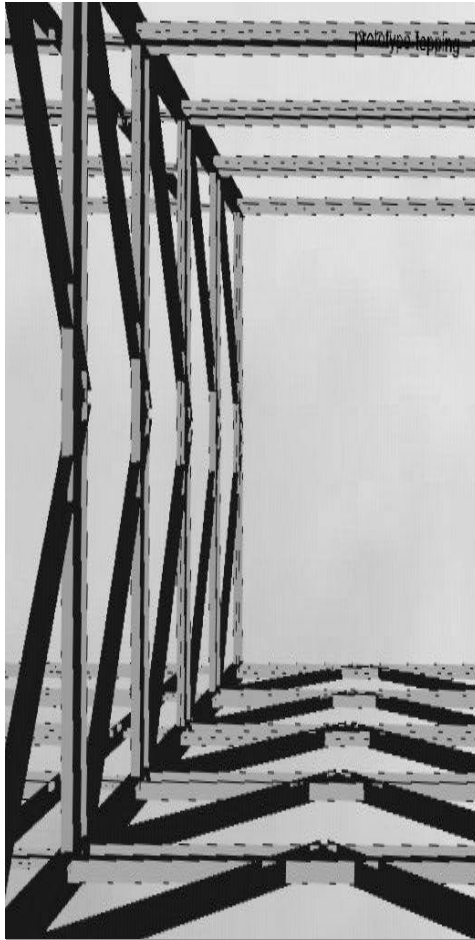
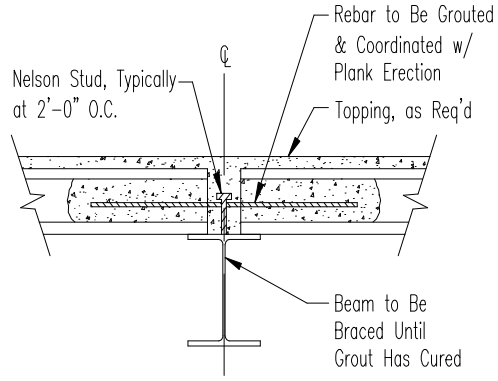


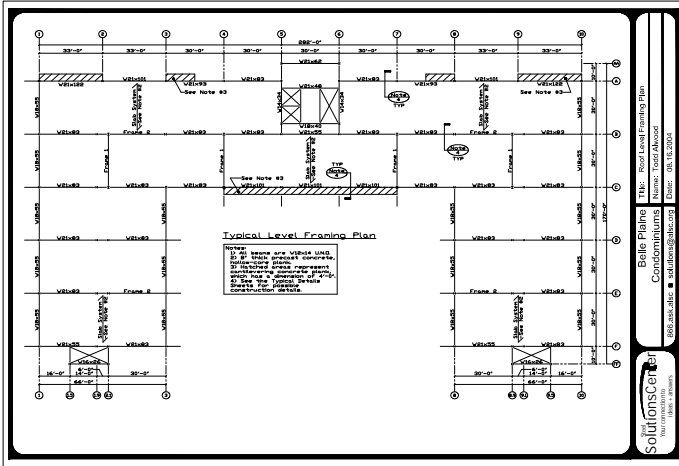
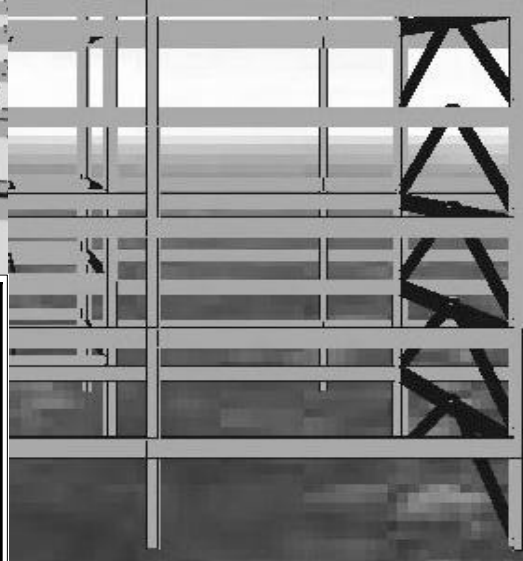
# Multi-Story



Plank Movement, and Beam's Top Flange Will Still Be Braced. Clearing and Clearance Dimensions for all Details.



INTERIOR BEARING - 2



NOT FOR CONSTRUCTION

<b>Belle Plaine Condominiums</b> <small>solutions@aisc.org</small>	Title: Typical Details for Interior Brg
	Name: Todd Alwood
	Date: 08.16.2004

# Residential Prototype II

## What's this?

This package tells the story of a fictitious project with an imaginary client and illustrates the type of inquiry that the AISC Steel Solutions Center (SSC) often receives. In this case, a Conceptual Solution is prepared for the client, which is then delivered with the continuing support of the SSC, the AISC Regional Engineer, and a local steel fabricator. As a team, AISC and its member fabricators commit to developing efficient, economical solutions in steel and providing continuous support for the life of the project. To best understand, let's look at an overview of the process and then experience the story of the Belle Plaine Condominiums.

## Project Inquiries:

Projects find their way to the SSC in a number of ways. Common scenarios include:

- An owner or architect is developing the concepts for a new project and is interested in determining the advantages available by using a structural steel framing system and contacts the SSC
- A project is over-budget in concrete, and a steel alternate is suggested. The architect, engineer, general contractor, or owner contacts a local steel fabricator for assistance who in turn contacts either the SSC or the AISC Regional Engineer for assist
- A fabricator or regional engineer hears of a new project in the early stages of development and contacts the owner or project architect to discuss similar steel projects and scenarios that could bring the advantages of steel to this project

## Developing a Solution:

The AISC team and client work together, often through conference calls, to determine what can be done to move the project toward steel. The SSC is involved in providing a wide range of solutions including a simple bay study, lateral system analysis, or foundation comparisons. There is no fee associated with these services other than the commitment from the project decision maker to seriously evaluate the alternatives and to reach an objective conclusion.

## What do I have here??

This prototype is one example of a Conceptual Solution the SSC can provide and is the highest level of response and involvement. Often, because it is representative of many steel, multi-story residential structures, SSC clients have found reviewing this level of prototype alone can convey the approach and benefits of utilizing a structural steel system and have moved forward in design.

Since our beginnings in 2001, the SSC has been involved in a broad range of projects...multi-story residential structures, parking decks, office buildings. Whether high, medium, or low rise we will help you identify an innovative solution for your project.

**And now to the story of the Belle Plaine Condominiums...**



866.ask.aisc ■ solutions@aisc.org

# The Multi-Story Residential Prototype II

Prepared by: AISC Steel Solutions Center

## The Belle Plaine Condominiums:

Roger Johnson of William Development, Inc. has decided to move forward with a new condominium project in Lakeview, Georgia and contacts an architect and general contractor whom has worked with him on other residential projects. In the past, a traditional concrete two-way, flat-slab system was used, but Roger recently became aware of several new steel, multi-story residential projects that have saved owners several dollars per square foot and been completed earlier than comparable concrete projects. He asks both his architect and general contractor to develop preliminary conceptual plans and pricing for both structural steel and concrete alternatives.

## HELP!

The architect and general contractor are both familiar with the concrete layout and pricing, but are unsure how to approach in steel. The G.C. calls a local steel fabricator, Ron Phillips with AAARF Steel located outside Atlanta for guidance on approaching this project in steel. Ron explains that as a member of the American Institute of Steel Construction he has access to the Steel Solutions Center (SSC) and the AISC Regional Engineer in his area, Dave Magee. As a team, they will look at the project on a confidential basis, and then meet with the G.C., architect and developer to discuss their approach and benefits structural steel will add. Within a day, Ron receives the schematic design drawings and has a conversation with the G.C. where he determines:

- The developer wishes for an upscale development with 9'-0" ceiling heights and open, flexible condominium spaces for their clients
- Due to local zoning requirements for building heights, the floor-to-floor heights will be limited to 10'-0"
- The architect is concerned about fire-proofing complications with such a limited space between the ceiling and finished floor
- Project schedule needs to be rapid and aggressive
- Preliminary geotechnical investigations have identified poor soil

## Engaging the Resources!!

Ron calls his AISC Regional Engineer, Dave Magee and explains the development, and Dave suggests involving the SSC staff. A conference call is arranged between Ron, Dave and a SSC advisor to qualify, discuss, and highlight the key issues with William Development's concerns, and the need to demonstrate structural steel's constructability, cost, and schedule highlighted. With the G.C.'s permission, a copy of the schematic drawings is sent to the SSC. **After looking at the schematic design (see attached sheet A-1.3), the SSC has ideas other than a traditional concrete solution!**

The team agrees a full Conceptual Solution will be developed for this project. The preliminary structural design and framing layouts will enable the fabricator to address the general contractor's and architect's perceptions of steel for use in residential projects. In addition, Ron will use the conceptual solution to develop cost and schedule estimates to share with the project team.



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# The Multi-Story Residential Prototype II

Prepared by: AISC Steel Solutions Center

Through a series of discussions, the “In-Wall Beam System”, utilizing a combination of steel girders and pre-cast plank, is the most advantageous steel approach. It provides low floor-to-floor height by spanning plank the width of the condominiums and enclosing girders within the demising walls, which will address the fireproofing requirements without increasing building height. This system provides schedule advantages by erecting both frame and slab together without having to cast and cure traditional concrete, plus this much lighter system will also decrease foundation loads and costs.

### **Delivering the Message!**

With the Conceptual Solution firmly in grasp, Ron produces a preliminary takeoff and schedule from the framing plans including tonnage figures and a piece list. With the assistance of Dave Magee, he organizes a meeting with the general contractor and architect to present his findings, which include:

- Reductions in construction costs for overall framing system
- Lower soft costs and earlier revenue generation due to decreased schedule
- Lighter framing system resulting in foundation savings
- Satisfaction of floor-to-ceiling height while meeting overall height restrictions
- Design openness and flexibility within individual condominium layout

The general contractor and architect are extremely impressed and surprised that structural steel provides such structural efficiency and competitive advantage within the multi-story residential market. Equipped with this information they invite both Ron and Dave to attend a meeting with the developer, where the project solutions are discussed and evaluated in detail. The developer voices his agreement – **“steel is the material of choice for my project!”**

### **Postscript:**

Yes, this is just a fictional account. But what happened in this story is being repeated on a daily basis. Project decision makers are reaching out to local fabricators, AISC regional engineers, or directly to the SSC for new ideas to solve their project challenges. The SSC is providing tools for local fabricators to assist local general contractors and architects in evaluating steel systems, while helping prepare those same architects and general contractors to effectively communicate the benefits of steel to their clients, the developers. The SSC provides a win-win for everyone involved.

### **What should you do next?**

Take a few minutes and examine the attached prototype - The Conceptual Solution for the Belle Plaine Condominium. Ask yourself if this system might be beneficial for your next project. And when you start to approach your next project, contact your local steel fabricator, AISC Regional Engineer, or call/e-mail the SSC directly to discuss why steel should be the material of choice for your next project.



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## The Multi-Story Residential Prototype II

Prepared by: AISC Steel Solutions Center

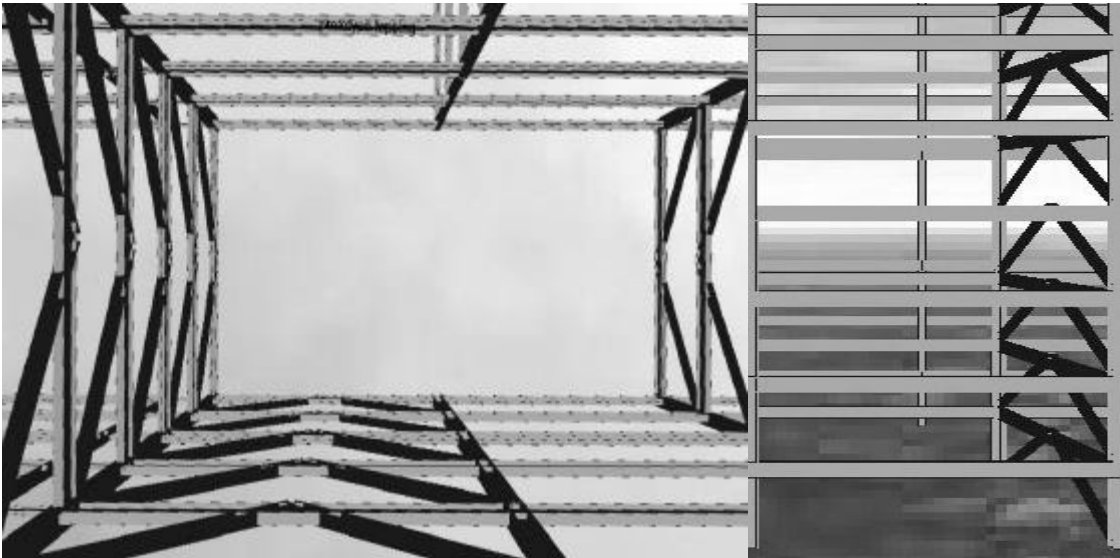


# Conceptual Solution: Belle Plaine Condominiums

Prepared by: Todd Alwood

Regional Engineer: Dave Magee

Date 12.10.2004



## This Package includes:

- Comments on the Provided Solution
- Loading Criteria
- Tonnage Takeoff
- Fire Proofing Comments
- Fire Proofing Implimentation
- Column Comparison
- Typical Wall Configurations
- Typical Level Framing Plan
- Roof Framing Plan
- Column Layout Plan
- Column Schedule
- Frame Elevation
- Typical Construction Details



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## Comments on Conceptual Solution

Project: **Belle Plaine Condominiums**  
Location: **Lakeview, Georgia**  
Company: **AAARF Steel, Inc.**

Date: **12/10/2004**  
Engineer: **Todd Alwood**  
Contact: **Ron Philips**

The structural system for the Belle Plaine Condominium Project located, in Lakeview, Georgia, is composed of the steel super-structure whose quantities and geometry are defined through the preliminary framing plans, column schedule, lateral elevations, and tonnage/piece takeoffs.

This project was based upon parameters defined through architectural drawings and project criteria received on November 29, 2004:

- 1) Reviewing your needs, we decided an In-Wall Beam system would be best. This system uses girders, enclosed within the demising walls, and then plank spans between to offer open, flexible spaces. Dave Magee will elaborate upon this system, and why it is the most economical and advantageous for your building.
- 2) The lateral system uses braced frames, which are labeled on the framing plans with member sizes shown on the lateral elevation.
- 3) An 8" thick precast concrete plank with 1" of non-structural topping is used on all residential levels, and the roof level uses only plank without topping. In addition, 8,000 Nelson studs are used and typically spaced at 2'-0" (O.C.) on all steel beams.
- 4) The topping mentioned above is due to the balcony configurations of the floor plate. At all balcony locations, the topping tapers to provide slope for drainage and exterior waterproofing. A non-structural topping can also be useful for leveling plank surfaces with differing cambers, and a structural topping can provide additional reinforcement for transferring diaphragm forces.
- 5) Floor-to-Floor Height is presumed to be 10'-0" for all levels, and Floor-to-Ceiling Height is 9'-4" (does not include a finished ceiling).
- 6) Walls enclosing lateral frames are larger than typical demising wall, but all column enclosures are smaller than typical concrete columns. See Column Comparison and Wall Configuration Sheets.
- 7) According to industry standards, girders supporting plank are to be shored at third points, confirmed by the Engineer of Record, until the final grouting has cured. The shoring reduces the construction moment and accounts for the beam's unbraced top flange.
- 8) **Results for the building are 792 tons at 6.50 PSF for the 242,400 SF structure with 1,073 pieces of steel.**



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Project: **Belle Plaine Condominiums**  
Location: **Lakeview, Georgia**  
Company: **AAARF Steel, Inc.**

Date: **12/10/2004**  
Engineer: **Todd Alwood**  
Contact: **Ron Philips**

## Loading Parameters per IBC 2003-

### Superimposed Dead Load-

Residential/Balconies:	73 psf (plank + 1" of topping)
Roof :	75 psf (plank + 15 psf Roofing)
Façade:	750 plf

### Live Load-

Corridors:	100 psf
Residential:	40 psf + 20 psf (Partition)
Balconies:	100 psf
Roof:	30 psf

### Basic Wind Speed:

90 mph

### Seismic Parameters:

S <sub>1</sub>	11 % of g
S <sub>s</sub>	25 % of g
R	3 (which requires no seismic detailing)



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# TONNAGE & PIECE TAKEOFF SHEET

Project: **Belle Plaine Condominiums**  
 Location: **Lakeview, Georgia**  
 Company: **AAARF Steel, Inc.**

Date: **12/10/2004**  
 Engineer: **Todd Alwood**  
 Contact: **Ron Philips**

**The following quantity estimate is based on a building area of 242,400 ft<sup>2</sup>:**

Columns (gravity)	118 tons	0.97 psf	208 pieces
Beams (gravity)	488 tons	4.03 psf	617 pieces
Columns (lateral)	63 tons	0.52 psf	56 pieces
Beams (lateral)	71 tons	0.59 psf	64 pieces
Braces (lateral)	52 tons	0.43 psf	128 pieces
<b>TOTAL</b>	<b>792 tons</b>	<b>6.5 psf</b>	<b>1073 pieces</b>

Total quantity of Nelson Studs = 8,000 Studs

\* The quantities are based on centerline dimensions

\*\*Miscellaneous steel is not included in the above-mentioned total tonnage. Miscellaneous steel includes such items as: framing for openings, connection material, slab edge material, screen walls, base plates, and architectural elements (i.e. façade attachments, stairs, lintels, etc.).



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# FIRE PROOFING COMMENTS

Project: **Belle Plaine Condominiums**  
Location: **Lakeview, Georgia**  
Company: **AAARF Steel, Inc.**

Date: **12/10/2004**  
Engineer: **Todd Alwood**  
Contact: **Ron Philips**

Fireproofing concerns were initially raised with the possibility of a steel structure, and additional review of these issues were desired. The information contained below highlight several key issues:

1) What is the fire rating for this building? Although the code can be very complicated, this description will be somewhat simple in explanation\*. One begins with IBC 2003 by determining the building's Use Group according to Section 3; then selecting the Construction Type located in Table 503; and finally, finding it's fire rating found in Table 601, as follows:

A) According to *Section 310.1*, Group R-2 is a residential occupancy containing two or more units where the occupants are primarily permanent in nature, which describes this project.

B) According to *Table 503*, our construction is Type IB, which states that the tabulated allowable height and area is permitted to be 11 levels w/ Unlimited SF (our project is only 8 levels w/ 33,300 SF, therefore we comply).\*

C) According to *Table 601*, Type IB Construction Fire Resistance Rating for building elements are required to be:

Structural Frames:	2 hours
Floor:	2 hours
Roof:	1 hours

D) According to *Section 708-Fire Partitions*, walls separating dwelling units (i.e. demising walls) in the same building (708.1, Paragraph 1) shall have a fire-resistance rating of 1 hour (708.3).

2) Are sprinklers required? According to *Section 903.2.7-Group R*, an automatic sprinkler system shall be provided throughout all buildings with a Group R rating. In addition, this system shall be designed and installed according to *Section 903.3.1.1-NFPA 13*, which outlines the policy and procedure of this process.

3) *Section 403-High-Rise Buildings* address all buildings having an occupied level above 75'-0" (i.e. residential or office level for example and not a roof or mechanical penthouse). This section provides for significant reductions in Fire-Resistance Ratings and Type of Construction, and it gives more specific direction to other life safety guidelines. Our building's highest occupied level is at 70'-0", so this section does not apply.

*\*Note that the tabulated allowable height and areas shown do not include any allowable height and area modifications as may be permitted in Sections 504-Height Modifications and 506-Area Modifications.*

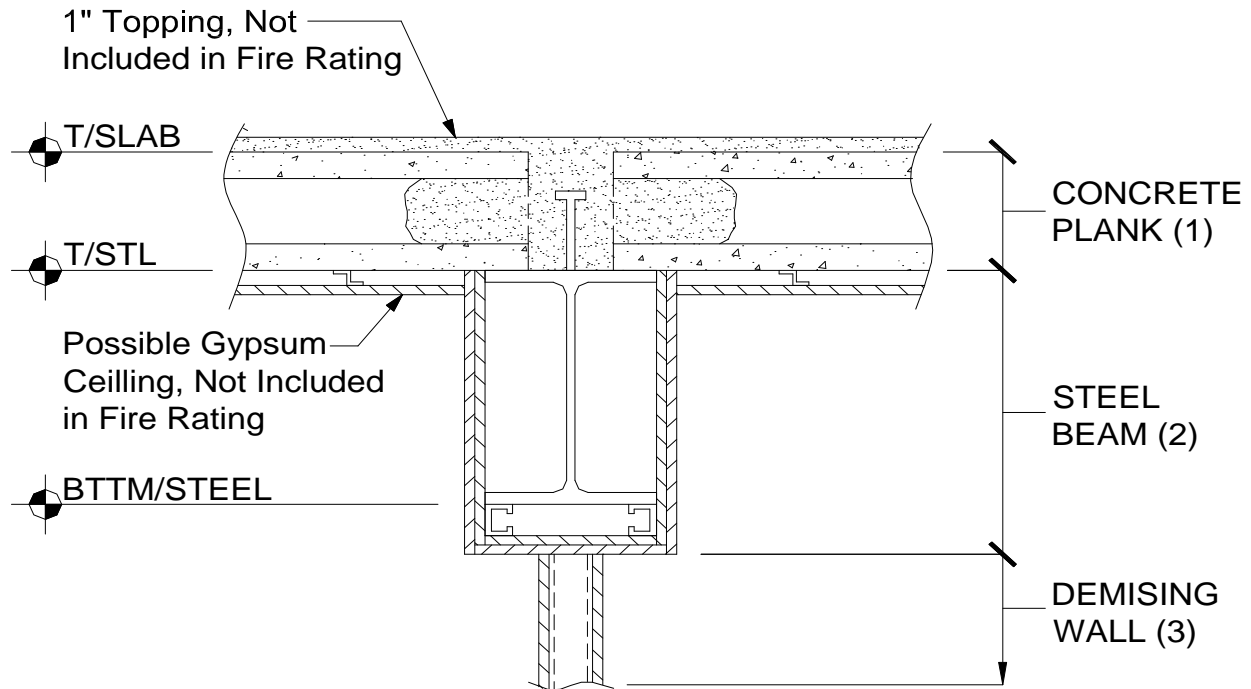


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# FIRE PROOFING IMPLIMENTATION

Project: **Belle Plaine Condominiums**  
Location: **Lakeview, Georgia**  
Company: **AAARF Steel, Inc.**

Date: **12/10/2004**  
Engineer: **Todd Alwood**  
Contact: **Ron Philips**



1) *Section and Table 721.2.2.1-Reinforced and Prestressed Floors and Roofs* state the minimum thickness for a 2-hour rating equals 5" for a siliceous concrete slab (worse case scenario). *Section 721.2.2.1.1-Hollow-core Prestressed Slabs* state the equivalent thickness is 'obtained by dividing the net cross-sectional areas of the slab including grout in the joints, by its width,' which equals 5.12" compared to the required 5". In addition, *Section 721.2.3.1-Slab Cover* refers to *Table 721.2.3(2)* for prestressed concrete. This table requires a cover of 1 3/4" for a 2-hour rating with an unrestrained, siliceous concrete slab (worse case scenario).

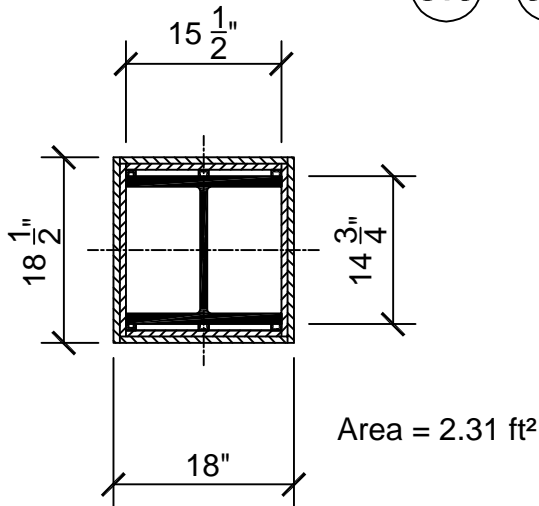
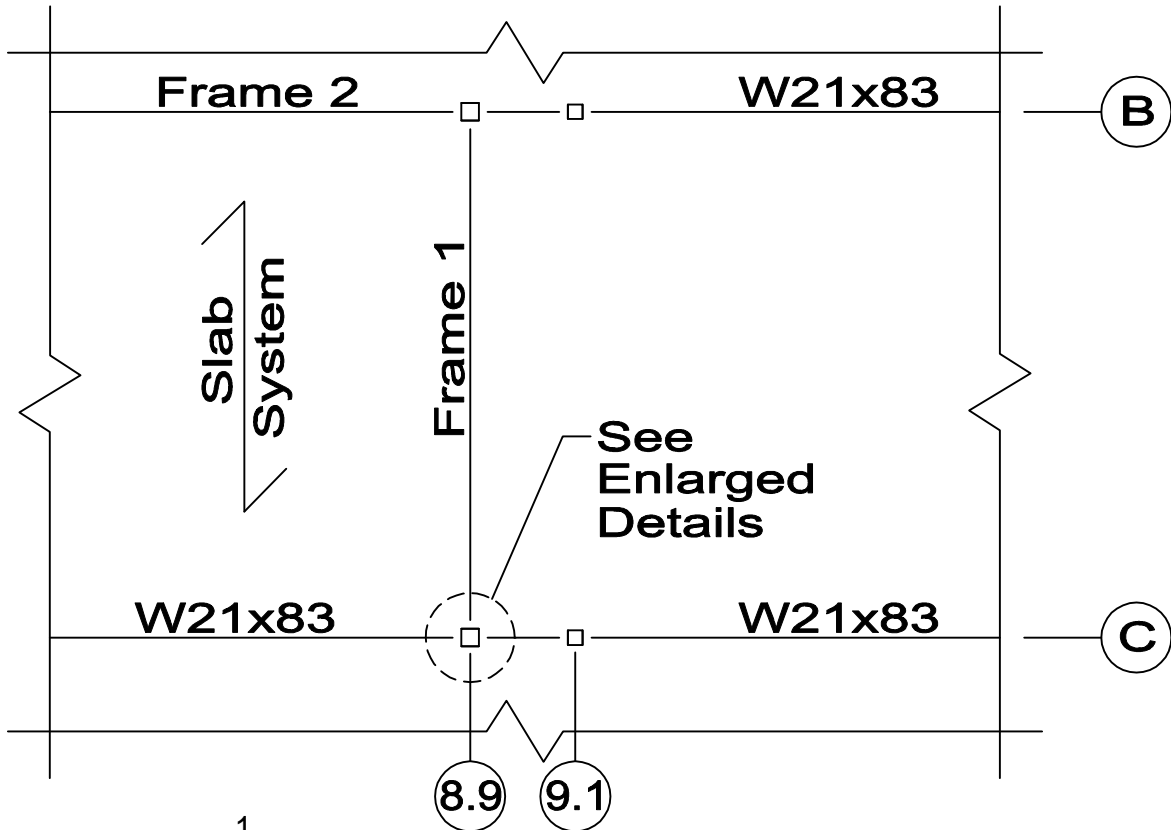
2) *Section 720-Prescriptive Fire Resistance* provides three tables (structural elements, walls & partitions, floor assemblies) with verbal, detailed descriptions of possible fire proofing configurations. *Table 720.1(1).2-Minimum Protection of Structural Parts Based on Time Periods for Various Noncombustible Insulating Materials* and item number 2-4.1 offers two options including specific directions for materials and installations to provide an enclosure for a 2-hour rating. Both options involve (2) layers of 5/8" Type X gypsum wallboard (this being the generic name for any non-proprietary brand of gypsum wallboard).

3) *Table 720.1(2).13-Rated Fire-Resistance Periods for Various Walls and Partitions* and item numbers 13-1.1 and 13-1.3 provide both a one-hour rating with the use of (1) layer of 5/8" Type X gypsum wallboard on each side of the demising wall.

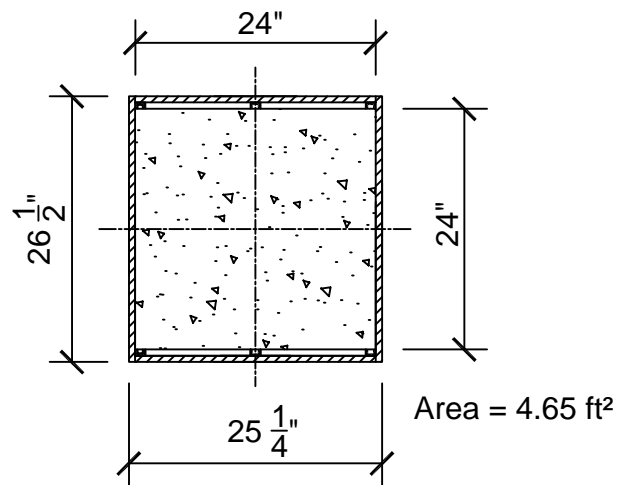


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# Architectural Details



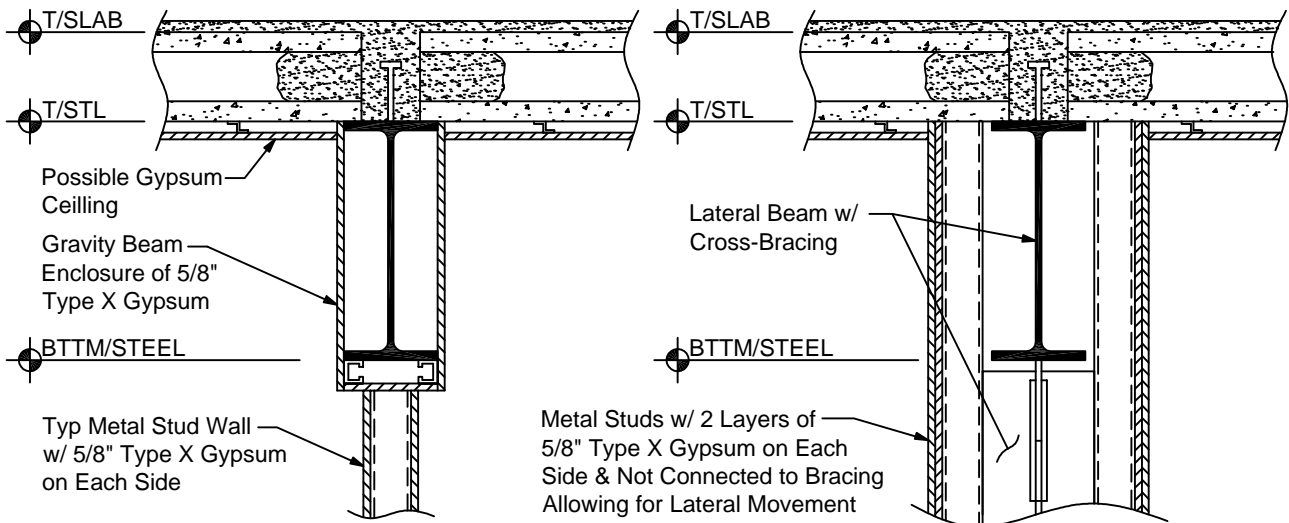
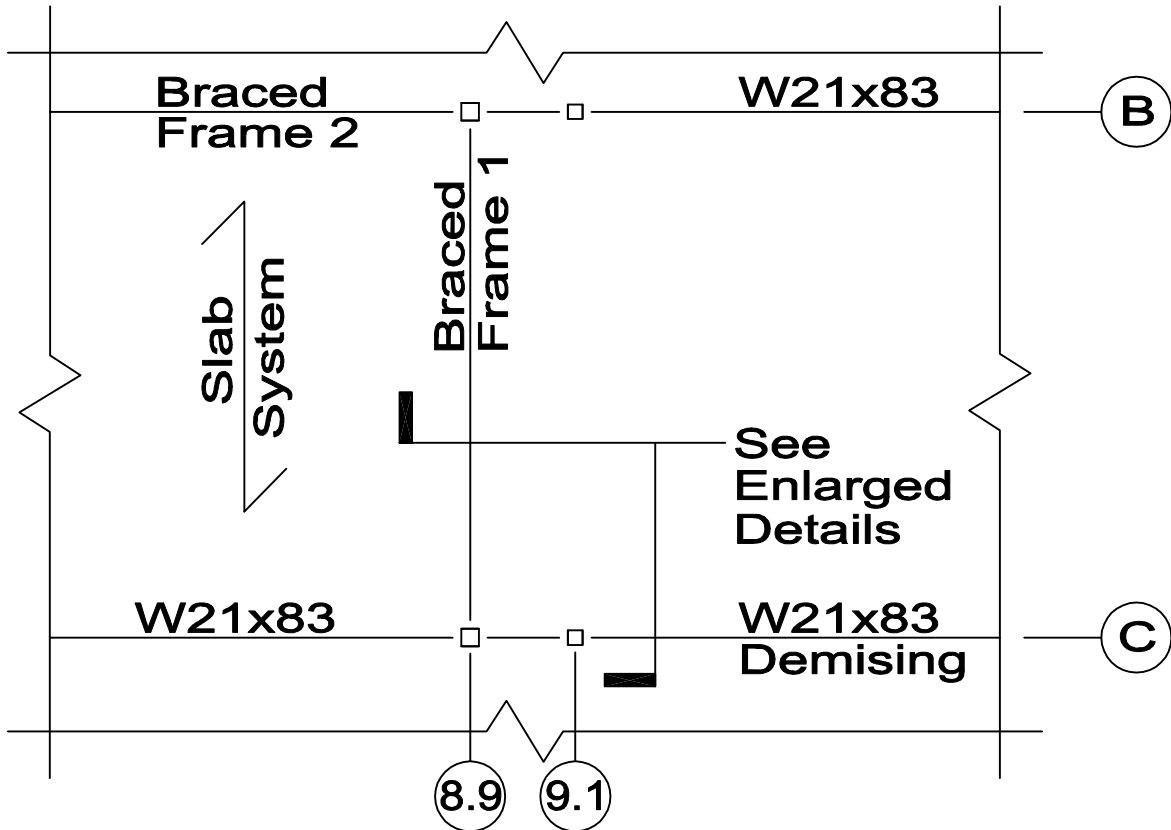
**STEEL COLUMN ENCLOSURE**  
(W14X145)



**CONCRETE COLUMN ENCLOSURE**  
(2'-0"x2'-0")

The details above compare area and dimensions for both a finished steel and concrete column (both are presumed to be lateral and located on the first level, which will usually be the largest). The concrete column is two-times larger than the steel column, which may not greatly effect the overall sellable square footage, but this would greatly effect the column's projection into a client's unit simplifying the layout and spatial aesthetics.

# Architectural Details

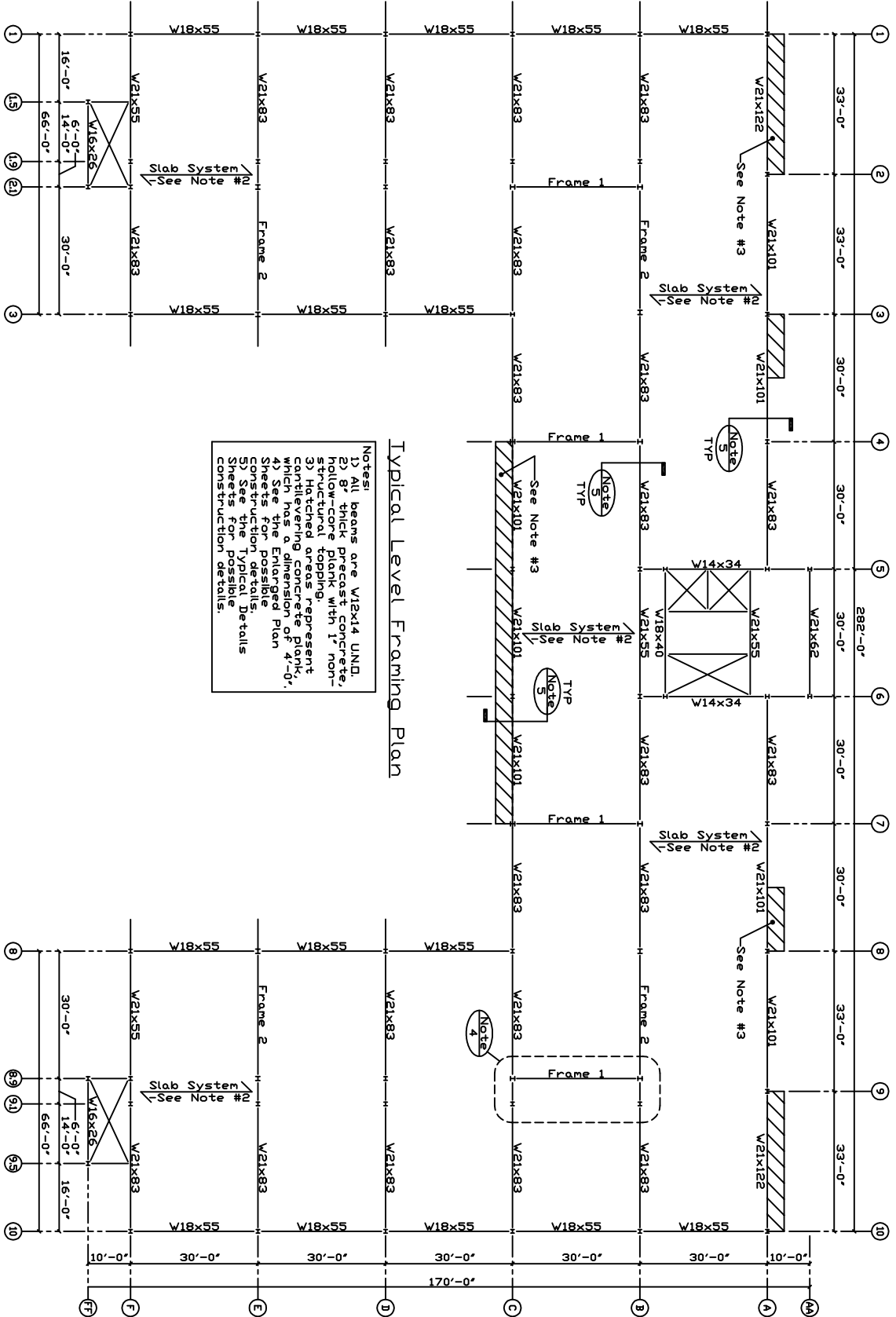


**DEMISING WALL ENCLOSURE**

**BRACED FRAME ENCLOSURE**

This typical demising wall shown above is relatively standard and provides a one-hour fire rating for separation, while the braced frame wall uses two-layers of gypsum to obtain a two-hour rating for the structural frame. In addition, the braced frame uses two metal studs on each side, and these studs are not connected to the frame, which allows lateral movement without disturbing the interior finishes.

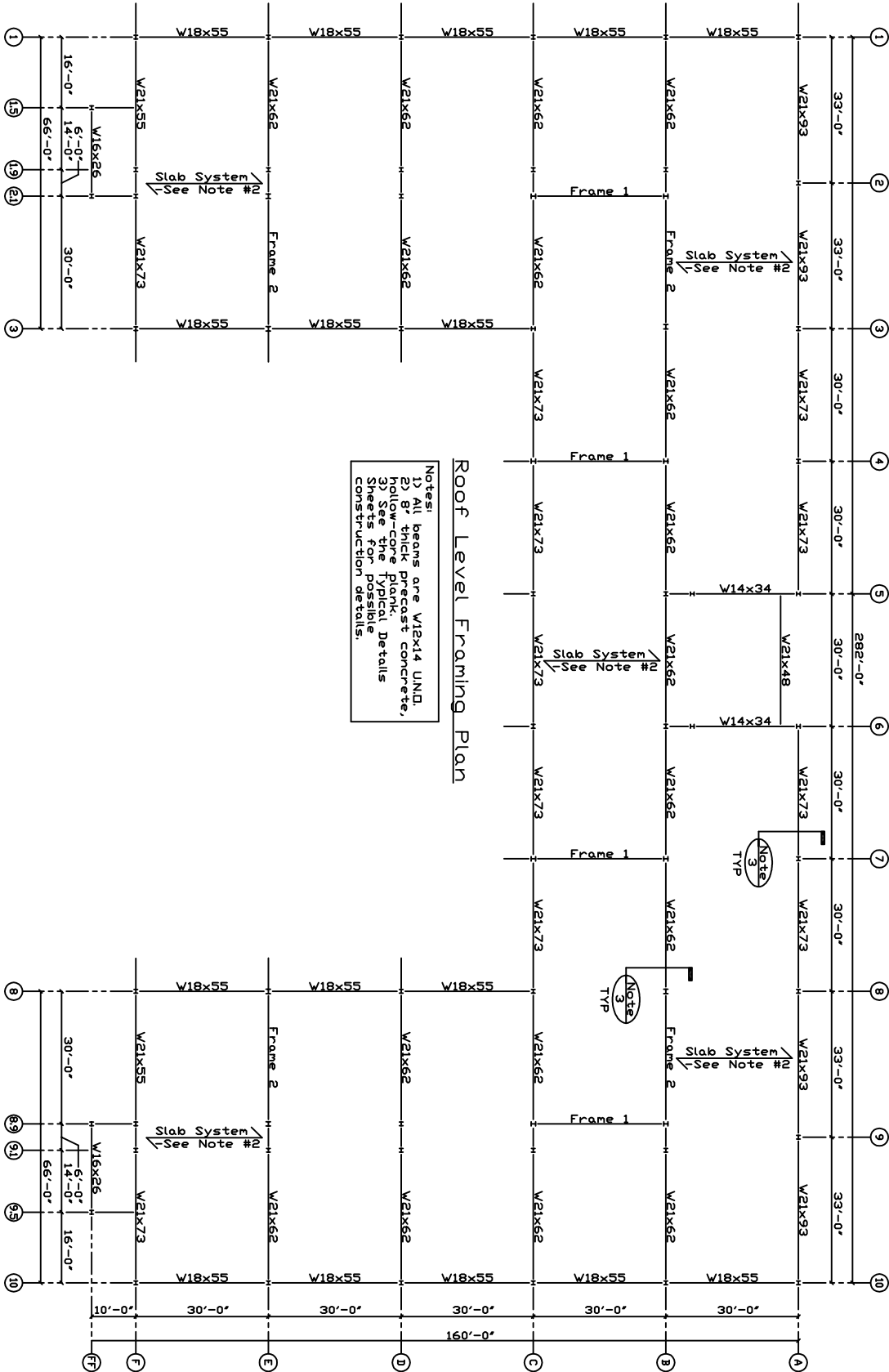
# Structural



Typical Level Framing Plan

- Notes:
- 1) All beams are W12x14 UN.D.
  - 2) 8" thick precast concrete, hollow-core plank with 1" non-structural topping.
  - 3) Hatched areas represent cantilevering concrete plank, which has a dimension of 4'-0".
  - 4) See the Entitled Plan Sheet for erection construction details.
  - 5) See the Typical Details Sheets for possible construction details.

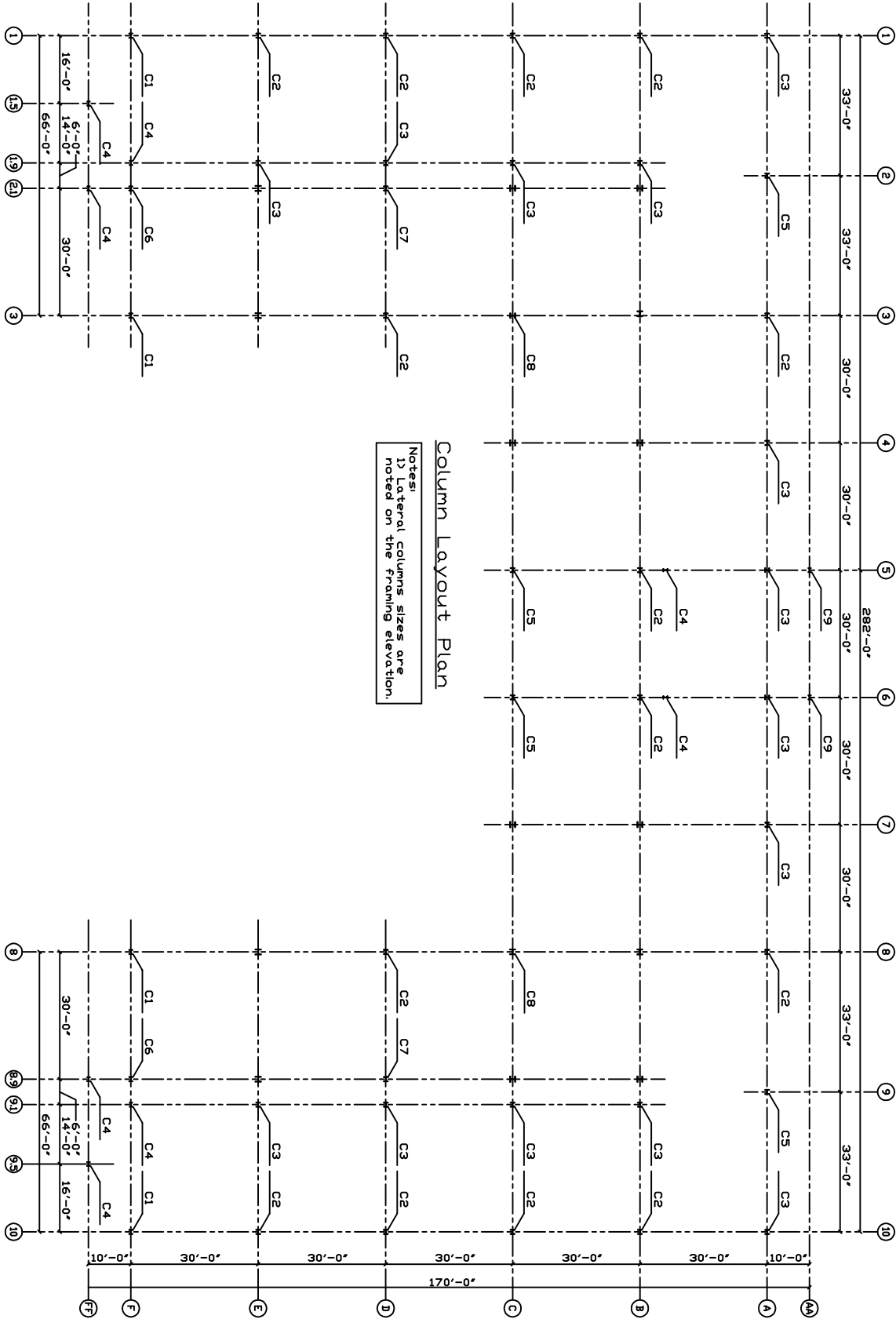
# Structural



**Notes**  
 1) All beams are W12x14 UNB.  
 2) All beams are W12x14 UNB.  
 3) See the Typical Details  
 sheets for possible  
 construction details.

**Roof Level Framing Plan**

# Structural



Notes:  
1) Lateral column sizes are noted on the framing elevation.

Column Layout Plan

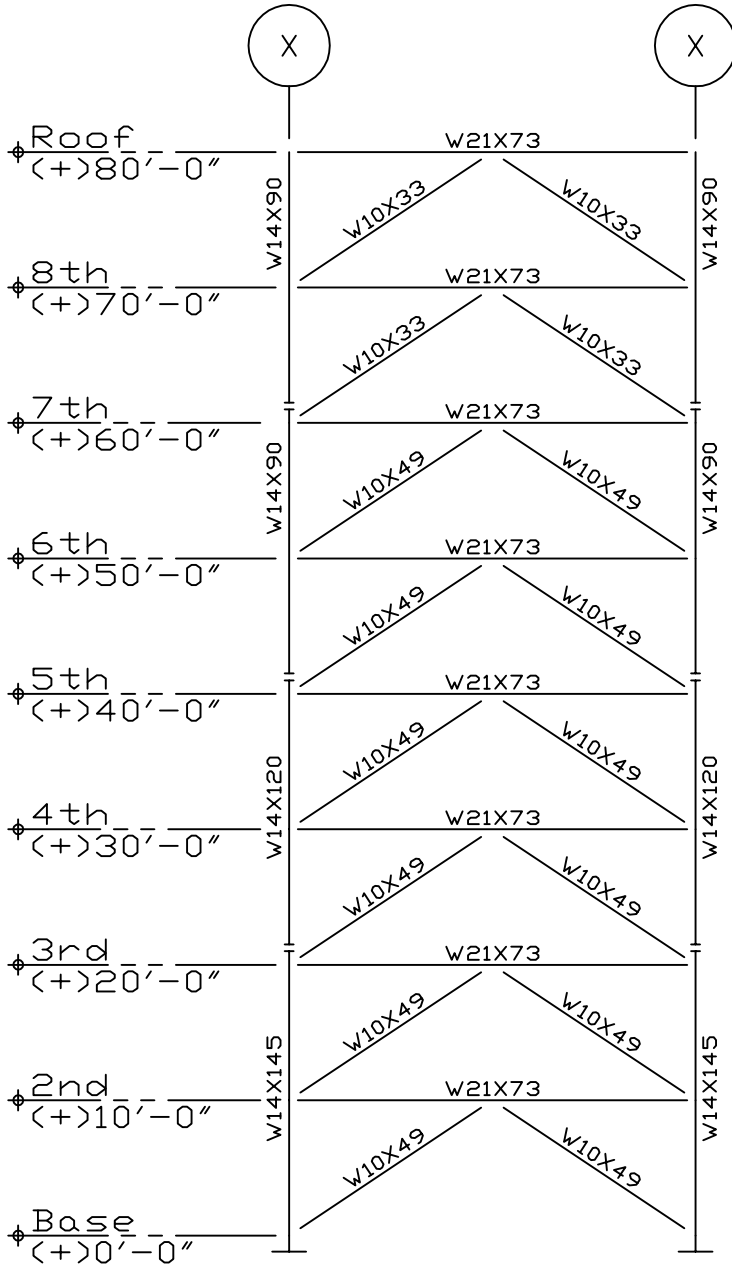


# Structural

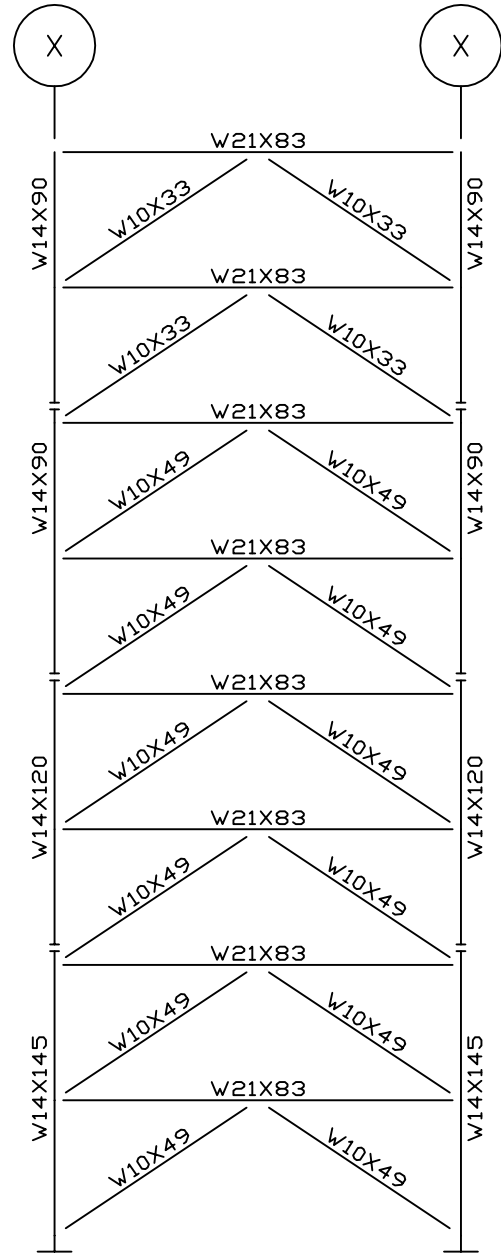
## COLUMN SCHEDULE

COLUMN MARK	C1	C2	C3	C4	C5	C6	C7	C8	C9
Roof <+>80'-0"	W12X40	W14X43	W12X40	W12X40	W12X40	W12X40	W12X40	W14X43	W12X40
8th <+>70'-0"	W12X40	W14X53	W12X50	W12X40	W12X53	W12X40	W12X45	W14X68	W12X40
7th <+>60'-0"	W12X40	W14X53	W12X50	W12X40	W12X53	W12X40	W12X45	W14X68	W12X40
6th <+>50'-0"	W12X40	W14X53	W12X50	W12X40	W12X53	W12X40	W12X45	W14X68	W12X40
5th <+>40'-0"	W12X53	W14X74	W12X65	W12X40	W12X72	W12X45	W12X58	W14X90	W12X40
4th <+>30'-0"	W12X53	W14X74	W12X65	W12X40	W12X72	W12X45	W12X58	W14X90	W12X40
3rd <+>20'-0"	W12X65	W14X90	W12X79	W12X50	W12X96	W12X53	W12X72	W14X109	W12X40
2nd <+>10'-0"	W12X65	W14X90	W12X79	W12X50	W12X96	W12X53	W12X72	W14X109	W12X40
Base <+>0'-0"									

# Structural



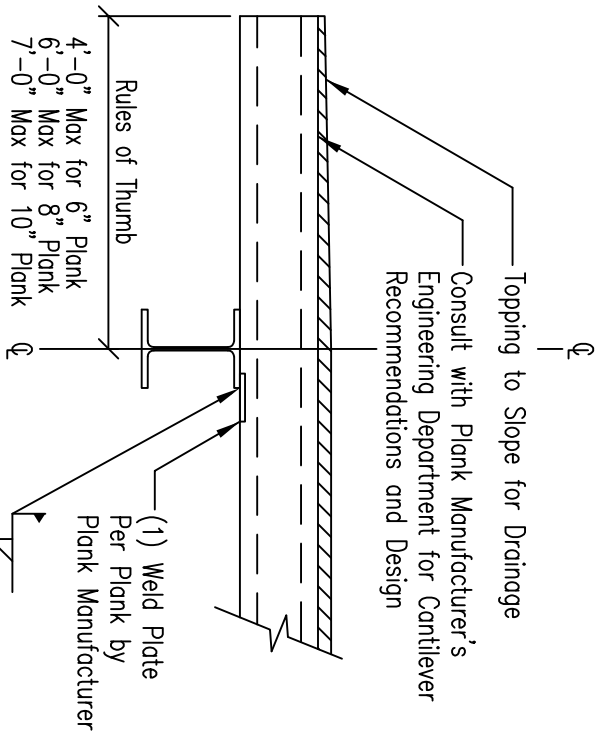
Frame 1



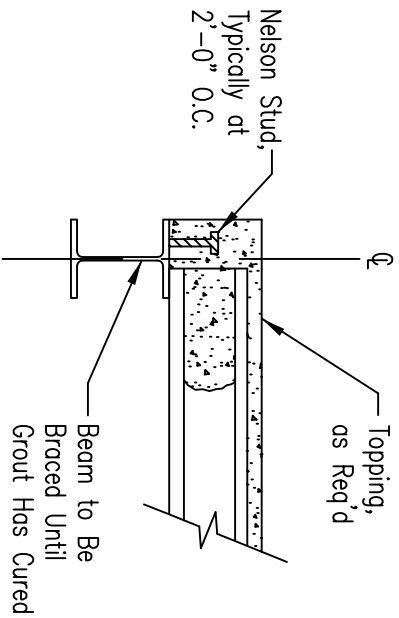
Frame 2

# Structural Details

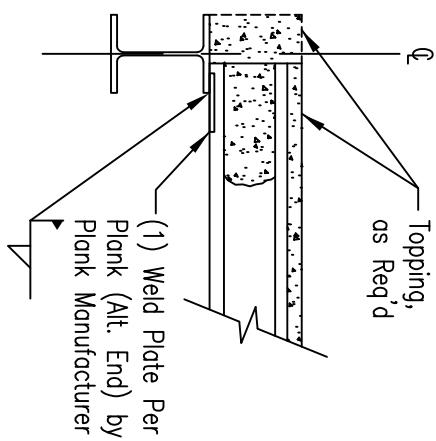
Note 1 – Do Not Weld Plank at Both Ends. Alternate for Plank Movement, and Beam's Top Flange Will Still Be Braced.  
 Note 2 – Check with Plank Manufacturer for Required Bearing and Clearance Dimensions for all Details.



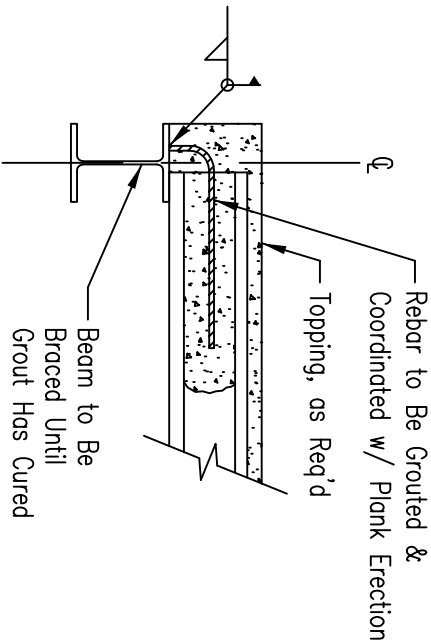
**Cantilever for Balconies**



**EXTERIOR BEARING - 2**



**EXTERIOR BEARING - 1**

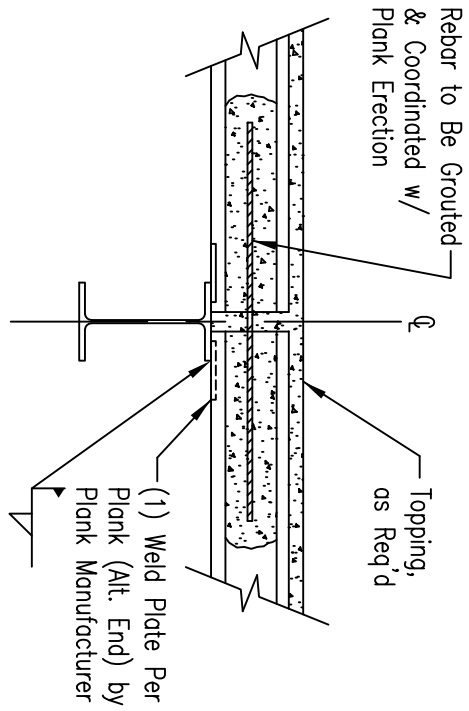


**EXTERIOR BEARING - 3**

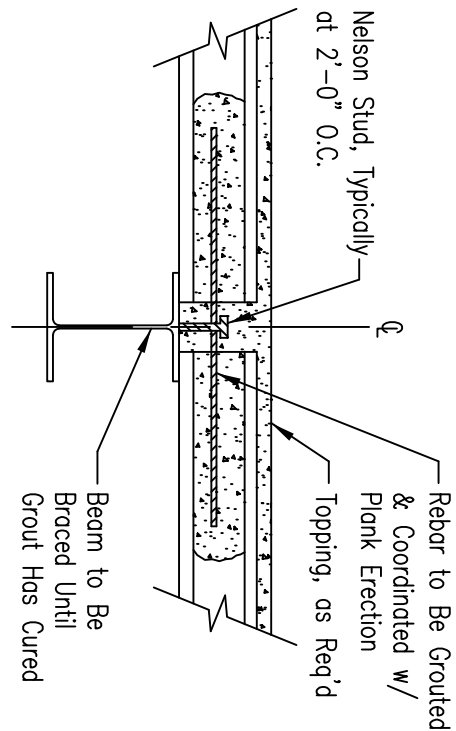
DETAIL(S) ARE NOT FOR CONSTRUCTION

# Structural Details

Note 1 – Do Not Weld Plank at Both Ends. Alternate for Plank Movement, and Beam's Top Flange Will Still Be Braced.  
 Note 2 – Check with Plank Manufacturer for Required Bearing and Clearance Dimensions for all Details.



INTERIOR BEARING - 1

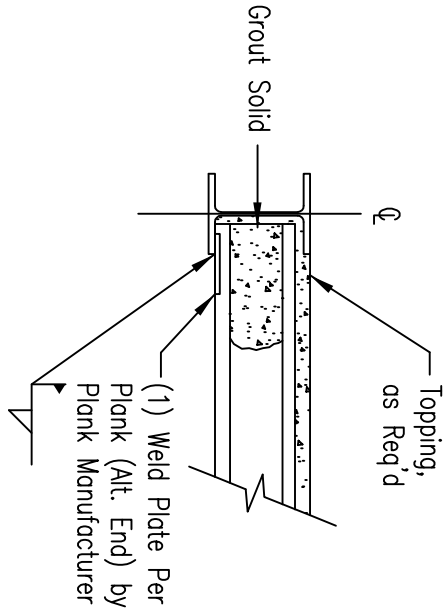


INTERIOR BEARING - 2

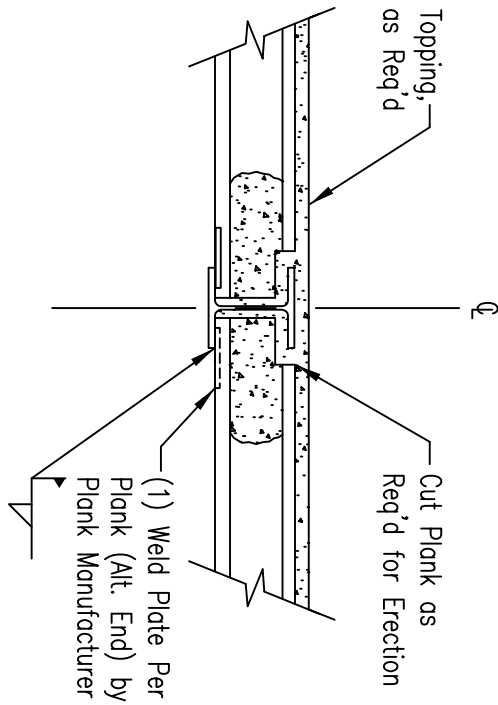
DETAIL(S) ARE NOT FOR CONSTRUCTION

# Structural Details

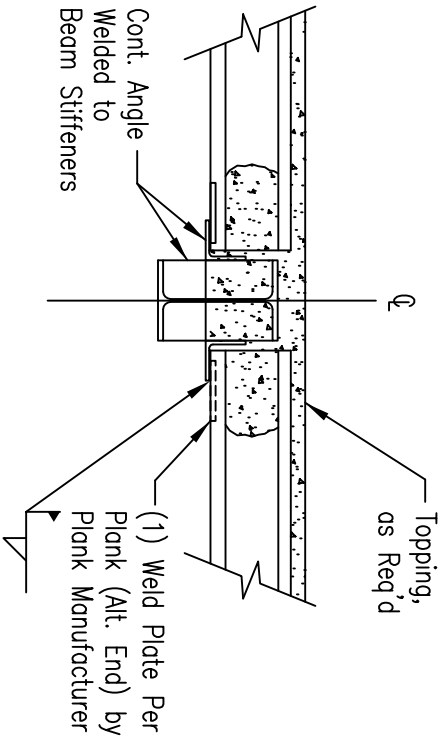
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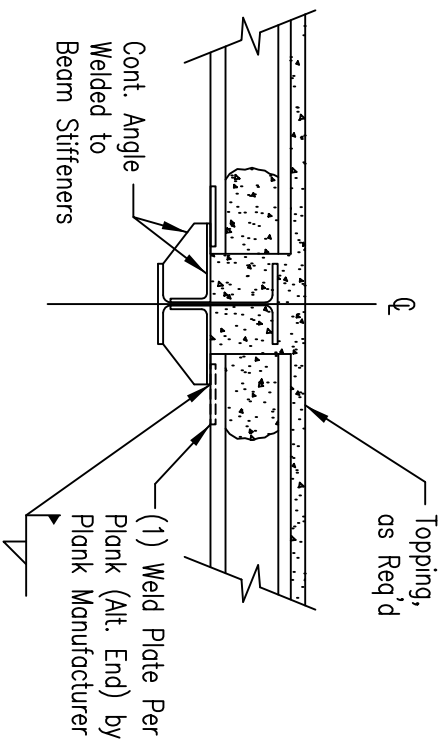
**END BEARING ON STEEL**



**INTERIOR BEARING ON STEEL - 1**



**INTERIOR BEARING ON STEEL - 2**



**INTERIOR BEARING ON STEEL - 3**

DETAIL(S) ARE NOT FOR CONSTRUCTION