

Environmental benefits of high strength steel in the Friends Arena

Did you know...?

- Through using high strength steel for the roof of Sweden's national football arena (Friends Arena), the weight could be reduced by 13 % and greenhouse gas emissions by 900 tonnes CO_{2e}.
- Globally, the use of high strength steel in built structures, as exemplified by the Friends Arena, can cut greenhouse gas emissions by as much as 150 Mt CO_{2e}. This is almost three times as much as the total annual greenhouse gas emissions in Sweden.

The world needs Swedish steel

Steel is the most widely used metallic construction material in the world, thanks to its strength in relation to weight and price. In 2013, almost 1.6 billion tonnes of steel were produced globally¹. The Swedish steel industry makes up about half a per cent of the world production, However, Swedish steel companies are highly specialised, in many cases they are world leaders within their respective niches².

Steel forms part of an eco-cycle and can be recycled endlessly as raw material for new steel without any deterioration in quality. This makes it unique among modern materials.

New, advanced steel grades are being developed all the time. Many of the steel grades that Swedish steel companies produce today were not even on the market five years ago².

High strength steel is stronger than conventional steel and enables the production of lighter steel designs. A doubling in the strength delivers a weight reduction of about 30 % in the upgraded structural

parts³. Lighter structures lead to reduced environmental impact through lower emissions, more energy-efficient products and the sustainable use of natural resources.

Case study

The construction industry is one of the sectors that use the largest amount of steel¹. The use of high strength steel in buildings makes it possible to reduce the quantity of steel employed. There is less environmental impact since less material needs to be produced and transported. The construction industry can benefit from the knowledge of the vehicle manufacturers, when it comes to constructing in high strength steel.

32 % of the roof construction in Friends Arena in Solna has been made from steel of higher strength than conventional steel. In a case study³, an estimate was made of the reduced environmental impact in the use of high strength steel when compared to the roof being built exclusively of conventional steel. A supplementary estimate, where just over 50 % high strength steel is assumed to be included in the roof structure, instead of 32 % with the present building, was carried out in order to investigate the possibility of further reducing the structure's weight.

In the study, the environmental impact arising from manufacture of the roof's structural element, the transportation and recycling have been quantified through life cycle assessments. In connection with the upgrade, certain structural elements were modified in order to achieve an optimal design. The upgraded structure includes different steel grades, with yield strengths of 355 and 900 MPa.

¹ World Steel Association

² Jernkontoret, *Steel shapes a better future*

³ The Steel Eco-Cycle, *Environmental Research Programme D 853*.



Weight, weight reduction and reduced greenhouse gas emissions

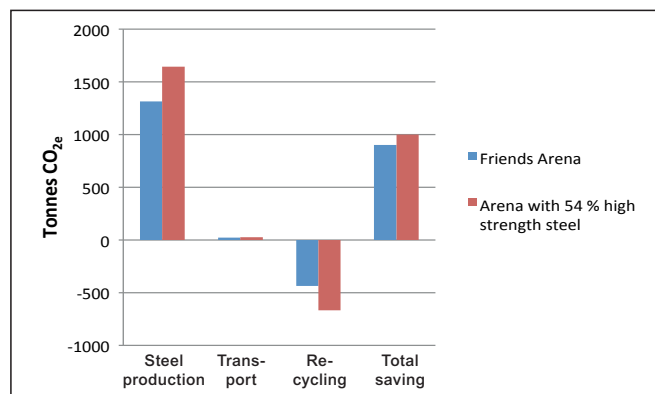
	Roof weight (kg)	Weight reduction (%)	Weight reduction upgraded parts (%)	Reduced emissions (tonnes CO _{2e})	Reduced energy use (MWh)
Reference arena 100 % S355	4 584	–	–	–	–
Friends Arena	4 000	13	21	900	3 600
Arena with 54 % high strength steel	3 852	16	28	1 000	4 000

Results

Through the use of high strength steel in Friends Arena, the weight of the roof structure was reduced from 4 584 tonnes to 4 000 tonnes. This resulted in a reduction in greenhouse gas emissions from steel production, transportation and recycling of 900 tonnes CO_{2e}. For a roof structure with 54 % high strength steel, the weight would be 3 852 tonnes and the greenhouse gas emissions would be reduced by 1 000 tonnes CO_{2e} when compared to a structure comprising only conventional steel.

The major part of the emission reduction is thanks to the lesser quantity of steel that needs to be produced, while a smaller part is due to a decrease in the quantity of steel that needs to be transported. Differences in the environmental impact between the different structures decrease when the scrap that can be recycled is taken into account. This is due to it being possible to recycle a greater quantity of steel from heavier structures compared with lighter, upgraded structures.

Reduced greenhouse gas emissions for the Friends Arena and a fictive structure with 54 % high strength steel, compared with a structure of conventional steel only. Other factors that have probably resulted in reduced environmental impact but that are hard to quantify are the



Reduced greenhouse gas emissions for the Friends Arena and a fictive structure with 54 % high strength steel, compared with a structure of conventional steel only.

handling of lighter structural elements and less welding work thanks to thinner materials.

The use of high strength steel in the Friends Arena also reduced the construction costs. The manufacturers of the structural elements have estimated the economic savings at about SEK 20 million. The savings are due primarily to the fact that there was a need for fewer welded joints and lower heating temperatures on welding owing to use of thinner steels.

Conclusion

The environmental benefits of high strength steel in buildings are not as great as those in vehicles, where the lower weight produces a lower environmental impact over their entire lifetime. On the other hand, great amounts of steel are used in the construction sector and there is therefore great potential for reducing the environmental impact through more resource-efficient structures.

Globally, the construction industry accounts for up to 50 % of the steel consumption¹, which corresponds up to about 750 million tonnes annually. A weight reduction of 13 % in the steel used in the construction industry would, according to the example of the Friends Arena, reduce greenhouse gas emissions by about 150 million tonnes CO_{2e}. This is almost three times as much as the total emissions in Sweden (55.7 million tonnes CO_{2e}, 2013⁴).

The case study of Friends Arena shows that the use of high strength steel in structures can result in more positive effects than the reduced environmental impact. These include lowered costs and simplified handling of the lighter structural elements.

The use of steel globally continues to increase driven by population growth and increased living standards in different parts of the world. To meet the increased demand it is essential to develop resource-efficient and carbon-efficient products.

The properties of steel in terms of high strength, long operating life and recyclability make the material a significant component of sustainable development.

⁴ Swedish Environmental Protection Agency

Do you wish to know more? Please contact us at Jernkontoret.

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