSUED FOR CONSTRUCTION" IN THE REVISIONS COLUMN, BY READ JONES CHRISTOFFERSEN LTD. THE DRAWINGS SHALL NOT BE USED FOR PRICING, COSTING, OR TENDER UNLESS SO INDICATED IN THE REVISION COLUMN. PRICING OR COSTING DRAWINGS ARE NOT COMPLETE AND ANY PRICES BASED ON PRICING OR COSTING DRAWINGS MUST INCLUDE ALLOWANCES FOR THIS.
3. THE INFORMATION ON THESE DRAWINGS SHALL NOT BE USED FOR ANY OTHER PROJECT OR WORKS. THE INFORMATION ON THESE DRAWINGS APPLIES SOLELY TO THIS PROJECT.

GENERAL

- 1. SECTION MARK SHOWN THUS [Symbol] MEANS SECTION #4 ON DRAWING S-3.
2. SEE ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS FOR SLEEVES, NAILERS, INSERTS, ETC., TO BE ENCASED IN CONCRETE.
3. SEE ARCHITECTURAL DRAWINGS FOR FLOOR AND ROOF ELEVATIONS, RECESSES, DRAINAGE SLOPES, ETC.
4. THE GENERAL CONTRACTOR SHALL REVIEW ALL THE DRAWINGS AND CHECK DIMENSIONS BEFORE CONSTRUCTION. REPORT DISCREPANCIES BETWEEN STRUCTURAL AND OTHER DISCIPLINES DRAWINGS FOR CLARIFICATION.
5. CONCRETE WORK SHALL CONFORM TO CAN/CSA-A23.1, CAN/CSA-A23.2, CAN/CSA-A23.3 AND REFERENCED DOCUMENTS.
6. STRUCTURAL STEEL WORK SHALL CONFORM TO CAN/CSA-S16 AND REFERENCED DOCUMENTS.
7. FIRE RESISTANCE RATINGS SEE ARCHITECTURAL DRAWINGS AND SPECIFICATIONS FOR PRECISE LOCATION OF REQUIRED FIRE RESISTANCE RATINGS.
8. DO NOT CUT OR DRILL ANY OPENINGS IN STRUCTURAL MEMBERS WITHOUT WRITTEN PERMISSION OF RJC.
9. REFER TO ARCHITECTURAL, MECHANICAL, ELECTRICAL, AND LANDSCAPE DRAWINGS FOR LOCATIONS, CONFIGURATIONS, EXTENT, AND SIZES OF ALL CURBS, UPSTANDS, DOWNTURNS; AND FOR OPENINGS THROUGH FLOORS AND WALLS FOR DUCTS, CONDUIT AND PIPING. PROVIDE FOR SAME.

ABBREVIATIONS:

Table with 2 columns: Abbreviation and Full Name. Includes terms like A.B., ALT., ARCH., B.C.E., B.L.L., B.M., BOT., B.U.L., B.W., CANTL., C.I.P., C.J., CL., CLR., CONC., CONT., CTR., C/W, DET., D.L., D.O., DP., D.T.S., DWG., DWLS., E.A., E.E., E.F., ELEV., ELEV., ELEC., EQ., E.S., E.W., EXIST., EXT., F.D., FAR, F.S., FTG., GA., GALV., G.L., GR., H.I.E., H.2.E., H & V, HORL., HORZ., HORIZ., HT., I.F., INT., JOINT, LG., L.L., L.L.B.B., L.L.H., L.L.V., L.S.H., L.S.V., L.T.S., L.V., L.W., MAX., MECH., MIN., N.F., N.I.C., N.S., N.T.S., O.C., O/C, O.P., O.W.S.J., P.P., P/T, R.D., R.O., R.T.S., R/W, S.D.L., SIM., S.L., S.L.B.B., S.L.S., S.O.G., SPEC., STAINL., STAG., STR., STL., S.W., SYM., T & B, T & C, T & G, THK., THRU, T.J., T.L.L., T.O., T.O.C., T.O.F., T.O.S., T.O.W., TR., T.U.L., TYP., ULS, U.N.G., U/S, VERT., W.P., WT.

Drawing Notes

Table with 4 columns: No., Revision, Date, By.

Project Name

Sheet Title

GENERAL NOTES AND TYPICAL DETAILS

Sheet Number

S1.01

Revision

**WALLS**

1. UNLESS OTHERWISE NOTED, WALLS SHALL BE REINFORCED AS FOLLOWS:

150 mm 10M@450 VERT. ----- 10M@330 HORIZ.  
 200 mm 10M@330 VERT. ----- 10M@280 HORIZ. OR 15M@500  
 250 mm 10M@500 VERT. E.F. STAG. ----- 10M@400 HORIZ. E.F. STAG.  
 300 mm 10M@450 VERT. E.F. STAG. ----- 10M@330 HORIZ. E.F. STAG.  
 350 mm 10M@380 VERT. E.F. STAG. ----- 10M@280 HORIZ. E.F. STAG.

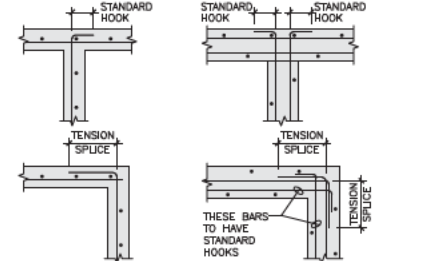
FOR OTHER THICKNESSES, REINFORCEMENT TO BE PROPORTIONAL TO ABOVE.

15M @ 500 MAY BE SUBSTITUTED FOR 10M @ 330 ONLY WITH THE APPROVAL OF RJC. FOR WALLS WITH A SINGLE LAYER OF STEEL, THE WALL REINFORCING SHALL BE PLACED IN THE CENTRE OF THE WALL U.N.O.

2. ALL WALL REINFORCING SHALL BE CONTINUOUS, WITH HOOKS OR CORNER BARS USED AT ALL WALL JUNCTIONS. EXTEND HOOKS TO FAR FACE OF WALL. CORNER BARS TO BE LOCATED ON OUTSIDE FACE OR CENTRE OF WALL.

3. HORIZONTAL AND VERTICAL SPLICES SHALL BE CASE 1 TENSION SPLICES. U.N.O. HORIZONTAL BARS NEED NOT BE CONSIDERED TOP BARS.

4. DETAILS OF HORIZONTAL REINFORCEMENT AT CORNERS (SEE ALSO ZONE REINFORCING DETAILS):



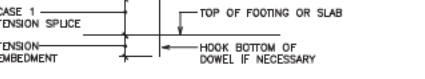
NOTE: SPLICED C BARS CAN BE USED INSTEAD OF HORIZONTAL BARS WITH STANDARD HOOK.

NOTE: SPLICED C BARS CAN BE USED INSTEAD OF HORIZONTAL BARS WITH TENSION SPLICE LENGTH HOOK.

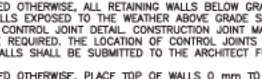
5. ENDS OF ALL WALLS SHALL HAVE 2-15M VERTICAL LAPPED 625 UNLESS OTHERWISE NOTED ON DRAWINGS.

6. ADD 2-15M PARALLEL TO ALL EDGES AND EXTENDING 625 BEYOND CORNERS AT OPENINGS IN WALLS.

7. UNLESS NOTED OTHERWISE, PROVIDE DOWELS AT BOTTOM OF WALLS (I.E. AT FOOTINGS OR WHEREVER WALL BEGINS) AS SHOWN BELOW. DOWELS TO MATCH VERTICAL STEEL.



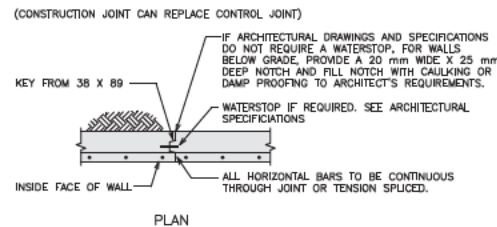
8. SEE ARCHITECTURAL DRAWINGS FOR EXTENT AND LOCATION OF CONCRETE UPSTAND WALLS, PLASTER WALLS AND CURBS. UNLESS NOTED OTHERWISE, PROVIDE REINFORCING AS GIVEN IN ITEM 1. VERTICAL BARS TO BE EMBEDDED IN MAIN STRUCTURE AS SHOWN BELOW:



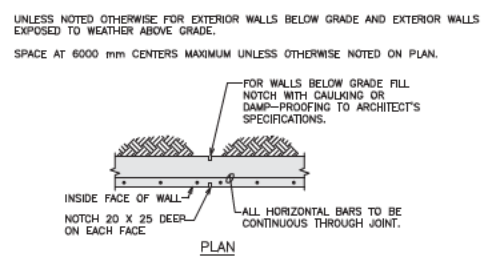
9. UNLESS NOTED OTHERWISE, ALL RETAINING WALLS BELOW GRADE AND ALL EXTERIOR WALLS EXPOSED TO THE WEATHER ABOVE GRADE SHALL HAVE CONTROL JOINTS. SEE CONTROL JOINT DETAIL. CONSTRUCTION JOINT MAY REPLACE CONTROL JOINT WHERE REQUIRED. THE LOCATION OF CONTROL JOINTS IN EXPOSED CONCRETE WALLS SHALL BE SUBMITTED TO THE ARCHITECT FOR REVIEW.

10. UNLESS NOTED OTHERWISE, PLACE TOP OF WALLS 0 mm TO 12 mm BELOW SOFFIT OF SUPPORTED CONCRETE STRUCTURE. IF TOP OF WALL PLACED ABOVE SOFFIT, CAREFULLY CHIP DOWN AS REQUIRED BY RJC.

**WALL CONSTRUCTION JOINT**



**WALL CONTROL JOINT**



**EMBEDMENT / DEVELOPMENT LENGTHS AND SPLICE LENGTHS**

**BASED ON CAN/CSA-A23.3**

WHERE EMBEDMENT OR SPLICES ARE DIMENSIONED ON THE DRAWINGS, SUCH DIMENSION SHALL APPLY.

WHERE THE DRAWINGS INDICATE A COMPRESSION EMBEDMENT, IT IS A COMPRESSION EMBEDMENT LENGTH AND IT SHALL BE AS NOTED BELOW.

WHERE THE DRAWINGS INDICATE A TENSION EMBEDMENT, IT IS A TENSION EMBEDMENT LENGTH AND SHALL BE AS NOTED BELOW.

WHERE NO EMBEDMENT OR EMBEDMENT TYPE IS CALLED FOR ON THESE DRAWINGS, IT SHALL BE A TENSION EMBEDMENT, EXCEPT FOR COLUMNS WHICH SHALL BE A COMPRESSION EMBEDMENT.

WHERE NO SPLICE OR SPLICE TYPE IS CALLED FOR ON THESE DRAWINGS, IT SHALL BE A TENSION SPLICE, EXCEPT FOR COLUMNS WHICH SHALL BE A COMPRESSION SPLICE.

IN TABLES BELOW, EMBEDMENT LENGTHS ARE SHOWN WITHOUT BRACKETS, AND SPLICE LENGTHS ARE SHOWN IN BRACKETS.

ALL LENGTHS ARE FOR  $F_y = 400 \text{ MPa}$  REBAR.

ALL TENSION SPLICE LENGTHS ARE CLASS "B" (1.3x).

**COMPRESSION EMBEDMENT AND SPLICE LENGTHS**

- COMPRESSION EMBEDMENT REFERS TO THE LENGTH REQUIRED TO PROVIDE THE "COMPRESSION DEVELOPMENT LENGTH" AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.3.2.

- SPLICE LENGTH REFERS TO THE MINIMUM LAP LENGTH REQUIRED FOR A COMPRESSION SPLICE AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.16.1.

CONCRETE STRENGTH	FUNCTION	REBAR DESIGNATION					
		10M	15M	20M	25M	30M	35M
20 MPa	EMBEDMENT	215	325	430	540	645	755
	(SPLICE) (300)	(440)	(585)	(730)	(880)	(1025)	
25 MPa	EMBEDMENT	200	290	385	480	580	675
	(SPLICE) (300)	(440)	(585)	(730)	(880)	(1025)	
30 MPa & GREATER	EMBEDMENT	200	285	355	440	530	620
	(SPLICE) (300)	(440)	(585)	(730)	(880)	(1025)	

**TENSION EMBEDMENT AND SPLICE LENGTHS**

- TENSION EMBEDMENT REFERS TO THE LENGTH REQUIRED TO PROVIDE A "TENSION DEVELOPMENT LENGTH" AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.2.3.

- SPLICE LENGTH REFERS TO THE MINIMUM LAP LENGTH REQUIRED FOR A CLASS "B" TENSION SPLICE (1.3x) AS PER CAN/CSA-A23.3 CLAUSE 12.15.

**CASE 1 TENSION EMBEDMENT AND SPLICE CONDITIONS**

TENSION EMBEDMENT AND SPLICE LENGTHS CONFORMING TO CAN/CSA-A23.3 TABLE 12.1 (0.6 $\sqrt{f_c}$ ,  $k_1 k_2 k_3 k_4 / f_c$ ) ARE TO BE AS PER THE FOLLOWING TABLE FOR:

- COLUMNS.
- BEAM AND GIRDER TOP AND BOTTOM BARS.
- SLAB BAND TOP BARS.
- TWO WAY SLAB TOP AND BOTTOM BARS.
- ONE WAY SLAB BOTTOM BARS.
- WALL HORIZONTAL AND VERTICAL DISTRIBUTED REINFORCING.
- SEE ALSO NOTES ON TOP BARS AND EPOXY COATED REINFORCEMENT.
- MEMBERS WHICH DO NOT SATISFY THE ABOVE CONDITIONS SHALL HAVE TENSION EMBEDMENTS AND SPLICES AS PER CASE 2 TABLE BELOW.

CONCRETE STRENGTH	FUNCTION	REBAR DESIGNATION					
		10M	15M	20M	25M	30M	35M
20 MPa	EMBEDMENT	325	485	645	1010	1210	1410
	(SPLICE) (420)	(630)	(840)	(1310)	(1570)	(1835)	
25 MPa	EMBEDMENT	300	435	580	900	1080	1280
	(SPLICE) (390)	(565)	(750)	(1170)	(1405)	(1640)	
30 MPa	EMBEDMENT	300	395	530	825	990	1155
	(SPLICE) (390)	(515)	(685)	(1070)	(1285)	(1500)	
35 MPa	EMBEDMENT	300	370	490	765	915	1065
	(SPLICE) (390)	(475)	(635)	(990)	(1190)	(1385)	

NOTES: - "TOP BAR" VALUES ARE 1.3 TIMES THE ABOVE LENGTHS. "TOP BAR" APPLIES TO HORIZONTAL REINFORCEMENT CAST WITH 300 mm OR MORE OF CONCRETE BELOW THE BAR.

- INCREASE THESE TABLE LENGTHS BY 1.5 TIMES FOR EPOXY COATED REINFORCEMENT. INCREASE THESE TABLE LENGTHS BY 1.7 TIMES FOR EPOXY COATED TOP REINFORCEMENT.

**CASE 2 TENSION EMBEDMENT AND SPLICE CONDITIONS**

TENSION EMBEDMENT AND SPLICE LENGTHS CONFORMING TO CAN/CSA-A23.3 TABLE 12.1 (0.6 $\sqrt{f_c}$ ,  $k_1 k_2 k_3 k_4 / f_c$ ) ARE TO BE AS PER THE FOLLOWING TABLE FOR MEMBERS NOT SATISFYING CASE 1 CONDITIONS AS SET OUT ABOVE. FOR EXAMPLE:

- ONE WAY SLAB TOP BARS (SEE TOP BAR NOTE).
- SLAB BAND BOTTOM BARS.
- BARS (EXCLUDING THE SPLICE) SPACED CLOSER TOGETHER THAN 2 BAR DIAMETERS.
- STIRRUPS IN BEAMS AND GIRDERS.
- SEE ALSO NOTES ON TOP BARS AND EPOXY COATED REINFORCEMENT.

CONCRETE STRENGTH	FUNCTION	REBAR DESIGNATION					
		10M	15M	20M	25M	30M	35M
20 MPa	EMBEDMENT	430	645	860	1345	1610	1880
	(SPLICE) (560)	(840)	(1120)	(1745)	(2095)	(2445)	
25 MPa	EMBEDMENT	385	580	770	1200	1440	1680
	(SPLICE) (500)	(750)	(1000)	(1580)	(1875)	(2185)	
30 MPa	EMBEDMENT	355	530	705	1100	1315	1535
	(SPLICE) (460)	(685)	(915)	(1425)	(1710)	(1995)	
35 MPa	EMBEDMENT	325	490	650	1015	1220	1420
	(SPLICE) (425)	(635)	(845)	(1320)	(1585)	(1850)	

NOTES: - "TOP BAR" VALUES ARE 1.3 TIMES THE ABOVE LENGTHS. "TOP BAR" APPLIES TO HORIZONTAL REINFORCEMENT CAST WITH 300 mm OR MORE OF CONCRETE BELOW THE BAR.

- INCREASE THESE TABLE LENGTHS BY 1.5 TIMES FOR EPOXY COATED REINFORCEMENT. INCREASE THESE TABLE LENGTHS BY 1.7 TIMES FOR EPOXY COATED TOP REINFORCEMENT.

**CONCRETE REINFORCEMENT**

1. REINFORCEMENT SHALL CONFORM TO THE FOLLOWING STANDARDS:

A. CAN/CSA-G30.18R - GRADE 400 MPa - 10M AND LARGER (U.N.O.)  
 B. CSA STANDARD G30.5 - GRADE 400 MPa - WELDED WIRE REINFORCEMENT  
 C. CAN/CSA-G30.18W - GRADE 400 MPa - ALL REINFORCING THAT WILL BE WELDED  
 D. CSA STANDARD G279 - PRESTRESSING STRANDS  
 E. EPOXY REINFORCING - ASTM A775M AND ASTM D3963  
 F. GALVANIZED REBAR

(NOTE: G30.18W MAY BE SUBSTITUTED FOR G30.18R)

2. UNLESS OTHERWISE NOTED CONCRETE COVER TO REINFORCEMENT SHALL BE:

A. FOR FIRE RATINGS:

ELEMENT	FIRE RATINGS	
	0-2 HOURS	3 HOURS
BEAMS, GIRDERS, COLUMNS, FORMED PILES (TO TIES OR STIRRUPS)	40 mm	40 mm
SLABS AND SLAB BANDS (NON-PARKING), STIRRUPS IN SLAB BANDS, ZONE TIES, NON RETAINING WALLS	25 mm (30M = 30 mm)	35 mm
SLABS AND SLAB BANDS (PARKING WITH MEMBRANE)	TOP COVER	40 mm
	BOT. COVER	30 mm
STRUCTURAL SLAB ON GRADE (NON PARKING)	TOP COVER	25 mm (30M = 30 mm)
	BOT. COVER	30 mm
RETAINING WALLS (F-2 EXPOSURE)	INSIDE FACE	25 mm (30M = 30 mm)
	GROUND OR EARTH SIDE	40 mm (30M = 45 mm)

B. CONCRETE CAST AGAINST EARTH OR GROUND ----- 75

C. FORMED FINISHED CONCRETE EXPOSED TO ----- 40 OR 1.5d WEATHER, EXPOSURE CLASS F1, F2, S1, S2 OR EARTH WHICHEVER IS GREATER

NOTES:  
 LARGEST COVER REQUIRED GOVERNS.  
 SEE ARCHITECTURAL DRAWINGS AND STRUCTURAL DRAWINGS FOR AREAS WHICH MAY REQUIRE 3 HOUR RATINGS.

DESIGNATION OF REINFORCING BARS:

A. BARS SHOWN THUS ----- IN BOTTOM OF BEAMS OR SLABS OR IN FAR FACE OF WALL

BARS SHOWN THUS ----- IN TOP OF BEAMS AND SLABS OR IN NEAR FACE OF WALL

B. STRAIGHT: E.G. 6-10M4200 MEANS 6-10M BARS 4200 LONG. E.G. 15M3800 + 15M3200 ALT. @ 300 MEANS 1-15M3800 BAR THEN 1-15M3200 BAR SPACED 300 AWAY

BENT BARS: E.G. 13-A20M4000 MEANS 13-20M BARS 4000 H.I.E. 180°. E.G. 3-C25M3000 MEANS 3-25M BARS 3000 LONG H.I.E. 90°. (NOTE: BENT BAR LENGTHS INCLUDE HOOK DIMENSION)

4. DO NOT SUBSTITUTE DEFORMED WIRE FOR REINFORCING BARS WITHOUT PRIOR APPROVAL OF THE RJC.

5. SUPPORT REINFORCING WITH CHAIRS, ACCESSORIES, OR REINFORCING BARS AS REQUIRED. BARS USED AS SUPPORT BARS SHALL BE CONSIDERED AS ACCESSORIES.

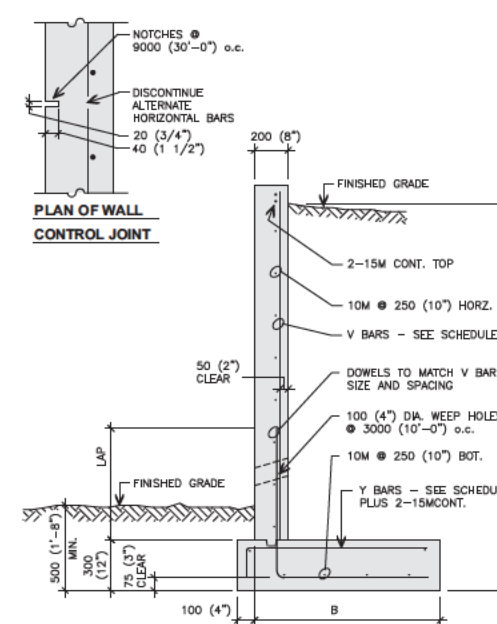
6. PROVIDE SUFFICIENT SUPPORTS TO MAINTAIN CONCRETE COVER AS SPECIFIED. ALL SUPPORTS AND BARS MUST BE TIED TOGETHER TO MAINTAIN REINFORCING STEEL SECURELY IN PLACE DURING CONCRETE PLACEMENT.

7. SEE STRUCTURAL DRAWINGS FOR EXTENT OF EPOXY COATED REBAR.

**TYPICAL CANTILEVERED RETAINING WALL**

**RETAINING WALL SCHEDULE**

H	B	V - BARS	Y - BARS	LAP
UP TO 1200 (4'-0")	300 (1'-0")	10M @ 400 (16")		450 (1'-6")
1200 (4'-0") TO 1800 (6'-0")	600 (2'-0")	15M @ 400 (16")	C15M @ 400 (16")	700 (2'-4")
1800 (6'-0") TO 2400 (8'-0")	900 (3'-0")	15M @ 300 (12")	C15M @ 400 (16")	700 (2'-4")
2400 (8'-0") TO 3000 (10'-0")	1200 (4'-0")	20M @ 250 (10")	C15M @ 350 (14")	900 (3'-0")
3000 (10'-0") TO 3600 (12'-0")	1500 (5'-0")	20M @ 150 (6")	C20M @ 300 (12")	900 (3'-0")



**CONCRETE COLD WEATHER REQUIREMENTS**

(SEE ALSO CAN/CSA-A23.1, CLAUSE 7.4.2.5, EXCEPT THE FOLLOWING MINIMUM REQUIREMENTS MUST ALSO BE MET)

1. FORECASTED AIR TEMPERATURE AT OR BELOW 5°C

A. THE AGGREGATE OR MIXING WATER SHALL BE HEATED TO MAINTAIN A MINIMUM CONCRETE TEMPERATURE OF 10°C.

B. CONCRETE SHALL NOT BE PLACED ON OR AGAINST ANY SURFACE WHICH IS AT A TEMPERATURE LESS THAN 5°C.

C. CONTRACTOR SHALL BE PREPARED TO COVER SLAB IF UNEXPECTED DROP IN AIR TEMPERATURE SHOULD OCCUR.

D. CONCRETE TEMPERATURE SHALL BE MAINTAINED ABOVE 10°C FOR AT LEAST 7 DAYS OR UNTIL THE CONCRETE REACHES 70% OF SPECIFIED STRENGTH.

2. FORECASTED AIR TEMPERATURE BELOW 2°C BUT NOT BELOW -4°C

(NOTE - FOR THESE CONDITIONS STRUCTURAL CONCRETE TOPPINGS ON METAL DECK SHALL SATISFY THE REQUIREMENTS OF 3).

A. FORMS AND STEEL SHALL BE FREE FROM ICE AND SNOW.

B. THE AGGREGATE OR MIXING WATER SHALL BE HEATED TO GIVE A MINIMUM CONCRETE TEMPERATURE OF 10°C AT POINT OF POUR.

C. CONCRETE SHALL NOT BE PLACED ON OR AGAINST ANY SURFACE WHICH IS AT A TEMPERATURE OF LESS THAN 5°C.

D. SLABS SHALL BE COVERED WITH CANVAS OR SIMILAR, KEPT A FEW INCHES CLEAR OF SURFACE.

E. IN WINDY WEATHER, STOREY BELOW SLAB SHALL BE ENCLOSED.

F. PROTECTION SHALL BE MAINTAINED FOR AT LEAST THE SPECIFIED CURING PERIOD.

G. CONCRETE TEMPERATURE SHALL BE MAINTAINED ABOVE 10°C FOR AT LEAST THE SPECIFIED CURING PERIOD.

3. FORECASTED AIR TEMPERATURE BELOW -4°C

A, B, C, D, AS UNDER POINT 2.

E. STOREY BELOW SHALL BE ENCLOSED AND ARTIFICIAL HEAT PROVIDED. HEATING TO BE STARTED AT LEAST ONE HOUR AHEAD OF POURING AND MAINTAINED FOR A MINIMUM OF THE SPECIFIED CURING PERIOD.

F. TEMPERATURE OF THE CONCRETE AT ALL SURFACES SHALL BE KEPT AT A MINIMUM OF 20°C FOR 3 DAYS, OR 10°C FOR 7 DAYS. CONCRETE SHALL BE KEPT ABOVE FREEZING TEMPERATURES UNTIL IT REACHES 70% OF ITS SPECIFIED STRENGTH.

G. ENCLOSURE MUST BE CONSTRUCTED SO THAT AIR CAN CIRCULATE OUTSIDE THE OUTER EDGES AND MEMBERS.

H. REINFORCING TO BE COVERED AND WARMED TO MAINTAIN ITS TEMPERATURE AT 0°C OR HIGHER AT THE TIME OF CONCRETE PLACEMENT.

**CONCRETE CONSTRUCTION TOLERANCES**

(TOLERANCES AS PER CAN/CSA-A23.1 CLAUSE 6.4.2, EXCEPT AS NOTED BELOW.)  
 CLOSER TOLERANCES SHALL BE MAINTAINED WHERE ARCHITECTURAL DETAILS OR OTHERS REQUIRE.

WHERE ANY DEVIATION OCCURS, AND IT IS ACCEPTABLE TO THE ENGINEER AND ARCHITECT, THE CONTRACTOR IS RESPONSIBLE FOR ADJUSTMENT OF OTHER BUILDING ELEMENTS TO ACCOMMODATE SUCH DEVIATION. COSTS FOR REMEDIAL WORK FOR DEVIATIONS NOT ACCEPTED SHALL BE BOURNE BY THE CONTRACTOR.

1. VARIATION FROM THE PLUMB.

A. IN THE LINES AND SURFACES OF COLUMNS, PIERS, WALLS AND IN ARRISSES: 0.25% OF HEIGHT (1 IN 400), MAXIMUM 40 mm OVER THE ENTIRE HEIGHT OF THE STRUCTURE.

ONLY ONE CURVATURE ALLOWED PER 3000 mm.

THE TOLERANCE GIVEN IS THE MAXIMUM VARIATION FROM A PLUMB LINE. ALL MEASUREMENTS SHALL BE TO THE SAME SIDE OF THE PLUMB LINE.

B. UNLESS SPECIFIED ELSEWHERE IN THE CONSTRUCTION DOCUMENTS - THE TOLERANCES FOR EXPOSED CORNER COLUMNS, CONTROL JOINT GROOVES, AND OTHER CONSPICUOUS LINES SHALL BE: (SEE ALSO ELEVATOR SHOP DRAWINGS ETC.)

0.125% OF HEIGHT (1 IN 800), MAXIMUM 20 mm.

ONLY ONE CURVATURE ALLOWED PER 6000 mm.

MAXIMUM VARIATION IN WINDOW BAYS 0.2% OF OPENING.

2. UNLESS SPECIFIED ELSEWHERE, FLOOR FINISHES SHALL BE CLASS A "INSTITUTIONAL AND COMMERCIAL FLOOR" ± 8 mm PER 3000 mm.

ONLY ONE CURVATURE ALLOWED IN 3000 mm.

CLOSER TOLERANCES MAY BE REQUIRED TO GIVE THE QUALITY OF FINISH FLOOR SURFACES CALLED FOR ELSEWHERE IN THE CONTRACT DOCUMENTS.

3. VARIATIONS OF STRUCTURAL CONCRETE ELEMENTS RELATED TO EACH OTHER AND RELATIVE TO A REFERENCED GRID SYSTEM FOR PLAN DIMENSIONS TO MEET CLAUSE 6.4.6 OF CAN/CSA-A23.1.

ONLY ONE CURVATURE ALLOWED PER 3000 mm.

4. VARIATION IN CROSS-SECTIONAL DIMENSIONS OF COLUMNS AND BEAMS AND IN THE THICKNESS OF SLABS AND WALLS: AS IN CAN/CSA-A23.1.

ONLY ONE CURVATURE ALLOWED PER 3000 mm.

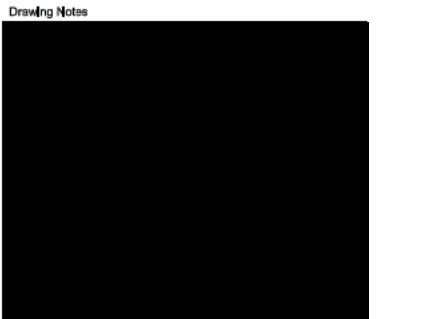
5. FOOTINGS:

A. VARIATION IN DIMENSIONS IN PLAN:  
 MINUS ----- 10 mm  
 PLUS ----- 50 mm

B. MISPLACEMENT OR ECCENTRICITY:  
 TWO (2) PERCENT OF THE FOOTING WIDTH IN THE DIRECTION OF MISPLACEMENT BUT NOT MORE THAN ----- 50 mm

C. REDUCTION IN THICKNESS:  
 MINUS ----- 5% OF SPECIFIED THICKNESS

6. THE ABOVE REQUIREMENTS DO NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY OF MEETING MORE RIGID REQUIREMENTS SPECIFIED ELSEWHERE IN THE CONSTRUCTION DOCUMENTS OR AS REQUIRED BY EQUIPMENT SHOP DRAWINGS OR SPECIFICATIONS SUCH AS THOSE FOR ELEVATORS ETC.



No.	Revision	Date	By



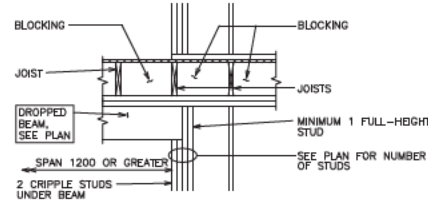
Project Name

Sheet Title

**GENERAL NOTES AND TYPICAL DETAILS**



C. CASE 2 - DROPPED BEAM - OPENING 1200 mm OR GREATER:



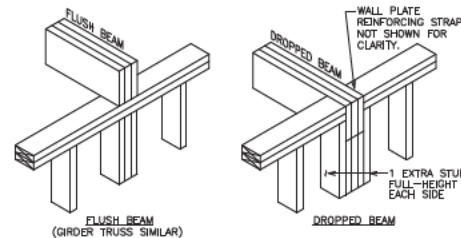
**WALLS**

- LOAD BEARING WALLS: DENOTED ON PLAN THIS.
- ALL EXTERIOR WALLS ARE LOAD BEARING.

FLOOR	EXTERIOR / OUTSIDE PERIMETER WALLS	INTERIOR WALLS	DOUBLE PARTY WALLS	38 X 140 WALLS
LEVEL 3 TO ROOF	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C
LEVEL 2 TO LEVEL 3	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C
LEVEL 1 TO LEVEL 2	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C

SEE ARCHITECTURAL DRAWINGS FOR LOCATIONS WHERE WIDER STUDS ARE USED (I.E. BATHROOM PLUMBING WALLS).

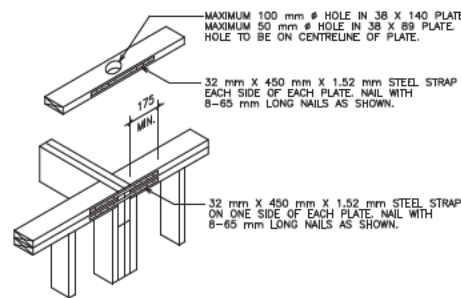
- SEE TYPICAL DETAILS FOR LOAD BEARING WALL CONNECTIONS BETWEEN FLOORS U.N.O.
- UNLESS NOTED OTHERWISE, PROVIDE A BUILT-UP STUD POST AT THE ENDS OF ALL BEAMS AND ORDER TRUSSES FRAMING INTO A WALL. THE BUILT-UP STUD POST SHALL MATCH THE WIDTH OF THE BEAM, AND THE STUD SIZE SHALL MATCH THOSE IN THE WALL U.N.O. ON PLAN.



- NAILING OF BUILT-UP STUD POSTS SHALL CONFORM TO THE FOLLOWING SCHEDULE. EACH STUD OF BUILT-UP POST SHALL BE NAILED.

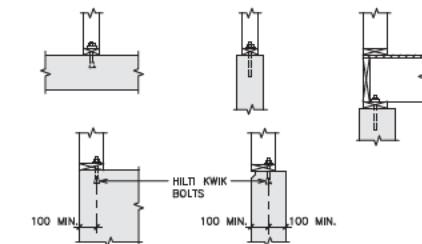
STUD	NAILING
38 X 89	75 mm NAILS @ 220 mm O/C
38 X 140	2 - ROWS OF 75 mm NAILS @ 220 O/C
38 X 184	2 - ROWS OF 75 mm NAILS @ 220 mm O/C

- ALL POSTS AND BUILT-UP STUD POSTS SHOWN ON ANY LEVEL SHALL BE CARRIED DOWN TO THE CONCRETE UNLESS NOTED OTHERWISE. PROVIDE SOLID BLOCKING BETWEEN JOISTS UNDER ALL POSTS AND BUILT-UP POSTS.
- ALL LOAD BEARING WALLS SHALL HAVE 2 CONTINUOUS TOP PLATES AND 1 CONTINUOUS BOTTOM PLATE. BEAMS OR HEADERS OVER OPENINGS IN WALLS SHALL BE DROPPED TO ALLOW THE TOP PLATES TO BE CONTINUOUS. WHERE 38 mm CONCRETE TOPPING IS USED ON THE FLOORS, PROVIDE 2 CONTINUOUS BOTTOM PLATES. DOUBLE PLATES SHALL BE SPLICED WITH A MINIMUM 600 mm STAGGER AND LAPPED AT CORNERS. TOP AND BOTTOM PLATES WHICH HAVE BEEN CORED OR WHICH ARE DISCONTINUOUS SHALL BE REINFORCED AS FOLLOWS:



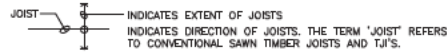
- WHERE PERMANENT SHEATHING IS NOT APPLIED TO STUDS PROVIDE BLOCKING AT 1000 mm O/C FOR 38 X 89 WALLS AND 600 mm O/C FOR 38 X 140 WALLS.
- FASTEN WOOD-FRAME STRUCTURE AT BASE BY BOLTING THE BOTTOM PLATE (SILL PLATE) TO THE CONCRETE WITH 13 mm Ø ANCHOR BOLTS @ 1200 mm O/C UNLESS NOTED OTHERWISE. ANCHOR BOLTS SHALL HAVE A MINIMUM 125 mm EMBEDMENT AND A MINIMUM 75 mm PROJECTION ABOVE THE CONCRETE. THE ANCHOR BOLTS MAY BE CAST IN PLACE OR GROUDED INTO PREDRILLED HOLES WITH THE HILTI-KWIK SYSTEM. HILTI-KWIK BOLTS WITH A 75 mm EMBEDMENT MAY BE USED WITH A 100 mm OR GREATER EDGE DISTANCE. NON-LOAD BEARING WALLS MAY BE FASTENED WITH 3 mm Ø POWER DRIVEN FASTENERS AT 400 mm O/C (MINIMUM 20 mm PENETRATION INTO CONCRETE). FULL WIDTH OF WALLS SHALL BEAR ON CONCRETE UNLESS NOTED OTHERWISE. SEE SHEAR WALL SCHEDULE FOR ADDITIONAL ANCHORING REQUIREMENTS OF SHEAR WALLS.

NON-SHEAR WALL ANCHORAGE EXAMPLES:

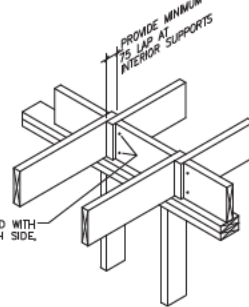


**JOISTS**

- REFER TO PLAN AND JOIST SCHEDULE FOR JOIST TYPE, SIZE, AND SPACING.



- DIMENSIONAL LUMBER JOISTS SHALL HAVE CROSS-BRIDGING OR FULL-DEPTH BLOCKING AT 1800 mm O/C ALONG THE SPAN FOR ALL SPANS GREATER THAN 3600 mm. CROSS BRIDGING SHALL CONSIST OF 38 X 38 TIMBER OR APPROVED STEEL BRIDGING. T.JI JOISTS SHALL BE BLOCKED AS PER MANUFACTURERS REQUIREMENTS. JOISTS SHALL HAVE FULL-DEPTH BLOCKING OVER LOAD BEARING WALLS, DROPPED BEAMS OR HEADERS. SEE TYPICAL LOAD BEARING WALL AND SHEAR WALL CONNECTIONS BETWEEN FLOORS FOR ADDITIONAL BLOCKING REQUIREMENTS.



- TRIM OPENINGS IN FLOORS AND ROOFS (I.E. STAIRS, FIREPLACES, SKYLIGHTS ETC) WITH DOUBLE JOISTS UNLESS NOTED OTHERWISE.

- PROVIDE DOUBLE JOISTS UNDER PARALLEL FRAME WALLS UNLESS NOTED OTHERWISE.



- STAIRS AND STRINGERS SHALL BE FRAMED IN ACCORDANCE WITH THE BUILDING CODE PART 9, UNLESS NOTED OTHERWISE.

- JOISTS ARE TO BE FLUSH UNLESS NOTED OTHERWISE. USE JOIST HANGERS OR FRAMING ANCHORS TO CONNECT JOISTS.



- UNLESS NOTED OTHERWISE JOIST HANGERS OR FRAMING ANCHORS SHALL BE CAPABLE OF DEVELOPING THE SHEAR STRENGTH OF THE SUPPORTED MEMBER. FOR DIMENSIONAL LUMBER JOISTS, THE FOLLOWING CAPACITIES ARE REQUIRED:

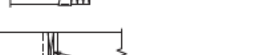
JOIST SIZE	REQUIRED SHEAR RESISTANCE (kN)	
	WORKING LOAD	FACTORED LOAD
38 X 89	5.5	7.2
38 X 140	7.2	9.4
38 X 184	8.2	10.6
38 X 235	9.53	12.4
38 X 286	10.5	13.7

FOR I-JOISTS, HANGERS SHALL BE SPECIFIED ON ENGINEERED SHOP DRAWINGS PROVIDED BY THE JOIST SUPPLIER.

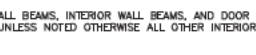
**BEAMS**

- BUILT-UP BEAMS (I.E. 3-38 X 235) SHALL BE NAILED TOGETHER WITH 2 ROWS OF 75 mm NAILS, EACH ROW WITH NAILS AT 300 mm O/C. INDIVIDUAL MEMBERS MAY NOT BE SPLICED BETWEEN SUPPORTS. FOR ENGINEERED PRODUCTS, NAILING REQUIREMENTS OF LAMINATES SHALL BE SPECIFIED ON ENGINEERED SHOP DRAWINGS PROVIDED BY BEAM SUPPLIER.

- FLUSH BEAMS



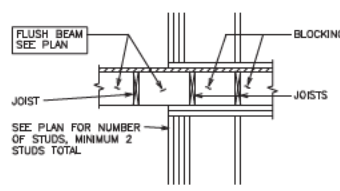
- DROPPED BEAMS



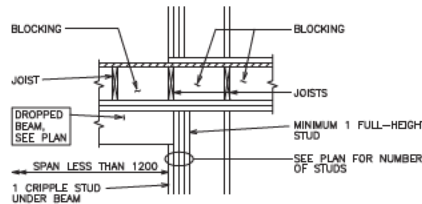
- U.N.O. ALL EXTERIOR WALL BEAMS, INTERIOR WALL BEAMS, AND DOOR HEADER BEAMS ARE DROPPED. UNLESS NOTED OTHERWISE ALL OTHER INTERIOR BEAMS ARE FLUSH.

- USE 2-38 X 235 BEAMS OVER ALL OPENINGS IN BEARING WALLS UNLESS NOTED OTHERWISE. BEAMS SHALL BE SUPPORTED AT EACH END AS SHOWN BELOW UNLESS NOTED OTHERWISE.

A. CASE 1 - FLUSH BEAM:



B. CASE 2 - DROPPED BEAM - OPENING LESS THAN 1200 mm:



**WOOD FRAMING**

**GENERAL**

- ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
  - BRITISH COLUMBIA BUILDING CODE 2012 - PART 9
  - CAN/CSA-086 - ENGINEERING DESIGN IN WOOD
  - CSA 0121 - DOUGLAS FIR PLYWOOD
  - CAN/CSA-LD 4000 - PARALLAMS AND MICROGLAMS
  - CAN/CSA-0122 - STRUCTURAL GLUED-LAMINATED TIMBER
  - CAN/CSA-0177 - QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
  - CSA 0437 SERIES - STANDARDS FOR OSB AND WAFFERBOARD
  - CSA B111 - WIRE NAILS, SPIKES AND STAPLES
  - CAN/CSA-B34 - MISCELLANEOUS BOLTS AND SCREWS
  - CANADIAN WOOD-FRAME HOUSE CONSTRUCTION - CMHC
  - "WOOD DESIGN MANUAL" - CANADIAN WOOD COUNCIL
  - "WOOD BUILDING TECHNOLOGY" - CANADIAN WOOD COUNCIL
- ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
- CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
- ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
- FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
- DO NOT COVER WOOD FRAMING WITH FINISHES UNTIL RJC'S FRAMING REVIEW IS COMPLETE. PROVIDE 24 HOURS ADVANCE NOTIFICATION WHEN FRAMING REVIEWS ARE REQUIRED.
- NOTCHING AND DRILLING OF STRUCTURAL ELEMENTS SHALL FOLLOW THE GUIDELINES SET FORTH IN THE BUILDING CODE PART 9, UNLESS OTHERWISE APPROVED IN WRITING BY RJC.
- ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
- ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
  - FLOORS - NOT MORE THAN 6 mm IN 3 m OUT OF LEVEL.
  - WALLS - NOT MORE THAN 6 mm IN 2.4 m OUT OF PLUMB, NOT MORE THAN 6 mm IN 3 m FOR ANY BOWING.
  - OVERALL - BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 10 mm DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

**MATERIALS**

- STUDS AND BUILT-UP POSTS TO BE S-P-F #2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) EXCEPT IN SHEARWALLS. REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS. FINGER JOINTED STUDS IN FIRE SEPARATIONS SHALL HAVE HEAT RESISTANT ADHESIVE (HSA).
- JOISTS TO BE S-P-F #2 GRADE OR BETTER.
- BUILT-UP BEAMS AND HEADERS TO BE S-P-F #2 GRADE OR BETTER.
- WALL PLATES TO BE D.FIR #2 GRADE OR BETTER WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
- POSTS AND BEAMS TO BE S-P-F #2 GRADE OR BETTER.
- ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S").
- PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
- TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
- NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
50 mm (2")	2.9 mm (0.113")	6d
65 mm (2 1/2")	3.3 mm (0.131")	8d
75 mm (3")	3.8 mm (0.148")	10d
80 mm (3 1/4")	3.8 mm (0.148")	12d
90 mm (3 1/2")	4.1 mm (0.162")	16d
100 mm (4")	4.9 mm (0.192")	20d
115 mm (4 1/2")	5.3 mm (0.207")	30d
125 mm (5")	5.8 mm (0.225")	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

- MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
- ANCHOR BOLTS SHALL BE ASTM F1554 OR ASTM A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DISTORTED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 40 mm AT THE BOTTOM.
- BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
- MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.
- ALL FASTENERS AND CONNECTION HARDWARE THROUGH PRESERVATIVE TREATED MATERIALS OR OUTSIDE OF THE MOISTURE BARRIER TO BE HOT DIPPED GALVANIZED OR STAINLESS STEEL AS SPECIFIED.

**NAILING**

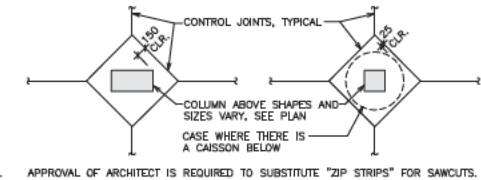
- NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 10 UNDER MATERIALS FOR COMMON NAIL SIZES.
- UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 64 mm NAILS AT 150 O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 250 O/C FOR FLOORS AND AT 300 O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING. IF SMALLER DIAMETER NAILS (I.E. PNEUMATICALLY DRIVEN NAILS OR "P-NAILS") ARE USED, INCREASE THE NUMBER OF NAILS BY 33%. SEE SHEAR WALL SCHEDULE OR DIAPHRAGM NAILING SCHEDULE FOR ADDITIONAL REQUIREMENTS.
- DO NOT USE PNEUMATICALLY DRIVEN NAILS WITH JOIST HANGERS OR CONNECTING HARDWARE. NAILS FOR HARDWARE SHOULD BE AS SPECIFIED OR SUPPLIED BY MANUFACTURER.
- DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

**MOISTURE BARRIERS**

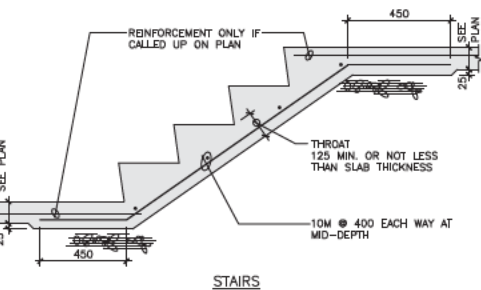
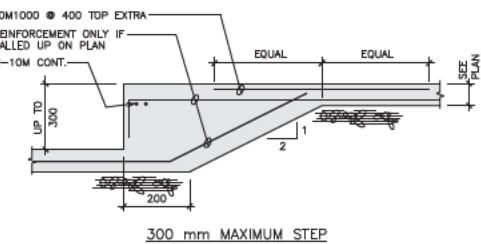
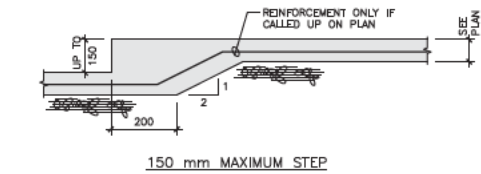
- PROVIDE A MOISTURE BARRIER BETWEEN WOOD ELEMENTS AND ALL CONCRETE OR MASONRY. THIS CAN BE A SHEET OF LIGHT-GAUGE (0.61 mm MINIMUM) GALVANIZED METAL, ASPHALT IMPREGNATED BUILDING PAPER (7.5 kg PER 10 m²), CLOSED-CELL FOAM GASKET MATERIAL, TYPE 3, ROLL ROOFING. SHEET POLYETHYLENE NOT PERMITTED. ALL JUNCTIONS AND TERMINATIONS TO BE LAPPED (50 mm MINIMUM) AND SEALED. BUTT JOINTS IN MOISTURE BARRIERS NOT PERMITTED.

**SLAB ON GRADE CONTROL JOINTS**

- UNLESS MORE RIGOROUS REQUIREMENTS ARE INDICATED ELSEWHERE ON THE STRUCTURAL AND ARCHITECTURAL DRAWINGS AND SPECIFICATIONS, SPACE CONTROL JOINTS AT 4500 mm O/C MAXIMUM.
- SAWCUT JOINTS 30 mm DEEP AS SOON AS PRACTICAL, BUT NO LATER THAN 12 HOURS AFTER PLACEMENT OF SLAB. USE EQUIPMENT THAT DOES NOT "RAVEL" THE EDGES OF THE CUT.
- UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS, RUN ANY SLAB ON GRADE REINFORCEMENT THROUGH THE JOINTS.
- UNLESS NOTED OTHERWISE, SAWCUT DIAMOND PATTERN AROUND COLUMNS, 150 mm CLEAR OF COLUMNS.



**TYPICAL SLAB ON GRADE STEP DETAILS - U.N.O.**



Drawing Note

No.	Revision	Date	By

Project Name

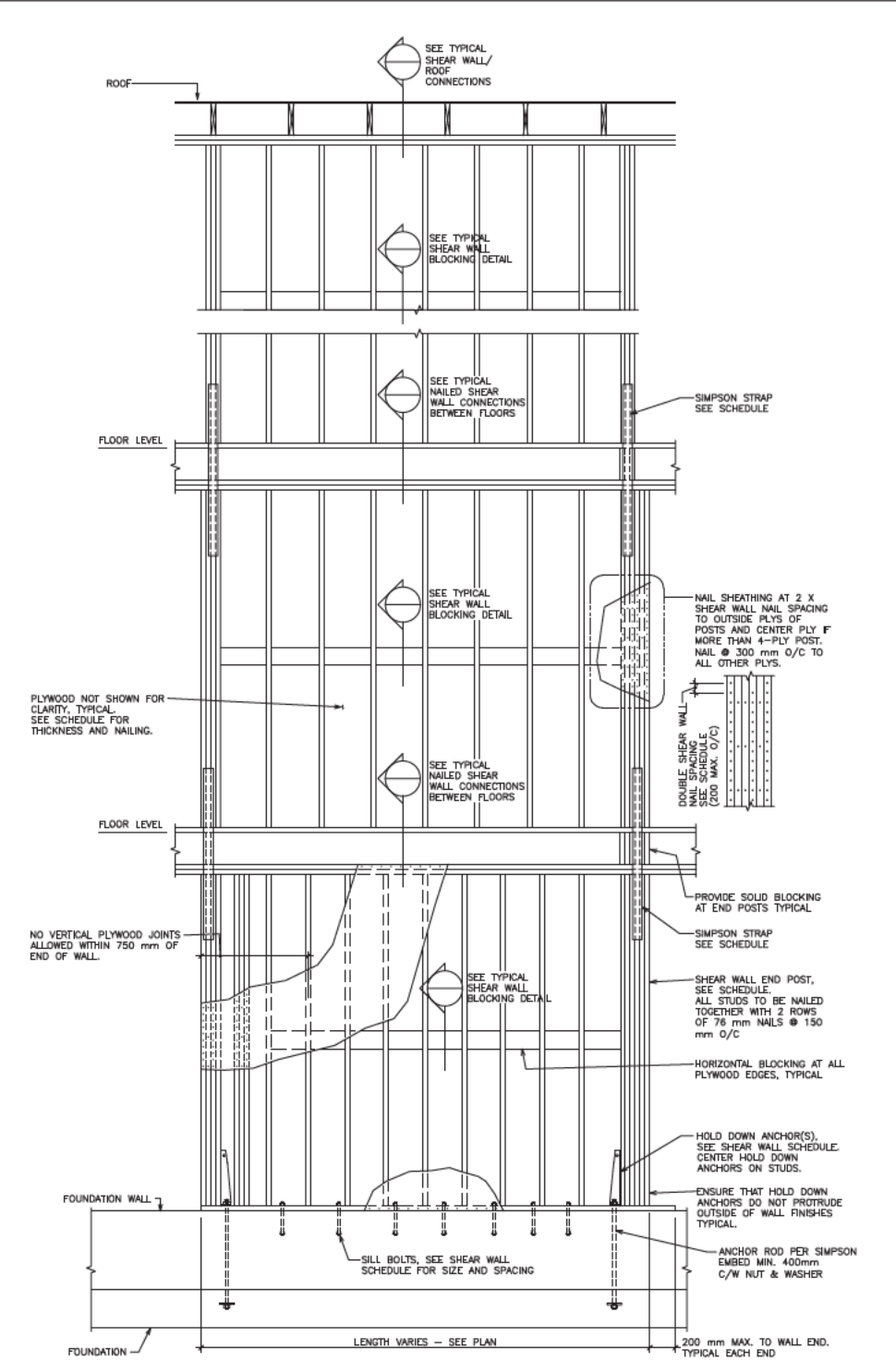
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**GENERAL NOTES AND TYPICAL DETAILS**

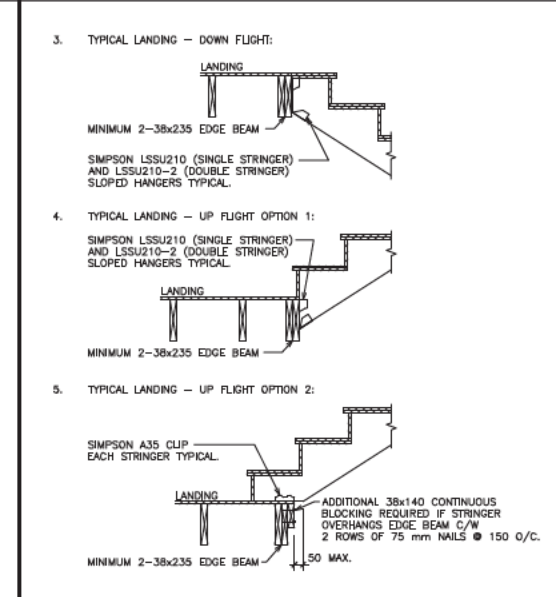
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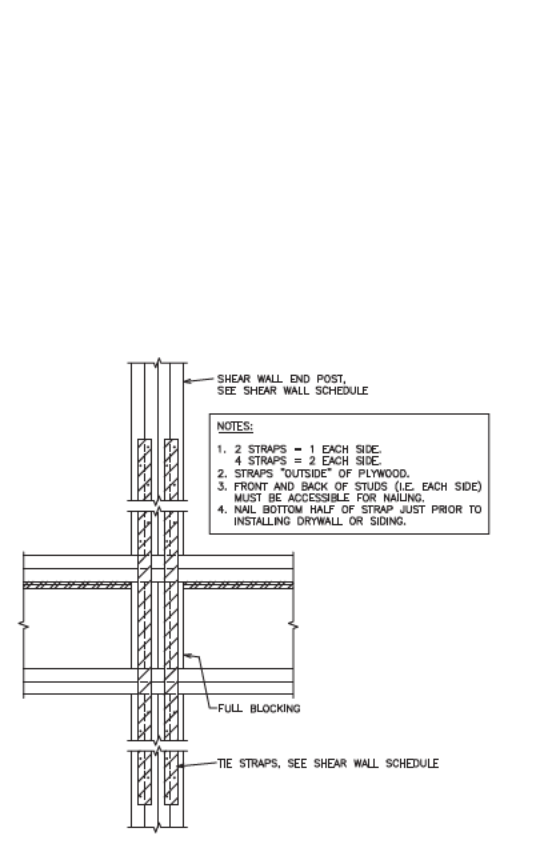
**S1.03**



**1 EXAMPLE WOOD FRAME SHEAR WALL ELEVATION**  
 S1.04 1:25 (TO BE USED AS A GUIDE ONLY)



**3 TYPICAL TIE STRAP HOLD DOWN**  
 S1.04 1:10



**2 TYPICAL SHEAR WALL BLOCKING DETAIL**  
 S1.04 1:10

- B. THE I-JOISTS SHALL BE DESIGNED FOR THE LOADS SPECIFIED IN THE GENERAL NOTES, OR AS SHOWN ON PLAN. SNOW LOADS SHALL BE BASED ON PART 4 OF THE BUILDING CODE, INCLUDING THE EFFECT OF SLIDING OR DRIFTING SNOW, PLUS ANY ADDITIONAL REQUIREMENTS SET OUT IN THE LOCAL BUILDING BY-LAW.
- C. I-JOIST SUPPLIER MUST DESIGN AND SUPPLY THE ENTIRE FLOOR SYSTEM WHICH INCLUDES THE FOLLOWING ELEMENTS:
  - JOIST HANGERS AND CONNECTING HARDWARE.
  - BRIDGING AND BLOCKING.
  - RM/BOX JOISTS.
  - SQUASH BLOCKS AND WEB STIFFENERS.
- D. I-JOIST SUPPLIER SHALL SUBMIT SHOP DRAWINGS OF THIS SYSTEM SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROVINCE OF [ALBERTA][BRITISH COLUMBIA][ONTARIO], TO THE ENGINEER OF RECORD AND ARCHITECT FOR REVIEW.
- E. SHOP DRAWINGS SHALL INCLUDE THE FOLLOWING ELEMENTS:
  - PLAN LAYOUT SHOWING ALL JOISTS AND BEAMS WITH THEIR DIRECTIONS AND SPACING.
  - LOADS USED IN DESIGN OF FLOOR SYSTEM.
  - ALL HANGERS AND CONNECTING HARDWARE.
  - ALL (E.W.P.) BEAMS, BLOCKING, RM BOARD, POSTS, SQUASH BLOCKING, WEB STIFFENERS, AND CROSS BRIDGING.
  - MATERIAL STRENGTHS AND SPECIFICATIONS.
- F. I-JOIST SUPPLIER SHALL PROVIDE PERIODIC FIELD REVIEW OF THE INSTALLATION OF THE ENGINEERED FLOOR SYSTEM TO ASCERTAIN COMPLIANCE WITH THE SHOP DRAWINGS. COPIES OF THE FIELD REVIEW INSPECTION REPORTS SHALL BE FORWARDED TO THE ENGINEER OF RECORD.
- G. I-JOIST SUPPLIER SHALL SUBMIT A LETTER ATTESTING TO THE SUCCESSFUL COMPLETION AND INSTALLATION OF ALL ELEMENTS IN COMPLIANCE WITH THE E.W.P. SHOP DRAWINGS TO THE ENGINEER OF RECORD. THIS LETTER SHALL BE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER REGISTERED IN THE PROVINCE OF [ALBERTA][BRITISH COLUMBIA][ONTARIO].
- H. I-JOIST SPACING SHALL NOT EXCEED 400 mm O/C FOR FLOORS AND 600 mm O/C FOR NON-OCCUPIED ROOFS.
- I. I-JOISTS SHALL MEET A MINIMUM DEFLECTION OF SPAN/480 FOR LIVE LOAD AND SPAN/240 FOR TOTAL LOAD. JOISTS SHALL ALSO BE DESIGNED IN ACCORDANCE WITH THE APPROPRIATE BUILDING CODE FOR VIBRATION CONTROL.
- J. FLOOR JOIST SYSTEM SHALL MEET THE U.L.C. AND S.T.C. RATINGS FOR THE FLOOR ASSEMBLY. REFER TO ARCHITECTURAL DRAWINGS FOR REQUIRED RATINGS.
- 7. DO NOT CUT, NOTCH, OR DAMAGE I-JOIST FLANGES.
- 8. REFER TO MANUFACTURERS SPECIFICATIONS FOR ALLOWABLE HOLES THROUGH JOIST WEBS.
- 9. PROVIDE AS A MINIMUM 16 mm PLYWOOD WEB STIFFENER TO EACH SIDE OF I-JOIST, ALL LOCATIONS WHERE I-JOISTS ARE CONTINUOUS OVER SUPPORTS AND THE SUPPORT WIDTH IS LESS THAN 133 mm WIDE. REFER ALSO TO MANUFACTURERS SPECIFICATIONS FOR WEB STIFFENERS.
- 10. U.N.D. ON PLAN STEEL CONNECTING HARDWARE FOR PSL AND LSL BEAMS SHALL BE CAPABLE OF DEVELOPING 100% OF THE BEAM SHEAR CAPACITY.
- 11. PRODUCT SUBSTITUTIONS MUST BE PRE-APPROVED.
- 12. DO NOT SUBSTITUTE BUILT-UP MEMBERS OF SAWN TIMBER FOR ENGINEERED WOOD PRODUCTS.
- 13. PARALLAMS USED IN EXTERIOR APPLICATIONS SHALL MEET THE EXPOSURE REQUIREMENTS SPECIFIED BY THE MANUFACTURER. DO NOT USE MICROLAMS.
- 14. ALL E.W.P. SHALL BE KEPT DRY AND PROTECTED FROM THE ENVIRONMENT DURING STORAGE ON OR OFF THE PROJECT SITE AS PER THE MANUFACTURERS REQUIREMENTS. STORE MATERIAL ELEVATED FROM GROUND AND WRAPPED TO SHED MOISTURE.
- 15. ALL STEEL CONNECTIONS / HARDWARE USED FOR CONNECTING BEAMS SHALL BE CAPABLE OF CARRYING THE SHEAR STRENGTH OF THE MEMBER.

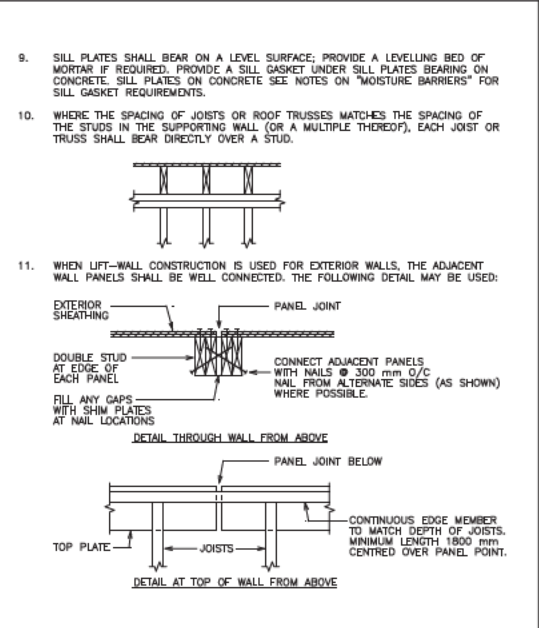
- GLUED-LAMINATED TIMBER (GLULAM)**
- 1. GLULAM MEMBERS SHALL SATISFY THE FOLLOWING:
    - A. DOUGLAS FIR/LARCH
    - B. STRESS GRADE : 24 f-Ex
    - C. APPEARANCE GRADE : QUALITY
    - D. MOISTURE CONTENT : 15% MAXIMUM
    - E. SERVICE GRADE : EXTERIOR SERVICE GRADE
  - 2. GLULAM MEMBERS SHALL BE MANUFACTURED BY A CSA APPROVED PLANT MEETING THE REQUIREMENTS OF CAN/CSA-0177.
  - 3. GLULAM MEMBERS SHALL BE KEPT DRY AND PROTECTED FROM THE ENVIRONMENT DURING STORAGE ON OR OFF THE PROJECT SITE AS PER THE MANUFACTURERS REQUIREMENTS.

**IMPERIAL EQUIVALENTS**

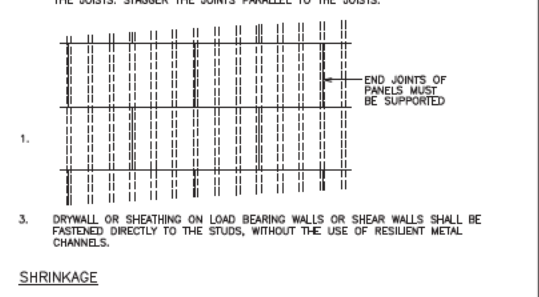
STRUCTURAL ELEMENTS SPECIFIED IN METRIC UNITS HAVE THE FOLLOWING EQUIVALENT IMPERIAL UNITS.

JOISTS	SHEATHING
38 x 89 = 2 x 4	6 mm = 1/4"
38 x 140 = 2 x 6	9.5 mm = 3/8"
38 x 184 = 2 x 8	12.5 mm = 1/2"
38 x 235 = 2 x 10	15.5 mm = 5/8"
38 x 286 = 2 x 12	19 mm = 3/4"
	22.5 mm = 7/8"

- STAIR CONSTRUCTION**
- 1. **TREADS:** STAIR TREADS SHALL CONFORM TO BUILDING CODE SECTION 9.8.9.5 AND SHALL BE CLOSED RISERS.
  - 2. **STRINGERS:** STAIR STRINGERS SHALL BE SELECT STRUCTURAL D.FIR U.N.D.
    - A. EXIT STAIRS WITH HALF HEIGHT LANDINGS:
      - MAXIMUM 3000 mm FLOOR TO FLOOR, MAXIMUM 1100 mm WIDE.
      - STAIR STRINGERS SHALL BE SPACED AT MAXIMUM 600 mm APART.
      - INTERIOR STRINGERS SHALL BE MINIMUM 2-38x286 NOTCHED
      - EDGE STRINGERS SHALL BE MINIMUM 1-38x286 NOTCHED
      - NO OVER CUTTING OF STRINGERS ALLOWED, MINIMUM 140 mm THROAT REQUIRED.
    - B. EXIT STAIRS WITHOUT HALF HEIGHT LANDINGS:
      - MAXIMUM 3000 mm FLOOR TO FLOOR, MAXIMUM 1100 mm WIDE.
      - STAIR STRINGERS SHALL HAVE MIN. 2-38x235 EACH SIDE OF STAIRS, NO CENTER STRINGER.
      - NO NOTCHING OF STRINGERS ALLOWED.
      - TREADS SHALL BE MINIMUM 38 mm THICK AND SUPPORTED AT TOE AND HEEL OF TREAD BETWEEN STRINGERS.



- SHEATHING**
- A. **ROOF SHEATHING**
    - SLOPED ROOF (SLOPE > 15%)
    - 12.5 mm PLYWOOD WITH H-CLIPS AT UNSUPPORTED JOINTS
    - FLAT ROOF (SLOPE ≤ 15%)
    - 15.5 mm TONGUE AND GROOVE PLYWOOD.
  - B. **FLOOR SHEATHING**
    - 15.5 mm TONGUE AND GROOVE PLYWOOD IF NO CONCRETE TOPPING IS USED. (ANY JOINT WITHOUT A TONGUE AND GROOVE CONNECTION SHALL BE BLOCKED WITH A 38 X 89).
    - 15.5 mm BUTT JOINT PLYWOOD IF 38 mm CONCRETE TOPPING IS USED.
  - C. **EXTERIOR WALL SHEATHING**
    - 9.5 mm PLYWOOD ON EXTERIOR SIDE TYP.
    - 12.5 mm PLYWOOD SHEATHING IF WALLS GLAD WITH VERTICAL STRAPPING OR BRICK VENEER. SEE ALSO ARCHITECTURAL FOR ADDITIONAL SHEATHING REQUIREMENTS.
  - D. **SHEAR WALL SHEATHING**
    - SEE SHEAR WALL SCHEDULE FOR SHEATHING REQUIREMENTS AT SHEAR WALL LOCATIONS.
2. LAY FLOOR AND ROOF SHEATHING WITH THE SURFACE GRAIN AT RIGHT ANGLES TO THE JOISTS. STAGGER THE JOINTS PARALLEL TO THE JOISTS.



- SHRINKAGE**
- 1. FRAMING DETAILS SHALL ENSURE UNIFORM VERTICAL SHRINKAGE. ADJACENT PORTIONS OF STRUCTURE SHALL BE SUPPORTED ON ROUGHLY EQUIVALENT AMOUNTS OF HORIZONTAL TIMBER (JOISTS AND SILL PLATES). DO NOT MIX KILN-DRIED AND NON-KILN DRIED JOISTS IN ANY GIVEN FLOOR.
  - 2. FRAMING DETAILS AROUND NON-SHRINKING STRUCTURAL ELEMENTS (CONCRETE, STEEL, PARALLAMS, GLULAMS, MICROLAMS, PLYWOOD ETC.) SHALL TAKE INTO ACCOUNT THE SHRINKAGE OF THE TIMBER. EXAMPLES:
    - NO JOINTS IN SHEATHING OVER GAP
    - SHRINKAGE GAP
    - SHRINKAGE GAP TOP AND BOTTOM
    - PLYWOOD FILLER PLATE IN BUILT-UP BEAM

**ENGINEERED WOOD PRODUCTS (E.W.P.)**

- 1. ENGINEERED WOOD PRODUCTS INCLUDE ALL PRE-MANUFACTURED BEAMS, COLUMNS, AND I-JOISTS SHOWN ON PLAN.
- 2. BEAMS EXPOSED TO VIEW IN FINISHED BUILDING SHALL BE SANDED APPEARANCE GRADE WITH STAMPS IN COVERED LOCATIONS.
- 3. SIZES OF BEAMS AND POSTS SHALL BE AS SPECIFIED ON PLAN.
- 4. **BEAMS:** MINIMUM STRENGTHS OF BEAMS AS SPECIFIED ON PLAN.

TRUS JOIST MACMILLAN DESIGNATION	MODULUS OF ELASTICITY	SHEAR RESISTANCE (Fv)	BENDING RESISTANCE (Fb)	BEARING RESISTANCE (Fcp)
PSL	2.0E (13700 MPa)	3.7 MPa	37 MPa	9.4 MPa
LSL	1.5E (10300 MPa)	5.1 MPa	29.5 MPa	10 MPa

BEAMS DEFLECTIONS ARE TO BE LIMITED TO LIVE LOAD SPAN/360 AND TOTAL LOAD SPAN/240.

PSL - PARALLAM BEAM    LSL - TIMBERSTRAND BEAM

- 5. **COLUMNS:** COLUMNS SHALL BE PSL 1.8E BY TRUS JOIST MACMILLAN OR PRE-APPROVED EQUIVALENT.
- 6. **I-JOISTS (INTERIOR USE ONLY):**
  - A. I-JOISTS TO BE TJ BY TRUS JOIST MACMILLAN OR PRE-APPROVED EQUIVALENT. JOISTS SHALL BE BLOCKED AND NAILED AS PER MANUFACTURER'S REQUIREMENTS IN ADDITION TO THE GENERAL NOTES.

**Drawing Notes**

No.      Revision      Date      By

Project Name

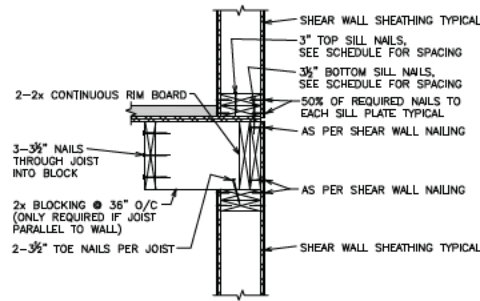
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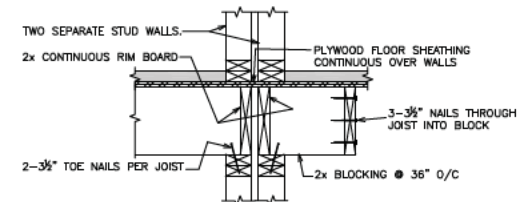
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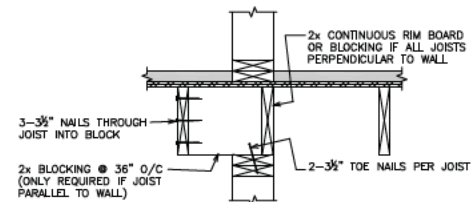
**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.  
 - PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.  
 - JOIST DIRECTION MAY VARY.



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - JOIST DIRECTION MAY VARY.

**TYPICAL LOAD-BEARING WALL CONNECTION BETWEEN FLOORS AT PARTY WALL SAWN LUMBER FLOOR JOISTS**

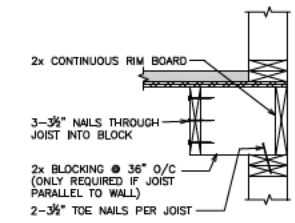
3 S1.05 1" = 1'-0"



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - JOIST DIRECTION MAY VARY.

**TYPICAL INTERIOR LOAD-BEARING WALL CONNECTION BETWEEN FLOORS SAWN LUMBER FLOOR JOISTS**

2 S1.05 1" = 1'-0"



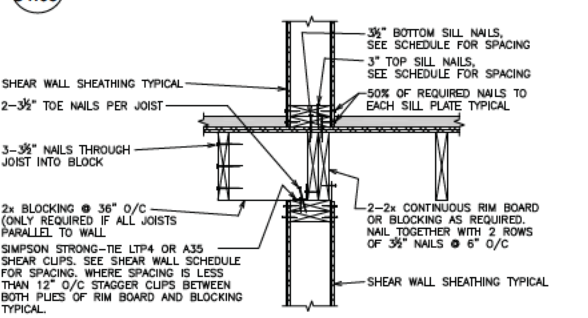
**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - JOIST DIRECTION MAY VARY.

**TYPICAL EXTERIOR LOAD-BEARING WALL CONNECTION BETWEEN FLOORS SAWN LUMBER FLOOR JOISTS**

1 S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL**

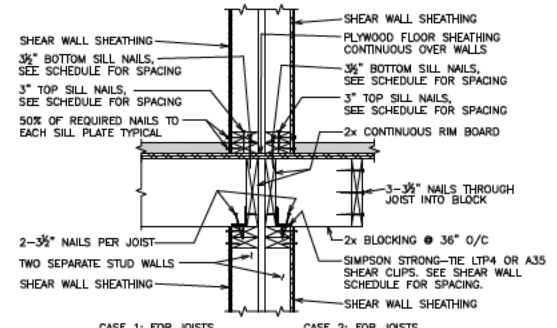
4 S1.05 1" = 1'-0"



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.  
 - PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.  
 - JOIST DIRECTION MAY VARY.  
 - SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

**TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL**

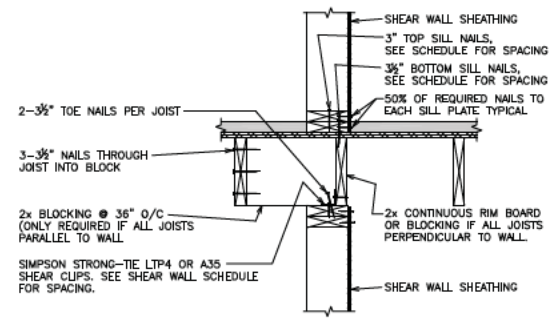
8 S1.05 1" = 1'-0"



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.  
 - PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.  
 - JOIST DIRECTION MAY VARY.  
 - SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT PARTY WALL**

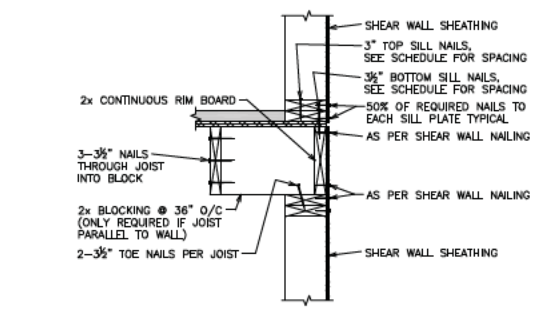
7 S1.05 1" = 1'-0"



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.  
 - PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.  
 - JOIST DIRECTION MAY VARY.  
 - SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL**

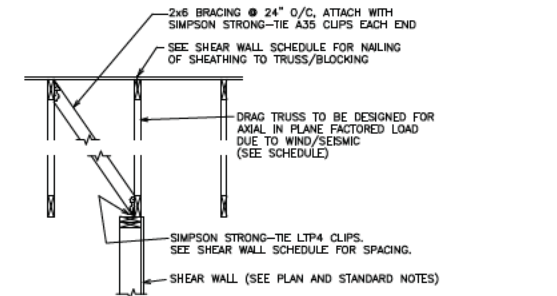
6 S1.05 1" = 1'-0"



**NOTES:**  
 - PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.  
 - ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.  
 - PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.  
 - JOIST DIRECTION MAY VARY.

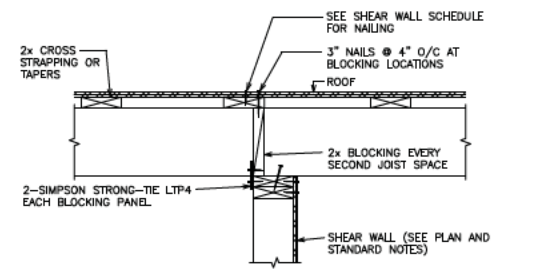
**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL**

5 S1.05 1" = 1'-0"



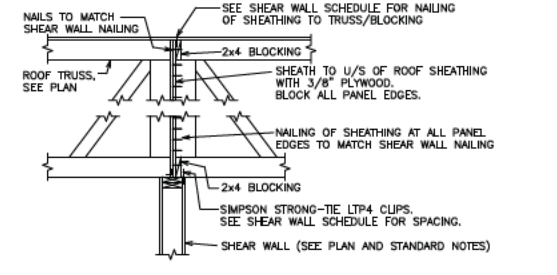
**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL - ALTERNATE 1**

13 S1.05 1/2" = 1'-0"



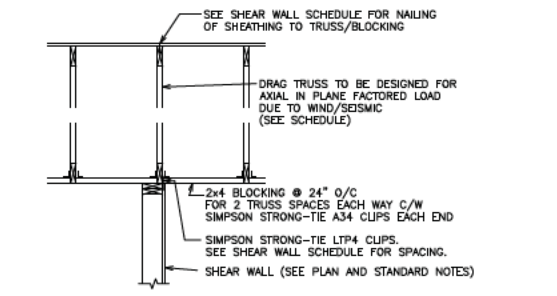
**TYPICAL SHEAR WALL TO SAWN LUMBER ROOF JOIST CONNECTION WHERE JOISTS RUN PERPENDICULAR TO WALL**

11 S1.05 1" = 1'-0"



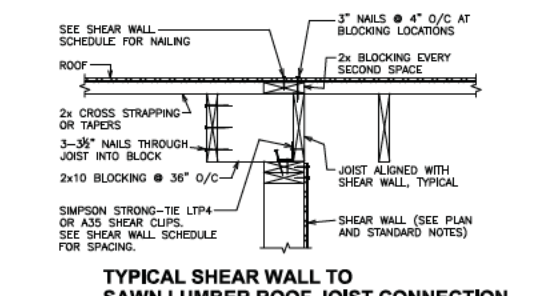
**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL - ALTERNATE**

9 S1.05 1/2" = 1'-0"



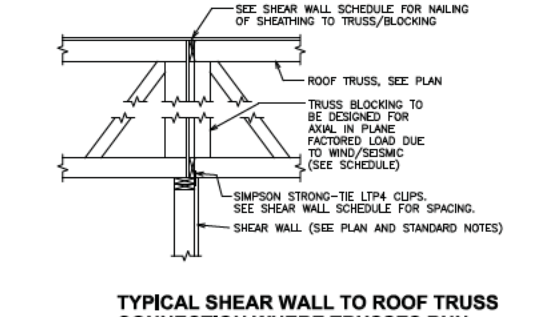
**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL - ALTERNATE 2**

14 S1.05 1/2" = 1'-0"



**TYPICAL SHEAR WALL TO SAWN LUMBER ROOF JOIST CONNECTION WHERE JOISTS RUN PARALLEL TO WALL**

12 S1.05 1" = 1'-0"



**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL**

10 S1.05 1/2" = 1'-0"

No.	Revision	Date	By

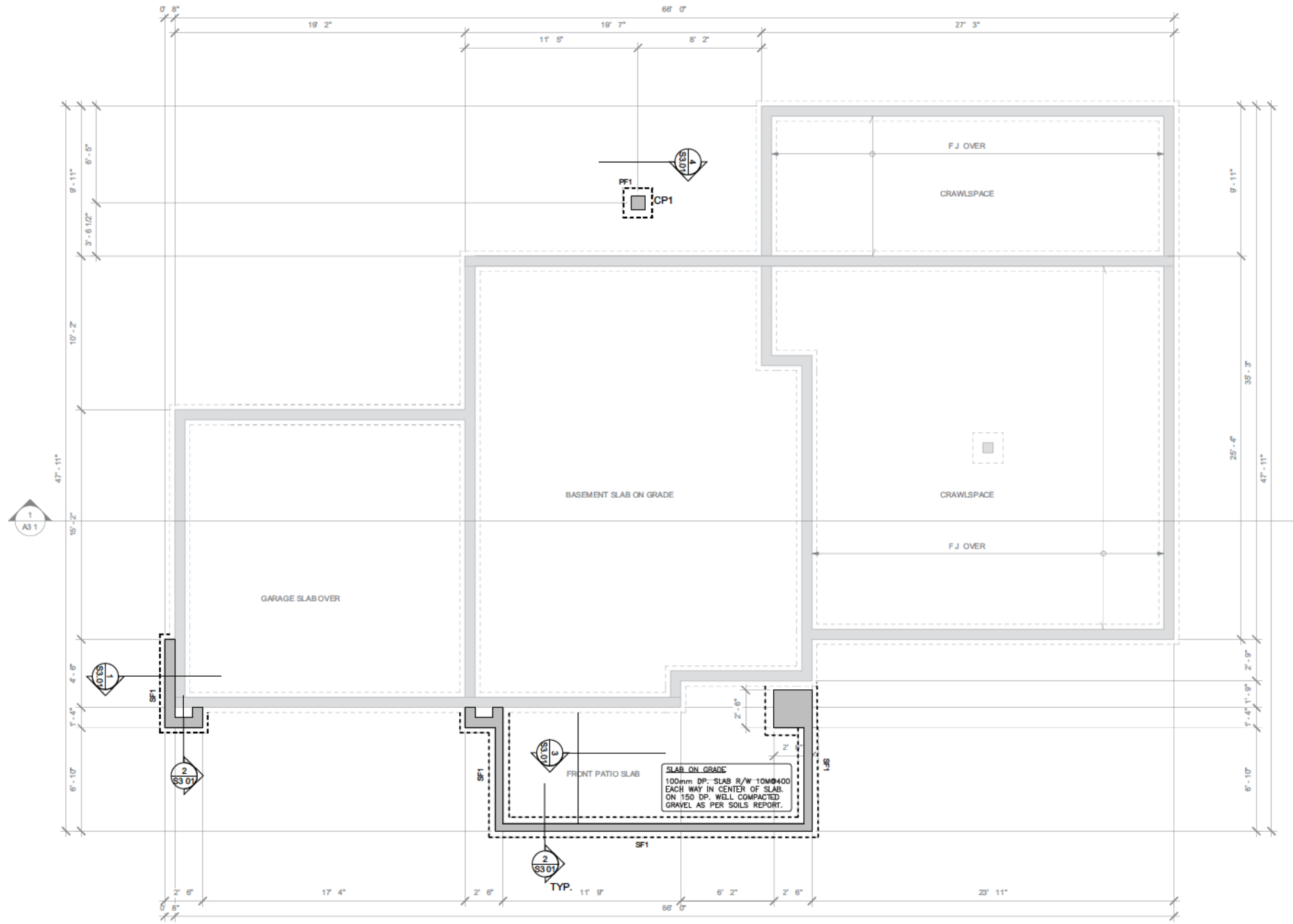
Project Name

Sheet Title  
**GENERAL NOTES AND TYPICAL DETAILS**

Sheet Number Revision

**S1.05**

PAD FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
PF1	2' 0" X 2' 0" X 10' DEEP	3 10M E W BOT
CP1	10" X 10"	4 10M VERTS
STRIP FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
SF1	400 WIDE x 250 DEEP x CONT.	2-15M CONT.



**1 FOUNDATION PLAN**  
S2.01 1/4" = 1'-0"

Drawing Notes

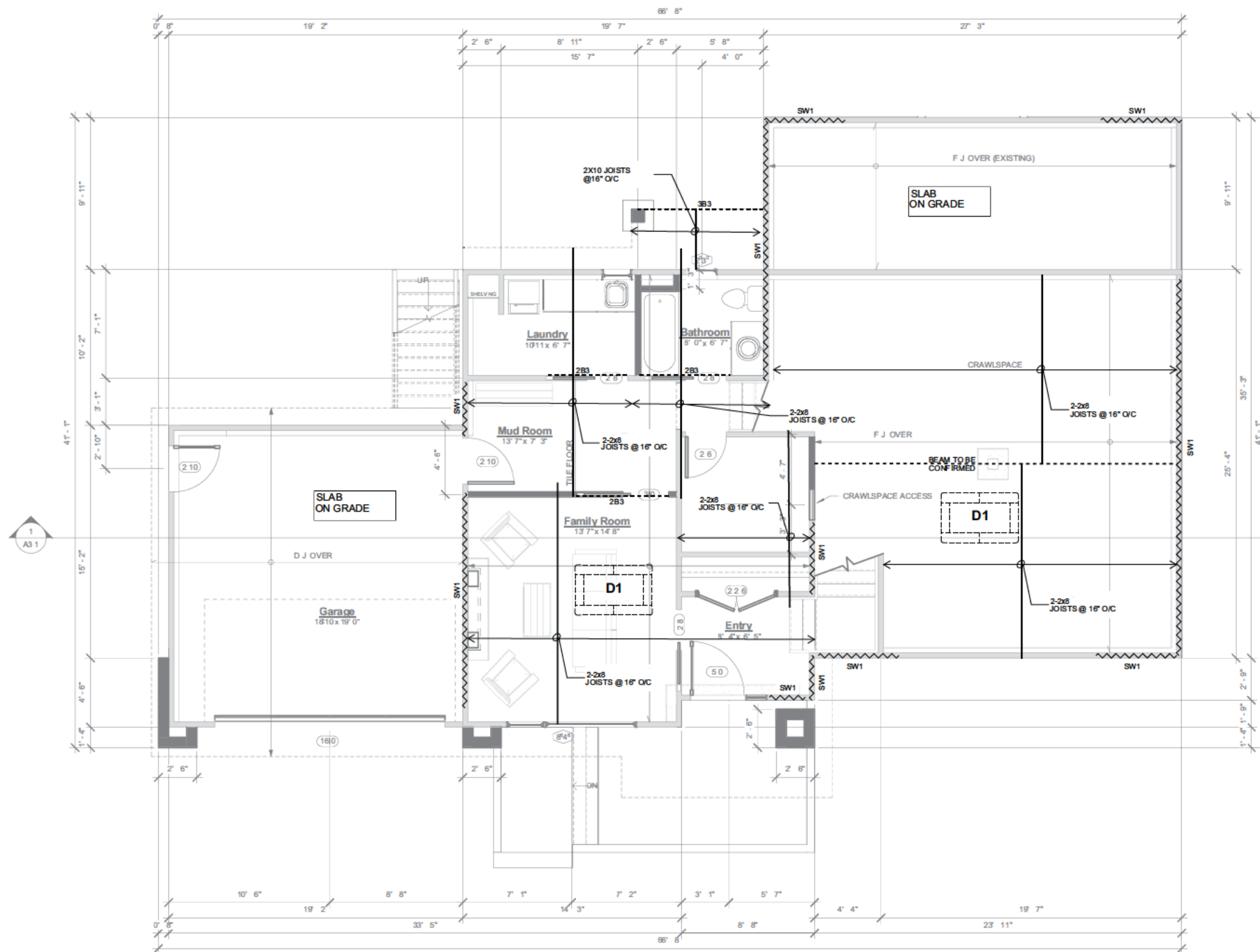
No.	Revision	Date	By
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Project Name

Sheet Title  
**FOUNDATION PLAN**

Sheet Number  
**S2.01**

Drawing Notes



**2** BASEMENT FLOOR FRAMING SHOWING UPPER FRAMING OVER  
S2.02 14' x 1' 0"

WOOD FRAME SHEAR WALL SCHEDULE																
MARK	SIZE	LEGEND	LEVEL	NOTES												
SW1	3" x 4" O.C.	NAILING TO BLOCKING/TRUSS	ROOF	<p>1. SHEAR WALLS SHOWN ON PLAN AS THIS: LINE O.S. OF WALL DESIGNATES PREFERRED SIDE TO ATTACH SHEATHING.</p> <p>2. DO NOT USE P-NAILS OR SPIRAL NAILS IN SHEAR WALLS. NAILS SHALL BE COMMON WIRE NAILS OR POWER DRIVEN NAILS THAT ARE EQUIVALENT TO THE COMMON NAIL SIZES BELOW:</p> <table border="1"> <thead> <tr> <th>COMMON NAIL SIZES</th> <th>LENGTH</th> <th>DIAMETER</th> </tr> </thead> <tbody> <tr> <td></td> <td>2 1/2"</td> <td>0.131"</td> </tr> <tr> <td></td> <td>3"</td> <td>0.148"</td> </tr> <tr> <td></td> <td>3 1/2"</td> <td>0.162"</td> </tr> </tbody> </table> <p>3. FOR SHEAR WALLS, BLOCKING OF EXTERIOR WALLS MAY INTERFERE WITH VENTILATION. IN THIS CASE, USE 2 X 4 ON THE FLAT BLOCKING OR 2 X 3 BLOCKING.</p> <p>4. NAILING SHOWN ON SCHEDULE APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O.C. ALONG INTERMEDIATE SUPPORTS.</p>	COMMON NAIL SIZES	LENGTH	DIAMETER		2 1/2"	0.131"		3"	0.148"		3 1/2"	0.162"
COMMON NAIL SIZES	LENGTH	DIAMETER														
	2 1/2"	0.131"														
	3"	0.148"														
	3 1/2"	0.162"														
A35	24" x 1/2" PLY O.S., 2-1/2" x 4" STUDS, 1-MST4S, 1-ROW @ 5"	SHEAR CLIPS T.O.W. SHEATHING NAILING END POSTS HOLD-DOWN(EACH END) SILL NAILS	UPPER FLOOR													
A35	16" x 1/2" PLY O.S., 2-1/2" x 3" STUDS, SIMPSON HDU8, 5/8" x 16"	SHEAR CLIPS T.O.W. SHEATHING NAILING END POSTS HOLD-DOWN SILL BOLTS	MAIN FLOOR													
			LOWER FLOOR													

DECKING SCHEDULE	
MARK	TYPE
D1	38mm CONCRETE ON 16mm PLY
D2	16mm T&G PLY

WOOD FRAME SCHEDULE			
WOOD JOIST SCHEDULE			
DIMENSIONAL LUMBER JOISTS			
MARK	SIZE	TYPE	SPACING
J1	2" x 6"	SL	SEE PLAN
J2	2" x 8"	SL	SEE PLAN
J3	2" x 10"	SL	SEE PLAN
J4	2" x 12"	SL	SEE PLAN
ENGINEERED I-JOIST			
MARK	SIZE	TYPE	SPACING
TJ1	302 DEEP	I-JOIST	SEE PLAN

WOOD BEAM SCHEDULE					
MARK	SIZE	TYPE	MARK	SIZE	TYPE
B1	2" x 6"	SL	B5	1 3/4" x 9 1/2"	LVL
B2	2" x 8"	SL	B6	1 3/4" x 11 7/8"	LVL
B3	2" x 10"	SL			
B4	2" x 12"	SL			

WOOD POST SCHEDULE		
MARK	SIZE	TYPE
P1	2" x 4"	SL
P2	2" x 6"	SL
P3	4" x 4"	SL
P4	6" x 6"	SL

- NOTES:**
- FLOOR OR ROOF FRAMING SHOWN ON THIS PLAN IS FOR THE LEVEL ABOVE. DOOR AND WINDOW HEADERS SHOWN ARE OVER THE DOOR AND WINDOW AT THIS LEVEL.
  - SEE PLAN FOR NUMBER OF LAMINATIONS REQUIRED. EXAMPLE: 3B1 = 3 2" x 6" MEMBERS
  - ABBREVIATIONS:  
SL --- SAWN LUMBER  
PSL --- PARALLEL STRAND LUMBER  
LSL --- LAMINATED STRAND LUMBER  
LVL --- LAMINATED VENEER LUMBER

No.	Revision	Date	By
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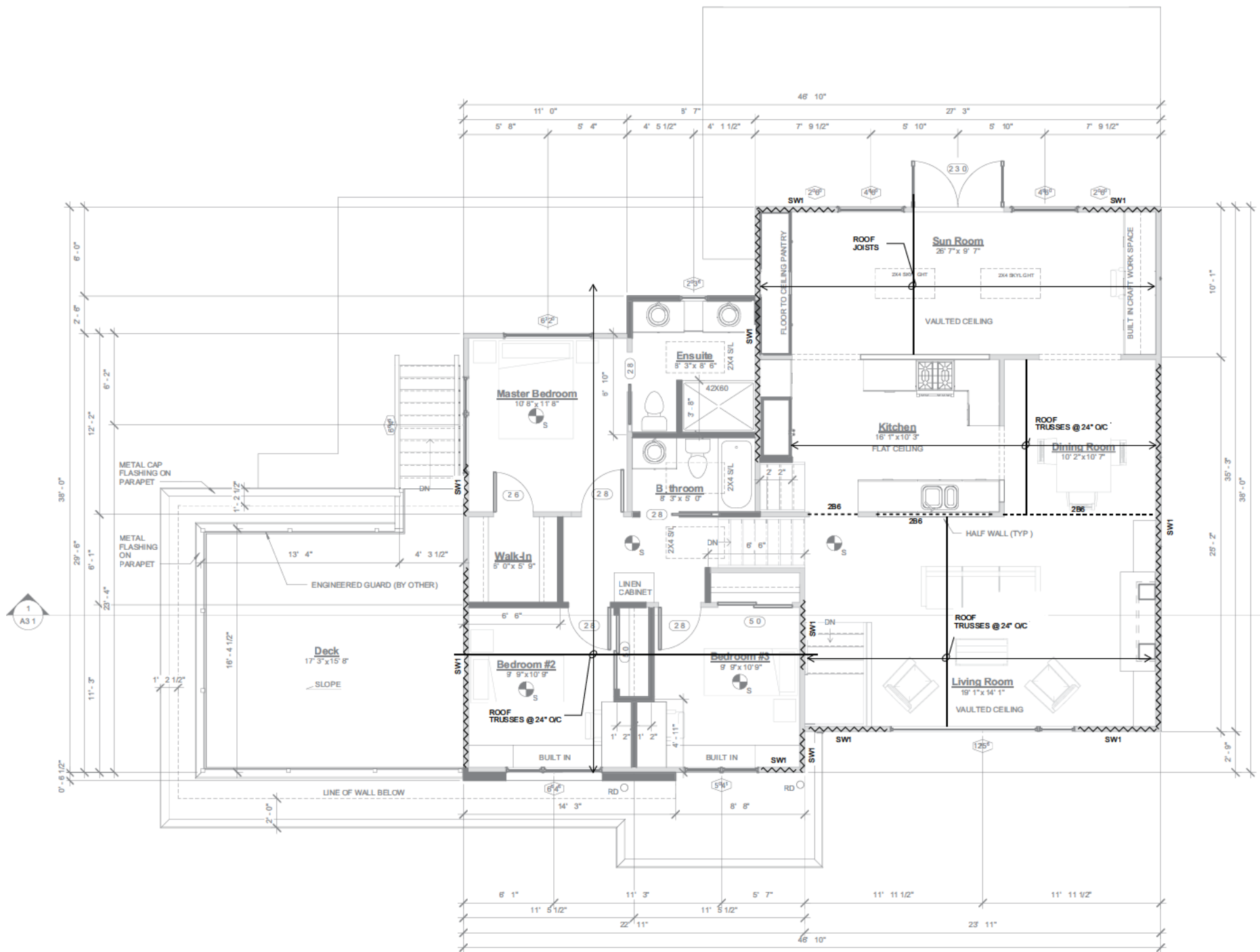
Project Name

Sheet Title

**BASEMENT FLOOR PLAN  
SHOWING MAIN FLOOR  
FRAMING OVER**

Sheet Number Revision

**S2.02**



1  
S2.03  
UPPER FLOOR FRAMING SHOWING ROOF FRAMING OVER  
1/4" = 1' 0"

WOOD FRAME SCHEDULE					
WOOD JOIST SCHEDULE					
DIMENSIONAL LUMBER JOISTS					
MARK	SIZE	TYPE	SPACING		
J1	2" x 6"	SL	SEE PLAN		
J2	2" x 8"	SL	SEE PLAN		
J3	2" x 10"	SL	SEE PLAN		
J4	2" x 12"	SL	SEE PLAN		
ENGINEERED I-JOIST					
MARK	SIZE	TYPE	SPACING		
TJ1	302 DEEP	I-JOIST	SEE PLAN		
WOOD BEAM SCHEDULE					
MARK	SIZE	TYPE	MARK	SIZE	TYPE
B1	2" x 6"	SL	B5	1 3/4" x 9 1/2"	LVL
B2	2" x 8"	SL	B6	1 3/4" x 11 7/8"	LVL
B3	2" x 10"	SL			
B4	2" x 12"	SL			
WOOD POST SCHEDULE					
MARK	SIZE	TYPE			
P1	2" x 4"	SL			
P2	2" x 6"	SL			
P3	4" x 4"	SL			
P4	6" x 6"	SL			
NOTES:					
1. FLOOR OR ROOF FRAMING SHOWN ON THIS PLAN IS FOR THE LEVEL ABOVE. DOOR AND WINDOW HEADERS SHOWN ARE OVER THE DOOR AND WINDOW AT THIS LEVEL.					
2. SEE PLAN FOR NUMBER OF LAMINATIONS REQUIRED. EXAMPLE: 3B1 = 3 2" x 6" MEMBERS					
3. ABBREVIATIONS: SL --- SAWN LUMBER      LSL --- LAMINATED STRAND LUMBER PSL --- PARALLEL STRAND LUMBER      LVL --- LAMINATED VENEER LUMBER					

No.	Revision	Date	By



Project Name

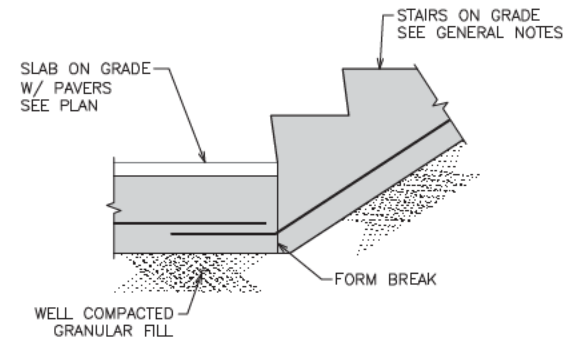


Sheet Title  
**BASEMENT FLOOR PLAN  
SHOWING MAIN FLOOR  
FRAMING OVER**

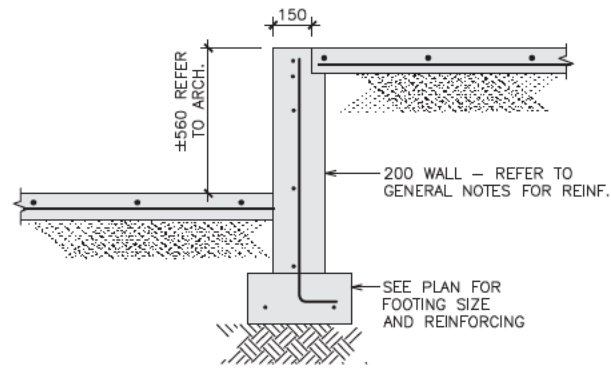


Sheet Number      Revision

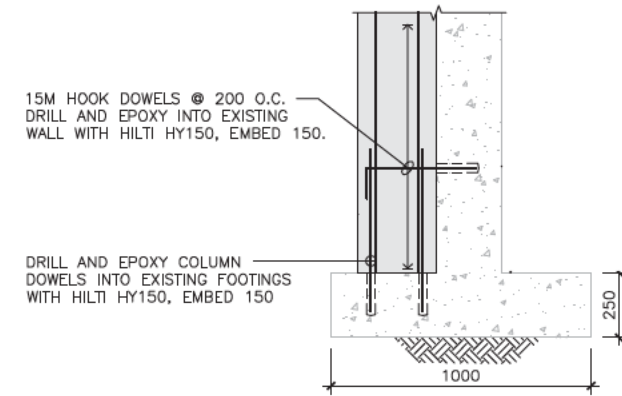
**S2.03**



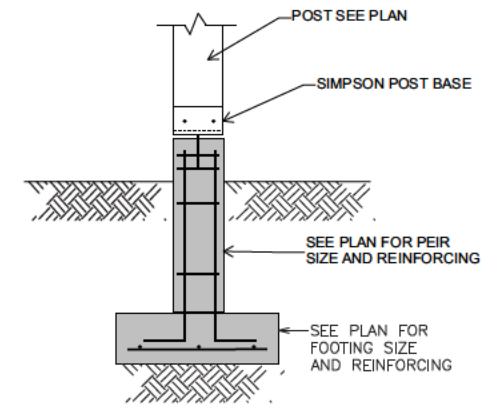
**3**  
S3.01  
NTS  
**STAIR TRANSITION DETAIL**



**2**  
S3.01  
NTS  
**TYPICAL STRIP FOOTING**



**1**  
S3.01  
NTS  
**SUPPORT WALL FOR STONE VENEER**



**4**  
S3.01  
NTS  
**FOOTING DETAIL**

Drawing Notes

No.	Revision	Date	By

Project Name

Sheet Title

**DETAILS**

Sheet Number

Revision

**S3.01**

## APPENDIX B – MINIMUM CODE DESIGN DRAWINGS

The design drawings in this Appendix were adapted from those created by RJC for the construction of the high-performance residence that is the subject of this research initiative [11].



**PROJECT INFORMATION:**

SITE ADDRESS:



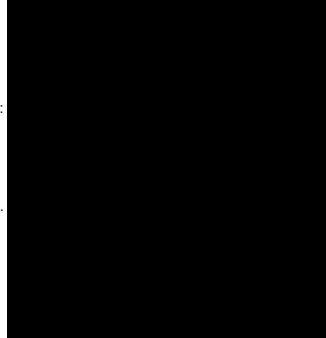
OWNER:

**SCOPE OF WORK:**

RENOVATION TO SINGLE FAMILY DWELLING

**PROJECT DIRECTORY:**

DESIGNER:



GENERAL CONTRACTOR:

STRUCTURAL ENGINEER:

BUILDING ENV. ENGINEER:

SURVEYOR:

**SHEET INDEX:**

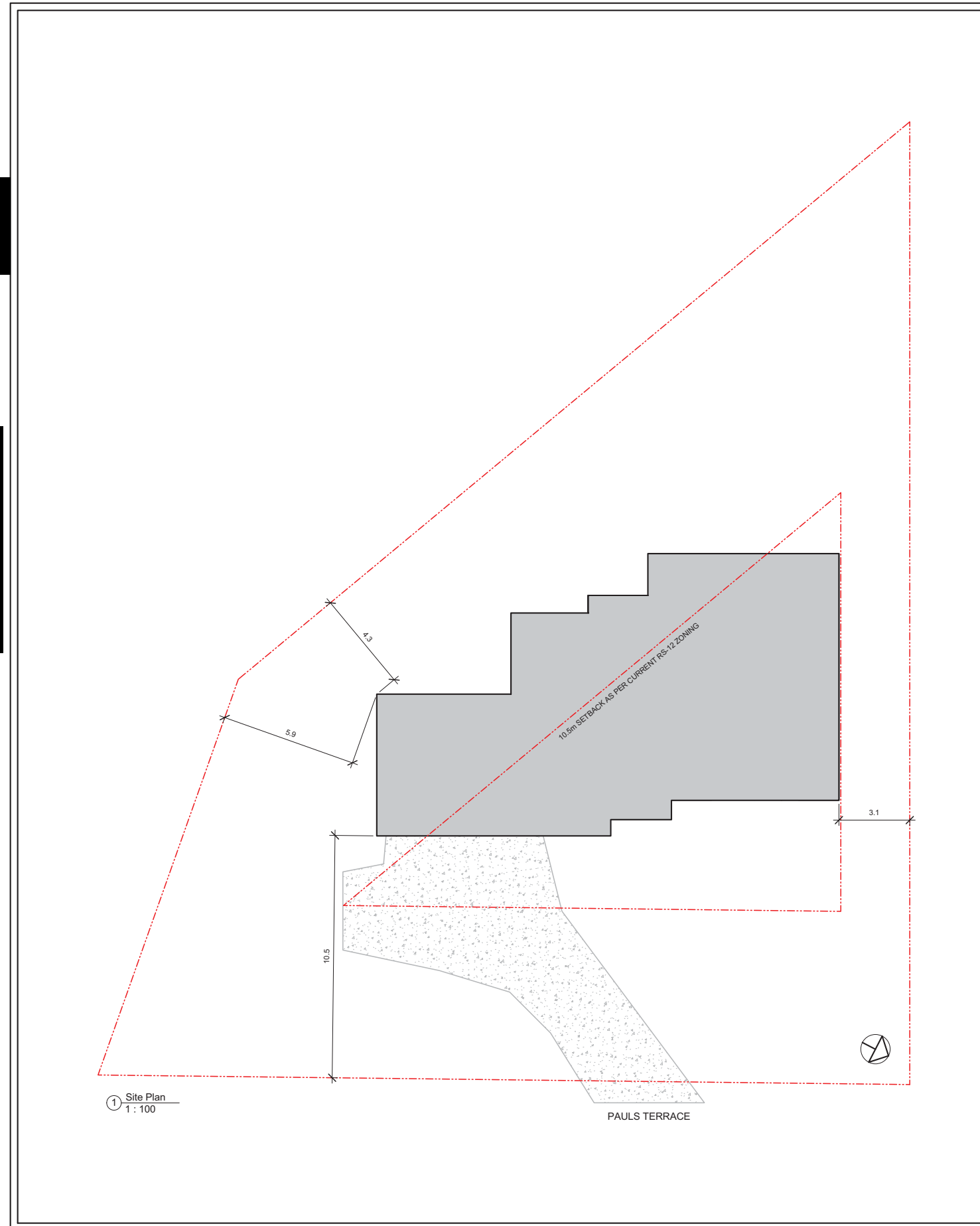
- A0.0 COVER SHEET
- A2.1 FOUNDATION
- A2.2 BASEMENT & CRAWLSPACE
- A2.3 MAIN & UPPER FLOOR
- A3.1 SECTION
- A4.1 ELEVATIONS
- A4.2 ELEVATIONS

**KEY PLAN:**

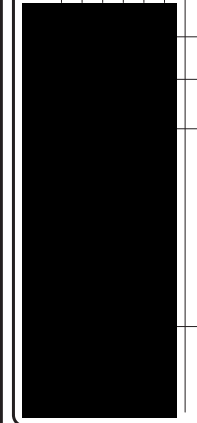


**ZONING ANALYSIS:**

<b>ZONE:</b>	RS-12	
<b>LOT AREA:</b>	917.6m <sup>2</sup>	
<b>GRADES:</b>	AVERAGE GRADE: 32.3m	
<b>F.S.R:</b>	<b>ALLOWABLE</b>	<b>PROPOSED</b>
(FSR GOVERNS)	0.50 = 458.8m <sup>2</sup>	0.22
<b>GROSS FLOOR AREA: ALLOWABLE</b>	<b>PROPOSED</b>	
LOWER LEVEL:	NO LIMIT	59.1m <sup>2</sup>
MAIN LEVEL:	NO LIMIT	81.8 m <sup>2</sup>
UPPER LEVEL:	NO LIMIT	61.0m <sup>2</sup>
TOTAL:	75% OF 458.8 = 344.1m <sup>2</sup>	201.9 m <sup>2</sup>
<b>LOT COVERAGE:</b>	<b>ALLOWABLE</b>	<b>PROPOSED</b>
	40%	200.8m <sup>2</sup> / 917.6m <sup>2</sup> = 21.9%
<b>HEIGHT:</b>	<b>ALLOWABLE</b>	<b>PROPOSED</b>
BUILDING HEIGHT:	7.5m	5.3m
LOWEST FACE:	7.5m	6.5m
<b>SETBACKS:</b>	<b>ALLOWABLE</b>	<b>PROPOSED</b>
FRONT:	7.5m	10.5m
REAR:	10.5m	4.3m
SIDE (N):	3.0m	3.0m
SIDE (S):	1.5m	6.0m



Comments:



Sheet Title:  
**Cover Sheet**

Project No.:  
**1494**

Sheet:  
**A0.0**

EW1	TYPICAL ABOVE GRADE WALL	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	CLADDING (FIBRE CEMENT SIDING)	0.03	0.15
3	¾" AIR SPACE (FROM STRAPPING)	0.18	1.00
4	¾" P.T. RAINSCREEN STRAPPING @ 8" O/C C/W INSECT SCREEN T&B	0.00	0.00
5	2-LAYERS OF BUILDING PAPER OR HOUSE WRAP TO CODE	0.00	0.00
6	½" PLYWOOD SHEATHING	0.11	0.62
7	R-19 BATT INSULATION (FACTORED FOR FRAMING)	2.36	13.40
8	2X6 WALL STUDS @ 16" O/C (SPF #2 OR BETTER)	0.00	0.00
9	6MIL POLY A/V BARRIER	0.00	0.00
10	½" GYPSUM WALL BOARD	0.08	0.45
11	FINISH TO OWNER'S SPECIFICATION	0.00	0.00
12	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>2.91</b>	<b>16.50</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.6.A		2.78	15.80

EW2	INSULATED FOUNDATION WALL	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	DRAINAGE MAT OR CAPILARY BREAK	0.00	0.00
3	DAMPPROOFING OR WATERPROOFING AS REQUIRED	0.00	0.00
4	8" CONCRETE FOUNDATION WALL	0.23	1.35
5	2" XPS INSULATION	1.76	10.00
6	2X4 WALL STUDS @ 16" O/C (SPF #2 OR BETTER)	0.00	0.00
7	½" GYPSUM WALL BOARD	0.08	0.45
8	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>2.91</b>	<b>12.65</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.8.A		1.99	11.30

EW3	EXTERIOR WALL - 2x4 STONE VENEER WALL	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	THINSTONE VENEER	0.01	0.06
3	GALV. METAL LATH AND 1/2" MORTAR BED	0.02	0.11
4	1/2" RAINSCREEN CAPILLARY BREAK	0.17	0.97
5	2-LAYERS OF BUILDING PAPER OR HOUSE WRAP TO CODE	0.00	0.00
6	1/2" PLYWOOD SHEATHING	0.11	0.62
7	2X4 WALL STUDS	0.00	0.00
8	R-19 BATT INSULATION (FACTORED FOR FRAMING)	2.36	13.40
9	6-MIL POLY A/V BARRIER	0.00	0.00
10	1/2" GYPSUM WALL BOARD	0.08	0.45
11	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>2.90</b>	<b>16.46</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.6.A		2.78	15.80

No.	Revision	Date	By

F1	FLOOR – GARAGE SLAB	RSI	R
1	COMPACTED SUB-BASE	0.00	0.00
2	6 MIL POLY A/V/M BARRIER	0.00	0.00
3	4" CONCRETE S.O.G. (32MPA) R/W 10M E.W. @ 24" O/C	0.00	0.00
4	SLOPED FINISH	0.00	0.00
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>0.00</b>	<b>0.00</b>
MINIMUM REQUIRED BY BCBC		N/A	N/A

F2	FLOOR – CRAWLSPACE GROUND SEAL	RSI	R
1	COMPACTED SUB-BASE	0.00	0.00
2	6 MIL POLY A/V/M BARRIER	0.00	0.00
3	2" GROUND SEAL CONCRETE SLAB	0.00	0.00
4	SLOPED FINISH	0.00	0.00
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>0.00</b>	<b>0.00</b>
MINIMUM REQUIRED BY BCBC		N/A	N/A

F3	FLOOR – OVER UNHEATED SPACE	RSI	R
1	FLOOR FINISH TO OWNERS SPEC	0.00	0.00
2	1/2" PLYWOOD SHEATHING	0.11	0.62
3	2x10 FLOOR JOISTS @ 16" OC	0.00	0.00
4	9" ROXUL COMFORT BATT	4.68	26.6
5	SOFFIT FINISH TO OWNERS SPECIFICATIONS	0.00	0.00
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>4.79</b>	<b>27.2</b>
MINIMUM REQUIRED BY BCBC		4.67	26.5

F4	FLOOR – MAIN FLOOR ASSEMBLY	RSI	R
1	FLOOR FINISH TO OWNER'S SPECIFICATION	0.00	0.00
2	5/8" T&G PLYWOOD SUBFLOOR	0.00	0.00
3	2X10 JOISTS @ 16" OC	0.00	0.00
4	5/8" GYPSUM BOARD	0.00	0.00
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>0.00</b>	<b>0.00</b>
MINIMUM REQUIRED BY BCBC		N/A	N/A

F5	FLOOR – BASEMENT S.O.G	RSI	R
1	COMPACTED SUB-BASE	0.00	0.00
2	10MIL POLY A/V BARRIER	0.00	0.00
3	2" XPS INSULATION 4' PERIMETER	0.00	0.00
4	3.5" CONCRETE S.O.G - HAND TROWEL FINISH	0.00	0.00
5	FINISH FLOOR TO OWNERS SPECIFICATIONS	0.00	0.00
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>0.00</b>	<b>0.00</b>
MINIMUM REQUIRED BY BCBC		0.00	0.00

R1	ROOF – TYPICAL TRUSSED ROOF	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	LAMINATED FIBERGLASS SHINGLES	0.11	0.00
3	ROOF UNDERLAYMENT	0.00	0.00
4	½" PLYWOOD ROOF SHEATHING C/W H-CLIPS	0.13	0.74
5	ENGINEERED ROOF TRUSSES (BY TRUSS SUPPLIER)	0.00	0.00
6	R-40 EQ. LOOSE FILL INSULATION	6.71	38.10
7	6 MIL POLY A/V BARRIER	0.00	0.00
8	5/8" GYPSUM BOARD	0.08	0.48
9	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>7.18</b>	<b>40.80</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.6.A		6.91	39.20

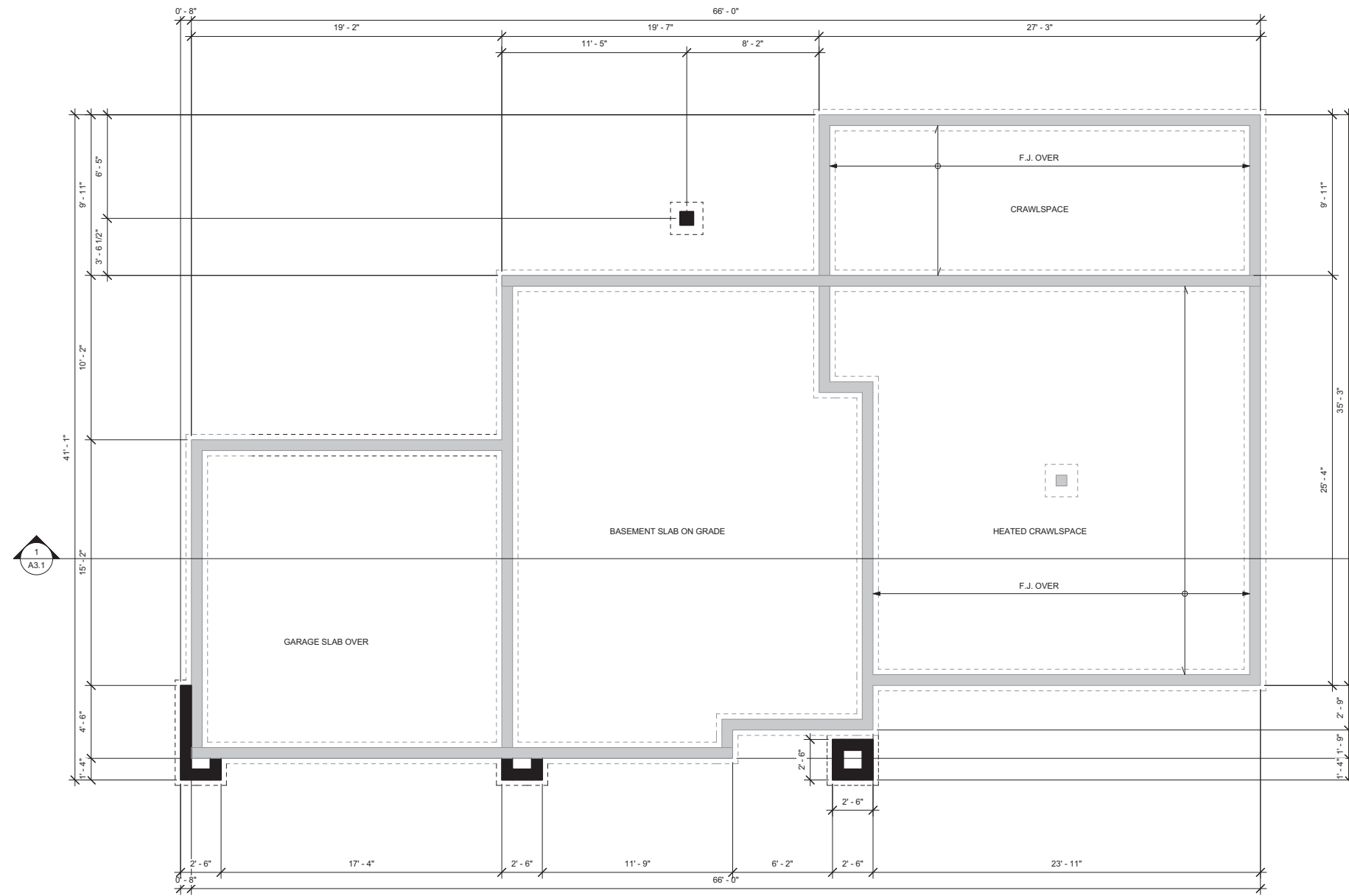
R2	CATHEDRAL ROOF	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	LAMINATED FIBERGLASS SHINGLES	0.11	0.44
3	ROOF UNDERLAYMENT	0.00	0.00
4	5/8" PLYWOOD SHEATHING WITH H-CLIPS	0.13	0.74
5	2X12 ROOF JOISTS	0.00	0.00
6	9" ROXUL BATT INSULATION (ADJUSTED FOR WOOD MEMBERS)	4.86	27.6
7	6-MIL POLY A/V BARRIER	0.00	0.00
8	5/8" GYPSUM BOARD	0.08	0.48
9	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>5.33</b>	<b>30.1</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.6.A		<b>4.66</b>	<b>26.5</b>

ADDITIONAL NOTES:

PART 9 WINDOWS  
NAFS REQ'D MIN. DOUBLE GLAZED. LOW 'E', ARGON FILLED, VINYL RESIDENTIAL WINDOWS.  
R-PG 45

EXTERIOR DOORS:  
PRE-HING, INSULATED FIBERGLASS PANEL DOOR TYP.  
NAFS R PG 45 LW (LIMITED WATER PENETRATION RESISTANCE REQUIRED DUE TO OVERHANG)

No.	Revision	Date	By

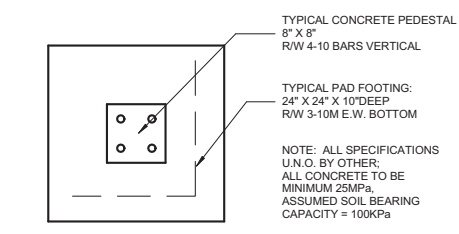


① Foundation  
1/4" = 1'-0"

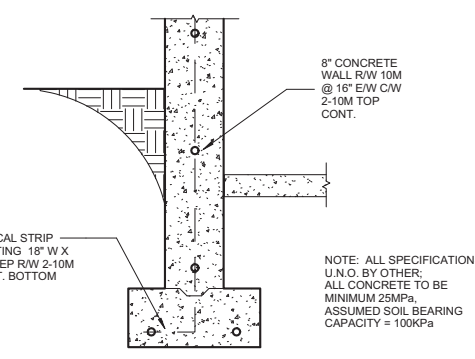
- FRAMING NOTES:**
1. ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  2. ALL LUMBER TO BE SPF#2 OR BETTER UNLESS NOTED OTHERWISE
  3. ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  4. ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN.
  5. ALL LINTELS TO BE 2-PLY 2X10 U.N.O.
  6. ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  7. ALL INTERIOR DOORS TO BE 68" TALL UNLESS NOTED OTHERWISE; PROVIDE MIN. 2-STUDS E/S AT JAMB FRAMING
  8. ALL EXTERIOR DOORS TO BE 70" TALL UNLESS NOTED OTHERWISE
  9. TYPICAL DOOR / WINDOW HEAD HEIGHT:  
MAIN FLOOR: 7'  
BASEMENT: 6'8"
  10. ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
  11. DESIGN LOADS:  
SAANICH: Ss: 2.1kPa  
Sf: 0.3kPa

**PLAN LEGEND**

WALLS	
ROOF OVER	
POST	
BEAM OVER	
SMOKE DETECTOR	
CO DETECTOR	
DOOR SIZE	
WINDOW SIZE	
JOIST SPAN DIRECTION	



② Foundation - Pad (PF1)  
1" = 1'-0"



③ Foundation - Strip  
1" = 1'-0"

Comments:

Sheet Title:  
**Foundation**

Project No.:  
**1494**

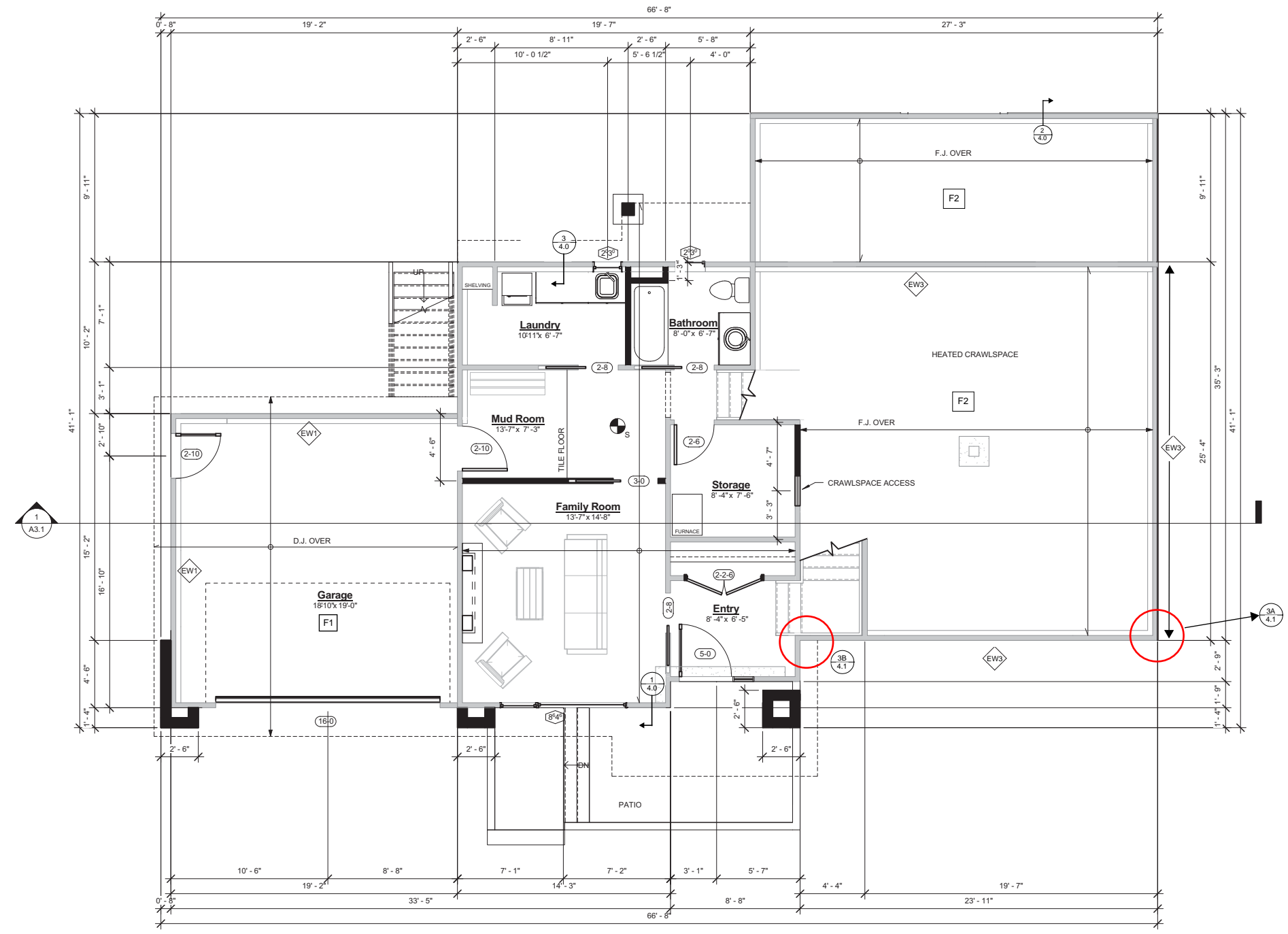
Sheet:  
**A2.1**

- FRAMING NOTES:**
1. ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  2. ALL LUMBER TO BE SPF#2 OR BETTER UNLESS NOTED OTHERWISE
  3. ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  4. ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN.
  5. ALL LINTELS TO BE 2-PLY 2X10 U.N.O.
  6. ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  7. ALL INTERIOR DOORS TO BE 6'8" TALL UNLESS NOTED OTHERWISE. PROVIDE MIN. 2-STUDS E/S AT JAMB FRAMING
  8. ALL EXTERIOR DOORS TO BE 7'0" TALL UNLESS NOTED OTHERWISE
  9. TYPICAL DOOR / WINDOW HEAD HEIGHT:  
MAIN FLOOR: 7'  
BASEMENT: 6'8"
  10. ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER, FIELD TREAT ALL CUTS
  11. DESIGN LOADS:  
SAANICH: Ss: 2.1kPa  
Sr: 0.3kPa

**PLAN LEGEND**

WALLS	
ROOF OVER	
POST	
BEAM OVER	
SMOKE DETECTOR	
CO DETECTOR	
DOOR SIZE	
WINDOW SIZE	
JOIST SPAN DIRECTION	

3-0 DENOTES 3'-0"  
3-3 DENOTES 3'-3"



1 Basement  
1/4" = 1'-0"

Comments:

Blank area for additional comments.

Sheet Title:  
**Basement & Crawl Space**

Project No.:

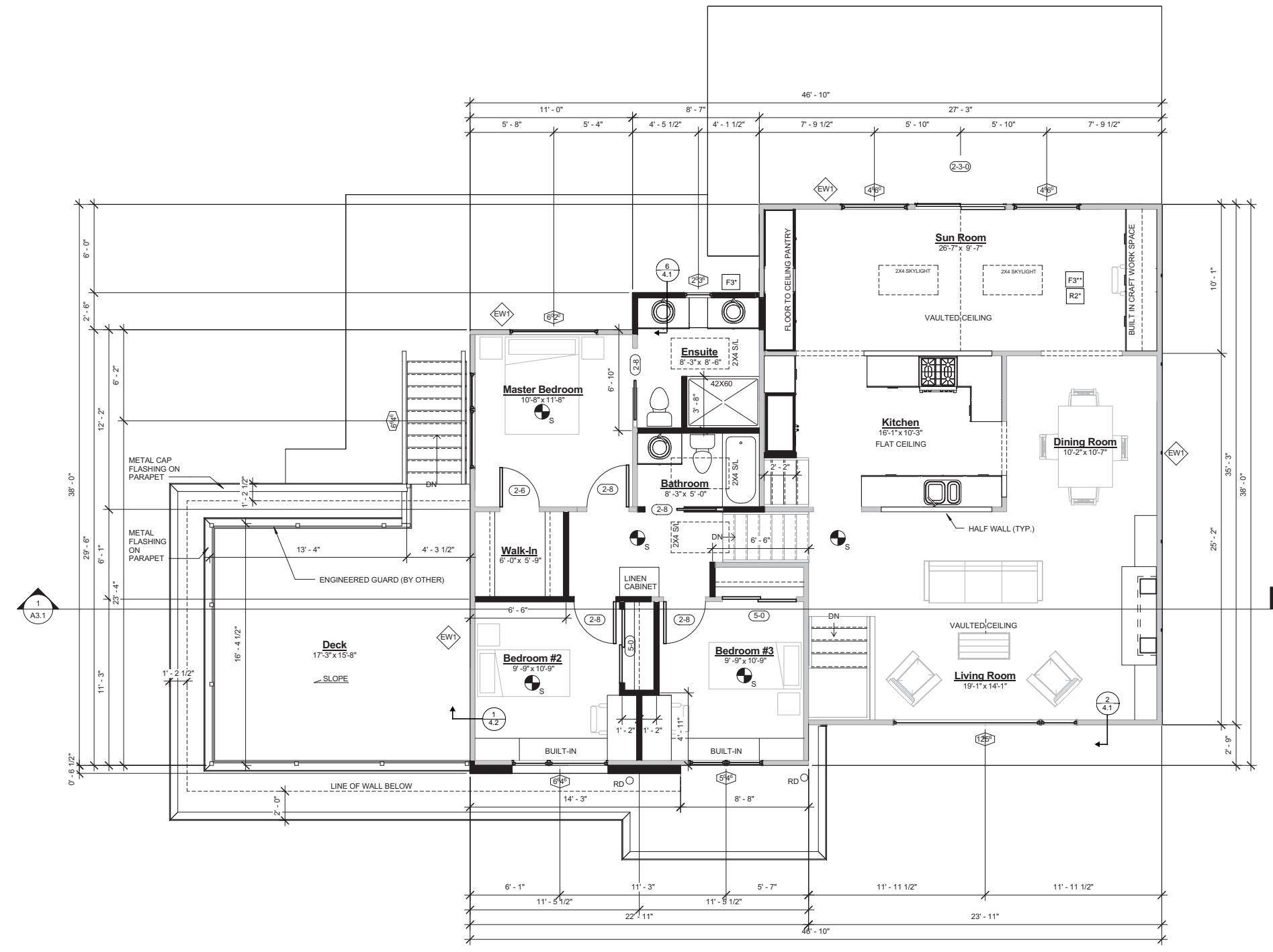
Sheet: **A2.2**

R2\* - CATHEDRAL CEILING ROOF DETAIL  
 F3\* - SECTION OF ENSUIT ABOVE UNCONDITIONED SPACE  
 F3\*\* - SUNROOM ABOVE UNHEATED CRAWLSPACE

- FRAMING NOTES:**
- ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  - ALL LUMBER TO BE SPF#2 OR BETTER UNLESS NOTED OTHERWISE
  - ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  - ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN. ALL LINTELS TO BE 2-PLY 2X10 UN.O.
  - ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  - ALL INTERIOR DOORS TO BE 68" TALL UNLESS NOTED OTHERWISE; PROVIDE MIN. 2-STUDS E/S AT JAMB FRAMING
  - ALL EXTERIOR DOORS TO BE 70" TALL UNLESS NOTED OTHERWISE
  - TYPICAL DOOR / WINDOW HEAD HEIGHT:  
 MAIN FLOOR: 7'  
 BASEMENT: 68"
  - ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
  - DESIGN LOADS:  
 SAANICH: Ss: 2.1kPa  
 Sr: 0.3kPa

**PLAN LEGEND**

WALLS	
ROOF OVER	
POST	
BEAM OVER	
SMOKE DETECTOR	
CO DETECTOR	
DOOR SIZE	
WINDOW SIZE	
JOIST SPAN DIRECTION	



1 Main & Upper  
 1/4" = 1'-0"

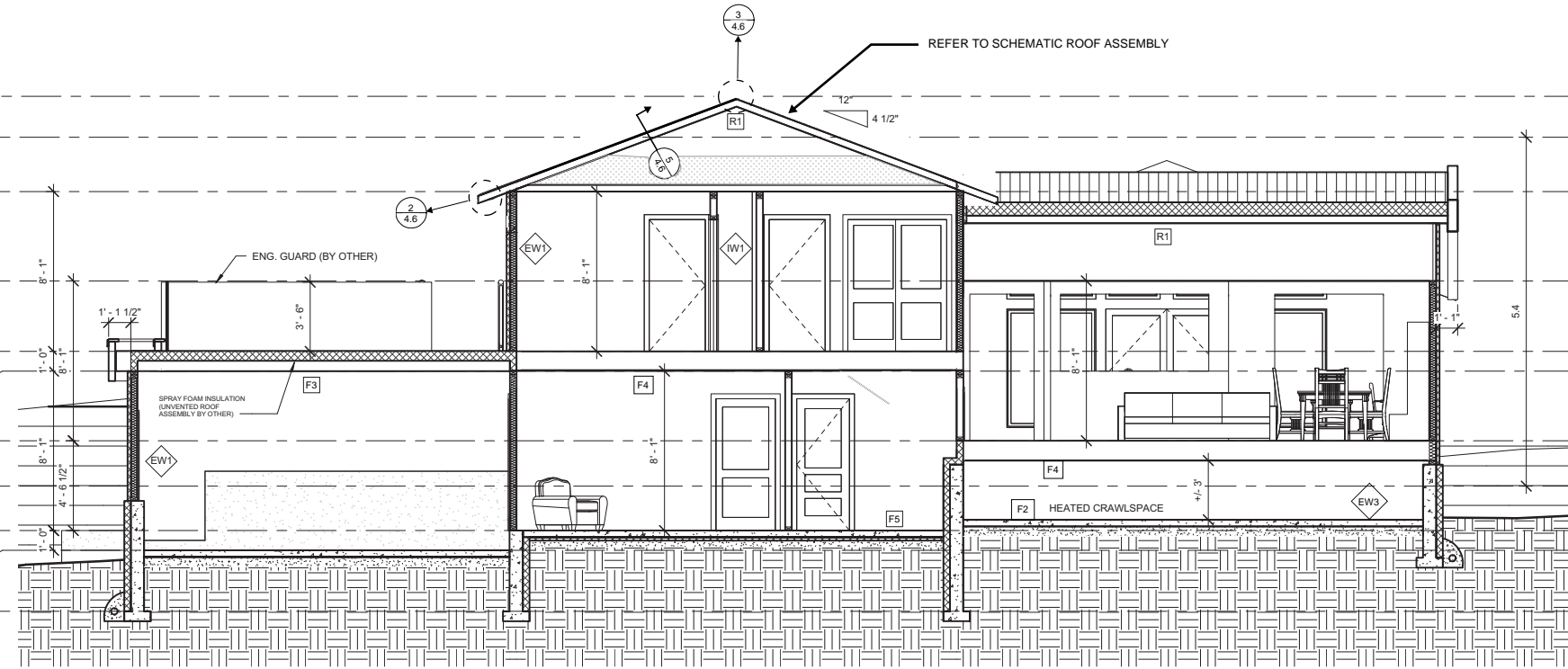
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 No.:  
 By:  
 Description:  
 Date:

Project No.:

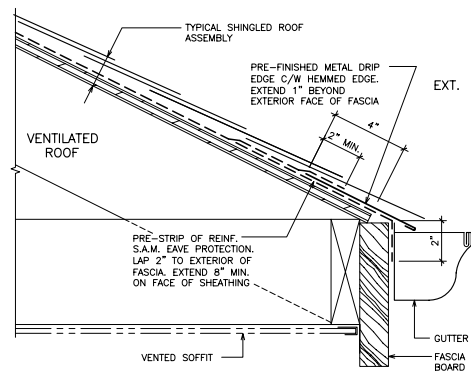
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**Main & Upper Floor**

Sheet:  
**A2.3**

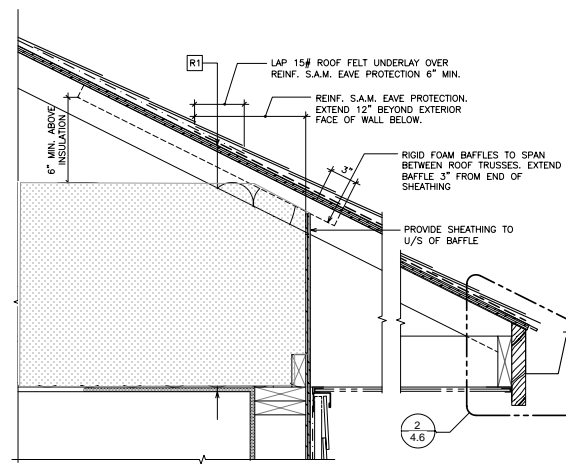
- T.O. Roof 38.3
- Mean Roof 37.7
- T.O. Second Walls 36.8
- T.O. Main Walls 35.5
- Second Floor 34.4
- T.O. Basement Walls 34.1
- Main Floor 33.0
- Average Grade 32.3
- Basement 31.6
- Garage 31.3
- Foundation 30.4



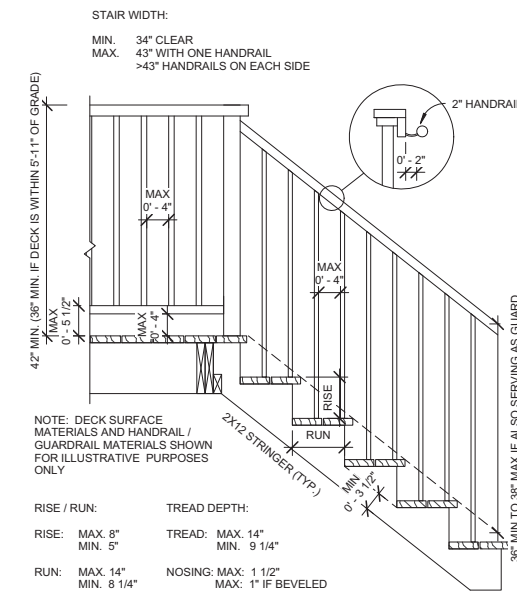
1 Section A  
1/4" = 1'-0"



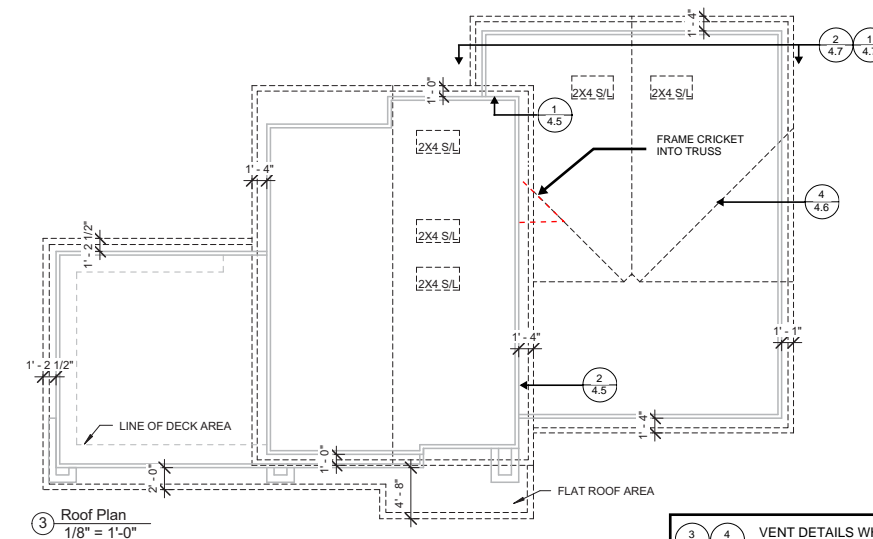
2 TYPICAL ROOF EAVE  
4.6



1 SCHEMATIC ROOF ASSEMBLY  
N.T.S.



4 Typical Residential Deck Stair Configuration



3 Roof Plan  
1/8" = 1'-0"

3 4 VENT DETAILS WHERE  
4.7 4.7 REQUIRED BY PLUMBING

- FRAMING NOTES:**
1. ALL FRAMING TO BE IN ACCORDANCE WITH THE 2012 BC BUILDING CODE
  2. ALL LUMBER TO BE SPP#2 OR BETTER UNLESS NOTED OTHERWISE
  3. ALL EXTERIOR WALL AND ROOF SHEATHING TO BE 1/2" STANDARD FIR PLYWOOD UNLESS NOTED OTHERWISE
  4. ALL EXPOSED EXTERIOR POSTS TO BE 8X8 MIN.
  5. ALL LINTELS TO BE 2-PLY 2X10 U.N.O.
  6. ALL CONCRETE TO BE MINIMUM 25MPa AT 28 DAYS
  7. ALL INTERIOR DOORS TO BE 6" TALL UNLESS NOTED OTHERWISE, PROVIDE MIN. 2-STUDS E/S AT JAMB FRAMING
  8. ALL EXTERIOR DOORS TO BE 70" TALL UNLESS NOTED OTHERWISE
  9. TYPICAL DOOR / WINDOW HEAD HEIGHT:  
MAIN FLOOR: 7'  
BASEMENT: 6'8"
  10. ALL EXPOSED EXTERIOR FRAMING TO BE PRESERVATIVE TREATED LUMBER; FIELD TREAT ALL CUTS
  11. DESIGN LOADS:  
SAANICH: Ss: 2.1kPa  
Sr: 0.3kPa

**PLAN LEGEND**

WALLS	
ROOF OVER	
POST	
BEAM OVER	
SMOKE DETECTOR	
CO DETECTOR	
DOOR SIZE	
WINDOW SIZE	
JOIST SPAN DIRECTION	

**HEATING SYSTEM**

FORCED AIR FURNACE

**VENTILATION REQUIREMENTS**

KITCHEN AND BATHROOM FANS  
IN ACCORDANCE WITH 9.32.3.6:

	INTERMITTENT	CONTINUOUS
KITCHEN:	47L/S	N/A
BATHROOM:	23L/S	9L/S

**PRINCIPAL VENTILATION SYSTEM SUPPLY AIR (9.32.3.4)**

DUCTED FORCED AIR SYSTEM WITH HRV

PROVIDE SUPPLY AIR TO EACH BEDROOM AND EACH FLOOR LEVEL WITHOUT A BEDROOM

**PRINCIPAL VENTILATION SYSTEM EXHAUST FAN (9.32.3.5)**

TOTAL FLOOR AREA:	204.8m <sup>2</sup>
NUMBER OF BEDROOMS:	3
PRINCIPAL EXHAUST FAN MINIMUM AIR-FLOW RATE PER 9.32.3.4:	28L/S

PRINCIPAL VENTILATION SYSTEM EXHAUST FAN:

**HEATED CRAWLSPACE VENTILATION (9.32.3.7)**

CRAWLSPACE HEAT SOURCE:

DUCTED FORCED AIR SYSTEM

TOTAL CRAWLSPACE AREA: 84.6m<sup>2</sup>

PROVIDE 1 AIR TRANSFER GRILLE TO FLOOR AREA ABOVE FOR EACH 30m<sup>2</sup> OF CRAWLSPACE AREA

Comments:

Sheet Title:  
**Section & Roof Plan**

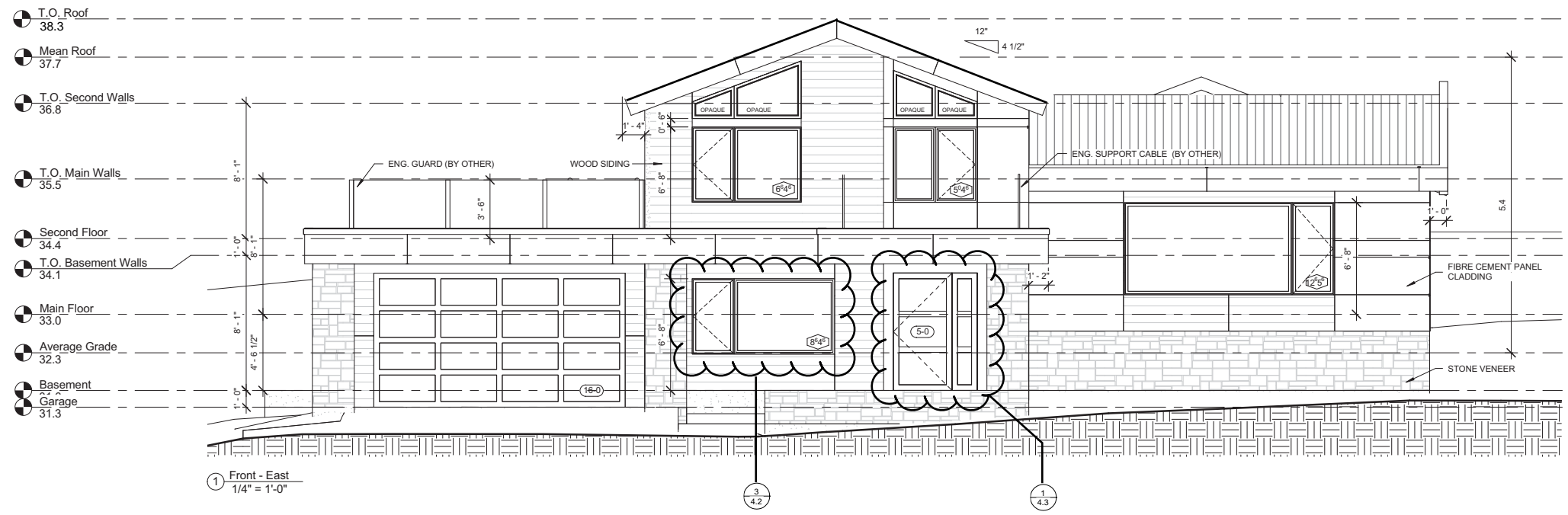
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1494

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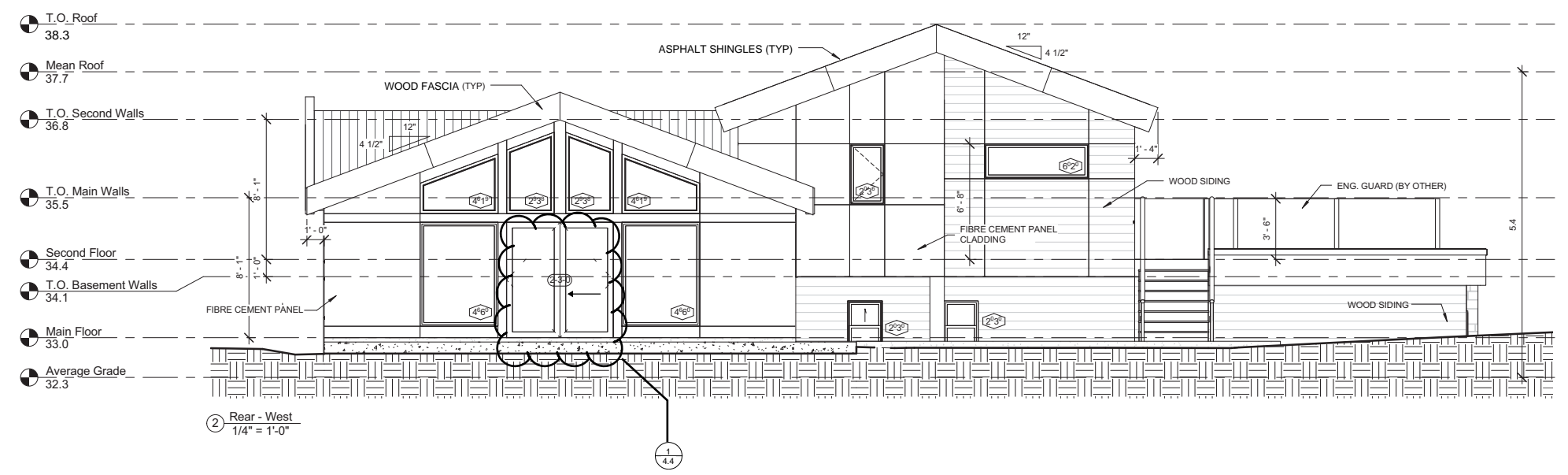
**A3.1**

3



**EXTERIOR FINISH NOTES**

SOFFIT:	TYPICAL EAVE: GABLE EAVE: U/S OF DECK: U/S OF ENTRY CANOPY:	SHEET METAL TO MATCH ROOF SHEET METAL TO MATCH ROOF STAINED FINELINE WOOD STAINED FINELINE WOOD
GUTTERS:	4" ROUND PAINTED PVC	
FASCIA:	1X8 COMB FACE - PAINTED TO OWERN SPEC (TYP.)	
WINDOW TRIM:	2x4 COMB FACE (SEE DETAIL 5-4.2)	
DOOR TRIMS:	2x4 COMB FACE (SEE DETAIL 2-4.3)	



Comments:

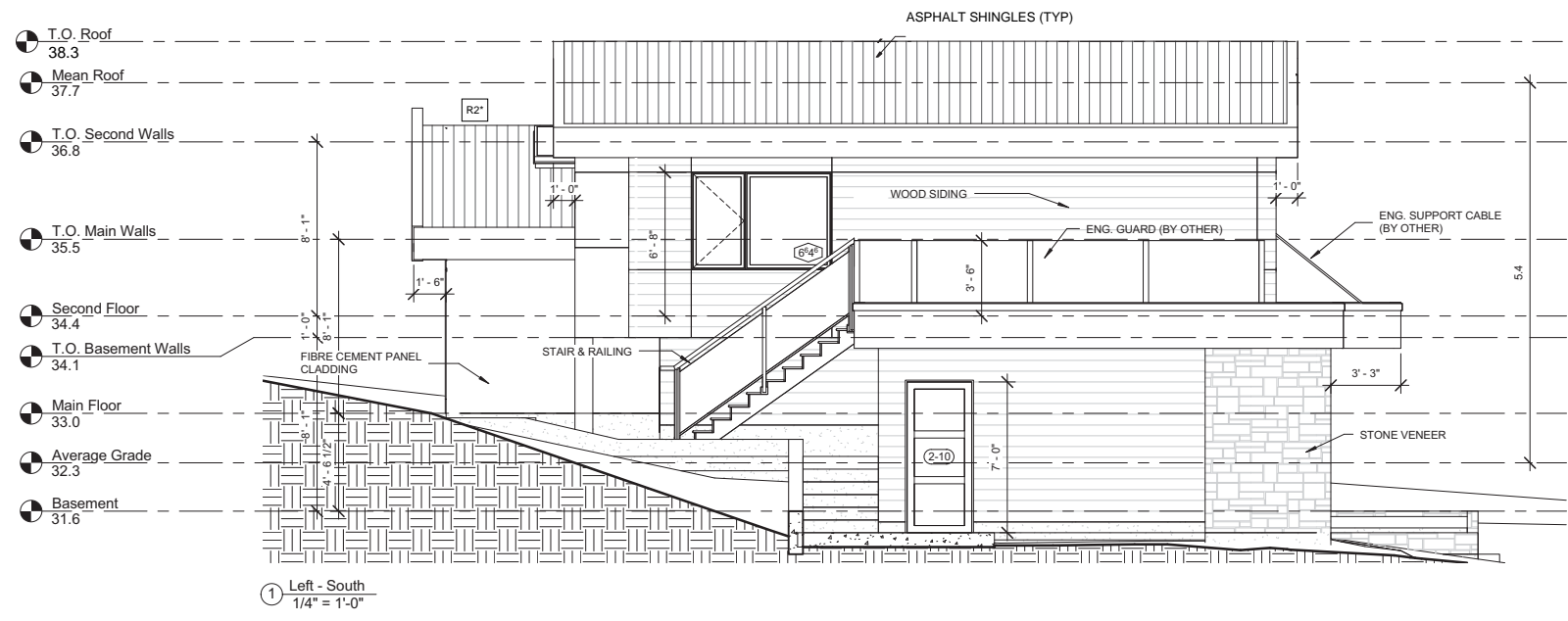
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Comments:

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**Elevations**

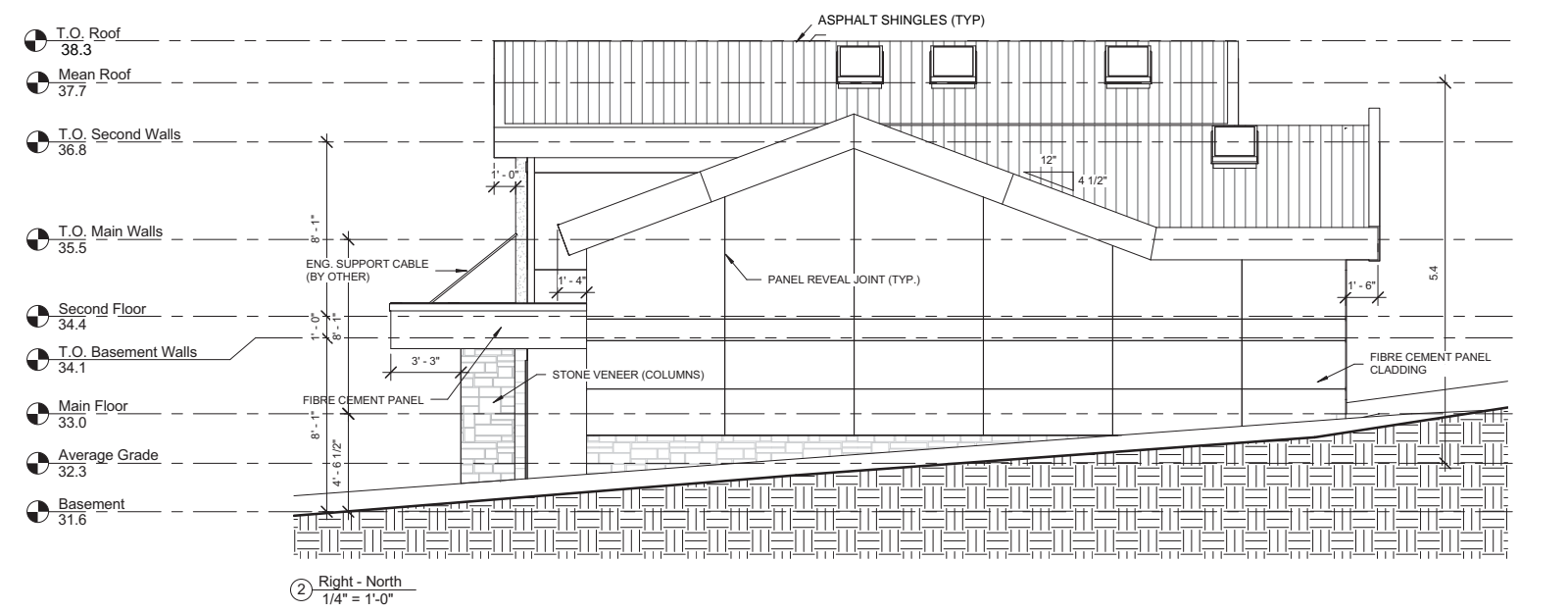
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Sheet:  
**A4.1**



**EXTERIOR FINISH NOTES**

SOFFIT:	TYPICAL EAVE:	SHEET METAL TO MATCH ROOF
	GABLE EAVE:	SHEET METAL TO MATCH ROOF
	U/S OF DECK:	STAINED FINELINE WOOD
	U/S OF ENTRY CANOPY:	STAINED FINELINE WOOD
GUTTERS:	4" ROUND PAINTED PVC	
FASCIA:	1X8 COMB FACE - PAINTED TO OWERN SPEC (TYP.)	
WINDOW TRIM:	2x4 COMB FACE (SEE DETAIL 5-4.2)	
DOOR TRIMS:	2x4 COMB FACE (SEE DETAIL 2-4.3)	



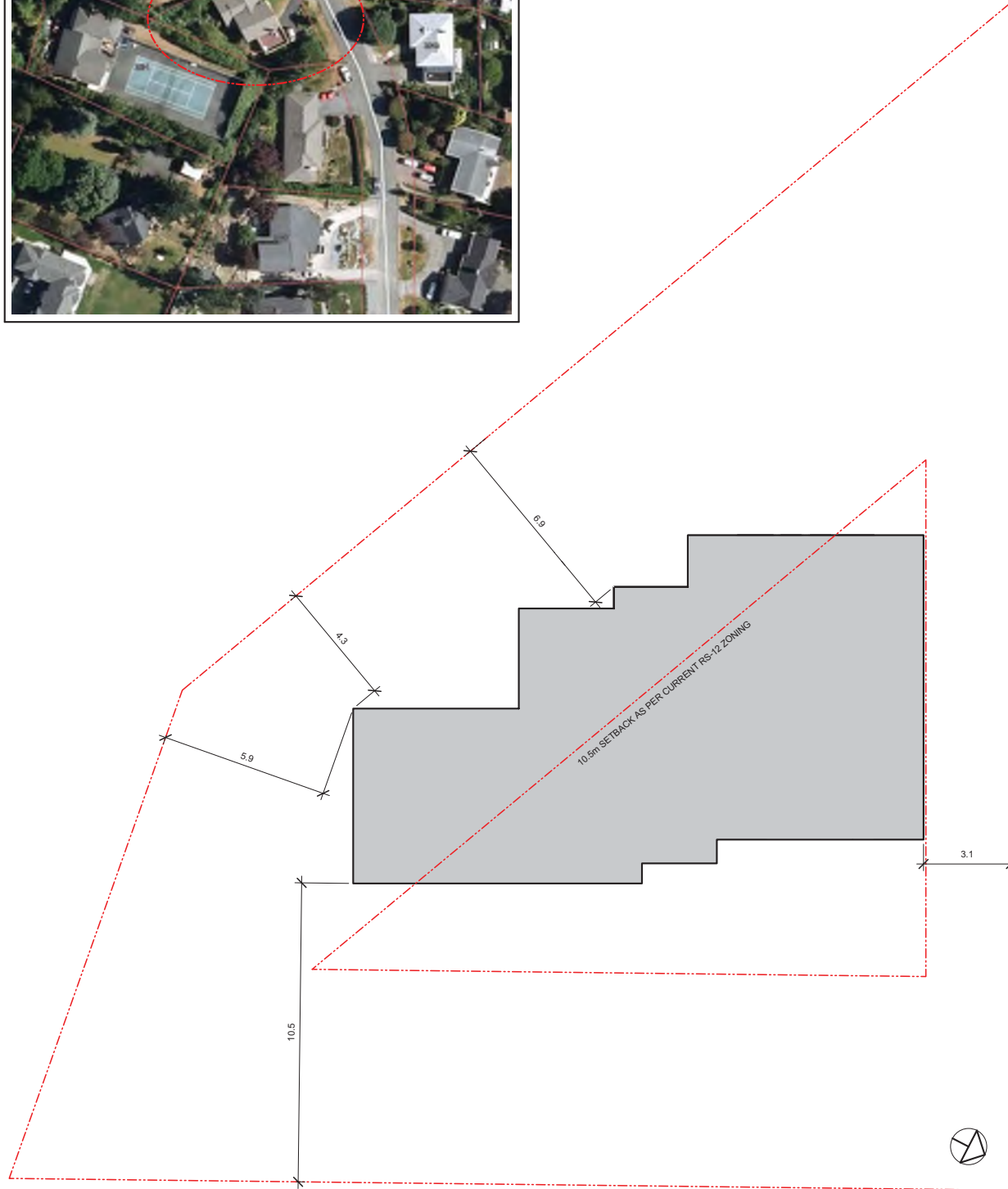
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Project No.: 1494


Sheet: **A4.2**

**KEY PLAN:**


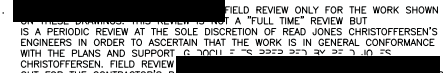
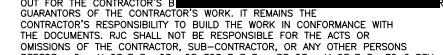
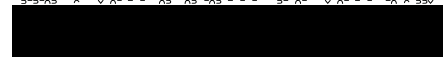
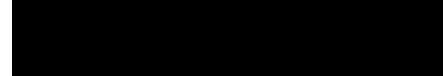


**SITE PLAN**  
NTS

**GENERAL NOTES**

- THIS SET OF DRAWINGS SHOWS THE COMPLETED PROJECT. THE DRAWINGS DO NOT SHOW COMPONENTS THAT MAY BE NECESSARY FOR CONSTRUCTION SAFETY. THE CONTRACTOR IS RESPONSIBLE FOR SAFETY IN AND ABOUT THE JOB SITE DURING CONSTRUCTION, AND THE DESIGN AND ERECTION OF ALL TEMPORARY STRUCTURES, FORMWORK, FALSE WORK, SHORING, ETC. REQUIRED TO COMPLETE THE WORK.
- THE USE OF THESE DRAWINGS IS LIMITED TO THAT IDENTIFIED IN THE REVISIONS COLUMN. DO NOT CONSTRUCT FROM THESE DRAWINGS UNLESS MARKED "ISSUED FOR CONSTRUCTION" IN THE REVISIONS COLUMN, AND SIGNED BY AN ENGINEER OF READ JONES CHRISTOFFERSEN LTD. THE DRAWINGS SHALL NOT BE USED FOR PRICING OR TENDER UNLESS SO INDICATED IN THE REVISION COLUMN.
- DESIGN**  
THE COMPLETED BUILDING ENVELOPE SHOWN ON THE DRAWINGS HAS BEEN DESIGNED IN SUBSTANTIAL ACCORDANCE WITH THE 1998 B.C. BUILDING CODE OR THE VICTORIA BUILDING BY-LAWS AS REQUIRED.
- SECTION MARK SHOWN THIS  MEANS SECTION #4 ON DRAWING R-2.
- DO NOT CUT OR DRILL ANY OPENINGS IN STRUCTURAL MEMBERS WITHOUT WRITTEN PERMISSION OF R.J.C.
- ALL MECHANICAL, ELECTRICAL, ARCHITECTURAL AND OTHER ITEMS THAT ARE AFFECTED BY RESTORATION MUST BE REPLACED IN ACCORDANCE WITH CURRENT APPLICABLE CODES AND USING GOOD PRACTICE. MODIFY AS REQUIRED.
- SHOP DRAWINGS**  
R.J.C.'S DRAWINGS, WHETHER IN ELECTRONIC FORMAT OR HARDCOPY, MAY NOT BE USED AS OR MODIFIED TO PROVIDE SHOP DRAWINGS UNLESS:  
- RJC IS REIMBURSED FOR THE DRAWINGS AND  
- THE CONTRACTOR RESPONSIBLE FOR THE SHOP DRAWINGS SIGNS RJC'S STANDARD AUTHORIZATION AND WAIVER FORM.

**DESIGN PARAMETERS**

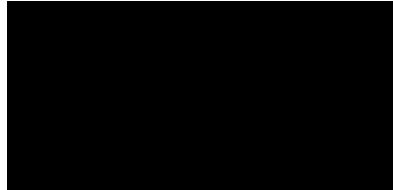
- THIS BUILDING ENVELOPE RESTORATION HAS BEEN DESIGNED USING "RAINSCREEN PRINCIPLES". THIS ASSEMBLY RELOCATES THE VAPOUR RETARDER AND INSULATION TO THE OUTSIDE OF EXTERIOR SHEATHING TO BETTER CONTROL VAPOUR TRANSFER AND AIR LEAKAGE, AND ENHANCE THE THERMAL PROPERTIES OF THE WALL.  
  
1.  FIELD REVIEW ONLY FOR THE WORK SHOWN IN THESE DRAWINGS. THIS REVIEW IS NOT A "FULL TIME" REVIEW BUT IS A PERIODIC REVIEW AT THE SOLE DISCRETION OF READ JONES CHRISTOFFERSEN'S ENGINEERS IN ORDER TO ASCERTAIN THAT THE WORK IS IN GENERAL CONFORMANCE WITH THE PLANS AND SUPPORT  CHRISTOFFERSEN, FIELD REVIEW  SEN GUARANTORS OF THE CONTRACTOR'S WORK. IT REMAINS THE CONTRACTOR'S RESPONSIBILITY TO BUILD THE WORK IN CONFORMANCE WITH THE DOCUMENTS. RJC SHALL NOT BE RESPONSIBLE FOR THE ACTS OR OMISSIONS OF THE CONTRACTOR, SUB-CONTRACTOR, OR ANY OTHER PERSONS 
- PROVIDE 24 HOURS ADVANCE NOTICE OF EACH REQUIRED FIELD REVIEW. FIELD REVIEWS SHALL BE SCHEDULED TO BE CARRIED OUT DURING NORMAL BUSINESS HOURS UNLESS SPECIAL ARRANGEMENTS ARE MADE WITH RJC.
- THE WORK TO BE REVIEWED SHALL BE GENERALLY COMPLETE.

**GENERAL**

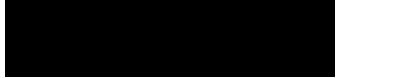
- ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:  
-BRITISH COLUMBIA BUILDING CODE PART 4 OR VICTORIA BUILDING BY-LAWS  
-CAN/CSA-08 ENGINEERING DESIGN IN WOOD  
-CAN/CSA-0121 DOUGLAS FIR PLYWOOD  
-CAN/CSA-0437 STRAND BOARD AND WAFERBOARD  
-CAN/CSA-B111 WIRE NAILS, SPIKES AND STAPLES  
-CAN/CSA-B24 MISCELLANEOUS BOLTS AND SCREWS  
-CANADIAN WOOD-FRAME HOUSE CONSTRUCTION-CMHC  
-"WOOD DESIGN MANUAL" - CANADIAN WOOD COUNCIL  
-"WOOD BUILDING TECHNOLOGY" - CANADIAN WOOD COUNCIL.
- ANY CHANGES TO THE EXISTING FRAMING SHALL HAVE PRIOR WRITTEN APPROVAL OF THE STRUCTURAL ENGINEER. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED IF NOT COMPLETED CORRECTLY.
- ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
- FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
- DO NOT COVER WOOD FRAMING WITH FINISHES UNTIL THE STRUCTURAL ENGINEER'S FRAMING REVIEW IS COMPLETE. PROVIDE 24 HOURS ADVANCE NOTIFICATION WHEN FRAMING REVIEWS ARE REQUIRED.
- NOTCHING AND DRILLING OF STRUCTURAL ELEMENTS SHALL FOLLOW THE GUIDELINES SET FORTH IN THE BRITISH COLUMBIA BUILDING CODE OF CANADA PART 9, UNLESS OTHERWISE APPROVED IN WRITING BY READ JONES CHRISTOFFERSEN.
- ALL NEW TIMBER AND SHEATHING TO BE PRESSURE TREATED WHERE SPECIFIED, FIELD TREAT ALL CUT ENDS.

**MATERIALS**

- STUDS & BUILT-UP POSTS TO BE S-P-F # 2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED.
- JOISTS TO BE SPF # 2 GRADE OR BETTER.
- BUILT-UP BEAMS AND HEADERS TO BE SPF # 2 GRADE OR BETTER.
- WALL PLATES TO BE S-P-F STUD GRADE OR BETTER. WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED.
- POSTS AND BEAMS TO BE SPF # 2 GRADE OR BETTER.
- ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ("S4S") AND S-DRY
- SHEATHING TO BE O.S.B
- TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, CANADA SCAFFOLD SUPPLY, MGA CONNECTORS OR APPROVED EQUAL.
- NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS OR COMMON SPIRAL NAILS. ALL NAILS IN CONTACT WITH PRESSURE TREATED MATERIALS OR OUTSIDE OF MOISTURE BARRIER TO BE HOT-DIPPED GALVANIZED OR STAINLESS STEEL.
- MISCELLANEOUS STEEL TO BE G40.21 OR APPROVED EQUAL.
- ANCHOR BOLTS SHALL BE ASTM A307 OR A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 1 1/2" AT THE BOTTOM.
- BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
- ALL FASTENERS AND CONNECTION HARDWARE THROUGH P/T MATERIALS TO BE HOT DIPPED GALVANIZED OR STAINLESS STEEL.

No.	Revision	Date	By
			

Project Name



Sheet Title

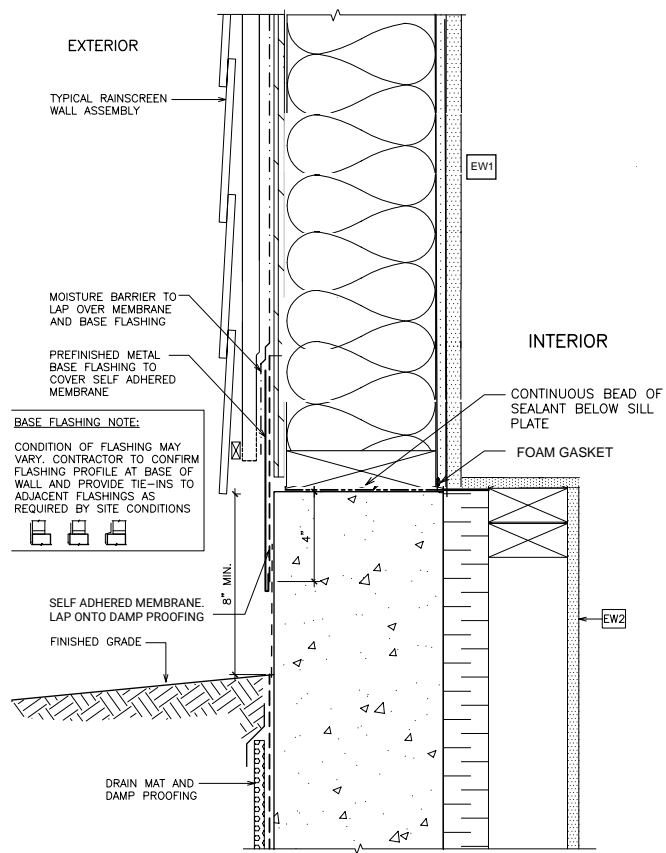
**GENERAL NOTES AND SITE PLAN**



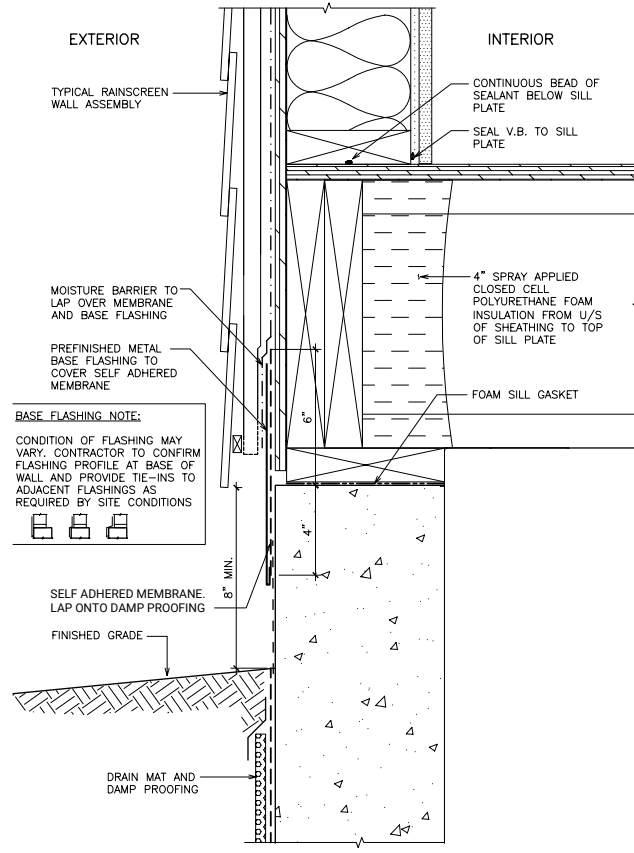
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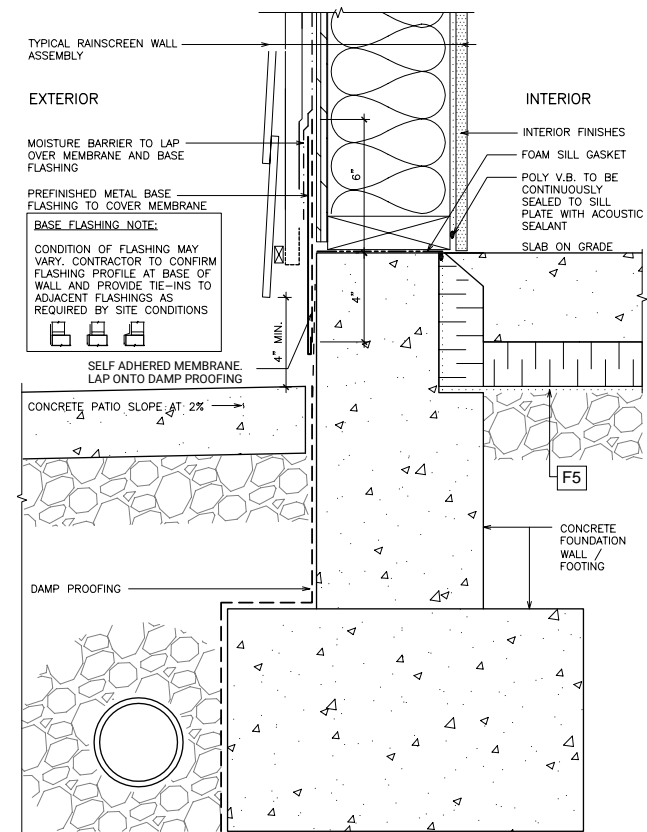
Revision



3  
4.0 TYPICAL BASE OF WALL AT FOUNDATION



2  
4.0 TYPICAL BASE OF WALL AT FOUNDATION



1  
4.0 TYPICAL BASE OF WALL AT FOUNDATION

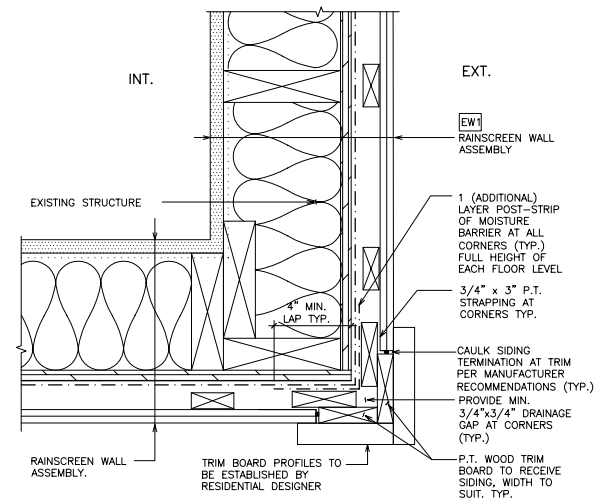
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Project Name  
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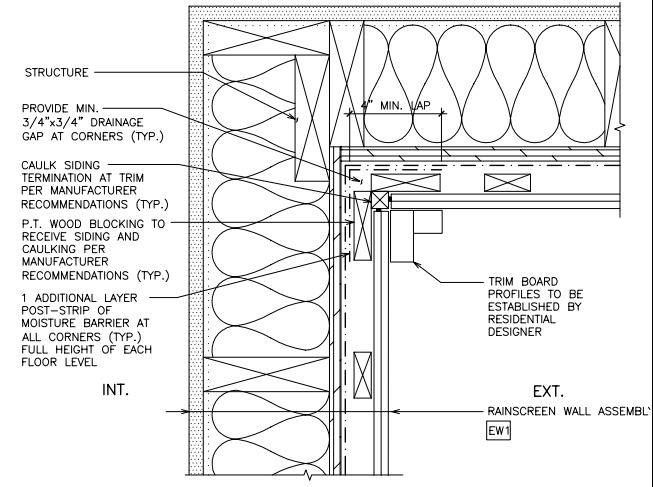
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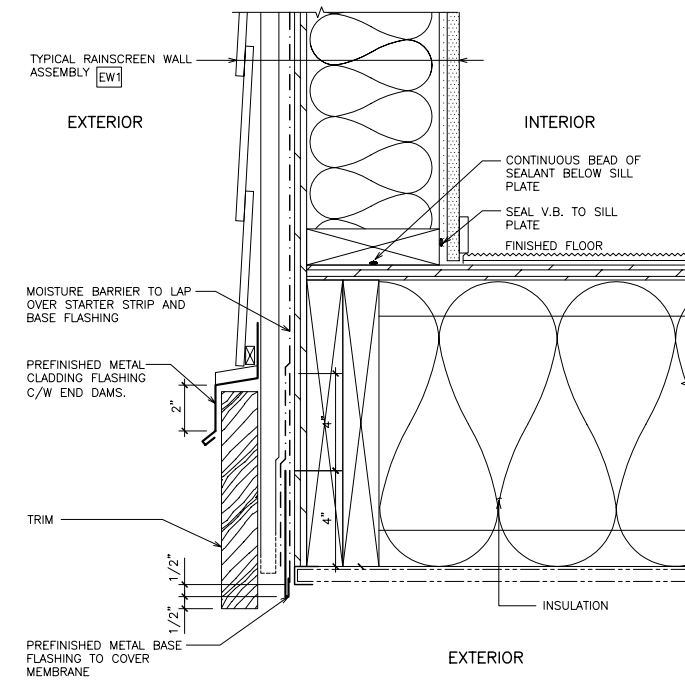
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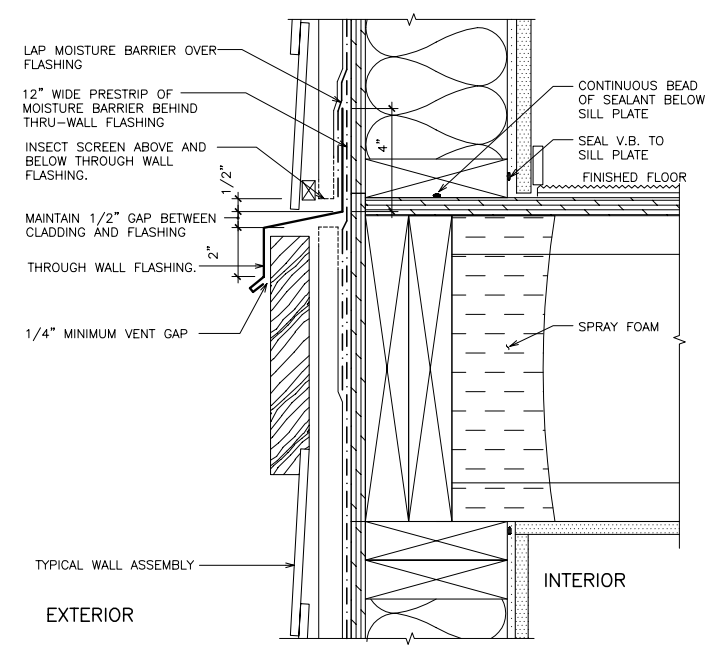
**3A**  
4.1  
**TYPICAL OUTSIDE CORNER**



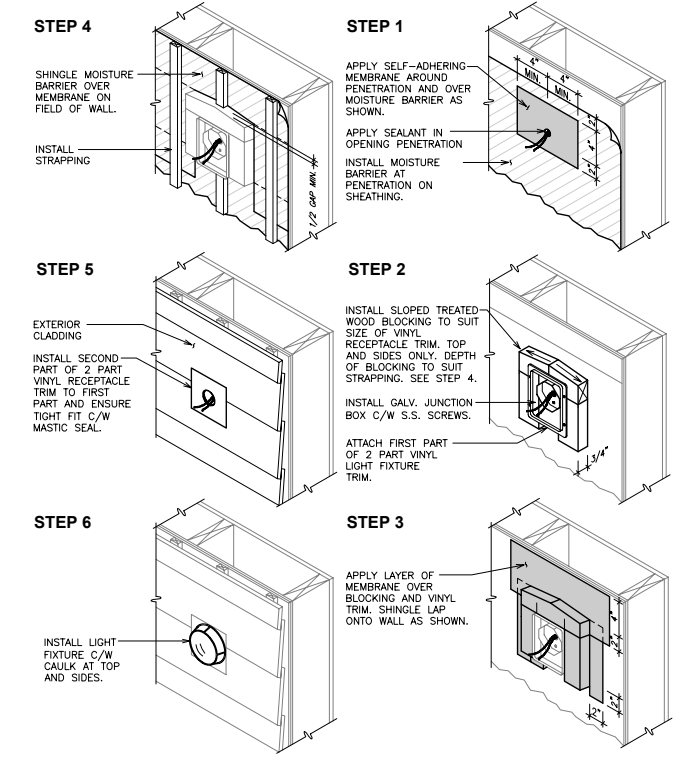
**3B**  
4.1  
**TYPICAL INSIDE CORNER**



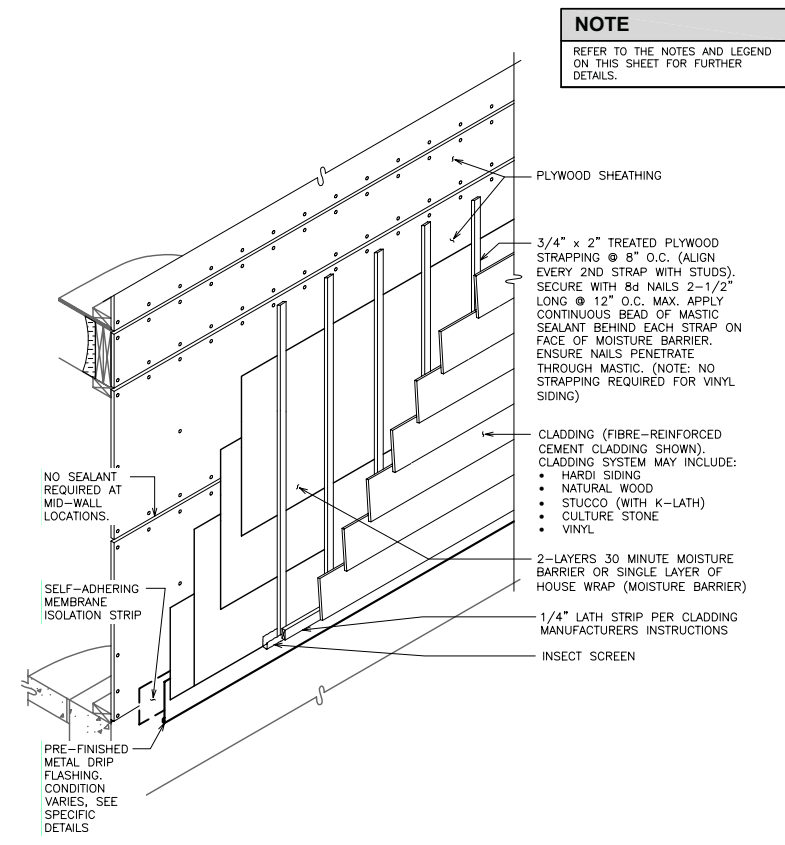
**6**  
4.1  
**OVERHANG AND SOFFIT DETAIL**



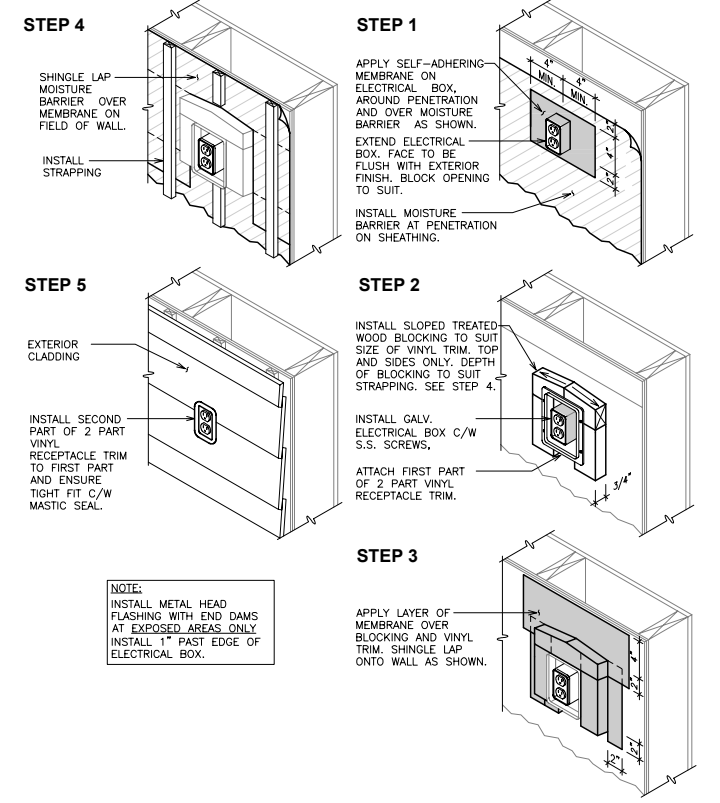
**2**  
4.1  
**TYPICAL THROUGH WALL FLASHING**



**5**  
4.1  
**TYPICAL LIGHT FIXTURE PENETRATION**



**1**  
4.1  
**TYPICAL RAINSCREEN ASSEMBLY**



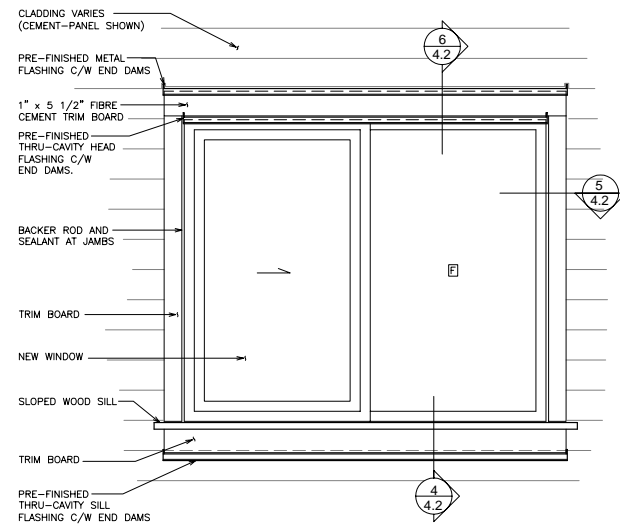
**4**  
4.1  
**ELECTRICAL RECEPTICAL INSTALLATION**

**NOTE**  
REFER TO THE NOTES AND LEGEND ON THIS SHEET FOR FURTHER DETAILS.

No.	Revision	Date	By

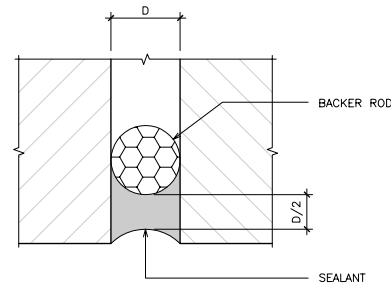
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Sheet Title  
**DETAILS**

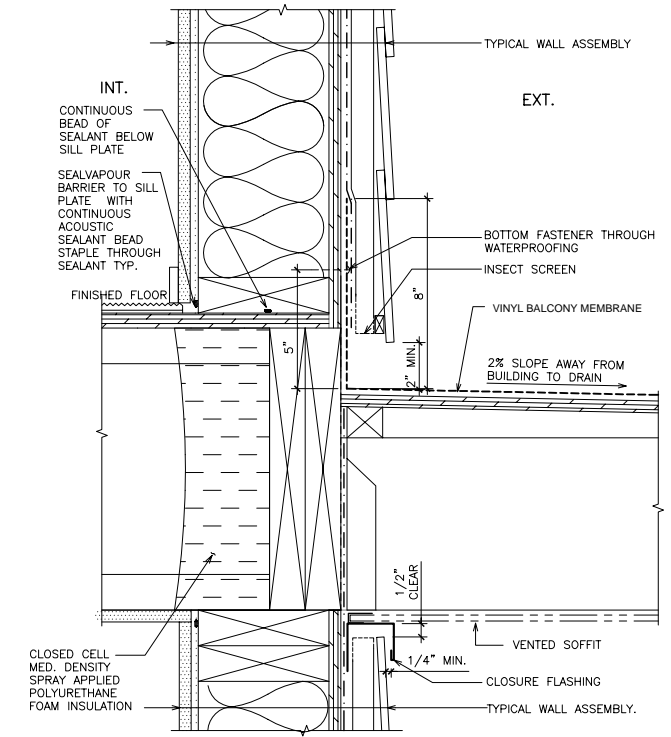


NOTE:  
 1. WINDOW SIZE, TYPE AND ARRANGEMENT VARIES. REFER TO ARCHITECTURAL WINDOW SCHEDULE.  
 2. CLADDING VARIES. REFER TO ELEVATIONS FOR LOCATION OF CLADDINGS RELATIVE TO WINDOW TYPES.

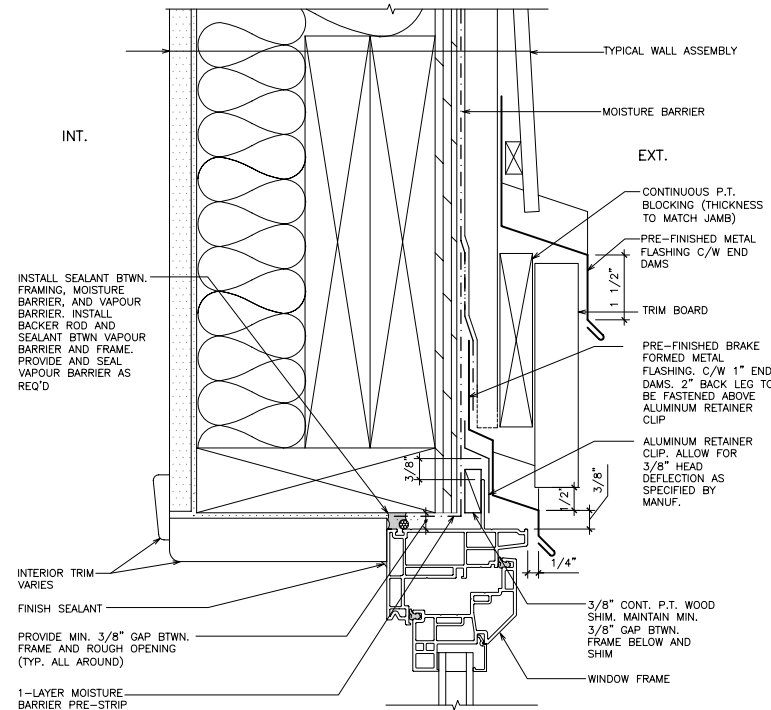
**3**  
 4.2 **SCHEMATIC WINDOW ELEVATION**



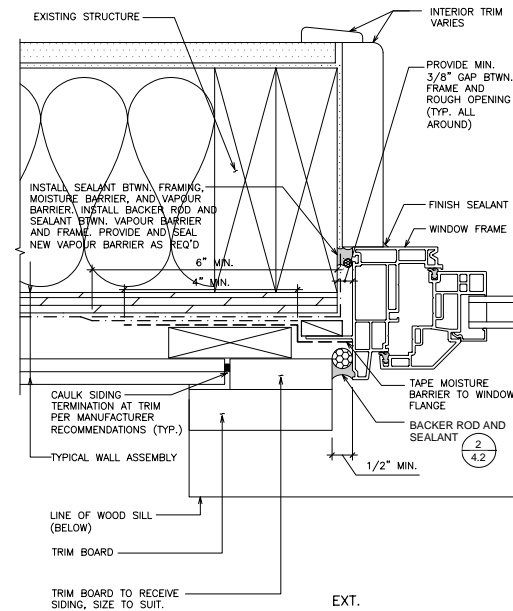
**2**  
 4.2 **TYPICAL BACKER ROD AND SEALANT**



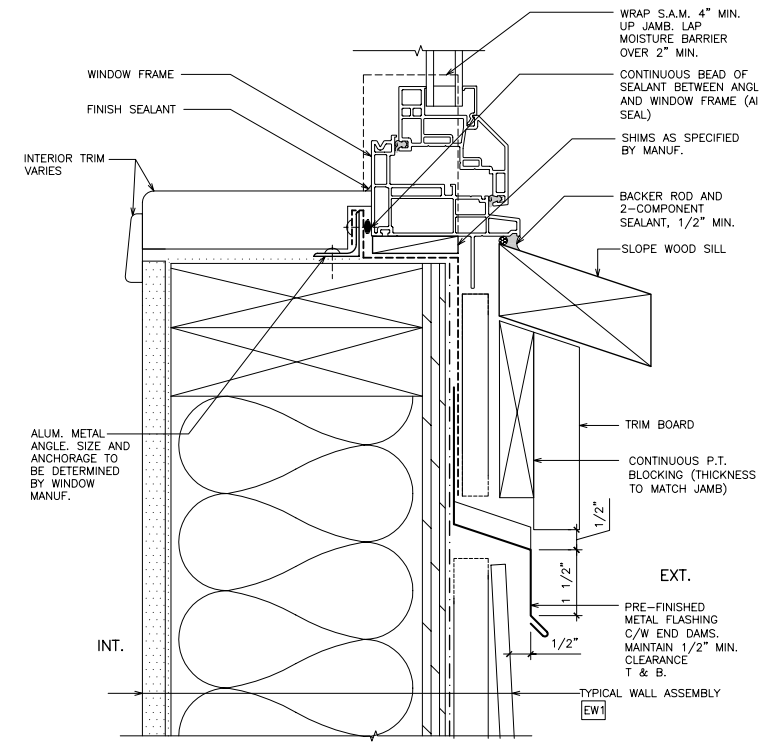
**1**  
 4.2 **TYPICAL DECK / BALCONY TO WALL TRANSITION**



**6**  
 4.2 **TYPICAL WINDOW HEAD**



**5**  
 4.2 **TYPICAL WINDOW JAMB**



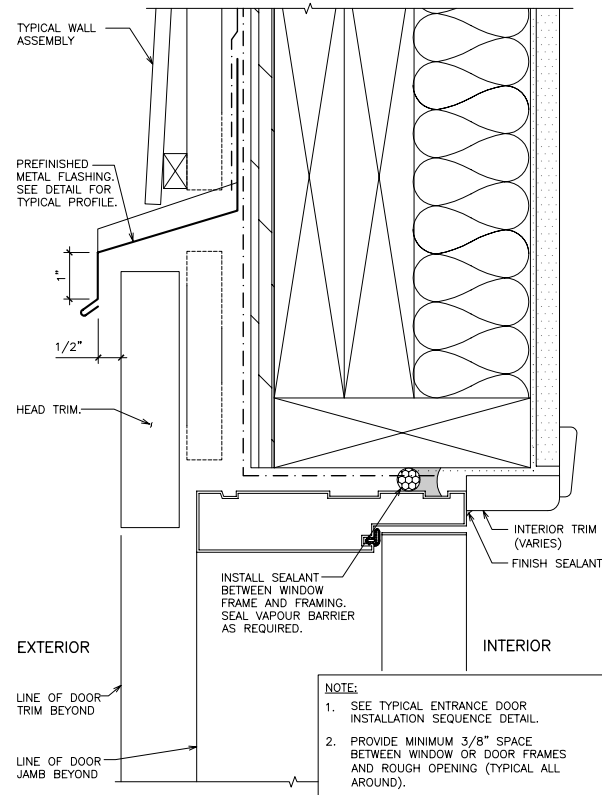
**4**  
 4.2 **TYPICAL WINDOW SILL**

No.	Revision	Date	By

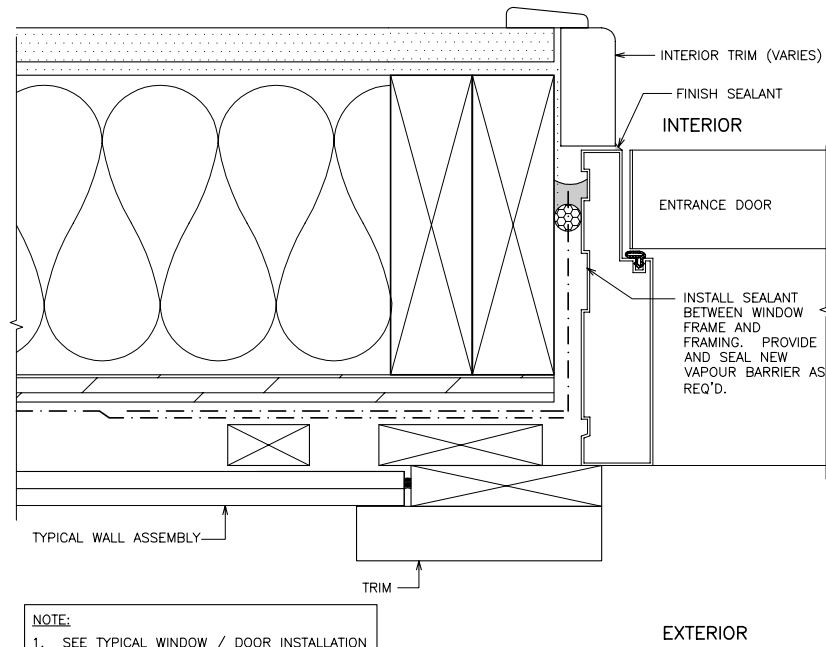
Project Name

Sheet Title

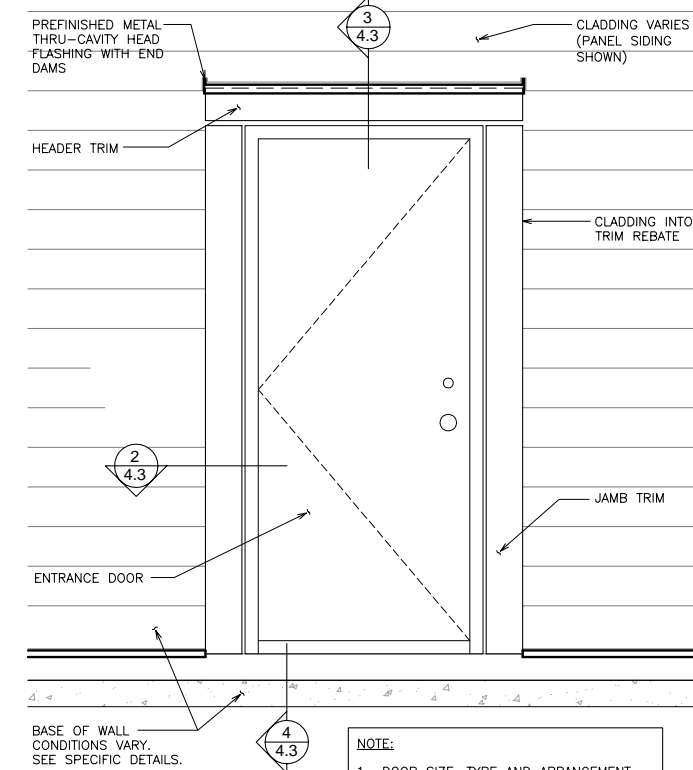
**DETAILS**



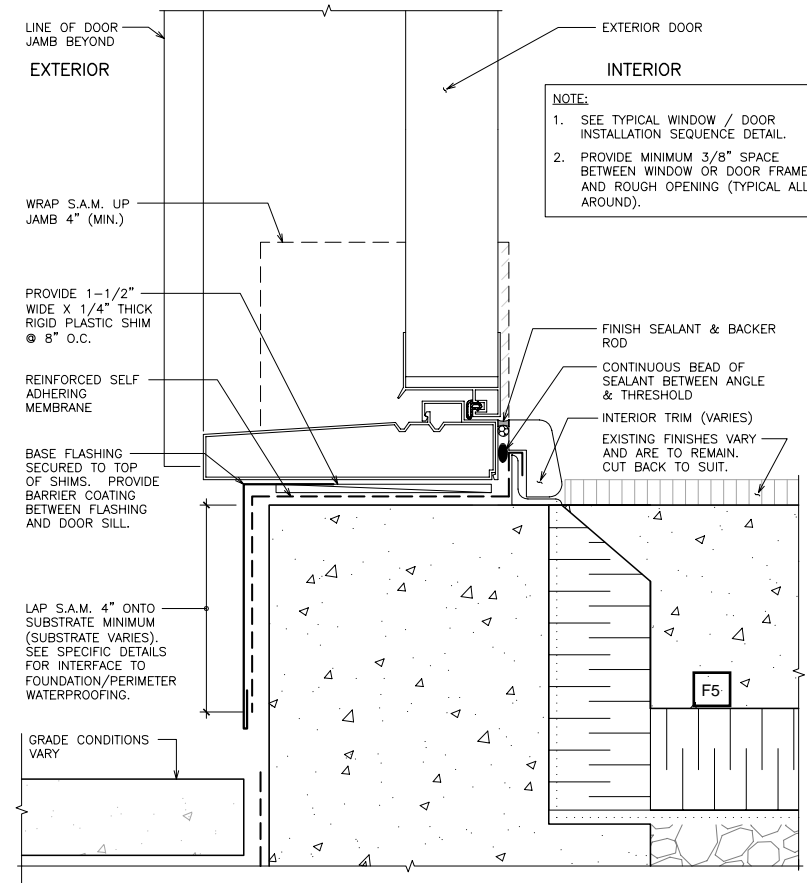
**3**  
4.3 TYPICAL ENTRANCE DOOR HEAD



**2**  
4.3 TYPICAL ENTRANCE DOOR JAMB



**1**  
4.3 SCHEMATIC TYPICAL ENTRANCE DOOR



**4**  
4.3 TYPICAL ENTRANCE DOOR SILL

No.	Revision	Date	By

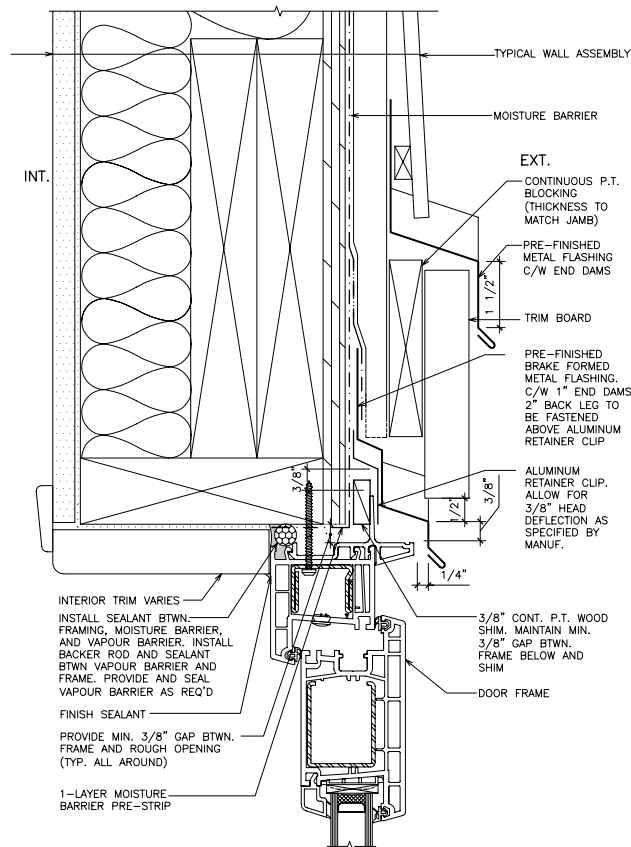
Project Name

Sheet Title

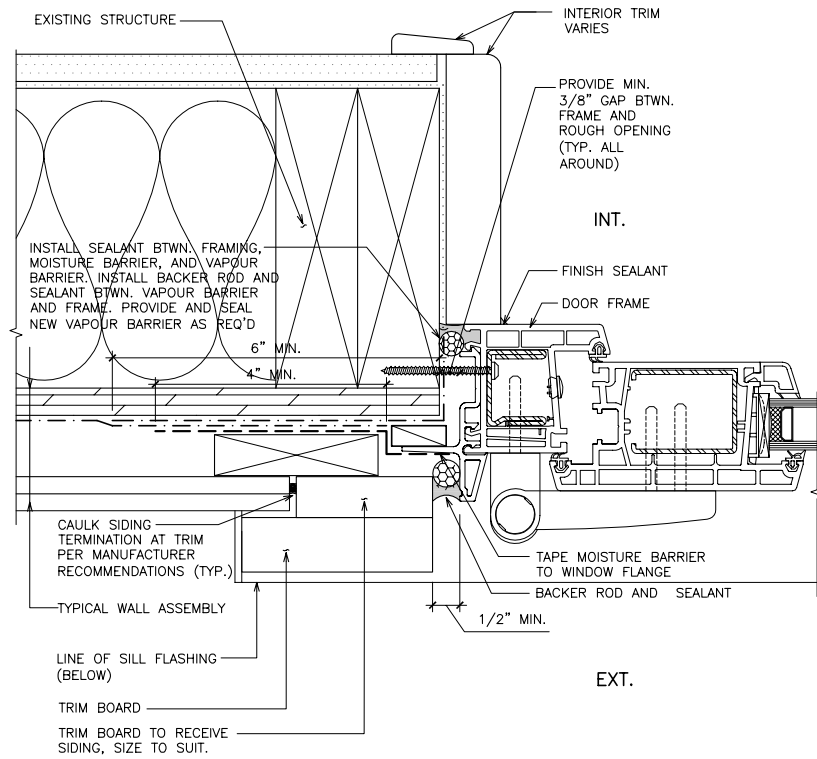
**DETAILS**

Sheet Number Revision

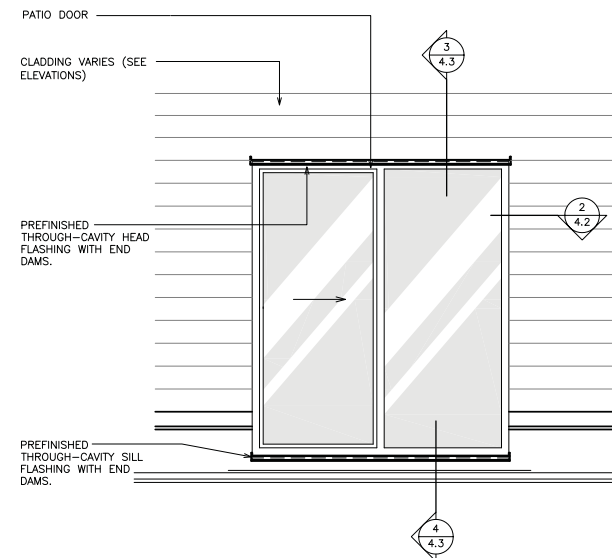
**R-4.3**



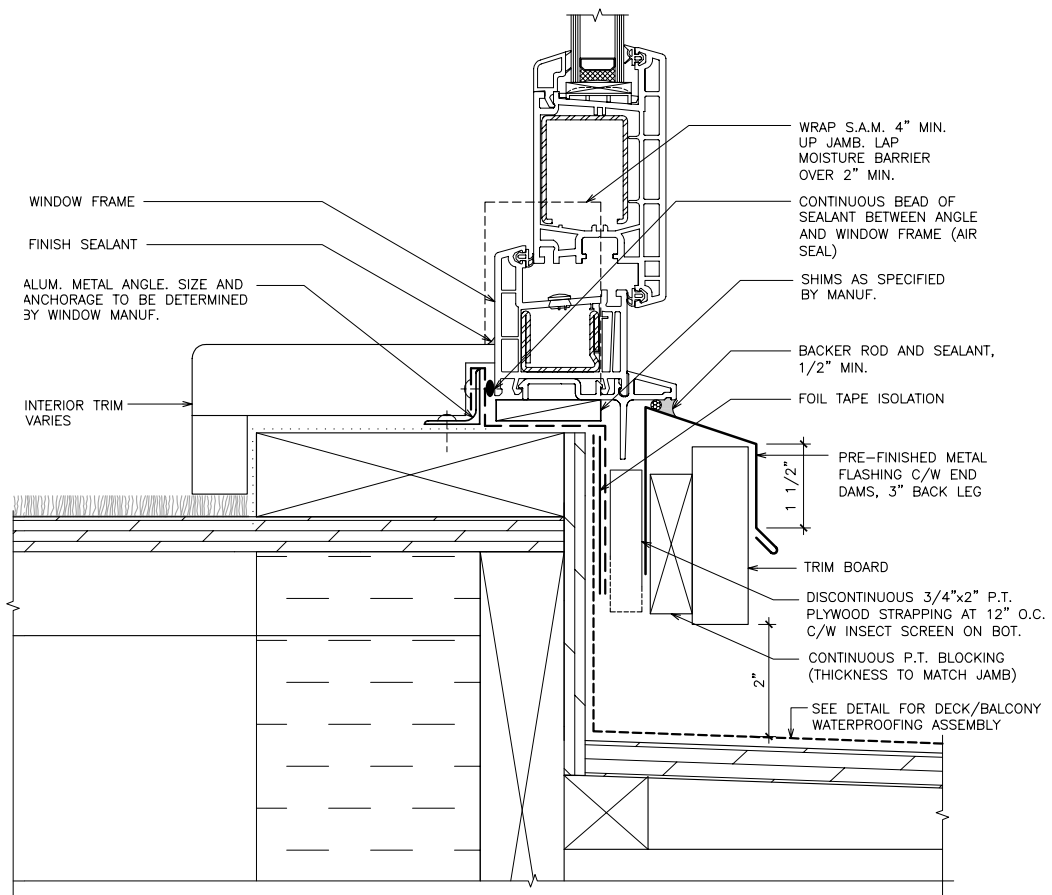
3  
4.4 TYPICAL DECK/BALCONY SWING DOOR HEAD



2  
4.4 TYPICAL DECK/BALCONY SWING DOOR JAMB



1  
4.4 SCHEMATIC PATIO DOOR ELEVATION



4  
4.4 TYPICAL DECK/BALCONY SWING DOOR SILL

No.	Revision	Date	By

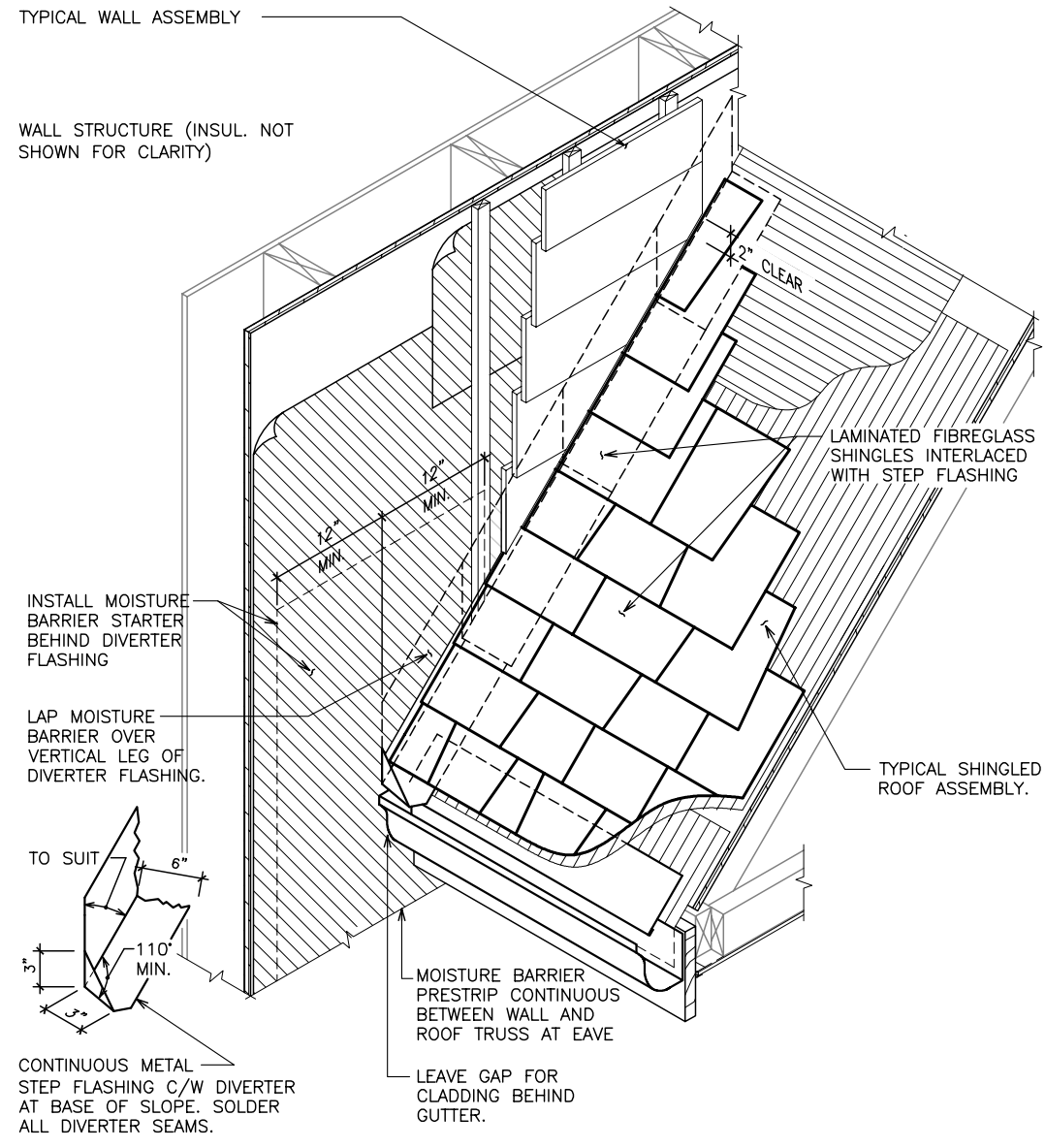
Project Name

Sheet Title

**DETAILS**

Sheet Number Revision

**R-4.4**



1  
4.5 TYPICAL ROOF TO WALL INTERFACE

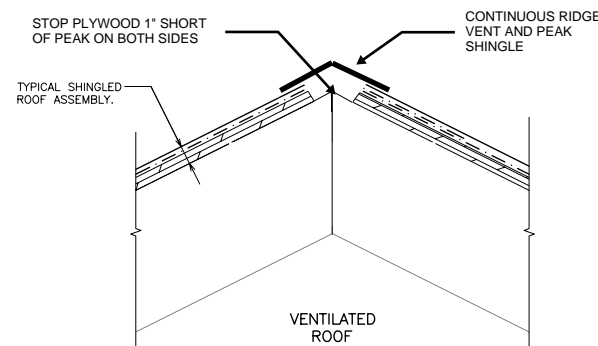
No.	Revision	Date	By

Project Name

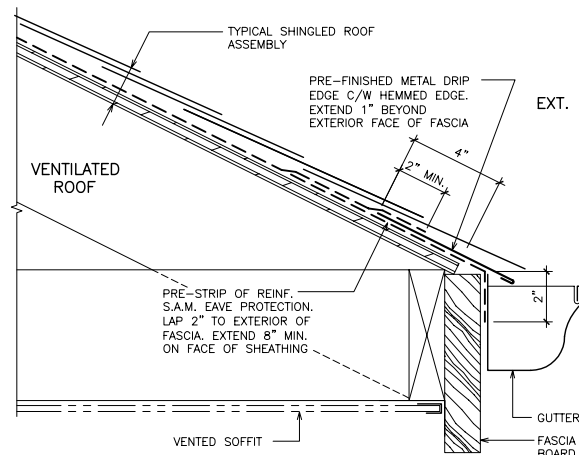
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**DETAILS**

Sheet Number  
**R-4.5**

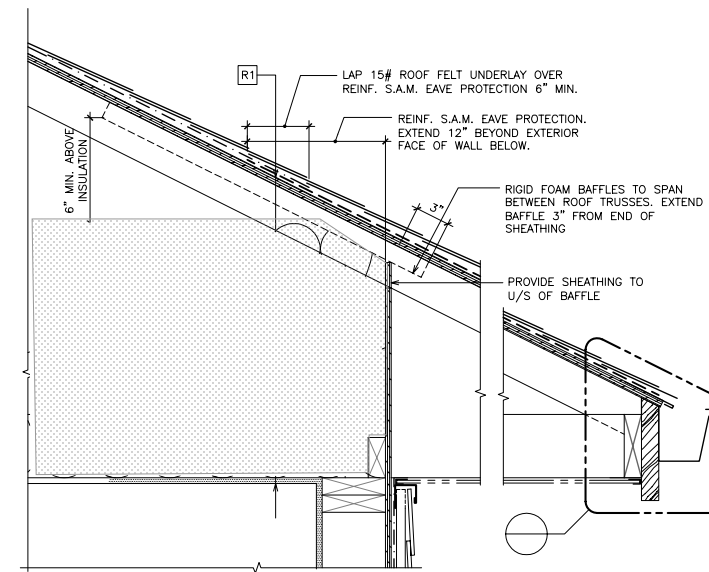
Revision



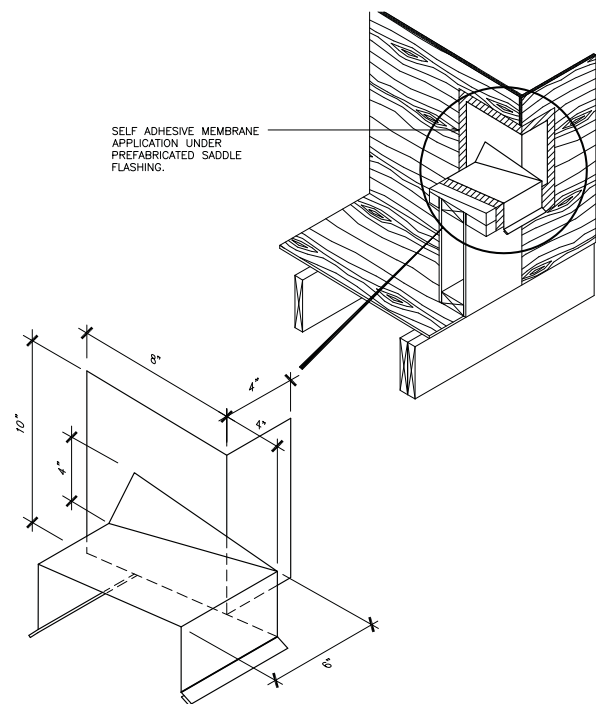
**3 TYPICAL ROOF PEAK**  
4.6



**2 TYPICAL ROOF EAVE**  
4.6

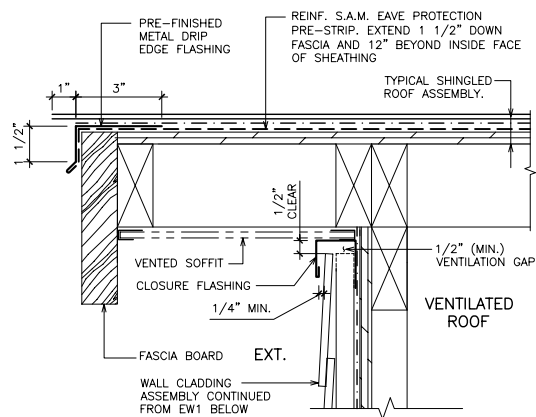


**1 SCHEMATIC ROOF ASSEMBLY**  
4.6 N.T.S.

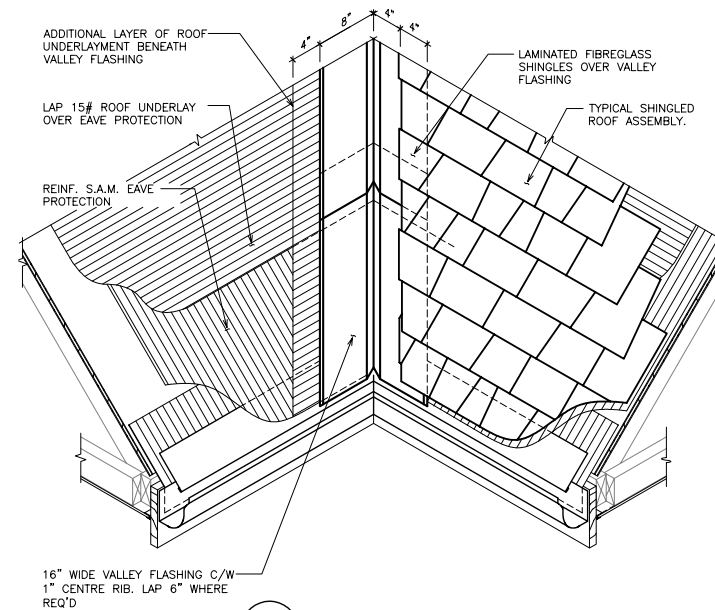


**6 TYPICAL SADDLE FLASHING ISOMETRIC AT ALL WALL TRANSITIONS**  
4.6 N.T.S.

**STRUCTURAL GABLE EXTENSION NOTES**  
STRUCTURAL FRAMING REQUIREMENTS TO BE DEVELOPED UPON REVIEW OF EXISTING CONDITIONS ON SITE.



**5 TYPICAL ROOF GABLE**  
4.6



**4 TYPICAL VALLEY**  
4.6 N.T.S.

No.	Revision	Date	By

Project Name

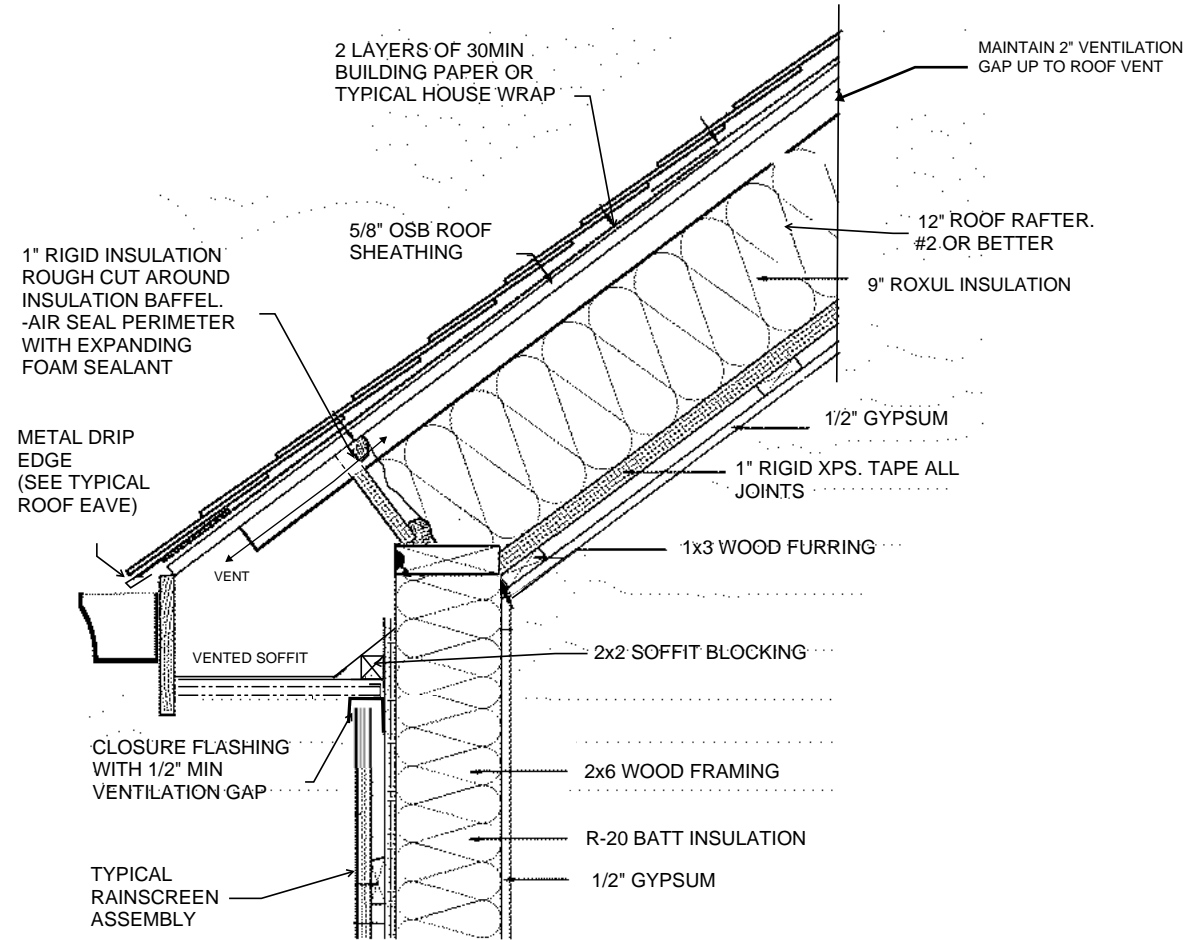
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**DETAILS**

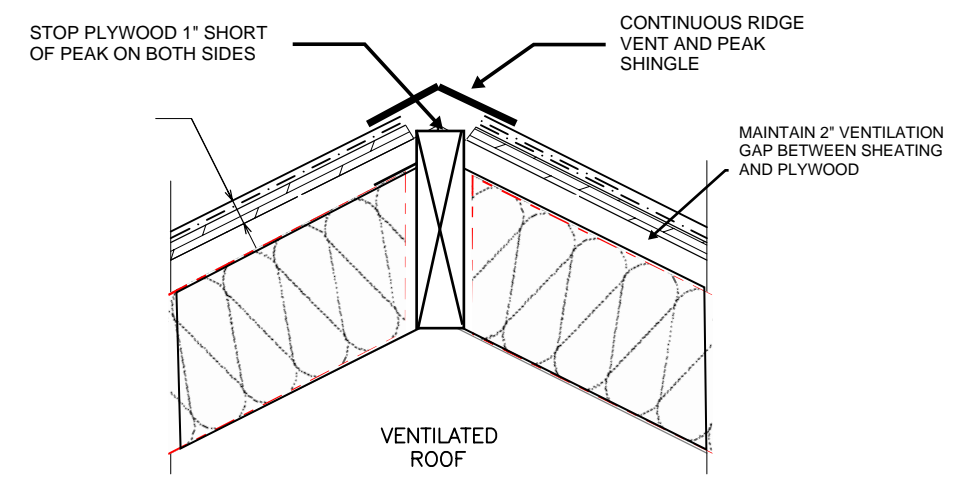
Sheet Number

**R-4.6**

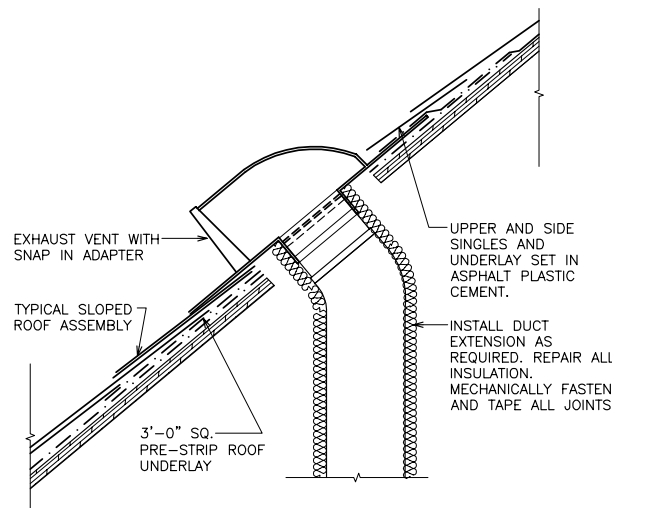
Revision



2  
4.7  
**TYPICAL ROOF PEAK**

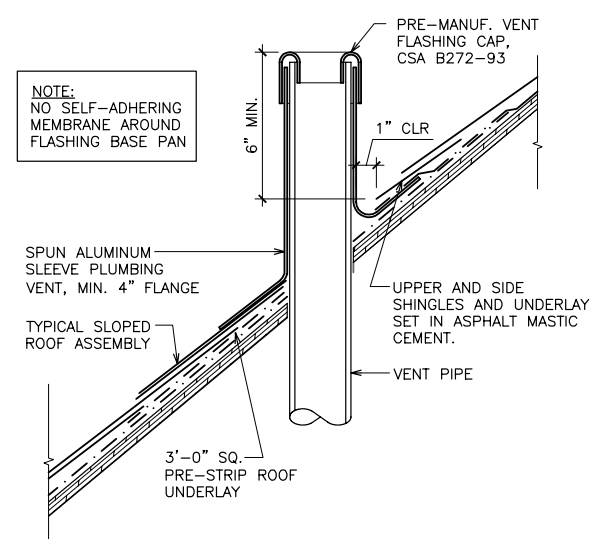


1  
4.7  
**TYPICAL CATHEDRAL ROOF PEAK**



NOTE:  
NO SELF-ADHERING MEMBRANE AROUND VENT FLANGE

4  
4.7  
**ROOF VENTS**



NOTE:  
NO SELF-ADHERING MEMBRANE AROUND FLASHING BASE PAN

3  
4.7  
**PLUMBING VENTS**

DETAIL ADAPTED FROM GREENBUILDINGADVISOR.COM  
FOUND AT:  
<http://www.greenbuildingadvisor.com/cad/detail/asphalt-roof-vented-cathedral-ceiling-1-rigid-insulation-vertical-board-siding-wood-furri>

R1	ROOF – TYPICAL TRUSSED ROOF	RSI	R
1	EXTERIOR AIR FILM	0.03	0.17
2	LAMINATED FIBERGLASS SHINGLES	0.11	0.44
3	ROOF UNDERLAYMENT	0.00	0.00
4	5/8" PLYWOOD SHEATHING WITH H-CLIPS	0.13	0.74
5	2X10 ROOF JOISTS	0.00	0.00
6	R-31 BATT INSULATION (ADJUSTED FOR WOOD MEMBERS)	3.82	22.65
7	1" XPS INSULATION	0.88	5.00
8	5/8" GYPSUM BOARD	0.08	0.48
9	INTERIOR AIR FILM	0.12	0.68
<b>EFFECTIVE RSI/R-VALUE OF ENTIRE ASSEMBLY</b>		<b>5.44</b>	<b>30.16</b>
MINIMUM REQUIRED BY BCBC TABLE 9.36.2.6.A		<b>4.66</b>	<b>26.5</b>

No.	Revision	Date	By

Project Name

Sheet Title  
**DETAILS**

Sheet Number  
**R-4.7**

## WALLS

1. UNLESS OTHERWISE NOTED, WALLS SHALL BE REINFORCED AS FOLLOWS:

150 mm	10M@450 VERT.	-----	10M@330 HORIZ.
200 mm	10M@330 VERT.	-----	10M@250 HORIZ.
250 mm	10M@500 VERT. E.F. STAG.	-----	10M@400 HORIZ. E.F. STAG.
300 mm	10M@450 VERT. E.F. STAG.	-----	10M@330 HORIZ. E.F. STAG.
350 mm	10M@380 VERT. E.F. STAG.	-----	10M@280 HORIZ. E.F. STAG.

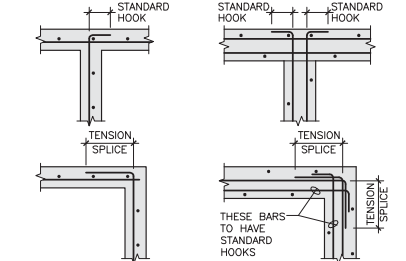
FOR OTHER THICKNESSES, REINFORCEMENT TO BE PROPORTIONAL TO ABOVE.

15M @ 500 MAY BE SUBSTITUTED FOR 10M @ 330 ONLY WITH THE APPROVAL OF RJC. FOR WALLS WITH A SINGLE LAYER OF STEEL, THE WALL REINFORCING SHALL BE PLACED IN THE CENTRE OF THE WALL U.N.O.

2. ALL WALL REINFORCING SHALL BE CONTINUOUS, WITH HOOKS OR CORNER BARS USED AT ALL WALL JUNCTIONS. EXTEND HOOKS TO FAR FACE OF WALL. CORNER BARS TO BE LOCATED ON OUTSIDE FACE OR CENTRE OF WALL.

3. HORIZONTAL AND VERTICAL SPLICES SHALL BE CASE 1 TENSION SPLICES. U.N.O. HORIZONTAL BARS NEED NOT BE CONSIDERED TOP BARS.

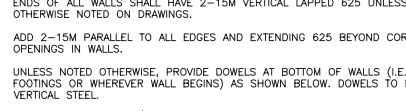
4. DETAILS OF HORIZONTAL REINFORCEMENT AT CORNERS (SEE ALSO ZONE REINFORCING DETAILS):



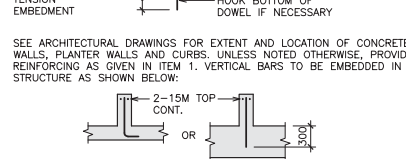
5. ENDS OF ALL WALLS SHALL HAVE 2-15M VERTICAL LAPPED 625 UNLESS OTHERWISE NOTED ON DRAWINGS.

6. ADD 2-15M PARALLEL TO ALL EDGES AND EXTENDING 625 BEYOND CORNERS AT OPENINGS IN WALLS.

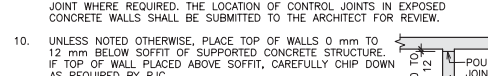
7. UNLESS NOTED OTHERWISE, PROVIDE DOWELS AT BOTTOM OF WALLS (I.E. AT FOOTINGS OR WHEREVER WALL BEGINS) AS SHOWN BELOW. DOWELS TO MATCH VERTICAL STEEL.



8. SEE ARCHITECTURAL DRAWINGS FOR EXTENT AND LOCATION OF CONCRETE UPSTAND WALLS, PLASTER WALLS AND CURBS. UNLESS NOTED OTHERWISE, PROVIDE REINFORCING AS GIVEN IN ITEM 1. VERTICAL BARS TO BE EMBEDDED IN MAIN STRUCTURE AS SHOWN BELOW:



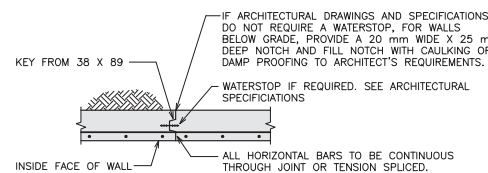
9. UNLESS NOTED OTHERWISE, ALL RETAINING WALLS BELOW GRADE AND ALL EXTERIOR WALLS EXPOSED TO THE WEATHER ABOVE GRADE SHALL HAVE CONTROL JOINTS. SEE CONTROL JOINT DETAIL. CONSTRUCTION JOINT MAY REPLACE CONTROL JOINT WHERE REQUIRED. THE LOCATION OF CONTROL JOINTS IN EXPOSED CONCRETE WALLS SHALL BE SUBMITTED TO THE ARCHITECT FOR REVIEW.



10. UNLESS NOTED OTHERWISE, PLACE TOP OF WALLS 0 mm TO 12 mm BELOW SOFFIT OF SUPPORTED CONCRETE STRUCTURE. IF TOP OF WALL PLACED ABOVE SOFFIT, CAREFULLY CHIP DOWN AS REQUIRED BY RJC.

## WALL CONSTRUCTION JOINT

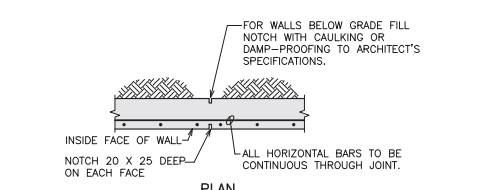
(CONSTRUCTION JOINT CAN REPLACE CONTROL JOINT)



## WALL CONTROL JOINT

UNLESS NOTED OTHERWISE FOR EXTERIOR WALLS BELOW GRADE AND EXTERIOR WALLS EXPOSED TO WEATHER ABOVE GRADE.

SPACE AT 6000 mm CENTERS MAXIMUM UNLESS OTHERWISE NOTED ON PLAN.



## EMBEDMENT / DEVELOPMENT LENGTHS AND SPLICE LENGTHS

BASED ON CAN/CSA-A23.3

WHERE EMBEDMENT OR SPLICES ARE DIMENSIONED ON THE DRAWINGS, SUCH DIMENSION SHALL APPLY.

WHERE THE DRAWINGS INDICATE A COMPRESSION EMBEDMENT, IT IS A COMPRESSION EMBEDMENT LENGTH AND IT SHALL BE AS NOTED BELOW.

WHERE THE DRAWINGS INDICATE A TENSION EMBEDMENT, IT IS A TENSION EMBEDMENT LENGTH AND SHALL BE AS NOTED BELOW.

WHERE NO EMBEDMENT OR EMBEDMENT TYPE IS CALLED FOR ON THESE DRAWINGS, IT SHALL BE A TENSION EMBEDMENT, EXCEPT FOR COLUMNS WHICH SHALL BE A COMPRESSION EMBEDMENT.

WHERE NO SPLICE OR SPLICE TYPE IS CALLED FOR ON THESE DRAWINGS, IT SHALL BE A TENSION SPLICE, EXCEPT FOR COLUMNS WHICH SHALL BE A COMPRESSION SPLICE.

IN TABLES BELOW, EMBEDMENT LENGTHS ARE SHOWN WITHOUT BRACKETS, AND SPLICE LENGTHS ARE SHOWN IN BRACKETS.

ALL LENGTHS ARE FOR  $F_y = 400 \text{ MPa}$  REBAR.

ALL TENSION SPLICE LENGTHS ARE CLASS "B" (1.3*s*).

### COMPRESSION EMBEDMENT AND SPLICE LENGTHS

COMPRESSION EMBEDMENT REFERS TO THE LENGTH REQUIRED TO PROVIDE THE "COMPRESSION DEVELOPMENT LENGTH" AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.3.2.

SPLICE LENGTH REFERS TO THE MINIMUM LAP LENGTH REQUIRED FOR A COMPRESSION SPLICE AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.16.1.

CONCRETE STRENGTH	FUNCTION	REBAR DESIGNATION					
		10M	15M	20M	25M	30M	35M
20 MPa	EMBEDMENT	215	325	430	540	645	755
	(SPLICE)	(300)	(440)	(585)	(730)	(880)	(1025)
25 MPa	EMBEDMENT	200	290	385	480	580	675
	(SPLICE)	(300)	(440)	(585)	(730)	(880)	(1025)
30 MPa & GREATER	EMBEDMENT	200	265	355	440	530	620
	(SPLICE)	(300)	(440)	(585)	(730)	(880)	(1025)

### TENSION EMBEDMENT AND SPLICE LENGTHS

TENSION EMBEDMENT REFERS TO THE LENGTH REQUIRED TO PROVIDE A "TENSION DEVELOPMENT LENGTH" AS DEFINED IN CAN/CSA-A23.3 CLAUSE 12.2.3.

SPLICE LENGTH REFERS TO THE MINIMUM LAP LENGTH REQUIRED FOR A CLASS "B" TENSION SPLICE (1.3*s*) AS PER CAN/CSA-A23.3 CLAUSE 12.15.

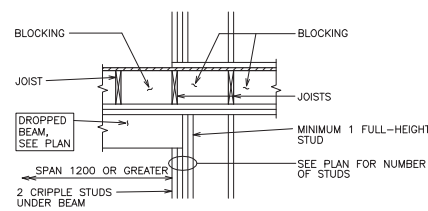
CASE 1 TENSION EMBEDMENT AND SPLICE CONDITIONS							
CONCRETE STRENGTH	FUNCTION	REBAR DESIGNATION					
		10M	15M	20M	25M	30M	35M
20 MPa	EMBEDMENT	325	485	645	1010	1210	1410
	(SPLICE)	(420)	(630)	(840)	(1310)	(1570)	(1835)
25 MPa	EMBEDMENT	300	435	580	900	1080	1260
	(SPLICE)	(390)	(565)	(750)	(1170)	(1405)	(1640)
30 MPa	EMBEDMENT	300	395	530	825	990	1155
	(SPLICE)	(390)	(515)	(685)	(1070)	(1285)	(1500)
35 MPa	EMBEDMENT	300	370	490	765	915	1065
	(SPLICE)	(390)	(475)	(635)	(990)	(1190)	(1385)

NOTES: - "TOP BAR" VALUES ARE 1.3 TIMES THE ABOVE LENGTHS. "TOP BAR" APPLIES TO HORIZONTAL REINFORCEMENT CAST WITH 300 mm OR MORE OF CONCRETE BELOW THE BAR.  
- INCREASE THESE TABLE LENGTHS BY 1.5 TIMES FOR EPOXY COATED REINFORCEMENT. INCREASE THESE TABLE LENGTHS BY 1.7 TIMES FOR EPOXY COATED TOP REINFORCEMENT.

### CASE 2 TENSION EMBEDMENT AND SPLICE CONDITIONS

TENSION EMBEDMENT AND SPLICE LENGTHS CONFORMING TO CAN/CSA-A23.3 TABLE 12.1 (0.6*s*<sub>1</sub>*k*<sub>2</sub>*k*<sub>3</sub>*k*<sub>4</sub>*k*<sub>5</sub>*k*<sub>6</sub>*k*<sub>7</sub>*k*<sub>8</sub>*k*<sub>9</sub>*k*<sub>10</sub>*k*<sub>11</sub>*k*<sub>12</sub>*k*<sub>13</sub>*k*<sub>14</sub>*k*<sub>15</sub>*k*<sub>16</sub>*k*<sub>17</sub>*k*<sub>18</sub>*k*<sub>19</sub>*k*<sub>20</sub>*k*<sub>21</sub>*k*<sub>22</sub>*k*<sub>23</sub>*k*<sub>24</sub>*k*<sub>25</sub>*k*<sub>26</sub>*k*<sub>27</sub>*k*<sub>28</sub>*k*<sub>29</sub>*k*<sub>30</sub>*k*<sub>31</sub>*k*<sub>32</sub>*k*<sub>33</sub>*k*<sub>34</sub>*k*<sub>35</sub>*k*<sub>36</sub>*k*<sub>37</sub>*k*<sub>38</sub>*k*<sub>39</sub>*k*<sub>40</sub>*k*<sub>41</sub>*k*<sub>42</sub>*k*<sub>43</sub>*k*<sub>44</sub>*k*<sub>45</sub>*k*<sub>46</sub>*k*<sub>47</sub>*k*<sub>48</sub>*k*<sub>49</sub>*k*<sub>50</sub>*k*<sub>51</sub>*k*<sub>52</sub>*k*<sub>53</sub>*k*<sub>54</sub>*k*<sub>55</sub>*k*<sub>56</sub>*k*<sub>57</sub>*k*<sub>58</sub>*k*<sub>59</sub>*k*<sub>60</sub>*k*<sub>61</sub>*k*<sub>62</sub>*k*<sub>63</sub>*k*<sub>64</sub>*k*<sub>65</sub>*k*<sub>66</sub>*k*<sub>67</sub>*k*<sub>68</sub>*k*<sub>69</sub>*k*<sub>70</sub>*k*<sub>71</sub>*k*<sub>72</sub>*k*<sub>73</sub>*k*<sub>74</sub>*k*<sub>75</sub>*k*<sub>76</sub>*k*<sub>77</sub>*k*<sub>78</sub>*k*<sub>79</sub>*k*<sub>80</sub>*k*<sub>81</sub>*k*<sub>82</sub>*k*<sub>83</sub>*k*<sub>84</sub>*k*<sub>85</sub>*k*<sub>86</sub>*k*<sub>87</sub>*k*<sub>88</sub>*k*<sub>89</sub>*k*<sub>90</sub>*k*<sub>91</sub>*k*<sub>92</sub>*k*<sub>93</sub>*k*<sub>94</sub>*k*<sub>95</sub>*k*<sub>96</sub>*k*<sub>97</sub>*k*<sub>98</sub>*k*<sub>99</sub>*k*<sub>100</sub>*k*<sub>101</sub>*k*<sub>102</sub>*k*<sub>103</sub>*k*<sub>104</sub>*k*<sub>105</sub>*k*<sub>106</sub>*k*<sub>107</sub>*k*<sub>108</sub>*k*<sub>109</sub>*k*<sub>110</sub>*k*<sub>111</sub>*k*<sub>112</sub>*k*<sub>113</sub>*k*<sub>114</sub>*k*<sub>115</sub>*k*<sub>116</sub>*k*<sub>117</sub>*k*<sub>118</sub>*k*<sub>119</sub>*k*<sub>120</sub>*k*<sub>121</sub>*k*<sub>122</sub>*k*<sub>123</sub>*k*<sub>124</sub>*k*<sub>125</sub>*k*<sub>126</sub>*k*<sub>127</sub>*k*<sub>128</sub>*k*<sub>129</sub>*k*<sub>130</sub>*k*<sub>131</sub>*k*<sub>132</sub>*k*<sub>133</sub>*k*<sub>134</sub>*k*<sub>135</sub>*k*<sub>136</sub>*k*<sub>137</sub>*k*<sub>138</sub>*k*<sub>139</sub>*k*<sub>140</sub>*k*<sub>141</sub>*k*<sub>142</sub>*k*<sub>143</sub>*k*<sub>144</sub>*k*<sub>145</sub>*k*<sub>146</sub>*k*<sub>147</sub>*k*<sub>148</sub>*k*<sub>149</sub>*k*<sub>150</sub>*k*<sub>151</sub>*k*<sub>152</sub>*k*<sub>153</sub>*k*<sub>154</sub>*k*<sub>155</sub>*k*<sub>156</sub>*k*<sub>157</sub>*k*<sub>158</sub>*k*<sub>159</sub>*k*<sub>160</sub>*k*<sub>161</sub>*k*<sub>162</sub>*k*<sub>163</sub>*k*<sub>164</sub>*k*<sub>165</sub>*k*<sub>166</sub>*k*<sub>167</sub>*k*<sub>168</sub>*k*<sub>169</sub>*k*<sub>170</sub>*k*<sub>171</sub>*k*<sub>172</sub>*k*<sub>173</sub>*k*<sub>174</sub>*k*<sub>175</sub>*k*<sub>176</sub>*k*<sub>177</sub>*k*<sub>178</sub>*k*<sub>179</sub>*k*<sub>180</sub>*k*<sub>181</sub>*k*<sub>182</sub>*k*<sub>183</sub>*k*<sub>184</sub>*k*<sub>185</sub>*k*<sub>186</sub>*k*<sub>187</sub>*k*<sub>188</sub>*k*<sub>189</sub>*k*<sub>190</sub>*k*<sub>191</sub>*k*<sub>192</sub>*k*<sub>193</sub>*k*<sub>194</sub>*k*<sub>195</sub>*k*<sub>196</sub>*k*<sub>197</sub>*k*<sub>198</sub>*k*<sub>199</sub>*k*<sub>200</sub>*k*<sub>201</sub>*k*<sub>202</sub>*k*<sub>203</sub>*k*<sub>204</sub>*k*<sub>205</sub>*k*<sub>206</sub>*k*<sub>207</sub>*k*<sub>208</sub>*k*<sub>209</sub>*k*<sub>210</sub>*k*<sub>211</sub>*k*<sub>212</sub>*k*<sub>213</sub>*k*<sub>214</sub>*k*<sub>215</sub>*k*<sub>216</sub>*k*<sub>217</sub>*k*<sub>218</sub>*k*<sub>219</sub>*k*<sub>220</sub>*k*<sub>221</sub>*k*<sub>222</sub>*k*<sub>223</sub>*k*<sub>224</sub>*k*<sub>225</sub>*k*<sub>226</sub>*k*<sub>227</sub>*k*<sub>228</sub>*k*<sub>229</sub>*k*<sub>230</sub>*k*<sub>231</sub>*k*<sub>232</sub>*k*<sub>233</sub>*k*<sub>234</sub>*k*<sub>235</sub>*k*<sub>236</sub>*k*<sub>237</sub>*k*<sub>238</sub>*k*<sub>239</sub>*k*<sub>240</sub>*k*<sub>241</sub>*k*<sub>242</sub>*k*<sub>243</sub>*k*<sub>244</sub>*k*<sub>245</sub>*k*<sub>246</sub>*k*<sub>247</sub>*k*<sub>248</sub>*k*<sub>249</sub>*k*<sub>250</sub>*k*<sub>251</sub>*k*<sub>252</sub>*k*<sub>253</sub>*k*<sub>254</sub>*k*<sub>255</sub>*k*<sub>256</sub>*k*<sub>257</sub>*k*<sub>258</sub>*k*<sub>259</sub>*k*<sub>260</sub>*k*<sub>261</sub>*k*<sub>262</sub>*k*<sub>263</sub>*k*<sub>264</sub>*k*<sub>265</sub>*k*<sub>266</sub>*k*<sub>267</sub>*k*<sub>268</sub>*k*<sub>269</sub>*k*<sub>270</sub>*k*<sub>271</sub>*k*<sub>272</sub>*k*<sub>273</sub>*k*<sub>274</sub>*k*<sub>275</sub>*k*<sub>276</sub>*k*<sub>277</sub>*k*<sub>278</sub>*k*<sub>279</sub>*k*<sub>280</sub>*k*<sub>281</sub>*k*<sub>282</sub>*k*<sub>283</sub>*k*<sub>284</sub>*k*<sub>285</sub>*k*<sub>286</sub>*k*<sub>287</sub>*k*<sub>288</sub>*k*<sub>289</sub>*k*<sub>290</sub>*k*<sub>291</sub>*k*<sub>292</sub>*k*<sub>293</sub>*k*<sub>294</sub>*k*<sub>295</sub>*k*<sub>296</sub>*k*<sub>297</sub>*k*<sub>298</sub>*k*<sub>299</sub>*k*<sub>300</sub>*k*<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C. CASE 2 - DROPPED BEAM - OPENING 1200 mm OR GREATER:



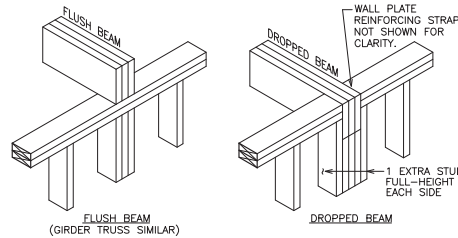
**WALLS**

- LOAD BEARING WALLS, DENOTED ON PLAN THUS:
- ALL EXTERIOR WALLS ARE LOAD BEARING.

FLOOR	EXTERIOR / OUTSIDE PERIMETER WALLS	INTERIOR WALLS	DOUBLE PARTY WALLS	38 X 140 WALLS
LEVEL 3 TO ROOF	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C
LEVEL 2 TO LEVEL 3	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C
LEVEL 1 TO LEVEL 2	38 X 140 @ 400 O/C	38 X 89 @ 400 O/C	38 X 89 @ 400 O/C	38 X 140 @ 400 O/C

SEE ARCHITECTURAL DRAWINGS FOR LOCATIONS WHERE WIDER STUDS ARE USED (I.E. BATHROOM PLUMBING WALLS).

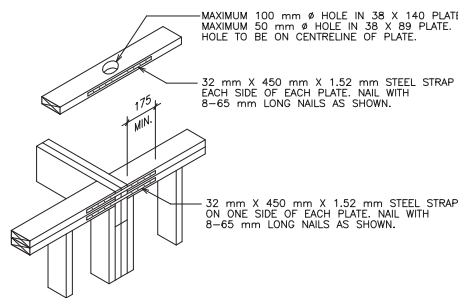
- SEE TYPICAL DETAILS FOR LOAD BEARING WALL CONNECTIONS BETWEEN FLOORS U.N.O.
- UNLESS NOTED OTHERWISE, PROVIDE A BUILT-UP STUD POST AT THE ENDS OF ALL BEAMS AND GIRDER TRUSSES FRAMING INTO A WALL. THE BUILT-UP STUD POST SHALL MATCH THE WIDTH OF THE BEAM, AND THE STUD SIZE SHALL MATCH THOSE IN THE WALL U.N.O. ON PLAN.



- NAILING OF BUILT-UP STUD POSTS SHALL CONFORM TO THE FOLLOWING SCHEDULE. EACH STUD OF BUILT-UP POST SHALL BE NAILED.

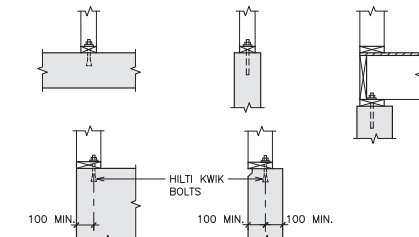
STUD	NAILING
38 X 89	75 mm NAILS @ 220 mm O/C
38 X 140	2 - ROWS OF 75 mm NAILS @ 220 mm O/C
38 X 184	2 - ROWS OF 75 mm NAILS @ 220 mm O/C

- ALL POSTS AND BUILT-UP STUD POSTS SHOWN ON ANY LEVEL SHALL BE CARRIED DOWN TO THE CONCRETE UNLESS NOTED OTHERWISE. PROVIDE SOLID BLOCKING BETWEEN JOISTS UNDER ALL POSTS AND BUILT-UP POSTS.
- ALL LOAD BEARING WALLS SHALL HAVE 2 CONTINUOUS TOP PLATES AND 1 CONTINUOUS BOTTOM PLATE. BEAMS OR HEADERS OVER OPENINGS IN WALLS SHALL BE DROPPED TO ALLOW THE TOP PLATES TO BE CONTINUOUS. WHERE 38 mm CONCRETE TOPPING IS USED ON THE FLOORS, PROVIDE 2 CONTINUOUS BOTTOM PLATES. DOUBLE PLATES SHALL BE SPLICED WITH A MINIMUM 600 mm STAGGER AND LAPPED AT CORNERS. TOP AND BOTTOM PLATES WHICH HAVE BEEN CORED OR WHICH ARE DISCONTINUOUS SHALL BE REINFORCED AS FOLLOWS:



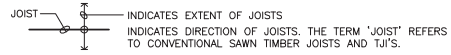
- WHERE PERMANENT SHEATHING IS NOT APPLIED TO STUDS PROVIDE BLOCKING AT 1000 mm O/C FOR 38 X 89 WALLS AND 600 mm O/C FOR 38 X 140 WALLS.
- FASTEN WOOD-FRAME STRUCTURE AT BASE BY BOLTING THE BOTTOM PLATE (SILL PLATE) TO THE CONCRETE WITH 13 mm @ ANCHOR BOLTS @ 1200 mm O/C UNLESS NOTED OTHERWISE. ANCHOR BOLTS SHALL HAVE A MINIMUM 125 mm EMBEDMENT AND A MINIMUM 75 mm PROJECTION ABOVE THE CONCRETE. THE ANCHOR BOLTS MAY BE CAST IN PLACE OR GROUDED INTO PREDRILLED HOLES WITH THE HILTI-KWIK SYSTEM. HILTI-KWIK BOLTS WITH A 75 mm EMBEDMENT MAY BE USED WITH A 100 mm OR GREATER EDGE DISTANCE. NON-LOAD BEARING WALLS MAY BE FASTENED WITH 3 mm @ POWER DRIVEN FASTENERS AT 400 mm O/C (MINIMUM 20 mm PENETRATION INTO CONCRETE). FULL WIDTH OF WALLS SHALL BEAR ON CONCRETE UNLESS NOTED OTHERWISE. SEE SHEAR WALL SCHEDULE FOR ADDITIONAL ANCHORING REQUIREMENTS OF SHEAR WALLS.

NON-SHEAR WALL ANCHORAGE EXAMPLES:

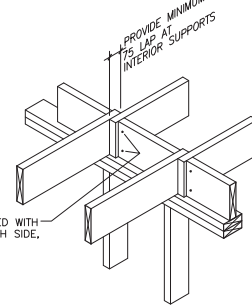


**JOISTS**

- REFER TO PLAN AND JOIST SCHEDULE FOR JOIST TYPE, SIZE, AND SPACING.

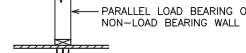


- DIMENSIONAL LUMBER JOISTS SHALL HAVE CROSS-BRIDGING OR FULL-DEPTH BLOCKING AT 1800 mm O/C ALONG THE SPAN FOR ALL SPANS GREATER THAN 3600 mm. CROSS BRIDGING SHALL CONSIST OF 38 X 38 TIMBER OR APPROVED STEEL BRIDGING. TJI JOISTS SHALL BE BLOCKED AS PER MANUFACTURERS REQUIREMENTS. JOISTS SHALL HAVE FULL-DEPTH BLOCKING OVER LOAD BEARING WALLS, DROPPED BEAMS OR HEADERS. SEE TYPICAL LOAD BEARING WALL AND SHEAR WALL CONNECTIONS BETWEEN FLOORS FOR ADDITIONAL BLOCKING REQUIREMENTS.



- TRIM OPENINGS IN FLOORS AND ROOFS (I.E. STAIRS, FIREPLACES, SKYLIGHTS ETC) WITH DOUBLE JOISTS UNLESS NOTED OTHERWISE.

- PROVIDE DOUBLE JOISTS UNDER PARALLEL FRAME WALLS UNLESS NOTED OTHERWISE.



- STAIRS AND STRINGERS SHALL BE FRAMED IN ACCORDANCE WITH THE BUILDING CODE PART 9, UNLESS NOTED OTHERWISE.

- JOISTS ARE TO BE FLUSH UNLESS NOTED OTHERWISE. USE JOIST HANGERS OR FRAMING ANCHORS TO CONNECT JOISTS.



- UNLESS NOTED OTHERWISE JOIST HANGERS OR FRAMING ANCHORS SHALL BE CAPABLE OF DEVELOPING THE SHEAR STRENGTH OF THE SUPPORTED MEMBER. FOR DIMENSIONAL LUMBER JOISTS, THE FOLLOWING CAPACITIES ARE REQUIRED:

JOIST SIZE	REQUIRED SHEAR RESISTANCE (kN)	
	WORKING LOAD	FACTORED LOAD
38 X 89	5.5	7.2
38 X 140	7.2	9.4
38 X 184	8.2	10.6
38 X 235	9.53	12.4
38 X 286	10.5	13.7

FOR I-JOISTS, HANGERS SHALL BE SPECIFIED ON ENGINEERED SHOP DRAWINGS PROVIDED BY THE JOIST SUPPLIER.

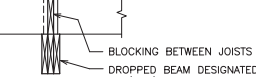
**BEAMS**

- BUILT-UP BEAMS (I.E. 3-38 X 235) SHALL BE NAILED TOGETHER WITH 2 ROWS OF 75 mm NAILS, EACH ROW WITH NAILS AT 300 mm O/C. INDIVIDUAL MEMBERS MAY NOT BE SPLICED BETWEEN SUPPORTS. FOR ENGINEERED PRODUCTS, NAILING REQUIREMENTS OF LAMINATES SHALL BE SPECIFIED ON ENGINEERED SHOP DRAWINGS PROVIDED BY BEAM SUPPLIER.

- FLUSH BEAMS



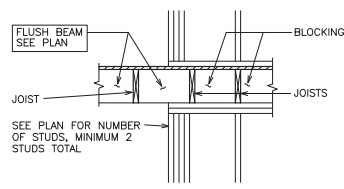
- DROPPED BEAMS



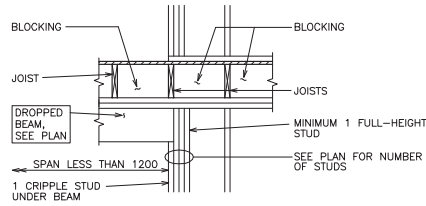
- U.N.O. ALL EXTERIOR WALL BEAMS, INTERIOR WALL BEAMS, AND DOOR HEADER BEAMS ARE DROPPED. UNLESS NOTED OTHERWISE ALL OTHER INTERIOR BEAMS ARE FLUSH.

- USE 2-38 X 235 BEAMS OVER ALL OPENINGS IN BEARING WALLS UNLESS NOTED OTHERWISE. BEAMS SHALL BE SUPPORTED AT EACH END AS SHOWN BELOW UNLESS NOTED OTHERWISE.

- CASE 1 - FLUSH BEAM:



- CASE 2 - DROPPED BEAM - OPENING LESS THAN 1200 mm:



**WOOD FRAMING**

**GENERAL**

- ALL DESIGN, DETAILS, MATERIALS AND CONSTRUCTION PROCEDURES SHALL CONFORM TO CURRENT EDITIONS OF THE FOLLOWING AS A MINIMUM:
  - BRITISH COLUMBIA BUILDING CODE 2012 - PART 9
  - CAN/CSA-086 - ENGINEERING DESIGN IN WOOD
  - CSA 0121 - DOUGLAS FIR PLYWOOD
  - CAN/CSA-L0 4000 - FIBREGLASS AND MICROLAMINATES
  - CAN/CSA-0122 - STRUCTURAL GLUED-LAMINATED TIMBER
  - CAN/CSA-0177 - QUALIFICATION CODE FOR MANUFACTURERS OF STRUCTURAL GLUED-LAMINATED TIMBER
  - CSA 0437 SERIES - STANDARDS FOR OSB AND WAFFERBOARD
  - CSA B111 - WIRE NAILS, SPIKES AND STAPLES
  - CAN/CSA-B34 - MISCELLANEOUS BOLTS AND SCREWS
  - CANADIAN WOOD-FRAME HOUSE CONSTRUCTION - CMHC
  - "WOOD DESIGN MANUAL" - CANADIAN WOOD COUNCIL
  - "WOOD BUILDING TECHNOLOGY" - CANADIAN WOOD COUNCIL
- ANY CHANGES TO THE FRAMING SHOWN ON THESE DRAWINGS SHALL HAVE PRIOR WRITTEN APPROVAL OF RJC. FRAMING CHANGES WHICH HAVE NOT BEEN SO APPROVED WILL BE REJECTED.
- CONFIRM ALL DIMENSIONS AND OUTLINES WITH THE ARCHITECTURAL DRAWINGS. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL DIMENSIONS, ELEVATIONS AND DETAILS.
- ANY TIMBER NOT GRADE MARKED WILL BE REJECTED.
- FINISHES SHALL BE DETAILED TO ACCOMMODATE SHRINKAGE OF THE TIMBER OVER TIME.
- DO NOT COVER WOOD FRAMING WITH FINISHES UNTIL RJC'S FRAMING REVIEW IS COMPLETE. PROVIDE 24 HOURS ADVANCE NOTIFICATION WHEN FRAMING REVIEWS ARE REQUIRED.
- NOTCHING AND DRILLING OF STRUCTURAL ELEMENTS SHALL FOLLOW THE GUIDELINES SET FORTH IN THE BUILDING CODE PART 9, UNLESS OTHERWISE APPROVED IN WRITING BY RJC.
- ALL TIMBER ELEMENTS ARE DESIGNED FOR DRY-SERVICE CONDITIONS. SEE ARCHITECTURAL DRAWINGS FOR WATERPROOFING AND VENTILATION DETAILS.
- ALL WOOD FRAME CONSTRUCTION SHALL SATISFY THE FOLLOWING CONSTRUCTION TOLERANCES AS A MINIMUM. REFER TO ARCHITECTURAL AND WARRANTY REQUIREMENTS FOR ADDITIONAL TOLERANCE SPECIFICATIONS.
  - FLOORS - NOT MORE THAN 6 mm IN 3 m OUT OF LEVEL.
  - WALLS - NOT MORE THAN 6 mm IN 2.4 m OUT OF PLUMB. NOT MORE THAN 6 mm IN 3 m FOR ANY BOWING.
- OVERALL - BUILDING WALLS AND FLOORS SHALL NOT BE MORE THAN 10 mm DIFFERENCE IN MEASUREMENT FROM DIMENSIONS SHOWN ON CONTRACT DOCUMENTS.

**MATERIALS**

- STUDS AND BUILT-UP POSTS TO BE S-P-F #2 GRADE OR BETTER. STUDS MAY BE FINGER-JOINTED (MAXIMUM 3 JOINTS/STUD) EXCEPT IN SHEARWALLS. REFER TO WOOD SHEAR WALL NOTES FOR ADDITIONAL REQUIREMENTS. FINGER JOINTED STUDS IN FIRE SEPARATIONS SHALL HAVE HEAT RESISTANT ADHESIVE (HSA).
- JOISTS TO BE S-P-F #2 GRADE OR BETTER.
- BUILT-UP BEAMS AND HEADERS TO BE S-P-F #2 GRADE OR BETTER.
- WALL PLATES TO BE D.FIR #2 GRADE OR BETTER WALL PLATES SHALL BE KILN-DRIED AND MAY BE FINGER JOINTED EXCEPT IN SHEAR WALLS.
- POSTS AND BEAMS TO BE S-P-F #2 GRADE OR BETTER.
- ALL DIMENSION LUMBER TO BE SURFACED FOUR SIDES ('S4S').
- PLYWOOD TO BE DOUGLAS FIR SHEATHING GRADE.
- TIMBER CONNECTION HARDWARE TO BE SIMPSON STRONG-TIE, OR EQUIVALENT APPROVED BY RJC. COMPLETE WITH NAILS SUPPLIED BY MANUFACTURER. DO NOT USE P NAILS.
- NAILS SHALL BE COMMON ROUND STEEL WIRE NAILS. NAILS ARE CALLED UP BY LENGTH AND SHALL CONFORM TO THE FOLLOWING TABLE:

LENGTH	DIAMETER	PENNY-WEIGHT
50 mm (2")	2.9 mm (0.113")	6d
65 mm (2 1/2")	3.3 mm (0.131")	8d
75 mm (3")	3.8 mm (0.148")	10d
80 mm (3 1/4")	3.8 mm (0.148")	12d
90 mm (3 1/2")	4.1 mm (0.162")	16d
100 mm (4")	4.9 mm (0.192")	20d
115 mm (4 1/2")	5.3 mm (0.207")	30d
125 mm (5")	5.8 mm (0.225")	40d

NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.

- MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
- ANCHOR BOLTS SHALL BE ASTM F1554 OR ASTM A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 40 mm AT THE BOTTOM.
- BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
- MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.
- ALL FASTENERS AND CONNECTION HARDWARE THROUGH PRESERVATIVE TREATED MATERIALS OR OUTSIDE OF THE MOISTURE BARRIER TO BE HOT DIPPED GALVANIZED OR STAINLESS STEEL STEEL AS SPECIFIED.

**NAILING**

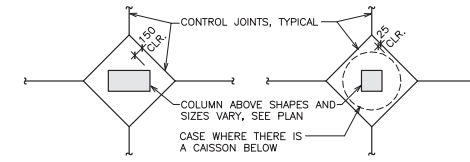
- NAILING SHALL CONFORM TO THE BUILDING CODE PART 9, AND "WOOD BUILDING TECHNOLOGY" PUBLISHED BY THE CANADIAN WOOD COUNCIL. NAILING CALLED UP ON THESE DRAWINGS (I.E. FOR SHEATHING) IS BASED ON COMMON NAILS. SEE NOTE 10 UNDER MATERIALS FOR COMMON NAIL SIZES.
- UNLESS NOTED OTHERWISE NAIL ALL WALL, FLOOR AND ROOF SHEATHING WITH 64 mm NAILS AT 150 O/C AT SUPPORTED EDGES OF SHEATHING SHEETS, AND AT 250 O/C FOR FLOORS AND AT 300 O/C FOR ROOFS AT INTERMEDIATE SUPPORTS TO ALL SUPPORTING MEMBERS. FLOOR SHEATHING SHALL BE NAILED WITH SPIRAL NAILS AND SHALL BE GLUED TO THE JOISTS IN ADDITION TO NAILING. IF SMALLER DIAMETER NAILS (I.E. PNEUMATICALLY DRIVEN NAILS OR "P-NAILS") ARE USED, INCREASE THE NUMBER OF NAILS BY 33%. SEE SHEAR WALL SCHEDULE OR DIAPHRAGM NAILING SCHEDULE FOR ADDITIONAL REQUIREMENTS.
- DO NOT USE PNEUMATICALLY DRIVEN NAILS WITH JOIST HANGERS OR CONNECTING HARDWARE. NAILS FOR HARDWARE SHOULD BE AS SPECIFIED OR SUPPLIED BY MANUFACTURER.
- DO NOT USE PNEUMATICALLY DRIVEN NAILS IN SHEAR WALL SHEATHING UNLESS THE NAILS MEET THE LENGTH AND DIAMETER OF NOTE 9 UNDER MATERIALS.

**MOISTURE BARRIERS**

- PROVIDE A MOISTURE BARRIER BETWEEN WOOD ELEMENTS AND ALL CONCRETE OR MASONRY. THIS CAN BE A SHEET OF LIGHT-GAUGE (0.61 mm MINIMUM) GALVANIZED METAL, ASPHALT IMPREGNATED BUILDING PAPER (7.5 kg PER 10 m²), CLOSED-CELL FOAM GASKET MATERIAL, TYPE 5, ROLL ROOFING, SHEET POLYETHYLENE NOT PERMITTED. ALL JUNCTIONS AND TERMINATIONS TO BE LAPPED (50 mm MINIMUM) AND SEALED. BUTT JOINTS IN MOISTURE BARRIERS NOT PERMITTED.

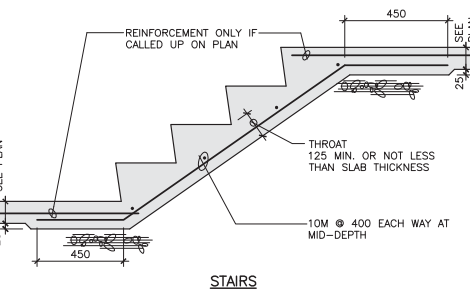
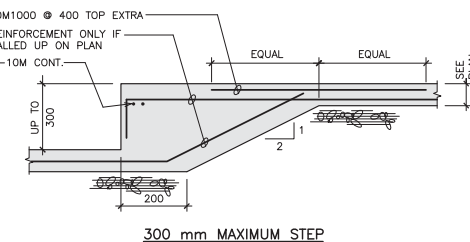
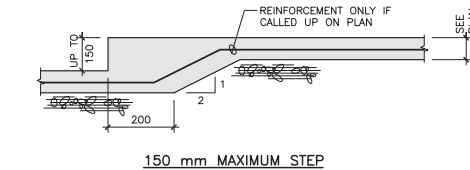
**SLAB ON GRADE CONTROL JOINTS**

- UNLESS MORE RIGOROUS REQUIREMENTS ARE INDICATED ELSEWHERE ON THE STRUCTURAL AND ARCHITECTURAL DRAWINGS AND SPECIFICATIONS, SPACE CONTROL JOINTS AT 4500 mm O/C MAXIMUM.
- SAWCUT JOINTS 30 mm DEEP AS SOON AS PRACTICAL, BUT NO LATER THAN 12 HOURS AFTER PLACEMENT OF SLAB. USE EQUIPMENT THAT DOES NOT "RAVEL" THE EDGES OF THE CUT.
- UNLESS NOTED OTHERWISE ON THE STRUCTURAL DRAWINGS, RUN ANY SLAB ON GRADE REINFORCEMENT THROUGH THE JOINTS.
- UNLESS NOTED OTHERWISE, SAWCUT DIAMOND PATTERN AROUND COLUMNS, 150 mm CLEAR OF COLUMNS.



- APPROVAL OF ARCHITECT IS REQUIRED TO SUBSTITUTE "ZIP STRIPS" FOR SAWCUTS.

**TYPICAL SLAB ON GRADE STEP DETAILS - U.N.O.**



- NOTE: SPIRAL OR PNEUMATIC NAILS MAY BE USED IF THEY CONFORM TO THE TABLE ABOVE.
- MISCELLANEOUS STEEL TO BE CAN/CSA-G40.21 OR APPROVED EQUAL.
- ANCHOR BOLTS SHALL BE ASTM F1554 OR ASTM A36 OR APPROVED EQUAL. ANCHOR BOLTS SHALL BE DEFORMED, THREADED ALONG THEIR FULL LENGTH OR HOOKED 40 mm AT THE BOTTOM.
- BOLTS SHALL BE ASTM A307 OR APPROVED EQUAL, USED WITH STANDARD CUT STEEL WASHERS UNLESS NOTED OTHERWISE ON DRAWINGS.
- MOISTURE CONTENT OF ALL TIMBER ELEMENTS SHALL NOT EXCEED 19% AT THE TIME OF CONSTRUCTION OR FABRICATION.
- ALL FASTENERS AND CONNECTION HARDWARE THROUGH PRESERVATIVE TREATED MATERIALS OR OUTSIDE OF THE MOISTURE BARRIER TO BE HOT DIPPED GALVANIZED OR STAINLESS STEEL STEEL AS SPECIFIED.

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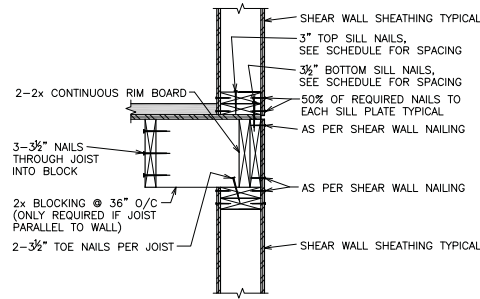
Project Name

Sheet Title

**GENERAL NOTES AND TYPICAL DETAILS**

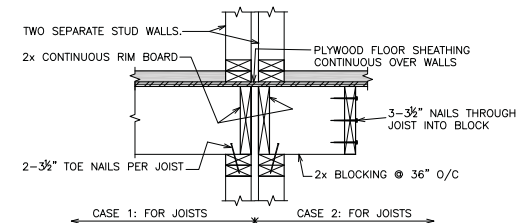
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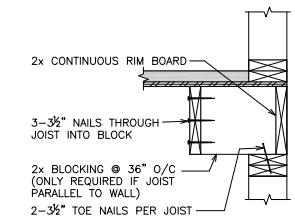
**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.



**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- JOIST DIRECTION MAY VARY.



**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- JOIST DIRECTION MAY VARY.

**3**  
S1.05 1" = 1'-0"

**TYPICAL LOAD-BEARING WALL CONNECTION BETWEEN FLOORS AT PARTY WALL SAWN LUMBER FLOOR JOISTS**

**2**  
S1.05 1" = 1'-0"

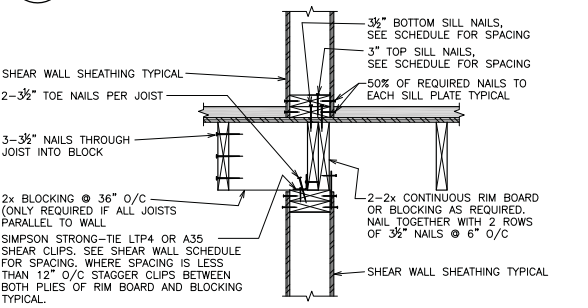
**TYPICAL INTERIOR LOAD-BEARING WALL CONNECTION BETWEEN FLOORS SAWN LUMBER FLOOR JOISTS**

**1**  
S1.05 1" = 1'-0"

**TYPICAL EXTERIOR LOAD-BEARING WALL CONNECTION BETWEEN FLOORS SAWN LUMBER FLOOR JOISTS**

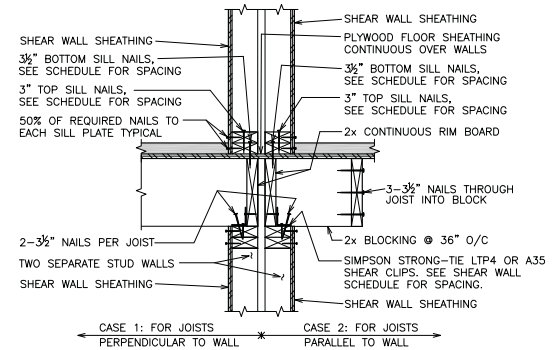
**4**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL**



**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

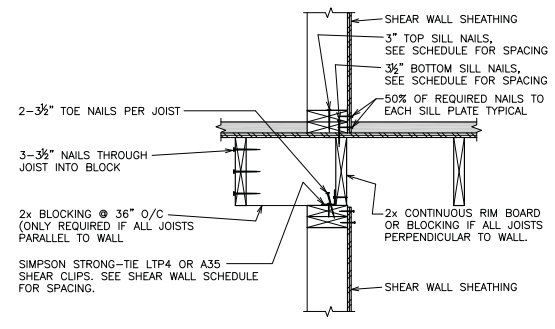


**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

**7**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT PARTY WALL**

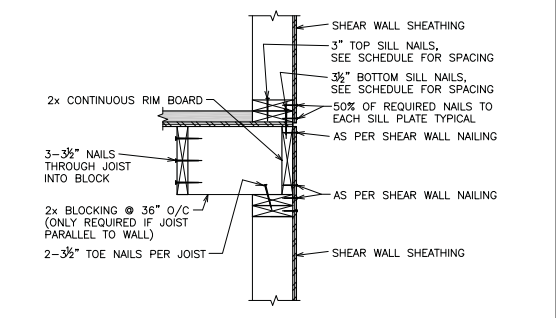


**NOTES:**

- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.
- SEE DETAIL FOR ALTERNATE WHERE ALL JOISTS PARALLEL TO WALL.

**6**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL**



**NOTES:**

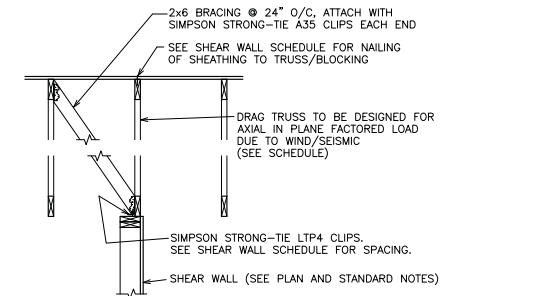
- PROVIDE FULL DEPTH BLOCKING AT POSTS OR BUILT-UP STUD POSTS AS PER WOOD FRAMING - WALL NOTE 5.
- ADDITIONAL FIELD VISITS REQUIRED FOR EACH WALL AS NAILING OF BOTTOM PLATE TO BLOCKING IS NOT VISIBLE AFTER WALL IS IN PLACE.
- PROVIDE SOLID BLOCKING AT ENDS OF SHEAR WALLS.
- JOIST DIRECTION MAY VARY.

**5**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON ONE SIDE CONNECTION TO SAWN LUMBER FLOOR JOISTS AT EXTERIOR WALL**

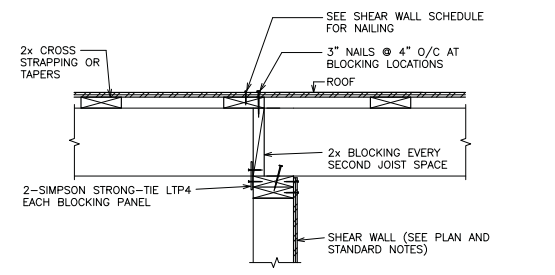
**8**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL SHEATHED ON BOTH SIDES CONNECTION TO SAWN LUMBER FLOOR JOISTS AT INTERIOR WALL**



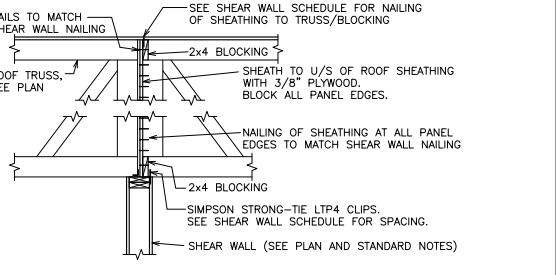
**13**  
S1.05 1/2" = 1'-0"

**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL - ALTERNATE 1**



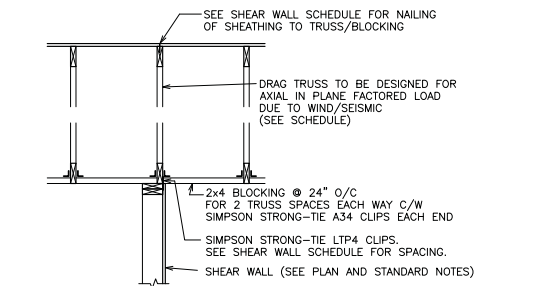
**11**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL TO SAWN LUMBER ROOF JOIST CONNECTION WHERE JOISTS RUN PERPENDICULAR TO WALL**



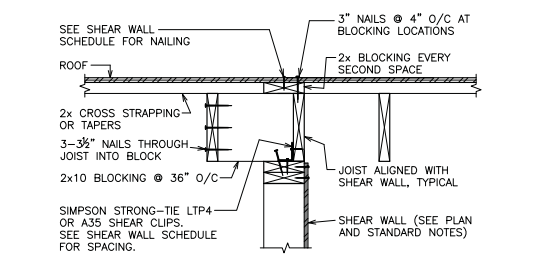
**9**  
S1.05 1/2" = 1'-0"

**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL - ALTERNATE**



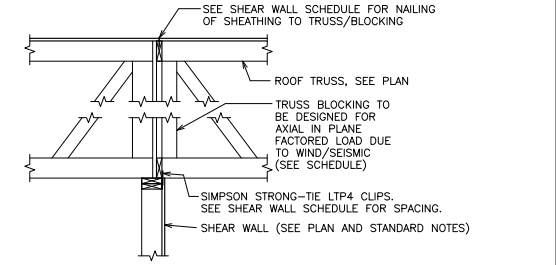
**14**  
S1.05 1/2" = 1'-0"

**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PARALLEL TO WALL - ALTERNATE 2**



**12**  
S1.05 1" = 1'-0"

**TYPICAL SHEAR WALL TO SAWN LUMBER ROOF JOIST CONNECTION WHERE JOISTS RUN PARALLEL TO WALL**



**10**  
S1.05 1/2" = 1'-0"

**TYPICAL SHEAR WALL TO ROOF TRUSS CONNECTION WHERE TRUSSES RUN PERPENDICULAR TO WALL**

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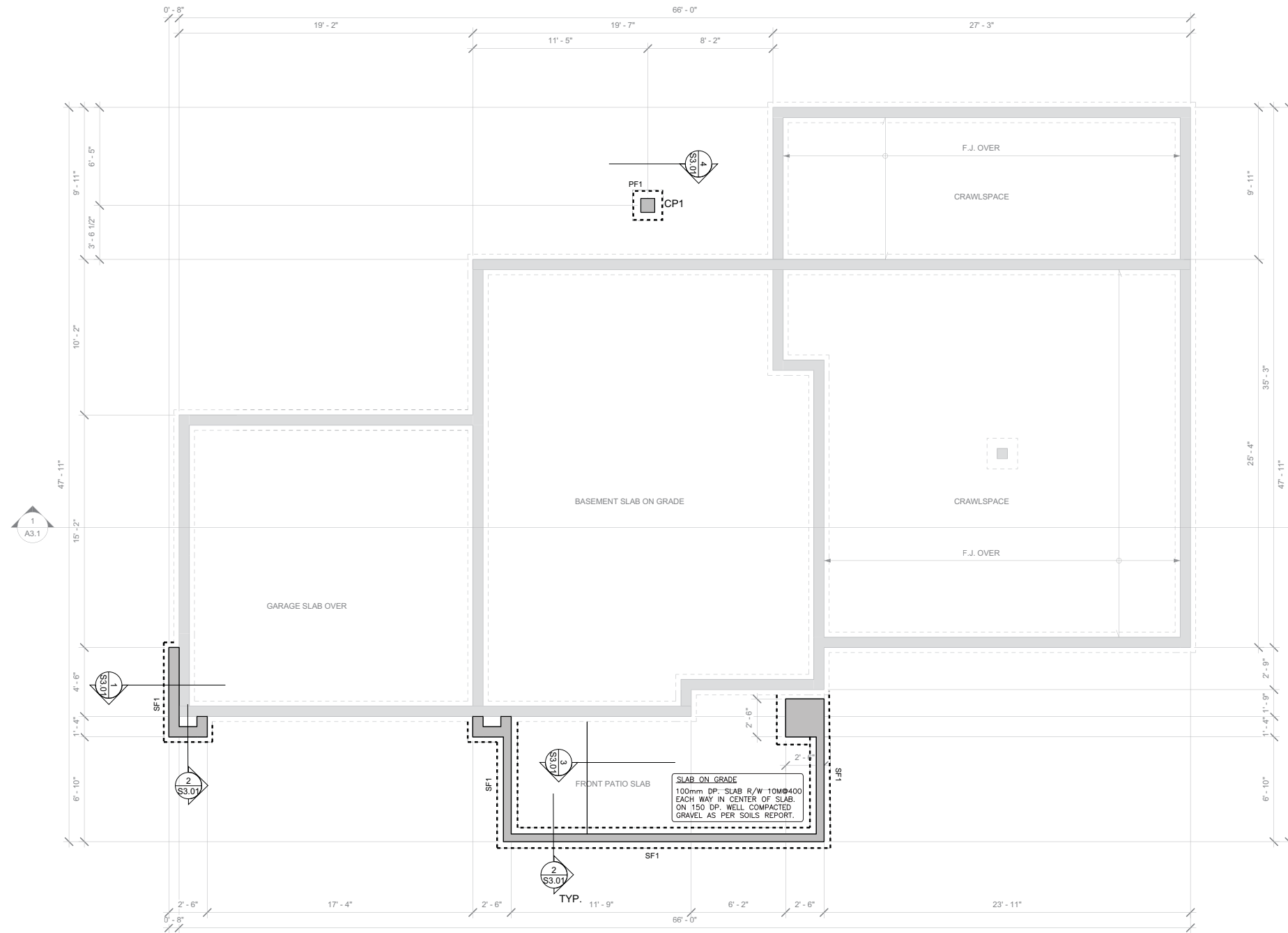
**GENERAL NOTES AND TYPICAL DETAILS**

Sheet Number

Revision

**S1.05**

PAD FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
PF1	2'-0" X 2'-0" X 10" DEEP	3-10M E.W. BOT
CP1	10" X 10"	4-10M VERTS
STRIP FOOTING SCHEDULE		
MARK	SIZE	REINFORCING
SF1	400 WIDE x 250 DEEP x CONT.	2-15M CONT.



1 FOUNDATION PLAN  
S2.01 1/4"=1'-0"

No.	Revision	Date	By

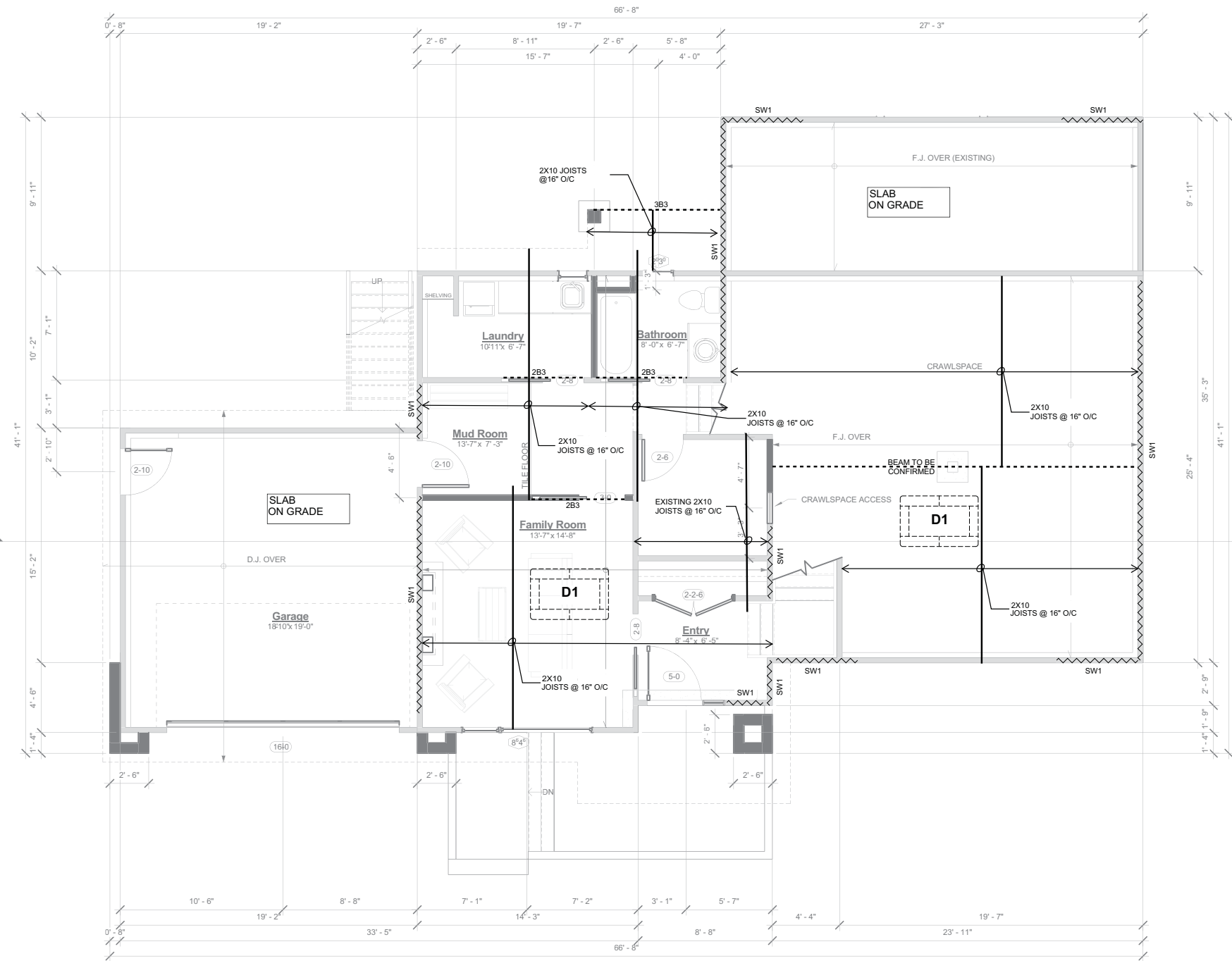
Project Name

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FOUNDATION PLAN

Sheet Number Revision

S2.01



**2**  
S2.02  
BASEMENT FLOOR FRAMING SHOWING UPPER FRAMING OVER  
14'-1'-0"

WOOD FRAME SHEAR WALL SCHEDULE														
MARK	SIZE	LEGEND	LEVEL	NOTES										
SW1	3" @ 4" O.C.	NAILING TO BLOCKING/TRUSS	ROOF	<p>1. SHEAR WALLS SHOWN ON PLAN AS THIS: LINE O.S. OF WALL DESIGNATES PREFERRED SIDE TO ATTACH SHEATHING.</p> <p>2. DO NOT USE P-NAILS OR SPIRAL NAILS IN SHEAR WALLS. NAILS SHALL BE COMMON WIRE NAILS OR POWER DRIVEN NAILS THAT ARE EQUIVALENT TO THE COMMON NAIL SIZES BELOW:</p> <table border="1"> <thead> <tr> <th colspan="2">COMMON NAIL SIZES</th> </tr> <tr> <th>LENGTH</th> <th>DIAMETER</th> </tr> </thead> <tbody> <tr> <td>2 1/2"</td> <td>0.131"</td> </tr> <tr> <td>3"</td> <td>0.148"</td> </tr> <tr> <td>3 1/2"</td> <td>0.162"</td> </tr> </tbody> </table> <p>3. FOR SHEAR WALLS, BLOCKING OF EXTERIOR WALLS MAY INTERFERE WITH VENTILATION. IN THIS CASE, USE 2 X 4 ON THE FLAT BLOCKING OR 2 X 3 BLOCKING.</p> <p>4. NAILING SHOWN ON SCHEDULE APPLIES TO ALL FREE EDGES OF SHEATHING PANELS. PROVIDE NAILS @ 12" O.C. ALONG INTERMEDIATE SUPPORTS.</p>	COMMON NAIL SIZES		LENGTH	DIAMETER	2 1/2"	0.131"	3"	0.148"	3 1/2"	0.162"
COMMON NAIL SIZES														
LENGTH	DIAMETER													
2 1/2"	0.131"													
3"	0.148"													
3 1/2"	0.162"													
A35 @ 24" 1/2" PLY O.S. 2-1/2" @ 4" 2 STUDS 1-MST48 1-ROW @ 5"		SHEAR CLIPS T.O.W. SHEATHING NAILING END POSTS HOLD-DOWN(EACH END) SILL NAILS	UPPER FLOOR											
A35 @ 16" 1/2" PLY O.S. 2-1/2" @ 3" 3 STUDS SIMPSON HDU8 5/8" @ 16"		SHEAR CLIPS T.O.W. SHEATHING NAILING END POSTS HOLD-DOWN SILL BOLTS	MAIN FLOOR											
			LOWER FLOOR											

DECKING SCHEDULE	
MARK	TYPE
D1	38mm CONCRETE ON 16mm PLY
D2	16mm T&G PLY

WOOD FRAME SCHEDULE			
WOOD JOIST SCHEDULE			
DIMENSIONAL LUMBER JOISTS			
MARK	SIZE	TYPE	SPACING
J1	2" x 6"	SL	SEE PLAN
J2	2" x 8"	SL	SEE PLAN
J3	2" x 10"	SL	SEE PLAN
J4	2" x 12"	SL	SEE PLAN

ENGINEERED I-JOIST			
MARK	SIZE	TYPE	SPACING
TJ1	302 DEEP	I-JOIST	SEE PLAN

WOOD BEAM SCHEDULE					
MARK	SIZE	TYPE	MARK	SIZE	TYPE
B1	2" x 6"	SL	B5	1-3/4" x 9-1/2"	LVL
B2	2" x 8"	SL	B6	1-3/4" x 11-7/8"	LVL
B3	2" x 10"	SL			
B4	2" x 12"	SL			

WOOD POST SCHEDULE		
MARK	SIZE	TYPE
P1	2" x 4"	SL
P2	2" x 6"	SL
P3	4" x 4"	SL
P4	6" x 6"	SL

- NOTES:**
- FLOOR OR ROOF FRAMING SHOWN ON THIS PLAN IS FOR THE LEVEL ABOVE. DOOR AND WINDOW HEADERS SHOWN ARE OVER THE DOOR AND WINDOW AT THIS LEVEL.
  - SEE PLAN FOR NUMBER OF LAMINATIONS REQUIRED. EXAMPLE: 3B1 = 3 - 2" x 6" MEMBERS
  - ABBREVIATIONS:  
SL --- SAWN LUMBER  
PSL --- PARALLEL STRAND LUMBER  
LSL --- LAMINATED STRAND LUMBER  
LVL --- LAMINATED VENEER LUMBER

No.	Revision	Date	By

Project Name

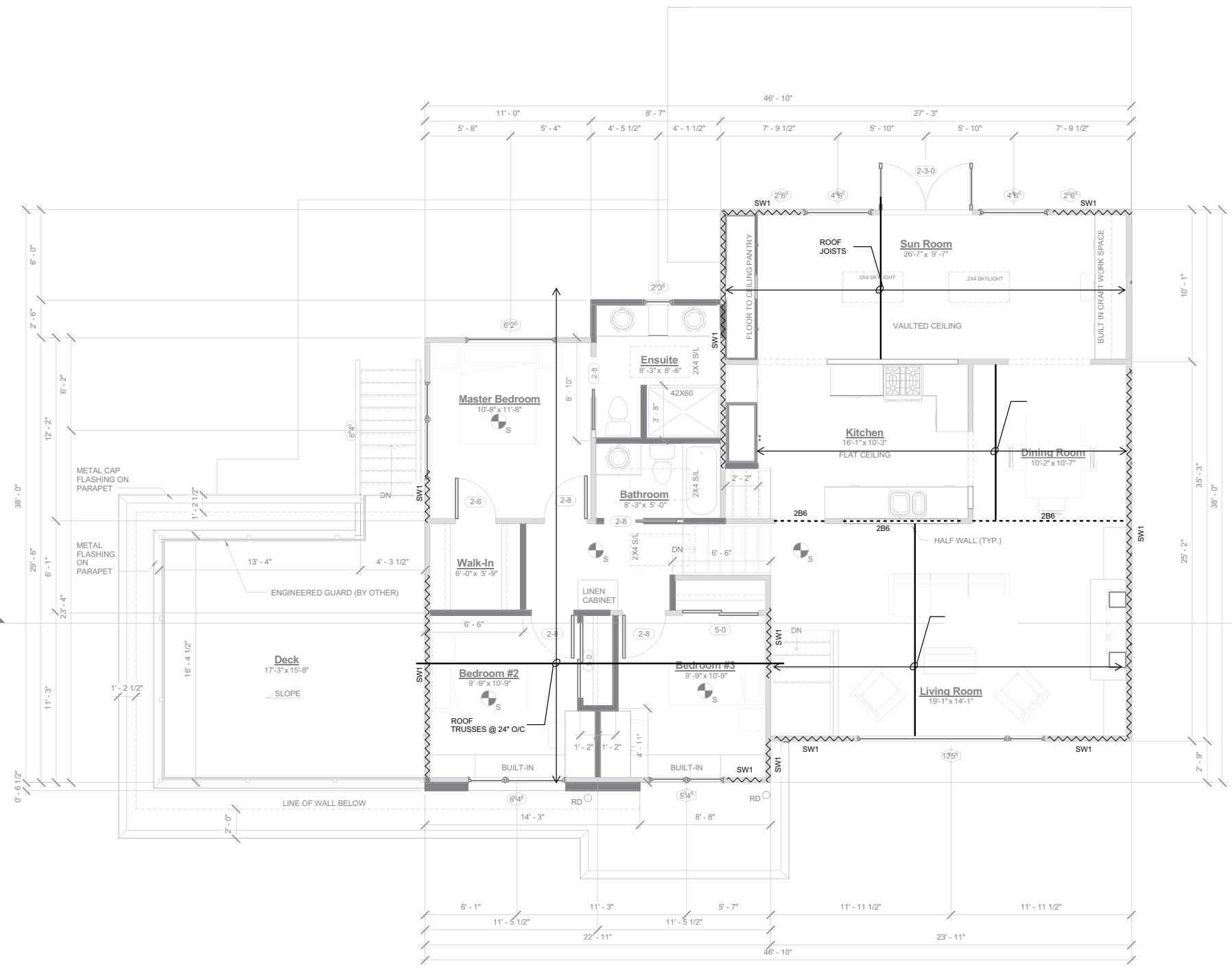
Sheet Title

**BASEMENT FLOOR PLAN  
SHOWING MAIN FLOOR  
FRAMING OVER**

Sheet Number

Revision

**S2.02**



1  
S2.03 1/4"=1'-0"  
UPPER FLOOR FRAMING SHOWING ROOF FRAMING OVER

WOOD FRAME SCHEDULE					
WOOD JOIST SCHEDULE					
DIMENSIONAL LUMBER JOISTS					
MARK	SIZE	TYPE	SPACING		
J1	2" x 6"	SL	SEE PLAN		
J2	2" x 8"	SL	SEE PLAN		
J3	2" x 10"	SL	SEE PLAN		
J4	2" x 12"	SL	SEE PLAN		
ENGINEERED I-JOIST					
MARK	SIZE	TYPE	SPACING		
TJ1	302 DEEP	I-JOIST	SEE PLAN		
WOOD BEAM SCHEDULE					
MARK	SIZE	TYPE	MARK	SIZE	TYPE
B1	2" x 6"	SL	B5	1-3/4" x 9-1/2"	LVL
B2	2" x 8"	SL	B6	1-3/4" x 11-7/8"	LVL
B3	2" x 10"	SL			
B4	2" x 12"	SL			
WOOD POST SCHEDULE					
MARK	SIZE	TYPE			
P1	2" x 4"	SL			
P2	2" x 6"	SL			
P3	4" x 4"	SL			
P4	6" x 6"	SL			
NOTES:					
1. FLOOR OR ROOF FRAMING SHOWN ON THIS PLAN IS FOR THE LEVEL ABOVE. DOOR AND WINDOW HEADERS SHOWN ARE OVER THE DOOR AND WINDOW AT THIS LEVEL.					
2. SEE PLAN FOR NUMBER OF LAMINATIONS REQUIRED. EXAMPLE: 3B1 = 3 - 2" x 6" MEMBERS					
3. ABBREVIATIONS: SL --- SAWN LUMBER      LSL --- LAMINATED STRAND LUMBER PSL --- PARALLEL STRAND LUMBER      LVL --- LAMINATED VENEER LUMBER					

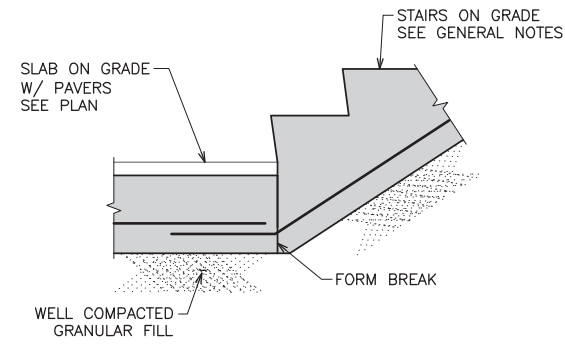
No.	Revision	Date	By

Project Name

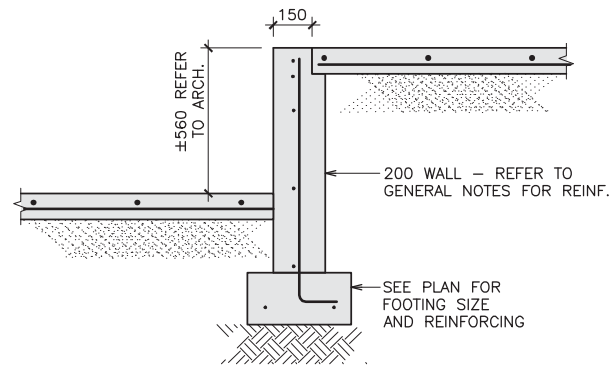
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**BASEMENT FLOOR PLAN  
SHOWING MAIN FLOOR  
FRAMING OVER**

Sheet Number      Revision

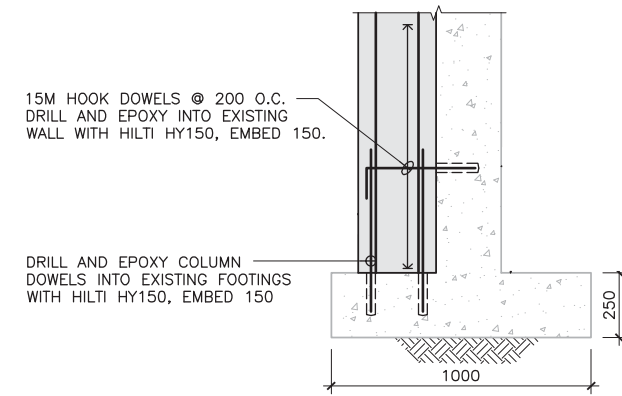
**S2.03**



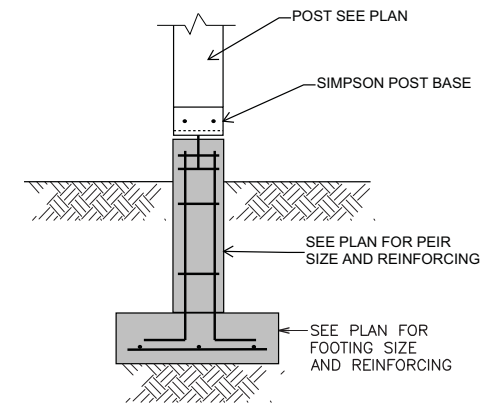
3  
S3.01 NTS  
**STAIR TRANSITION DETAIL**



2  
S3.01 NTS  
**TYPICAL STRIP FOOTING**



1  
S3.01 NTS  
**SUPPORT WALL FOR STONE VENEER**



4  
S3.01 NTS  
**FOOTING DETAIL**

No.	Revision	Date	By
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Project Name

Sheet Title

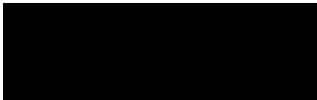
**DETAILS**

Sheet Number Revision

**S3.01**

## APPENDIX C – LIST OF PULL-OUT COSTS

This list of pull-out costs was created by RJC during the design and construction of the case-study residence and adapted for use in this report [11].



Actual Costs					
Project: [REDACTED]					
Item	Description	\$ Est. Cost/unit	Number of units	Estimated Subtotal	Final Paid Total
ATT Electrical	Temporary construction power and permit fee				\$470.00
Horizon	Install power pole & meter				\$1,900.00
Horizon / BC Hydro	Electrical service routed to new pole				\$320.00
BC Hydro	Upgrade to 200 amp service				\$520.00
Fortis	Natural gas service and meter install				\$120.00
Bin There Dump That	Bin/dumpster services				\$4,400.00
Victoria Truss	Trusses				\$4,300.00
Colonial Railings	Supply and install exterior glass deck rails				\$5,700.00
Garage Door Depot	Supply and install garage door				\$6,000.00
Convoy	Supply new sky lights (5)				\$1,700.00
The Ensuite	Kitchen faucet (Kohler)				\$270.00
Andrew Sheret	American Standard Toilets (smooth sides - hidden trap)	\$310.00	3	\$930.00	
Andrew Sheret	Hans Grohe bathroom sink faucets	\$150.00	5	\$750.00	
Andrew Sheret	Kitchen sink (30" Blanco apron front)			\$885.00	
Andrew Sheret	Delta shower trims and hand helds (3)			\$1,100.00	
Andrew Sheret	Tub spouts	\$45.00	2	\$90.00	
Arnold's Plumbing	Rough-in plumbing and various fixtures (tubs, valves, h/w tank)				\$20,500.00
Arnold's Plumbing	Andrew Sheret invoices to Arnold's Plumbing (paid indirectly)				
Home Depot	Glass tub shields (2)				\$780.00
ATT Electrical	All electrical: Interior & Exterior (Rough and finish and recessed light fixtures)				\$23,900.00
Grohovac	New security system (hard wire only)				\$430.00
Four Seasons	Sheet metal: Duct work				\$4,700.00
Four Seasons	New furnace				\$5,500.00
Four Seasons	New gas fireplace				\$6,300.00
Four Seasons	New electric fireplace				\$2,000.00
Home Depot	Kitchen Cabinets (Thomasville, Anson, Gypsum White)				\$10,000.00
Home Depot	Office Cabinets (Match kitchen)				
Lumberworld	Cabinet door pulls				\$160.00
Tyndal Distributors	Kitchen granite countertops				\$5,500.00
Tyndal Distributors	Office laminate countertop				\$850.00
Costco	Closet organizers and pantry shelving				\$1,500.00
Home Depot Appliances	All appliances				\$10,000.00
Home Depot Doors	Pantry doors, closet doors, metal door at interior garage wall				\$3,000.00
Rona	Door handles (levers and for pocket doors)				\$300.00
Ikea	Bathroom cabinets, sinks, shelves, mirrors, etc.				\$2,500.00
Cypress Cove	Interior finishing carpentry				\$5,000.00
Windsor Plywood	11 doors:4 pocket doors, 3 solid, 4 glass panel				\$2,700.00
Windsor Plywood	Trim materials				\$2,800.00
Coastal Painting	Interior painting				\$10,000.00
Fuzzy Wuzzy	Laminate flooring on main floor and stairs				\$9,500.00
Fuzzy Wuzzy	Bedroom carpeting				\$4,200.00
Fuzzy Wuzzy	Laundry room and utility room linoleum				\$600.00
Fuzzy Wuzzy	Rec room carpet squares				\$700.00



<b>Tile Town</b>	Tile for entry, mudroom and bathrooms				\$2,600.00
<b>Home Depot</b>	Fireplace tile				\$390.00
<b>Costco</b>	Kitchen backsplash tile				\$380.00
<b>Van's Tile</b>	Tile install, Kerdi system install, heated flooring install, etc.				\$6,350.00
<b>Van's Tile</b>	Supplies from Pacific Rim				\$3,540.00
<b>Costco</b>	LED lights: Stairs & art nook				\$360.00
<b>Costco</b>	TV wall supports				\$300.00
<b>Budget Blinds</b>	Blinds installed (9 blinds on 4 windows)				\$2,800.00
<b>Rona</b>	Misc lighting fixtures and bulbs				\$600.00
<b>Builders Choice</b>	Supply and install interior glass deck rails, and glass shower				\$6,000.00
<b>Access Loader</b>	Front yard scrape/level and bark mulch				\$900.00
<b>Totals</b>					<b>\$ 183,340.00</b>

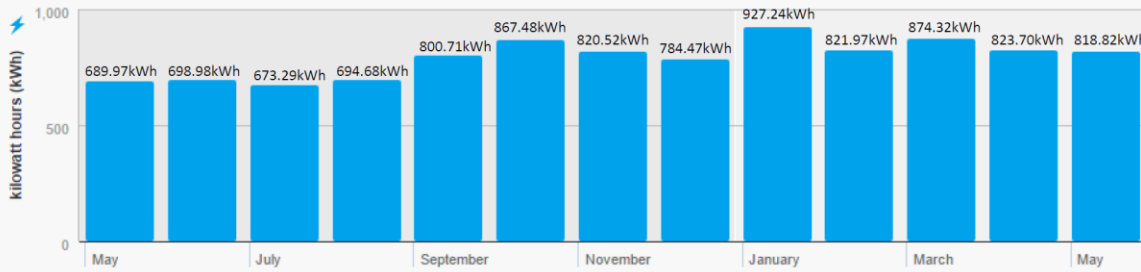
## APPENDIX D – ENERGY DATA FROM SUPPLIERS

The energy data in this Appendix was compiled from the Energy data obtained for the residence from BC-Hydro and Fortis, BC.

## BC Hydro Data

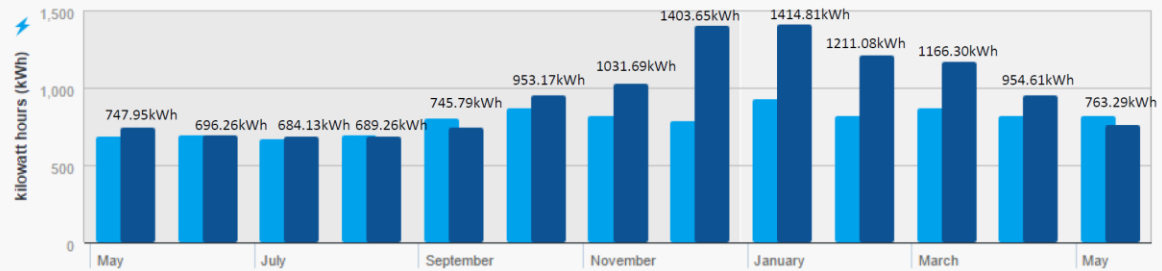
Monthly consumption for May 2016 – May 2017

Note: Hot water tank, oven, and clothes dryer have the highest draws of electrical consumption. In the summer, prefer to hang clothes outside to dry.



Monthly consumption for May 2016 – May 2017

kWh of Similar Homes Nearby



Monthly consumption for May 2016 – May 2017

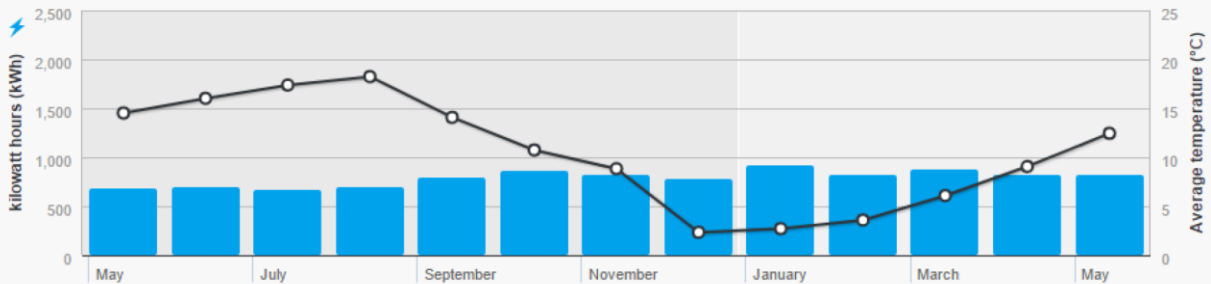
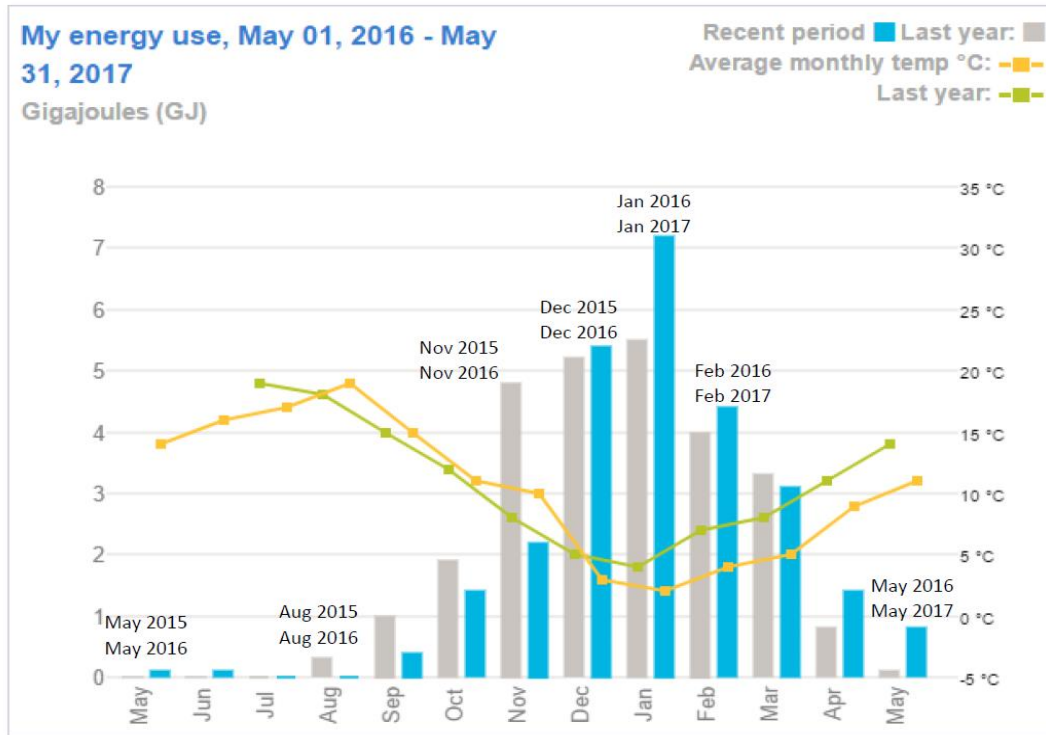


FIGURE 49 - BC HYDRO DATA FIGURES [21]

## Fortis BC Data



May 2015: 0 GJ	May 2016: 0.1 GJ
June 2015: 0 GJ	June 2016: 0.1 GJ
July 2015: 0 GJ	July 2016: 0 GJ
Aug 2015: 0.3 GJ	Aug 2016: 0 GJ
Sept 2015: 1 GJ	Sept 2016: 0.4 GJ
Oct 2015: 1.9 GJ	Oct 2016: 1.4 GJ
Nov 2015: 4.8 GJ	Nov 2016: 2.2 GJ
Dec 2015: 5.2 GJ	Dec 2016: 5.4 GJ
Jan 2016: 5.5 GJ	Jan 2017: 7.2 GJ
Feb 2016: 4 GJ	Feb 2017: 4.4 GJ
Mar 2016: 3.3 GJ	Mar 2017: 3.1 GJ
Apr 2016: 0.8 GJ	Apr 2017: 1.4 GJ
May 2016: 0.1 GJ	May 2017: 0.8 GJ

- Appliances using gas:

  - Gas Furnace
  - Gas Fireplace
  - Gas Cooktop

FIGURE 50 - FORTIS BC DATA [22]