Collaborative steel joist design

Early teamwork can bring cost reductions to most steel projects

By Michael Roach, P.E.

In addition to meeting an architect's vision, collaboration during the steel joist and metal decking design phase often begins a chain reaction of cost reductions that benefit the owner, developer, and entire project team. Cost reductions are evident throughout the project and can be realized by the general contractor and erector experiences.

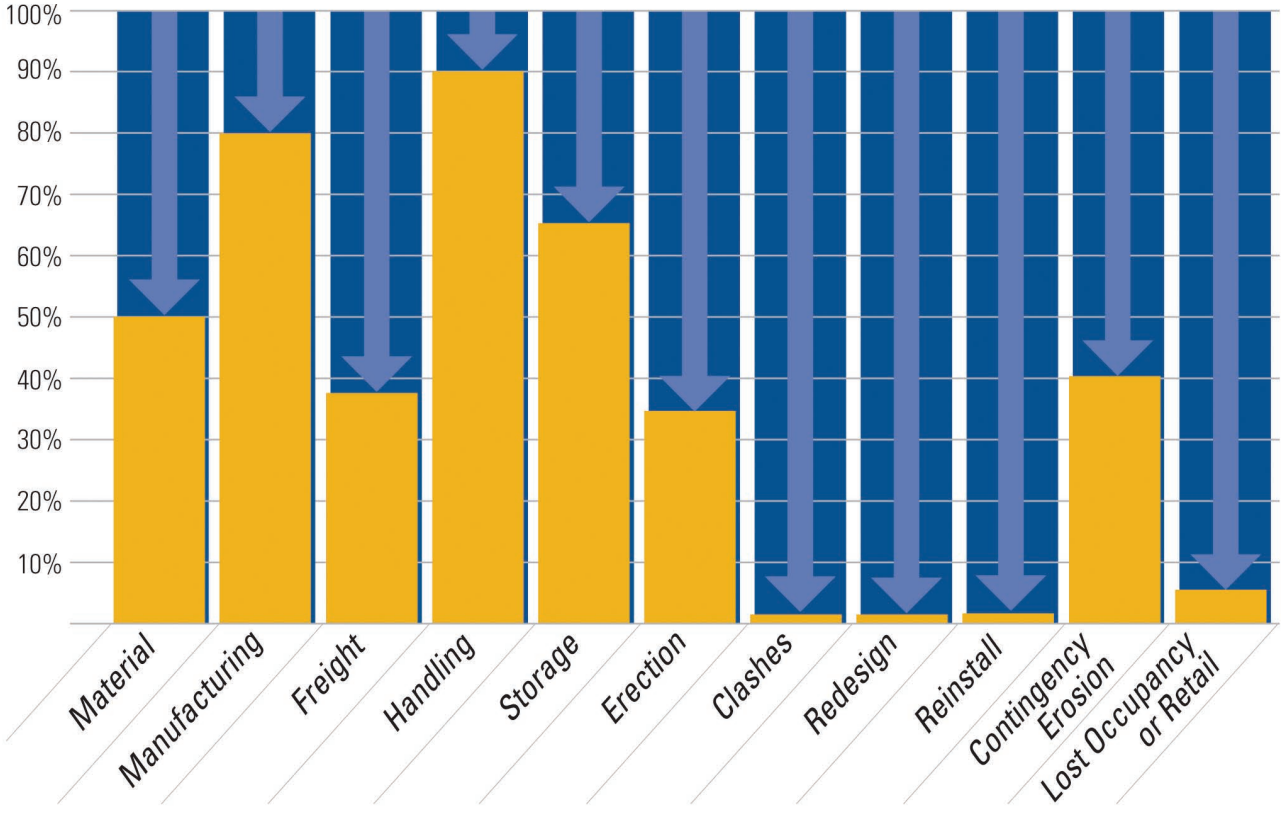
Design strategies may include optimizing joist and joist girder depths, increasing joist spacing to reduce piece counts, and re-evaluating loading conditions to ensure that joist and joist girders are designed efficiently. The design can be based on "load per foot joists" in lieu of standard "load table" joists, and roof live loads may often be reduced. Load zones can be identified where mechanical units are supported instead of designing an entire roof for collateral loads. In addition, joist and joist girder designs can be based on actual concentrated loads rather than on the use of KCS joists.

Depending on project size, New Millennium Building Systems has experienced actualized material savings up to 35 percent, but more commonly, between 5 and 10 percent.

Participating in the redesign of a midsized warehouse project last year, New Millennium reduced steel joist materials by $124,883 for the $1,282,000 project, an overall material savings of 9.74 percent. This did not include related cost reductions for shipping, on-site storage, handling, and erection. Moreover, further savings are often achieved by way of clash prevention, avoiding the costs for re-design, re-manufacturing, and re-installation of mechanical, electrical, and plumbing runs within steel joist structures.

Recent construction of the South Carolina Governor's School for Science and Mathematics illustrates the range

Improved joist design caused a chain reaction of cost reductions on the Governor's School project, starting with a 50 percent reduction in material costs. New Millennium estimates that on average, five to 10 percent of related expenditures can be engineered out of a project by way of collaborative steel joist and metal decking design early in the project.



of cost accountability within steel joist design. New Millennium engineered and manufactured the joists for the athletic wing over the school's gym area. The architectural vision called for an exposed look using very large gable joists. The gable joists had an overall length of 92 feet and the profile had a center depth of nearly 16 feet. Cost considerations extended to the tonnage of material, wide-load deliveries, limited on-site storage space, complexities of large-joist erection, related labor/crane time, and worker safety.

In place of the conventional double-pitch gable design, in which triple-pitch long-span joists are erected with a smaller gable joist set atop, New Millennium designed a three-piece Fink-Truss design, reducing cost at nearly every phase of design, delivery, assembly, and erection. Steel tonnage was reduced by more than 50 percent, which resulted in 20 percent less manufacturing time, 67 percent less transportation costs with no wide-load requirements, and reduced on-site storage space. In addition, the project realized a 66 percent reduction in erection labor and 60-ton crane costs.

"The joists were engineered to make erection very quick and safe for our crews," said Brice Harry of Dargan Construction Company, LLC, the general contractor on the project. "They created a one-step approach for placing the joist units, versus a double-layer joist approach. The erector was able to completely assemble each joist on the ground. Once each unit was set on the walls, anchored, and attached, we moved on to the next unit, placing the decking right behind it. This eliminated having to fly up pieces and assemble 30 feet in the air — adding time, cost, and safety issues."

According to the erector on the project, Bubba Howard of Allstate Erectors, the cost preventive design extended to the precise locations of the steel joists' connection points. "Everything lined up," Howard recalled. "All the holes lined up to bolt the X bridging together, and on an open ceiling design, everything has to line up straight."

Soon, digital, three-dimensional steel joist and metal decking design will bring even greater cost-accountability to a project. ▼

Michael Roach is the engineering manager at New Millennium's Lake City, Fla., location. He can be reached at michael.roach@newmill.com.