

SPECIAL AWARD FOR COMPOSITE STEEL/TIMBER STRUCTURE ALNWICK GARDEN PAVILION AND VISITOR CENTRE NORTHUMBERLAND

ARCHITECT HOPKINS ARCHITECTS STRUCTURAL ENGINEER BURO HAPPOLD LTD
STEELWORK CONTRACTOR S H STRUCTURES LTD MAIN CONTRACTOR SIR ROBERT McALPINE
CLIENT THE ALNWICK GARDEN

The construction of the Visitor Centre and Pavilion is part of the ongoing development of Alnwick Gardens – one of the largest visitor attractions in the North-East. These buildings were constructed to cater for the increasing numbers of visitors to the gardens, following the completion of the final stages of work that involved the “Poison Gardens” and the “Tree House”.

The buildings are to be the modern equivalence of the conservatory that once occupied the site that forms the gateway to the gardens through an historically listed wall. As flexibility of the spaces was of key importance, the buildings were constructed as “buildings within buildings”. The two main buildings have clear span roof structures supported on free standing columns, abutting these are two smaller structures housing the shops. These roofs provide a continuous enclosure to the building footprints, with glazed screen walls forming separation between spaces and pods being used for the service areas. The main servicing requirements to the spaces were provided by basements beneath the two buildings thus leaving the above ground structures totally clear of any primary servicing.

The Pavilion and Visitor Centre are similar in structural design and share an innovative timber barrel-vaulted structure with a diagrid roof grillage supported on timber flitched columns. These buildings each measure about 60 x 16m on plan. The main difference between the two spaces is the treatment of the inflated roof foil cushions that varied in transparency, insulation and acoustic performance, reflecting the various functions of the spaces beneath.

The building design required very close co-ordination with the engineer, architect and steelwork contractor as the structural frame is fully exposed. Buro Happold worked closely with Hopkins Architects to achieve a structural solution which would support the foil roof and applied loads, yet maintain a slender diagrid roof framework and columns. This was achieved by tying the column capitals, which support the diagrid roof of solid larch beams, creating a cable truss that

also provided intermediate support to the roof. The pre-stress in the cables were balanced to match the dead loads of the roof to optimise the member sizes and reduce the thrusts applied to the columns.

The use of steelwork within the diagrid shell enabled the stresses in the members to be controlled such that the sizes of the solid timber rafters were acceptable. A further example of integration of steel within the structure is the columns. Here the stability forces were resisted by cantilever bending of the columns, with the major axis being stiffened by a steel flitch plate. This helped control the deflections of the roof, thus reducing the bending in the rafters, and hence controlling their size. This was crucial in reducing both the member sizes and rise of the arch to create the aesthetic form required by the architect, client and planners for such a sensitive site, the overall height of the building being controlled by protected views across the Capability Brown landscape and the height of the listed wall.

This roof was constructed and installed by a steelwork contractor - the value of the timber works was small in comparison to the total roof contract that utilised approximately 300 tons of steel. This was made up by the cast nodes, tie rods and struts, closure ladder beams and the elegant façade wind posts. All elements were fully exposed and great care was taken in detailing and fabrication to achieve the finished result. The design life for the frame is 100 years, and great attention was made to the detailing and corrosion protection to ensure this.

The early involvement of S H Structures was crucial in the development of the structure. The grillage was developed such that the eccentric angles and twists were taken out at the joints, to enable the beam elements to be straight members with identical bolt patterns at each end. This also ensured that all nodes were geometrically identical. Weldable steel casting were adopted for these elements onto which the additional cable lugs etc could be attached to adapt the standard nodes for the various locations.



S H Structures was also available to manage the design and fabrication of the complex interface details between buildings and with the façades; this was done using an X Steel CAD model from which the fabrication processes could be directly implemented to achieve the high tolerance requirements of the grillage. S H Structures was also responsible for the installation of the frames; this was done by pre-fabricating ladder sections and lifting them onto the free-standing columns avoiding the need for extensive scaffolding.

The use of a steelwork contractor experienced in the design, fabrication and installation of complex buildings was crucial in the project. This was further supported by the tender returns that show the cost effectiveness of using a steelwork contractor that helped save the roof from extensive VE. It is thought that this is the first time that a steelwork contractor has been responsible for the detailed design and construction of a timber roof; but this shows how the expertise of the steel industry can be adapted to various building types.



JUDGES' COMMENT

A delicate and sympathetic treatment of the large continuous roofscape, covering a variety of space uses in this hugely popular destination.

Steel is a crucial element in the diagrid shell roof areas, and the elegant columns. Finely shaped and detailed timber adds robustness and cosmetic appeal to the structure.

A fine example of a multi-material solution, which is highly effective and delights the eye of the visitor.