ANNEX 3-B

Case study

PALESTRA LONDON USES PARALLEL BEAMS

A new design concept takes shape on London's Blackfriars Road and demonstrates a range of new steel construction technologies, including cement grout-filled columns, and continuous twin beams which lead to the minimum structural depth.

PALESTRA LONDON USES PARALLEL BEAMS

Architect Alsop's Palestra building uses many innovative design concepts to create this 28,000m^2 commercial development in Southwark, London. The 12 composite storey structure comprises tubular columns that support pairs of continuous cellular beams connected by brackets to the columns.

At the 9th floor, the building projects outwards by up to 9m on the front elevation and 1.5 m on the side elevations, on the ground and 7th floor, columns are inclined to add to the visual interest, which was accommodated by the unusual structural system chosen by structural engineer, Buro Happold.

The building is 31.5 to 36 m wide and approximately 90 m long and comprises three service and lift cores. The floor to floor depth is only 3.65 m. The 3,500 tonnes of steelwork was installed in only 32 weeks, and the structure was completed in 10 months out of a 30 month overall construction programme.

Servicing is by Fan coil units placed between the beams. Ducts and pipes pass in a 400 mm deep zone below the secondary beam and through the regular circular openings in the primary beams, which provide for future upgrading if the services.

Cement-filled tubular columns incorporate an internal CHS, which were used instead of concrete-filled steel tubes with reinforcement. In this way, the compressive resistance is improved and the fire resistance of the 508 mm diameter circular columns can achieve 2 hours without an application of secondary fire protection such as intumescent paint or boarding. The columns were grout filled over 9 floors from the top. This speeded up erection and simplified programming. Holes at the top and bottom of the columns at each storey height provide for venting of steam inside the column in the event of fire.

The façade is fully glazed by storey-high panels from Italian supplier, Permasteelisa. The principle is based on a structural silicone-glazed system.

Application Benefits

- Long-span but shallow construction
- Stiff floor due to continuity in the beams
- Inclined tubular columns
- Fire engineered solution
- Highly glazed façade
- Rapid construction programme

Project Team

Client:	Blackfriars Investments and Royal London Asset Management joint venture
Architect:	Alsop and Partners
Structural Engineer:	Buro Happold
Contractor:	Skanska
Steelwork Contractor:	William Hare
Steel Decking:	Richard Lees Steel Decking Ltd

Cellular parallel beams

Tubular column connection

Construction Details

The twin fabricated cellular beams are 600 mm deep within an overall combined structural services zone of 900 mm. They typically comprise 25 mm thick flange plates and 15 mm web, which are designed to transfer shear across the 400 mm diameter openings without requiring stiffeners. Continuity in the primary beams improves the stiffness and vibration characteristics of the floor structure, with the pinned splice located at the point of contraflexure.

The 200mm deep secondary beams are designed compositely and span 6.65 m which is reduced by utilising twin beams. These beams are connected to the web of the primary beams so that the top of the 140 mm deep composite slab is level at the top of the primary beams. A fire resistance of 90 minutes can be achieved by applying only a thin single layer of intumescent coating to the fabricated beams. The primary beams are also designed to act compositely with the slab. Instead of using conventional shear connectors composite action is achieved by passing reinforcement through holes in the web into the slab.

On two floors, the columns are inclined, and combined with the significant overhang at the 9th floor, create permanent horizontal forces on the building, the magnitude of which are in the region of 20 times the force experienced by the building due to winds. The steel and concrete frame transfers the high forces back to the steel K braced stability system.

The composite slab comprised *Ribdek* 60 and 80 profiles, depending on the span. Special details were required at the primary beams where the deck was not directly supported by the beam flange. This required welding plates periodically to the beam web and fixing light steel angles to the plates to prevent local deformation and concrete loss.