
DESIGN CRITERIA FOR THE SELECTION OF STRUCTURAL SYSTEMS

If you wish to create a building with a highly irregular form:

Choose systems with simple floor and roof framing that are fabricated mostly on-site, such as

Sitecast concrete using any slab system without beams or ribs (pages 107–123)

Light gauge steel framing (pages 88–91)

Platform frame (pages 49–65)

Masonry construction with either concrete slab or wood light floor framing (pages 71–85)

If you wish to leave the structure exposed while retaining a high fire-resistance rating:

Choose structural systems that are inherently resistant to fire and heat, including

All concrete systems (although ribbed systems may require added thickness in the ribs or slab, or an applied fireproofing) (pages 107–135)

Heavy timber frame (pages 49–69)

Mill construction (pages 71–85)

Structural steel is highly susceptible to loss of strength in a fire and usually must be protected with a fire-resistive finishing system. For further information on the fire resistance of various structural systems and uses for which they are permitted, see pages 304–315.

20

If you wish to allow column placements that deviate from a regular grid:

Use systems that do not include beams or joists in the floor and roof structure, such as

Sitecast concrete two-way flat plate or flat slab (pages 118–121)

Metal space frame

If you wish to minimize floor thickness to reduce total building height or to reduce floor spandrel depth on the building facade:

The thinnest floor systems are concrete slabs without ribs, preferably prestressed, such as

Sitecast concrete two-way flat plate or flat slab, especially when post-tensioned (pages 118–121)

Precast prestressed hollow core or solid slab (pages 132–133)

Posttensioned one-way solid slab (pages 114–115)

If you wish to minimize the area occupied by columns or bearing walls:

Consider long-span structural systems, such as

Heavy wood trusses (pages 66–67)

Glue laminated wood beams (pages 62–63)

Glue laminated wood arches (pages 68–69)

Conventional steel frame (pages 87–105)

Open-web steel joists (pages 100–101)

Single-story rigid steel frame (pages 102–103)

Steel trusses (pages 104–105)

Sitecast concrete waffle slab, particularly when posttensioned (pages 122–123)

Precast concrete single or double tees (pages 134–135)

You may also wish to consider other long-span systems, such as specially fabricated steel beams, suspended systems, arches, vaults, and shells.

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<i>If you wish to allow for changes to the building over time:</i>	<p>Consider short-span one-way systems that permit easy structural modification, such as</p> <ul style="list-style-type: none"> Light gauge or conventional steel frame (pages 87–105) Any wood system, including those incorporating masonry construction (pages 49–79) Sitecast concrete one-way solid slab or one-way joist construction, excluding posttensioned (pages 114–117) Precast concrete solid or hollow core slab (pages 132–133)
<i>If you wish to permit construction under adverse weather conditions:</i>	<p>Select a system that does not depend on on-site chemical processes (such as the curing of concrete or mortar) and that can be erected quickly, such as</p> <ul style="list-style-type: none"> Any steel system (pages 87–105) Any wood system (pages 49–69) Precast concrete systems, particularly those that minimize the use of sitecast concrete toppings and grouting (pages 125–135)
<i>If you wish to minimize off-site fabrication time:</i>	<p>Consider systems in which the building is constructed on-site from easily formed, relatively unprocessed materials, such as</p> <ul style="list-style-type: none"> Any sitecast concrete system (pages 107–123) Light gauge steel framing (pages 88–91) Platform frame (pages 49–65) Any masonry system (pages 72–79)
<i>If you wish to minimize on-site erection time:</i>	<p>Consider systems using highly preprocessed, prefabricated, or modular components, such as</p> <ul style="list-style-type: none"> Single-story rigid steel frame (pages 102–103) Conventional steel frame, particularly with hinge connections (pages 87–105) Any precast concrete system (pages 125–135) Heavy timber frame (pages 49–69)
<i>If you wish to minimize construction time for a one- or two-story building:</i>	<p>Consider systems that are lightweight and easy to form, or prefabricated and easy to assemble, such as</p> <ul style="list-style-type: none"> Any steel system (pages 87–105) Heavy timber frame (pages 49–69) Platform frame (pages 49–65)

(continued)

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If you wish to minimize construction time for a 4- to 20-story building:

Choose from the following systems

Precast concrete (pages 125–135)

Conventional steel frame (pages 87–105)

Once the structural components for either of the above systems are prefabricated, on-site erection proceeds quickly.

Any sitecast concrete system (pages 107–123)

The absence of lead time for the prefabrication of components in these systems allows construction of the building to begin on-site at the earliest time.

If you wish to minimize construction time for a building 30 stories or more in height:

Choose a system that is strong, lightweight, prefabricated, and easy to assemble

Steel frame (pages 87–105)

Systems of precast and sitecast concrete are also becoming economical alternatives to steel frame construction in some regions.

The structural design of high-rise buildings is a specialized task, and the necessary consultants should be sought out as early as possible in the design process.

22

If you wish to minimize the need for diagonal bracing or shear walls:

Choose a system that is capable of forming rigid joints, such as

Any sitecast concrete system, particularly those with beams or deepened slabs around the columns (pages 107–123)

Steel frame with welded rigid connections (pages 87–105)

Single-story rigid steel frame (pages 102–103)

When depending on a rigid frame for lateral stiffness, the sizes of the framing members often must be increased to resist the added bending stresses produced in such systems.

If you wish to minimize the dead load on the building foundation:

Consider lightweight or short span systems, such as

Any steel system (pages 87–105)

Any wood system (pages 49–69)

If you wish to minimize structural distress due to unstable foundation conditions:

Frame systems without rigid joints are recommended, such as

Steel frame, with bolted connections (pages 87–105)

Heavy timber frame (pages 60–63)

Precast concrete systems (pages 125–135)

Platform framing (pages 49–65)

Welded steel frame, masonry bearing wall, and sitecast concrete frame are particularly to be avoided.

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If you wish to minimize the number of separate trades and contracts required to complete the building:

Consider systems that incorporate many of the functions of a complete wall system in one operation, such as

Masonry construction, including Mill or Ordinary construction (pages 72–85)

Precast concrete loadbearing wall panel systems (pages 128–129)

If you wish to provide concealed spaces within the structure itself for ducts, pipes, wires, and other building mechanical systems:

Consider systems that naturally provide convenient hollow spaces, such as

Truss and open-web joist systems (pages 64–67, 100–101, 104–105)

Light gauge steel framing (pages 88–91)

Platform frame (pages 49–65)

Light gauge steel framing and platform frame construction are often applied as finish or infill systems in combination with other types of building structure to provide such spaces. For more information on the integration of building services and the structural system, see pages 170–189 and 202–221.