PROGRESS 2017-2020: Provisions for Greater Reuse of Steel Structures

The largest stream of waste in Europe is generated by the construction and demolition industries. There needs to be an increased focus on reducing this waste, as the task is only going to become more difficult. The cost of material separation and recycling is likely to increase, as recycling processes come under stricter control and the use of multi-material building components becomes more popular.

Although, most building materials are already being recycled, there is considerable potential to create a closed loop of building components and improve the value of deconstructed buildings, which in turn carries benefits for the environment.

What is PROGRESS?

The PROGRESS project provides recommendations, as well as tools and methodologies, for reusing steel-based components in both planned and existing buildings. The project is primarily concerned with the deconstruction and subsequent reuse of elements such as load-bearing frames, trusses and envelopes.

The project aims to support the transformation to a more resource-efficient economy in Europe, in line with the European Union's Circular Economy Package to mitigate the impacts of climate change.

PROGRESS is focused on increasing the share of reused steel components. In Europe, the current reuse rate of structural steel components is approximately 10%. However, reuse practices differ greatly across Europe.

While the recycling rate of steel increased from 93% to 96% between 2000 and 2014, reuse rates stagnated in the same period.

If the environmental burden of all processes associated with the lifecycle of a building's construction is analysed, steel production typically accounts for 75% of the energy consumption and a large portion of the CO_2 emissions. Meanwhile, fabrication accounts for a much smaller portion of the energy and CO_2 burden. Hence, there is a significant potential for savings if semi-finished products are reused by the manufacturing and construction industries.

PROGRESS Project Consortium

The project consortium consists of two research institutes (VTT Technical Research Centre in Finland, and the Steel Construction Institute in the United Kingdom), two universities (RWTH Aachen University in Germany, and Universitatea Politehnica Timişoara in Romania), two companies (Ruukki Construction in Finland, and Paul Kamrath Ingenieurrückbau in Germany) and one European association (European Convention for Constructional Steelwork in Belgium).

The seven partners from five European Union countries have sufficient expertise and facilities to cover the necessary operational needs of the proposed project and networks to disseminate the results. They also represent the essential stakeholders in the process of steel reuse, such as material and products manufacturing and design (Ruukki Construction), deconstruction and distribution of recovered elements (Paul Kamrath Ingenieurrückbau) and facility owners (RWTH).

For further information about PROGRESS, please visit: **www.vtt.fi/sites/progress/**.

Case Study

National Tube Stockholders Building (Thirsk, United Kingdom)

The original single-storey building (74,700 m^2) was fabricated for the Irish company Quin Therm by Fisher Engineering at their Thirsk facility in the United Kingdom. The original building was to be a manufacturing facility that produced insulation for the construction industry. Designed and fabricated in 2008, the contract was cancelled before the structure could be shipped or erected because of the economic recession.

In 2013, the fabricated steelwork for the building was divided into four parts (lots) and sold at auction. National Tube Stockholders (NTS) purchased one lot. The steelwork was to be erected as a new warehouse for NTS on their neighbouring site in Thirsk.

Several elements of the new building required either a new design or a redesign, including strengthening of the columns along the eastern column line. The eastern column line of the original building was an internal column line, whereas the column line in the new building was an external wall line. The new design therefore required stiffening in order to limit deflection tolerances. This was achieved by welding a T-section (T 305mm x 152mm x 49mm split from a UC) to all 26 columns (UB 610mm x 229mm x 101mm) on this grid line.

In addition, the base plates for the outer column lines required redesign. The original base plate design (750mm x 400mm x 25mm) was retained for the central valley line. However, larger base plates were used for the two external column lines. The pad foundations for the external wall columns were 3.5m x 2.5m x 0.6m deep. The pads for the central (valley) line of columns was 2.8m x 2.0m x 0.6m deep.

New cleats were welded onto the columns to support the side rails. This was required because the original cleats were for an unknown (but non-standard) wall cladding system and did not match the new Tata Steel Trisomet cladding. Some cleats were also missing. In addition, the original cladding was to be hung horizontally whereas on the new building, the cladding was to hang vertically. The side rails are a single-span, sleeved system.

The original coating on the steelwork was epoxy. Following fabrication in 2008, the structural members were left outside for approximately 10 years and showed significant deterioration. The steelwork required shot-blasting to remove the loose and flaking paint and repainting before erection.

However, shot-blasting only removed the loose paint. Shot-blasting the paint on the welds caused problems since shotblasting the welds did not remove the paint and when the new paint was applied to these areas it became ‘soggy and blistered’. Consequently, the paint on the welds had to be manually scraped off.

A Cost Effective Alternative

Excluding the costs relating to the secondary steelwork, cladding and site management, the total cost associated with the primary structure was £491.75k or £42/m^2. By comparison, the indicative new build cost for a large span, high eaves, portal frame structure as at Q2 2017, would have been £82 to £112/m^2. This large-scale, case study demonstrates the economic savings that can be achieved through reusing structural steel.

However, the project was not without its challenges. There were numerous issues surrounding the structural drawings, particularly integrating the old drawings with the new design, which were exacerbated by software incompatibilities. In addition, it was difficult to find a steelwork contractor to erect the project. Generally, steelwork contractors are hesitant to take on this type of work because they are reluctant to sacrifice production efficiency by dealing with reclaimed structural sections. This suggests that a different supply chain is required to support structural steel reuse rather than try to fit steel reuse within the existing structural steel supply chain.

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