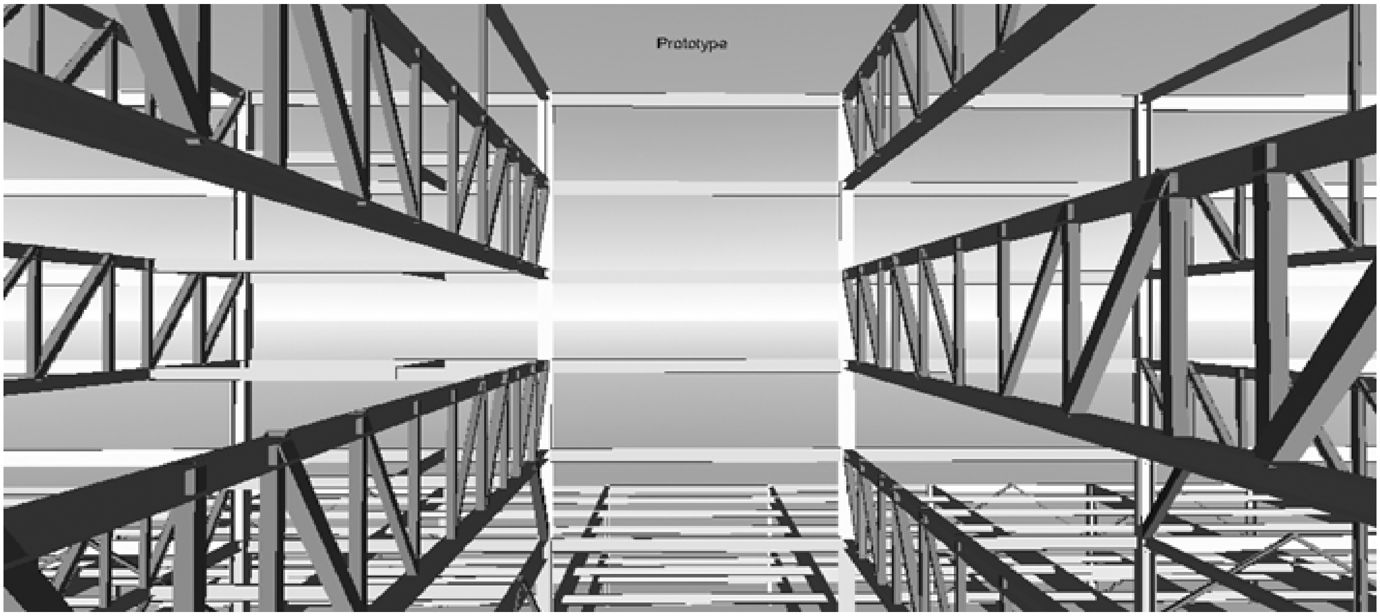
THE MULTI-STORY



RESIDENTIAL PROTOTYPE I

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The Multi-Story Residential Prototype I

What's this?

This package contains a fictitious project with an imaginary client. It illustrates the type of information that the AISC Steel Solutions Center (SSC) typically receives and the Conceptual Solution that might be prepared in reply. It is important to note that the information comes with the continued involvement of the Steel Solutions Center and more directly AISC's Regional Engineers. Together, we are committed to developing efficient, economical solutions in steel and providing continuous support for the life of the project.

Incoming:

A project can find its way to the Steel Solutions Center a variety of ways. Common scenarios include:

1. A project is over-budget in concrete, and a steel alternate is suggested, in which an engineer, general contractor, or developer could contact their favorite fabricator for assistance.
2. A fabricator hears of a lead and contacts their AISC Regional Engineer to present to the general contractor or developer the advantages that a steel frame could provide to their project.

The Solution:

The AISC team and the client work together—often via conference call—to determine what can be done to move the project forward in steel. The Steel Solutions Center can provide a wide range of solutions from a simple bay study to a lateral system analysis, foundation comparison and conceptual estimate. A unique Conceptual Solution matching the detail of this prototype would represent the SSC's highest level of response.

What now?

This Prototype is one example of the Conceptual Solutions the SSC can provide. More importantly, because it is representative of many real steel multi-story residential (MSR) structures, many SSC clients have found this Prototype alone can capture the developer's attention.

The Steel Solutions Center has been involved in a broad range of projects since our inception in 2001. In addition to MSR structures, we can help you find innovative solutions for high-rise offices, parking structures and more.

Meeting the expectations of the people we work with is important to us. The last two pages communicate what our clients can expect from the Steel Solutions Center and what the SSC expects from our clients. Remember the Conceptual Solution is only the beginning. The AISC team will continue to provide assistance for the life of your project.

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The incoming fax...

Incoming:

John Philips, who is a developer outside of Milwaukee, learned of the Steel Solutions Center (SSC) while a fabricator was making their routine sales call to his office and suggested that John contact the SSC for assistance on his upcoming project. John faxed the below information to the SSC and was then contacted later that day by a Regional Engineer and a SSC Advisor to discuss how the SSC could be of service.

AAARF DEVELOPMENT

1342 HINKLE ROAD
BUTLER, WISCONSIN 43210
412-555-1234

DECEMBER 1, 2003

TO: AISC STEEL SOLUTIONS CENTER VIA FAX

FROM: JOHN PHILIPS

RE: POTENTIAL CONDOMINIUM PROJECT

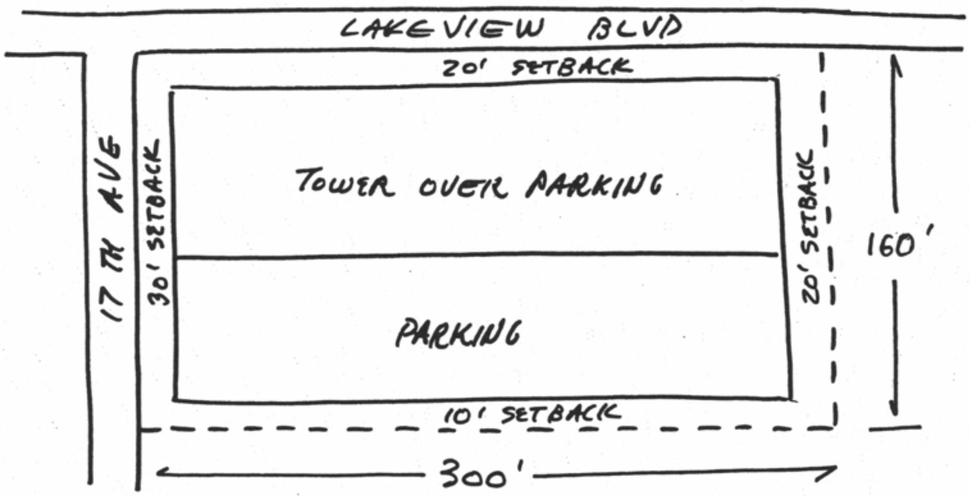
I AM CONSIDERING THE CONSTRUCTION OF A HIGH RISE CONDOMINIUM PROJECT IN THE MILWAUKEE AREA. THE PROPERTY IS SITUATED NEAR LAKE MICHIGAN WITH 300 FEET OF LAKE VIEW FRONTAGE AND A PROPERTY DEPTH OF 160 FEET. PROPERTY AND PRELIMINARY SKETCHES ARE ATTACHED. AREA HEIGHT RESTRICTIONS DO NOT ALLOW A BUILDING TO EXCEED A HEIGHT OF 85 FEET. PARKING MUST BE PROVIDED UNDER THE OCCUPIED FLOORS. THE FOLLOWING UNITS ARE ANTICIPATED:

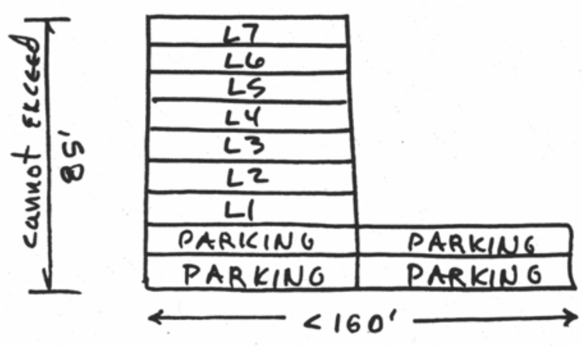
16	1500 SQ FEET +/-
30	1200 SQ FEET +/-
40	1000 SQ FEET +/-

WE ANTICIPATE 7 FLOORS OF RESIDENCES OVER TWO LEVELS OF PARKING. TWO PARKING SPACES MUST BE PROVIDED FOR EACH UNIT. CAN YOU PROVIDE A LAYOUT UTILIZING A STEEL FRAMING SYSTEM ALONG WITH IT'S ASSOCIATED COST AND SCHEDULE?

THANK YOU.

The incoming fax...





The Multi-Story Residential Prototype I

The Solution:

Following the arrival of John's fax, the Regional Engineer, a SSC Advisor, and John participated in a conference call to qualify and discuss the project in greater detail. The project is located in Milwaukee, Wisconsin, and therefore Michael Gustafson, the Regional Engineer of the Great Plains Region, is responsible for the project. The following is what the AISC team learned from this continued discussion:

- John had mainly constructed buildings out of concrete, so he was out of his comfort zone in regards to steel.
- John had a tight schedule due to several other condo projects on the horizon in this particular area.
- John said foundations were to be an issue due to poor soil conditions and close proximity to the lake front.
- He had a working relationship with a fabricator in his local area.

After reviewing all the information at hand, the AISC team agreed a steel option would meet the owner's needs and provide cost & schedule savings for this project. They also agreed that influencing the owner would require the SSC's highest level of response, including a preliminary structural design performed specifically for this project; teaming up with John's fabricator to help confirm cost and schedule; and the SSC's continued support to ease John's reservations of dealing with a steel structure.

The Outcome:

The AISC team decided on the Staggered Truss Framing System, which would offer John the same low floor-to-floor heights he used with flat-plate construction. In addition, the system would

- More flexibility in unit layout
- 50% fewer columns, which would reduce the foundation costs
- A column-free level above the parking area

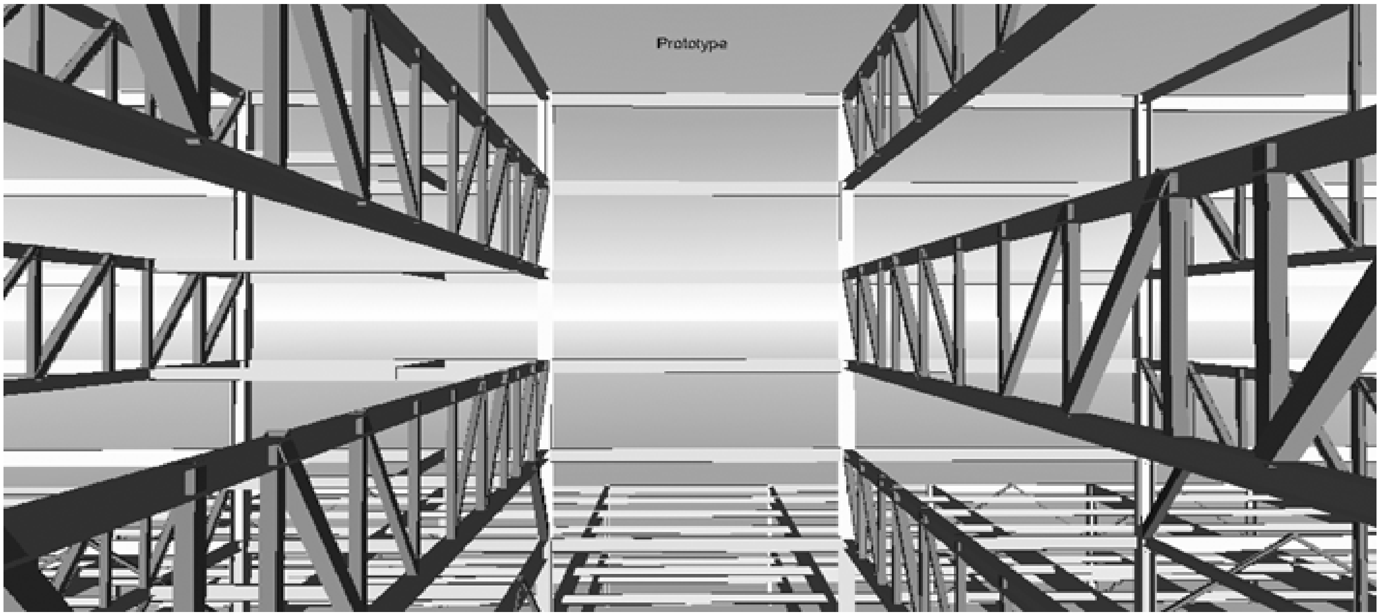
The fabricator used the Conceptual Solution to put together a cost and schedule takeoff and also arranged a meeting between the developer, Michael Gustafson, and himself to present the above information. At the meeting, they not only talked about the typical reduction in schedule with a steel frame, but also stated reduced operation and construction loan costs resulting from the shorter schedule and 25% savings in foundation cost due to the lighter steel structure and fewer columns.

The savings in both time and money caught John's attention. The fabricator and Michael had met all of John's reservations with using a steel structure and had reduced his schedule and related costs. John decided to proceed with steel and also agreed to look into steel with all his future endeavors. A success for not only the fabricator but the developer, too!

Milwaukee Mixed-Use Condominium

Project Location: Southern Wisconsin
Prepared for: AAARF Development
Contact: John Philips

12.15.2003
Prepared by: Todd Alwood
Regional Engineer: Tabitha Stine



This Package Includes:

- Comments on Provided Solution
- Steel Quantity Takeoff
- Piece Takeoff
- Parameters and Criteria
- Fire Protection Comments
- Condominium Unit Information
- Architectural Layout Plans
- Floor Framing Plans
- Column Layout and Schedule
- Frame Elevations
- Staggered Truss Elevation and Details

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COMMENTS ON PROVIDED SOLUTION

Milwaukee Mixed-Use Condominium December 12, 2003

The information contained in this document is not intended as a basis for structural design for this or any project. Rather, it is a conceptual approach to the project that demonstrates the viability of the steel system for project requirements, budget, and schedule.

1) The steel quantities and geometry based on this investigation are provided on floor layouts, a column and frame layout plan, a column schedule, and frame elevations on the following pages.
2) The design criteria per IBC 2000 is summarized and included in the following pages.
3) The residential floor system is presumed to be eight-inch thick, hollow-core plank spanning perpendicular to staggered trusses. The plank is not cambered and has no additional topping.
4) The parking levels use a 3-inch thick, metal deck with 3 ¼" of concrete for a total slab thickness of 6 ¼".

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STEEL QUANTITY TAKEOFF:

Total Structure

Milwaukee Mixed-Use Condominium

December 12, 2003

Suspended Steel Floor Areas:

172,287 ft^2 Total area

Estimated Steel Quantities:

Gravity Columns		
W12s	8 tons	0.09 psf
Beams (gravity)		
Wide Flange	257 tons	3.0 psf
Lateral Frames and Staggered Truss		
Beams	223 tons	2.59 psf
Columns	109 tons	1.27 psf
Braces (HSS)	102 tons	1.18 psf
	699 tons	**8.1 psf**

* The quantities are based on centerline dimensions
** Quantities do not include connection material, slab edge material or façade attachments.

Material Specification

Wide flange shapes are A992, Gr. 50
Rectangular HSS sections are A500 Gr. B

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STEEL QUANTITY TAKEOFF:

Total Structure

Milwaukee Mixed-Use Condominium

December 12, 2003

Member Type	Second Level	Third Level	Fourth Level	Typical Level	Roof Level
Columns (gravity)	6	6	0	6	6
Beams (gravity)	149	149	22	24	14
Columns (lateral)	32	32	26	16	16
Beams (lateral)	20	20	24	16	16
Braces (lateral/truss)	40	40	32	72	80

Member Type	Total
Columns (gravity)	48
Beams (gravity)	454
Columns (lateral)	186
Beams (lateral)	160
Braces (lateral/truss)	552
TOTAL	**1400**

Floor	Total
Roof	132
Ninth	134
Eighth	134
Seventh	134
Sixth	134
Fifth	134
Fourth	104
Third	247
Second	247
TOTAL	**1400**

*Even though columns may extend over two floors, column splices are not taken into account with the above piece count, meaning the column is counted per floor level of height.

BUILDING CODE CRITERIA:
IBC 2000

Milwaukee Mixed-Use Condominium | December 12, 2003

This investigation is based on the following criteria. The Steel Solutions Center does not assert that these are the criteria that apply to this project. The criteria are chosen based on the project location and the widely adopted model building code, [building code]. Requirements by local and state jurisdictions have not been considered. If actual project criteria differ significantly from those listed, the results presented may no longer be valid.

Gravity Loads

Dead Loads

Residential (plank)	60 psf
Roof (plank)	60 psf

Superimposed Dead Loads

Residential	10 psf (misc)
Roof	20 psf (roofing)

Live Loads

Parking	50 psf
Residential	50 psf
Partitions	50 psf
Roof	30 psf

Cladding Loads

Typical Façade	150 plf

Wind Load Parameters

Basic Wind Speed = 90 mph

Basic Seismic-Force-Resisting System

Structural Steel System not Specifically Detailed for Seismic Resistance

Seismic Design Parameters

Seismic Use Group =	I
Seismic Importance Factor, I_E =	1.00
Seismic Design Category =	B
Site Class =	D
Spectral Response Acceleration at Short Periods (0.2s), S_s =	0.100 g
Spectral Response Acceleration at One Second Period, S_1 =	0.050 g

	X-axis	Y-axis
Building Period Coefficient, C_T =	0.002	0.002
Response Modification Coefficient, R =	3.0	3.0
System Overstrength Factor, Ωo =	3.0	3.0
Deflection Amplification Factor, C_d =	3.0	3.0

Note: Seismic Provisions were not applied to this investigation.

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FIRE PROTECTION COMMENTS

Milwaukee Mixed-Use Condominium December 12, 2003

Due to the increase of combined occupancies being seen lately by the SSC, myths surrounding fireproofing have been on the rise. The information contained below highlight several key issues with regards to this topic, plus fire protection, in general:

1) When are sprinklers required in a structure? According to Sections 403.1 & 403.2 of the IBC 2000, buildings with an occupied level (i.e. residential or office level for example and not a roof or mechanical penthouse) above 75'-0" require sprinklers throughout the entire structure. For the Milwaukee Condo Project, the ninth level is the highest occupied floor at 76'-1", so the building would need to be sprinkled throughout.
2) Are there increases for separation between two different occupancies in the same structure? Separation requirements are covered in Section 302.3 – Mixed Occupancies, and the specific ratings are located in Table 302.3.3. For the Milwaukee Condo Project, the specific separation results to 2 hours.
3) How do you determine the fire rating for a building? Though this description will be somewhat simple in explanation, one begins by determining the building's Use Group according to Section 3; then select the Construction Type located in Table 503; and finally its fire rating found in Table 601, as follows:

<u>Scheme #1 is for an ENCLOSED PARKING Garage with Residential above.</u>

Residential Portion:

-Group R-2, Section 310.1 requires two or more units where the occupants are primarily permanent in nature

-Construction is Type IB, where Table 503 states that the tabulated allowable height and area is permitted to be 11 levels w/ Unlimited SF (for our project only 9 levels w/ 16,000 SF, therefore we comply)*****

Garage Portion:

-Group S-2, Section 311.3 is classified as low-hazard storage for open or enclosed parking garages

-Section 406.4.1 states Enclosed Garages shall be limited to the allowable heights and areas specified in Table 503

-Construction is Type IB (to match the more stringent requirements of the residential portion above and in order to meet IBC requirements concerning single-type of construction classification), where Table 503 states that the tabulated allowable height and area is permitted to be 11 levels w/ 79,000 SF (for our project only 3 levels w/ 30,000 SF, therefore we comply)*****

According to Table 601, Type IB Construction Fire Resistance Ratings for building elements are required to be:

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

***** *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)*

Scheme #2 is for an OPEN PARKING Garage with Residential above.

Residential Portion:

Same as previous example.

Garage Portion:

-Group S-2, Section 311.3 is classified as low-hazard storage for open or enclosed parking garages

-Section 406.3 states *Open Parking Garages* states requirements for said spaces.

-Construction is Type IIA where Table 406.3.5 states that the tabulated allowable height and area is permitted to be 8 tiers w/ 50,000 SF (for our project only 3 tiers w/ 30,000 SF, therefore we comply)

According to Table 601, Type IB Construction Fire Resistance Ratings for the residential building elements are required to be:

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

According to Table 601, Type IIA Construction Fire Resistance Ratings for the OPEN garage building elements are required to be:

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

*According to Section 508.8.1, separation of occupancies will follow Table 302.3.3 as stated on the previous page and type of construction shall apply to each individual occupancy, except that all structural frame members within the open parking area shall be protected with the more restrictive fire-resistance rating between the associated construction types as shown in Table 601. Meaning that the rating for the Structural Frame was increased from 1 hour as stated in Table 601 for IIA Construction to 2 hour for IB Construction.

FIRE PROTECTION COMMENTS

Milwaukee Mixed-Use Condominium December 12, 2003

Below is a list of the most typical types of fire protection used throughout the construction industry, and they start with the most common & economical to the most specialized & expensive:

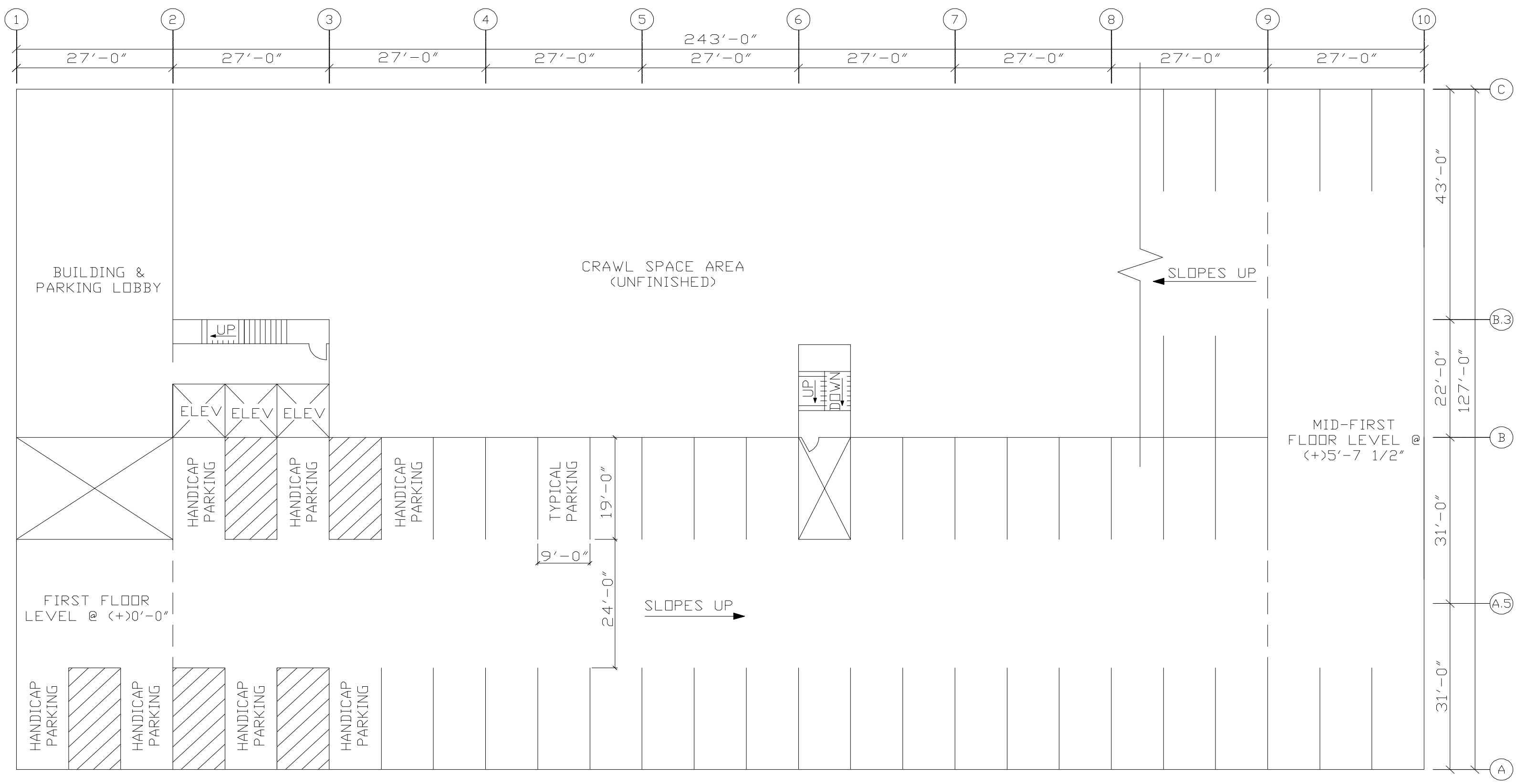
Typical Types of Fireproofing

Gypsum Board Fireproofing is one of the most commonly used types of fire protection in the industry. Typical construction assemblies with a combination of sheet thickness and layering have been previously tested and are specified for such standard areas as stairwells, partition, and demising walls throughout a building.

Spray-On Fireproofing is a combination of water, an adhesive, and most commonly cellulose material. This mixture is then sprayed onto the specific area, which can include structural members and metal decking, and is ideal for complicated configurations due to its ability to adhere and fill in voids.

Cementitious Fireproofing is typically made of either gypsum plaster or Portland cement and mixed with water, and the combination is then sprayed onto the specific member. Also, this fireproofing can be troweled to a smooth finish, which is comparable to concrete in smoothness and durability.

Intumescent Fireproofing is a paint-like coating, which is applied to structural members in a similar manner as primer or paint. When the coating is subjected to extreme temperatures, it will expand to a meringue-like consistency to insulate the steel and create a barrier of protection.



FIRST FLOOR LAYOUT PLAN

Title: First Floor Layout Plan
Name: Todd Alwood
Date: 12.15.2003

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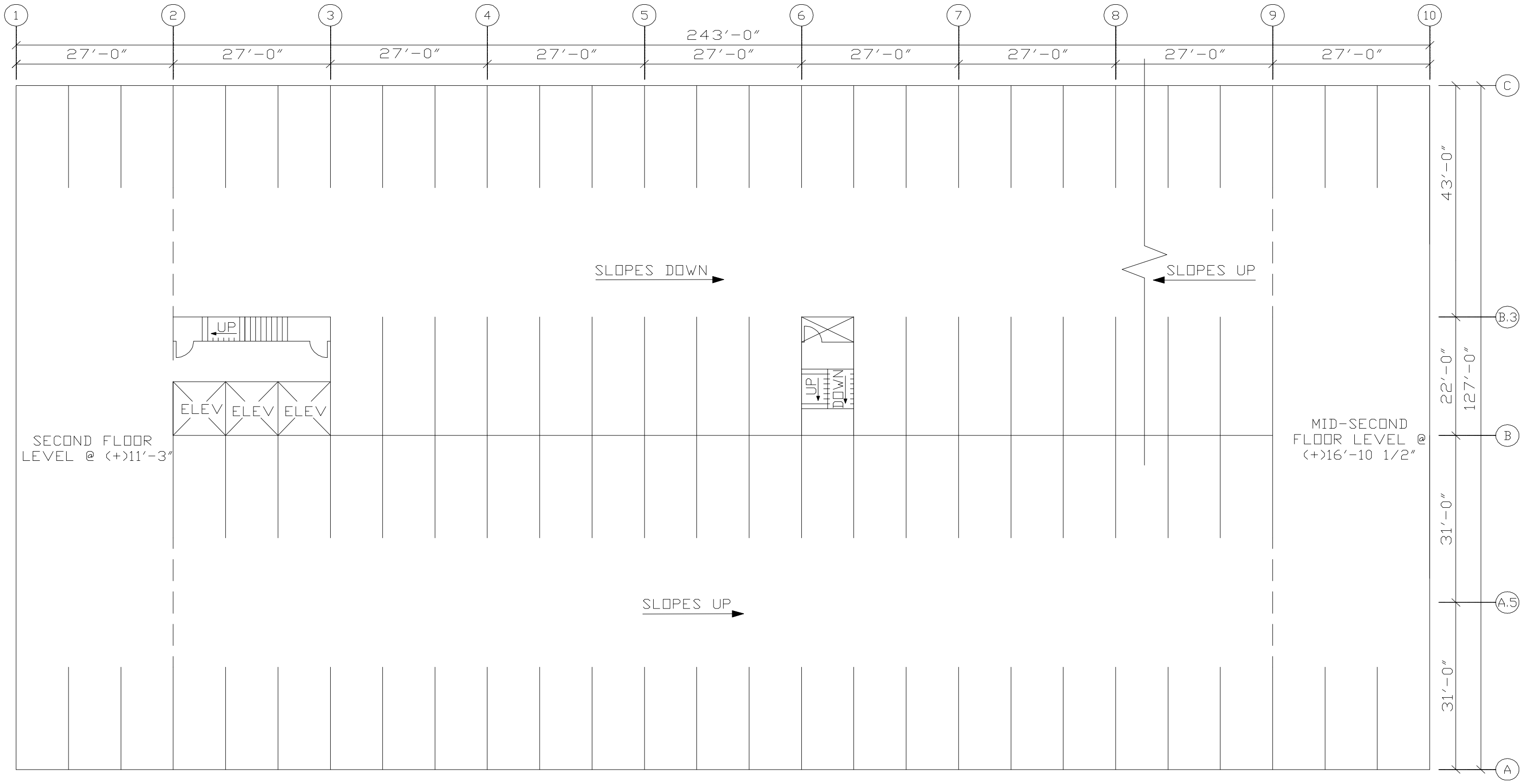

SECOND FLOOR LAYOUT PLAN

Title: Second Floor Layout Plan
Name: Todd Alwood
Date: 12.15.2003

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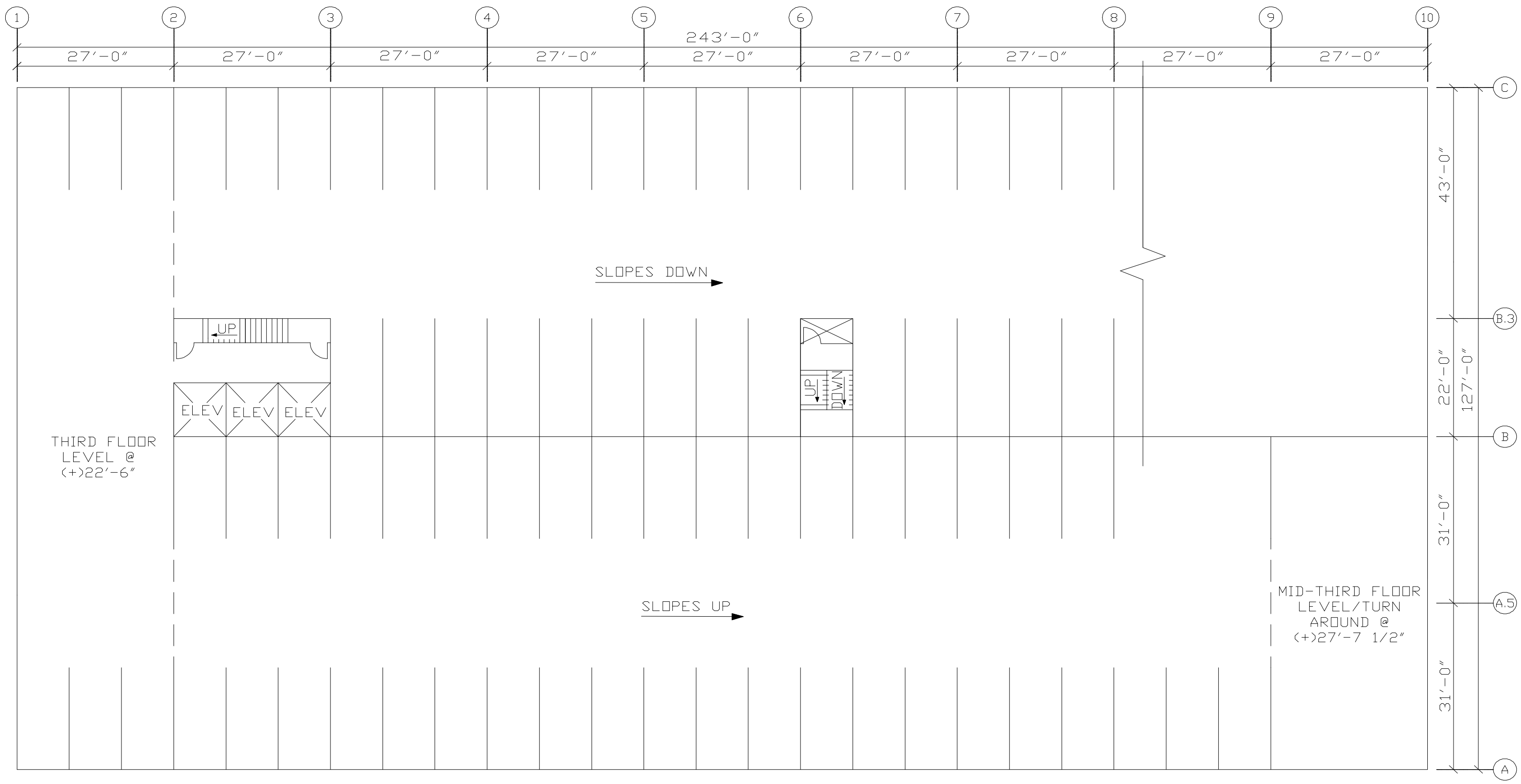

THIRD FLOOR LAYOUT PLAN

Title: Third Floor Layout Plan
Name: Todd Alwood
Date: 12.15.2003

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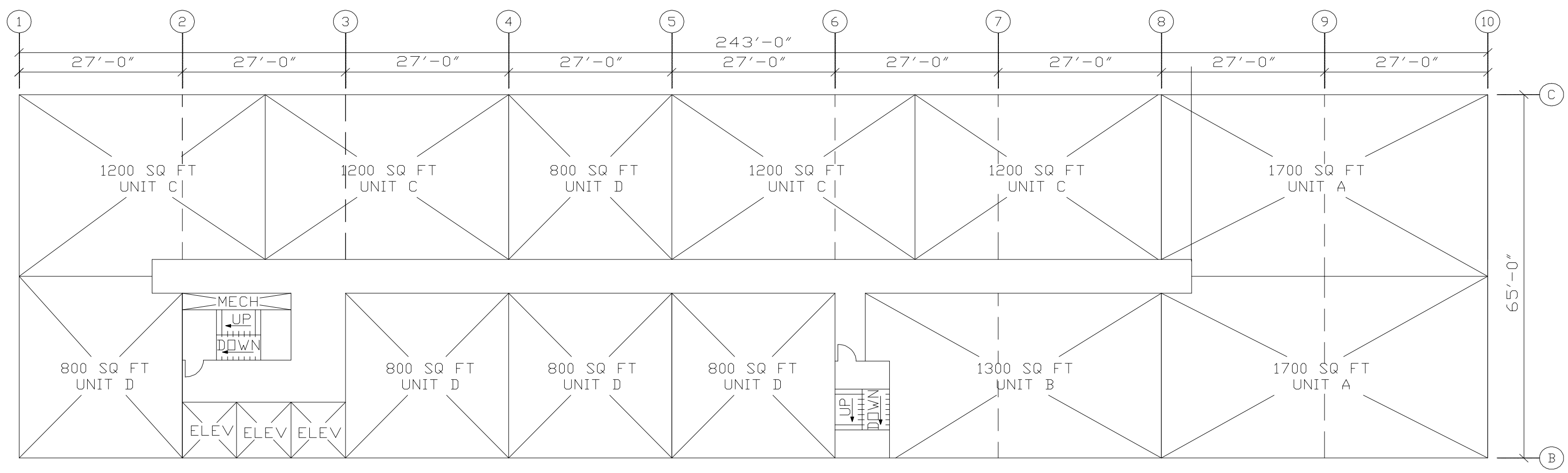

TYPICAL RESIDENTIAL FLOOR LAYOUT PLAN

Title: Typical Residential Layout Plan

Name: Todd Alwood

Date: 12.15.2003

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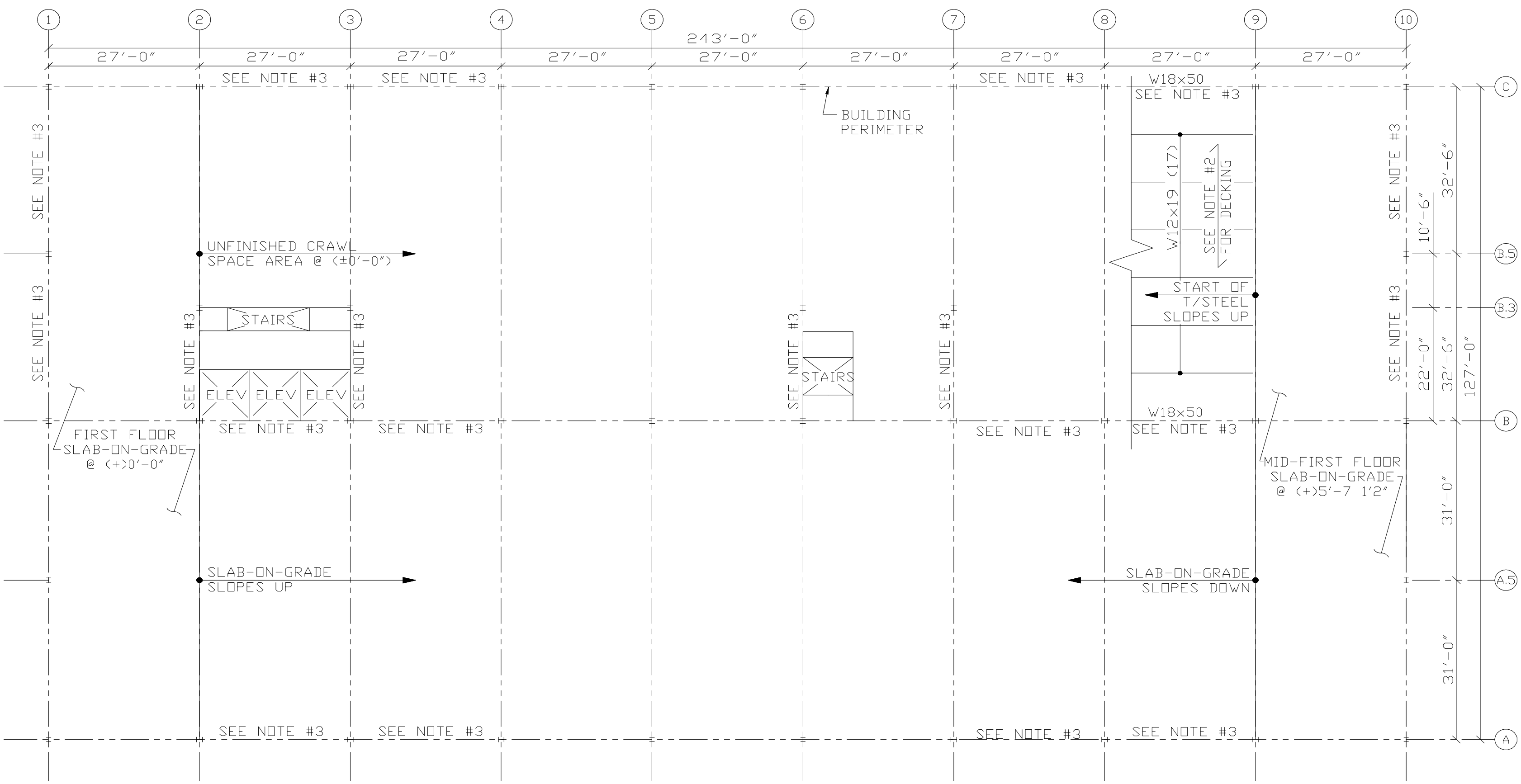

FIRST FLOOR FRAMING PLAN

NOTE: 1) 3" THICK, METAL DECK WITH 3 1/4" LT WT CONCRETE FOR TOTAL SLAB THICKNESS OF 6 1/4".
2) (*) REPRESENTS EQUALLY SPACED NUMBER OF STUDS.
3) INDICATES CROSS-BRACED BAY, SEE FRAMING ELEVATIONS FOR MEMBER SIZES AND CONFIGURATION.

Title: First Floor Framing Plan
Name: Todd Alwood
Date: 12.15.2003

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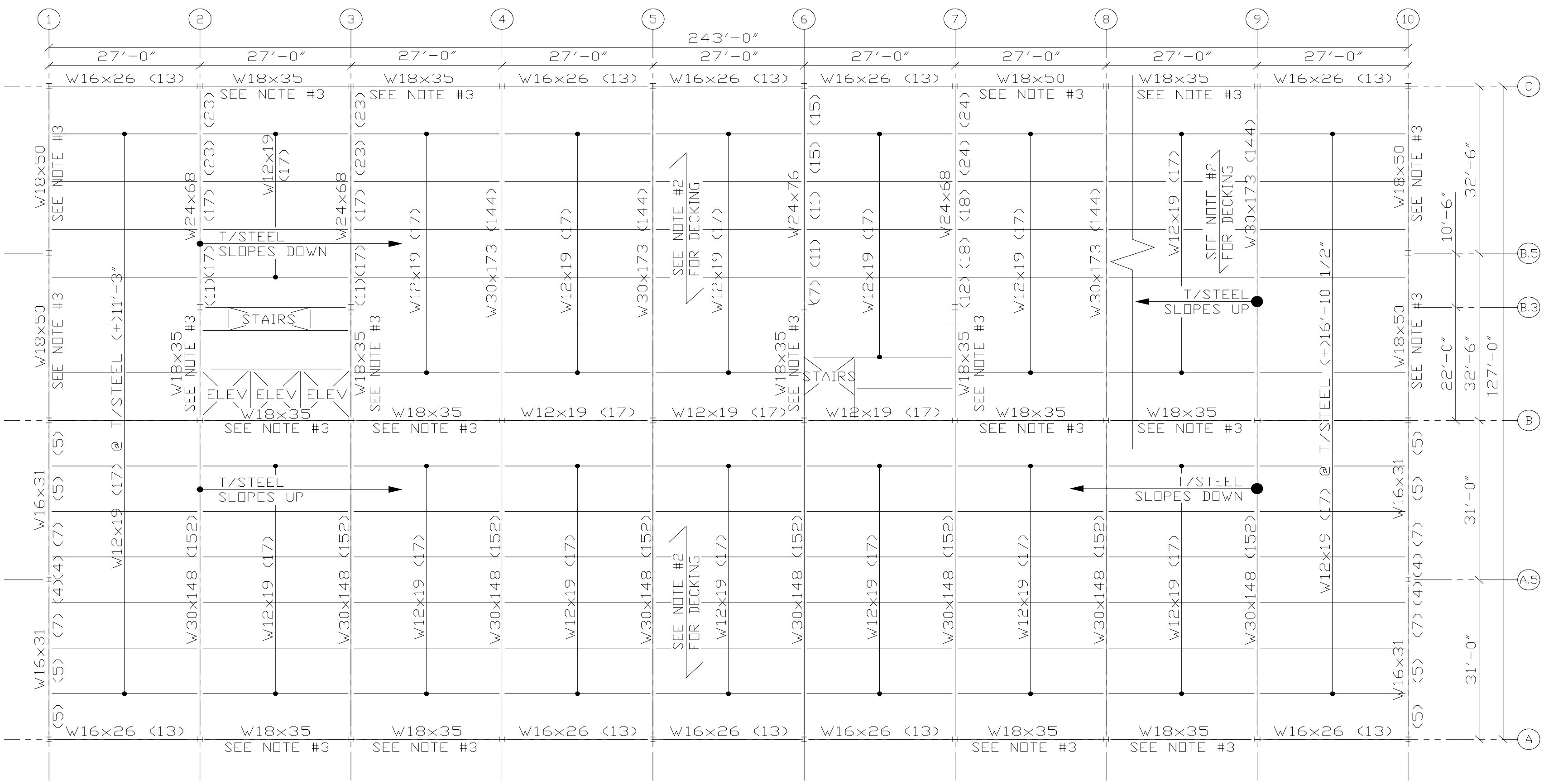

SECOND FLOOR FRAMING PLAN

NOTE: 1) ALL BEAMS ARE W12x14 UNLESS NOTED OTHERWISE.
2) 3" THICK, METAL DECK WITH 3 1/4" LT WT CONCRETE FOR TOTAL SLAB THICKNESS OF 6 1/4".
3) INDICATES CROSS-BRACED BAY, SEE FRAMING ELEVATIONS FOR MEMBER SIZES AND CONFIGURATION.
4) (*) REPRESENTS EQUALLY SPACED NUMBER OF STUDS.

Title: Second Floor Framing Plan

Name: Todd Alwood

Date: 12.15.2003

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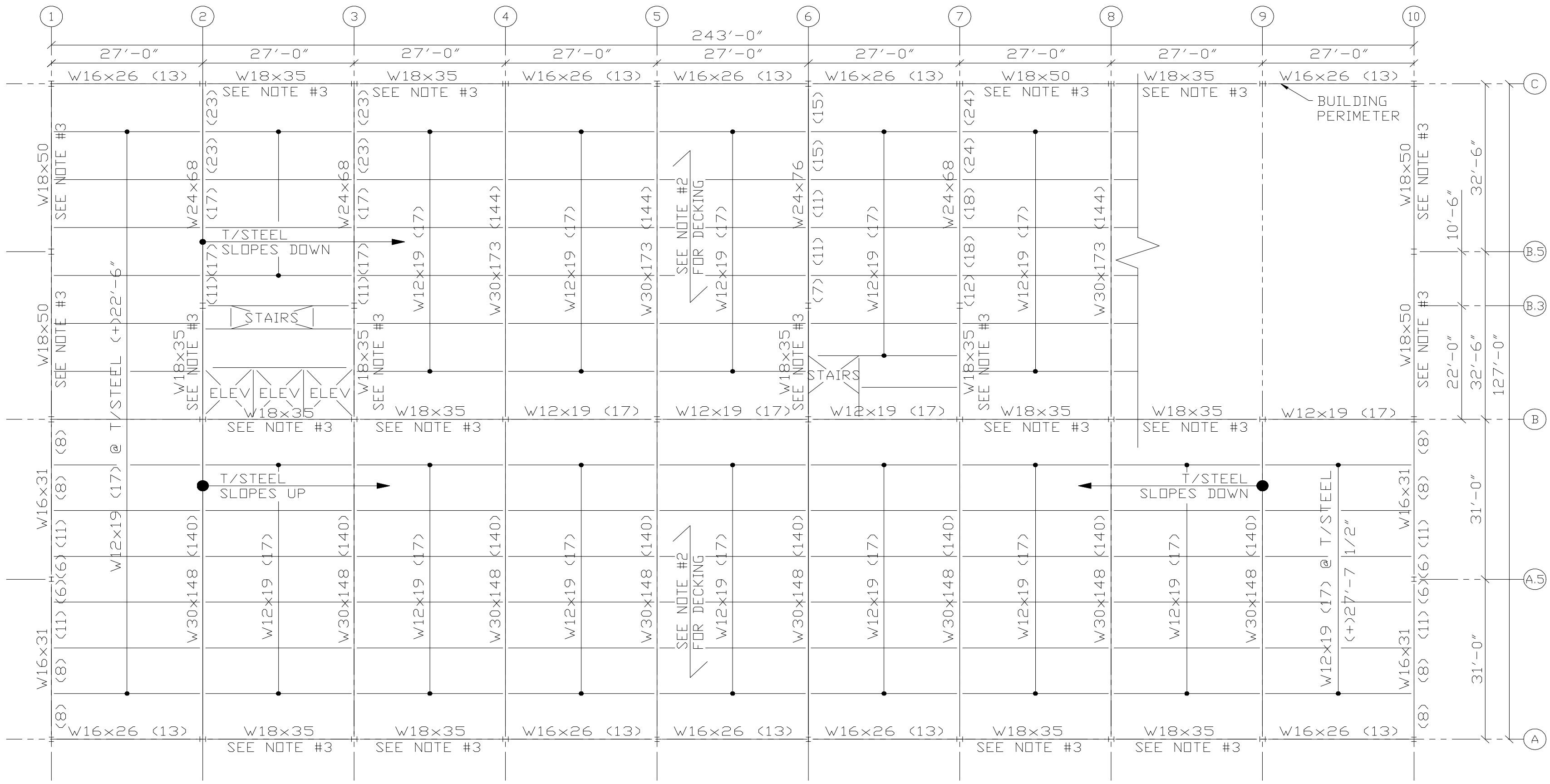

THIRD FLOOR FRAMING PLAN

NOTE: 1) ALL BEAMS ARE W12x14 UNLESS NOTED OTHERWISE.
2) 3" THICK, METAL DECK WITH 3 1/4" LT WT CONCRETE FOR TOTAL SLAB THICKNESS OF 6 1/4".
3) INDICATES CROSS-BRACED BAY, SEE FRAMING ELEVATIONS FOR MEMBER SIZES AND CONFIGURATION.
4) (*) REPRESENTS EQUALLY SPACED NUMBER OF STUDS.

Title: Third Floor Framing Plan
Name: Todd Alwood
Date: 12.15.2003

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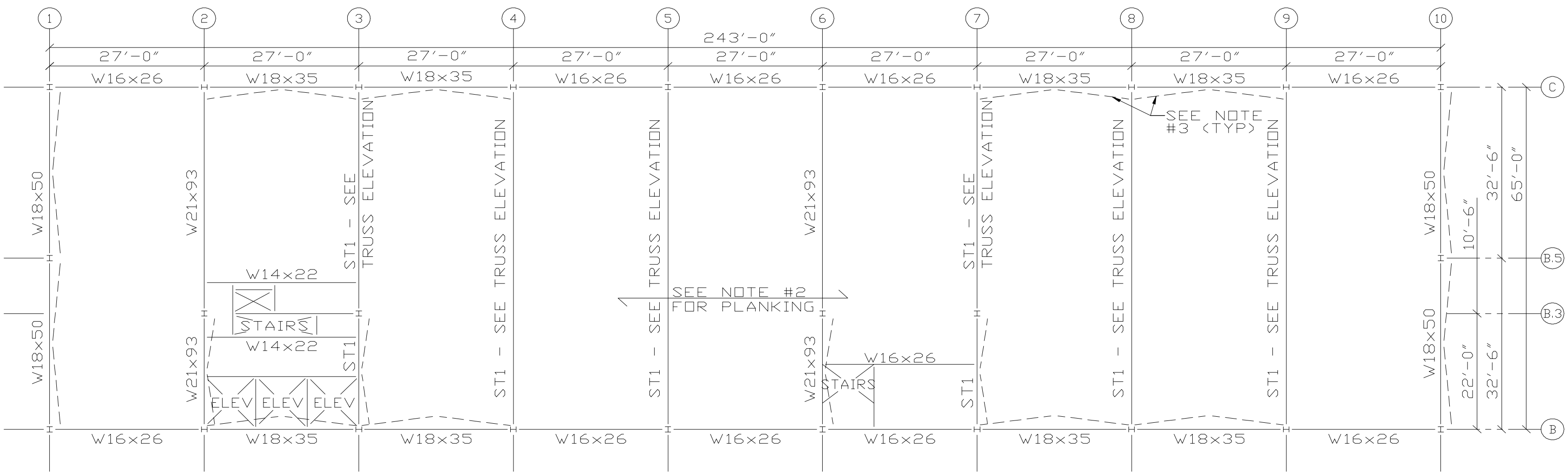

FOURTH FLOOR FRAMING PLAN

NOTE: 1) ALL BEAMS ARE W12x14 UNLESS NTED OTHERWISE.
2) ALL PLANKING TO BE 8" THICK, UN-TOPPED & NON-CAMBERED, PRECAST HOLLOW-CARE PLANK.
3) DASHED LINES INDICATE CROSS-BRACING BELOW. SEE ELEVATIONS FOR MEMBER SIZES.

Title: Fourth Floor Framing Plan
Name: Todd Alwood
Date: 12.15.2003

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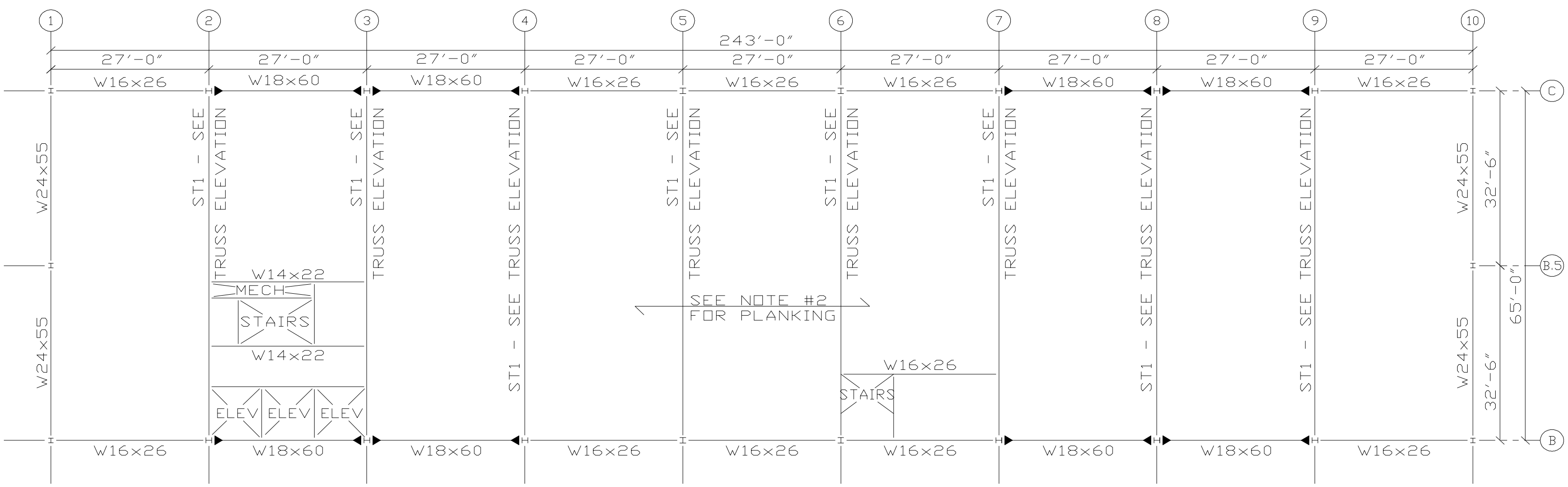

FIFTH THROUGH EIGHTH FLOOR FRAMING PLAN

NOTE: 1) ALL BEAMS ARE W12x14 UNLESS NTED OTHERWISE.
2) ALL PLANKING TO BE 8" THICK, UN-TOPPED & NON-CAMBERED, PRECAST HOLLOW-CARE PLANK.

Title: Fifth Through Eighth Floor Framing Plan

Name: Todd Alwood

Date: 12.15.2003

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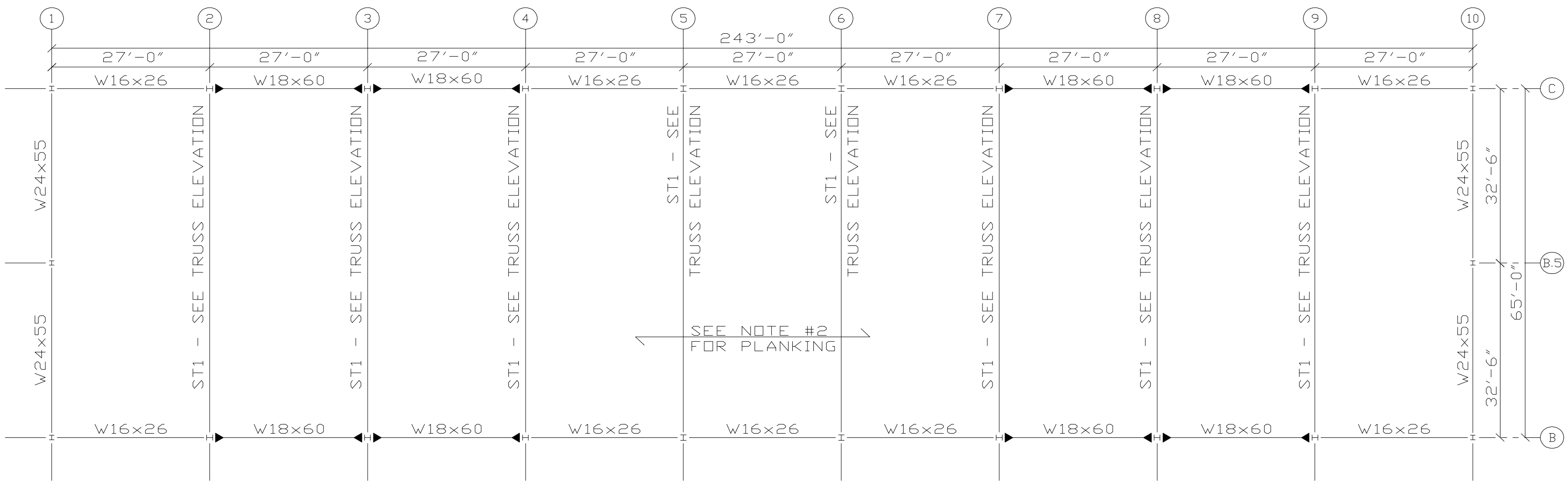

ROOF FRAMING PLAN

NOTE: 1) ALL BEAMS ARE W12x14 UNLESS NTED OTHERWISE.
2) ALL PLANKING TO BE 8" THICK, UN-TOPPED & NON-CAMBERED, PRECAST HOLLOW-CARE PLANK.

Title: Roof Framing Plan
Name: Todd Alwood
Date: 12.15.2003

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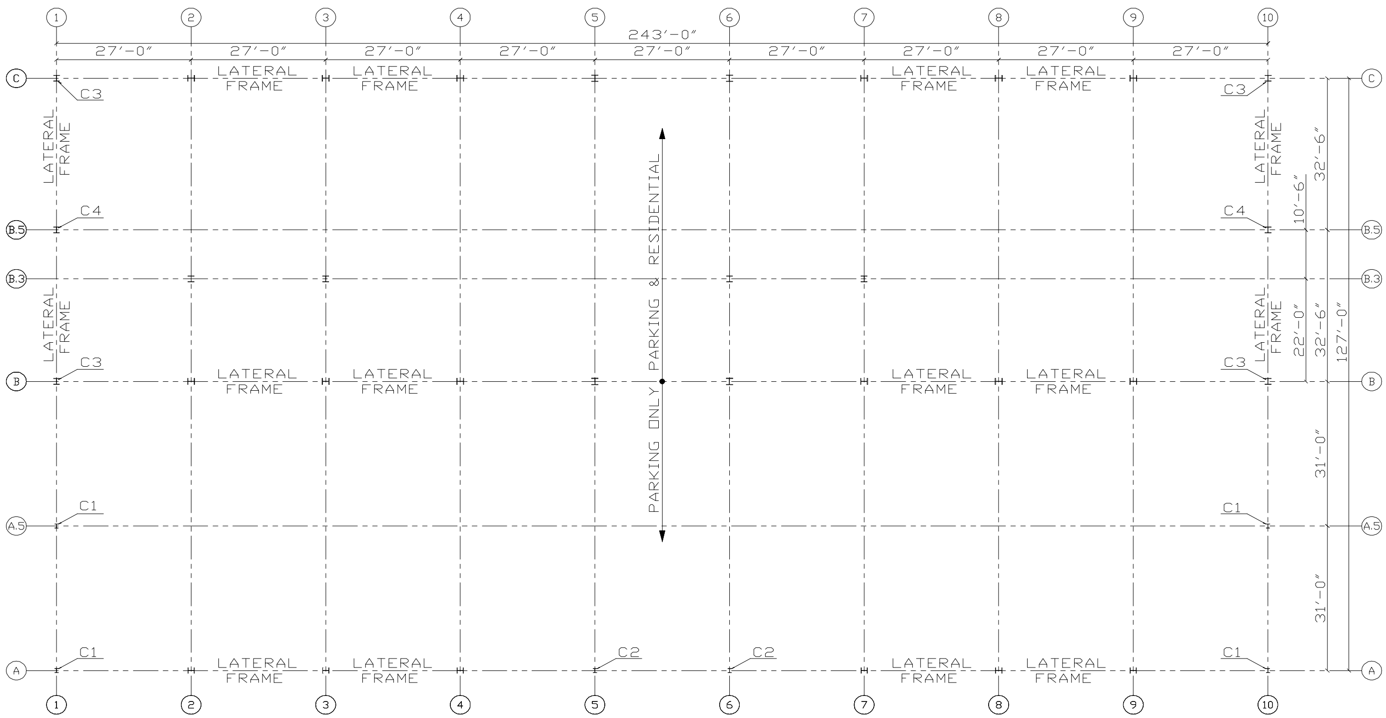
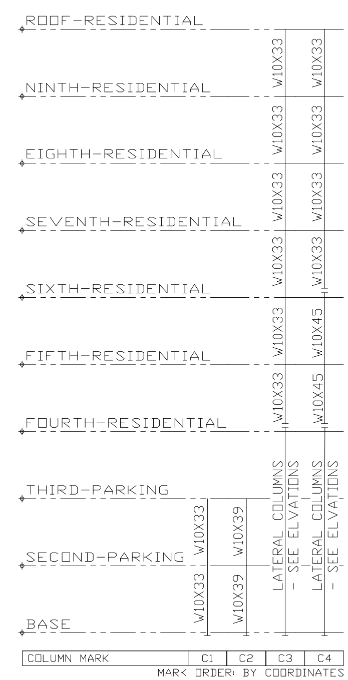


COLUMN LAYOUT PLAN



COLUMN SCHEDULE

Title: Column Schedule and Layout Plan
Name: Todd Alwood
Date: 12.15.2003

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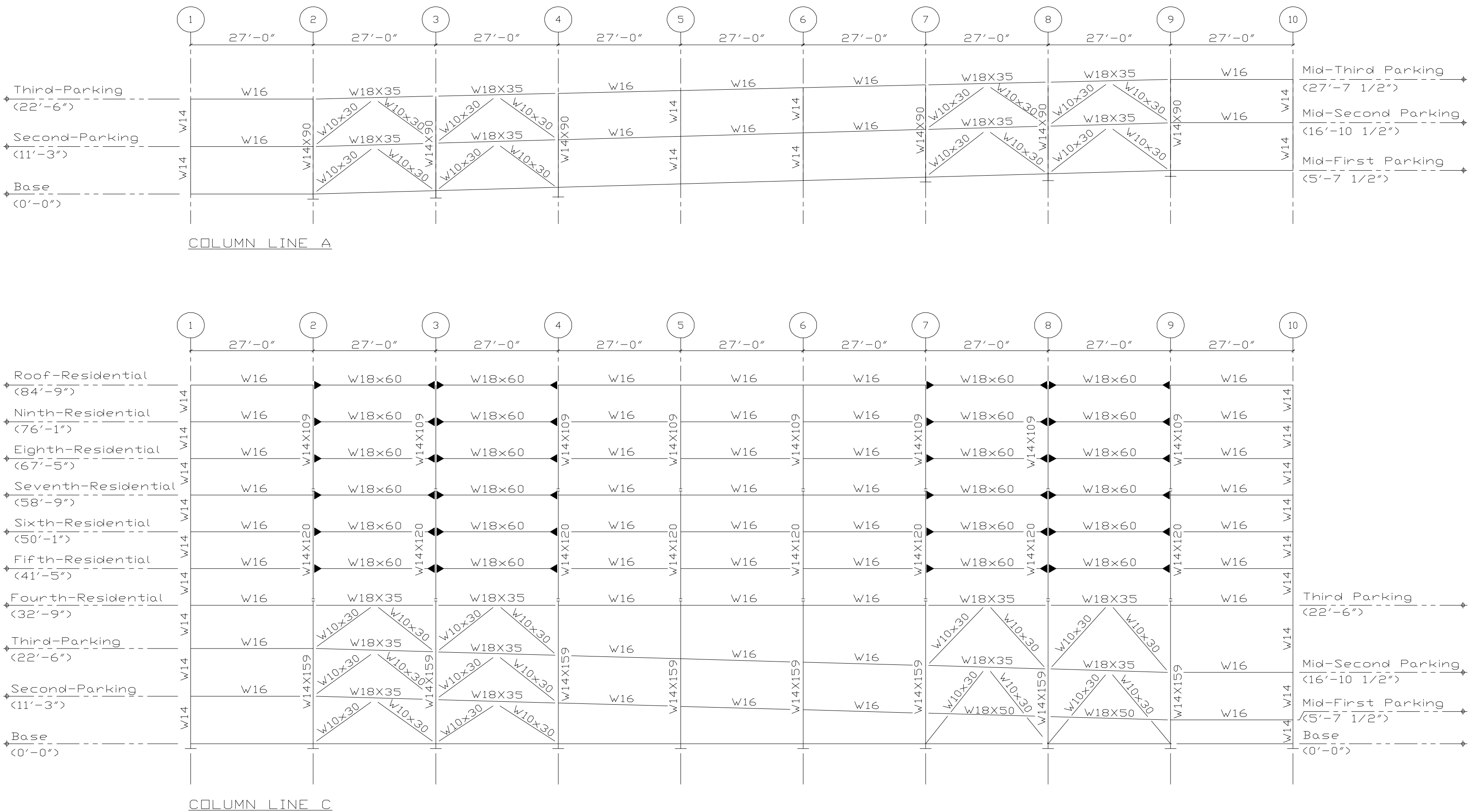

Title: Column Line Elevation A & C
Name: Todd Alwood
Date: 12.15.2003

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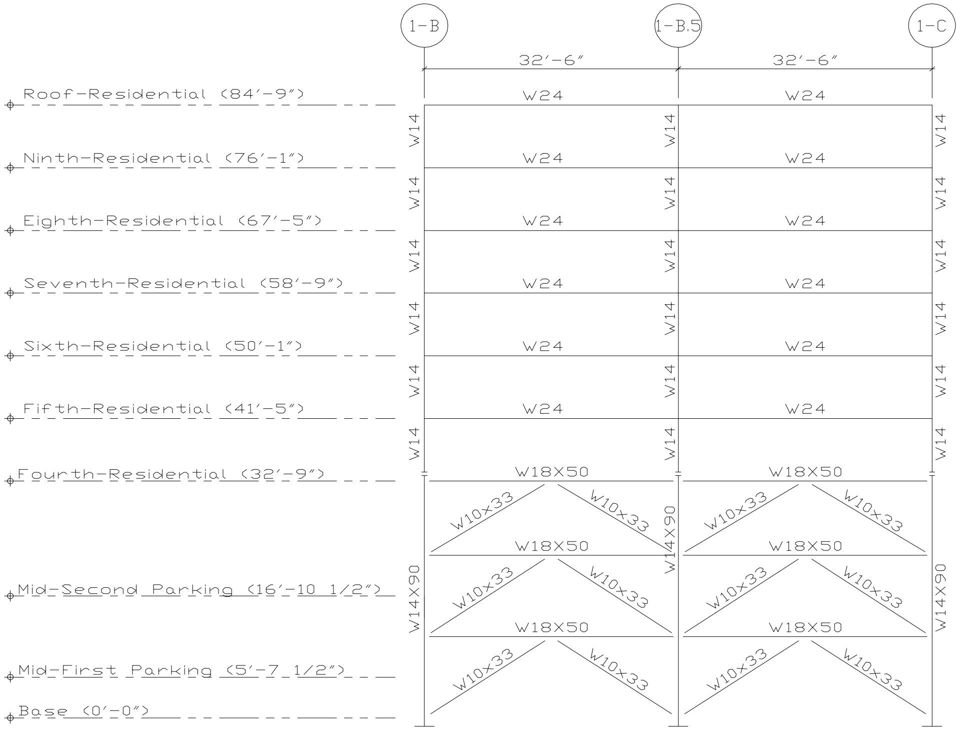
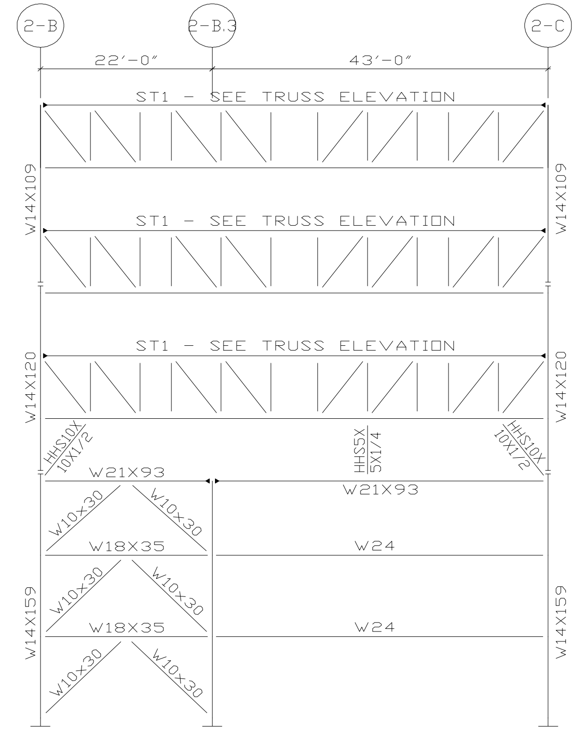


COLUMN LINE 1



COLUMN LINE 2

Title: Column Line Elevations 1 & 2
Name: Todd Alwood
Date: 12.15.2003

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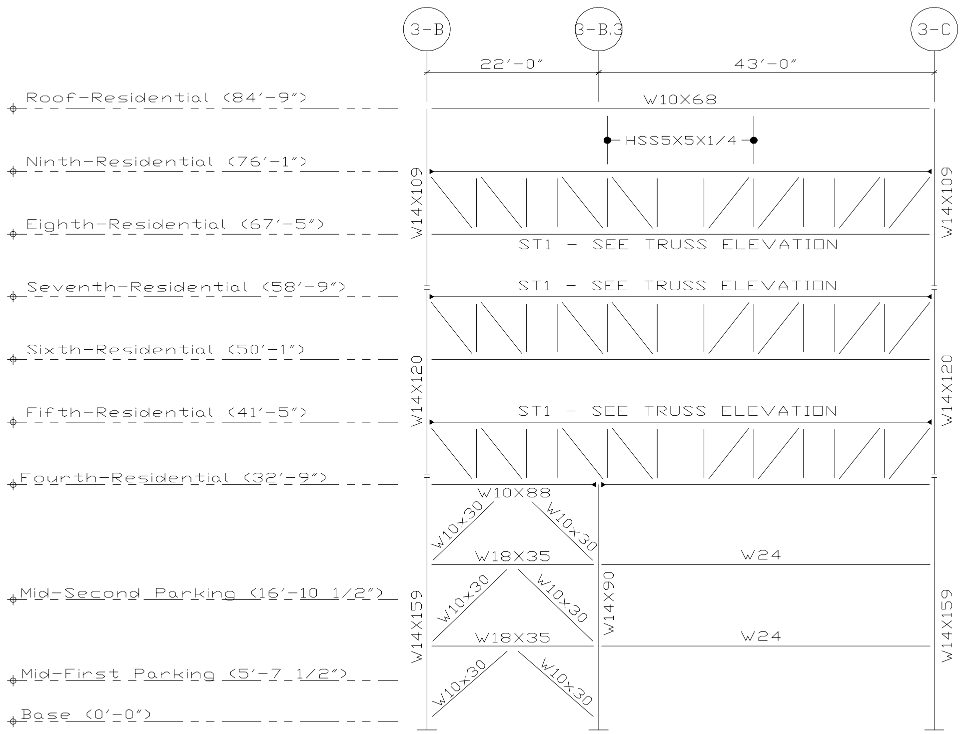
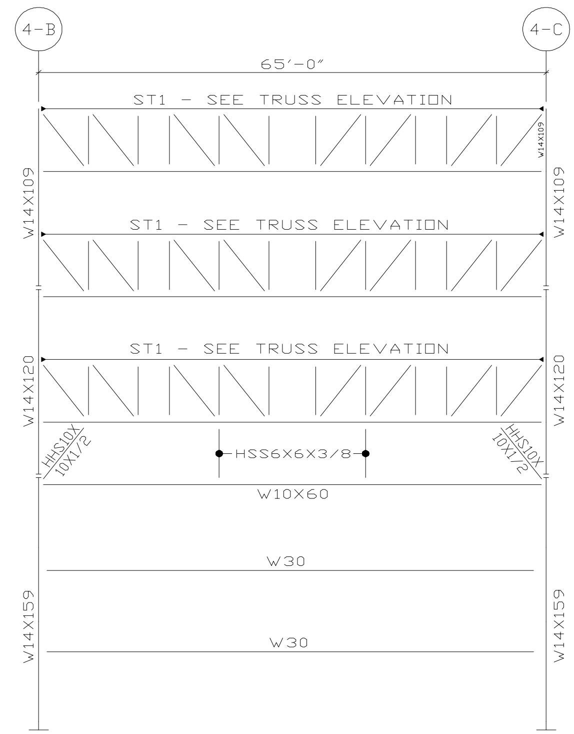


COLUMN LINE 3



COLUMN LINE 4

Title: Column Line Elevations 3 & 4
Name: Todd Alwood
Date: 12.15.2003

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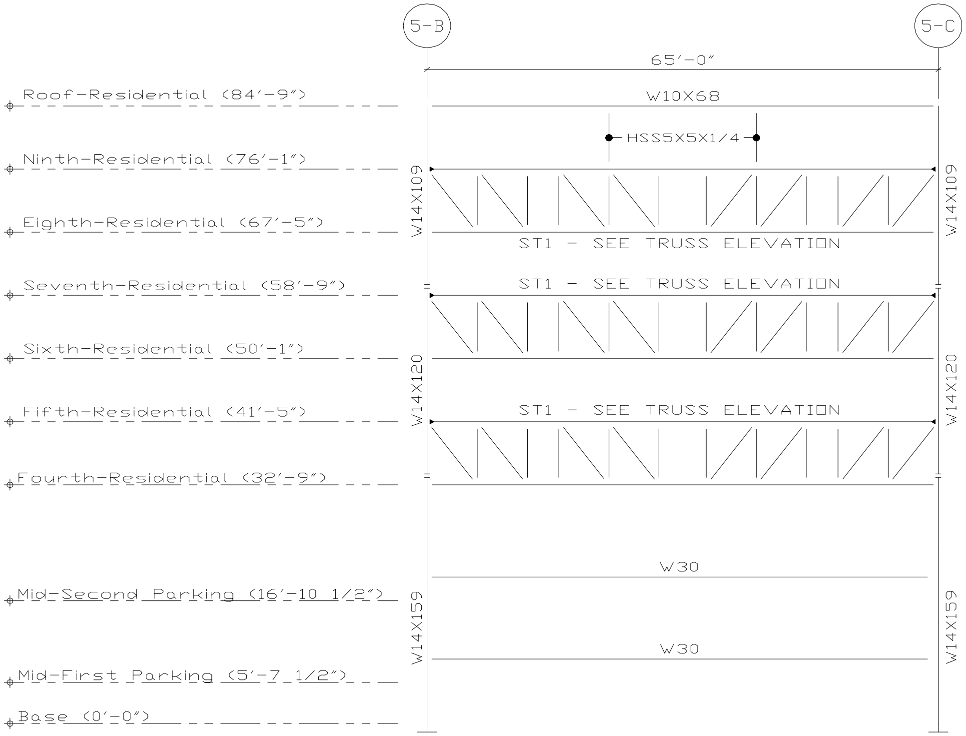
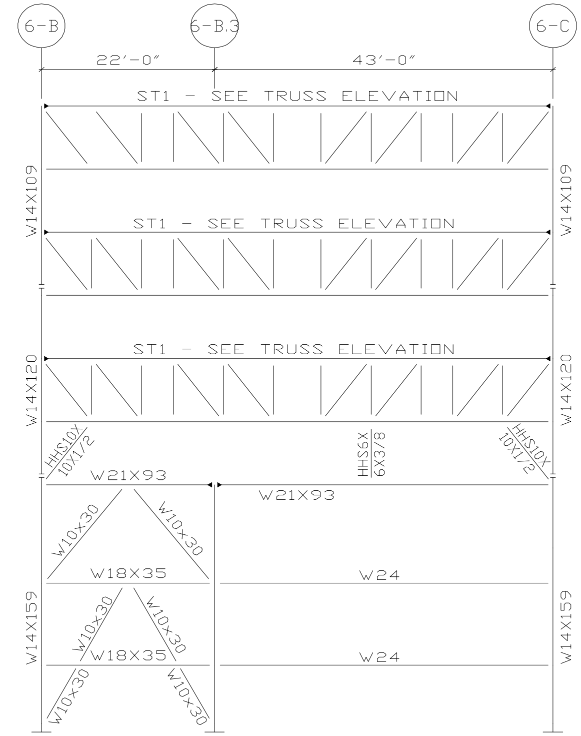


COLUMN LINE 5



COLUMN LINE 6

Title: Column Line Elevations 5 & 6
Name: Todd Alwood
Date: 12.15.2003

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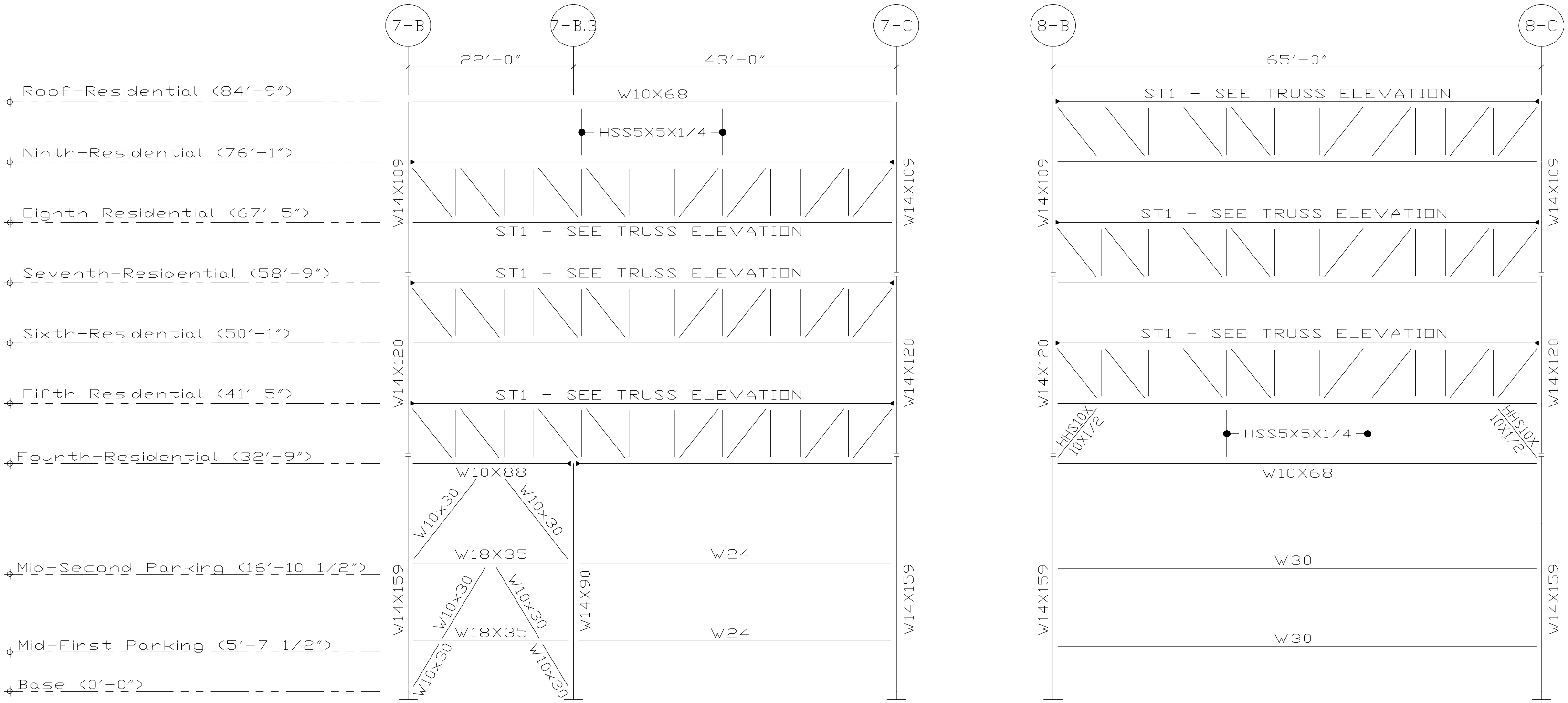

COLUMN LINE 7

COLUMN LINE 8

Title: Column Line Elevation 7 & 8

Name: Todd Alwood

Date: 12.15.2003

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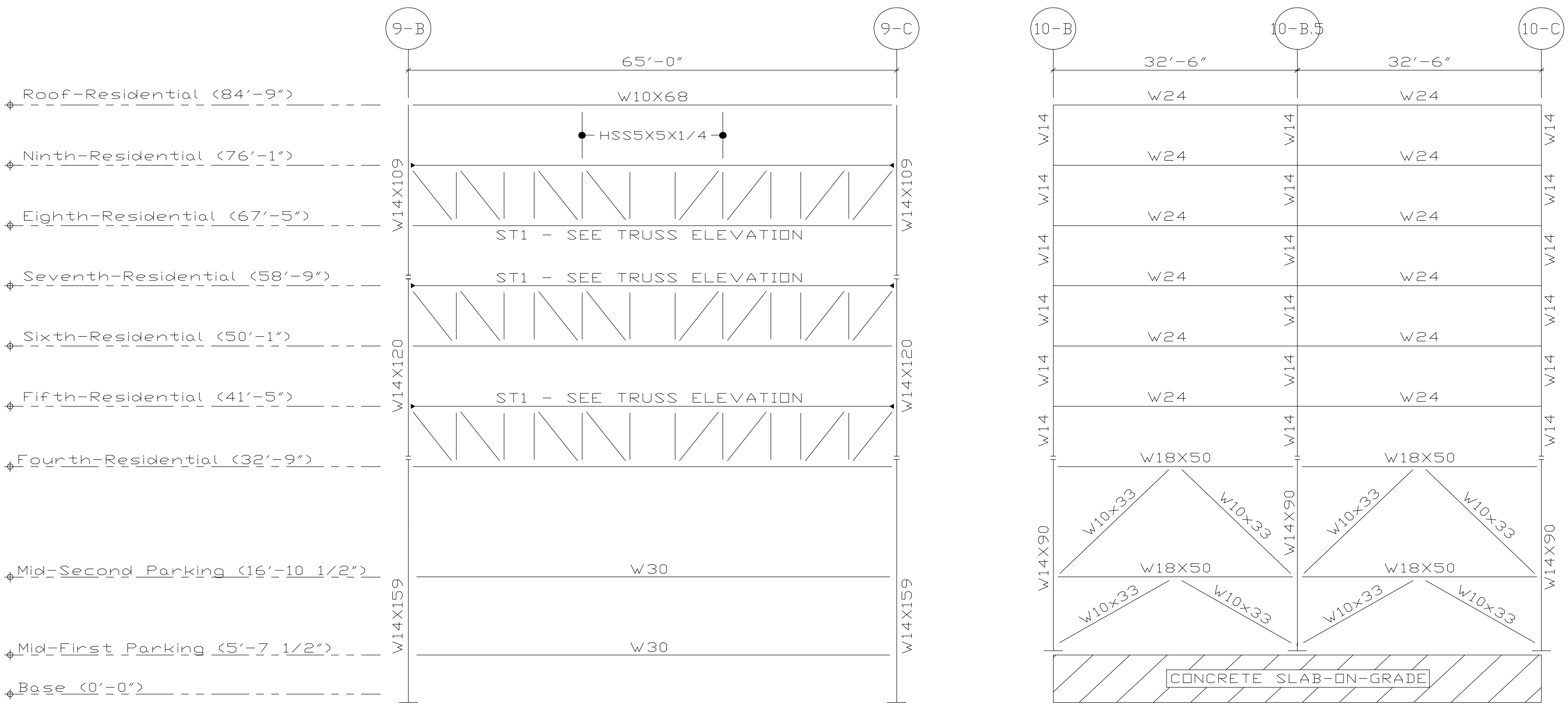

COLUMN LINE 9

COLUMN LINE 10

Title: Column Line Elevations 9 & 10

Name: Todd Alwood

Date: 12.15.2003

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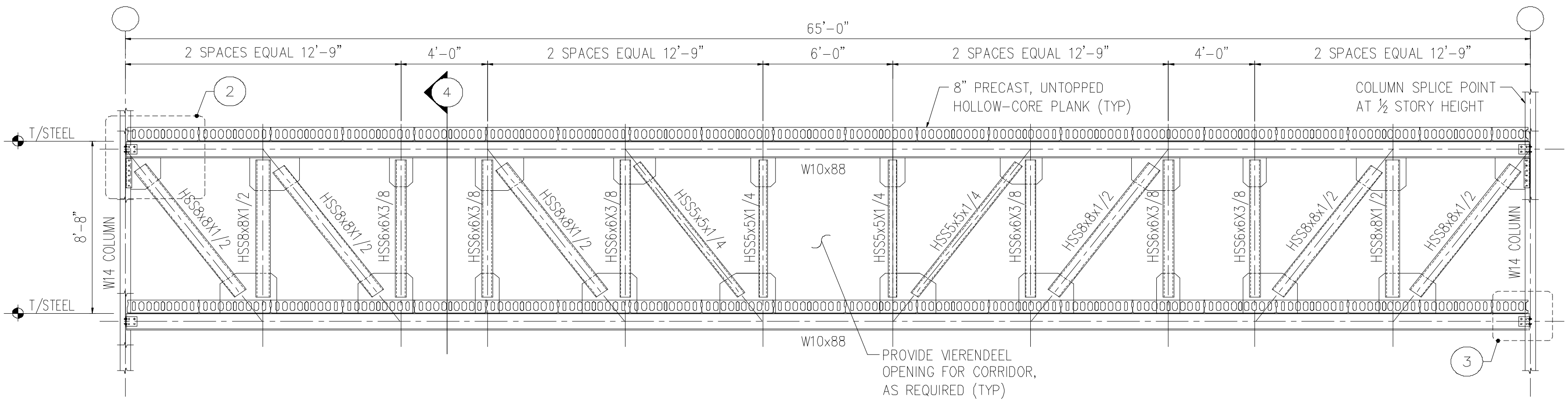
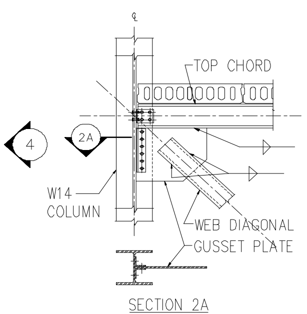
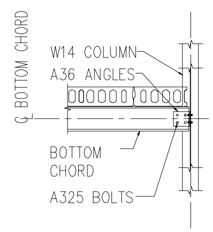


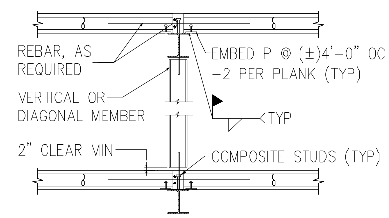
1 TYPICAL STAGGERED TRUSS ELEVATION (ST1)
SCALE: NO SCALE



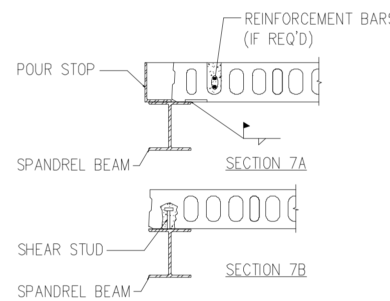
2 TRUSS TO COLUMN CONNECTION
SCALE: NO SCALE



3 BOTTOM CHORD TO COLUMN CONNECTION
SCALE: NO SCALE



4 TRUSS SECTION
SCALE: NO SCALE



5 PLANK TO SPANDREL CONNECTION
SCALE: NO SCALE

Title: Staggered Truss & Details
Name: Todd Alwood
Date: 12.15.2003

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