



# Steel Meets Challenges at Bluewater Mall

By Nadia Cadby

The designers of the Bluewater development introduced structural steel construction to provide the optimum cost-effective solution to several engineering challenges; notably the highly profiled mall roofs, the long span structures to two of the anchor stores and several bridges.

The former Blue Circle chalk quarry covered 240 acres of Kent and was 50 m deep. In 1985 Shearwater first talked to Blue Circle about building a shopping centre on the quarry site, and in 1986 the two companies created Bluewater plc. Planning permission was given for the retail development, but it was not until 1994 that Australian developer Lend Lease entered the picture and acquired the land, at which time the scheme progressed at full steam. Waterman Partnership, who had been involved in the project for many years, was appointed by Lend Lease as civil, structural, public health and environmental engineers.

The ethos at Bluewater was to produce a development that was an attraction in its own right and a location that would be visited for its own inherent qualities. The objective was to provide the Bluewater Experience, a day out at a site of both aesthetic interest and quality retailing.

With the ability to provide advanced steel fabrication, the engineer was able to provide the client and the architects with designs that fully met all their aspirations and visions of a 21st Century retail and leisure centre. From the inception of the scheme, the form and structure of the external bridges was discussed with the team players. The options of reinforced or pre-stressed concrete were considered but rejected in favor of steel. The main advantages of steel derive from its high strength to weight ratio and high tensile strength. Short relative construction periods were another factor. For the modest spans that were catered for at Bluewater, steel was considered com-



petitive economically and exemplary aesthetically. For the principal bridges, plate girders were the automatic choice as these were to be highway bridges with spans above the limit of Universal Beams. The advantage of being able to change sections along the girder length was utilised fully in the gently curving arches that give the bridges their unique character.

Construction of Bluewater started on October 1, 1995, the plan being to complete some £370 million (\$555 million) of construction work and to fit out three anchor stores and more than 300 further high-class retail outlets by the opening date of March, 16 1999. Before any construction could begin, more than 3,000,000 m<sup>3</sup> of Thanet sand had to be moved by truck from the adjoining eastern quarry, which was separated by the Bean Road. Initially, 9m diameter twin tunnels were bored beneath the road, allowing a fleet of lorries to transport the sand, one of the largest earth movement contracts in the UK.

For the next eight months, a fleet of six 35-tonne excavators and thirty 40-tonne trucks ferried the sand seven days a week with, at peak, one truck passing thorough the tunnel every 14 seconds. The final depth of sand averages some 17m over the 450,000 m<sup>2</sup> of the site, much of which had to be dynamically compacted using three 40-tonne and two 100-tonne cranes. Throughout this period controlled de-watering was necessary. Close monitoring of the effects of the de-watering was also essential as Bluewater sits above a class I aquifer.

With the earth movement complete, the next operation was to install around 16,000 piles. At the time this was the largest piling contract in Europe, as underlined by the statistic that, laid end to end, the piles would reach from the site in Kent to Paris.



The development demonstrated the effectiveness of harnessing structural steel with various forms of reinforced concrete and produce efficient and aesthetically pleasing structures. The development was completed on programme and to budget in 170 weeks, having a gross area of 216,400 m<sup>2</sup> (excluding car decks). The total tonnage of structural steel-

work used in the development was 16,000 tonnes, excluding the two main triple span arched bridges. Elevated slabs in the anchor stores used composite steel and concrete floor construction.

Here are some other interesting facts about the Bluewater project:

- Bluewater is the largest retail and





- leisure destination in Europe
- Around 30 million visitors a year
  - There is parking for 13,000 cars
  - Bluewater has created 6,800 permanent jobs
  - The former chalk quarry is 50 m deep and 1 km in diameter.
  - At the height of the contract, 17 tower cranes worked simultaneously
  - With some 16,000 piles it was the largest piling contract in Europe
  - Erection period 85 weeks with maximum output of 300 tonnes per week
  - Mall roof structures accounted for 6,000 tonnes (60,000 pieces and 250,000 bolts)
  - Eastern Entry Bridge: twin deck three span continuous (34, 23 and 30 m) composite plate girder deck
  - Western Entry Bridge: three span continuous (28, 17 and 30 m) composite plate girder deck
  - Ramp Bridge: 15 m single span composites steel beam deck over carriageway providing ramp access to a deck car park
  - Ramp Bridge: 12 m single span composite steel beam deck over carriageway providing ramp access to a deck car park
  - John Lewis Link Bridge: 13 m long, 9 m wide single span composite deck with arch plate girder, with a steel roof, linking car park to retail centre
  - House of Fraser Link Bridge: 16 m long, 6 m wide single span composite deck with arch plate girders, with a steel roof, linking car park to retail centre
  - Marks and Spencers Link bridge: 14 m long, 10 m wide single span composite deck with arch plate girders, with a steel roof, linking car park to retail centre
  - West Village Fire Escape Bridge: 20 m long, 11 m wide single span composite deck with plate girders for fire escape.

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