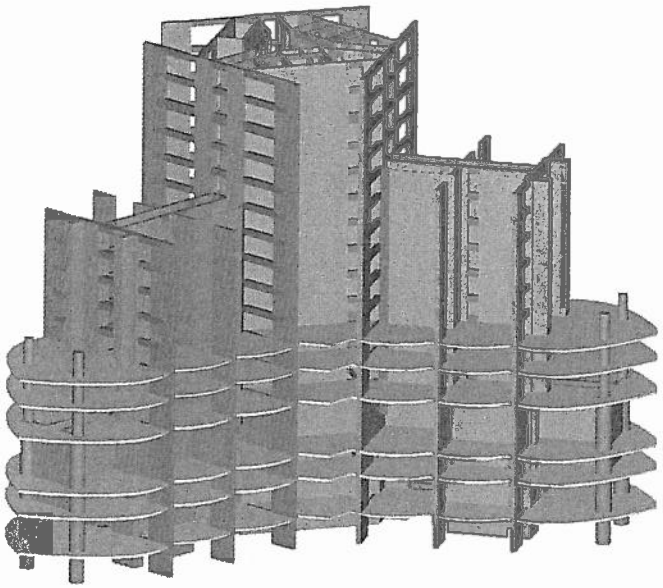
● **Dams, pollution and poor management are responsible for drying 10 of the world's major rivers, says a new World Wildlife Fund report. The worst affected major rivers are Danube, South America's La Plata and Rio Grande/Rio Bravo, the Nile-Lake Victoria system, Australia's Murray-Darling, and Asia's Yangtze, Mekong, Salween, Ganges and Indus.**

● **A French high-speed train (TGV) has smashed the world speed record on conventional rails by reaching 574.8kmh on a track between Paris and the eastern city of Strasbourg. The previous TGV record of 515kmph was set in 1990.**

Change in slab spec blamed for Burj Dubai reinforcement



Floor slabs span 9m and cantilever 3m. Carbon fibre reinforcement has been added to slab bottoms at mid span and to slab tops at the edges to stop deflection

LAST-MINUTE design changes are to blame for progressive slab deflection at Burj Dubai, set to become the world's tallest building, it has emerged.

An engineer on the project told *NCEI* that the floor design had been changed from post-tensioned slabs with a depth of 200mm to conventional reinforced concrete, but the depth of the slab had not been increased to compensate.

Carbon fibre reinforcement has been added to at least 10 floor slabs of the reinforced concrete tower as they were deflecting more than anticipated. "We couldn't ignore those deflections. They were increasing with time – it was a continuous process," said the engineer.

The floors span 9m between walls and cantilever 3m at the edge. Deflections were occurring in the middle of the floors and on the cantilevers, the engineer said.

A UK-based high-rise specialist contacted by *NCEI* calculated that a conventional reinforced concrete floor slab spanning 9m would need to be 325mm thick.

But the engineer on the project said: "The thickness [of the slab] wasn't enough and the amount of steel inside wasn't enough – rebar was at large distances."

After the deflections were noticed on floors six to 16, the slab design for subsequent floors was "completely changed", with extra rebar added.

"The designer couldn't increase the depth of the floor slabs because that would add a large amount of weight to the building which would limit its height," the engineer said. "Extra steel was put in to locally stiffen the floors," he explained.

Client Emaar has been secretive about the final height of the structure, but it is believed to be more than 800m. The concrete structure currently stands about 400m tall and will be just over 600m tall when complete. This will be topped with a steel superstructure.

Carbon fibre strips can be bonded to the concrete surface to provide external reinforcement. The material's high tensile strength helps reduce deflections and cracking in the concrete.

Emaar has issued a statement denying that there were any strength problems with the slabs, but saying: "During the course of design refinement and construction co-ordination, it was decided to further increase the stiffness of the slabs to reinforce the long-term performance of the tower."

Structural engineer and architect for the Burj Dubai is Skidmore Owings & Merrill. Hyder is the client's engineer. The contractor is a Samsung/Besix/Arabtech joint venture.

More reinforcement has also been required on the structure where holes have been cut to allow installation of mechanical and electrical services.

"There were changes in electrical and mechanical co-ordination after floors had been constructed," said the engineer working on the project. "Holes had to be drilled in [floor] slabs, which had to be strengthened."

It is understood that Emaar invited tenders for a £35,000 contract to supply carbon fibre fabric last year and that Swiss firm Sika won the job. Sika has also carried out reinforcement design.

Structural expert Stuart Alexander, WSP group technical director, said that: "A bit of cracking in a concrete floor slab isn't terribly significant. Most of the time you wouldn't need to fill them. Things have to be pretty bad before you start putting carbon fibre on." WSP is not involved in the project.

It is also believed that different reinforcement techniques were considered by Emaar before carbon fibre reinforcement was selected.

"To convince the main consultants and the owner that carbon fibre was the best option three to four slabs were reinforced using different systems and then loaded," the engineer said.

"Carbon fibre performed the best – it's been used on the underside of slabs to correct deflection in the middle of the floor, and to the tops of the slabs to cope with deflection of the cantilevers."

But both project designers and the client played down the reported cracking.

Andy Davids, chief structural engineer for Hyder, the client's engineer, said there were "no serious problems" with the structure. He would not confirm that carbon fibre reinforcement is being used but said that all "sorts of leading edge technologies are deployed in a building of this size".

Emaar assistant project director Greg Sang denied carbon fibre is being used "anywhere".

Andrew Mylius