COURSE OUTLINE

DRA 217	**Structural Steel Design and Drafting**
Course Title	Course Number

3	**2 / 3**
Credits	Lecture/Laboratory Hours

COURSE DESCRIPTION

Examines the structural design of steel relative to the architectural frame of a structure. Relies heavily on the principles of mechanics; and develops knowledge of drawings. Requires familiarity with general steel design codes and the preparation of structural drawings.

Text (s):   **Reference Division Booklist**

Prerequisites: **ABT120, CIV104, DRA190, ENT116**

Co-requisites: **CIV237**

Course Coordinator:Jim Maccariella   **Latest Review: Fall 2021**

I.   GENERAL OBJECTIVES

    A. Familiarize students with the requirements, methods, and knowledge necessary to design basic structural steel elements.

    B. Apply knowledge gained in the study of mechanics and mechanics of materials to design structural steel members.

    C. Locate and use standard tables found in texts and literature for the design of structural steel members.

    D. Expand drawing skills to include structural steel design and detail drawing of floor plans, beam and column details, and framed connections.

    E. Acquaint the student with structural failures.

II.   SPECIFIC OBJECTIVES

UNIT I - Review of Principles & Diagrams (2 weeks)

The student will be able to:
    A. List and draw the various standard shapes of structural steel.

    B. List the types of steel generally used in construction along with their yield points.

    C. Define:
1. Stress	5. Ultimate strength
2. Strain	6. Modulus of Elasticity
3. Shear	7. Safety factor
4. Yield point	8. Allowable stress

    D. Using a simply supported, overhanging, or cantilever beam, calculate:
1. Loads	3. Reactions
2. Moment	4. Shear

UNIT II - Properties of Beams (3 weeks)

The student will be able to:
    1. For built-up members, calculate:
        a. the location of the centroid
        b. moments of inertia
        c. section modulus
        d. radii of gyration

    2. Use beam formulas to find the maximum potential carrying capacity or the computed bending stress of loaded beams.

    3. Calculate the deflection of loaded beams.

    4. Calculate the load which will cause a given deflection.

Project

At this point, a project will be outlined which will consist of designing, sizing, and drawing the members for a steel frame structure. The structure will be organized so that problems and drawings produced during the remainder of the semester may be used for the project.

All calculations produced for each member and/or connection will be expected to be neatly done and entered into a project folder. Each entry is to be properly noted and each number dimensioned.

Each drawing is to be done in a professional manner and to be as complete as possible using proper drawing techniques, call-outs, and dimensions. The Structural Detailing text and sample drawings provided by the instructor will be guide criteria for quality and completeness. The execution of the title block and name of each drawing will be required.

UNIT III - Beam Design & Floor Framing (3 weeks)

The student must be able to:
1. Define a laterally supported beam.

2. Demonstrate working knowledge of the general procedure for the design of simple beams, overhanging beams and cantilever beams.

3. Use correctly the safe load tables.

4. Define and calculate web yielding loads and base plate requirements.

5. Calculate floor and roof loads using building material weight tables and live load occupancy charts.

6. Design, draw, and specify the steel members necessary for a floor of a typical interior bay of a building.

UNIT IV - Columns (2 weeks)

The student will be able to:

1. Compute the slenderness ratio of a given column.
2. Calculate allowable column load applied along its centroidal axis.
3. Determine the most economical column capable of supporting a given load applied along its centroidal axis.

UNIT V Connections (3 weeks)

The student will be able to:

1. List and draw the types of riveted joint failures.
2. Determine the safe load capacity of a given riveted or bolted connection.
3. List and draw the typical welded joint connections.
4. Determine mathematically the strength of a given weld.
5. Calculate the weld necessary to develop a safe connection for a given problem.
6. Draw typical bolt, rivet, and welded connection details using proper call-outs and symbols.

<u>**UNIT VI – REVIEW (2 weeks)**</u>

Building Project

The student will complete the calculations and drawings for the project which will include:
1. Floor structure
2. Columns
3. Beams
4. Typical connections

III. <u>**METHOD OF PRESENTATION**</u>

The lecture-discussion approach will be used. The text will be the main source of required information with handouts and transparencies used as appropriate. The AISC Manual of Steel Construction will be used as the primary code.

IV. <u>**EVALUATION**</u>

There will be a test given for each unit consisting of 4 to 6 problems covering the material of that unit.

Absenteeism and tardiness will adversely affect the final grade. Perfect attendance will result in an increase in grade average.

The building project will be collected at the end of the semester for comprehensive evaluation.

Approximate grade weights:

Tests 1, 2, and 3	50%
Final Exam	20%
Projects, Homework, Interest, Attendance	30%

<u>**Academic Integrity Statement**</u>**:**
Students are expected to comply with the college-wide requirements for academic integrity. Mercer County Community College is committed to Academic Integrity—the honest, fair, and continuing pursuit of knowledge, free from fraud or deception. This implies that students are expected to be responsible for their own work. Presenting another individual's work as one's own and receiving excessive help from another individual will qualify as a violation of Academic Integrity. The entire policy on Academic Integrity is located in the Student handbook and is found on the college website.
(http://www.mccc.edu/admissions_policies_integrity.shtml).

<u>**Special Services**</u>

Any student in this class who has special needs because of a disability is entitled to receive accommodations. Eligible students at Mercer County Community College are assured services under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973. If you believe you are eligible for services, please contact Arlene Stinson, the Director of Academic Support Services. Ms. Stinson's office is LB 217, and she can be reached at (609) 570-3525.

LECTURE SCHEDULE

WEEK

1, 2   **Introduction**
       AISC Manual and Codes. Review of Principles of Equilibrium
       Types of Steels
       Moments of Inertia

3   **Tension Member** (Analysis)
       Staggered holes

       Tension Member (Design)

4   **Loadings on Building Floor Systems**

5   **Review of Shear and Bending Moment Diagrams**

6, 7   **Beams** (Analysis)

8   **Beams** (Design)

9, 10   **Beams** (Types of Failures)
       Shear
       Web Yielding
       Deflection

11, 12   **Compression Members**
       Analysis
       Design

13   **Riveted Connections**

14, 15   **Bolted Connections**
               Welded Connections

INSTRUCTIONAL MATERIALS AND REFERENCES

1. Architectural Graphic Standards - Ramsey & Sleeper - Wiley

2. Basic Steel Design - Johnston & Lin - Prentice Hall

3. BOCA Basic Building Code - Building Officials & Code Administrators – International, Inc.

4. Building with Steel - Halperin - American Technical Society

5. Construction of Structural Steel Building Frames - Rapp - Wiley

6. Hot Rolled Steel Shapes and Plates - US Steel

7. Steel Construction Manual AISC

8. Steel Structures - McGuire - Prentice Hall

9. Strength of Materials - Fitzgerald - Addison Wesley

10. Structural Steel Data for Architectural and Engineering Students - Bethlehem Steel

11. Structural Steel Detailing AISC

12. Structure in Architecture - Salvadori & Heller - Prentice Hall

13. Sweets Industrial Construction File

14. Times-Saver Standards - Callender - McGraw Hill

DRA217 LAB

STRUCTURAL STEEL DESIGN AND DRAFTING

LABORATORY PROJECT

BUILDING DESIGN

Professor J. Maccariella

I.   PURPOSE

The purpose of this project is to have the student:
1. Proceed through the stages of structural analysis and design of a steel building.

2. Prepare detail fabrication drawings of several structural steel components.

3. Prepare a well-organized set of calculations.

II.   OBJECTIVES

1. Determine the live and dead loadings on beams, columns and trusses.

2. Analyze the loading conditions on various structural members.

3. Design the following structural steel members:
   a. A minimum of two different filler beams for the second and third floors
      (4 beams in all).
   b. A minimum of one different girder beam for the second and third floors
      (2 beams in all).
   c. A minimum of one spandrel beam for the second and third floors
      (2 beams in all).
   d. A minimum of one exterior column.
   e. A minimum of one interior column.

4. Prepare detail fabrication drawings for one filler beam, one girder beam, and two columns.

III.   FORMAT

The finished set of calculations and drawings is to be submitted to the instructor during the last laboratory period of the semester. An **MCCC report folder shall be used** to contain the calculations. A diazo print of the drawings shall be made, folded and placed in the report folder.

All calculations are to be done on 8-1/2 x 11 cross-section paper. Detail drawings are to be done using computer aided drafting software.

IV.   GRADING OF LABORATORY PROJECT

Grades will be based on the following:
   a. Completeness (attainment of objectives).
   b. Accuracy.
   c. Organization and neatness.
   d. Participation in laboratory sessions.
   e. Professional quality of CAD drawings.

V.   GIVEN CRITERIA

A. Finish floor/roof elevations:

Ground floor	Elevation 100.00
Second floor	Elevation 110.00
Third floor	Elevation 120.00
Roof	Elevation 150.00

B. The minimum size of the building is to be 75' x 100' (center to center of exterior columns).

C. The third floor is to be used as an auditorium. Interior columns are to stop at the third floor and the roof is to be supported by trusses.

D. Dead and Live Loads.

1. The "use" for determination of live loads is left to the student. However, a minimum of two uses with different live loads shall be chosen (use the A.I.S.C. Code).

2. Choice of floor, wall and roofing material is left to the student (use the A.I.S.C. Code for weights of materials).

3. The roof snow load is 40 pounds/square foot.

E. Stairways and one elevator are to be provided.

F. Neglect any loading due to wind, mechanical and electrical equipment.

G. Channel purlins shall support the roofing material. Purlins shall be spaced so as to fall at truss panel points.

H. Neglect interior partitions (Assume their weight is included in the live load for the particular use).

I. Assume the following for the weight of the beam.

- filler	30 plf
- girder	45 plf
- spandrel	45-55 plf

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