Award ~ Industrial Buildings

LUL Stratford Market Depot, London E15

Owner: LUL Jubilee Line Extension

Architect: Chris Wilkinson Architects Ltd

Structural Engineer: Hyder Consulting Ltd

Steelwork Contractor: Rowen Structures Ltd

Main Contractor: John Laing Construction Ltd - Southern Region

London Underground's new Jubilee Line Extension Project maintenance depot in Stratford, East London is located on a site previously occupied by a fruit and vegetable market, old railway sidings and low grade industrial buildings. Iron Age and Roman remains have also been found on the site, along with the remains of a medieval Abbey which affected the location of the new buildings.

The 11-hectare site provides stabling for 33 trains and maintenance facilities for the whole 59-train fleet. All elements for the main shed and other buildings were chosen solely for their fitness for purpose. The architecture is thus derived from a clear expression of the function and engineering requirements.

Designed under tight site constraints and track alignment requirements (which allow the rails to straighten before entering the depot), the parallelogram-shaped main building measures 180m long by 100m wide. Framed by the connection of discrete parallel chord plane steel tubular truss elements in a diamond configuration, it has a 30 degree 'diagrid' roof structure and is supported by two lines of concrete-filled steel 'Tree' columns on a 18m by 42m grid.

Difficulties arising from site and track layout are resolved by a clearly articulated and well engineered design to provide an attractive, light and efficient working environment.

Tapered tubular steel struts branch from the tops of these columns to meet three node points at the underside of the diagrid space frame trusses. Horizontal struts across the diamond form a tetrahedral structure.

The internal cantilever columns are the primary elements providing stability against lateral loads, although it was recognised that owing to the skewed nature of the building the perimeter vee-columns would come into play even when loads were applied normal to the plane of these frames.

The effects of these complex loading conditions were assessed through modelling the entire structure on a computer program. Temperature effect-induced loads were particularly important, as any attempt to introduce internal movement joints would destroy the integrity of the three dimensional structure.

Virtually unrestrained movement of the diagrid was allowed to deal with these temperature loads, with free expression across the building acting normal to the vee-columns and longitudinal eave trusses. Restraint against these actions is only encountered at the internal column positions, so it was important to balance the stiffness of the columns to minimise reactive forces transmitted into the diagrid against strength required for overall stability.

Particular attention was paid to the design and detail considerations of the joints, especially those forming the top node in diagrid truss members. The diagrid top node joint is composed of flat tongues welded to the ends of each truss with each tongue from four meeting trusses clamped between shaped stiffened cover plates with SHFG bolts. CAD modelling of this joint enabled accurate dimensional co-ordination of the joining elements and allowed an assessment of required tolerances for both fabrication and erection.

Introducing a skewed frame to a normally curved roof produces a 'lazy' curve in the plan line of the structure. This means that the horizontal alignment of one plane elements of structure across the roof deviates from a straight line, with the different radii of the top and bottom of the roof truss elements resulting in a horizontal misalignment within the depth of the structure. Computer aided calculations were used as a check against CAD produced deviations to accurately assess these deviations in relation to the connection of the planar gable end structures to the roof trusses.

Good lighting was key to the brief and was provided by rooflights, clevestory glazing on the side walls, planar glazing to the north wall and a translucent south wall of insulated fibreglass composite panels which provide good daylight without glare or heat build up. Structural framing for these walls comprises horizontal tubular trusses spanning 9m between, and cable braced from 'cellform' wind posts.