



DESIGNING WITH STRUCTURAL

STEEL

A GUIDE FOR ARCHITECTS

SECOND EDITION



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PART III

DETERMINING MEMBER SIZES FOR DETAILING

DETERMINING GIRDER AND BEAM SIZES FOR FLOORS & ROOFS

The architectural planning of any building requires many individual elements. During the pre-schematic design stages, one important aspect to establish is the building height. During these stages of design, preliminary structural information is required. This information will include such things as floor and roof system fire ratings, floor slab depths, roof decking depths, floor beam depths, roof purlin depths, and floor and roof girder depths. Each of these items in combination with the mechanical and electrical system requirements will establish the "ceiling sandwich" and the vertical proportions of the architectural design can be established.

Many times, during the early stage of planning and design, projects will be "designed" with very little participation by the structural team. Without the early involvement by the structural engineer, inaccurate assumptions for member depths and floor/roof systems could be made. Table sets A, B, C and D aid the architectural designer in determining floor and roof system depths. Each set of tables represents a distinct set of floor and roof system parameters. Three different live load conditions for each range of beam and girder spans have been presented. The tables present nominal member depth ranges for beam spans of 20 ft to 40 ft (example: W24 beams have a nominal depth of 24 in.), as well as girder spans from 20 ft to 40 ft. Preliminary beam and girder depths can quickly be determined from the tables for square and rectangular bay sizes ranging from 20 ft × 20 ft to 40 ft × 40 ft. Finally, Table E provides representative span ranges of different structural steel components.

The member sizes indicated in Table sets A-D represent a range of member depths for a particular span. It must be brought to the attention of the user that, as the member depth of any given beam or girder becomes shallower, an increase in member weight will occur. As a general "rule-of-thumb", a 25 percent increase in member weight will occur with each size of depth reduction. As an example, if the reported range is W18 - W24 there will be an approximate 25 percent increase in weight for a W21 member to meet the same design criteria as a W24. A W18 member will have an approximate 25 percent increase in weight if used in place of a W21. Should a W18 member be used in place of a W24, the minimum increase in member weight will be approximately 60 percent (1.25×1.25).

As with any design problem there are many solutions. Each project will have a unique set of loading and serviceability parameters. The design information and example have been prepared accurately and are consistent with current structural design practices for several different load cases. The information presented in this publication has been prepared in accordance with recognized engineering principles and is for general information only. While it is believed to be accurate, this information should not be used or relied upon without competent professional examination and verification of its accuracy, suitability, and applicability by a licensed professional engineer, designer, or architect.

Design Parameters and Limitations

Many specific parameters and limitations go into the design of any structural member. Imposed loadings caused by earthquake, wind, snow, rain, construction methods, etc., vary across the country. Live loads are generally specified in the applicable building codes. Dead loads are much more system-dependent and require special attention in their computation. Specific requirements for serviceability, strength, lateral stability of individual elements, and the lateral resistance of the building all contribute to the design of a safe and efficient building. The



information presented in the tables that follow is intended for use in establishing preliminary floor and roof framing member depths only, without regard to earthquake loading or contributing to lateral resistance of the building.

Beam spans range from 20 ft to 40 ft in 5-ft increments. Girder spans range from 20 ft to 40 ft in 5-ft increments for each of the beam span ranges noted. Therefore, girder depths reported cover 25 different bay sizes for each of three load cases. Dead loads address the self-weight of the floor/roof framing system. Three different slab conditions and one type of roof construction have been considered.

The girder and floor beam sizing tables are based on the following parameters:

- *Load and Resistance Factor Design Specification*, American Institute of Steel Construction, 1999
- Live and dead loads are uniformly distributed over a bay area
- Full live load has been applied to a full bay; no live load reduction has been taken into account
- No analyses have been made for floor vibration/vibration susceptibility
- A construction live load of 20 psf has been applied for composite member design
- Beam and girder depths represent designs for composite as well as non-composite member design
- Live load deflection has been limited to 1/360 of the member span
- Shear connectors for composite type metal decking
- Normal weight concrete unit weight used in the designs is 145 pcf; lightweight concrete unit weight used in the designs is 110 pcf
- Beams and girders have been selected assuming that cambering will be considered by the structural engineer of record for the placement of "level" floors
- Connection designs have not been considered
- 50 ksi steel yield strength and 3000 psi concrete strength
- Actual depths vary from the nominal depths tabulated. For actual member depths, refer to the properties tables found in the Materials Section of this Guide.

Selection Example for Girder and Floor Beam Sizing Tables

Known Design Criteria:

- Dead load includes system self weight (slab + steel)
- Superimposed dead load = 25 psf (partitions + MEP)
- Loads are uniformly distributed over bay area



- Live load = 100 psf
- Dead load = 25 psf (partitions + MEP)
- Self weight considered on the table formulation
- 4¼ in. lightweight concrete topping
- 2 in. metal decking (composite)
- 50 ksi yield strength
- Floor system requiring a 3-hour fire rating (floor assembly, unprotected metal deck)
- Bay size 30 ft x 35 ft (girder span x beam span)

Solution:*Beam depth selection:*

Enter Table C, Beam Sizes, second row for 100 psf live loading.

Under Beam Span: B1 (ft), fourth column for a 35 ft beam span. Read the range of the member sizes to be W21-W24. This indicates that the nominal beam depth could be as shallow as 21 in. for the W21 beam or as deep as 24 in. for the W24 beam.

Girder depth selection:

Enter Table C35, Girder Sizes/Beam Span 35 ft, second row for 100 psf live loading.

Under Girder Span: G1 (ft), third column for a 30 ft girder span. Read the range of the member sizes to be W24-W30. This indicates that the nominal girder depth could be as shallow as 24 in. for the W24 girder or as deep as 30 in. for the W30 girder. An intermediate nominal depth of 27 in. for a W27 could also be selected.

Summary:

35 ft beam span: W21-W24 (note that actual depths will vary).

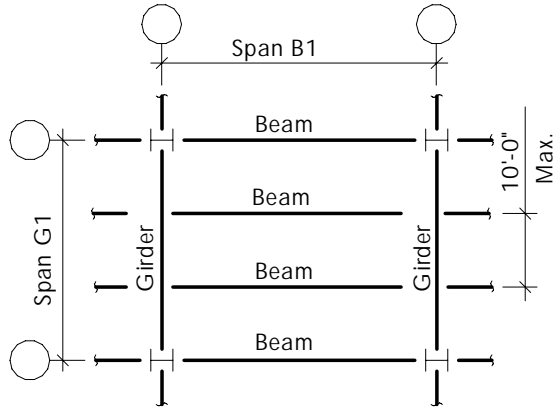
30 ft girder span: W24-W30 (note that actual depths will vary).

Member cambers may be required (consult a structural engineer for specifics).



Tables A to A40

- Dead load includes system self weight (slab + steel)
- Superimposed dead load = 25 psf (partitions + MEP)
- Loads are uniformly distributed over bay area
- 3¼ in. lightweight concrete topping
- 2 in. composite metal decking
- 50 ksi steel yield
- 3 ksi concrete strength
- 2-hour fire rating



| Table A Beam Sizes | | | | | | |
|-----------------------|--------------------|---------|---------|---------|---------|----------------|
| Live Load, psf | Beam Span: B1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W10-W16 | W14-W16 | W16-W21 | W18-W21 | W21-W27 | Office |
| 100 | W12-W16 | W14-W18 | W16-W24 | W18-W24 | W21-W27 | Assembly |
| 150 | W14-W18 | W18-W21 | W18-W24 | W21-W27 | W24-W30 | Storage |

| Table A20 Girder Sizes | | | | | | Beam Span 20 feet |
|---------------------------|----------------------|---------|---------|---------|---------|----------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W18 | W18-W21 | W21-W24 | W24-W27 | W24-W27 | Office |
| 100 | W18-W21 | W21-W24 | W24-W27 | W24-W30 | W27-W30 | Assembly |
| 150 | W21-W24 | W21-W24 | W24-W27 | W24-W30 | W30-W33 | Storage |



| Table A25 Girder Sizes | | | | | | Beam Span 25 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W18 | W16-W18 | W18-W24 | W21-W27 | W24-W30 | Office |
| 100 | W18-W21 | W21-W24 | W21-W27 | W24-W30 | W27-W33 | Assembly |
| 150 | W21-W24 | W21-W24 | W24-W27 | W30-W33 | W30-W33 | Storage |

| Table A30 Girder Sizes | | | | | | Beam Span 30 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W21 | W18-W21 | W18-W24 | W24-W30 | W27-W30 | Office |
| 100 | W18-W21 | W21-W24 | W21-W27 | W27-W30 | W30-W33 | Assembly |
| 150 | W21-W24 | W21-W24 | W24-W27 | W30-W33 | W33-W36 | Storage |

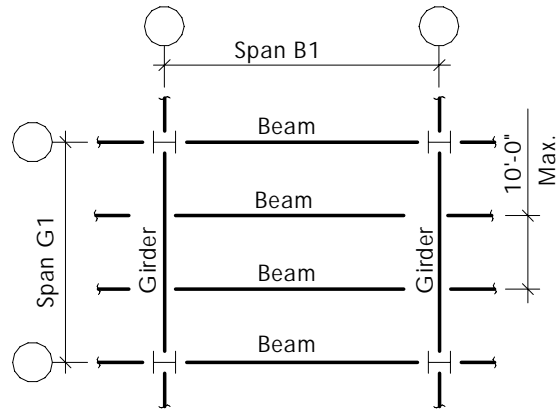
| Table A35 Girder Sizes | | | | | | Beam Span 35 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W18-W21 | W21-W24 | W24-W27 | W24-W27 | W27-W30 | Office |
| 100 | W21-W24 | W24-W27 | W24-W30 | W24-W30 | W30-W33 | Assembly |
| 150 | W14-W18 | W18-W21 | W18-W24 | W21-W27 | W27-W30 | Storage |

| Table A40 Girder Sizes | | | | | | Beam Span 40 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W21-W24 | W21-W24 | W24-W27 | W24-W27 | W27-W33 | Office |
| 100 | W24-W27 | W24-W27 | W24-W27 | W27-W30 | W30-W33 | Assembly |
| 150 | W21-W24 | W24-W27 | W24-W27 | W30-W36 | W33-W36 | Storage |



Tables B to B40

- Dead load includes system self weight (slab + steel)
- Superimposed dead load = 25 psf (partitions + MEP)
- Loads are uniformly distributed over bay area
- 4½ in. normal weight concrete topping
- 2 in. composite metal decking
- 50 ksi steel yield
- 3 ksi concrete strength
- 2-hour fire rating



| Table B | | | | | | |
|----------------|--------------------|---------|---------|---------|---------|----------------|
| Beam Sizes | | | | | | |
| Live Load, psf | Beam Span: B1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W12-W16 | W16-W21 | W18-W24 | W21-W24 | W24-W27 | Office |
| 100 | W14-W16 | W16-W21 | W18-W24 | W21-W27 | W27-W30 | Assembly |
| 150 | W14-W18 | W16-W18 | W21-W24 | W24-W30 | W27-W33 | Storage |

| Table B20 | | | | | | Beam Span 20 feet |
|----------------|----------------------|---------|---------|---------|---------|----------------------|
| Girder Sizes | | | | | | |
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W21-W24 | W21-W24 | W24-W27 | W24-W27 | W27-W33 | Office |
| 100 | W24-W27 | W24-W27 | W24-W27 | W27-W30 | W30-W33 | Assembly |
| 150 | W21-W24 | W24-W27 | W24-W27 | W30-W36 | W33-W36 | Storage |



| Table B25 Girder Sizes | | | | | | Beam Span 25 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W18 | W21-W24 | W24-W27 | W27-W30 | W27-W33 | Office |
| 100 | W16-W21 | W18-W24 | W21-W30 | W27-W30 | W30-W33 | Assembly |
| 150 | W18-W24 | W21-W24 | W24-W27 | W27-W30 | W30-W36 | Storage |

| Table B30 Girder Sizes | | | | | | Beam Span 30 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W21 | W18-W24 | W21-W24 | W24-W27 | W27-W30 | Office |
| 100 | W18-W24 | W21-W27 | W21-W24 | W24-W30 | W24-W33 | Assembly |
| 150 | W18-W24 | W24-W30 | W27-W33 | W27-W33 | W30-W36 | Storage |

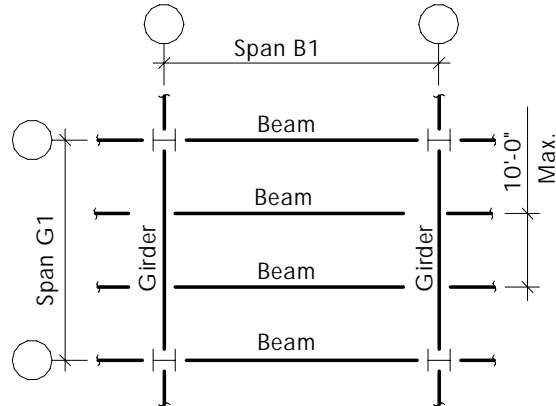
| Table B35 Girder Sizes | | | | | | Beam Span 35 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W18-W24 | W21-W24 | W21-W27 | W24-W30 | W27-W33 | Office |
| 100 | W21-W24 | W21-W24 | W24-W27 | W27-W30 | W30-W36 | Assembly |
| 150 | W21-W24 | W24-W27 | W27-W33 | W30-W36 | W33-W36 | Storage |

| Table B40 Girder Sizes | | | | | | Beam Span 40 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W21-W24 | W21-W24 | W24-W27 | W27-W30 | W27-W36 | Office |
| 100 | W24-W27 | W24-W30 | W27-W30 | W27-W36 | W33-W36 | Assembly |
| 150 | W24-W27 | W24-W30 | W27-W33 | W30-W36 | W33-W40 | Storage |



Tables C to C40

- Dead load includes system self weight (slab + steel)
- Superimposed dead load = 25 psf (partitions + MEP)
- Loads are uniformly distributed over bay area
- 4¼ in. lightweight concrete topping
- 2 in. composite metal decking
- 50 ksi steel yield
- 3 ksi concrete strength
- 3-hour fire rating



| Table C | | | | | | |
|----------------|--------------------|---------|---------|---------|---------|----------------|
| Beam Sizes | | | | | | |
| Live Load, psf | Beam Span: B1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W10-W16 | W14-W16 | W16-W21 | W18-W21 | W21-W27 | Office |
| 100 | W12-W16 | W14-W18 | W16-W24 | W21-W24 | W21-W27 | Assembly |
| 150 | W14-W16 | W16-W21 | W18-W24 | W21-W27 | W24-W30 | Storage |

| Table C20 | | | | | | Beam Span 20 feet |
|----------------|----------------------|---------|---------|---------|---------|----------------------|
| Girder Sizes | | | | | | |
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W18 | W18-W21 | W21-W24 | W21-W24 | W24-W30 | Office |
| 100 | W16-W18 | W18-W21 | W21-W24 | W24-W27 | W24-W30 | Assembly |
| 150 | W16-W21 | W18-W21 | W21-W24 | W24-W27 | W27-W33 | Storage |



| Table C25 Girder Sizes | | | | | | Beam Span 25 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W16-W18 | W16-W21 | W21-W24 | W21-W27 | W24-W27 | Office |
| 100 | W18-W21 | W18-W24 | W21-W24 | W24-W30 | W24-W30 | Assembly |
| 150 | W18-W21 | W21-W24 | W24-W30 | W27-W33 | W30-W36 | Storage |

| Table C30 Girder Sizes | | | | | | Beam Span 30 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W18-W21 | W18-W24 | W21-W24 | W24-W27 | W27-W30 | Office |
| 100 | W18-W21 | W21-W24 | W21-W30 | W24-W33 | W27-W36 | Assembly |
| 150 | W21-W24 | W24-W30 | W24-W33 | W27-W33 | W30-W36 | Storage |

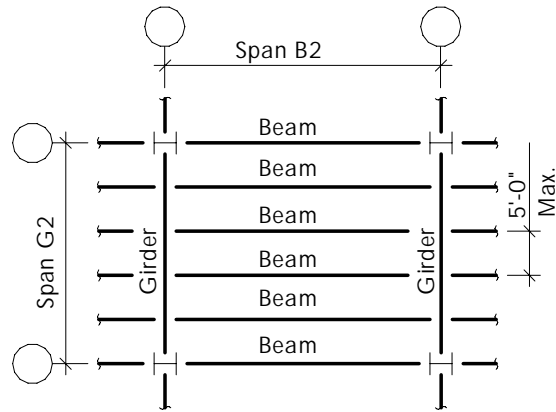
| Table C35 Girder Sizes | | | | | | Beam Span 35 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W18-W24 | W21-W24 | W24-W27 | W24-W30 | W27-W30 | Office |
| 100 | W21-W24 | W21-W27 | W24-W30 | W27-W33 | W30-W36 | Assembly |
| 150 | W24-W27 | W24-W30 | W27-W30 | W27-W33 | W30-W36 | Storage |

| Table C40 Girder Sizes | | | | | | Beam Span 40 feet |
|----------------------------------|----------------------|---------|---------|---------|---------|------------------------------------|
| Live Load, psf | Girder Span: G1 (ft) | | | | | Classification |
| | 20 | 25 | 30 | 35 | 40 | |
| 50 | W21-W24 | W21-W24 | W24-W30 | W27-W30 | W30-W33 | Office |
| 100 | W24-W27 | W24-W30 | W24-W30 | W27-W33 | W30-W36 | Assembly |
| 150 | W27-W30 | W27-W30 | W27-W33 | W30-W36 | W33-W40 | Storage |



Tables D to D40

- Dead load includes system self weight (slab + steel)
- Superimposed dead load = 20 psf (roofing systems + MEP)
- Loads are uniformly distributed over bay area
- 1½ in. metal roof decking
- 50 ksi steel yield



| Table D Beam Sizes | | | | | |
|------------------------------|--------------------|---------|---------|---------|---------|
| Live Load, psf | Beam Span: B2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W12-W16 | W12-W16 | W14-W18 | W16-W21 | W18-W24 |
| 30 | W12-W16 | W14-W16 | W16-W21 | W18-W24 | W21-W24 |
| 40 | W14-W16 | W16-W21 | W18-W21 | W21-W24 | W21-W27 |

| Table D20 Girder Sizes | | | | | Beam Span 20 feet |
|----------------------------------|----------------------|---------|---------|---------|----------------------|
| Live Load, psf | Girder Span: G2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W16-W18 | W16-W18 | W18-W24 | W21-W24 | W24-W27 |
| 30 | W16-W18 | W16-W21 | W18-W24 | W21-W27 | W24-W30 |
| 40 | W18-W21 | W18-W24 | W21-W24 | W24-W27 | W24-W30 |



| Table D25 Girder Sizes | | | | | Beam Span 25 feet |
|----------------------------------|----------------------|---------|---------|---------|-----------------------------|
| Live Load, psf | Girder Span: G2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W16-W18 | W16-W21 | W21-W24 | W21-W24 | W24-W27 |
| 30 | W18-W21 | W18-W21 | W21-W24 | W21-W27 | W24-W30 |
| 40 | W18-W21 | W18-W24 | W21-W24 | W24-W30 | W27-W33 |

| Table D30 Girder Sizes | | | | | Beam Span 30 feet |
|----------------------------------|----------------------|---------|---------|---------|-----------------------------|
| Live Load, psf | Girder Span: G2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W18-W21 | W18-W24 | W21-W24 | W24-W27 | W24-W30 |
| 30 | W18-W21 | W21-W24 | W21-W30 | W24-W30 | W27-W33 |
| 40 | W18-W21 | W21-W27 | W24-W30 | W27-W30 | W27-W33 |

| Table D35 Girder Sizes | | | | | Beam Span 35 feet |
|----------------------------------|----------------------|---------|---------|---------|-----------------------------|
| Live Load, psf | Girder Span: G2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W18-W24 | W21-W24 | W24-W27 | W24-W30 | W27-W30 |
| 30 | W21-W24 | W21-W24 | W24-W30 | W24-W30 | W30-W33 |
| 40 | W21-W24 | W21-W24 | W24-W30 | W27-W33 | W30-W36 |

| Table D40 Girder Sizes | | | | | Beam Span 40 feet |
|----------------------------------|----------------------|---------|---------|---------|-----------------------------|
| Live Load, psf | Girder Span: G2 (ft) | | | | |
| | 20 | 25 | 30 | 35 | 40 |
| 20 | W21-W24 | W21-W24 | W24-W27 | W27-W30 | W27-W33 |
| 30 | W21-W24 | W24-W27 | W24-W30 | W27-W33 | W30-W33 |
| 40 | W24 | W24-W30 | W27-W30 | W27-W33 | W30-W36 |



Table E

Span Ranges

| Representative Span Ranges of Different Structural Steel Components | | | | | | | | | | | | |
|--|------------------|----|----|----|----|-----|---|---|---|---|--|--|
| Component | Span Range, feet | | | | | | | | | | | |
| | 10 | 20 | 40 | 60 | 80 | 100 | | | | | | |
| Roof Framing | | | | | | | | | | | | |
| 1 ½ in. Metal Deck | ■ | | | | | | | | | | | |
| 3 in. Metal Deck | ■ | ■ | | | | | | | | | | |
| 6 in. Metal Deck | | ■ | ■ | | | | | | | | | |
| Beams (See Tables) | | | ■ | ■ | | | | | | | | |
| Girders (See Tables) | | ■ | ■ | ■ | | | | | | | | |
| Joists | | | | | | | | | | | | |
| K Series | | ■ | ■ | ■ | | | | | | | | |
| LH Series | | | ■ | ■ | ■ | ■ | | | | | | |
| Floor Framing | | | | | | | | | | | | |
| Composite Slab | | ■ | ■ | | | | | | | | | |
| Noncomposite Slab | ■ | ■ | | | | | | | | | | |
| Beams (See Tables) | | | ■ | ■ | ■ | | | | | | | |
| Girders (See Tables) | | ■ | ■ | ■ | | | | | | | | |
| Long Spans | | | | | | | | | | | | |
| Plate Girders – Fabricated Beams | | | | | ■ | ■ | ■ | | | | | |
| Trusses – Fabricated | | | | ■ | ■ | ■ | ■ | ■ | ■ | ▶ | | |
| Joists "DLH/SLH" Series | | | | | | | ■ | ■ | ■ | ▶ | | |
| Space Frames | | | | ■ | ■ | ■ | ■ | ■ | | | | |



DETERMINING INTERIOR COLUMN SIZES

Determining the overall size for column enclosures is a function of the column dimensions as well as utility services which may be running vertically, immediately adjacent to the columns. Column sizes determined by the structural engineer must account for gravity loads as well as lateral loads. Having a fairly accurate selection of a column size during the planning and schematic design phases of a project can greatly assist the architectural and interior design teams.

Preliminary column dimensions have been tabulated for buildings ranging from one story to six stories. Two different commonly used floor live loadings have been tabulated. One roof live loading was selected to be used for each of the floor live loadings. The selection of a single roof live load was found to have a very minimal effect on the overall column size selection. The interior columns are assumed not to contribute to the lateral load resisting system for the building. The tables presented (see Table sets F, G and H) indicate representative interior column dimensions for square and rectangular bay sizes ranging from 20 ft × 20 ft to 40 ft × 40 ft. Each set of tables represents a different floor construction type meeting a two-hour fire rated floor system.

Exterior columns have not been considered in the formulation of the column size tables for two reasons. First, exterior columns are commonly engaged as part of the lateral load resisting system, particularly in the case of moment resistant lateral frames. Secondly, exterior beams and girders often transfer exterior wall loads to the exterior columns. Façade types as well as façade loads can vary significantly. As a result it would be difficult to formulate a concise set of generalized tables to account for these conditions. As a general "rule of thumb", exterior columns can be approximated to be the same size as interior columns.

As with any design problem there are many solutions. Each project will have a unique set of loading parameters. The design information and example have been prepared accurately and consistent with current structural design practice for several different load cases. The information presented in this publication has been prepared in accordance with recognized engineering principles and is for general information only. While it is believed to be accurate, this information should not be used or relied upon without competent professional examination and verification of its accuracy, suitability, and applicability by a licensed professional engineer, designer, or architect.

Design Parameters and Limitations

Many specific parameters and limitations go into the design of any structural member. Imposed loadings caused by earthquake, wind, snow, rain, construction methods, etc. vary across the country. Live loads are specified in the applicable building codes. Dead loads are much more system-dependent and require special attention in their computation. Specific requirements for serviceability, strength, lateral stability of individual elements, and the lateral resistance of the building all contribute to the design of a safe and efficient building. The information presented in the tables to follow is intended for use establishing preliminary interior column dimensions only without regard to earthquake loading or contributing to lateral resistance of the building.

Column dimensions have been selected based on properties for rolled wide flange shapes, as well as hollow structural section and pipe column shapes. Bay sizes range from 20 ft × 20 ft to 40 ft × 40 ft in 5 ft increments. Both square and rectangular bays have been accounted for. As a result, 15 different bay sizes for each of two load cases have been tabulated for three different slab construction types. Dead loads address the self-weight of the floor/roof framing system.



Interior column sizing tables are based on the following parameters:

- *Load and Resistance Factor Design Specification*, American Institute of Steel Construction, 1999
- Live and dead loads are uniformly distributed over a bay area
- Full live load has been applied to a full bay: No live load reduction has been taken into account
- Maximum floor-to-floor height is 15 ft
- Column sizes tabulated do not account for lateral resistance of the building
- All connections to the columns are considered to be "simple" connections—no moment transfer from beam/girder to column has been considered
- Normal weight concrete unit weight used in the designs is 145 pcf; lightweight concrete unit weight used in the designs is 110 pcf
- A maximum 40 psf roof live load has been considered for all column designs
- 35 ksi steel yield has been used for pipe columns
- 46 ksi steel yield has been used for hollow structural section columns
- 50 ksi steel yield has been used for rolled wide flange columns
- Only square hollow structural sections have been used in the tabulated dimensions
- Actual dimensions have been tabulated. The involvement of a qualified structural engineer shall determine actual pipe, hollow structural section, or rolled wide flange section designation required for any specific project and loading condition.



Interior Column Sizing Table F1

- 3/4 in. lightweight topping
- 2 in. metal decking
- Floor live load = 50 psf
- Roof live load = 40 psf

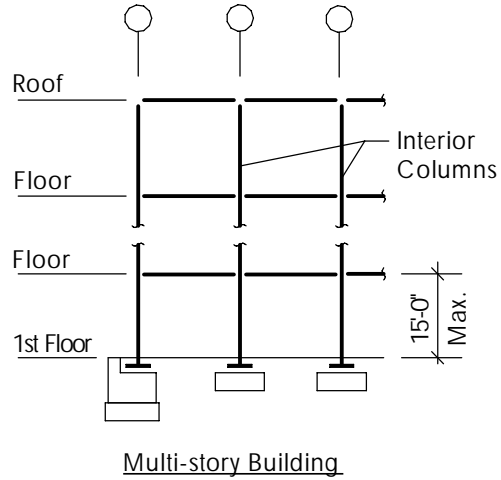


Table F1

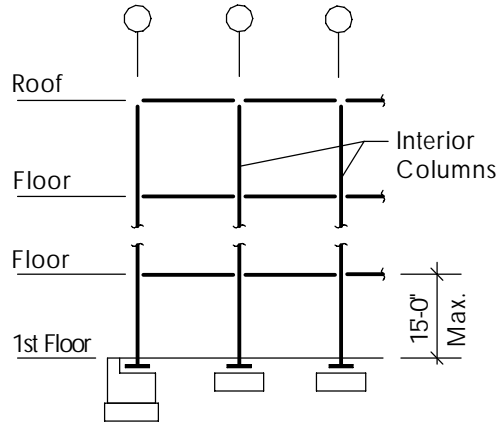
Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 6 X 6 | 10 X 10 | 12 X 10 | 14 X 10 | 14¼ X 10¼ |
| 20 X 25 | 4 X 4 | 8 X 8 | 10 X 10 | 12 X 10 | 14 X 10 | 14¼ X 10¼ |
| 20 X 30 | 5 X 5 | 8 X 8 | 10 X 10 | 12 X 10 | 14 X 10 | 14¼ X 10¼ |
| 20 X 35 | 5 X 5 | 10 X 8 | 10¼ X 10 | 12¼ X 12 | 14¼ X 10¼ | 14 X 14½ |
| 20 X 40 | 6 X 6 | 10 X 8 | 10¼ X 10 | 12¼ X 12 | 14¼ X 10¼ | 14 X 14½ |
| 25 X 25 | 4 X 4 | 7 X 7 | 10 X 10 | 12 X 10 | 14¼ X 10¼ | 14¼ X 10¼ |
| 25 X 30 | 5 X 5 | 7 X 7 | 10¼ X 10 | 12¼ X 12 | 14¼ X 10¼ | 14 X 14½ |
| 25 X 35 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 25 X 40 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 30 X 30 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 30 X 35 | 5 X 5 | 8½ X 8½ | 12¼ X 12 | 14 X 14½ | 14¼ X 14¾ | 14½ X 14¾ |
| 30 X 40 | 5 X 5 | 10¼ X 10¼ | 12¼ X 12 | 14 X 14½ | 14¼ X 14¾ | 14½ X 14¾ |
| 35 X 35 | 6 X 6 | 10¼ X 10¼ | 12¼ X 12 | 14 X 14½ | 14¼ X 14¾ | 14½ X 14¾ |
| 35 X 40 | 6 X 6 | 10¼ X 10¼ | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ | 15 X 15¾ |
| 40 X 40 | 8 X 8 | 12¼ X 10 | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ | 15 X 15¾ |



Interior Column Sizing Table F2

- 3¼ in. lightweight topping
- 2 in. metal decking
- Floor live load = 100 psf
- Roof live load = 40 psf



Multi-story Building

Table F2

Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 6 X 6 | 10 X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 20 X 25 | 4 X 4 | 6 X 6 | 10 X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 20 X 30 | 5 X 5 | 6 X 6 | 10 X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 20 X 35 | 5 X 5 | 8 X 8 | 10¼ X 10¼ | 12¼ X 12 | 12¾ X 12¼ | 13 X 12¼ |
| 20 X 40 | 6 X 6 | 8 X 8 | 10¼ X 10¼ | 12¼ X 12 | 12¾ X 12¼ | 13 X 12¼ |
| 25 X 25 | 4 X 4 | 6 X 6 | 10 X 10 | 12¼ X 12 | 12½ X 12 | 12½ X 12¼ |
| 25 X 30 | 5 X 5 | 7 X 7 | 12¼ X 12 | 12¾ X 12¼ | 13¼ X 12½ | 13½ X 12½ |
| 25 X 35 | 5 X 5 | 8 X 8 | 12¼ X 12 | 12¾ X 12¼ | 13¼ X 12½ | 13½ X 12½ |
| 25 X 40 | 5 X 5 | 8 X 8 | 12¼ X 12 | 12¾ X 12¼ | 13¼ X 12½ | 13½ X 12½ |
| 30 X 30 | 5 X 5 | 8 X 8 | 10¼ X 10¼ | 12¾ X 12¼ | 13¼ X 12½ | 13½ X 12½ |
| 30 X 35 | 5 X 5 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 30 X 40 | 5 X 5 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 35 X 35 | 6 X 6 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 35 X 40 | 6 X 6 | 10½ X 10¼ | 13 X 12¼ | 14½ X 14¾ | 15¼ X 15¾ | 15¾ X 15¾ |
| 40 X 40 | 8 X 8 | 10½ X 10¼ | 13 X 12¼ | 14¾ X 14¾ | 15¼ X 15¾ | 15¾ X 15¾ |



Interior Column Sizing Table G1

- 4½ in. normal weight topping
- 2 in. metal decking
- Floor live load = 50 psf
- Roof live load = 40 psf

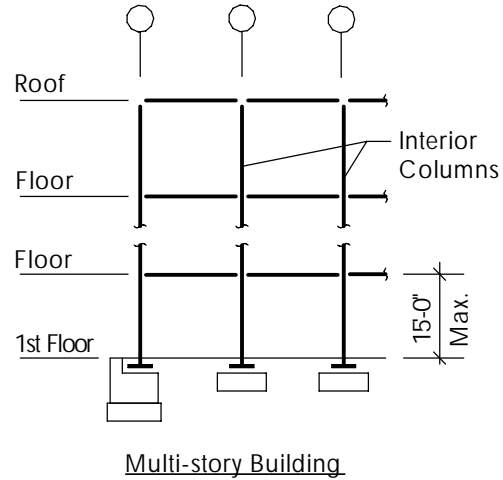


Table G1

Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 25 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 30 | 5 X 5 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 35 | 5 X 5 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 20 X 40 | 6 X 6 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 25 X 25 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 25 X 30 | 5 X 5 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 25 X 35 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 25 X 40 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 30 X 30 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 30 X 35 | 5 X 5 | 8½ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 30 X 40 | 5 X 5 | 8¾ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 35 X 35 | 6 X 6 | 8¾ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 35 X 40 | 6 X 6 | 10¼ X 10¼ | 12½ X 12¼ | 14½ X 14¼ | 14¾ X 15½ | 15¼ X 15¾ |
| 40 X 40 | 8 X 8 | 10¼ X 10¼ | 12½ X 12¼ | 14½ X 14¼ | 14¾ X 15½ | 15¼ X 15¾ |



Interior Column Sizing Table G2

- 4½ in. normal weight topping
- 2 in. metal decking
- Floor live load = 100 psf
- Roof live load = 40 psf

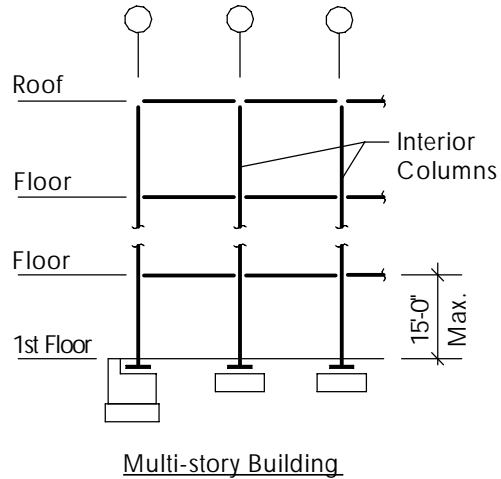


Table G2

Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 25 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 30 | 5 X 5 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 20 X 35 | 5 X 5 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 20 X 40 | 6 X 6 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 25 X 25 | 4 X 4 | 8 X 8 | 8½ X 8¼ | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ |
| 25 X 30 | 5 X 5 | 8¼ X 8¼ | 8¾ X 8¼ | 12¼ X 12 | 12½ X 12¼ | 12¾ X 12¼ |
| 25 X 35 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 25 X 40 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 30 X 30 | 5 X 5 | 8½ X 8¼ | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 13 X 12½ |
| 30 X 35 | 5 X 5 | 8½ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 30 X 40 | 5 X 5 | 8¾ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 35 X 35 | 6 X 6 | 8¾ X 8¼ | 12¼ X 12 | 14 X 14½ | 14½ X 14¾ | 14¾ X 14¾ |
| 35 X 40 | 6 X 6 | 10¼ X 10¼ | 12½ X 12¼ | 14½ X 14¼ | 14¾ X 15½ | 15¼ X 15¾ |
| 40 X 40 | 8 X 8 | 10¼ X 10¼ | 12½ X 12¼ | 14½ X 14¼ | 14¾ X 15½ | 15¼ X 15¾ |



Interior Column Sizing Table H1

- 4¼ in. lightweight topping
- 2 in. metal decking
- Floor live load = 50 psf
- Roof live load = 40 psf

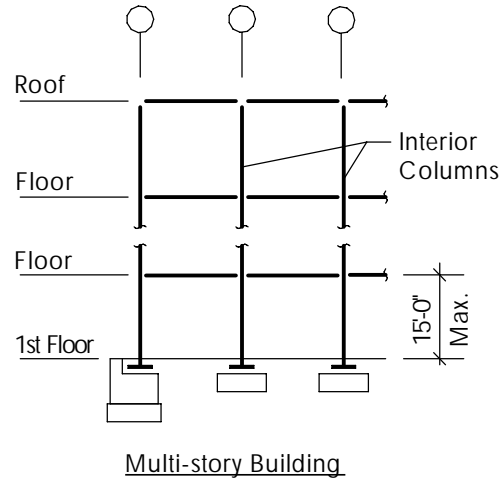


Table H1

Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 6 X 6 | 10¼ X 8 | 12 X 10 | 14 X 10 | 12¼ X 12 |
| 20 X 25 | 4 X 4 | 8 X 8 | 10¼ X 8 | 12 X 10 | 14 X 10 | 12¼ X 12 |
| 20 X 30 | 5 X 5 | 8 X 8 | 10¼ X 8 | 12 X 10 | 14 X 10 | 12¼ X 12 |
| 20 X 35 | 5 X 5 | 10 X 8 | 10¼ X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 20 X 40 | 6 X 6 | 10 X 8 | 10¼ X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 25 X 25 | 4 X 4 | 7 X 7 | 10¼ X 8 | 12 X 10 | 14¼ X 10¼ | 14¼ X 10¼ |
| 25 X 30 | 5 X 5 | 10 X 8 | 10¼ X 10 | 12¼ X 12 | 12¼ X 12 | 12½ X 12¼ |
| 25 X 35 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 25 X 40 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 30 X 30 | 5 X 5 | 8½ X 8½ | 12¼ X 10 | 12¼ X 12¼ | 14 X 14½ | 14¼ X 14¾ |
| 30 X 35 | 5 X 5 | 8½ X 8½ | 12¼ X 12 | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ |
| 30 X 40 | 5 X 5 | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ |
| 35 X 35 | 6 X 6 | 10¼ X 10¼ | 12¼ X 12 | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ |
| 35 X 40 | 6 X 6 | 10¼ X 10¼ | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ | 15 X 15¾ |
| 40 X 40 | 8 X 8 | 12¼ X 10 | 12½ X 12¼ | 14¼ X 14¾ | 14½ X 14¾ | 15 X 15¾ |



Interior Column Sizing Table H2

- 4¼ in. lightweight topping
- 2 in. metal decking
- Floor live load = 100 psf
- Roof live load = 40 psf

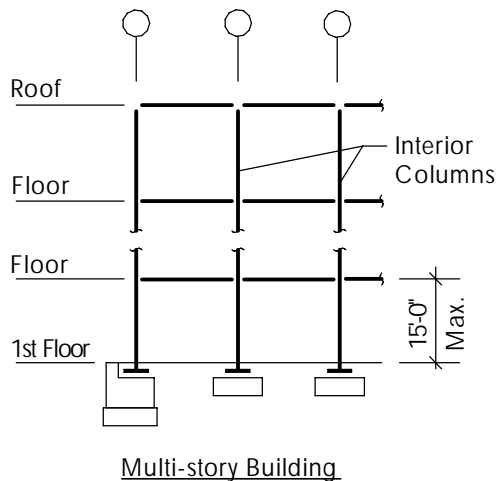


Table H2

Typical Interior Column Size (Depth × Width)

| BAY SPACING | NUMBER OF STORIES | | | | | |
|-------------|-------------------|-----------|-----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 20 X 20 | 4 X 4 | 6 X 6 | 10 X 10 | 10½ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ |
| 20 X 25 | 4 X 4 | 6 X 6 | 10 X 10 | 10½ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ |
| 20 X 30 | 5 X 5 | 6 X 6 | 10 X 10 | 10½ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ |
| 20 X 35 | 5 X 5 | 8 X 8 | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 14½ X 14¾ |
| 20 X 40 | 6 X 6 | 8 X 8 | 10¼ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ | 14½ X 14¾ |
| 25 X 25 | 4 X 4 | 6 X 6 | 10 X 10 | 10½ X 10¼ | 12½ X 12¼ | 12¾ X 12¼ |
| 25 X 30 | 5 X 5 | 7 X 7 | 12¼ X 12 | 12½ X 12¼ | 13¼ X 12½ | 14½ X 14¾ |
| 25 X 35 | 5 X 5 | 8 X 8 | 12¼ X 12 | 12¾ X 12¼ | 13¼ X 12½ | 14¾ X 15½ |
| 25 X 40 | 5 X 5 | 8 X 8 | 12¼ X 12 | 12¾ X 12¼ | 13¼ X 12½ | 14¾ X 15½ |
| 30 X 30 | 5 X 5 | 8 X 8 | 10¼ X 10¼ | 12¾ X 12¼ | 13¼ X 12½ | 14¾ X 15½ |
| 30 X 35 | 5 X 5 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 30 X 40 | 5 X 5 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 35 X 35 | 6 X 6 | 10¼ X 10 | 12½ X 12¼ | 14½ X 14¾ | 14¾ X 14¾ | 15 X 15¾ |
| 35 X 40 | 6 X 6 | 10½ X 10¼ | 13 X 12¼ | 14¾ X 15½ | 15¼ X 15¾ | 15¾ X 15¾ |
| 40 X 40 | 8 X 8 | 10½ X 10¼ | 13 X 12¼ | 14¾ X 15½ | 15¼ X 15¾ | 15¾ X 15¾ |