Abstract for the Training School for Young Researchers in Malta on Fire Engineering

Post-tensioned concrete structures at elevated temperature and in fire

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Modern high-rise concrete structures are increasingly being built using prestressed steel reinforcement via the construction method of post-tensioning (PT). This type of construction provides various economic advantages over conventional (non-prestressed) reinforced concrete structures by enabling longer and thinner flat plate floor slabs, rapid construction, and better control of in-service deflections. Today our knowledge of PT concrete buildings during and after fire is based on prescriptive standard fire testing of simply supported concrete floors that were primarily tested during the early 1960s. These tests failed to capture the true structural behaviour observed during real fires in real buildings (particularly considering the changes which have occurred in PT construction techniques and materials since the 1960s). To address this knowledge gap, this project is taking a novel and holistic approach to rationally assess and understand the behaviour of modern PT concrete structures during and after fire. This is being achieved in three research phases;

1) Assessing current international (Europe, North America, and Asia) prescriptive and performance based fire code practices for modelling realistic post tensioned buildings exposed to realistic heating scenarios (with and without induced spalling),

2) Defining, using novel digital image correlation techniques, the true high temperature mechanical behaviour of both antiquated and modern prestressing steels (softening, strength and creep behaviours), and

3) Rationally describing, through large-scale structural testing, the interaction between concrete and prestressing steel in realistic continuous PT concrete assemblies under fire.