Lakhta Center, Russian Federation

The use of reinforcing bar couplers and reinforcement continuity systems on the Lakhta Center Tower in the Russian Federation has helped reduce reinforcement congestion, improve build quality and accelerate the speed of construction. ***Hervé Poveda*** *of* ***Ancon*** *and* ***Mikhail Desyatkin*** *of* ***Inforceproject*** *report.*

The Lakhta Center is a large mixed-use non-residential development featuring the first supertall skyscraper in St Petersburg, a scientific and educational complex, sports and leisure facilities, and an outdoor amphitheatre.

Construction of the 87-floor, 462m-high tower was completed in 2018. The main contractor was Renaissance Construction with Samsung C&T as the client's technical representative. Detailed structural design for the tower was undertaken by Inforceproject.

Concrete frame

The tower superstructure rests on a 3.6m-thick foundation raft. The concrete pour for the raft, which ended on 1 March 2015, was registered by *Guinness World Records* as the largest-ever continuous pour at the time.

The superstructure consists of a cylindrical reinforced concrete core. Overall stability is achieved by means of four sets of outriggers positioned at intermediate levels, connected to the perimeter of the core and to ten external columns. The external columns follow a helicoidal pattern as they progress upwards.

Couplers and headed anchors

Due to exceptional reinforcement volumes, Ancon reinforcing bar couplers and headed anchors were used extensively in the construction of the foundation raft to avoid unnecessary overlapping of bars and minimise congestion.

Nearly 80,000 CXL32 reinforcing bar couplers were used for the splicing of 32mm-diameter horizontal reinforcement bars, which were arranged in 15 layers in orthogonal directions over the depth of the foundation raft.

Over 45,000 CXL32HA and 6000 MBT ETHA32 headed anchors were used at the extremities of the reinforcement at the edges of the raft to replace traditional hooked ends, which would otherwise have exacerbated reinforcement congestion.

CXL couplers are compact and produce a full-strength joint. The end of each bar is enlarged by a special cold forging process, increasing the core diameter of the bar to ensure that the joint is stronger than the bar. Parallel metric threads are cut onto the enlarged ends, which are systematically proof-tested to a force equal to the characteristic yield strength of the bar.

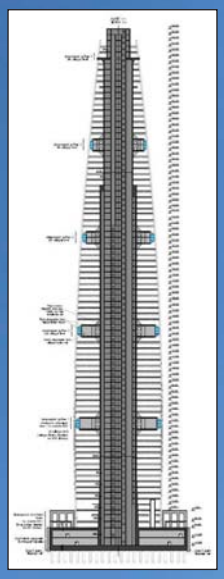
MBT ETHA headed anchors are designed to provide dead-end embedment: a bearing plate welded to the MBT coupler body transfers the full tension load of the bar to the surrounding concrete. The bar end is supported within the coupler body by two serrated saddles and as special lockshear bolts are tightened, the conical ends of the bolts embed themselves into the bar, while the serrated saddles bite into both the bar and the shell of the coupler, thus creating a full-strength joint.

Vertical reinforcement splicing

CXL Type B splices were also used to minimise congestion in the multi-layered vertical reinforcement of the central core – CXL40 and CXL36 couplers for the lower portion of the core and CXL32 couplers for the upper portion.

Ancon CXL32 coupler.

Lakhta Center Tower nearing completion – August 2018.



Above: Vertical cross-section through foundation raft and superstructure.

Slipforming of central reinforced concrete core.

CXL bar threading facility.

In this method, one of the bars to be joined is threaded for a full coupler length, which allows the coupler to be rotated from this position to the second fixed bar to make the splice. These Type B slices are ideal where it is difficult to rotate the reinforcing bars and were a significant advantage in this instance due to the length and weight of the reinforcement.

Reinforcement continuity

Continuity of reinforcement between floor slabs and the central core was achieved by means of two Ancon systems:

- Ancon KSN threaded anchors
- Ancon CXL coupler box.

First-phase internally threaded anchors and couplers were supplied fixed to timber carriers or steel casings respectively, which enabled rapid and accurate installation of multiple items to the core reinforcement. After slipforming of the core, these continuity systems provide an indented shear key in the concrete face to increase design capacity of the joint.

Continuation reinforcement bars, featuring CXL parallel threads, were inserted in the anchors and couplers to complete the connection and then lapped with the slab's main reinforcement.

The principal advantage of these connection methods was a significant increase in the speed of installation over rebend continuity systems and individually fixed items.

Outrigger connections

The outriggers are 7.1m-deep beams, combining structural steelwork lattice girders with reinforced concrete.

Connections between the outriggers and the external columns used 25mm-diameter Shearfix CXL studs.

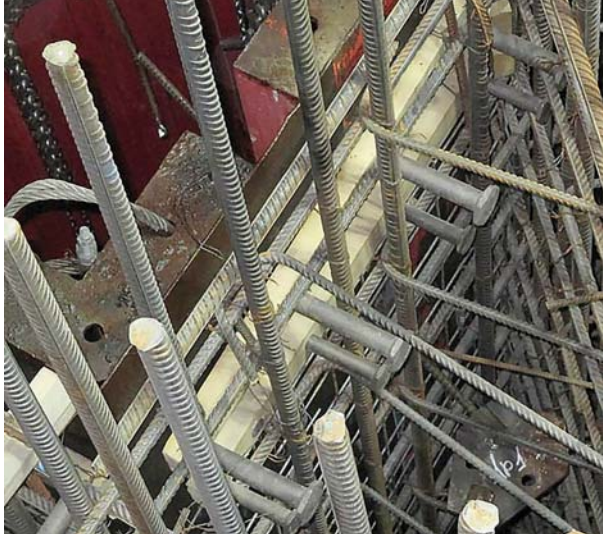
Reinforced concrete connections between the outriggers and the central core used a combination of 25mm-diameter Shearfix CXL studs and 32mm anchor bars fitted with CXL32 couplers at one end and welded anchor plates at the other end.

Ancon KSN system, featuring timber carrier and CXL continuation bars.

CXL32HA and MBT ETHA32 headed anchor.

Shearfix CXL studs feature an anchor head formed at the end of a length of reinforcing bar using a special hot-forging and quenching process. The other extremity of the stud is fitted with a CXL coupler, enabling connection with a threaded continuation bar to be cast in the second-phase concrete.

CXL Type B coupler.



KSN connections between floor slabs and central core.

Connections between outriggers and central core.

Accelerated speed

The avoidance of lapped reinforcement in the foundation raft and central core minimised reinforcement congestion and ensured that fresh concrete was able to flow effectively when poured, avoiding segregation and structural defects.

The use of KSN headed anchors, CXL coupler box and Shearfix CXL studs for the connection of slabs and outriggers to the central core and external columns meant that plain-faced formwork could be adopted throughout.

Overall, these solutions have resulted in an accelerated speed of construction and a high level of quality in the pouring of concrete, ensuring that construction could keep pace with a demanding site programme. ■

Lakhta Center Tower, Russian Federation

Owner	Mixed-Use Complex 'Lakhta Center'
Architectural design	RMJM, Gorproekt
Client's technical representative	Samsung C&T
Tower structural design & detailing	Inforceproject
Main contractor	Renaissance Construction
Reinforcement threading operations	NPO Energomashservice/Globetz
Reinforcement couplers and reinforcement continuity systems	Ancon