Roadway Design Using InRoads XM

Course Curriculum

Revised: January 2010

This course replaces the courses ***Roadway Design Using InRoads*** and ***InRoads XM for Experienced Designers.***

Duration:

Four days

Prerequisites:

Prerequisite courses are:

- ***MicroStation Essentials*** or work experience with MicroStation drafting tools
- ***InRoads Geometry Fundamentals*** or work experience with InRoads geometry tools

Classroom requirements include:

- Be involved in an active design project using InRoads XM
- Student will bring to class the following data: a) existing surface file(s) (*.dtm), b) alignment file (*.alg), cross sections views to be used on the project. Classroom instruction will rely heavily on the data that the student brings.

Course Objectives:

The course is structured in a lecture/lab format with the instructor providing background information on how and why certain items are required by the software. Rather than a button-to-button approach, this course uses workflow-based reference material and labs to teach the key components necessary for success with CDOT's new standards and related processes.

This course covers key features and functionality of InRoads XM and the CDOT configuration with an emphasis on developing project-specific typical sections and modeling the roadway using the template and Roadway Designer tools of InRoads. This course will also cover using the new tab sheets.

Students are required to currently be working on a design project and to bring their own project data to the class. Course objectives include:

- Create roadway sections using the standard components delivered with the CDOT configuration and develop the knowledge and skills to modify them to fit project-specific conditions.
- Create roadway sections, recognize the concept of corridors, show how handling superelevation has changed, practice using the interactive design process available through the new Roadway Designer. The majority of the time will be spent on point controls.
- Refine the design of the roadway section by testing the outcome of different point control options and create the final surfaces of single and multiple corridors on their own projects. Use cross sections and volumes to evaluate the final design.
- Identify other enhancements to the InRoads software impacted by the new template library and Roadway Designer. Reinforce the concepts learned in the previous three days by working extensively on the student project.

Refer to the day-to-day schedule for additional objectives for the course.

What to Bring:

Students are required to bring the following data from their active design project:

- Typical section(s) – either in the form of a paper or electronic drawing
- Existing surface data files for the design project (*.dtm)
- Project alignment data file (*.alg)
- Criteria for the development of a roadway corridor including design speed, right of way limits, pavement design, and maximum superelevation.
- The student is encouraged to bring a copy of the M&S Standards and the 2005 Roadway Design Guide as reference material for the design of their project.

Students should bring the data to class either on a ***CD*** or ***Flash drive***.

Resources:

Students will find electronic copies of the reference material and labs associated with this course online under the ***Manuals and Training*** page of the CADD and Engineering Innovation web page located at www.dot.state.co.us/DesignSupport/CADD and Engineering Innovation.

Instructional Media:

This is an instructor-led hands-on course. Each student will have a computer for the duration of the course. The instructor will utilize a whiteboard and projection system for demonstrating key topics and techniques of the software. Students will access the reference material for this course electronically, either locally or online as noted under the section ***Resources***.

The instructor will provide each student a hard copy of the lab material. Course data files will be pre-loaded on the computer used in class. As with the reference material, course data files will also be available online for students to download and work through at their convenience.

Material Requirements:

A printed copy of the course labs will be provided in the class. The lab material will be used in conjunction with an electronic copy of the resource manual ***A Practical Guide for Using InRoads XM***. Students will refer to ***A Practical Guide for Using InRoads XM*** during the lecture portion of the class for detailed explanations of how to use a specific InRoads command and to gain an understanding of the command options.

Time Requirements:

The course will conform to the time constraints identified for each topic in this curriculum. The student may need to choose smaller portions of their project to work on during Student Project lab time in order to complete the assigned tasks in the allotted time.

CDOT Standards:

This course uses all CDOT standard configuration files, including the new standard CDOT_Civil.xin and template library files. During the class, several InRoads workflows will be presented that can then be applied to a range of different project circumstances.

Class Schedule and Objectives

DAY 1 – Templates

Objective:

Review the design process taught in the ***InRoads Geometry Fundamentals*** course to establish the groundwork for this course. Students will then take information prepared by the pavement engineer and create typical sections (templates) of the proposed roadway prism.

1. Introduction and Overview of Changes 0.5 hours

A brief discussion of the class format will be given followed by an overview of key concepts from the ***InRoads Geometry Fundamentals*** course. Other topics to be covered in this section are:

- How to get support
- Guidelines for converting a project from the 2004 edition to XM

2. Template Library – 0.5 hours

Templates define the shape and materials used for the proposed road surface. The template library contains the building blocks (called components) that are used to assemble templates. The layout and contents of the CDOT standard template library are discussed. Other key topics covered include:

- InRoads Create Template interface, set-up options, and tools
- Template library management concepts such as creating project-specific libraries and copying templates from another library

3. Defining Templates - 3 hours

With an understanding of the template library structure, students will learn about the various parts of a template and the methods for assembling those parts into a complete template. Other key topics covered include:

- An overview of the CDOT Standard Sample Templates that are included in the Template Library
- How the relationships between points (called constraints) are used to define the shape of the component and how points react as related points move
- Building components, component types, creating new components, component properties, point properties, point constraints

Lab: Building Components

- This lab illustrates the concepts of point constraints and the various constraint types. It demonstrates the methods for creating and editing point and component properties.

Lab: Building Sections

- This lab illustrates the methods for creating sub-assemblies from new and existing components that can be used later to create a complete template. It also illustrates the relationships of Parent Components and Display Rules that can exist between components.

Lab: Modifying Templates

- This lab illustrates the methods for modifying existing templates to make them specific to a project. These include changing point and component properties, deleting unneeded components, and adding new components to the existing template.

4. **Student Project Lab - 4 hours**

   Students will gain practical experience of the concepts learned in the morning session by developing templates for their actual project.

DAY 2 - Roadway Designer

Objective:

Once the horizontal and vertical geometry and the typical sections have been established for a project, the next step is to use these to define the design surface. The horizontal and vertical geometry defines the path of the proposed design. The template defines the shape of the road prism. When the template is placed at regular intervals along the design path, the proposed surface is formed.

5. **Corridors - 1 hour**

   A corridor associates the geometry with the templates to define the proposed surface. This section explains how to create a corridor and assign geometry and templates to that corridor. Other topics in this section include:

   - An overview of the InRoads Roadway Designer interface
   - Set-up options and tools for Roadway Designer
   - How to define a corridor
   - How to create template drops

6. **Superelevation - 1.5 hours**

   Superelevation adjusts the shape of the road prism to counteract the centrifugal forces encountered when a vehicle rounds a curve. This topic covers how to apply CDOT's superelevation design standards to the project corridor and template. Topics in this section include:

   - Creating superelevation definitions for a corridor
   - Methods used to modify existing superelevation

7. **Point Controls – 3.5 hours**

   The road prism (defined by the template) may not always be a constant shape throughout the length of a project. Changes in the road prism can be accomplished by creating new templates for each change. In addition, Roadway Designer offers a method of modifying a template assigned to the corridor, called Point Controls. These temporarily override the assigned constraint values assigned to the controlled point. There are several methods that will be covered including Standard Point Controls, Secondary Alignments, Parametric Constraints, Template to Template Transitions, End Condition Overrides, Modifying Single Template Drops, and Target Aliasing. These methods will be covered in groups as follows:

   - Standard Point Controls, Secondary Alignments, Parametric Constraints (1.5 hours incl. lab)
   - Template to Template Transitions, End Condition Overrides (1 hour incl. lab)
   - Modifying Single Template Drops, and Target Aliasing (1 hour incl. lab)

8. **Student Project Lab – 2.0 hours**

   Students will gain practical experience of the concepts learned in the afternoon session by developing corridors and superelevation and working with point controls using their actual project data.

DAY 3

Objective:

Continuing the design process, the corridor definition is completed by specifying the geometry, templates and point controls used for the corridor. The proposed surface model can then be created and evaluated.

9. Point Control Review - 1 hour

Point controls are one of the key concepts used in Roadway Designer and students need a solid understanding on them. This review is meant to reinforce the objectives covered on the previous day.

10. Creating Surfaces - 1 hour

The goal of Roadway Designer is to create a proposed surface or surfaces that can be used to calculate project quantities. In this section the process for creating the proposed surfaces is explained. Topics in this section include:

- Creating a single surface from a single corridor
- Creating multiple surfaces from multiple corridors
- Creating a single surface from multiple corridors

Lab: Creating Surfaces

11. Displaying Cross Sections – 1 hour

A cross section set is the primary evaluation tool used on a proposed surface. Cross sections are also used to produce end-area volumes and check for right-of-way clearance. Topics in this section include:

- Setting Global Scale Factors for cross section display
- An overview of cross section preferences
- An overview of other important settings
- Displaying cross section set
- Annotating and updating cross sections

Lab: Create Cross Sections

12. Calculating Volumes – 1 hour

End area volume calculations are used to determine earthwork quantities like embankment and excavation. This section describes how to compute end area volumes and how to adjust those calculations based on a variety of situations such as unsuitable material in the construction zone and volume exceptions. Topics in this section include:

- Basic end area volumes
- End area volume reports
- Adding unsuitable material to calculations
- Creating a volume exception

Lab: Calculate End Area Volumes, Unsuitable Material, and Volume Exceptions

13. Student Project Lab - 4 hours

Students will continue applying the principles of point controls on their projects. In addition, students will generate the design surface and sub-surfaces for their projects.

DAY 4

Objective:

With the design completed, the focus of the project turns to plan production. This can include Plan and Profile sheets, Tab Sheets, and various reports. InRoads provides tools to aid in the production of Plan and Profile sheets and reports. In addition, CDOT has provided standard Excel spreadsheets that make the production of tab sheets easier.

14. Plan and Profile Generator - 1 hours

Assembling plan and profile sheets can be a tedious task. InRoads has automated the process of laying out and compiling plan sheets with a tool called Plan and Profile generator. Topics in this section include:

- Plan and Profile generator preferences
- Plan and Profile generator tab settings
- Adjusting plan sheet layout

Lab: Creating Plan Sheets

15. Reports in InRoads XM - 1 hours

Reports come in many types and styles. InRoads uses review and results reports to communicate with the user. Geometry and surfaces can be compared to generate XML reports. This section describes where reports come from, how to create them, and the formatting options available.

Labs: Volume Reports and Station Base Reports

16. Additional Enhancements to the CDOT Configuration - 1 hour

Transcribing data from various sources to create tab sheets allows many opportunities for input errors. The CDOT standard tab sheets automates the process of creating tab sheet headers thus reducing some of the transcription errors. This section explains the functionality and use of the CDOT standard tab sheets.

Lab: Standardized Tab Sheets

17. Workflow-Based Labs - 2 hours

Intersections and ramp mergers are two common design situations encountered. The intersection and the interchange labs illustrate a specific workflow that can be adapted to most intersection and merging road situations.

Labs: Intersection and Interchange

18. Project Specific Questions and Help - 4 hours

The remaining time will be used for student prompted review and additional time to work on Student Projects.