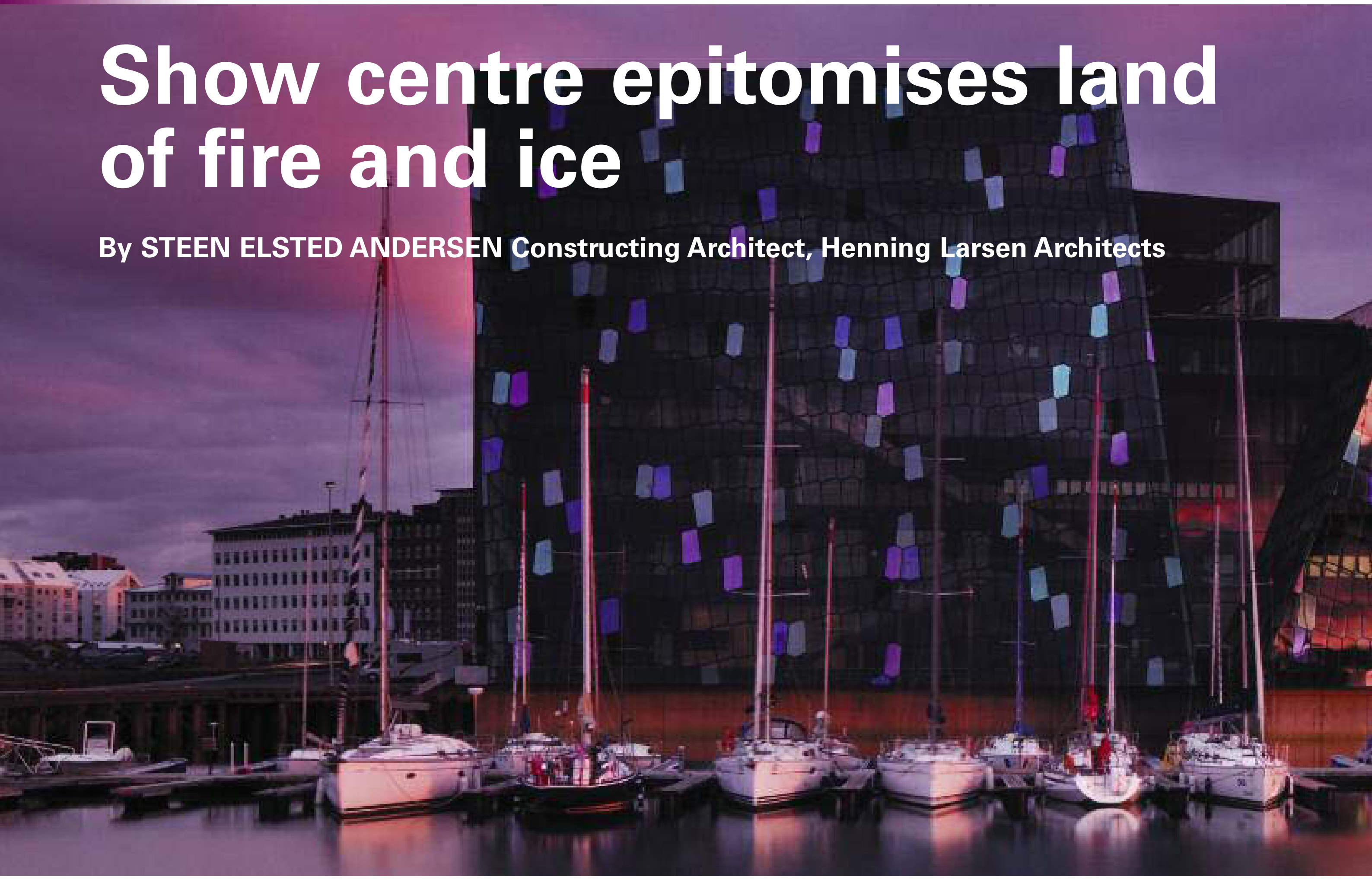


Show centre epitomises land of fire and ice

By STEEN ELSTED ANDERSEN Constructing Architect, Henning Larsen Architects

Inspired by the northern lights and the dramatic Icelandic scenery, the new Harpa–Reykjavik Concert Hall and Conference Centre combines three different innovative façade types.

Harpa's multifaceted glass façades are the result of a unique collaboration between the renowned artist, **Olafur Eliasson** and Henning Larsen Architects. The design is based on a geometric principle, actualised in two and three dimensions and inspired by the crystallised basalt columns commonly found in Iceland.

Made of twelve-sided space-fillers of glass and steel that Eliasson calls 'quasi bricks', the building appears as an ever-changing play of colour reflected in the more than 1000 three-dimensional bricks composing the southern façade. Based on five-fold symmetry, the geometry was originally developed by **Einar Thorsteinn**, a close collaborator of Eliasson in his Berlin studio. The remaining façades and the roof are made of sectional representations of this geometric system resulting in two-dimensional flat façades of five- and six-sided structural frames.

The first type is an add-on steel/structural glazing façade which constitutes the base of the building. The second is a non-standard grid façade based on an add-on steel system that appears as a spider's web and is called the 'cut quasi façade'. It covers the building to the east, west and north.

Quasi brick façade

The third and last type is the 'quasi brick façade'. This south facing face is a three-dimensional, self-supporting steel frame clad in glass on both sides.

The quasi brick façade is inspired by the basalt formations created when red hot lava penetrates the earth's crust and meets a glacier. These hexagonal rock formations feature an extremely rigid structure compared to the rest of the wild, Icelandic scenery.

The quasi brick is a twelve-sided, self-supporting steel frame which – in combination with the other bricks of the façade – carries the load of the remaining building structure. This makes it possible to avoid supporting columns inside the foyer.

Furthermore, the characteristic shape of the quasi brick allows for them to be stacked without any cavity between the individual units. By using stacked quasi bricks in the south façade, the outer skin has developed into a piece of art in itself and at the same time, meets the requirements for a building envelope.

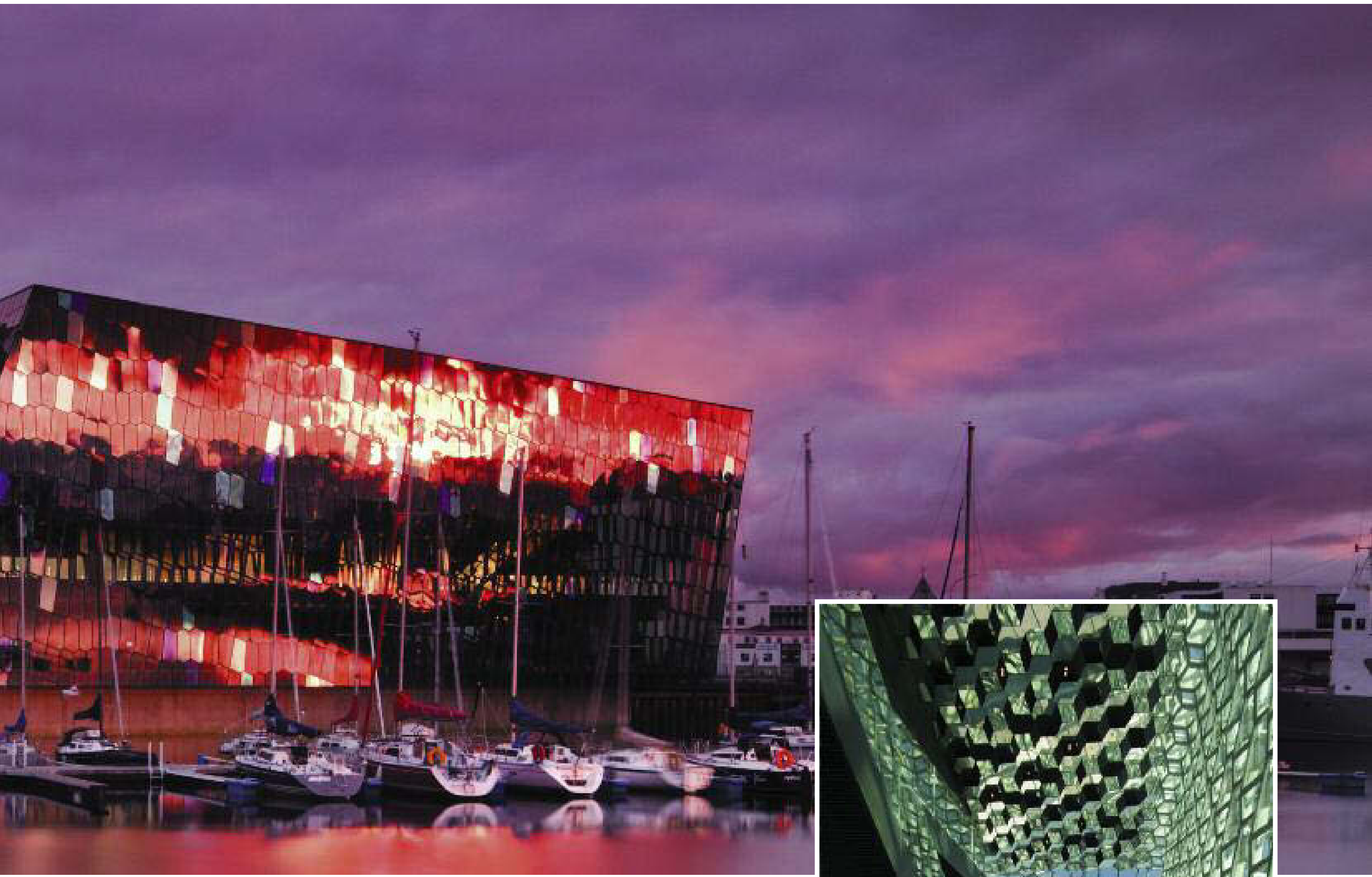
The external geometry of the brick was decided at an early stage based on studies by Eliasson. Subsequently, the internal geometry of the brick was modified to make the profiles as slim as possible and determine the daylight factor through the façade. All profiles and cross sections in the bricks were carefully examined. This led to no less than twelve different diamond-shaped profiles. The profiles had to be made of 10mm steel plates for the structure to withstand wind and dead loads.

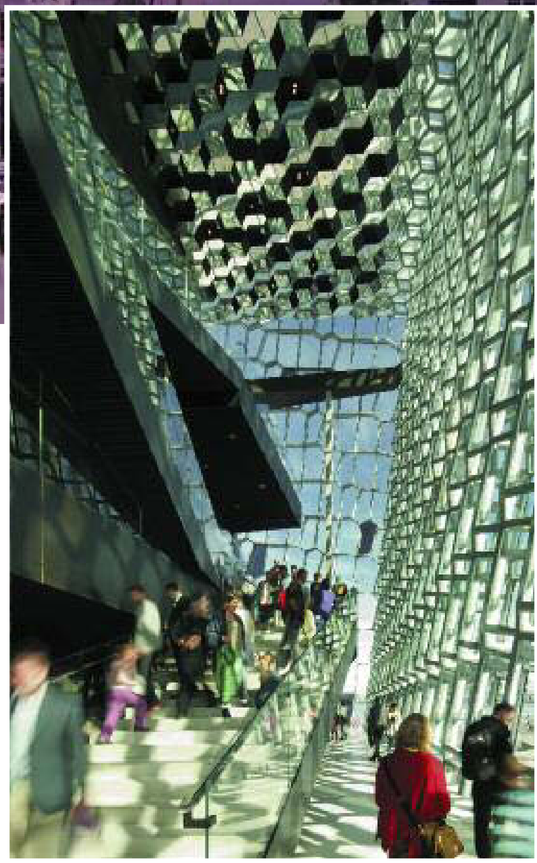
Designing corners

To connect the profiles and at the same time make the structure take up the loads of the façade, the corners were cast in steel and welded together with the profiles afterward.

The casting makes it possible to design the corners with countersunk holes for the bolts heads. The bolts are visible but at the same time hidden in the corners which means that all bricks stand out clearly and individual elements are exposed.

Another benefit of casting the corners is the possibility to shape the outside corners with an extra washer-like thickening. These thickenings serve as load transfer points – the points that touch the next brick. After assembling a brick, it is possible to measure the exterior geometry and adjust the size accordingly by grinding down





Photos: Nic Lehoux

the washer thickenings. This solution solves the problem of transferring the loads from one brick to the next and at the same time helps to absorb the tolerances.

To finish off the bricks, all welds were grinded down and painted to make an individual brick appear as one unit. To avoid thermal movements in the steel structure, double glazed units are placed on the outside.

Cut quasi façade

The 'cut quasi façade' is based on a pattern that was developed in a 3D computer model by stacking the quasi bricks in the entire building volume, starting from the south façade and then cutting along the outer shape of the house.

For architectural and structural reasons, it is important that the transoms meet in the corners. Because of the pattern however, none of the profiles met at first. Therefore all corners were designed in 3D to make the outer sealant meet. Still it was almost impossible to make the inside of the transoms meet because of the sloping façades. Hence vertical steel plates were introduced in the corners – custom made for each profile.

Due to very large spans in the cut quasi façade, it was necessary to use an add-on steel system for mullions and transoms although the design did not allow more than 60 by 260mm profiles.

The profiles are fabricated as rectangular hollow steel sections, welded from four 10mm steel plates. In some areas the load on the façade is bigger and in order to keep the same outer dimension, the profiles in these areas feature 10mm steel on the sides and 25mm steel plates in the front and back. Silicone gaskets were applied to ensure water tightness.

Project Team

Architects: Henning Larsen Architects and Batteriid Architects

Façade design and development: Olafur Eliasson and Studio Olafur Eliasson in collaboration with Henning Larsen Architects

Contractor/Design Manager: IAV hf., Iceland Prime Contractor

Structural Engineer: Art Engineering GmbH

Façade Sub Contractor: Wuhan Lingyun