

High-strength steel – sustainable and money saving

Molybdenum’s unique properties are often used to deliver sustainability advantages in energy production, energy efficiency, resource conservation and environmental protection. The newly-constructed Friends Arena in Solna Municipality, Stockholm, is a great example of how “a little moly goes a long way” in reducing the environmental impact of a new building and saving cost at the same time.

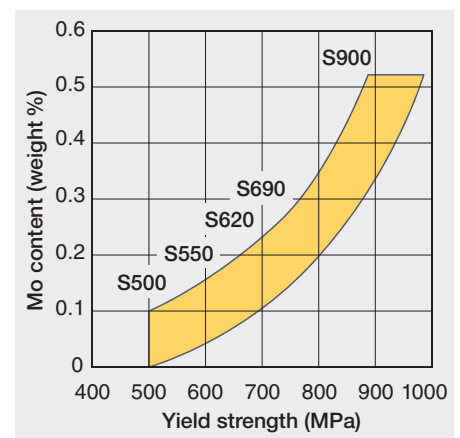
Steel is part of the fabric of our modern world, but the iron and steel industry has one of the largest carbon footprints of all industrial sectors, contributing 4% to global man-made emissions¹. If there were a way of using less steel to build the same structure, CO₂ emissions would be reduced and natural resources conserved. With moly-containing high-strength steel (HSS), that’s exactly what happens. Because the steel is so much stronger, less is needed to build the same structure and the overall environmental impact is reduced.

The Friends Arena, the second largest indoor stadium in Europe, was designed utilizing this approach: the roof trusses supporting the retractable roof are partially constructed from molybdenum-containing HSS. The structural engineers optimized the design by using different

grades of HSS in the various structural elements within the roof truss. The result is a very light roof for a stadium of its size. This is particularly noteworthy because designers in Sweden have to take much higher snow loads into consideration than in other parts of the world.

Moly for light-weighting

Known as “light-weighting”, the use of HSS to achieve weight savings is becoming increasingly important in the manufacture of trucks, cars and pipelines, as well as in large construction projects like the Friends Arena. There are many ways to increase the strength of steel. For example, by simply adding more carbon the strength goes up, but this can have a detrimental effect on both the weldability and ductility of steel. By adding molybdenum to the steel instead, it is made stronger without



Yield strength of 20 mm thick plate for various HSS grades with increasing Mo content.

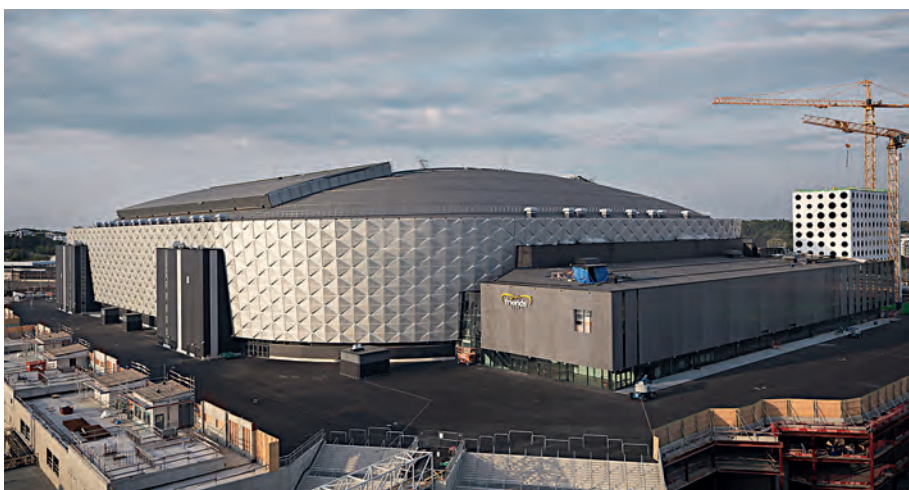
compromising its weldability. Depending on the required strength level and the plate thickness, the molybdenum content in HSS can range from 0.1% to 0.5% (see figure above).

Savings all round

HSS grades S460, S690 and S900 make up nearly one third of the weight of the arena’s 4000 tonnes roof:

- S460 (no Mo): 904 tonnes
- S690 (0.2% Mo): 265 tonnes
- S900 (0.5% Mo): 44 tonnes
- S355 (no Mo): balance of roof

The use of HSS led to a reduction of 584 tonnes² or 13% of the total weight of the roof compared to a roof constructed from conventional S355 steel. Although HSS is slightly more expensive than



The Friends Arena opened in 2012 and holds up to 65,000 spectators. © Sweden Arena Management



High-strength steel trusses supporting the retractable roof. © Sweden Arena Management

conventional structural steels, the reduced tonnage led to an overall cost saving. The cost of the roof structure was € 2.2 million or 15% less than a traditional design using all conventional steel, largely due to the reduced tonnage of steel and the resulting lower requirement for welding.

In life cycle terms, the greatest reduction in environmental impact also came from

the lower amount of steel used. Taking into account the additional effect of transport savings and steel recyclability at end of life, the HSS design achieved an environmental saving of nearly 900,000 kg of CO₂ equivalent or 17%, compared to construction with all conventional steel. This saving is comparable to the CO₂ absorbed by about 80 hectares of pine forest in a year.

A sustainable “win win”

The Friends Arena is a very visible reminder of how the addition of a small amount of moly can make a big difference. High-strength steel is just one example of how the properties of molybdenum can be harnessed to bring significant, cost-effective sustainable benefits to a project. (Louise Haskins)

- 1 2009 EAA report No. 9. Greenhouse gas emission trends and projections in Europe 2009. Annex: Additional information on greenhouse gas emission trends and projections.
- 2 Cederfeld, L. and Sperle, J-O: High Strength Steel in the Roof of Swedbank Arena Savings in Weight, Cost and Environmental Impact. Nordic Steel Construction Conference 2012, Oslo Norway.