CTBUH Research Division:

First Composite Megacolumns Test a Big Success

BEIJING - The large research team working on the “Study on the constructability and the engineering properties of composite megacolumns” research project, funded by ArcelorMittal, gathered on February 5th in Beijing to start the test campaign on the first megacolumn samples.

Six specimens representing scaled-down megacolumns, built using an innovative design system with large I-shaped profiles encased in concrete, were assembled in the previous weeks at China Academy of Building Research (CABR)’s laboratories. The innovative aspect of this research is the use of hot-rolled Jumbo profiles, instead of plates welded together. The use of hot-rolled profiles is eagerly anticipated by designers and developers, as it will ease construction by reducing the number of on-site operations, and it will also boost construction quality, by avoiding errors and unwanted simplifications in the assembly of profiles originated by welded plates.

According to the research program, which has been peer reviewed by a group of international experts (LINK TO FIRST REPORT), the column specimens are to be brought to failure by compression only, with eccentricity factors of 0, 10 and 15 percent.

The first specimens were then brought to the Tsinghua University Structural Lab in the Department of Civil Engineering, one of the few that has a press large enough to break the specimens, even if they represent the real columns only at a 1:4 scale.

Researchers held their breath when they realized that the lab press was reaching the maximum capacity (18,000 kN, equal to a load of 1,800 metric tons) and the composite columns were still behaving in “elastic mode,” that is, they were not suffering any damage, and no deformation was recorded, beyond that which by simply un-loading the specimen. Only above 17,000 kN, applied with no eccentricity, some cracks appeared on the edges of the specimen and the column collapsed at 17,300kN, well above the limit originally anticipated.

Even if it still too early to prove the design method is correct, and to suggest this as a construction system for actual tall buildings, the researchers were pleased with the behavior of the specimen during the test. The studs performed well by transferring the shear force from the steel profiles to the concrete, thus making the two materials work together in true composite behavior.

One more test with no eccentricity will be performed next, immediately followed by other 1:4 scale tests with 10% and 15% eccentricity, respectively

In April, new tests will be performed with a different strategy, by applying not only an axial force, but a lateral force as well, again with eccentricities between zero and 15%. This will simulate the column behavior under the effect of an earthquake, finally proving the real potential applications of composite megacolumns made of encased hot-rolled steel profiles.
Research group and some external guests in front of Tsinghua University. Left to right: Jingye Wang (MKA), Congzhen Xiao (CABR), Rob May (Buro Happold), Donald Davies (MKA), Christoph Odenbreit (University of Luxembourg), Dario Trabucco (CTBUH · IUAV), Olivier Vassart (ArcelorMittal), Nicoletta Popa (ArcelorMittal), Chen Tao (CABR), Fei Deng (CABR)

Researchers in front of the large press at Tsinghua University

Column Specimen after failing under 17,300 kN (1,730 metric tons) of force.