Techniques, Materials and Design Considerations for Strengthening of Existing Concrete Structures

Although the analysis and upgrade of concrete structures is somewhat of a "scientific art" that has been practiced for many years, it has evolved into a complex science that requires a blend of engineering, material science and construction perspectives. Strengthening projects may utilize traditional materials such as conventional cement-based and steel materials as well as advanced composite materials (Fiber Reinforced Polymer, FRP). The techniques used to design and install these materials for upgrade applications are not common to the engineering and general construction industry which can make strengthening projects even more challenging and complex than new construction.

There are many factors that create the need for strengthening. They include construction and design errors, increase in live load, new code requirements, low concrete strength, voids created during concrete placement, new penetrations and prevention of progressive collapse from blast loads.

This meeting/presentation will describe the design strategies, different techniques, materials and design concepts used for upgrading concrete structures. Below is a brief outline of the presentation:

- **Introduction –** regarding Structural Group and the strengthening industry
- **Factors affecting the performance or capacity of reinforced concrete**
  - New loads
  - Change in use
  - Construction or design errors
  - Missing, misplaced or damaged reinforcement
  - Cutting of new penetrations that affect existing reinforcement
- **Strengthening with externally bonded FRP systems**
  - Typically used forms
  - Installation techniques and QA/QC
  - Design Concepts - per ACI 440 2R
  - Near-surface mounted (NSM) FRP rods
  - FRP limitations and strengthening limits
  - Case Studies
- **Conventional strengthening techniques for cases where FRP is not viable**
  - External Post Tensioning
  - Section Enlargement (Self-Consolidating Concrete)
- **DUCON System** – micro-reinforced concrete system used for strengthening, precast shapes and anti-terrorism/force protection applications.

The presenter - Shaun Loeding, P.E. - is a Director of Strengthening Solutions at STRUCTURAL GROUP, a $400M specialty design/build repair contractor. He has over 15 years of structural engineering and construction experience in the repair and strengthening of structural elements. Shaun is a Masters Graduate (Structural Engineering) from the University of California, San Diego and presents on technical and construction issues that directly relate to designers and engineers. You may contact Shaun at (cell) 631.488.7421 and (email) sloeding@structuraltec.com.