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From Experience

The Essentials of Roof Load Capacity

When working on a large expansion project, Hixson was able to review the original, 1960's-era drawings of the client's facility. Those drawings, along with historical data on framing, enabled Hixson to determine the capacity of the original structure, a calculation that showed the building was designed for loads approximately 10 pounds per square foot above current code requirements. In addition to the minor miracle of having the drawings themselves, the fact that the original load capacity was still able to meet current code requirements was also great news. With that reserve capacity, and by changing out the existing roofing to a new, lighter membrane-based roofing, Hixson was able to complete the planned renovations, which added collateral piping and mechanical equipment weight to the roof, without adding the cost of any extra structural retrofitting, providing significant savings to the client.

Since original drawings for older buildings are often lost or discarded over time, many renovation projects are not as fortunate as the project noted above. In such cases, structural engineers must spend significant time trying to determine whether a roof can sustain additional weight. Yet trying to

get more load capacity from an existing roof can be difficult even for more modern facilities where drawings do exist. If your facility is planning to add rooftop equipment, hung conveyors, utility piping, solar panels, or other additional weight to your roof structure, here is a list of factors to consider:

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EXPERIENCE IN BRIEF

We've Seen It All (Almost)

- Roof leaks repaired with internal gutters, tarps, and five-gallon buckets.
- Steel beams torch cut haphazardly to allow piping to pass through.
- Joist stabilization bridging removed to fit one more level of pallet storage.
- Pre-engineered metal roof bracing cut and abandoned to make way for a new exhaust fan.
- An old refrigeration unit repurposed to prop up a roof beam with excessive deflection.

Even if your roof situation isn't as dire, contact the Structural Engineering group at Hixson for help when your roof projects result in changing loads or capacities.

1. Roofs have limits to their structural capacity: Only so much load can be placed on a roof. This may seem obvious, but sometimes this fact is overlooked.
2. It is much easier to build extra capacity into a new roof than it is to add capacity later. Providing an allowance for additional collateral on the roof to account for future expansions and operational changes is a good way to avoid roof capacity problems in the future.
3. Code changes regarding snow and live loading have been implemented over time. If the scope of your new work is significant, your existing roof will need to meet the criteria of the current building code.
4. Snow pile-up can cause roof overloads and collapse when not properly considered during design. When planning to add weight to the roof, try to avoid adding new demands in areas more susceptible to snow pile-up, such as parapets or directly adjacent to higher roofs.
5. Pre-engineered metal buildings are typically designed with little allowance for future increases in load. Furthermore, member sizes are customized by each manufacturer, so there is no reliable database to help determine loading capacity.
6. Be careful with reinforcing work. Adding new steel plates to “beef up” beams requires care, as welding adds heat to the steel, temporarily weakening it. Welding should be performed in segments and ideally stitch welded (intermittent welds with spacing in between) to limit the heat’s effect on the steel member. In more extreme cases, temporarily shoring members while they are being reinforced is required.
7. Joists don’t like concentrated loading. Joists are very efficient at supporting uniform loads imparted by the continuous roofing overhead, and diagonal web members often vary in size across the length of a joist (larger members near ends and smaller members near mid-span) to gain further cost efficiencies. While this efficiency works for uniform loading, it does not work well when concentrated loads (hung conveyors, utility piping, hoist beams, etc.) are added to joists.

Due to the factors listed above (and several others not mentioned), it is best to have a professional engineer evaluate the existing roof structure before making changes that add or move loads on the roof.

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