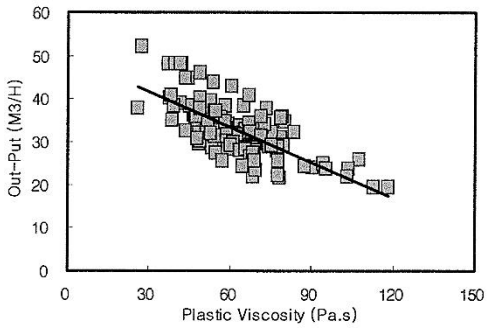
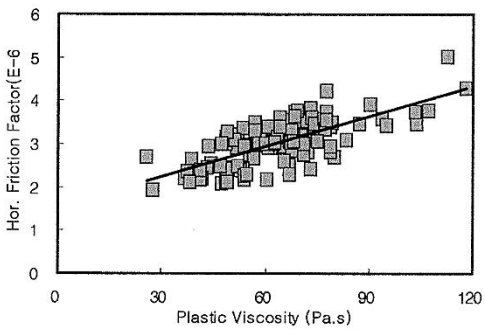
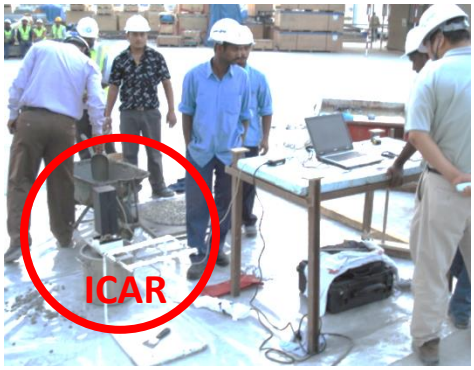
# NDTitans in action

## Case 11.1 Rheology at the Burj Dubai Super Tall Building construction, DUBAI








Most of super tall buildings, including the revolutionary Burj Dubai world tallest building, are reinforced concrete structures which have been or are being built with high performance concrete (HPC) to a greater or lesser extent. The stiffness provided by high modulus HPC has benefits in terms of limiting displacements and its high strength is necessary to keep the cross section of structural elements within reasonable slender dimensions. Also, the high early strength along with prefabricated reinforcing cages and new slip form/climb form technologies allow that large structures can be constructed at rates of 2 to 3 levels per week.

On the other hand, HPC is usually more sensitive than conventional concrete during the plastic and early hardening phase, so, among many other challenges, the ability to pump and place concrete at high ambient temperature to significant heights is crucial for the efficient and economic use of HPC. In the case of the Burj Dubai, it would not be economically viable to use HPC if large quantities needed to be placed by crane. With the development of powerful pumps, the possibility to conduct single stage pumping to heights of more than 600 m was possible in this project.

Besides a very careful design of the concrete mixtures, the pumping set up and all the logistical issues involved, detailed monitoring of the rheological properties of the fresh concrete before and after pumping played a key role for the success of the works. Experience with pumping concrete in the Middle East had shown the potential for blockage of the pipelines due to temperature effects so limited variation in rheology and concrete temperature had to be achieved to minimize pumping problems.

For this purpose, the **ICAR Rheometer** was extensively used both during the trials and the construction process. At the beginning, pumping through the 150 mm diameter high pressure pipes was found to approximately half the plastic viscosity of the concrete and double the dynamic yield stress. Also, correlations of rheological properties vs. key pumping parameters like friction factor and out-put flow were developed. These findings allowed to optimize the concrete mixtures and procedures of systematic quality control to carry out the actual works.

The success of projects such as the Burj Dubai shows the advantages of HPC in building super tall structures. The ICAR Rheometer was of great help to overcome the challenges faced in pumping so high under very tough climate conditions and prevent pump blockages and other problems which would severely limit the benefit of using this material.

Case summarized by **NDTitan Hugo Orozco**

*Ref.: James Aldred. "Burj Khalifa – a new high for high-performance concrete". Proceedings of the Institution of Civil Engineers - Civil Engineering. Vol. 163-2, May 2010, pp. 66-73, "Test Right – Sleep Tight"*