

CE-493N (CRN 87673) Fall-2018
SPTP: STRUCTURAL DESIGN WITH FRP REINFORCEMENT
 TR 9:30--10:45, Room ESB G-78A
 Dr. P.V.Vijay, Ph.D., P.E., p.vijay@mail.wvu.edu
(please use only the above e-mail ID for communication)
 Office: 611C ESB, Telephone Number: 304-293-9985
 Office Hours: TR 11:00-Noon or by appointment
 Prerequisite: CE361

TEXTS AND REFERENCES (Required)

- Design of Concrete Structures with FRP - Hota V.S. GangaRao, N. Taly, P.V.Vijay
- Codes -ACI 440 and ACI 318

COURSE OBJECTIVES

The primary objective is to develop a sound understanding of the design of structures with FRP as a reinforcing material with a firm foundation of design principles. The design methodology will include understanding of material properties, determination of loads, structural planning, member design under flexure and shear, consideration of ACI codes for bond, confinement effects, and rehabilitation techniques.

Course Outcome Description	ABET Program Outcome*
(1) Learn about FRP as a structural material and study its design principles in comparison with conventional materials for engineering applications	(a), (c), (e)
(2) Learn about analysis, design, and manufacturing of FRP laminates, bars, and wraps under bending (tension and compression) and shear, with due regard to fiber orientation and bond properties.	(a), (c), (e), (j)
(3) Learn about analysis, design, and rehabilitation of FRP for various structural applications with the help of American Concrete Institute (ACI) design codes and use simple software tools for analysis/design	(a), (c), (e), (j), (k)

- * (a) Apply knowledge of math, science, and engineering
 (c) Design civil engineering projects and components of projects
 (e) Identify, form, and solve civil engineering projects
 (j) Need/ability to engage in lifelong learning (contemporary issues)
 (k) Use techniques, skills, and modern engineering tools

HOMEWORKS, QUIZZES, AND EXAMS

It doesn't matter how you acquire your knowledge. You may discuss or seek help from anyone. However, **the final work has to be yours. Don't Copy!** Generally, late homework will not be accepted and there will be a penalty of 25% per day at the discretion of the instructor. Homework due dates will be specified on each assignment; typically, you will have one week for each assignment. Quizzes may be unannounced and exams are always announced. We will have a mid-term exam roughly five weeks after the start of the semester. Final exam will be held as per the

University Schedule. *Design students are expected to submit work that is reasonably neat; complete yet concise; orderly and well organized in format.* Sketches should be used to illustrate and summarize the design.

GRADING

- (1) Exams/Quizzes - 35%; (2) Homework- 35%; (3) Final/Projects-30%
- A Grade: 90% and above
 - B Grade: 80% and less than 90%
 - C Grade: 70% and less than 80%
 - D Grade: 60% and less than 70%
 - F Grade: Less than 60%

POLICY AND GUIDELINES

Academic Honesty: You are bound by the University honor code; it is your responsibility to know the code and the risks of violations (See The Mountie, WVU Student Handbook).

INCLUSIVITY STATEMENT

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion. If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (304-293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives, please see <http://diversity.wvu.edu/>.

TOPICS

1. Properties of FRPs and conventional (concrete, steel, and timber) materials
2. Manufacturing of FRP and conventional (concrete and timber) materials (manufacturing plant visit will be in October/November time frame)
3. ACI Codes, loads, and allowable stresses
4. Bond, shear, and durability properties
5. Design aspects of beams, slabs, and columns with FRP and conventional materials
6. Laminated Members (theoretical and practical considerations)
7. FRP wrapping for rehabilitation design on beams and columns (strengthening and confinement effects)
8. Concrete and Bridge Rehabilitation Design- Case Study and Project
9. Special topics (Manufacturing, recycled polymers, and case studies)

REFERENCES

- Reinforced Concrete: A Fundamental Approach, Edward G. Nawy, Pearson Publication (any of the recent editions)
- FRP Handbook (any of the recent editions)
- Fiber-Reinforced Composites: Materials, Manufacturing, and Design, P.K. Mallick, CRC Press (any of the editions)