

# Concrete structures



General view of the completed scheme meandering through the Berkshire countryside.

The nine-mile long Newbury bypass, opened in November 1998, relieves a bottleneck between Southampton and the Midlands. By using a design with materials adaptable to differing complex geometries – and paying a great

deal of attention to appearance – the engineering teams achieved practical, elegant solutions with a high degree of standardisation and low maintenance needs, fully exploiting the benefits and versatility of concrete construction. The bridges are visually attrac-



High slag content concrete enhanced the finish and gave a uniform colour.

## A34 Newbury Bypass

tive and harmonious in form, while at the same time being efficient in engineering and economic in construction.

### The bypass

Now that the bypass has removed most of the 50,000 vehicles (including 10,000 heavy goods vehicles) that used to thunder through the centre of Newbury each day, local residents have at last reclaimed their town. Gone are the delays of over an hour – and access difficulties for local shops and businesses – caused by traffic which had increased the level of harmful oxides in the air near the A34 to three times that elsewhere in the town.

### Approach to the design

Four major factors affected the choice of each structure: cost, construction, maintenance and appearance. Precast prestressed concrete beams were selected where deck falsework would be expensive or impractical. In-situ reinforced concrete decks were selected for overbridges with spans up to 37m, this being economic and enabling a simple but pleasing appearance to be achieved.

To minimise maintenance, all the overbridge decks used continuous construction and many of the underbridges, including the Kennet River Bridge which has a skew of 27°, have decks integral with their abutments.

The wing walls to the underbridges were aligned to be parallel to the cross routes so as to blend into the adjacent embankments.

### The site

The site included the following major concrete structures: eight overbridges;

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six underbridges; three accommodation/footbridges; one railway bridge; one canal bridge; three river bridges; five bridges to other water courses; and 13 culverts to watercourses.

### Specification and workmanship

A feature of the structural concrete specification of particular note is the selection of a mix with the cementitious component containing 60% slag. Chosen for durability, this gave rise to a number of constructional issues:

- The increased susceptibility to plastic settlement following placing required attention to detail at the concrete finishing stage
- The initial slow strength development increased shutter striking time and required careful planning: this was more than compensated by the forgiving nature of the concrete, especially with respect to delivery times and increased workability



Precast concrete parapets with exposed aggregate finish shown over the London-Pentance railway.

- The oxidation of the slag following striking resulted in an aesthetically pleasing and extremely uniform light-coloured finish
- The low heat of hydration gave benefits in reducing susceptibility to thermal effects

Most structures were finished using a sawn board feature. The use of a rubberised form liner, cast using specially selected rough cut timber, provided a superior finish. All exposed areas of concrete were treated with silane and sacrificial anti-graffiti coatings.

All structural concrete – totalling more than 60,000m<sup>3</sup> – was dry batched on site.

### Environmental constraints

The environmental and ecological impact of the bypass was given one of the most extensive assessments of any new highway built in the UK. Throughout the design and the construction phases, the environment was given the fullest consideration and set new standards for a civil engineering project, not just to blend with its surroundings but to enhance them.

Piled abutments were to within half a metre of the banks of the rivers, which were designated as Sites of Special Scientific Interest by English Nature. Despite the scale of the works at this close proximity, these habitats remained undisturbed throughout construction.

The appearance of the completed works were designed to act in harmony with their surroundings.

### Piling

The ground conditions in the valleys of the Rivers Enborne, Kennett and Lambourn typically comprised peat/alluvium overlying chalk. In these locations, structures were piled, the pile types varying to suit the conditions. Three piling methods were adopted: precast driven piles; bored piling; and secant piles.

The secant method, using hard and soft piles, provided the abutments to the river bridges and associated training to the rivers. The slow strength development of the high slag concrete mix allowed its use in lieu of the traditional bentonite cement mix,



Sawn-board finish using rubberised form liner

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The project repays inspection both at close quarters and at a distance.

thus avoiding the potential contamination of water courses by bentonite in environmentally sensitive locations.

### Culverts

A number of long drainage culverts were required. The economies of scale and speed of construction made precast concrete boxes the most economic solution. This meant the work could be progressed in parallel off-site, so minimising disruption to site traffic during installation.

### Services

Statutory undertakers' plant and highway drainage were all accommodated using sleeves to pass through the structures. These were generally incorporated between the beams of the precast elements, giving a quick and simple form of construction.

### Education

The site was used for educational visits from schools, universities and professional organisations to promote the image of the construction industry and the effective use of methods and materials. Education packs were distributed to local schools to help explain all aspects of the scheme including specifics relating to the use of concrete.

### Conclusion

The A34 Newbury Bypass provides an excellent demonstration of the versatility of concrete. The project proves that, with considerate design and good construction methods, concrete is both economically and environmentally effective. ■



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### Judges' comments

The quality of design and construction has resulted in a solution that is both aesthetically and environmentally sensitive in a project that attracted much initial publicity. The careful consideration to detail of form, process and environmental impact, developed in a successful partnership between the community, client and suppliers, is apparent. The project is a clear demonstration how concrete can be best used to maintain a balance between changing social and environmental demands.

### A34 Newbury Bypass

<i>Client:</i>	<i>Highways Agency</i>
<i>Consulting engineer:</i>	<i>Mott MacDonald Ltd</i>
<i>Main contractor:</i>	<i>Costain Civil Engineering Ltd</i>
<i>Formwork, steelfixing and concrete works:</i>	<i>M J Gallagher Contractors Ltd</i>
<i>Ready-mixed concrete – structures:</i>	<i>Tarmac Topmix Ltd</i>
<i>Cement:</i>	<i>Blue Circle Cement, Westbury</i>
<i>GGBS:</i>	<i>Civil and Marine Slag Cement, Llanwern</i>
<i>Precast concrete, culverts and beams:</i>	<i>Tarmac Precast</i>
<i>Falsework:</i>	<i>Rapid Metal Developments Kwikform</i>