Advanced Roadway Modeling Using InRoads XM

Course Curriculum

Revised: January 2010

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
- ***Roadway Design Using InRoads*** or work experience using InRoads profile and cross section tools, creating templates, and creating models with Roadway Designer.

Course Objectives:

This course is designed to pick up where ***Roadway Design Using InRoads*** left off and introduce the user to the more advanced topics and procedures required for modeling roadways. The areas covered include modeling divided highways following different horizontals and verticals, using end conditions for advanced side-slopes, interfacing with ramps, including gores, retaining walls, etc., and using feature creation and editing tools to enhance and develop models.

This course will address:

- Creating complex surfaces with Surface Editing tools
- Developing templates and end conditions for a variety of situations
- Creating complex surfaces using Roadway Designer

Course objectives include:

- Gaining an understanding of how to create surfaces without using templates
- Increasing knowledge of templates and how the components within a template work
- Modeling walls with and without a corridor
- Developing an understanding of how to solve problems and devise solutions for approaching different modeling scenarios with InRoads

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

What to Bring:

Although the following items are not required, students may bring the following data from their active design project. These items will be used only if time permits.

- Bridge model and/or roadway model
- Existing surface data files for a design project (*.dtm)
- Project alignment data file (*.alg)

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 may be asked to refer to ***A Practical Guide for Using InRoads XM*** during the lecture portion of the class for detailed explanations of how to use specific InRoads commands and to gain an understanding of the command options.

CDOT Standards:

This course uses all CDOT standard configuration files, including the new standard CDOT_Civil.xin and template library files.

Class Schedule and Objectives

DAY 1

Objective:

There are some design surface elements that should be included in a proposed surface model for quantity calculations, but are not easily modeled with a template. Items like detention ponds, driveways, traffic control islands, and bridge abutments fall into this category. InRoads has several tools that are used to create and modify surface features without the use of Roadway Designer. These tools are examined in this section.

1. **Getting Started - 0.5 hour**

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

   - How to get support.

2. **Generate Longitudinal Feature and Generate Sloped Surface - 3.0 hours**

   In many cases, additional surface features can be created from existing surface features or MicroStation graphic elements. The Generate Longitudinal Feature command uses the data from a selected feature or graphic element along with input from the user to create a new surface feature. The Generate Sloped Surface command uses a selected feature or graphic element as a path that the new sloped surface will follow.

Lab: Creating a Detention Pond

Applying the above to a CDOT project model file.

3. **More Design Surface Commands - 2.5 hours**

   Driveway modeling is not generally done at the same standards as the main roadway. Typically, there is no geometry created for them and the design criteria is not as stringent. Because of this, the tools for creating roadways may not be suited for constructing a driveway surface model. However InRoads has a number of tools that can be used to create driveway and similar proposed surface models. In this section the following tools are examined:

   - Drape Surface - used to match existing surface elevations
   - Join Feature - used to create a single feature from two or more separate features
   - Fillet Feature - used to create a connecting arc feature between two features
   - Apply Template - used to drop templates without using Roadway Designer

   Lab: Constructing a Driveway

   Students will model a driveway from the proposed edge of pavement of the design corridor to the existing ground at the right-of-way line.

4. **Edit Surface Commands - 2.0 hours**

   Features used in proposed surface models can come from many sources. They can come from Roadway Designer, copied from an existing surface, imported from MicroStation graphics, or created using the design surface commands. Many of these methods will create features that are not exactly what is needed, but they are close. The tools in the Edit Surface toolbox are used to tweak these elements.

   Lab: Creating an Island

   Students will create an island with pedestrian ramps on the southeast corner of the intersection. Surface features of the island are built using various MicroStation commands and InRoads surface design and editing tools.

   - Lay out the horizontal geometry of the island
   - Identify ramp locations
   - Add elevations to the island shape
   - Create curb and ramp features

   Lab: Modeling Around Bridge Abutments

   The students will learn to use a simple slope to model around bridge abutments. In general, the student will use InRoads tools to create breaklines that define the desired surface.

   - Modeling surfaces without templates.
   - Using Surface tools can create breaklines necessary for modeling surfaces at the ends of a bridge.

DAY 2

Objective:

Basic templates were used in the ***Roadway Design Using InRoads XM*** course. While these templates are good for the majority of applications, there are circumstances where a more complex template would be more efficient. This section explores using specialized templates inside and outside of Roadway Designer.

5. **Terraced Walls - 2.5 hours**

   In this scenario, three terraced walls are to be used under the SH52 bridge over SH119. Horizontal alignments have already been defined for the three walls along with verticals for the tops of the walls. A template will be created and run along the top wall to seek the other two walls and create the slopes between them.

   Lab: Terraced Walls

6. **Widening and Overlay - 3.0 hours**

   Widening and overlay projects are an increasingly large part of the CDOT workload. This section illustrates the MicroStation and InRoads tools used for this type of project. The focus of this section is to present a workflow that can be used on similar projects. This workflow includes:

   - Create complex chains for the pavement edges from existing ground features
   - Import the chains as horizontal and vertical alignments
   - Develop a widening and overlay template
   - Define a corridor for the project
   - Setting up point controls using the imported alignments
   - Creating the proposed surface model

   Lab: Widening and Overlay

7. **Variable Median Ditch - 2.5 hours**

   When a divided highway has separate horizontal and vertical controls for each driving surface, the median can not have a fixed width. There are numerous methods to choose from when creating templates and corridors for this type of project. The method used here has two corridors, one for each driving surface. The first corridor is created with no components defining the median. The second corridor is a mirrored copy of the first, with the addition of a specialized median section that ties to the first corridor in different configurations. This section focuses on the construction of the median section of the template.

   Lab: Variable Median Ditch

DAY 3

Objective:

Continuing from Day 2, additional specialized template designs are examined and workflows for specific situations are presented.

8. **Using Walls in a Corridor Run - 2.0 hours**

   Walls are used to reduce the width of side-slopes in areas restricted by right-of-way, roads or other structures, or natural obstacles. In this section, the wall components in the standard typical library are examined with an eye towards how they can be modified for particular circumstances.

   Lab: Using Walls in a Corridor Run

9. **Create Raised Median - 3.0 hours**

   Roadways with raised medians present special challenges to the designer. The major challenge is to model the median noses at the ends of the raised median. This section describes a workflow that will build a complete proposed surface model, including the median noses, using only two templates. The workflow includes:

   - Using a single template to model the mainline with and without a median
   - Creating display rules which determine when the raised median excluded
   - Defining point controls for the location of the median nose
   - Combining multiple corridors in a single final surface

   Lab: Create Raised Median

10. **Create Ramp Model - 3.0 hours**

    The tapered single lane entrance ramp is one of the most common accesses to a freeway. In this section, the InRoads design process for creating a single lane freeway entrance ramp is explained. Modeling the infield, gore and taper area segment of the mainline are also covered. This workflow includes:

    - Revise and tie a ramp vertical alignment into the edge of lane of the mainline taper using the Vertical Gore tool
    - Create a freeway entrance ramp (tapered type) model and the infield, gore and taper area segment of the mainline model
    - Create a ramp and mainline surfaces from the Roadway Designer, display cross sections and examine the results

    Lab: Create Ramp Model

DAY 4

Objective:

End conditions are used to project design components to a specific location, or “target”. This is usually a surface, but it could be an alignment, a surface feature, or multiple surfaces. The functionality built in to end conditions lets the designer make the template look for many design considerations and situations that previously had to be examined manually. This section examines ways to make the template’s end conditions aware of these design considerations.

11. **Forcing Toes Inside of the Right-of-Way - 3.0 hours**

    There are numerous reasons why it may not be possible to acquire additional right-of-way on a project. In these situations, the end conditions must adjust to the location of the right-of-way where it is restrictive and follow the proper design criteria where it is not. This section illustrates how to modify an existing end condition section to honor both the design criteria and restrictive right-of-way.

    Lab: Forcing Toes Inside of the Right-of-Way

12. **End Conditions that Require Multiple Solutions - 2.0 hours**

    The standard end conditions do not look at some design considerations like the minimum depth of ditch. This section illustrates how end conditions can be set up to account for these design considerations by chaining multiple end conditions together, end to end.

Lab: End Conditions that Require Multiple Solutions

13. Create End Conditions to Search a Surface - 3.0 hours

Designers are not always given a complete existing ground surface that covers the full extent of their project. They may have to piece their existing surface together from multiple surveys. Other considerations along this line include stratum surfaces. This section demonstrates the ability of an end condition to target multiple surfaces, using target aliasing.

Lab: Create End Conditions to Search a Surface