

Fielding Modifications with EASE

BY BRADY BROOM

Breaking down communication barriers will improve
joist modifications in the field.

FIELD MODIFICATIONS HAPPEN. And open-web steel joists and joist girders are by no means immune.

While the structural engineer of record (SER) is ultimately responsible for joist field modification details, it is typically the joist manufacturer that provides the proposed modification details for SER review and approval. As such, timely and direct communication between the SER, field workers and the joist manufacturer is crucial to a successful modification. While the manufacturer is sometimes prohibited from communicating directly with the SER due to the subcontractor chain of command, a project's interest is best served by open and direct communication between these two parties.

Loading, Bearing and Length Changes

For example, if a joist needs to be analyzed (and possibly modified) for revised design loading, the manufacturer needs the most accurate loading information available to provide an economical design solution. Joists specified with standard Steel Joist Institute (SJI) designations are often inherently selected

with some amount of additional total load capacity above the minimum required design loading for the project. Analysis with more precise design loading may minimize reinforcement requirements, thereby reducing the modification cost and schedule. If the only load change information provided is "a rooftop unit is to be supported by a pair of joists," then the manufacturer is forced to model as a worst-case scenario. If, on the other hand, specific location, size and corner weights of the rooftop unit are provided, the extent of the fieldwork can be greatly reduced. Additionally, distributing these loads to as many joists as possible by using additional framing can significantly reduce or eliminate overstresses due to the load distribution.

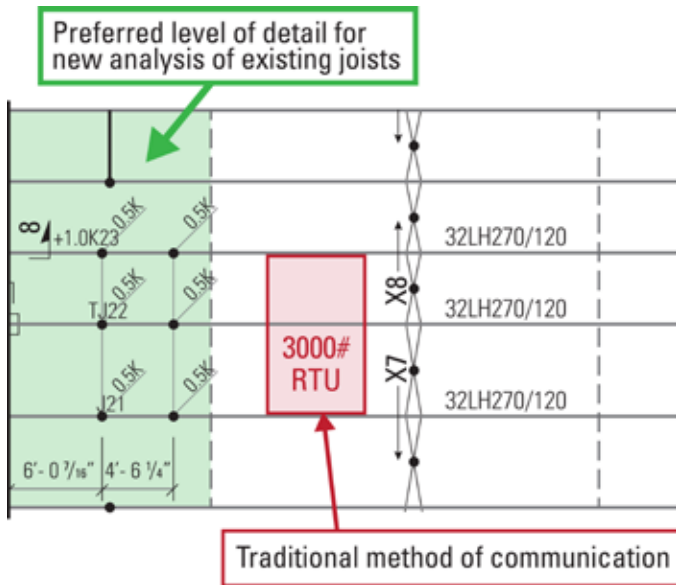
Specifying applicable load categories can also help to minimize required fieldwork. For example, when a positive and negative concentrated load is provided with no load category, the joist manufacturer can conservatively model the downward load with other gravity loads. This may be the quickest and easiest approach for the initial fabrication design, but for time-sensitive field modifications it can lead to unnecessary fieldwork. If the



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Joist Matters

The Steel Joist Institute provides plentiful resources to owners, architects, specifying professionals, contractors and anyone seeking information on the topic of joist field modifications. From the "Joist Investigation Form" that is used to help identify older joists in the field to Technical Digest 12 *Evaluation and Modification of Open Web Joists and Joist Girders*, SJI is a good starting point for assistance in locating the joist manufacturers and accessing modification-related information. For more information on SJI resources, please visit www.steeljoist.org.



- Fieldwork costs can be greatly reduced when instructions are made clear. The information highlighted in red illustrates how information, such as revised rooftop unit loading requirements, is typically communicated. The green area communicates this information more clearly.
- This joist was not detailed correctly and the erection crew made this modification prior to contacting the structural engineer or joist manufacturer. The end web primary tension member of the joist is not over the bearing member, which created a serious structural concern, and the joist had to be reworked a second time to address the problem.



positive and negative concentrated loads are due to wind, running the analysis with proper load combinations and accompanying factors may yield minimal reinforcing requirements, if any.

In cases where a joist length or bearing condition needs to be changed, it is important to have the joist manufacturer provide the modification details so they can also verify the impact on all other joist components. It is critical that they be provided with precise information about the new bearing conditions in order to develop the new design model and draft the field details. Precise modifications are critical to minimizing joint eccentricities, which impact the structural performance of the joists, and proper placement of the new end web and seat is critical to ensuring that the joist reaction is located over the bearing member, regardless of support type.

Additional Tips

In addition to involving the joist manufacturer in changes to load, bearing and length, there are a few other things to consider when it comes to joist field modifications.

Stay grounded. It is always beneficial to make joist modifications on the ground rather than in situ—not only for safety reasons but also due to ease of handling/access, elimination of worker lifts, and better control of the work area and materials. If an in situ modification is required, special care must be taken to properly shore the joist—and while the joist manufacturer may provide recommended shoring locations, the SER is responsible for designing the shoring.

Stick to the original plan. When feasible, it is best to show revised loads on the original joist erection plans provided by

the manufacturer, which are usually available upon request in electronic format. Doing so can allow even complex loading schemes to be easily communicated to the manufacturer's engineering staff, thereby decreasing time required to develop the revised loading model.

Reduce stress by allowing overstress. When investigating joist modifications, the required fieldwork may often be reduced by allowing a small theoretical overstress; many SERs allow small overstresses when analyzing existing structures for new purposes. Since joists are typically designed at or near their full theoretical capacity, any amount of new loading is likely to overstress some components of the joist. Allowing small overstresses can reduce the number of chord or web members that must be modified or reinforced due to revised loading. The amount of allowable overstress may only be specified by the SER.

When new joists are justified. At times, due to the amount of fieldwork required, it may become more cost-effective to have a completely new joist manufactured to meet the project's revised requirements. New joists can be fabricated with a field-bolted splice to facilitate installation into an existing building, and the joist seats can also be fabricated at a lesser depth for field shimming to the correct deck bearing elevation.

Once a project's joist goals are established and/or when field modifications become necessary, a joist manufacturer can present options, provide advice and assist with analysis and any needed modification details (most manufacturers have specialized programs that can handle joist stress analysis much more efficiently than commercially available structural analysis software). Making them a part of the joist design process can help reduce the time, cost and headaches associated with these modifications. ■