Course Syllabus
CE 4407 - Transportation Design
College of Engineering
Spring 2015

Instructor Information

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E-mail: kalluri@mtu.edu
Office Hours: Thu, 2-3 pm, Fri 11-12 am, or by appointment

Course Identification

Course Name: Transportation Design
Course Location / Times: MW 11:05 – 11:55am (130 Fisher) T 11:05am-12:55 pm (330 EERC)
Prerequisites: CE 3401

Course Description/Overview

An introduction to the planning-design-construction process for highways, intersections, and railroads. Operations, capacity, safety, and geometric design features. Horizontal and vertical alignment and cross sections. Design criteria, standards, environmental aspects, cost, and construction considerations. Use of CAD systems in preparing contact plans.

The course introduces students to the design and development of construction documents for highway and railroad projects. The course will provide participants with sufficient understanding of roadway and track components and design criteria. Specific topics include horizontal and vertical geometry, turnouts and intersections, cross-section components, quantities and costs.

The course takes a hands-on approach where assigned readings, interactive lectures, homework assignments and other instructional materials will be applied by participants to complete design exercises both manually and in MicroStation and Geopak software, eventually leading to a real-life rail / road design project.
The course will require students to use teamwork and creative thinking to solve an open ended design challenge. The students will work both individually and in 2-3 person teams throughout the course and perform assignments needed to complete the project from the initial conception, through the design to the delivery of final plans, quantities and cost estimates for construction.

**Course Learning Objectives**

Course has two key goals:

1) Learning the roadway and railroad track design principles using current recommended practices and guidelines. This goal includes developing an understanding of interrelationships between design, document production and construction, internalization of design principles and criteria and identification of key process steps in road and rail related projects. Specific attention will be paid to the similarities and differences in rail track versus roadway design.

2) Applying the design principles in a computer-aided design process. Students will learn to take the guidance, instructions and references and apply them toward developing a real solution and documents necessary to present their solution while working in a team where they have to depend on each other’s individual expertise to get the product done.

3) By the end of the program, students will have a basic understanding in the fundamentals of the roadway / track components, design principles and criteria, construction process and estimating the basic project costs. They should also have gained hands-on experience in how to use MicroStation and Geopak software in the design part of the project.

**Course Resources**

**Course Website(s)**

- Canvas<http://www.courses.mtu.edu>

**Required Course Text**

- No required text.

- Selected texts from various sources, handouts and other additional material will be provided by the instructor during the course and through Canvas site. Students are encouraged to look for additional information from internet and other sources provided by the instructor. Some of the publications used during the course include “Practical Guide for Railroad Engineering and Manual for Railway Engineering” by AREMA, “Manual of Uniform Traffic Control devices”, selected material developed by AREMA Committee 24 – Education and Training, Track Design Guidelines by various companies, and MDOT Road Design Manual. Tutorials and help files by Bentley for MicroStation and Geopak will also be useful sources to assist in the course exercises and final project which utilize both software.
**Grading Scheme**

**Grading System**

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Percentage</th>
<th>Grade points/credit</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93% &amp; above</td>
<td>4.00</td>
<td>Excellent</td>
</tr>
<tr>
<td>AB</td>
<td>89% – 93%</td>
<td>3.50</td>
<td>Very good</td>
</tr>
<tr>
<td>B</td>
<td>85% – 89%</td>
<td>3.00</td>
<td>Good</td>
</tr>
<tr>
<td>BC</td>
<td>80% – 84%</td>
<td>2.50</td>
<td>Above average</td>
</tr>
<tr>
<td>C</td>
<td>75% – 80%</td>
<td>2.00</td>
<td>Average</td>
</tr>
<tr>
<td>CD</td>
<td>70% – 75%</td>
<td>1.50</td>
<td>Below average</td>
</tr>
<tr>
<td>D</td>
<td>64% - 70%</td>
<td>1.00</td>
<td>Inferior</td>
</tr>
<tr>
<td>F</td>
<td>63% and below</td>
<td>0.00</td>
<td>Failure</td>
</tr>
<tr>
<td>I</td>
<td>Incomplete; given only when a student is unable to complete a segment of the course because of circumstances beyond the student’s control. A grade of incomplete may be given only when approved in writing by the department chair or school dean.</td>
<td></td>
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</tr>
<tr>
<td>X</td>
<td>Conditional, with no grade points per credit; given only when the student is at fault in failing to complete a minor segment of a course, but in the judgment of the instructor does not need to repeat the course. It must be made up within the next semester in residence or the grade becomes a failure (F). A (X) grade is computed into the grade point average as a (F) grade.</td>
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**Grading Policy**

Grades will be based on the following:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Percentage</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>“U.S. Roadway/Railroad Project” poster/presentation</td>
<td>15%</td>
<td>90 pts</td>
</tr>
<tr>
<td>Roadway / Track design project presentation and report</td>
<td>45%</td>
<td>270 pts</td>
</tr>
<tr>
<td>Attendance and Participation (includes potential quizzes)</td>
<td>10%</td>
<td>60 pts</td>
</tr>
<tr>
<td>Homework assignments (including MicroStation)</td>
<td>30%</td>
<td>180 pts</td>
</tr>
</tbody>
</table>

**Total Percentage / Points**

100%  600 points
The grading of the class will incorporate following methods.

- There will be no tests during the course, but written quizzes and level of active participation during class sessions will be used to evaluate participation grade. All absences from the class must be approved by the instructor in advance and students are responsible for securing material covered during the missed lectures / labs. Active participation and proper preparation to team activities and to interactive lectures are absolutely essential to the success. Each student will provide feedback on the performance of themselves and their team members in the end of semester and these will be compared with the instructor’s evaluation. In total, attendance and participation will affect 10% of the overall grade.

- Homework assignments include both calculations and individual MicroStation assignments. They will be used to test the knowledge on instructional material covered during interactive lectures and capability to produce basic designs in MicroStation / Geopak. These tests and homework assignments will account for 30% of the overall grade.

- There will be one team poster/presentation session and one written report during the course. First will be in selected U.S. Roadway/Railroad Project Assignment and second in the final design product. The presentation and report (including design plans) will form the majority of the grade (60%). The grades will be based on the quality of the presentations and reports and are determined by course instructor and the evaluations by the fellow students and invited guests. The grade for the presentations and project will be the same for each team member. The design plans and reports will be graded in their draft form, but 50% of the points lost in the draft report grade will be rewarded to those teams, who sufficiently address the reviewer comments in the final report.

Late Assignments
Late submittals of assignments will cause automatic 50% reduction of available points, unless exceptional circumstances have prevailed, as determined by the instructor. Assignments will be submitted in electronic or paper format, based on instructor instructions.

Course Policies
Any absence from the class must be discussed in advance and absence without permission will affect negatively to the participation portion of the grade. In case conflicts arise within team members, the teams are expected to solve potential conflicts internally and are advised to approach the instructor for conflict resolution only when internal efforts haven't been effective.
**Collaboration/Plagiarism Rules**

Collaboration on individual and group assignments is HIGHLY recommended, but each student must submit their own assignments, unless otherwise instructed. One submission by each group is required for group assignments.

Cell phones, Blackberries, iPods, PDAs, or any other electronic devices are not to be used in the classroom. Please make sure to bring a calculator with you to class. Calculators on other devices are strictly prohibited. Information exchanges on these devices during class are also prohibited and violate the Academic Integrity Code of Michigan Tech.

**University Policies**

Academic regulations and procedures are governed by University policy. Academic dishonesty cases will be handled in accordance the University's policies.

**Academic Integrity:**
http://www.mtu.edu/dean/conduct/policy/academic-integrity/

If you have a disability that could affect your performance in this class or that requires an accommodation under the Americans with Disabilities Act, please your instructor as soon as possible so that we can make appropriate arrangements.

**Disability Services:**
http://www.mtu.edu/dean/disability/policies/

The Affirmative Action Office has asked that you be made aware of the following:

*Michigan Technological University complies with all federal and state laws and regulations regarding discrimination, including the Americans with Disabilities Act of 1990. If you have a disability and need a reasonable accommodation for equal access to education or services at Michigan Tech, please call the Dean of Students Office at 487-2212. For other concerns about discrimination, you may contact your advisor, Chair/Dean of your academic unit, or the Affirmative Programs Office at 487-3310.*

**Affirmative Action:**
http://www.admin.mtu.edu/aa0/

**Equal Opportunity Statement:**
http://www.admin.mtu.edu/admin/boc/policy/ch5/
## Course Schedule

Tentative content: (lecture / lab topics may be reorganized or changed as deemed necessary. Detailed assignment schedule can be found at the Canvas site.

<table>
<thead>
<tr>
<th>Module</th>
<th>Week(s)</th>
<th>Topics/Activities</th>
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</table>
| 1      | 1       | Welcome to transportation design course & Road / Railroad Project process  
- Review of the syllabus and Canvas Site.  
- Introduction to the reference materials.  
- Transportation project justification and introduction to the project phases/steps.  
- **Team Ass 1. – U.S. Rail / Road Research Projects**  
- **Lab: MS 1 – Introduction to Microstation.** Getting started with MicroStation. Doing the setup, discussing the levels and completing a tutorial. |
| 2      | 2-3     | Geometric design principles – Horizontal curves and transitions  
- Monday, Jan 19, MLK Day Recess (No class)  
- Horizontal curves and railroad vs. highway curve comparison. Arc/chord definition in curve design, limits of curvature and reasons behind them. Stopping sight distance.  
- Superelevation, curve transitions  
- **Ass 1. Curve Calculations**  
- **Lab: MS 2 – Introduction to Geopak**  
- **Lab. MS 3 – Curve Design** |
|        | 1/21    | *Last day to drop full semester courses with a refund  
*Last day to add full semester courses or change a section |
| 3      | 3-4     | Geometric design principles – Turnouts and Intersections  
- Geometric design of diverging locations (railroad turnouts and roadway intersections).  
- Critical dimensions and parameters.  
- **Ass 2. Turnout & Intersection Design**  
- **Lab: MS 4 – Turnouts & Intersections** |
|        | 1/30    | *Last day to drop full semester courses without a grade appearing on the academic record - No Refund |
| 4      | 4-5     | Geometric design principles – Alignments and Clearances  
- Horizontal alignment development and critical points.  
- Alignment development and stationing. Horizontal and vertical clearance considerations. |
<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Topics</th>
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</thead>
</table>
| 5    | 6-7   | Vertical design principles  
- U.S. Railroad Project poster/presentation session.  
- Introduction to vertical curves and profiles.  
- Limits of grades, vertical curves and reasons behind them. No vertical curve areas and special considerations for vertical curves.  
- Track profile development principles and design. Matching profile elevations  
- Ass 4. Vertical Alignments  
- Lab: MS 6 – Vertical Alignments |
| 6    | 7-8   | Substructure and Cross-sections  
- Introduction to substructure considerations and materials. Challenges in subgrade design.  
- Cross section components, materials and critical issues in developing existing and proposed cross sections for construction documents. Typical sections.  
- Team Ass 2. – Final Project.  
- Lab: MS 7 – Cross-section development. |
| 7    | 8-9   | Drainage and Superstructure  
- How to guide water to the preferred locations. How to design ditch profiles and determine, if closed drainage system is necessary. Basic sewer calculations and sizing of the pipes under the tracks.  
- Superstructure components and design considerations.  
- Lab: MS 8 – Plan production. |
| Week | 8.5   | Spring Break |
| 8    | 9-10  | Grade crossing design  
- Types and materials used in the crossings.  
- Critical geometric design elements and considerations.  
- Pavements markings. Other MUTCD issues. |
| 9    | 10-11 | Quantity and Cost estimates for rail projects  
- Quantity takeoffs from design documents and cross sections. Typical work items descriptions and units.  
- Unit costs and their application in the process. Different types of
contracts at the unit cost estimate. Other types of cost estimates and alternative comparisons through cost estimates.
- Applying quantity and cost data to a project environment.
- Developing engineer’s estimate.
- Ass 4. Quantities and costs

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<thead>
<tr>
<th>Date</th>
<th>Week</th>
<th>Topic</th>
</tr>
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<tbody>
<tr>
<td>3/27</td>
<td></td>
<td>Last day to drop full semester courses with a grade of 'W'</td>
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<tr>
<td>10</td>
<td>12-13</td>
<td>Other considerations and construction process</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Utilities</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Environmental challenges and considerations.</td>
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<tr>
<td></td>
<td></td>
<td>- Construction documents and specifications.</td>
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<tr>
<td></td>
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<td>- Draft Final plans due.</td>
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<tr>
<td>11</td>
<td>14</td>
<td>Feedback and conclusions</td>
</tr>
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<td></td>
<td>- Feedback on draft design plans to be incorporated in the final reports.</td>
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<tr>
<td></td>
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<td>- Course feedback session.</td>
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<tr>
<td></td>
<td></td>
<td>- Draft Final Reports due</td>
</tr>
<tr>
<td>12</td>
<td>Finals week</td>
<td>Final plans and reports due (TBD).</td>
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