Rivets were the most common connection used in the early decades of structural steel. Although many of the early riveted structural steel framed buildings have succumbed to urban renewal, thousands are still in use in our cities today, including high-rises such as the Empire State Building in New York City.

Photo 1 shows a part of Union Station in Indianapolis, Indiana, that has been converted into a hotel lobby. At the time this was built (1900), structural steel members (i.e., columns, girders, I-beams, and other shapes) were assembled from steel plate and angles using rivets.
Photo 2 shows the top of the column from Photo 1, with its riveted connections to girders and beams. Note that the connections between column and beam or girder were often reinforced with additional layers of steel angles and flat plate. The columns and girders were assembled with rivets at the steel mill, with holes punched for field riveting, and then shipped to the construction site. The columns and girders were set in place by cranes, and bolts were used for temporary connections to hold the steel members plumb and level and to clamp them together for riveting. After the rivets were installed in all of the holes, the bolts were removed to be reused and replaced with rivets.
Photo 3 shows the top of another column from the same structure with its riveted connections to girders and beams.
Photo 4 shows bridging riveted between two beams, with the riveted steel railroad track bed above. The bridging is also visible in the background in Photo 3.
Photo 5 shows the riveting of a butt joint in a column of the Empire State Building in 1930. By this time, steel mills had the ability to roll steel into more complex shapes like I-beams and H-columns, eliminating the need for these to be fabricated from steel angles and plates using rivets.
Riveting a joint on a construction job site was complex and labor intensive. Rivets were received at the job site with a head already formed on one end. They were heated to the proper temperature in a furnace similar to a blacksmith’s forge, often with a mechanical blower or bellows. The tender would keep the fire hot and turn the rivets with long-handled tongs to heat them evenly and keep them at the temperature needed for riveting (usually judged by the shade of red of the rivet). If the rivet was too hot, it would be too big to fit into the hole in the structural steel. If it was not hot enough, the head would not form properly, and the rivet would not expand to completely fill the hole in the structural steel. The rivet furnace was usually located a floor or two below the level of the connections.

When a rivet crew (Photo 5) needed another rivet, the following will happen:

- The foreman would call down to the lower level for a rivet.
- The furnace tender would hand off a rivet of the proper temperature to the “pitcher,” who would take the rivet in his tongs and pitch it up through an opening in the temporary floor deck to the “catcher” (right, Photo 5).
- The catcher would catch the red-hot rivet in the conical pail in his left hand, remove it with the tongs in his right hand, and insert it into the next hole in the structural steel.
- The “holder” (center, Photo 5) would press the rivet into the hole with the rivet holder until the head was in firm contact with the structural steel and hold it in place until riveting was complete.
The “riveter” (left, Photo 5) would set the end of the pneumatic rivet gun onto the unformed end of the hot rivet and hold the trigger until the head was completely formed and the rivet was completely expanded.

A rivet furnace with a tender and pitcher could supply several rivet crews. A rivet crew with an experienced tender and accurate pitcher might be able to install one rivet per minute in larger sizes or two rivets per minute in smaller sizes. Riveting had to be done quickly before the rivet cooled from contact with air and the structural steel.

Riveted structural steel was sometimes left exposed, as was the case at Union Station. It was protected from weather and moisture by red-lead primer and lead-based paint. Where fire resistance was required, the structural steel would be enclosed in concrete or in masonry or it was covered with hollow terra-cotta tiles with mortared joints. The steel might or might not have red-lead primer on it if enclosed in masonry or concrete.

In a building with a riveted structural steel frame—which should be noted on the preincident plan for the building—a firefighter’s concerns should include the following:

- Are the fire-resistant coverings over the structural steel still intact? If not, are the replacement fire resistive materials as effective as those originally used?
- Have the riveted joints been protected against moisture? Dampness or wetness speed the natural oxidation of iron or steel. This oxidation (rust) can weaken the rivets and the riveted joint.
- Is the automatic fire sprinkler system in this building well-maintained and functioning?

Riveted connection of structural steel has been replaced in new construction by high-strength steel bolts and welding.

For more information on riveted joints in structural steel, do an Internet search for “riveted structural steel,” “structural steel rivet,” and “ASTM A502.”

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