SHARIF UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING

Fall 2014

Repair and Rehabilitation of Structures

INSTRUCTOR: Vahab Toufigh, Ph.D.
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OFFICE HOURS: Sun & Tue: 11:00-12:00, or by appointment

PREREQUISITES: An introductory course in concrete and steel design.

REFERENCES:
- ACI 222R-01: “Corrosion of Metals in Concrete.”
- National Cooperative Highway Research Program (NCHRP) Report 514: "Bonded Repair and Retrofit of Concrete Structures Using FRP Composites.”
- ACI 440.02: “Guidelines for Design of Concrete Structures Externally Bonded with Epoxy Bonded FRP Composites.”
- ACI 440.3R-04: “Guide Test Methods for Fiber-Reinforced Polymers (FRPs) for Reinforcing or Strengthening Concrete Structures.”
- ACI 503.5R-92: “Guide for the Selection of Polymer Adhesives with Concrete.”
- ACI 440.1R-03: “Guide for the Design and Construction of Concrete Reinforced with FRP Bars.”

HOMEWORK: Accepted on A4 sheets using only one side. Homework must be presented in a neat, professional manner and it must be turned in at the beginning of the class period. Late homework is not acceptable without a valid cause.
EXAMS: There will be one midterm exam and a comprehensive final exam. Exam date TBA.

GRADING: Exam I 30%
Final Exam 35%
Homework 15%
Term Project 20%

COURSE OUTLINE:
1. **Introduction**
   What is Infrastructure?
   Infrastructures and the Economy
2. **Deterioration of Structures**
   Causes of Deterioration in Steel and Concrete Structures
   Mechanism of Corrosion of Steel in Concrete
   Protection Against corrosion in Construction
3. **Method of Strengthening Existing Structures (Conventional Techniques)**
   Composite Steel-Concrete Structures
   - Influence of Construction Method (shored vs. unshored)
   - Design Guidelines (AASHTO)
   - Design Examples
   External Post-Tensioning in Composite Steel-Concrete
   - Method of Application of Prestressing Steel Structures (Preflex, Hybrid, and End Anchoring High Strength Steel Wires or bars)
   - Calculation of bar force using strain energy approach
   - Design and Retrofit of the Section
4. **Method of Strengthening Existing Structures (Modern Techniques)**
   Development and Evolution of Fiber Composites in Civil Engineering
   - The Available Codes and Design Guidelines
   - Test Methods and Mechanical Properties of Fiber Composites
   - Design and Retrofit of Beams and Columns Using Fiber Composites
   - Design and Retrofit of Masonry Walls Using Fiber Composites
5. **Durability and Long-term Performance of Fiber Composites**
   Degradation Mechanisms in Fiber Composites
   Diffusion Process and Remaining Life Prediction
6. **Case Studies**
   Steel and Concrete Pipes
   Interface Behavior of FRP and Backfill Soil