

Motorola's new £40 million Groundwell factory at Swindon covers an area equivalent to three football pitches placed end-to-end and expresses the use of steelwork in an exposed, innovative but efficient way. Providing excellent working facilities for 1,300 blue and white-collar workers, it is extremely imposing and can be seen for miles around from the flat landscape.

The 300m x 78m factory roof is supported by four spans of tapering tubular braced triangular gull-wing steel trusses, which in turn are supported from A-frames. The roof is clad in aluminium giving an impression of an undulating wave and walls clad in grey powder coated aluminium and glass.

Under the 4.5m clear height roof, 10 assembly lines run 24 hours a day, seven days a week, 52 weeks a year. The number of columns has been kept to a minimum, through the use of structurally efficient tubular A-frames and slender struts, which prop the ends of the gull-wing trusses, providing the most efficient solution.

The tubular A-frames provide general stability in all directions and act as mini-portal frames, stiff enough to withstand buckling forces and wind loads. Bracing was deliberately avoided as the roof sheeting provides a diaphragm action while the three-dimensional "Toblerone shaped" gull-wing trusses were brought to site in two pieces and then welded together to form a 37.5m span propped cantilever roof. Each A-frame and pair of gull-wings provide their own stability and are self-contained. Considerable research went into the decision to place these at an optimum 12m centres. The process was undertaken using space frame computer analysis as it proved to be reiterative and time consuming.

The curved gull-wing trusses are 1.8m deep where they are pinned to their supporting A-frames. They taper to a point that provides an ideal solution as they are deepest where the maximum bending moment is generated by the roof loads and where the substantial part of the roof is transmitted to the foundations.

Above each A-frame, futuristic housing encloses substations and air conditioning units. This, combined with the giant cowls, serves to add to the supertanker impression. The visual heaviness of the plant is reduced by the delicate steel spiral staircases and catwalks, which connect back to the vast main service tube running the full length of the building.

The 300m long x 5.5m diameter tube - which is large enough to drive a family car through - is the most dominant feature. Supported on the roof, it carries not only the usual M&E services but also nitrogen and compressed air for the assembly line equipment in the heavily serviced building.

The structure follows the M&E distribution route from the services tube then turns 90 degrees and distributes the services through successively smaller and smaller tubes to the extremities of the gull-wing trusses.

All the services are carried on the roof. A floor based distribution system was considered, and eventually disregarded as it resulted in a complex system of trenches and ducts. A raised floor was also considered, with the services laid simply over the concrete surface. The heavy floor loads imposed by the equipment also precluded this option. The concrete floor is thus wire free and covered in special earthed plastic flooring. From the main artery, services are transferred down to the factory floor level by 'droppers', which are either a simple ladder type assembly carrying electrical supplies or a more substantial vertical truss carrying pipework for compressed air and nitrogen. The vital link tube has sufficient capacity to cope with the planned future expansion so expensive retrofitting should not be required.

Value engineering was continually assessed during design; as many repetitive fabricated units as possible were specified. For the roof, 104 identical trusses were made and the steelwork contractor was able to reuse the jibs ensuring that costs were kept as low as possible in the first phase of the 27 ha complex. The use of standardised design items gave the main contractor a head start in the project, ensuring the contract's completion within the 52 weeks deadline.

Maximum CHS member sizes ranged from 323.9mm x 20mm for the A-frames to 193.7mm x 12.5mm or 139.7mm x 8mm for the gull-wing trusses. All steel was grade S355J0H and was brought to site in purpose made cradles to protect the fully shop painted surfaces of the steelwork during transportation.

Flexibility and modulisation for future expansion were watchwords. To achieve these aims, the trusses along with western façade were exposed and the curtain wall was built behind them. When the time is right for expansion, another manufacturing plant could be built to the west and connected to the existing structure. The wall could then be removed, enabling the manufacturing facility to be extended without the loss of production down time.

The high level glazed meeting rooms within the 'street' were specifically designed to create an impression of a light airy space where activity in this, as well as that of the 'interaction area', can be observed.

On the factory floor level, silicon glazing along the west façade relieves the expanse of the grey powder coated cladding panels, giving staff an uninterrupted view across the landscape.





Motorola Network Solutions Sector, Swindon



Judges' Comment

An industrial building fit for the integrated services and future expansion requirements of a hi-tech business client. Slender tubular gull-wing trusses with 'A' frame supports cover the main factory area. Proof that modularisation is no deterrent to a good design.

Architect: **Sheppard Robson**
Structural Engineer: **Mott MacDonald Ltd**
Steelwork Contractor: **Watson Steel Ltd**
Main Contractor: **Tilbury Douglas Construction Ltd**
Owner: **Motorola**