

Real-life Adventures in Staggered Truss Framing

Project engineer Rod Gervais shares his experience constructing a staggered truss project with AISC Regional Engineer Tom Faraone.

What makes the staggered truss system a success? Is it the direct dollar savings? The faster project-completion time? Is it the more-functional end product?

The Marriott Hotel and Spa, in Mystic, CT is a six-story, 285-room, staggered-truss-framed building, completed in June 2001. An key to the success of this project was the hands-on involvement of Rod Gervais, project engineer for Wolman Construction, and the owner/developer/operator/general contractor for the Mystic Marriott project.

Although he had never seen a staggered truss framing plan before, Rod immersed himself in the drawings, studied the system, recognized the benefits, and embarked on a mission with only one goal in mind: Staggering success! Tom met with Rod at the completed Mystic Marriott to learn more about his experience:

Faraone: You've been in the construction industry for a long time. Can you share a little of your background with our readers?

Gervais: I grew up in the construction industry. My father was a general contractor. I started out as a carpenter's helper.



Rod Gervais (L) and Tom Faraone (R).

I worked days and studied nights. Twenty-nine years later I'm a project engineer for Waterford Development.

So you've been constructing hotels for some time now ?

Eighteen years—including a Comfort Inn project in 1987, which we completed in three months and one week.

So you really know construction from the hotel owner/developer's perspective.

Yes. A hotel owner's perspective is different from a contractor's perspective. Lowest first cost is not always the best option. Long-term hotel operations factor into the construction decisions. Most of these decisions are made above and beyond what we eventually see from a construction point of view.

The decision to use the staggered truss system came early in the planning process of the Mystic Marriott.

Yes, this project was near the minimum size for a staggered truss project. It's important to have enough repetition of identical trusses to make it worthwhile. The fabricator must build a fixture in which to construct the trusses and a "jig" to control layout. In order to maximize the economy of this system, the fabricator should make as many similar trusses as possible.

You also considered a poured-in-place concrete frame and a structural steel braced frame.

No, we never considered cast-in-place concrete for this project. Concrete has never been competitive from a cost basis for this type of project in our region.

What made staggered truss frame the winner over the steel braced frame in this case?

The advantage of wide-open bays in the building. The staggered truss removed the need for interior columns on the first floor of our building. This was our main reason for ini-



Concrete plank is placed on the staggered trusses during the construction of the Mystic Marriott.

tially considering this system. This also created wide-open bays in the floors above, and we didn't have to deal with columns rising through the building at the corridors.

A staggered truss frame lowered our steel and foundation costs, and increased our total productivity. Lower floor-to-floor height also came into play. Aside from the fact that ultimately this lowers operations costs (i.e.: lower heating- and cooling-energy consumption), often towns have zoning limits on total building heights in particular areas. You might be able to pick up a floor with this system that you would lose with conventional steel framing.

The ability to get the building constructed sooner was a major factor in the decision to go with a staggered truss frame.

Cost is always a consideration—but opening date is also extremely important. The owner does not want to have lost revenue due to a slip in the completion date. Using the staggered truss system allowed us to complete the project on time.

Once you were on the job, you really embraced the staggered truss system.

This project was the first time I'd ever seen the staggered truss system. I was apprehensive. I had heard horror stories about the erection process. But the more I studied it the more I realized the benefits of the system. By the time erection began, I had a lot of faith in the system.

Did site conditions factor into the construction process at all?

Although we had plenty of lay-down area here, we picked the trusses and plank directly off the trucks because it made most sense from a construction point of view. The trusses came in standing up, three per truck. The fabricator, plank manufacturer and the erector coordinated the entire erection process. That was in their contract. However, I would point out that in conventional steel-frame construction, a shake-out area is really the best way to go. If space is a limiting fac-

tor, such as exists in inner-city construction, the use of the staggered truss frame will go a long way towards simplifying the construction process.

The use of a staggered truss frame significantly reduced foundation construction. That was a big benefit too.

The steel tonnage of the trusses was reduced significantly, which was directly reflected in reduced foundation loads.

Since construction speed was paramount, the steel and plank erection process must have required careful attention.

Yes. The erection crew never erected a staggered truss frame before, and the fabricator had never constructed one. They did, however, visit a few sites where a staggered truss frame was under construction. They learned quite a bit by observing these other projects.

For example, on one project there were problems with the locations and size of some of the plate connections—the plates actually protruded into the corridor. Fixing a problem like that in the field is rather expensive, to say the least. One other problem they observed on this project had to do with the clearances between the top plate of the bottom chord and the lower end of the web assemblies—which were very tight on that project. They learned that more clearance should be allowed for smoother installation of the plank.

Even with these site visits, we still encountered a few erection problems. In the first week of erection, we actually had to remove some steel to get the second-floor plank in place. Once we figured that out, it went up very fast.

I understand it is important to maintain alignment of the trusses as you go up.

It is for a variety of reasons. Structurally it's very important that the trusses are straight for stability purposes. Architecturally it's a concern as well. We worked with a 1/2" tolerance between the truss and the finished stud wall. If the truss is out more than that, it affects the walls of the guest rooms. Er-

rors are compounded because the plank will push the succeeding truss further out of alignment. We also learned this the hard way. We had to remove some plank in order to align the trusses. Fortunately, this was early enough in the process to avoid schedule delays.

I understand you installed the plank with the reinforcing bars already in the cores.

Yes, that is true. We installed fiberglass insulation 3' into each core of the plank while on the trailer. We then set 6' rebar, per design, through the insulation completely into the core. After the plank was in place, we slid the rebar into the adjoining plank cores.

One thing that contributed to the reduced schedule was the ability to get other trades in much sooner.

This building, due to the C-shaped plan and large floor plate, allowed all the other trades to work in one wing, while steel and plank erection was going on in the other wings. The trades followed the steel erection.

The use of precast plank helped in that regard as well.

Yes. Once the plank is in place, there is no shoring below, as would be required for cast-in-place concrete. The space is then free and clear for the other trades.

The majority of the fire resistance of the steel was provided with membrane protection (gypsum board).

That's true. All of the steel for the staggered truss portion of the project was fire protected with gypsum board. This eliminated the time-consuming process of spray-applied fire protection. It sometimes requires 15 days for the spray-on fire protection to cure and be tested, depending on temperatures and humidity levels. This would have affected the completion of the building enclosure. We didn't want to risk schedule delays. One of the other large benefits of constructing the fire protection with gypsum products is an increased STC rating between guest rooms. This is always a plus in hotel construction.

Did local code officials require any special documentation of the fire resistance of the steel in order to issue their approvals?

No. All structural steel protectives conformed to specific UL-listed assemblies. We provided them with UL documentation and copies of the special inspections for this work. Nothing additional was required.

The hollow-core slab-floor system was left untopped, yet provided a very uniform surface for carpet.

We paid a premium for 'carpet-ready' plank. During the installation we used an alignment system utilizing a bolt and plate, which alleviated the need for interior shoring for plank alignment. The premium in plank was small relative to the savings in cost and time required by the installation of a lightweight topping.

The ceiling was finished with a textured paint on the underside of the plank. Very economical, and everyone was very satisfied.

Yes. The underside of the plank was finished with the same quality as the top of the plank. With a simple caulk joint between plank, and a textured spray surface, the outcome was a ceiling finish more than adequate for a four-diamond hotel.

You've mentioned that you would pay more to get the building completed earlier. Did you pay more for Mystic Marriott?

No. There have been occasions in my career where we have paid premiums to finish sooner. But not in this case. The use of the staggered truss system on this project saved money from a construction and a schedule point of view.

This project required close cooperation between all project players.

In projects like this, where the owner/developer is also the GC and end user, very careful cooperation and coordination is required by all the players. It's critical that the developer's staff maintains close involvement with the design team. It is equally important for the design professionals to have staff capable of interfacing with the development team. They must honestly evaluate the suggestions and recommendations of the developer's staff. Ego can kill a project like this.

Waterford's next project, the Hartford Marriott, will use a staggered truss frame. This is quite a testament to the success of the Mystic Marriott.

I am extraordinarily excited about the staggered truss system; but the use of any system on a given project is based on the suitability of that system for that particular project. As we discussed earlier, the repetition of typical trusses is a requirement of the staggered truss system. The Hartford project meets that requirement. I personally would evaluate any project we build for suitability with a staggered truss frame, and if applicable, pursue it. And although we've discussed only residential applications here, the staggered truss system can be utilized for other building-use groups.

Finally, you've been quoted "The system is a sweetheart—it's a challenge but it's a sweetheart." I guess the careful attention to details makes it all worthwhile.

I think it is a sweetheart of a system. If anything, it succeeded in spite of me, not because of me. I've always been excited about steel construction in general and always will be. This system, as well as other systems, will always have a place in construction. I find it exciting to be a part of that. ★

To learn more about staggered truss framing, check out AISC's Design Guide 14: Staggered Truss Framing Systems, available at www.aisc.org/bookstore. A 24" by 36" blue-line of typical staggered truss framing details is available by e-mailing the AISC Steel Solutions Center at solutions@aisc.org, or by calling 866.ASK.AISC.