Parking

Conventional Steel Framing Study

STEEL SOLUTIONS CENTER

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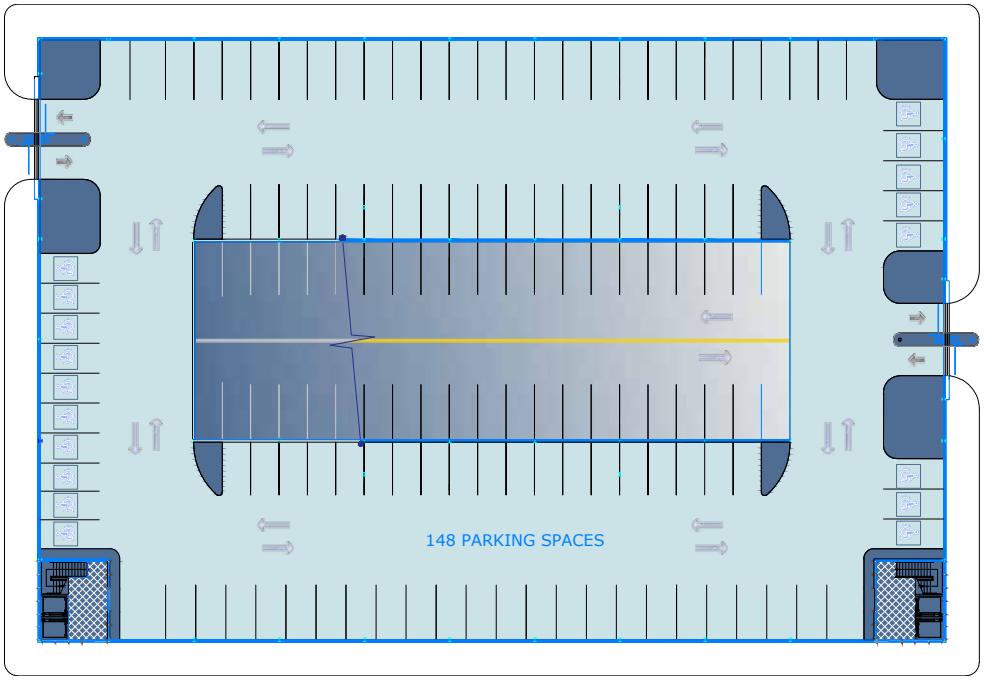
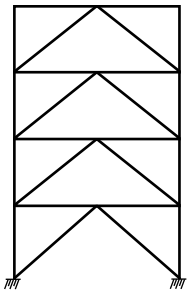
Project Information

- Denver, Colo.
- Five-story parking structure
- Conventional steel framing with castellated in-fill beam (optional)
- Steel ordinary concentrically braced frames and moment frames
- Typical floor-to-floor height: 11’-4”

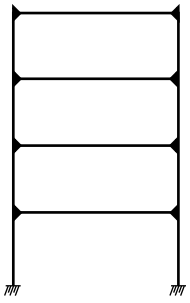
Architectural Floor Plans



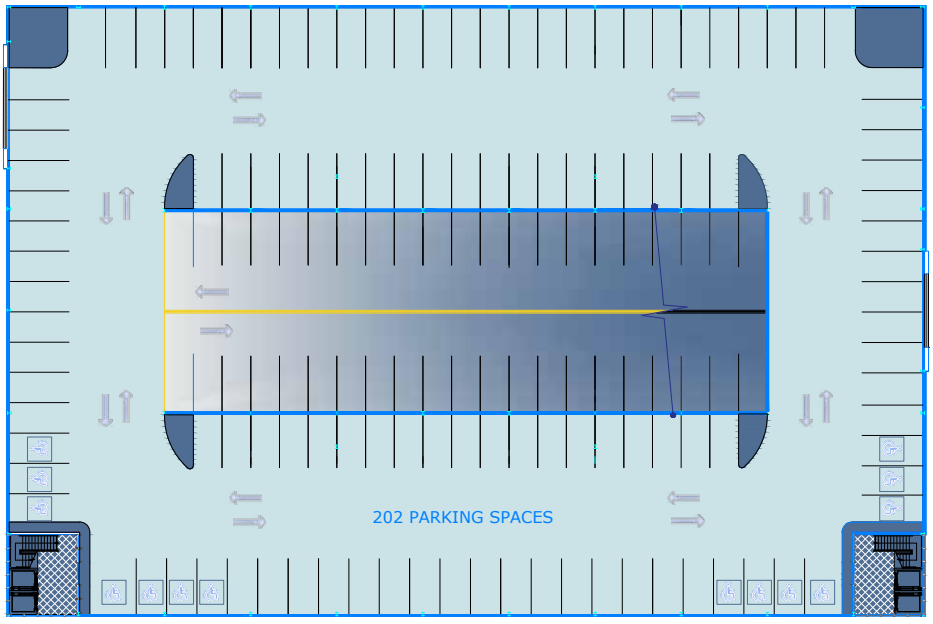
First Floor Plan



Concentrically Braced Frame



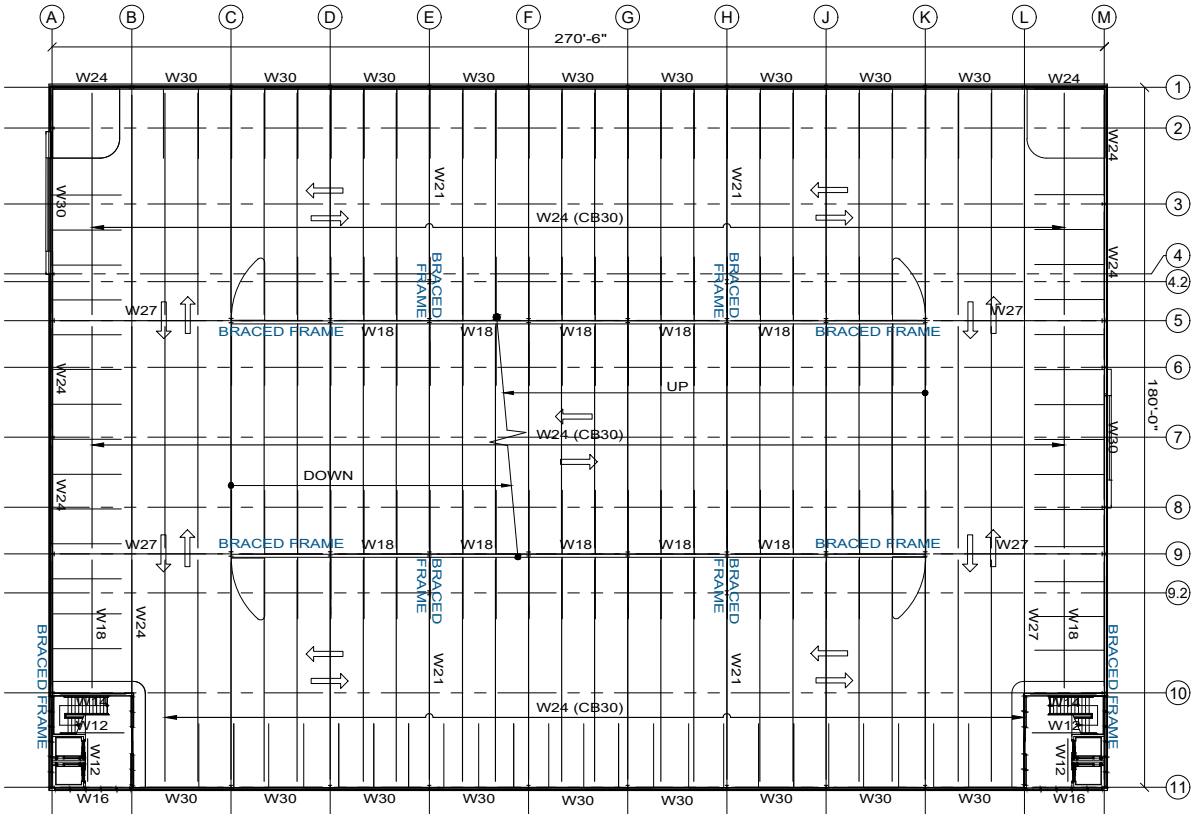
Moment Frame



Typical Floor Plan

Typical Structural Framing Plan

See pages 5 through 8 for detailed framing plans and frame elevations.



Steel Quantity Totals

See page 4 for detailed steel quantity information.

Total Building Area = 192,730 sq. ft				
Total Steel Tonnage	Total Pounds Per sq. ft	Total Pieces	Total Studs	Total Cambered Beams
728	7.55	939	10,722	354

Steel Benefits

Steel framing will reduce overall project costs, including lower foundation costs due to steel's higher strength-to-weight ratio, general condition savings due to faster construction schedules, and increased revenue from earlier occupancy thanks to faster construction.

Structural steel's recycled content and recycling rate exceed those of any other construction material, with steel produced within the United States containing approximately 93% recycled steel scrap and 98% of all structural steel recycled back into new steel products, at the end of a building's life.

Castellated in-fill beams include web openings at a regular interval, which can easily accommodate mechanical, electrical, and plumbing services through the web openings rather than under the beam.

Long-span beams with open, column-free spaces are ideal for parking

Schedule and Pricing

Contact the Steel Solutions Center for assistance with locating an AISC member fabricator in your area for pricing and schedule information. You may also search our website for further information on member fabricators in your region. AISC member fabricators are an excellent source of pricing and schedule information. Email **solutions@aisc.org** or call 866.ASK.AISC to find an AISC member fabricator in your area.

Loading Summary

Gravity Loading	
Live Loads	
Garage	40 psf
Roof Snow	20 psf
Dead Loads	
Typical Floor	46 psf (2 in. metal deck with 4½ in. NW Concrete)
Superimposed Dead Loads	
Floof	5 psf (CMEP, etc.)
Cladding	
Precast Façade	600 plf
Wind Loading	
Basic Wind Speed	115 mph
Exposure Category	C
Drift Limit	H/500

Seismic Loading	
Seismic Design Category	C
Seismic Importance Factor	1.00
Spectral Response Acceleration, Short Period, S_s	0.182 g
Spectral Response Acceleration, One Second Period, S_1	0.058 g
Site Class	D
Building Period Coefficient, C_T	0.02
Response Modification Factor, R	3.00
System Overstrength Factor, Ω_0	3.00
Deflection Amplication Factor, C_d	3.00
Allowable Story Drift Coefficient	0.02
Lateral Force Resisting System	
Steel Systems Not Specifically Detailed For Seismic Resistance	
Risk Category	II

Steel Quantity Takeoff

Suspended Steel Floor Areas		**Total Area**	**194,760 ft²**	
Estimated Steel Quantities				
Gravity Columns	W12s	42 tons	0.43 psf	76 pieces
Lateral Frames	Beams	26 tons	0.27 psf	40 pieces
	Columns	44 tons	0.49 psf	80 pieces
	Braces (HSS)	30 tons	0.31 psf	80 pieces
Column & Lateral Subtotal		146 tons	1.5 psf	276 pieces
Conventional Option				
	Wide Flange Beams	953 tons	9.79 psf	637 pieces
		21,444 tons		
		354 Beams cambered between 0.75 in. and 2 in.		
Steel not indicated in sketches (5%)		55 tons	0.56 psf	
Column & Lateral Subtotal		146 tons	1.50 psf	276 pieces
Conventional Option Total		**1154 tons**	**11.85 psf**	**913 pieces**
Castellated Option				
	Castellated Beams	455 tons	4.67 psf	332 pieces
	Wide Flange Beams	285 tons	2.93 psf	305 pieces
		15,816		
		354 Beams cambered between 0.75 in. and 2 in.		
Steel not indicated in sketches (5%)		44 tons	0.45 psf	
Column & Lateral Subtotal		146 tons	1.50 psf	276 pieces
Castellated Option Total		**930 tons**	**9.55 psf**	**913 pieces**

Notes

1. The quantities are based on centerline dimensions.
2. Steel not indicated in sketches accounts for framing not included in the estimate such as framing for openings or various members eliminated for simplification. It does not include connection material, slab edge material or façade attachments.

Material Specification

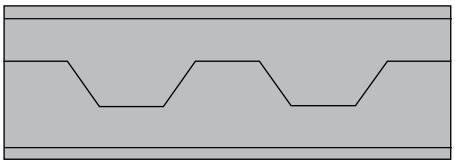
1. Wide flange shapes are ASTM A992
2. Rectangular HSS sections are ASTM A500 Gr. C.

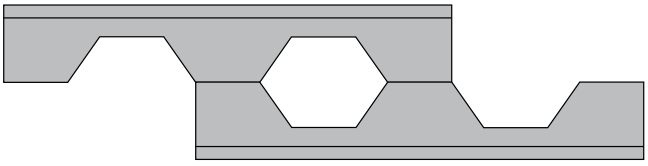
Castellated Shape Usage

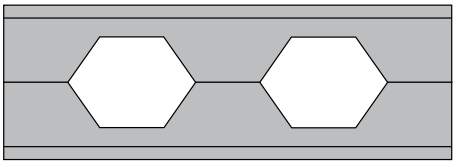
Castellated beams have been used in the United States for nearly every building usage and exhibit the inherent advantages of building with structural steel. In addition, castellated beams can also provide advantages, allowing MEP systems to move from being placed below the beams and girders to within the openings of the castellated members. This can reduce the floor-to-floor height of the facility, and allows for easy organization and modification of these systems. Exposed castellated beams allow for the flow of light (natural or bulb) through the webs of the beams providing greater indoor environments.

Castellated Beam Advantages

- Members are lightweight and structurally sound.
- Members, like wide flange framing, can be painted or fire protected.
- Beams provide lower floor-to-floor height by passing ductwork and utilities through openings.
- Members, like wide flange framing, provide a bright and open look.
- Steel construction has the ease and speed of erection.



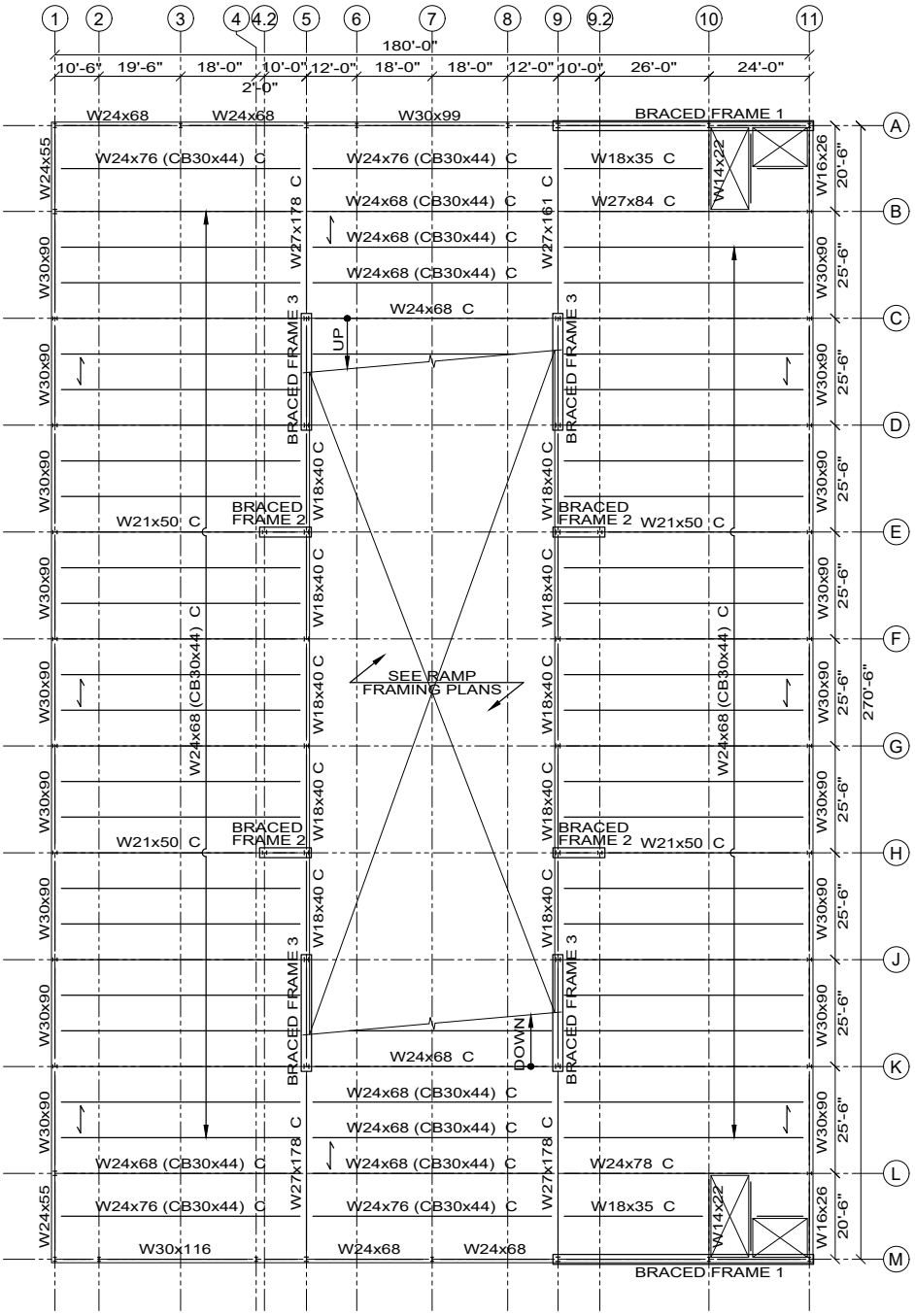




Fabrication

The fabrication process for castellated members can be performed easily by today's more automated fabrication shops. The sections are created by cutting a standard wide-flange shape in a zig-zag pattern along the web, separating the member into two halves. The two halves (which can originate from two different parent wide flange sizes) are then welded at the web posts to create the castellated member. During the creation of these members, camber can be fabricated into the cutting/welding of the member. For castellated beams, it is recommended that a high-performance coating system be utilized rather than galvanizing as this decreases the chances of cracks forming at the edges of the hexagonal openings during the galvanization process.

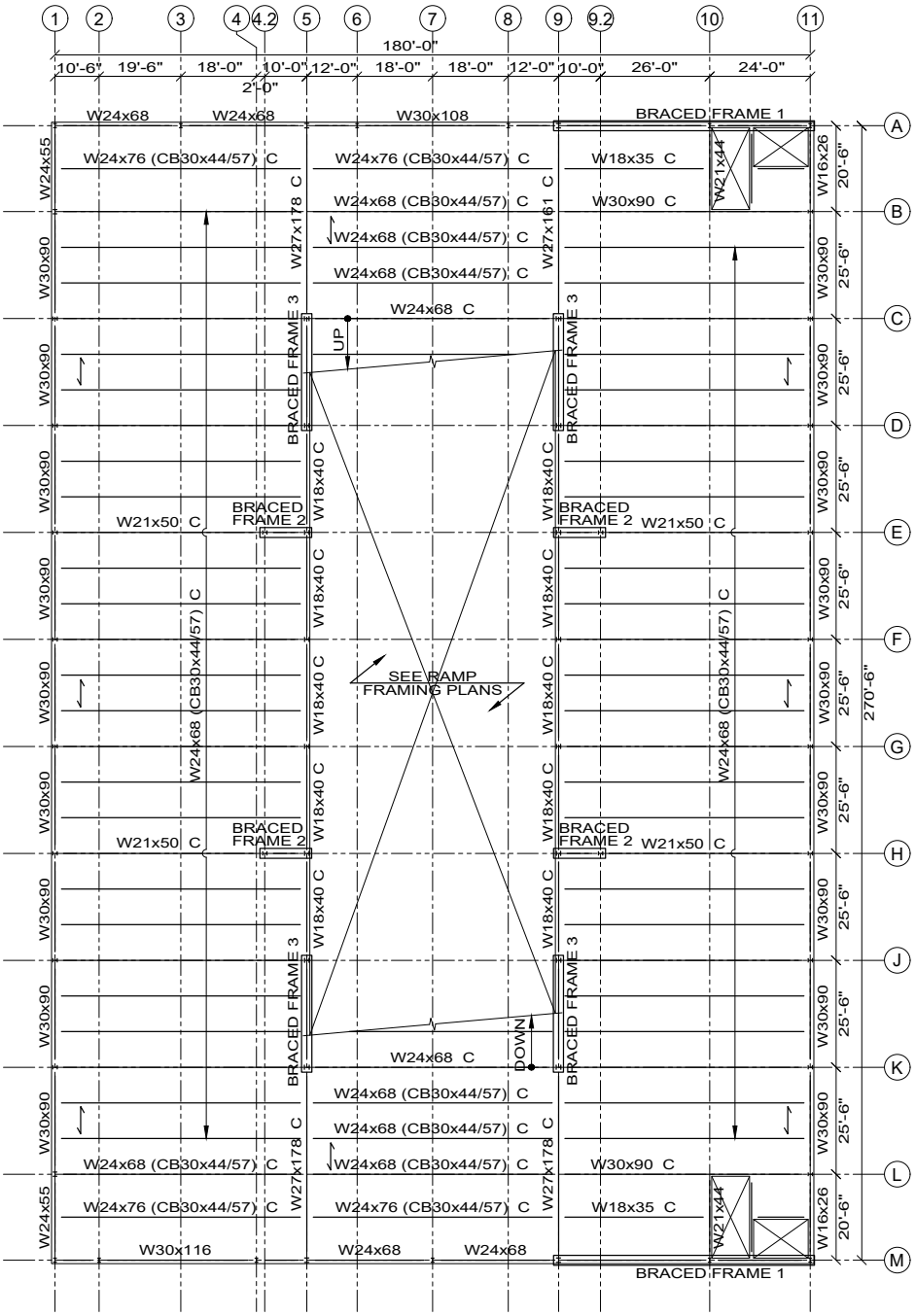
Typical Floor Framing Plan



Notes:

1. Each member is marked with the estimated member size for wide-flange (W) or alternate castellated (CB) beam and the designation for camber; the size of the castellated beam is indicated within the parentheses. If present, the designation "C" indicates an assumed camber from ¾ in. to 2 in. The estimated number of studs for each member is not indicated. A total estimated number of studs is provided in the quantities.
2. Boxes The wide-flange beams are pin-connected to the columns in the braced frames. NO special base plate detail is assumed for the columns.
3. ⟵⟶ indicates the direction of the estimated floor slab which consists of a 2 in. metal deck and a 4½ in. concrete topping.
4. See the Column Layout Plan and the Column Schedule for gravity column sizes.
5. All beams are W12×14, unless noted otherwise.

Roof Framing Plan



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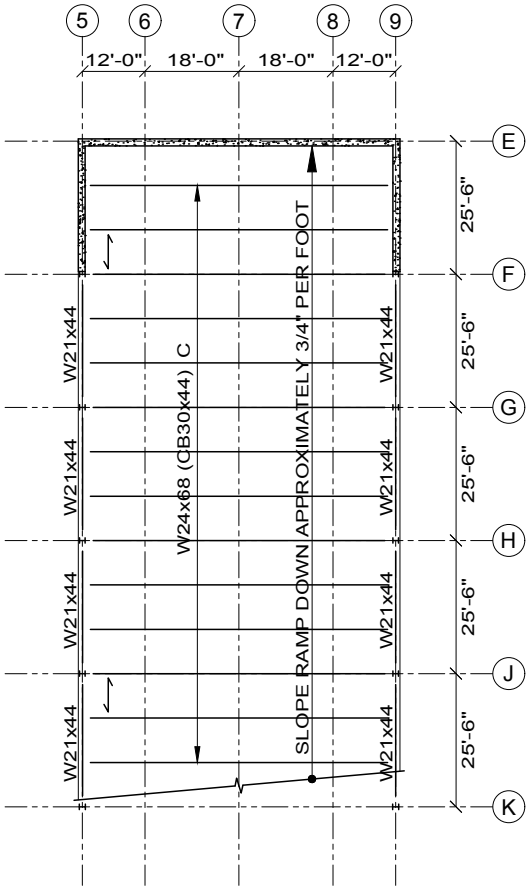
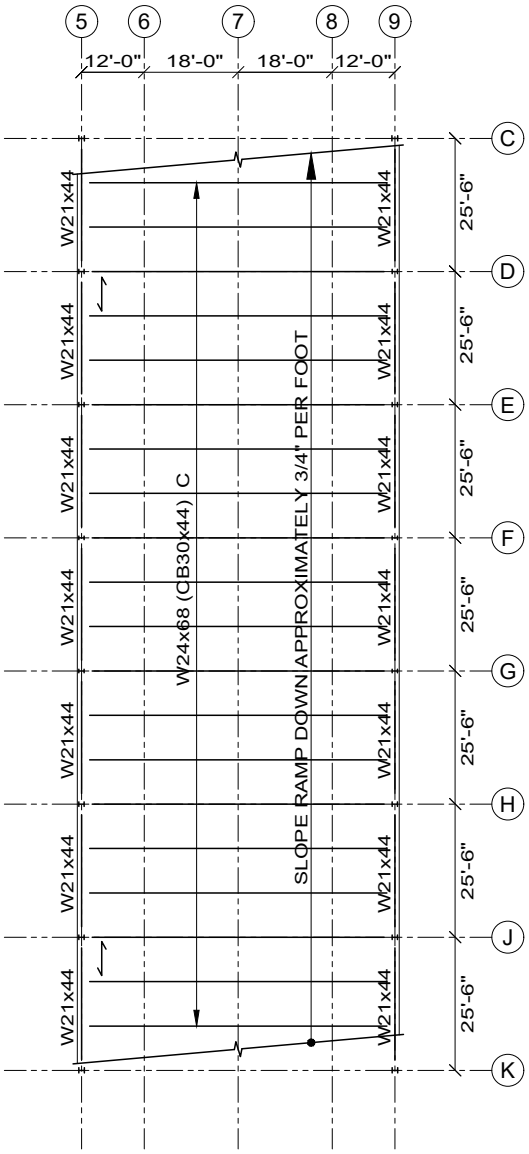
Second Floor Ramp Framing Plan



Typical Ramp Framing Plan



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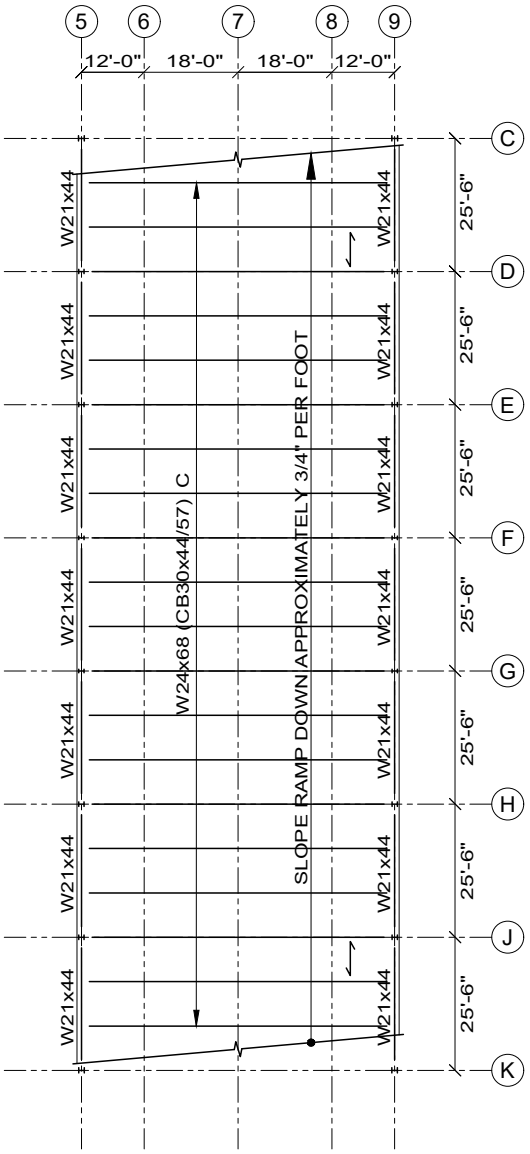
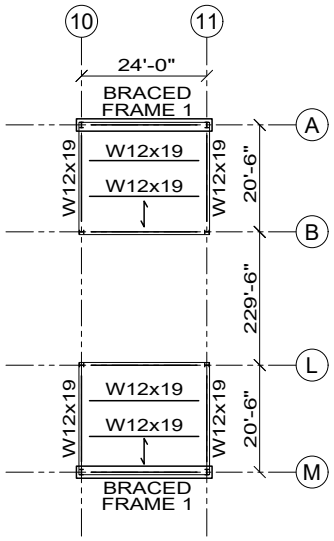
5. All beams are W12×14, unless noted otherwise.

Roof Ramp Framing Plan



High Roof Framing Plan



Notes:

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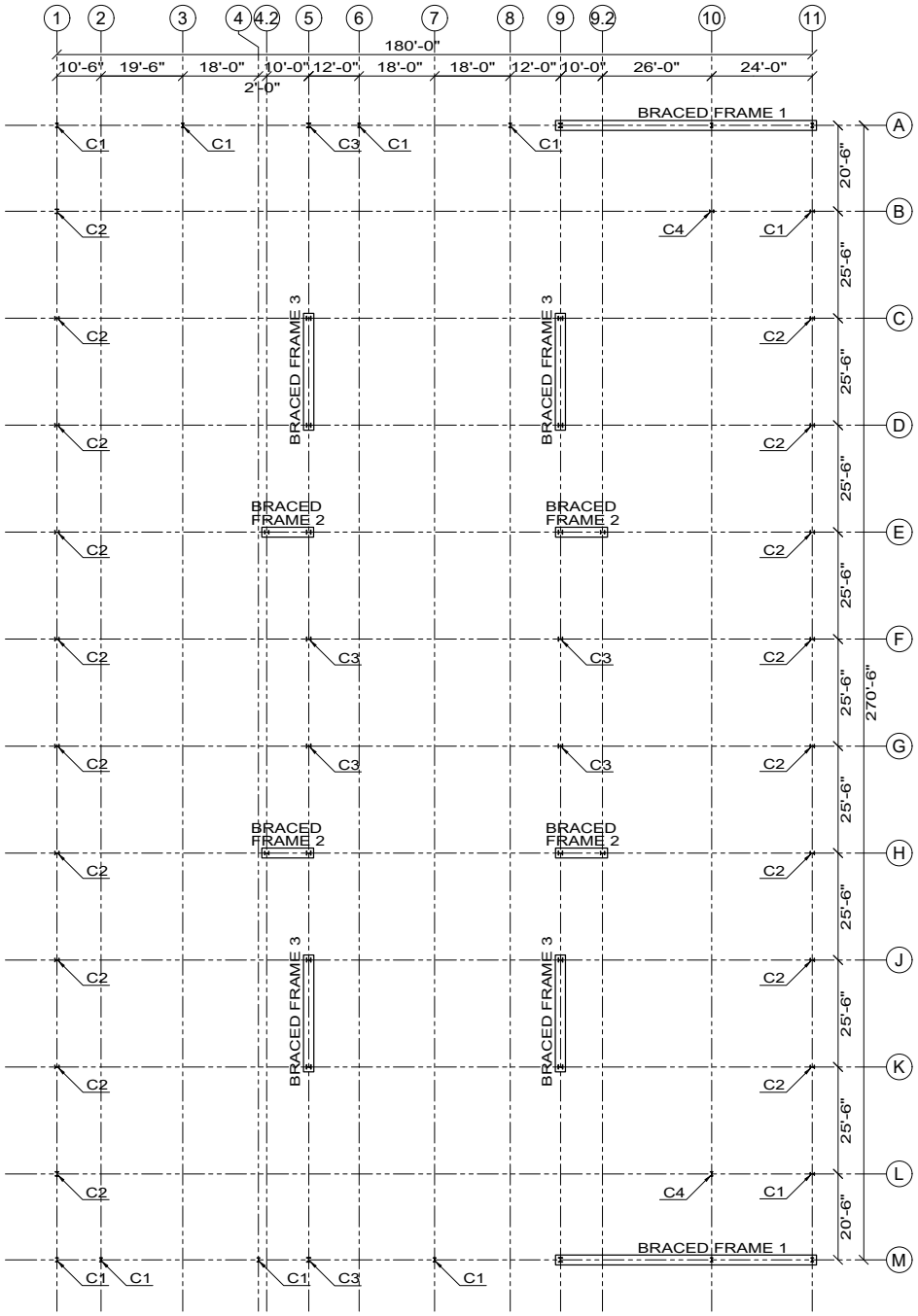
2. Boxes The wide-flange beams are pin-connected to the columns in the braced frames. NO special base plate detail is assumed for the columns.
3. ⟵⟶ indicates the direction of the estimated floor slab which consists of a 2 in. metal deck and a 4½ in. concrete topping.
4. See the Column Layout Plan and the Column Schedule for gravity column sizes.
5. All beams are W12×14, unless noted otherwise.

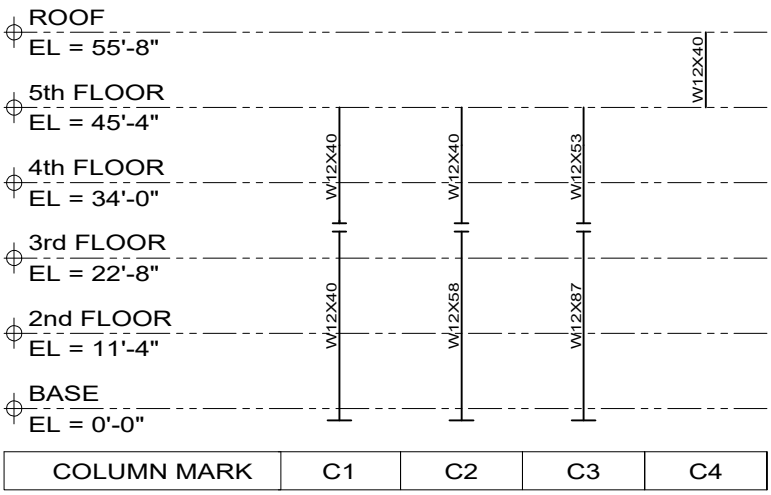
Column Layout Plan



Notes:

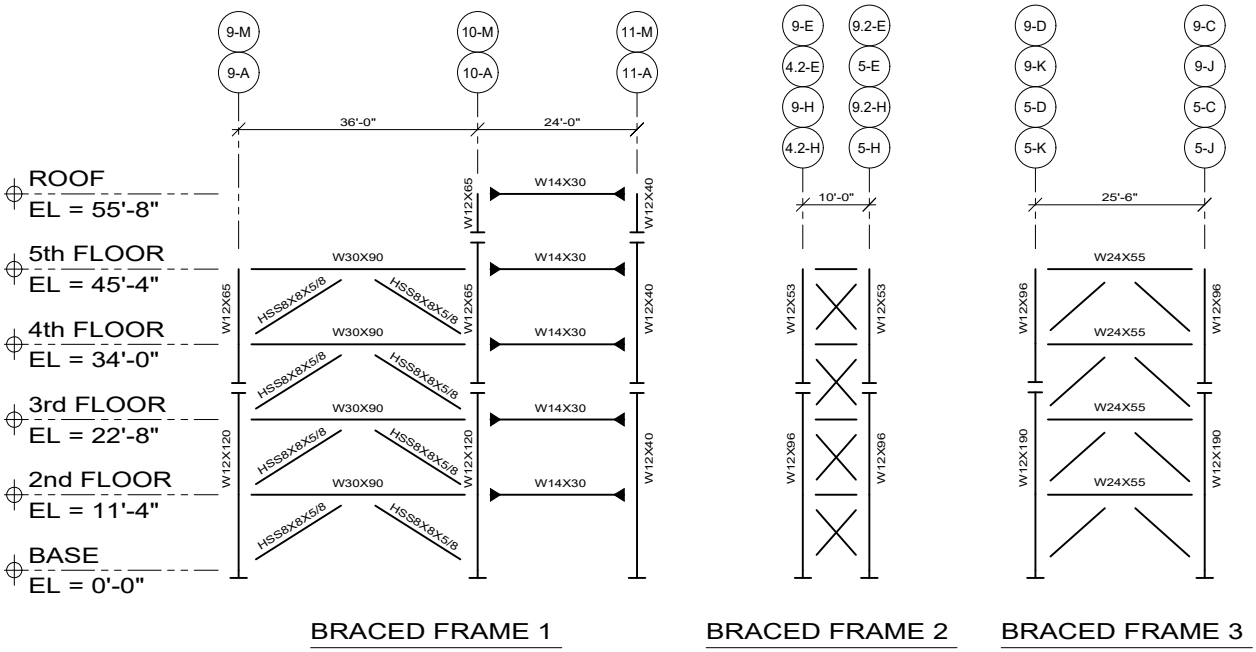
1. Boxes indicate lateral frames. The wide-flange beams are pin-connected to the columns in the braced frames. NO special base plate detail is assumed for the columns.
2. See the Column Schedule for gravity column sizes.

Column Schedule



COLUMN MARK	C1	C2	C3	C4

Frame Elevations



BRACED FRAME 1 BRACED FRAME 2 BRACED FRAME 3

Notes:
1. All braces are HSS6×6×⅝, unless noted otherwise.

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AISC steel experts assisted the project team
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