The European Spallation Source (ESS) in Lund is set to be the world’s most powerful neutron-based research facility. The ESS will provide a location for the discovery and development of new materials in sectors including manufacturing, pharmaceuticals, aerospace, engineering and biotechnology. The key elements of the facility are a 600 metre long liner proton accelerator and a 4-tonne tungsten target wheel, which will work together to transmit neutron pulses towards the experimental stations where the advanced research takes place.

BuroHappold Engineering was commissioned to design the large steel-framed roof structure which covers the target wheel and experimental halls. The roof will act as a point of orientation for the campus area and provide a strong identity for ESS, which is located nearby the Max IV research facility and the Lund Science Village.

Covering a footprint of 200x150 metres, the roof’s long spans were a challenging aspect of the engineering design for our team. Flexibility was a key requirement in the design to allow for future alterations to the testing facility, so a column free design was needed. In addition to this, the profile of the roof cantilevers up to 35 metres beyond the perimeter of the building, which increases the risk of environmental factors such as wind pressures and the build-up of snow impacting on the roof.

In order to overcome these issues, our team developed a semi-porous facade system that reduces the environmental loading and therefore the quantity and the cost of steelwork. In close collaboration with the architectural team and facade specialists, we developed a design for the external facade below the cantilevered roof that incorporates aluminium fins. The fins are specially shaped to allow wind to pass through and snow to fall to the ground. In collaboration with specialist testing companies, the effects of wind and snow have been verified with scale model testing and computational fluid dynamic (CFD) analysis.
Our team also created a parametric modelling tool connected to the Building Information Modelling (BIM) model that allowed the adjustment of steel truss heights, spacing and pitch to ensure an optimal engineering design.

Further adding value, we considered the construction process during the early stages of the project, ensuring efficiency. Solutions include standardising steelwork elements despite the complex geometry of the roof and specifying prefabricated roofing panels, allowing them to be quickly and safely installed on-site. Demonstrating our experience with working on complex structures, a specialist parametric modelling tool was produced by our SMART team to significantly reduce the number of different types of facade panels required for the cantilevered roof. This resulted in great efficiencies in terms of fabrication and installation from a sustainability perspective, while the amount of material wastage in this system is significantly reduced.

The European Spallation Source facility is set to become a leading research centre that is 20 years in the making, and bought together by the work of 17 countries across the globe. The work within the facility will further our understanding of the world and the universe, providing invaluable insight that was not previously possible to achieve.