

Low Floor Heights: The Low-Down

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There are several practical options for reducing floor-to-floor heights.

A COMMON INQUIRY TO THE AISC STEEL SOLUTIONS CENTER IS: “How can we reduce the floor-to-floor heights of our structures without sacrificing open, flexible floor designs?”

Minimizing the structural depth at each level translates into an overall savings in building height. If you can save 6 in. per floor on a 20-story building, this turns into 10 ft of savings on building cladding, plumbing risers, and vertical mechanical chases. Ten feet of savings is equivalent to knocking a whole story out of a building. If an owner can fit 11 stories of rentable space into the height traditionally reserved for 10 stories, their profit has just risen by 10%.

In addition to providing low structural depths, the systems described below also bring the traditional advantages that structural steel adds to a project: speed, sustainability, and quality control of shop fabrication.

Staggered Truss

A staggered truss system uses story-high trusses spaced in alternate bays to carry gravity and, in most cases, lateral loads. The truss spans the entire width of the building, often 60 to 75 ft. As a gravity system it works similar to the beam-in-wall system (discussed later), with trusses running in demising walls between residential units. Plank spans between trusses and is supported at one end by the top chord of a truss and at the other end by the bottom chord of a truss. In this pattern, 60-ft-wide column-free spaces are achieved.

Vierendeel panels, traditionally in the center of the truss, allow openings for a central hallway corridor. This system is applicable in buildings that have a uniform room layout, such as hotels, dormitories, apartments, and condos. It has been applied in rectangular, L-shaped, and square buildings with a central atrium. It has

also been applied in buildings that arc in plan. The cost-effectiveness of this system improves based on the level of repetition that can be achieved. A good rule of thumb is that there should be about 20 uniform trusses to consider using the system for a project.

A huge competitive advantage of this system is that it provides a base level with no interior columns. This means that areas like ballrooms and meeting spaces can be accommodated with no transfer beams. The fact that there are no interior columns means that there is a significant reduction in the number of foundations required and the cost associated with them. Erection is speedy because the trusses are set, then the plank is set, and so on. The staggered truss system is a completely dry system and can be erected in any type of weather.

Beam-in-wall: Economical, Speedy, Flexible

The system we refer to as “beam-in-wall” refers to running beams in demising walls between rooms, with precast plank or metal deck slabs spanning between beams. The demising wall may need to soffit around the beam. This system is a straightforward way to achieve a minimal structural depth; because beams are buried in the demising walls, the depth of the floor slab is the only structural depth that needs to be accommodated.

This system is flexible if your room layout isn't exactly uniform or symmetric across a hallway. It can be applied in situations where the building layout isn't regular enough to use the Girder-Slab or staggered truss systems.

Room layout and spacing often dictates which type of floor slab to use. A main consideration is whether to have the slab span from demising wall to demising wall or from perimeter to corridor. Spanning from perimeter to corridor creates a very flex-



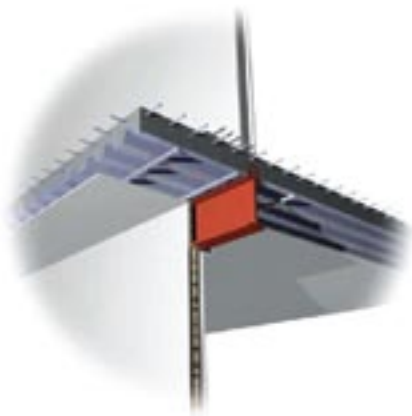
Schematic view of the staggered truss framing system.



Column-free lower level.



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Beam-in-wall system.

ible, open space if your room layouts are irregular. In addition, the corridor can usually be spanned only with deck. This provides plenty of plenum space to run utilities down the corridor, which usually has a lower ceiling height than the rooms. If the plank will span from demising wall to demising wall, perimeter beams may only be necessary for erection and can often be removed afterward. This helps avoid spandrel beams and the soffits they create.

If your project will use plank flooring, it is helpful to speak with your plank provider. Do they feel that they can provide you with carpet-ready plank or do they usually recommend a skim coat? How will you attach the façade of your building to the plank? September's SteelWise article "Let's Be Plank..." (www.modernsteel.com) is very helpful in identifying things to consider when designing with plank.

Long-span Deck

The availability of long-span deck has increased greatly over the past few years. Manufacturers like CSI, Epic, United, and Corus all produce a deep, long-span deck available within a 4- to 5-week lead time. It usually comes in depths of 4.5 in. or 6 in. and sometimes can go up to 7.5 in. deep. CSI produces "Deep-Dek". It is available in gauges from 20 to 14. Based on continuous slab design, the 6-in. deck in 14 gauge material with 5 in. of normal weight cover can span about 19 ft unshored and about 35 ft with one row of shoring. United Steel Deck produces type "LS". Type LS is available in depths up to 7.5 in. and gages from 16 to 10. Type LS 7.5 in 10 gauge material can span about 25 ft unshored based on single-span conditions with normal-weight concrete and a 10.5 in. total slab thickness.

Many of these products have been

vibration tested according to the guidelines of AISC's Design Guide 11, *Floor Vibrations due to Human Activity*. There are also UL fire ratings for assemblies using these decks. Speak with your deck provider to plan the specific details of your project.

Girder-Slab

Girder-Slab is a patented system, available through all structural steel fabricators, that uses dissymmetric beams (D-Beams) that carry precast plank on their bottom flanges. The D-Beams come in 8-in. or 9-in. depths. The sections are produced from "parent" sections (W10s or W12s) that are sliced in half through the web in a hexagonal pattern to form two equal T-sections. A 3-in.-wide bar is used to form the top flange. Traditionally, 9-in.-deep D-beams are for plank systems that require a structural topping. Eight-inch D-beams are usually sufficient for plank systems that only require a nominal skim coat topping or no topping. By resting the plank on the beams' bottom flanges, the whole structural depth is incorporated into D-Beam depth.

The beams are designed to develop composite action between the planks and grouted cells. Once the planks are erected on the beams, they are grouted into place. Grout flows through the openings in the web of the beam and into the hollow cores of the plank before it solidifies.

The precast plank slab can span either parallel or perpendicular to the perimeter of the building, and each has its own advantages. When plank spans parallel to the perimeter, D-Beams run in demising walls between residential units. Spandrel beams can often be removed after they are used for erection purposes. Because of this, true floor-to-ceiling windows can be achieved if this is a priority for your project. When plank spans perpendicular to the perimeter



Girder-Slab system.

(spandrel beam carries plank load), beams will run along the perimeter and corridor walls. This provides truly open space between units and is helpful if the units in your building are not laid out regularly. The system is UL certified (Design K912) for fire with spray-on or board assemblies. A typical D-Beam spans 16 ft to 20 ft and can be increased to 24 ft with the use of tree columns. With precast plank spanning an average of 28 ft to 30 ft, bay sizes of about 20 ft by 30 ft are usually efficient.

This system reduces and sometimes eliminates soffits. It is optimum in regularly laid-out condo, hotel, or dormitory structures. Any steel contractor can become authorized to distribute the Girder-Slab system.

MSC

Vendor Contact Information

Girder-Slab

www.girder-slab.com

CSI

www.metaldek.com

United Steel Deck

www.njb-united.com

Epic

www.epicmetals.com

Corus

www.corusconstruction.com



Unobstructed ceilings with Girder-Slab system.