

# Niagara Falls Exchange - Studio Building

## Project Scope

### Background and Scope

The Niagara Falls Exchange is a multi-cultural hub that consists of a Market Hall and a Studio Building. The Exchange has a major focus on art, creativity, and sustainability and contains artist studios, a workshop, a café, and a gallery.

The scope for this project is to complete the total structural design of the Studio Building (13,950 ft<sup>2</sup>).

### Constraints

The Studio Building has multiple open spaces on each floor which cannot be impeded by columns or other structural elements. The Building also contains a large percentage of glazing around the ground floor, limiting allowable deflection of elements.

### Unique Features (refer to model)

(1) The Studio Building has a concrete canopy which wraps around the West and North sides of the building.

(2) The sawtooth roof is a unique feature which has implications on loading and constructibility.



Architectural Rendering of the Studio Building

## Design Process

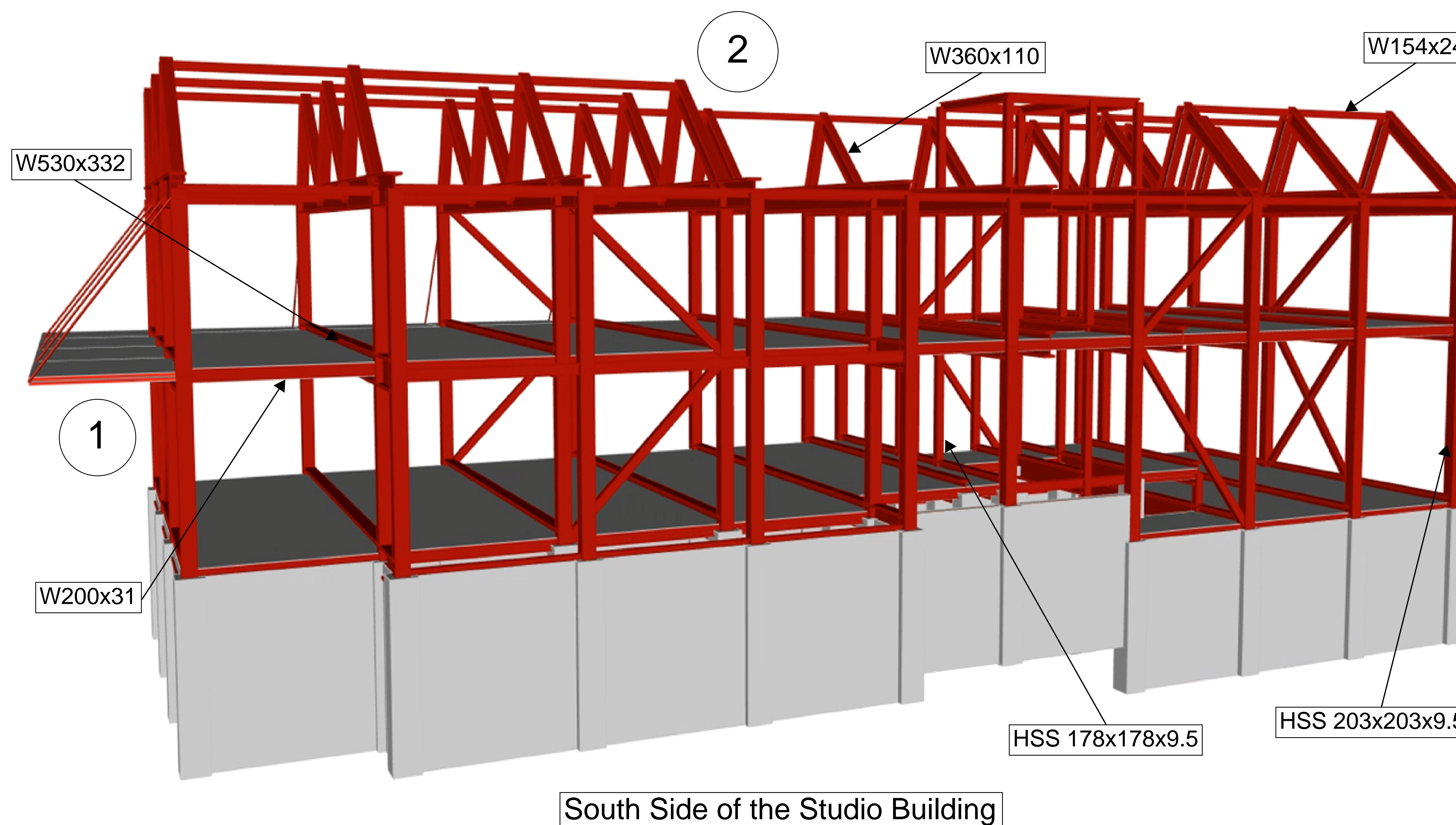
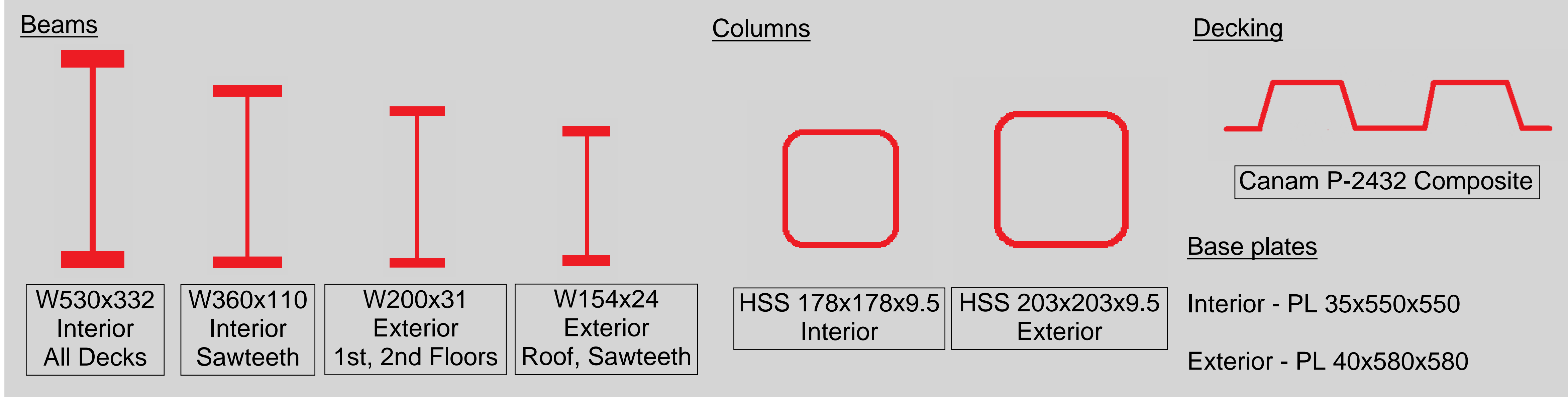
### Options Analysis

Three structural materials were considered for this design: steel, concrete, and timber. Timber was decided against due to the Group's lack of familiarity with its structural properties. Concrete was considered for shear walls, but challenges arose with openings in the walls. Thus, the structure is a primarily steel structure, with a steel lateral load resisting system, and concrete foundation elements.

### Process

1. Calculate all gravity and lateral design loads.
2. Complete an options analysis
3. Generate a member layout/schematics
4. Design steel columns and beams
5. Design foundations (footings, walls)
6. Design connections
7. Model and analyze structure in SAP2000
8. Design the lateral load resisting systems
9. Complete a Class A cost estimate
10. Generate a set of structural drawings of all designed elements.

## Steel Elements



South Side of the Studio Building

## Concrete Elements

### Square Spread Footings

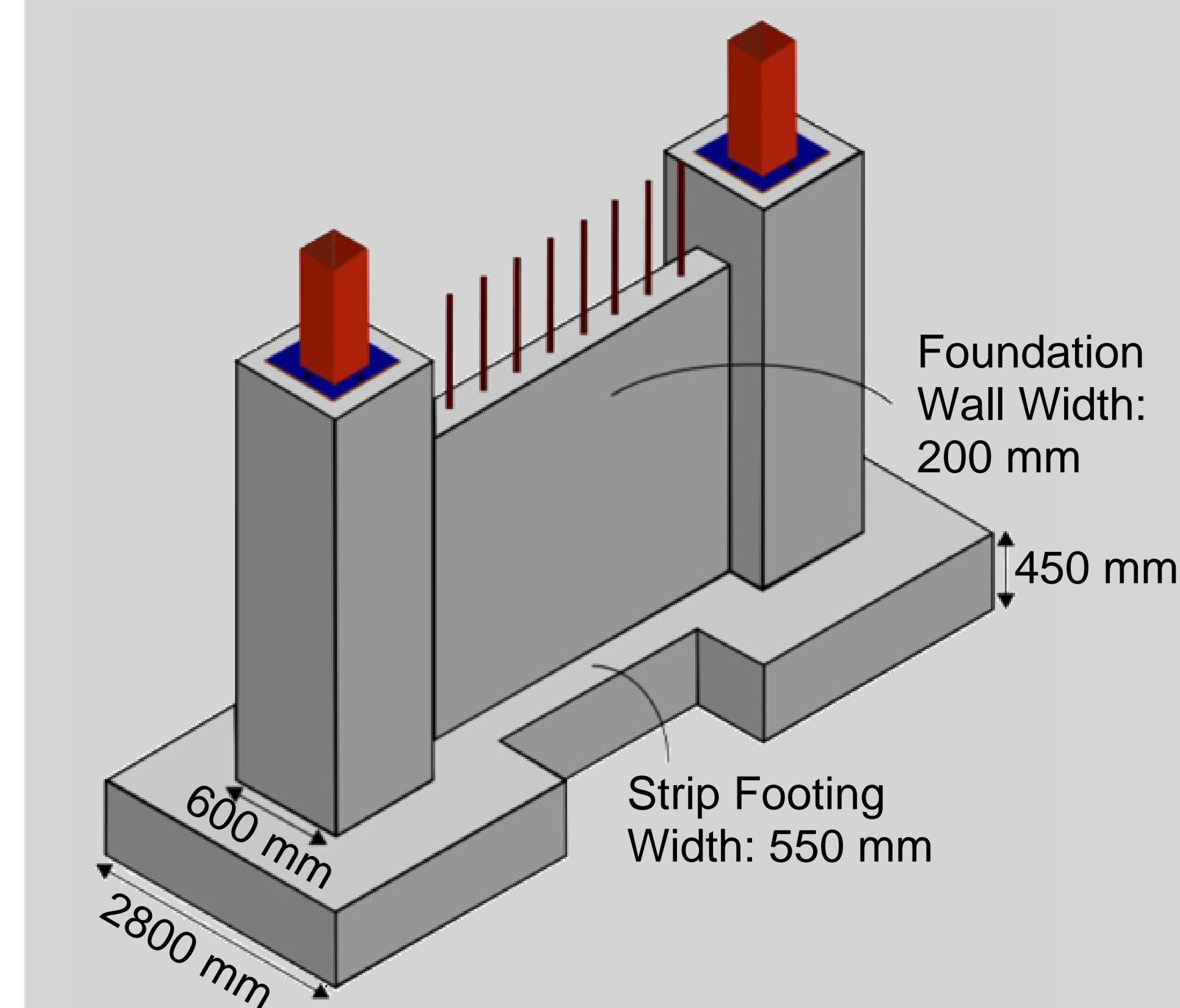
Interior	Exterior
2300 mm x 450 mm	2800 mm x 450 mm
11-15M@210 mm	14-15M@200 mm

### Strip Footings

550 mm x 450 mm  
Flexural Reinforcing: 500 mm<sup>2</sup>/m  
Longitudinal Reinforcing: 1-10M @ center of footing

### Foundation Walls

Height: 3.6 m  
Thickness: 200 mm  
9-15M@110 mm (vertical) per meter length of wall  
8-15M@450 mm (horizontal) throughout height of wall

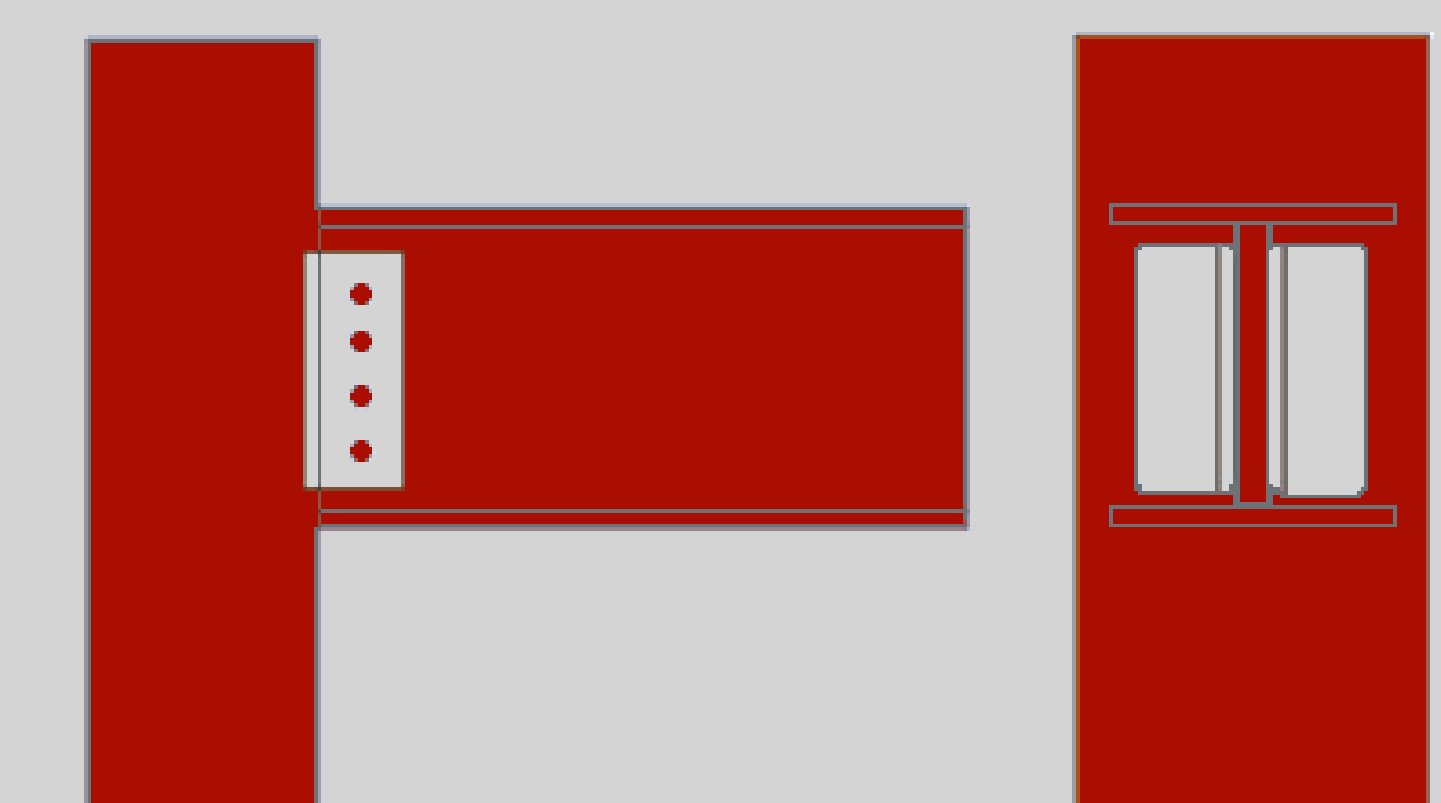


Exterior Columns, Footings, and Foundation Wall

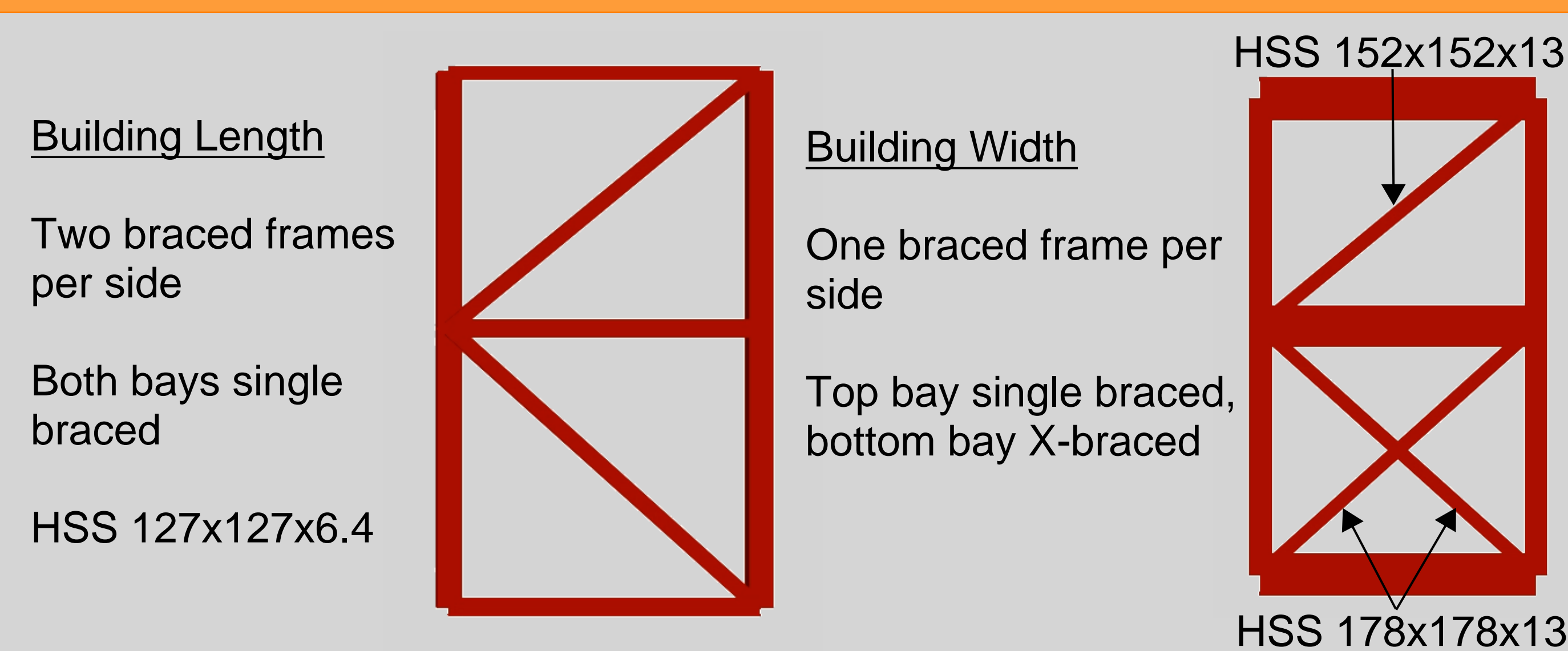
## Connections and Details

Six unique connections designed for the structure. Pictured below:

*Interior Beam Connected to Exterior Column*  
L 102x102x19  
4-M20 bolts (connecting angles to beam)  
8 mm fillet welds (connecting angles to column)



## Bracing Design



## Class A Cost Estimate

A Class A cost estimate was performed for the Niagara Falls Exchange Studio Building using current market prices in Ontario.

The contingencies required for a Class A cost estimate are 10%. The total cost estimate for the Niagara Falls Exchange Studio Building structure is approximately \$2.8 million.