Reclaimed Structural Steel and LEED Credit MR 3 – Materials Reuse

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Reclaiming and reusing steel products provides a strong environmental option not available with many other construction materials.

ONE UNIQUE ADVANTAGE of structural steel buildings is that at the end of their useable lives, they can be dismantled like a kit of parts. While it is well known that the steel can be recycled, it also is possible that steel beams and columns can be recovered from the demolition site and sent to a steel fabricator for reuse on a new project. While steel is a true "cradle-to-cradle" material in that it can be recycled multiple times with no loss of material properties, it is also a high reuse material as it can be reused multiple times prior to being recycled.

Using reclaimed structural steel is an effective strategy to reduce the environmental impact of a building by eliminating the energy required to recycle scrapped steel into new structural sections. The United States Green Building Council (USGBC) has recognized the value of reused components through LEED Credit MR 3 – Materials Reuse. One or two points will be awarded, respectively, if the project can demonstrate that 5% or 10% of the total monetary value of materials on the project is reclaimed, refurbished, or reused. This credit applies only to materials permanently installed in the final building. The *LEED Reference Guide for Green Building Design and Construction* lists possible strategies for obtaining points for this credit. Salvaged, refurbished, or reused beams, posts, flooring, paneling, doors and frames, cabinetry and sometimes furniture can be applied to this credit.

As prominent as LEED is, garnering the MR 3 credit should not be the ultimate goal of incorporating reused steel. In fact, only a small percentage of all LEED Certified projects have been able to obtain this credit. Salvaged materials are being incorporated into many projects without the recognition of LEED Certification, simply because it is the environmentally preferable option.

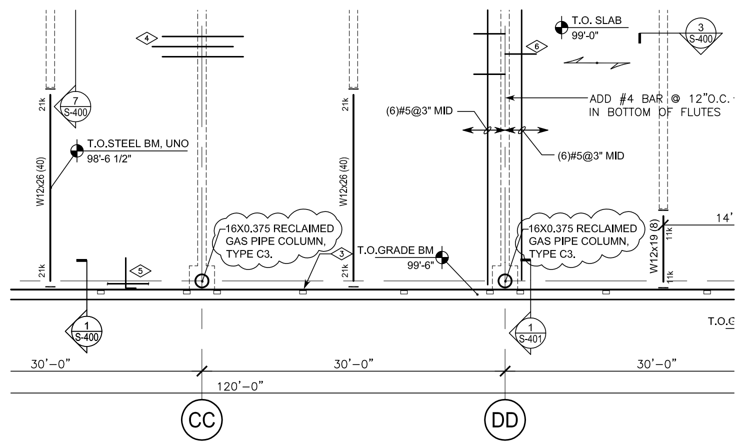

Figure 1: Reclaimed pipe column callout from NREL Laboratory, Golden, Colo. Courtesy of KL&A Engineers.

Figure 2: Reclaimed Pipe columns at the NREL Laboratory in Golden, Colo. Courtesy of KL&A Engineers.

How would one go about obtaining salvaged material? How is it tested and/or recertified? Who is responsible for the inspection? All of these are common questions in this rapidly emerging area of structural steel reclamation and reuse. Following are some examples of how reclaimed steel is being incorporated into current and future projects.

Recent Project Highlights

The new National Renewable Energy Laboratory (NREL) building made use of steel reclaimed from a gas pipeline for the building columns.

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Denver-based KL&A, Inc., served as Engineer of Record (EOR) and steel detailer on the project; Omaha-based Paxton & Vierling Steel Company was the steel fabricator.

The salvaged pipe used was a combination of 10¾-in. and 16-in.-diameter material. The smaller size was recovered from an existing gas pipeline that was being removed from service. The 16-in. pipe was purchased for pipeline use but never installed.

The original use of this pipe was not structural in the sense of Section 2 of the AISC *Code of Standard Practice*, and as a result the material was not labeled with any common ASTM standards for pipe or HSS. However, coupons were cut and tested, and the results allowed the material to be designed as conforming to ASTM A500 Grade B requirements.

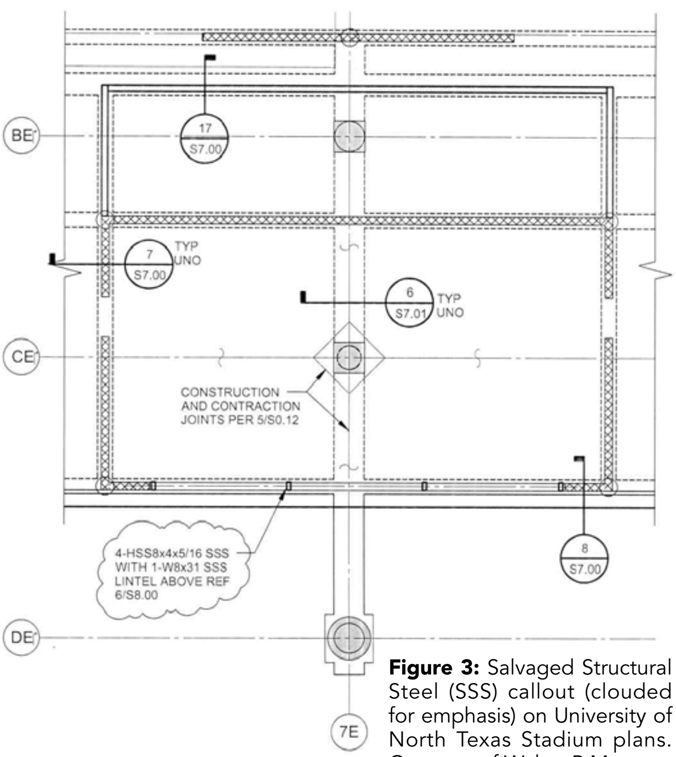

Figure 3: Salvaged Structural Steel (SSS) callout (clouded for emphasis) on University of North Texas Stadium plans. Courtesy of Walter P Moore.

Some cost savings was anticipated by choosing to use salvaged pipe for the columns in place of new wide-flange material. However, market conditions at the time of construction minimized the differential cost. From an environmental perspective, though, the savings were significant. A draft life-cycle cost analysis indicates that using salvaged material reduced CO_2 emissions by 69% and total embodied energy by 68%, compared to what would have been attributed to using new wide-flange columns.

As another example, the University of North Texas (UNT) stadium in Denton, Texas, near Dallas, is using salvaged steel beams repurposed as headers that will frame openings for concession stands. While these beams represent a small portion of the overall steel tonnage on the job, their use lowers the overall environmental impact of the project.

The Austin, Texas, office of Walter P Moore and Associates is the EOR and is working on this project with Planet Reuse, a consulting and material sourcing company based in Kansas City, Mo. Planet Reuse's mission is to educate project teams in the areas of using reclaimed materials and also aid in material acquisition. On a day-to-day basis, the company keeps in touch with demolition contractors to salvage wood, steel, and stone products for reuse in buildings.

Cost of Salvaged Material

The price of salvaged material can vary greatly, but generally it will be higher than the scrap value and lower than the cost of new steel from the mill. The effective price also depends upon many variables. These might include the transport distance from the demolition site to the fabrication shop and subsequent project site, requirements for material testing, surface treatment of the steel, and special material handling and demolition practices.

For example, when dismantling steel members to be sold to a scrap yard, demolition contractor normally cuts the members down to 5 ft or smaller segments that are easily transported and sold. However, for steel to be reused, it must be recovered in as much of its original intact length as possible. Early communication with the demolition contractor is key for them to understand what lengths are needed when the salvaged steel is to be reused.

Example Specification for Reclaimed Structural Steel

Walter P Moore's Austin office has generously shared some of the main tenets of its specification for Salvaged Structural Steel (SSS). While some of the ideas presented below apply specifically to the University of North Texas project, they represent a good starting point for crafting a specification for Salvaged Structural Steel (SSS). This specification can be added to section 051200 in the typical project specification.

Specification Ideas:

- ➜ Salvaged structural steel is referred to herein and on the drawings as SSS.
- ➜ Salvage Location: For all SSS members submit documentation showing the location and building structure where the members were salvaged from, including date of construction of original building.
- ➜ All SSS shall come from a building structure located in the continental United States and constructed after 1930.
- ➜ SSS shall not come from bridge structures.
- ➜ All SSS members shall be continuously rolled members. Built-up members are not permitted.
- ➜ SSS members should not include welded, riveted, or bolted splices along the length of the member.
- ➜ All SSS shall be certified to the section properties and material grade as specified on the drawings or general notes.
- ➜ SSS members shall not have areas of accelerated localized corrosion or show other evidence of localized section loss.
- ➜ SSS members shall not have existing holes within 3 in. of locations where new holes are to be drilled in the member.
- ➜ If original drawings and specifications are not available, a testing program must be initiated:
  - Similar requirements to AISC 360-05 Appendix 5
  - Mechanical Testing per ASTM A370
  - Chemical Testing per ASTM A751
- ➜ Remove any existing coatings and surface scaling by preparing the surface to SSPC-SP 6, "Commercial Blast Cleaning."

Testing

Ideally mill test reports will be available for the reclaimed steel. As this often is not the case, Appendix 5, "Evaluation of Existing Structures," in the 2005 AISC *Specification* is a great starting point for evaluating salvaged steel. While geared toward renovation projects, the guidelines in the appendix can easily be applied to use of salvaged structural steel.

Section 5.2 outlines the testing that is required to determine unknown properties of steel, including tests per ASTM A370 to determine yield strength, tensile strength, and percent elongation. Note that the yield and tensile strength of salvaged material might differ from what is used with today's common material specifications. Also, a chemical composition test per ASTM A751 is used to determine the weldability of the material and provide information needed for the preparation of appropriate Welding Procedure Specifications (WPS). As stated in the appendix, the EOR ultimately must determine what tests are necessary, and upon how many different samples these tests must be performed.

Fabricator and Engineer Communication

The use of salvaged structural steel on a project requires open communication between the steel fabricator and the EOR. In many cases, salvaged structural steel may require more shop labor than virgin steel because of the previous fabrication and erection operations that have been performed on it. For example, existing bolt holes, in-place welds and connection material, and previous painting might require design consideration and affect current fabrication and/or erection plans.

In general, welded connection material may be left in place for statically loaded members (the norm in buildings). The presence of bolt holes can be evaluated according to the net section provisions in Chapters D (for tension) and F (for flexure) of the 2005 AISC *Specification*. Fabrication and erection considerations also may affect whether welds and holes can remain or must be treated. Extra unfilled bolt holes are not necessarily detrimental to a beam, but depending upon the final in-place application of the beam, the architect or engineer may want existing unused bolt holes filled with bolts.

Another question must be answered if the salvaged steel has been painted: Can it remain or must it be removed? This is especially important to address if the steel was recovered from a building built in the 1970s or before, which means there is a good chance that the existing paint is lead-based.

Carbon Footprint

The production process (including scrap recovery) for structural steel from an electric arc furnace contributes approximately 0.73 tons of CO_2 per ton of steel, with transportation, fabrication and erection contributing roughly an additional 0.3 tons of CO_2 per ton of steel. If the steel for your project is truly salvaged from deconstruction of an existing building, the only embodied energy that the in-place steel will carry is that generated from transport, fabrication, and erection processes. **MSC**

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References and Additional Resources

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