

Tips from the AISC Steel Solutions Center  
on how to create your own Conceptual Solution.

# How to Conceptualize Your Next Project in Steel

BY CARLO LINI, P.E.

**THE STEEL SOLUTIONS CENTER (SSC)** was established by AISC in 2001 to provide decision makers with easily understandable information demonstrating the viability of a structural steel solution to meet their project needs. To that end, the SSC has completed more than 775 conceptual solutions over the years with good results. Of the projects where a competing or no framing system had been chosen, 40% have been converted to steel.

As we have conceived them, conceptual solutions are studies that demonstrate the viability of structural steel framing solutions for specific projects. They provide the information needed to evaluate the feasibility, aesthetics, and economics of a structural steel framed option for your new construction project.

The best time to look at a conceptual solution is during the schematic/conceptual design phase when you are exploring structural systems; however, such a study can be performed later in the design process as well. Conceptual solution studies can be applied to any building type—apartment buildings, medical office buildings, small industrial facilities, etc.—and for projects of all sizes located throughout the United States. As far as the level of detail to include, that's up to you. However, our most popular request involves generating a 3D model from which you can generate floor framing plans, column schedules and lateral frame size and locations. We refer to these as Full Conceptual Studies and will discuss this more later.

## Creating Your Own Conceptual Solution

Did you know that you can do exactly what we do on your own? Here is a list of questions that the SSC typically asks early on when evaluating various materials, framing and layout constraints, and you should as well on your next project.

### *What is the required floor-to-floor height?*

Total building height may be restricted by local codes. If so, minimizing floor-to-floor heights may provide enough room for an additional floor. Reducing floor heights can also reduce costs in areas such as the façade, elevator systems and operating energy.

### *What are the serviceability requirements?*

Consider the vibration requirements for the floor system and inter-story drift limitations required to prevent damage to the cladding material. If you're designing a steel parking structure in an area where frequent freeze-thaw cycles are typical and deicing salts are used on roadways, and are concerned with durability, a cast-in-place post-tensioned slab might be a better floor system option than a cast-in-place conventionally reinforced on metal deck floor system. Serviceability questions differ from project to project and must be based upon the needs of the project.

### *What is the desired project schedule?*

There are benefits to having an accelerated steel schedule, such as allowing for early occupancy and generating income sooner. A shorter steel schedule can also allow for more design time to identify potential issues and work through coordination issues while still meeting the desired occupancy date.

### *What stage is the project team at in terms of project development?*

If you can get involved early on, you may have more flexibility with the building geometry. Maybe you can suggest moving columns around to fit a particular floor system better or create better locations for your lateral system.

### *What are the architectural limits?*

Make sure that the lateral system type or column layout will work within the building layout (i.e., without interfering with open rows, windows, doors, etc.). Also, if you're trying to achieve a

lower floor-to-floor height, you may look at integrating your steel framing within walls.

***What are the local erection/trade constraints in construction?***

You may be looking at a parking structure and considering a cast-in-place post-tensioned slab for the floor system. Make sure that contractors in the region of the project are experienced and comfortable with this particular construction technique.

***Are there any special installation considerations?***

Some floor systems may require shoring and could have an impact on the construction schedule and cost. Also, check to see if you are specifying heavy crane pick loads (long span girders or trusses, for example) as these may exceed the capacity of the crane the general contractor anticipated using.

***Are there any site constraints?***

There may be no vacant adjacent space for onsite fit-up or assembly. Does your system allow for this in a tight area? If you are planning on using large built-up trusses, do you have a laydown area that is large enough to accommodate them? Some members may need to be taken straight from the truck to the structure.

***Are there any potential issues regarding material availability?***

While both WF and HSS members are readily available in the marketplace it is possible that local service centers may not stock every section in every length. It is always a good idea to contact service centers in the vicinity of the project to determine which sections are typically stocked in their region in order to ensure quick delivery of material to the selected fabricator.

***Are there plans for future expansion?***

If there are plans for vertical expansion, make sure the columns and lateral system have been designed to account for this. What impact will a future expansion have on the required fire rating?

***What is the season of construction?***

Time is money so it is important to plan ahead to reduce the risk of costly interruptions due to weather. What kind of weather do you expect during the time of construction and what is the ease of construction of a particular structural steel system in that kind of environment?

***How can we limit the interdependence of trades?***

Try to make each construction activity as independent as possible. The more coordination that is required between trades, the more complicated the construction process will be.

***How can we improve the coordination between designers and construction trades?***

Early involvement of the contractor, designers and subcontractors is vital to the success of any project. The earlier the structural, mechanical and electrical trades can coordinate to avoid clashes and possibly optimize layouts to avoid field issues, the sooner project success can be realized.

***How complex is the building geometry?***

Determine if the building layout is atypical or non-repetitive. Some floor systems have greater flexibility than others. With more bay-to-bay and floor-to-floor replication, greater efficiencies can be gained. Where anticipating complexity, discuss your options with all involved. For example, if you have a complicated connection, work with the fabricator to find the best solution.

***Will this be a mixed-use facility?***

Integrating multiple uses into one structure can be a challenge. Structures such as parking, office and residential all have unique architectural demands and possible structural optimal layouts. How is it best to integrate these into one structural layout to minimize transfer girders while considering all of the structural layout demands?

***Is there a possibility for future modifications of the interior space?***

If there is a possibility for future interior space modifications, some steel floor framing systems may provide greater flexibility than others. Future tenants may need a floor system that can easily be upgraded to handle heavier floor loads or penetrations for new elevators or stair towers.

***How can we limit field work?***

If you're looking at a conventional steel frame system, the farther you can space out your infill beams, the fewer pieces there will be to fabricate, erect and install. If shoring is required, make sure to consider the shoring cost. What connections will work best for the field? Remember that material costs are approximately 30% of the steel package and the remainder is fabrication and erection labor.

***What are the life-cycle costs associated with a particular system?***

Successful paint systems can achieve between 25-30 years before a new coat is required. Galvanized steel typically can last 75 to 100 years without maintenance. Factor in the cost of maintenance when comparing these options. Also make sure to not specify paint if it's not required. In building structures, steel need not be primed or painted if it will be enclosed by building finish, coated with a contact-type fireproofing, or in contact with concrete. Also, when looking at other construction materials, factor in joint rework costs.

The preceding questions are intended to provide a good starting point. A great next step would be reviewing the AISC *Steel Design Guide No. 5, Low- and Medium-Rise Steel Buildings*, and AISC *Steel Design Guide No. 23, Constructability of Structural Steel Buildings*.

**Contacting the  
AISC Steel Solutions Center**

The AISC Steel Solutions Center makes it easy for you to find, compare, select, and specify the right system for your project. From typical framing studies to total structural systems, including project costs and schedules, we can provide you with up-to-date information for your next project. If you have a project and would like to evaluate a steel framed option, please let us know. You can reach out to your regional engineer (see [www.aisc.org/myregion](http://www.aisc.org/myregion)) or contact the solution center directly.

phone: 866.ASK.AISC (866.275.2472)

email: [solutions@aisc.org](mailto:solutions@aisc.org),

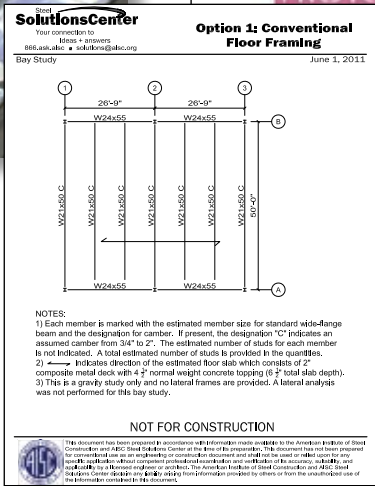
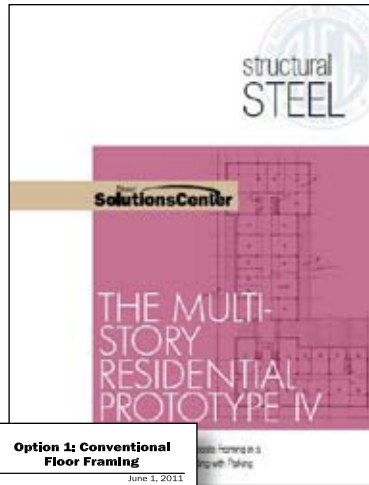
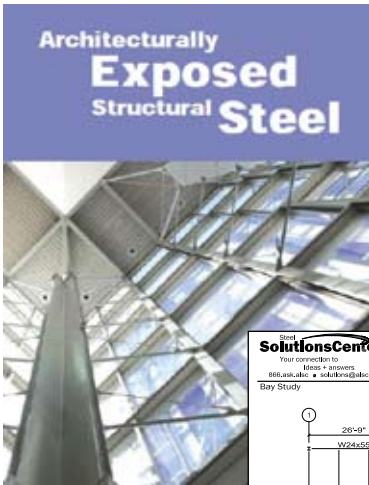
website: [www.aisc.org/askaisc](http://www.aisc.org/askaisc)

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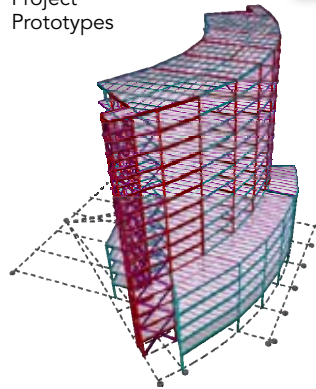
## Conceptual Solution Levels

### Reference Material



### Framing Bay Study

### Project Prototypes



### Full Conceptual Study

**Similar Study**  
Project Location:  
Prepared for:  
Contact:

**BUILDING CODE CRITERIA**  
IBC 2006

**STEEL QUANTITY TAKEOFF:**  
Addition to Existing Structure

**COMMENTS ON PROVIDED SOLUTION**

### Similar Study

Filled with useful information, both are available as free downloads for AISC members at [www.aisc.org/dg](http://www.aisc.org/dg).

### Let Us Help You

If you don't have time, or if you want help, call us. When most people think about the Steel Solutions Center, the first thing that comes to mind is a source for answers to technical questions. It's easy to understand why. The SSC receives around 200 questions per week and has answered more than 93,000 questions since it was created in 2001. However, that's not the only guidance the SSC provides. The SSC also can provide complimentary conceptual solutions to assist engineers of record that are intended to highlight the benefits of a structural steel framed system for your project. There are essentially five different levels of detail, depending on what you're looking for from the SSC and how fast you need the information.

- ▶ **Level 1: Reference Material.** The SSC provides basic information on steel framing solutions for a variety of building types including parking structures, offices, multi-story residential buildings, and more. It's a good starting point for someone exploring steel framing for their project.
- ▶ **Level 2: Project Prototypes.** The SSC has gone through hundreds of conceptual solutions looking for similarities in the framing systems used for offices, hospitals, parking garages, and other building types. Based on this research, we have developed project prototypes to provide what we consider typical framing layout for a particular building type. These prototypes are available in print, on the SSC website, or by email.

- ▶ **Level 3: Similar Study.** The SSC maintains a database of all conceptual solutions it has provided. We can search these to identify a project similar to yours. This earlier project can be used to generate a ballpark cost and schedule estimate for your project. You may also receive a copy of the original study with all identifying references removed. The main benefit of a similar study is the speed with which it can be completed.
- ▶ **Level 4: Framing Bay Study.** The SSC can help evaluate structural steel framed floor systems for the typical bays/floors in your project by providing approximate beam and deck layouts and cost comparisons. A floor system/layout can have a big impact on project costs so it's always a good idea to look at your options early on.
- ▶ **Level 5: Full Conceptual Study.** This is the most popular and most involved Conceptual Solution option. A framing model is created and evaluated for gravity and lateral loads. The SSC then presents the information in report format—a cover page with a 3D image of the structural steel frame, floor and roof framing plans, column and lateral frame elevations, material takeoff sheet, loading criteria information, and notes that provide additional information on the study. It's important to note that the conceptual study is just that—*conceptual*. The engineer of record for the project may use the information as a reference when developing full project documents. Keep in mind, though, that the final design for the project may be quite different than the conceptual solution. However, the quantities, costs and schedule presented in the conceptual solution are typically quite close to those of the final design.

## What You Can Expect

When providing a conceptual solution, the SSC considers several factors. What framing systems provide an economical and constructible solution to meet the project requirements (low floor-to-floor height requirements, for example)? Is a particular project a great fit for the staggered truss framing system? Would hollow-core precast plank or long-span deck be a better option than traditional metal deck with concrete topping? The SSC will ask these questions when putting a Conceptual Solution together while not losing sight of engineering and fabrication issues such as beam copes, camber limitations, seismic detailing and member sizes, material ordering, and repetitious member sizing. Other efficiencies are also considered, such as foundation savings, fire protection costs, and reduced schedule time. The SSC also can provide information on protective coating systems for exposed steel.

Additionally, the SSC can explore innovative steel solutions in addition to more traditional framing systems. Many innovative structural steel systems are available in the marketplace, and it is definitely worth exploring the benefits that they may bring to your project. Steel plate shear walls, castellated/cellular beams, Girder-Slab, Peikko, ConXtech, SidePlate, and Versa-Floor [HR] are just a few examples of recent innovation in the structural steel industry. The SSC maintains up-to-date information on many of these systems, which allows the SSC to evaluate them in addition to more traditional framing systems. Having a good understanding of all of the options that are available allows the SSC to make accurate comparisons of different systems and provide decision makers with

the best steel option for their project. By keeping up to date on these different framing systems, the SSC can provide you with the information you'll need to make your project a success.

How much does a conceptual solution cost? The SSC provides conceptual solutions at no cost to you. There are no asterisks and no fine print. You may be doubtful, thinking there is no such thing as free. But in this case, it's true! As long as you are serious about the use of steel for your project, the SSC will be glad to put together a conceptual solution that will allow you to compare different construction materials and decide what is best for your project. The SSC is always willing to demonstrate the reality of AISC's viewpoint that "There is always a solution in steel." Conceptual solutions allow you to see what that solution is. Armed with this additional information, you can decide if the steel solution is the best solution for your project.

Due to regional variations, project complexities, and changing market conditions, project costs must be evaluated on a case-by-case basis. The SSC has determined that the best source of up-to-date and project-specific cost and schedule information is a structural steel fabricator located near the project location with experience in the project type being investigated. Steel fabricators also can provide tremendous insight into additional cost-saving measures and make suggestions regarding material availability. After the SSC develops a conceptual solution, the AISC regional engineer will involve a local fabricator to develop cost and schedule estimates. This information is crucial to the project decision makers in order to evaluate cost-effectiveness of various framing alternatives.

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## Elements of a Typical Level 5 Conceptual Solution Package

**Project Name**

Project Location: Prepared for: Date: Contact: Regional Engineer: Gene M. Martin

**Comments**

**COMMENTS ON PROVIDED SOLUTION**

- 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.
- The conceptual solution and estimates for this project are based on parameters defined through architectural drawings and project criteria received on date.
- The steel quantities and geometry of this investigation are provided on the Floor Framing Plans, the Column Layout Plan, the Column Schedule, and the Frame Elevations on the following pages.
- The design criteria per the International Building Code 2006 (IBC 2006) is summarized and included in the Building Code Criteria page.
- Based on the available options, the In-Wall Beam system best fits the needs of the Project. The In-Wall Beam system uses steel girders and then precast concrete planks between to offer open, flexible spaces for the designer.
- 8" precast hollow-core planks were used for the office and hotel tower floors of the building. A 10" precast hollow-core plank was used for the hotel amenities floor of the building (6th floor).
- The precast hollow-core plank is not cambered. The plank is assumed to have no structural topping. Plank keyways should be grouted per manufacturer's recommendations. It is recommended that carpenter-ready, higher-end planks with a uniform top surface be specified to minimize the on-site labor involved in leveling the planks. Eliminating topping materials saves time and money. Non-structural topping may be used if necessary to level the top of the plank.
- Steel studs are assumed to be provided every 24" necessary if entred plates are welded to the steel.
- According to industry standards, wide flange girders confirmed by the engineer of record, with final load moment and accounts for the beam's unbraced top flanges for construction loads before the final floor.
- Based on the available options, the traditional concrete slab structure - the traditional composite system.

**STEEL QUANTITY TAKEOFF: Total Structure**

Material	Quantity	Weight	Volume	Notes
Gravity Columns W14s	79 tons	0.75	93 pieces	
Gravity Beams Wide Flange	268 tons	2.7	916 pieces	
8x8 studs	179 beams			cambered between 0.75 in. and 2.5 in.
Beams	255 tons	2.41	375 pieces	
Columns	325 tons	3.07	232 pieces	
Braces (W8)	34 tons	0.32	38 pieces	
Braces (HSS)	190 tons	1.79	434 pieces	
Steel not indicated in sketches	2%	59 tons	0.55	
<b>Total</b>	<b>1,236 tons</b>	<b>11.6</b>	<b>1688 pieces</b>	

**BUILDING CRITERIA IBC 2006**

This investigation is based on the following criteria. The Steel Solutions Center criteria that apply to this project. The criteria are chosen based on the project building code, IBC 2006. Requirements by local and state jurisdictions have criteria differ significantly from those listed, the results presented may no longer be accurate.

**2ND - 4TH FLOOR FRAMING PLAN**

**NOT FOR CONSTRUCTION**

**Column Schedule**

Column	Size	Height			
C1	C2	C3	C4	C5	C6

**NOT FOR CONSTRUCTION**

**FRAME ELEVATIONS**

**NOT FOR CONSTRUCTION**

**Building Criteria**

**Floor Framing Plan**

**Column Schedule**

**Lateral Frame Elevations**