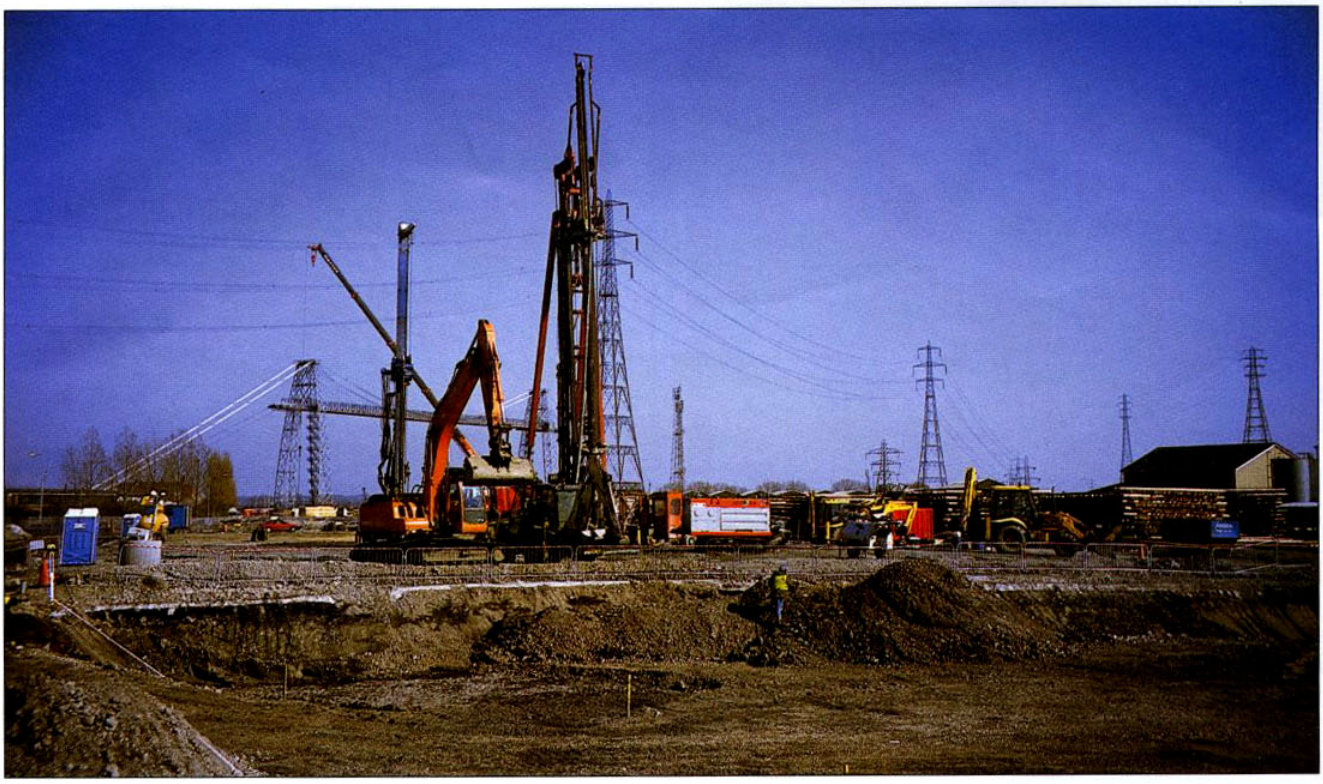


Another stunner in the family

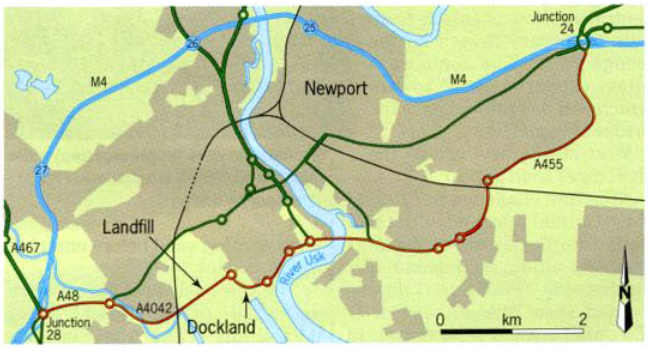
Admirers of the stunning bridge on Newport's new bypass should spare a thought for the ground improvement and other geotechnical techniques that are making its construction possible. Gareth Beazant reports.

The River Usk in South Wales is to have a another showpiece crossing, this one in the shape of a 200m long bowstring arch.

The bridge, which forms part of the Newport Southern Distributor Road (NSDR), will join distinguished company. Newport already boasts the grade I listed Transporter Bridge, built in 1906 and one of the world's few surviving "aerial ferries", and Britain's first cable stay bridge, the George Street Bridge.

Headlines will focus on the new bridge, but construction of the 9.5km road has involved a wealth of detailed engineering and environmental work.

The NSDR route starts in the east at the Coldra Roundabout by junction 24 of the M4 motorway and swings south of Newport to end in the west at the Pont Ebbw roundabout, close to junction 28 of the motorway.



Morgan Est has teamed up with Vinci to design, build, finance and operate the £55M private finance initiative scheme over a 40-year period. It is the fourth time the two have worked together, and their first PFI.

The work can be split into three sections: the east side of the river, which involves dualling a single carriageway; constructing the bridge; and the west side of the river, which involves building a new dual carriageway as well as dualling a single carriageway.

"It has always been part of Newport's long term strategy to have a dual carriageway on this route," explains Reg Ball of Capita Gwent Consultancy, Newport City Council's nominee in the project.

"It's an extremely busy road and the NSDR will help relieve congestion in Newport city centre and open up the southern rim of the city for future development. When the existing single lane was built in the 1960s and 1970s, provisions were made for dualling, with land set aside for the eventual widening programme."

However, this has not left the project team without challenges. The route has to negotiate the region's largest working landfill, areas of disused dock, overhead and underground power cables, culverts and one of the biggest tidal ranges in the world.

David Tullett, project manager for Morgan Vinci Construction Joint Venture, says: "The east section requires fewer environmental considerations and shallow embankments. Construction is mainly at the existing depth of the road and the ground is predominantly virgin.

"It's on the west side of the river where things prove more challenging. The area is mainly brownfield land and a lot of environmental considerations and planning are taking place."

On the east section two new lanes are being built alongside the old one. Once complete, traffic will be transferred to the new road. The old section will then be upgraded and both roads joined to form the dual carriageway.

One of the main challenges on this section is a former cricket pitch and a small tidal inlet connected to the River Usk. The road here will be supported by Controlled Modulus Columns (CMCs), a system developed by French contractor Menard.

The soil/cement columns are formed using an auger that displaces soil laterally, producing very little spoil. As the auger is extracted, a column is formed using pressure grouting to achieve a predetermined stiffness ratio with the surrounding ground.

To cope with changing water levels on this stretch, columns

were installed between two rows of sheet piles.

Two footbridges will require piled foundations, although design is yet to be determined.

"Either side of the Usk we have two viaducts, the Monkey Island viaduct and the Maltings Viaduct on the west side," explains Morgan Vinci CJV construction manager Pierre Villard.

"Through value engineering we decided that the first spans of the viaducts heading towards the bridge could be replaced with a reinforced soil embankment. This puts more of a load on the ground beneath, so 800 CMCs are needed to reinforce the ground."

These are being installed by an all-French Menard team using three rigs. A large Fundex rig is installing 30 piles (450m) a day, a Casagrande rig is installing 40 piles a day and an Enteco machine is installing up to 50 piles a day. About 8,500 piles will be installed by Menard under a £3M contract, which is about 60% complete.

Having the French team has led to a few changes on site. Inductions are being carried out in French and Anglo-French documentation has been produced.

The span of the viaduct that the reinforced soil is replacing is about 34m. On the bridge itself, 30, 900mm diameter CFA piles are being installed on the abutments to depths of between 26m and 27m.

Temporary piles are needed in the middle of the river to take the weight of the central span of the bridge. These 1m diameter piles of 36mm thick steel are being installed in groups of four with a pile cap and then vibrated and hammered to refusal level at about 350kN.

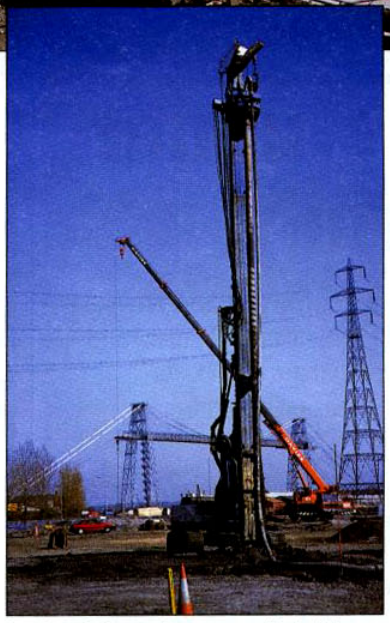
"They have two uses," explains Villard. "First, they take the weight of the bridge deck during the initial slide until the hangers are installed. And second, they support temporary towers that support the arch during construction."

The arch is being installed in three parts. The two side pieces are put in place first and the central section is raised from four temporary towers on the bridge deck. The temporary piles support these towers which will be removed once the bridge is complete.

West of the new bridge the challenges soon appear.

"The first challenge on the west side is a tidal inlet and outlet that feeds into the estuary," explains Sean McCallion, section manager on this side. "We decided on two rows of sheet piles either side of the outlet with H piles driven in between. These will then take the weight of a load transfer platform that will pass over the top to support the road."

As the road approaches Newport docks, the ground becomes brownfield. CMCs are again being used here, up to 15m deep, to consolidate the ground and support a 10m embankment that will bridge over another road before entering the dockyard.



Foundation work progresses (top) while Menard is piling in the shadow of the Transporter Bridge.

"In the dock area, great care has had to be taken," says McCallion. "The road crosses 132kV cables that are the main power supply between Newport and Cardiff, then a 11kV cable that powers the dock area and a brick culvert, known as the Docks Feeder, that supplies water to the docks."

The solution has been to install load-bearing CMCs either side of the crossings and a load-bearing platform over the top to ensure the services are protected.

Beyond the dockyards lies an active landfill site. CMCs have been proposed for the first part of this section. These have to be shallow and stop at the level of underlying alluvium which acts as a natural barrier to prevent escape of landfill gas.

A detailed environmental impact assessment was carried out and Morgan Vinci CJV has worked closely with the Environment Agency for the design of the second part of the landfill.

Here, the proposal is for a 24,000m^3 surcharge that will be about 3m high and will rest on a geomattress to balance further settlements. The system was chosen because overhead power cables meant rigs could not be used to install CMCs. The ground below the surcharge will be left to settle for six months before the road is laid on top. Approval for the proposal is expected in early May. At the far end of the landfill the road will cross the Docks Feeder again and CMCs are being considered.

The final hurdle is a retaining wall that will not withstand the weight of the new road. It will be modified and shored up with 18 ground anchors.

The road is due to be completed in autumn 2004. If it achieves its aim of reducing congestion, drivers should not get the chance to stop and consider the complex engineering that went into its construction.