

**SHARIF UNIVERSITY OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING**

Fall 2014

Repair and Rehabilitation of Structures

- INSTRUCTOR:** Vahab Toufigh, Ph.D.
2nd Floor Earthquake Engineering Research Center
- PHONE:** (21) 6601 4275
- Email:** toufigh@sharif.edu
- 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."

Transportation Research Board (TRB) Report 12-28(4), ERI.
"Methods of Strengthening Existing Highway Bridges."

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