

Three Experts On the Advantages Of Designing With Composite Steel Joists

To offer valuable insights around the advantages of designing with composite steel joists, we spoke with three esteemed experts who have an impressive breadth of experience within the industry and actively work with these materials in their current roles.

- Rafik Gerges, Ph.D., P.E., S.E. Principal at HSA & Associates
- Dave Samuelson, structural research engineer – GTS at Nucor Vulcraft/Verco Group, Chairman, SJI Composite Joist Subcommittee
- John Whiteman, S.E., business development manager at Vulcraft/Verco Group

A Superior Option

When looking at some of the alternative materials in use today for floor construction our experts agree on one thing: Composite steel joists are the superior option. Dave believes that, in one product, “composite steel joists combine the efficiency of composite steel deck construction and the economy of steel joists.” Rafik agrees, selling it to clients in a single line. He says, “It’s twice the performance with half the weight.”

Some of the most notable advantages are cited as lighter weight, increased strength-to-weight ratios, reduced floor-to-floor heights, easy MEP accommodation, and increased bay lengths, but that’s not all. Dave shares, “There are a couple other things that I hear people talking about. One is the fact that it is possible to fabricate large Vierendeel openings, ideally near the middle quarter span of the CJ-Series joist, which permits the passage of large HVAC ducts. Also, composite joists are fabricated in special rigging tables, which permit customized and consistent camber to be placed into each joist. So for places where it’s critical for the floors to be as level as possible after pouring the concrete, CJ-Series joists require less concrete surface grinding.”

In many cases, this is for a reason you may not expect: to facilitate robot travel. “Robot and automated systems are becoming more and more common in a variety of facilities,” says John. “You want to have a floor that’s very level and free of cracks.”

Another less-discussed advantage is duct and sprinkler penetrations. Rafik adds, “You will spend zero time coordinating sprinkler penetrations in keeping the project schedule. In many cases, the ducting and sprinkler layout isn’t available while the steel is being fabricated. You don’t have these issues with composite joists because the web is open.”

Unmatched Cost Savings

The use of composite steel joists often translates into direct cost savings for the building owner. This is because they are readily available from many SJI member companies

located across the country, which makes shipping costs minimal — as long as the project is happening within the continental U.S.

John says, “With any type of steel project a very important factor is steel weight. Part of the cost is based on a per-pound price, so when you’re able to decrease the weight of the member, it decreases the cost of that member.” This, in turn, decreases shipping costs because you can get more product on the truck for transport to the project site.

“We commonly see cost savings when you’re hit with a huge steel mill order, and you want to secure this as a wide flange. There’s a fixed amount of wide flange the mills can produce in a given time. A lot of times, this will drive the schedule of the project,” says Rafik. With a composite joist, because they are made out of readily available angles, schedules usually aren’t heavily impacted, even when building significant structures.

Advising on Materials and Building With Confidence

Dave encourages builders to take a serious look at composite joists with flush frame top chord bolted connections. “This type of joist end connection makes it easy to design the girders compositely, which can reduce the girder weights by 20% versus non-composite girders,” he says. In this case, the result is significant reductions in floor acceleration, which occur with the flush frame top chord bolted connection as you’re transferring vibrational energy into the adjacent floor bay.

As part of an innovative new initiative, SJI is currently working with structural software vendors to automate the design and cost analysis for CJ-Series joists. In the near future, structural engineers will be able to identify cost savings for building owners using SJI CJ-Series joists versus other floor framing alternatives in just minutes, which could be a game changer for stakeholders across the industry.

Composite joists create excellent floor framing systems, which perform in cases where one has long spans and heavy floor loads. To Dave, this means cost savings for building owners. “Significant structural steel weight savings and corresponding cost savings can be seen. Each composite joist provides an optimized design for the specific loading and serviceability requirements of that specific floor location,” says Dave.

One of the biggest advantages John sees is that it allows much longer spans to be used for the floor framing, which gives owners and architects more flexibility with their floor plans. They can lay things out with fewer columns and have the ability to rearrange the area in the future if needed. “For the builder/owner, there are fewer pieces and fewer things to erect, which speeds up the erection time and brings down costs,” John says.

Composite Steel Joists Powering E-Commerce Fulfillment

CJ-Series joists utilized in e-commerce fulfillment centers tend to be fabricated with flush frame top chord bolted end connections. “With this type of joist seat connection, steel decks can be placed directly in contact with the top flanges of the girder and top chord of the composite steel joist. Both girders and composite joists are designed

compositely with the net result being significant structural steel weight savings,” Dave says.

Flush frame top chord bolted connections tend to provide increased rotational restraint at the ends of the joists, reducing the potential for negative cracking of the concrete slab surface over the girders. In fact, recent floor vibration measurements of an e-commerce fulfillment center by Dr. Brad Davis, assistant professor at University of Kentucky, shows significant floor vibrational benefits associated with the flush frame top chord bolted connections.

Dave says, “Having a floor free of surface cracks and excellent vibration characteristics are very important serviceability considerations where you have large numbers of robots simultaneously traveling at high speeds over a floor surface.”

Structural Stability With Lighter Weights

In addition to cost savings, composite steel joists offer a great advantage specific to the West Coast. John points out, “When you decrease the weight of the joist, you simultaneously decrease your seismic load to that floor. Your floor system doesn’t have to be designed for anywhere near as high a seismic load, which translates to all your lateral force systems, helps your moment frames and helps your foundations. So there’s a real benefit to the overall project in seismic regions by decreasing that weight and having a really efficient product being used.”

Rafik adds, “The lightweightness of CJ-Series joists means you can make use of every inch you have in the structural depth allowed by the story-to-story height and you can customize these depths. So, if you take a typical design for a 50-foot span, first designing it with wide flange beams and then taking the exact design and doing it with 36-inch-deep CJ-Series joists, you’re going to end up with about half the steel weight utilizing CJ-Series joists. And that is significant savings for the project.”

Possibilities Afforded by Composite Joists

John says, “Composite joists can help in some of your medical office buildings, especially with that bolted flush frame connection where your vibration characteristics are very good to dampen the energy if you start getting things like MRIs, CAT scans and things that are extremely sensitive to vibration. Having those deeper joists that are composite that take advantage of that depth and stiffness can allow you to get those to work on the floor with a lot fewer requirements being involved than other framing options.”

For more on the benefits of designing and building with composite steel joists, visit <https://steeljoist.org/>.