myCivil Plus 2016

Intensive Training For Beginners

Road & Highway Module

Prepared and Conducted by:

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OVERVIEW

1.0 Introduction

AutoCAD Civil 3D software provides engineers and his design team with a comprehensive AutoCAD®-based package for importing and exporting data as well as wide range of site analysis tools. Using an industry-proven, dynamic engineering model, AutoCAD Civil 3D links design and production drafting, greatly reducing the time taken to implement design changes and evaluate multiple scenarios. A change made in one place instantly updates the entire project, helping you complete projects faster, smarter, and more accurately. All team members work from the same consistent, up-to-date model, so they stay synchronized throughout all project phases.

2.0 Objectives

This intensive training session is customized to meet the following objectives:-

(a) To expose AutoCAD Civil 3D & myCivil Plus technology and solutions provided by it.
(b) To synergize AutoCAD Civil 3D & myCivil Plus with current engineering workflow.
(c) To ensure end-users are able to kick-start their preliminary design using AutoCAD Civil 3D & myCivil Plus.
(d) To familiarize users on the workflow of simple road design in AutoCAD Civil 3D & myCivil Plus.

3.0 Training Content Preparation

This training should be accompanied by the following training materials:
(a) Training Courseware (this book).
(b) Training Datasets (one piece DVD) which includes various drawings and data for each exercise.

CHAPTER 1 : INTRODUCTION TO AutoCAD Civil 3D and myCivil Plus

1.1 AutoCAD Civil 3D Interface and Commands

The user interface of AutoCAD Civil 3D offers a window-based, easy to use and configurable environment. There are sets of ribbon menus, toolbars, and palettes that are grouped and organized so that users can create a custom, task-oriented design environment.

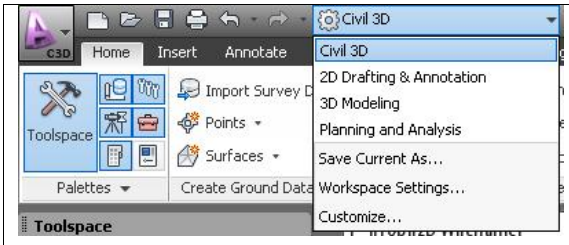


Figure 1.1 : Workspace menu drop-down

Use "**Workspace**" to quickly change the interface of AutoCAD Civil 3D (Figure 1.1). The application offers a set of pre-defined workspaces that break down the user interface into typical design tasks. We can quickly switch between these workspaces to have an environment that is tailored for a certain task or workflow, such as planning & analysis, 2D drafting and annotation.

In the example on the left, you can switch the interface to "2D Drafting & Annotation" if you require to work in regular AutoCAD interface.

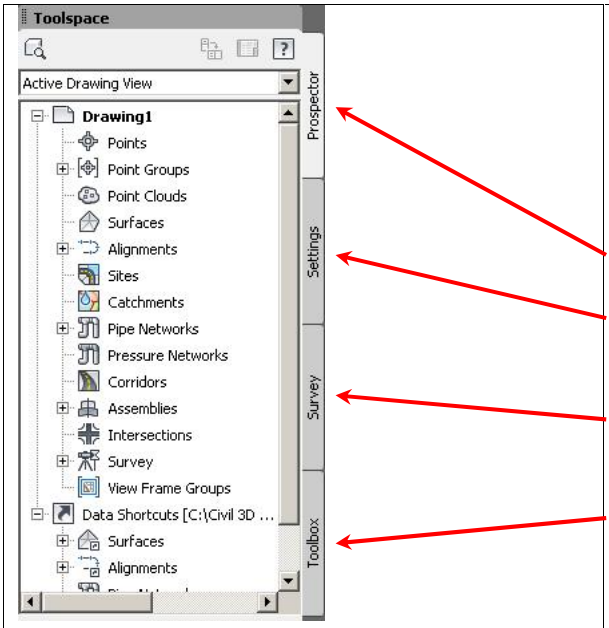


Figure 1.2 : Toolspace panel

"**Toolspace**" (Figure 1.2).

To activate, Home tab > Toolspace

The Toolspace has several tabs; *Prospector, Settings, Survey and Toolbox.*

Prospector : to manage project and drawing objects.

Settings : to manage styles for AutoCAD Civil 3D objects and to control settings for drawings and commands.

Survey : to manage survey and system settings as well as survey data.

Toolbox : to access the Reports Manager and to add custom tools.

Another important component of the AutoCAD Civil 3D user interface are ribbon tabs and toolbars (Figure 1.3). AutoCAD Civil 3D offers a ribbon menu for each object that can be created. It also offers consistent set of toolbars for the layout and editing objects.

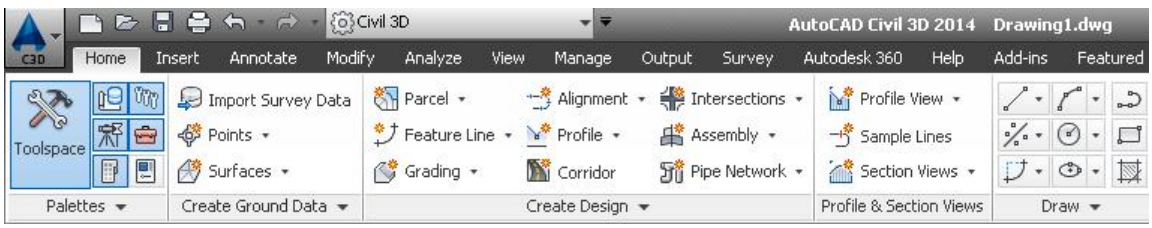


Figure 1.3 : AutoCAD Civil 3D Ribbon Menus and Toolbars

1.2 myCivil Plus Template

When you first launch AutoCAD Civil 3D, it always define the new drawing by using the *"_AutoCAD Civil 3D (Metric) NCS.dwt"* template. There is not much stylization in the default *"_AutoCAD Civil 3D (Metric) NCS.dwt"* template.

In order to get more efficient analysis, design and stylization settings, based on local standard, please install myCivil Plus template included in this manual.

1.2.1 myCivil Plus Installation Guide

This section provides step-by-step procedures to install the myCivil Plus on top of AutoCAD Civil 3D Standalone license. This document is also applicable to the Clients/Workstations in a Network license environment.

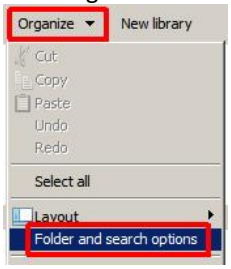
The installation procedures are divided into four (4) stages:

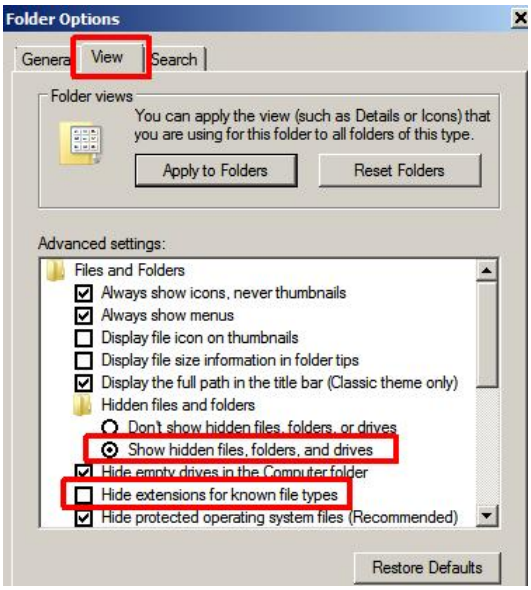
- Stage 1 : Showing Windows Explorer hidden folders and file extensions.
- Stage 2 : Installing the C3D DWT file.
- Stage 3 : Installing the Design Criteria Standards.
- Stage 4 : Installing the Cassini Projection Coordinate Systems.

PRE-REQUISITES BEFORE INSTALLATION:

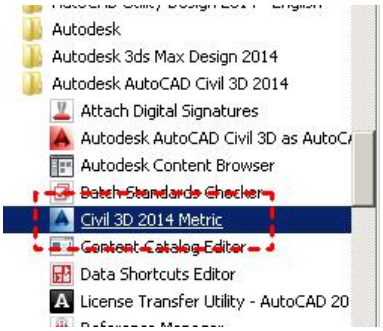
- Ensure you have login as the **Administrator** or login as Power Users privileges.
- The steps in this documentation are targeted for Windows 7 operating system and its variants. Windows XP and 8 operating systems may have different interfaces but the procedures are similar to the Windows 7.
- RC = "Right-Click" mouse.

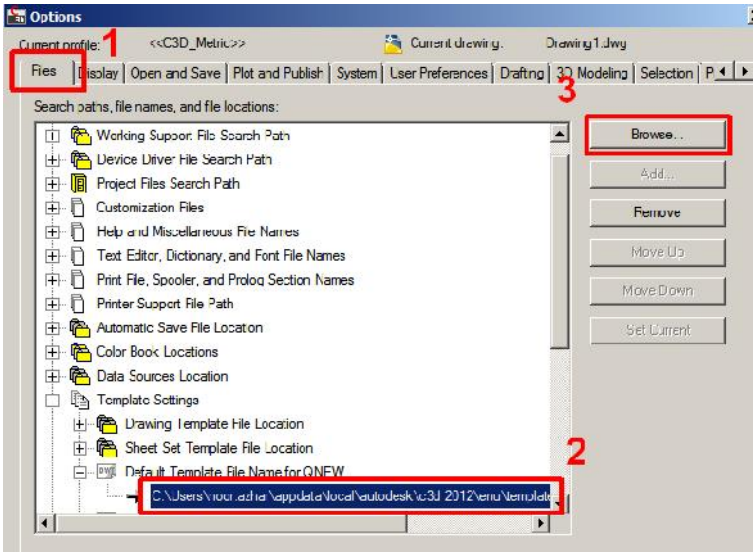
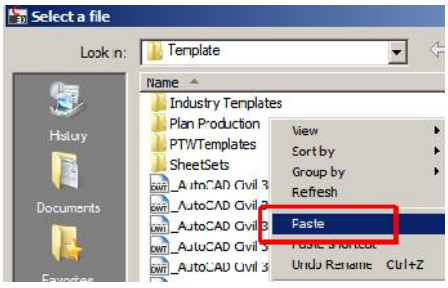
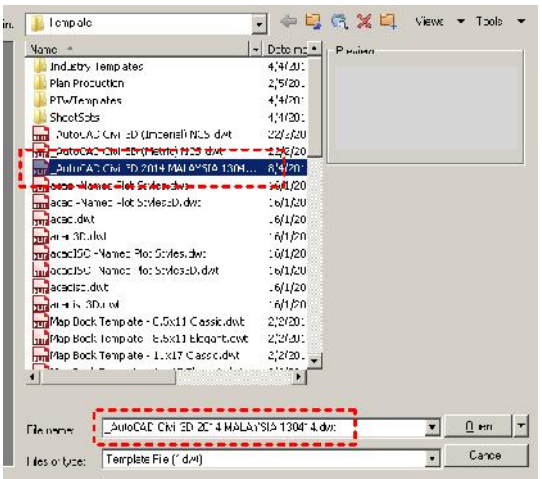
STAGE 1 : SHOWING WINDOWS EXPLORER HIDDEN FOLDERS AND FILE EXTENSIONS.

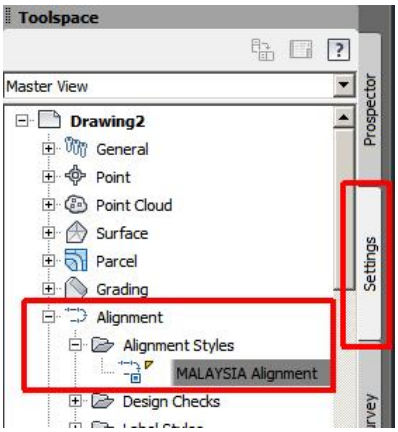
No.	Descriptions	Commands/Remarks
1.1	Launch "Windows Explorer".	RC "Start" > Open Windows Explorer  Or, press "Windows + E" keyboard to launch Windows Explorer.
1.2	Goto Folder Options.	Click Organize > Folder and search options  Note : For Windows XP, goto Tools > Folder Options...

1.3	Activate the settings as highlighted.	Goto "View" tab and change the settings as highlighted below.  Click "OK" to close the Folder Options dialog box.

STAGE 2 : INSTALLING THE C3D DWT FILE.

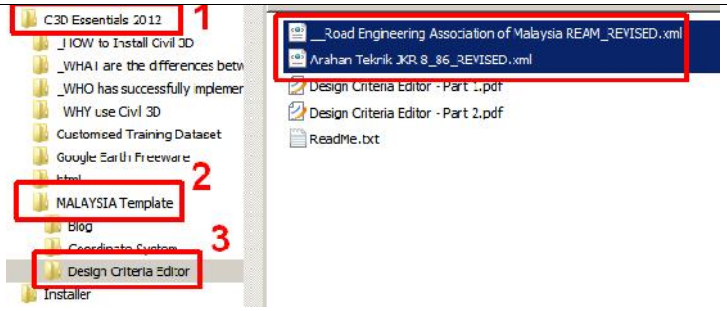
No.	Descriptions	Commands/Remarks
2.1	Copy the Malaysian Template from the CD directory. ***Please note that the "_AutoCAD Civil 3D 20xx MALAYSIA yymmdd.dwt" template is developed as per intended. Any values presented in this template must be verified.***	While still in the Windows Explorer application, goto the CD directory at "**../C3D Essentials 20*xx*/MALAYSIA Template/**". **Copy** the filename "**_AutoCAD Civil 3D 20*xx* MALAYSIA *yymmdd*.dwt**". Note : *xx* = the version of myCivil Plus release. *yymmdd* = the version of the Malaysian Template in year-month-day format.
2.2	Launch "AutoCAD Civil 3D 20xx Metric".	"Start" > All programs > Autodesk > AutoCAD Civil 3D 20xx Metric.  **Note : Ensure to launch the "Metric" version as the units will be in "meter".** The "Imperial" version will be having units in "feet" and "inches".

2.3	Launch "Options" dialog box.	RC on the drawing area > Options...
2.4	Change the QNEW file.	Goto "Files" tab > Template Settings > Default Template File Name for QNEW > highlight the file path > "Browse..." button. 
2.5	Paste the template in the AutoCAD Civil 3D template directory.	RC anywhere in the list > Paste 
2.6	Assigning the template.	Highlight the pasted DWT file > Open 

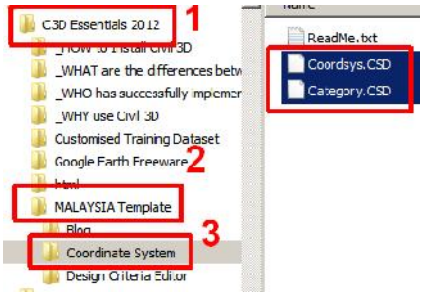
2.7	Verifying the QNEW template has been successfully assigned.	Ensure the QNEW directory is referring to ".._Autocad Civil 3D 20xx malaysia yymmdd.dwt"  Click "OK" to apply the settings.
2.8	Close AutoCAD Civil 3D 20xx application.	
2.9	Re-launch AutoCAD Civil 3D 20xx **Metric**.	• If required, click "Enable Macros" to accept macros running in the application. • If required, click "OK" to accept additional language dialog.
2.10	Double check the template has been applied appropriately.	Once the blank drawing is opened, goto "Settings" tab > Alignment > Alignment Styles  You should be able to see "MALAYSIA Alignment" style as depicted above. If you do not see them, please repeat steps 2.1 previously.

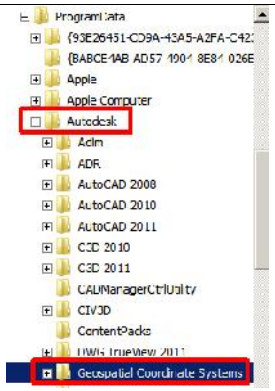
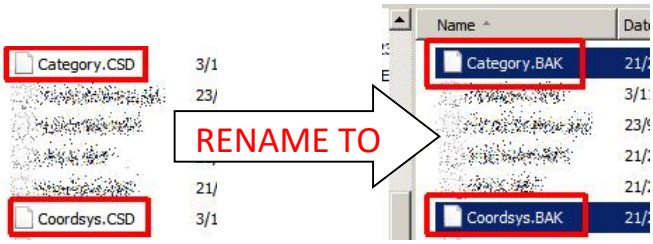
STAGE 3 : INSTALLING THE DESIGN CRITERIA STANDARDS.

No.	Descriptions	Commands/Remarks
3.1	Copy the Design Criteria Standards from the CD directory.	Launch back the Windows Explorer application, goto the CD directory at "**../C3D Essentials 20xx/MALAYSIA Template/Design Criteria Editor**". **Copy** filenames "**__Road Engineering Association of Malaysia REAM_REVISED.xml**" and "**Arahan Teknik JKR 8_86_REVISED.xml**" as depicted below.

		
3.2	Pasting the XML files.	Still in the Windows Explorer, **paste** both XML files into the following directory: For **Windows XP**, C:\ Documents and Settings \ All Users \ Application Data \ Autodesk \ C3D 20xx \ enu \ Data \ Corridor Design Standards \ Metric For **Windows 7/8**, C:\ ProgramData \ Autodesk \ C3D 20xx \ enu \ Data \ Corridor Design Standards \ Metric

STAGE 4 : INSTALLING THE CASSINI PROJECTION COORDINATE SYSTEMS.

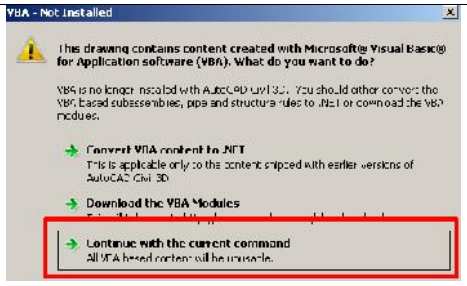
No.	Descriptions	Commands/Remarks
4.1	Copy the coordinate system files from the CD directory.	Launch back the Windows Explorer application, goto the CD directory at "**../C3D Essentials 20xx/MALAYSIA Template/Coordinate System**". **Copy** filenames "**Category.CSD**" and "**Coordsys.CSD**" as depicted below. 
4.2	Back-up the default Coordinate System files.	For **Windows XP**, browse to: C:\ Documents and Settings \ All Users \ Application Data \ Autodesk \ Geospatial Coordinate Systems For **Windows 7/8**, browse to C:\ ProgramData \ Autodesk \ Geospatial Coordinate Systems

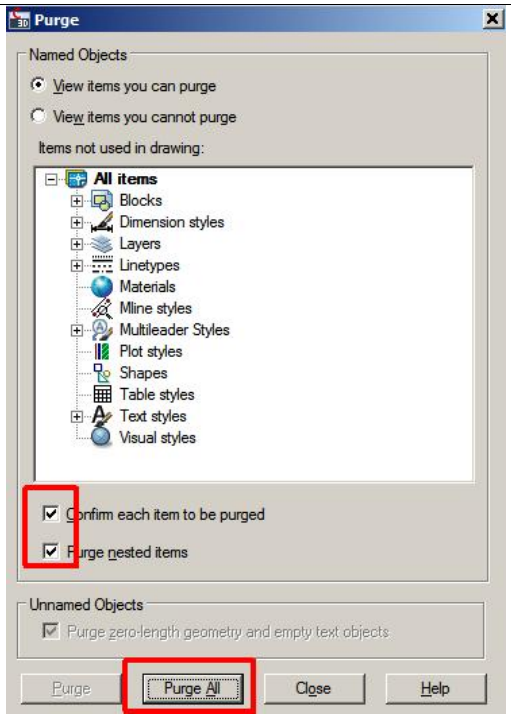
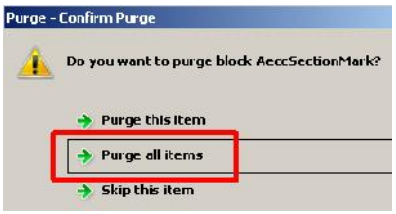
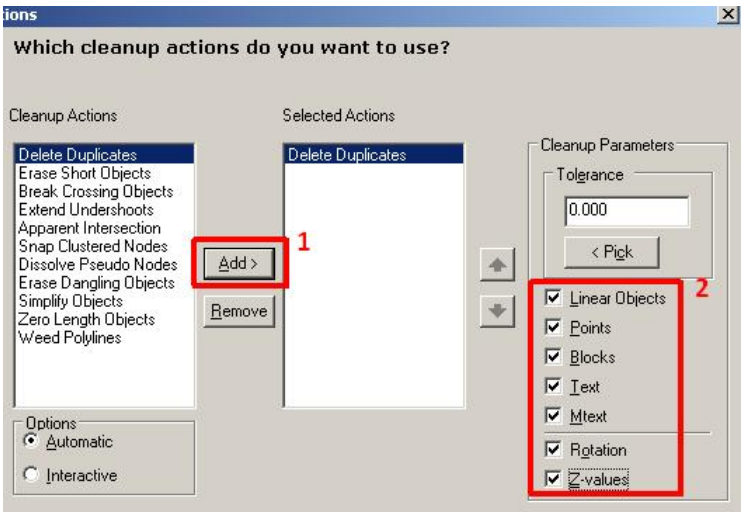
		
4.3	Rename the default Coordinate System files to .BAK file.	Rename both file extensions **from** .CSD **to** .BAK as depicted below. 
4.4	Pasting the new Coordinate System files.	Right-Click on the "Geospatial Coordinate Systems" folder > Paste 
4.5	Close myCivil Plus application and re-launch to begin your project.	

That's all. You have now configured myCivil Plus running on top of AutoCAD Civil 3D application. Enjoy the power of myCivil Plus.

CHAPTER 2 : CLEAN-UP THE SURVEY DRAWINGS

Everytime we receive any drawings from any parties, we have to clean-up these drawings before inserting them into myCivil Plus. This will ensure the drawings are free from malicious and erroneous data that can affect myCivil Plus performance.

No.	Descriptions	Commands/Remarks
1.	Open the survey / architect drawing.	 Browse to filename “01 Proposed Highway 2013_START.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Check the drawing unit and scale.	Randomly check the drawing values (e.g. bearing-distance; drainage width, road width, etc.) so that they are in the correct unit and scale. myCivil Plus ONLY works in metric unit (i.e. all drawing objects must be in “meters”). Use the AutoCAD “DISTANCE” (e.g. “DI”) command to check the unit of the objects. If the drawing is not in “meters” unit, please consult your drafting department on how to convert the drawing appropriately.
4.	Refresh opened drawing.	“REA”
5.	Turn on/thaw/unlock all layers.	“LA”. Ensure all layers are turn on, thaw and unlock.
6.	Zoom Extents.	“ZE”. Remove any erroneous data.
7.	Remove unwanted AutoCAD entities.	“PU” > “Purge All” > “Purge All Items”

		 
8.	Remove unwanted hidden AutoCAD entities.	"-PU" > "Regapps" • Enter name(s) to purge = * • Verify each name to be purged? = N
9.	Advanced drawing clean-up.	"mapclean" > "Next"  Hit "Next" > "Finish"

10.	Refresh drawing.	"REA"
11.	Saving the cleaned drawing.	"Save As". Filename = "*02 Proposed Highway 2013_CLEANED.dwg*" If you received pre-com/architect plan separately, please repeat step 1-8 above.
12.	Close myCivil Plus application.	

CHAPTER 3 : CREATING EXISTING/ORIGINAL GROUND SURFACE

There are three (3) methods to create Original Ground Level (OGL) surface, namely:

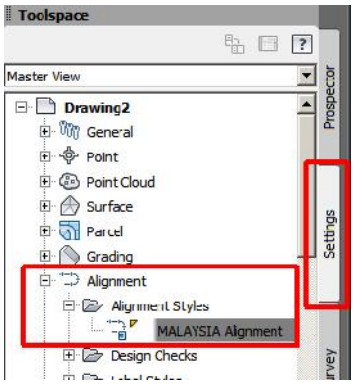
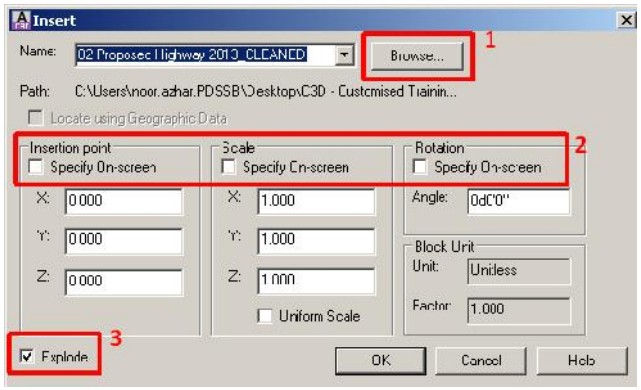
i. OGL from AutoCAD TEXTS
ii. OGL from AutoCAD POINTS
iii. OGL from AutoCAD COUNTOUR LINES (Recommended)

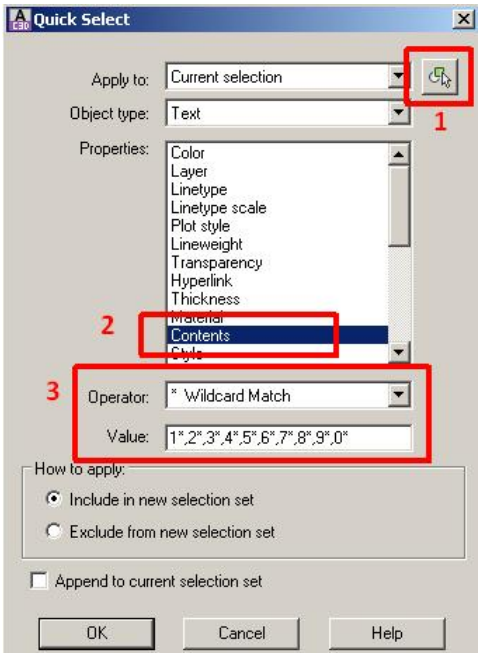
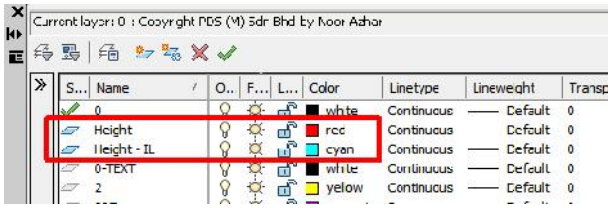
Users have to choose one from the above. The most accurate surface is generated from COUNTOUR LINES, followed by AutoCAD POINTS and the least accurate will be from AutoCAD TEXTS. The selection between the three above is depending on what information is embedded into the Survey drawing and whether these data can be processed directly or indirectly.

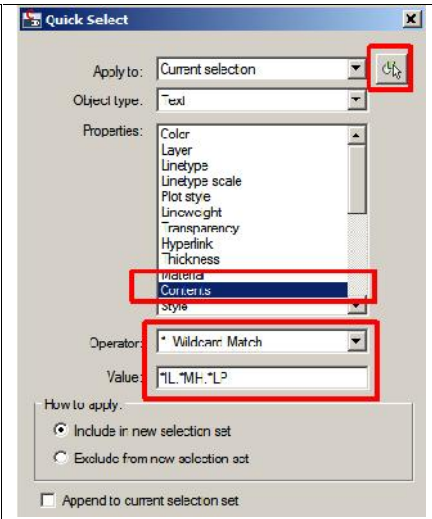
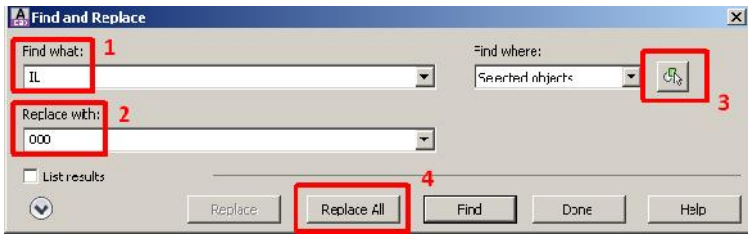
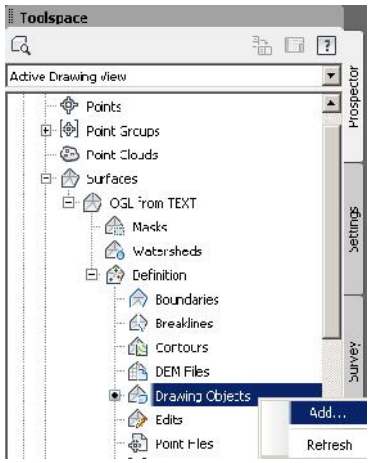
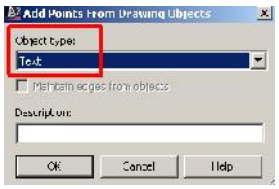
Alternatively, the OGL Surface can be generated from ASCII text file. The text file contains Easting, Northing and Elevations of all the points. Refer to "*C3D10 - Generic Demo.avi*" video for more details.

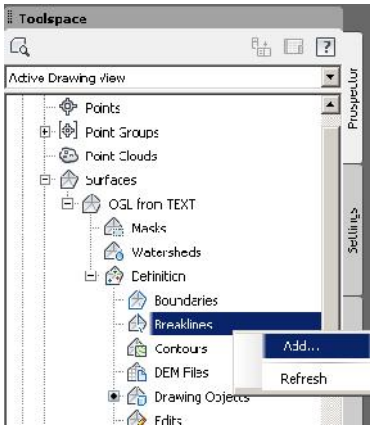
myCivil Plus can also convert GIS (e.g. MapInfo tab file, etc.) and GPS (e.g. Garmin ASCII text file, etc.) data to create OGL surface. Refer to "*GIS to DWG.avi*" video for more details.

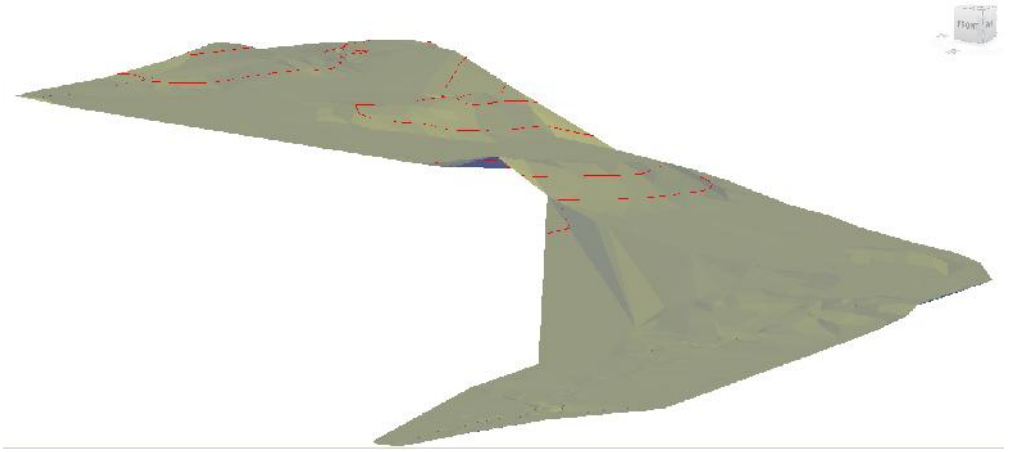
3.1 Creating OGL Surface from AutoCAD TEXTS (OPTION 1)

No.	Descriptions	Commands/Remarks
1.	Launch AutoCAD Civil 3D Metric and ensure the Malaysia Template is applied.	"Settings" tab > Alignment > Alignment Styles  If the settings above is not available, please refer to CHAPTER 1 – Section 1.2.1 "**mycivil Plus Installation Guide**"
2.	Insert the cleaned survey / architect drawings.	Type "Insert" in command line > browse to the CLEANED drawing. 

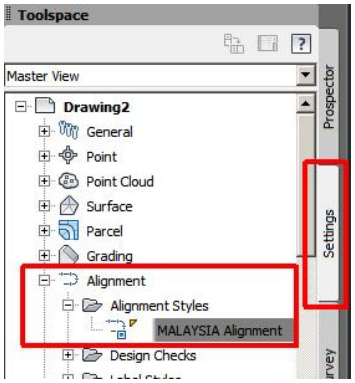
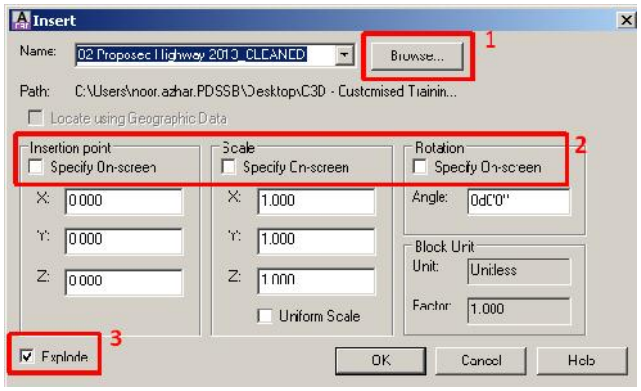
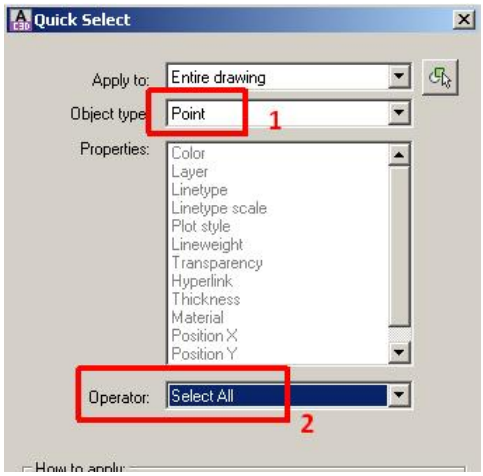
3.	"Zoom Extents" and refresh the inserted drawing.	"ZE" & "RE".
4.	Displaying only survey spot levels.	Select any spot level text > RC > "Select similar" > RC > "Isolate Objects" > "Isolate Selected Objects".
5.	Filtering only numerical text points (eg. Ground elevations, invert levels, manholes depth, etc.)	RC > "Quick Select"  RC > "Isolate Objects" > "Isolate Selected Objects"
6.	Creating two new layers; ie. "HEIGHT" & "HEIGHT-IL". *Note : This step is OPTIONAL*.	"LA" 
7.	Assigning layer to elevations. *Note : This step is OPTIONAL*	• Select all text points. • Change layer name to "HEIGHT".
8.	Selecting miscellaneous elevations (eg. invert levels, manholes depth, etc.) *Note : This step is OPTIONAL*	• RC > "Quick Select".

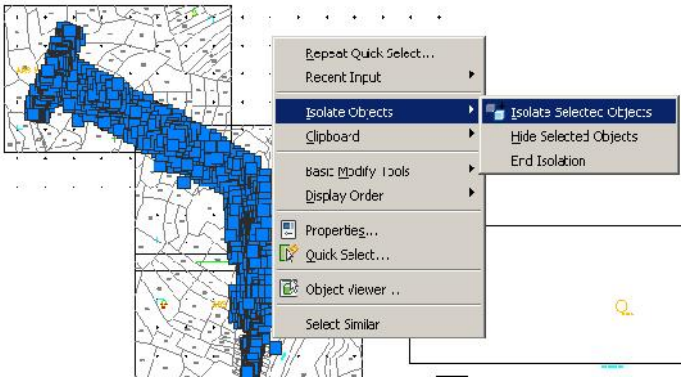
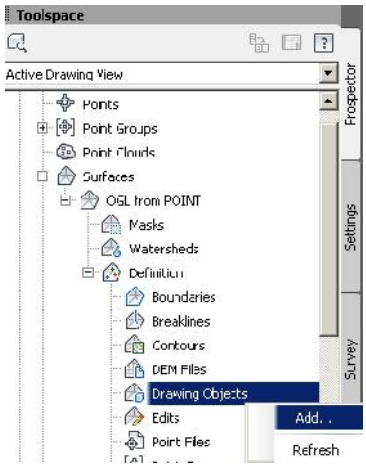
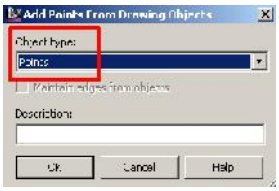
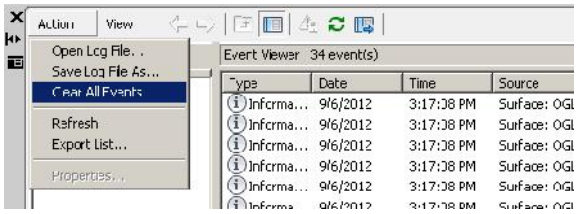
		 • Change the selected text object layer name to “HEIGHT-IL”.
9.	Find and Replace “IL” with number “000”. *Note : This step is OPTIONAL*	RC > “Find…”  Click “Replace All”. You may need to repeat these steps for "MH", "LP", etc. separately.
10.	Converting 2D text points to 3D text points.	“Modify” tab > “Surface” > “Surface Tools” > “Move Text to Elevation” > select all 3D text points > ENTER.
11.	Creating Original Ground Level (aka OGL) surface.	• Prospector > RC “Surfaces” > “Create Surface…” • Name = “OGL from TEXT” • Leave other default values > OK
12.	Prospector tab > OGL from TEXT > Definition > RC “Drawing Objects” > Add...  >  > Select all 3D text points > ENTER	

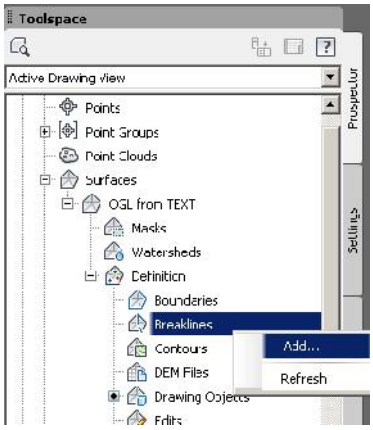
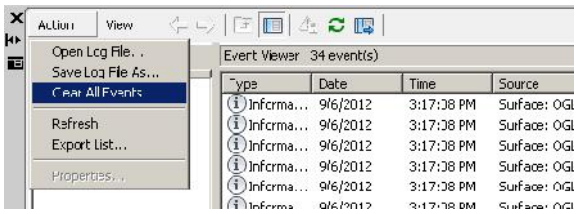
13.	Refresh drawing.	"REA"
14.	Viewing OGL surface in 3D mode.	Select the surface contours > RC > "Object Viewer"
15.	If in 3D viewing mode, the model is completed without erroneous data, proceed to next step. Else, investigate the erroneous data and rectify them.	
16.	Ending the isolate object mode.	RC > "Isolate Objects" > "End Object Isolation"
17.	Zoom Extents & Refresh drawing.	• "ZE" • "REA"
18.	Saving drawing.	"Save As" filename "*03 Proposed Highway 2013_OGL from TEXT.dwg*"
19.	Improving the OGL surface to emphasize existing culverts, berms, monsoon drain, etc.	In the drawing area, select any culvert line > RC > Select similar
20.	Adding breaklines to the OGL surface.	Prospector tab > Surfaces > OGL from TEXT > Definition > RC Breaklines > Add... 
21.	Assigning Proximity Breaklines.	Change the Breaklines type to "Proximity" > OK. 
22.	Viewing OGL surface in 3D mode.	Select the surface contours > RC > "Object Viewer"
23.	If in 3D viewing mode, the model is completed without erroneous data, proceed to save the drawing. Else, investigate the erroneous data and rectify them.	

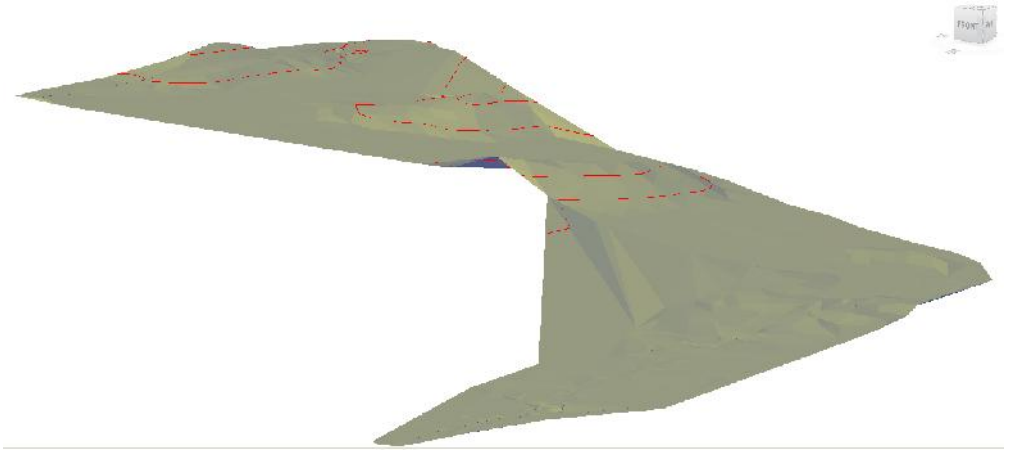
		
24.	Saving drawing.	“Save”.
25.	Close the drawing and application.	

3.2 Creating OGL Surface from AutoCAD POINTS (OPTION 2)

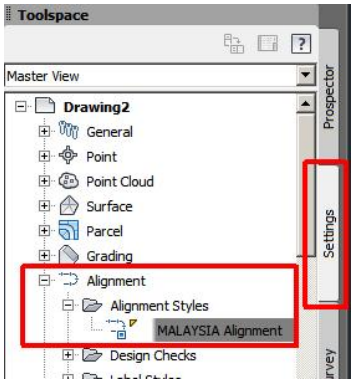
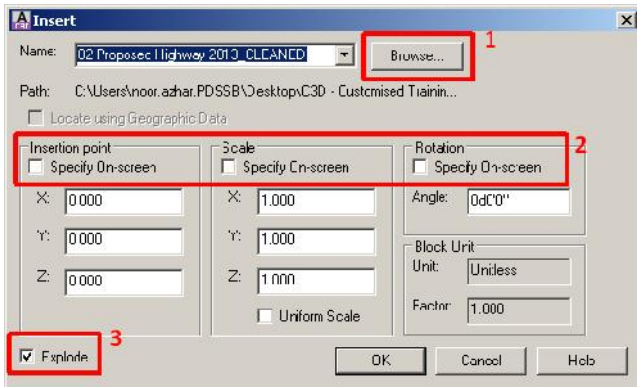
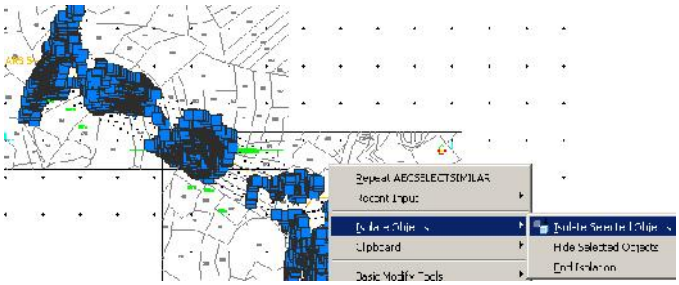
No.	Descriptions	Commands/Remarks
1.	Launch AutoCAD Civil 3D Metric and ensure the Malaysia Template is applied.	"Settings" tab > Alignment > Alignment Styles  If the settings above is not available, please refer to CHAPTER 1 – Section 1.2.1 "**myCivil Plus Installation Guide**"
2.	Insert the cleaned survey / architect drawings.	Type "Insert" in command line > browse to the CLEANED drawing. 
3.	"Zoom Extents" and refresh the inserted drawing.	"ZE" & "RE".
4.	Selecting all AutoCAD points.	RC > "Quick Select". 

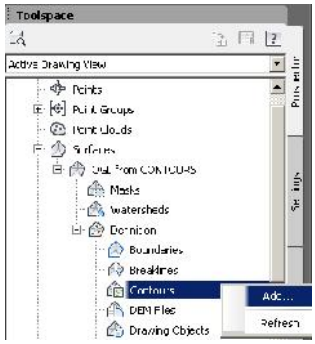
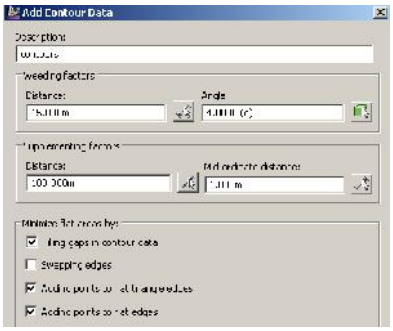
5.	Displaying only survey spot levels.	While all the points are selected > RC > "Select similar" > RC > "Isolate Objects" > "Isolate Selected Objects". 
6.	Creating Original Ground Level (aka OGL) surface.	• Prospector > RC "Surfaces" > "Create Surface…" • Name = "OGL from POINT" • Leave other default values > OK
7.	Prospector tab > OGL from POINT > Definition > RC "Drawing Objects" > Add...  >  > Select all points > ENTER	
8.	Clean the progress report.	Action > Clear All Events > Close 
9.	Refresh drawing.	"REA"
10.	Viewing OGL surface in 3D mode.	Select the surface contours > RC > "Object Viewer"
11.	If in 3D viewing mode, the model is completed without erroneous data, proceed to next step. Else, investigate the erroneous data and rectify them.	
12.	Ending the isolate object mode.	RC > "Isolate Objects" > "End Object Isolation"

13.	Zoom Extents & Refresh drawing.	• "ZE" • "REA"
14.	Saving drawing.	"Save As" filename *"03 Proposed Highway 2013_OGL from POINT.dwg"*
15.	Improving the OGL surface to emphasize existing culverts, berms, monsoon drain, etc.	In the drawing area, select any culvert line > RC > Select similar
16.	Adding breaklines to the OGL surface.	Prospector tab > Surfaces > OGL from TEXT > Definition > RC Breaklines > Add... 
17.	Assigning Proximity Breaklines.	Change the Breaklines type to "Proximity" > OK. 
18.	Clean the progress report.	Action > Clear All Events > Close 
19.	Viewing OGL surface in 3D mode.	Select the surface contours > RC > "Object Viewer"
20.	If in 3D viewing mode, the model is completed without erroneous data, proceed to save the drawing. Else, investigate the erroneous data and rectify them.	

		
21.	Saving drawing.	“Save”.
22.	Close the drawing and application.	

3.3 Creating OGL Surface from COUNTOUR LINES (OPTION 3)

No.	Descriptions	Commands/Remarks
1.	Launch AutoCAD Civil 3D Metric and ensure the Malaysia Template is applied.	"Settings" tab > Alignment > Alignment Styles  If the settings above is not available, please refer to CHAPTER 1 – Section 1.2.1 "**mycivil Plus Installation Guide**"
2.	Insert the cleaned survey / architect drawings.	Type "Insert" in command line > browse to the CLEANED drawing. 
3.	"Zoom Extents" & refresh the inserted drawing.	"ZE" & "RE".
4.	Select all contour lines.	Select any AutoCAD contours > RC > "Select similar" > RC > "Isolate Objects" > "Isolate Selected Objects". 
5.	Creating Original Ground Level (aka OGL) surface.	• Prospector > RC "Surfaces" > "Create Surface…" • Name = "OGL from CONTOUR" • Leave other default values > OK
6.	Prospector tab > OGL from CONTOUR > Definition > RC "Contours" > Add...	

	 >  > Select all contours > ENTER	
7.	Clean the progress report.	Action > Clear All Events > Close 
8.	Refresh drawing.	"REA"
9.	Viewing OGL surface in 3D mode.	Select the surface contours > RC > "Object Viewer"
10.	If in 3D viewing mode, the model is completed without erroneous data, proceed to next step. Else, investigate the erroneous data and rectify them.	
11.	Ending the isolate object mode.	RC > "Isolate Objects" > "End Object Isolation"
12.	Zoom Extents & Refresh drawing.	• "ZE" • "REA"
13.	Saving drawing.	"Save As" filename "*03 Proposed Highway 2013_OGL from CONTOUR.dwg*"
14.	Close the drawing and application.	

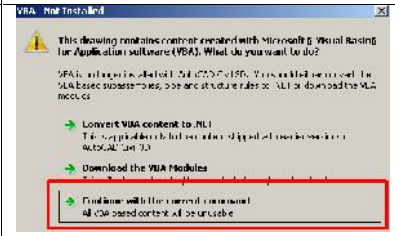
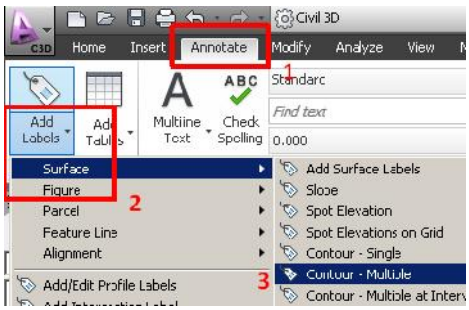
All three surfaces have been created in separate drawings. We shall continue with filename "*03 Proposed Highway 2013_OGL from POINT.dwg*" because the provided contour lines are not covering the whole corridor properly.

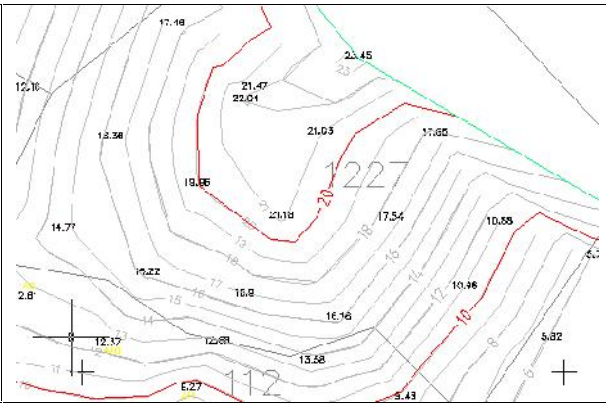
CHAPTER 4 : myCIVIL PLUS ANALYSIS

Once we have created the OGL surface, we shall investigate the site for drainage planning and allocating proposed alignments.

myCivil Plus comes with pre-defined analysis functions. The analyses included are contours, directions, elevations, slopes, slope-arrows, user-defined contours, watersheds and water drops.

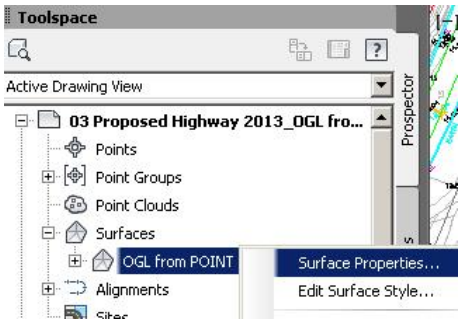
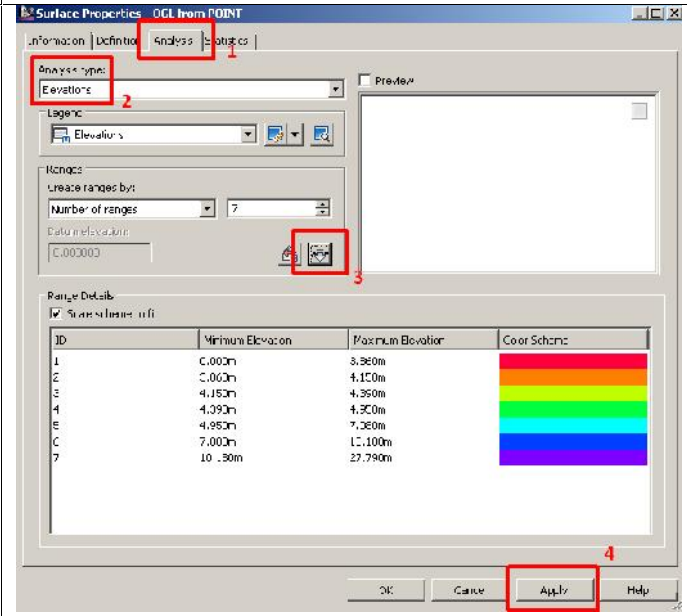
4.1 Contour Labeling

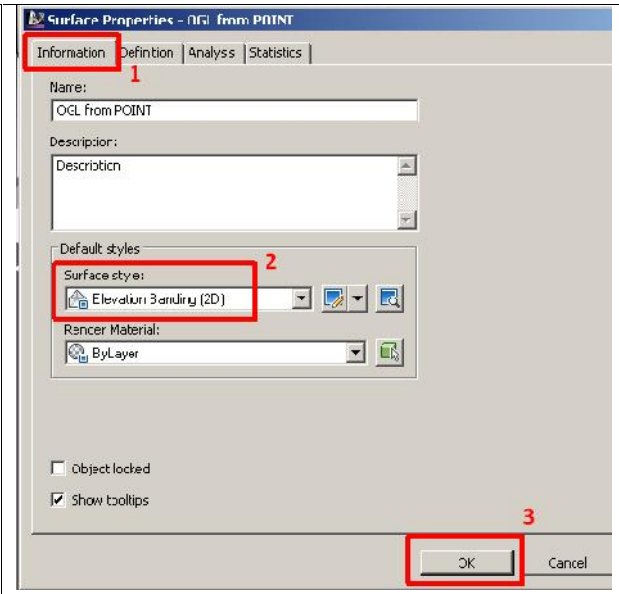
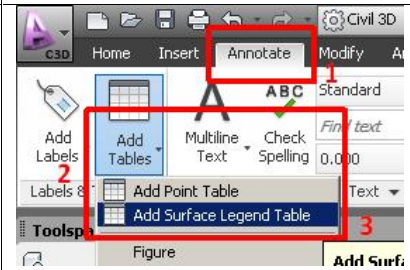
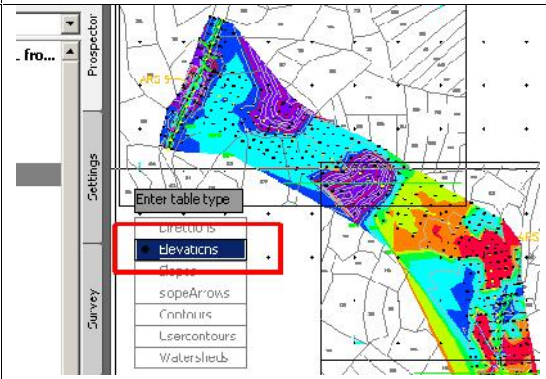
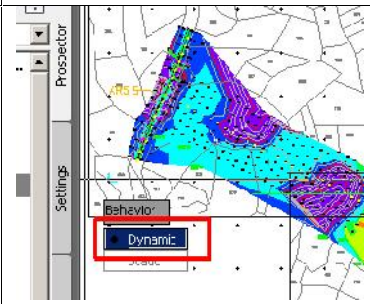
No.	Descriptions	Commands/Remarks
1.	Open the OGL Surface drawing.	 Browse to filename "03 Proposed Highway 2013_OGL from POINT.dwg"
2.	Ignore "VBA – Not Installed" message. Select "Continue with the current command".	
3.	Check the drawing unit and scale.	Randomly check the drawing values (e.g. bearing-distance; drainage width, road width, etc.) so that they are in the correct unit and scale. myCivil Plus ONLY works in metric unit (i.e. all drawing objects must be in "meters"). Use the AutoCAD "DISTANCE" (e.g. "DI") command to check the unit of the objects. If the drawing is not in "meters" unit, please consult your drafting department on how to convert the drawing appropriately.
4.	Labeling the contour lines.	Annotate tab > Add Labels > Surface > Contour - Multiple 
5.	Placing the label on the drawing.	Ensure OSNAP is off. Click any two points crossing the OGL surface contours.

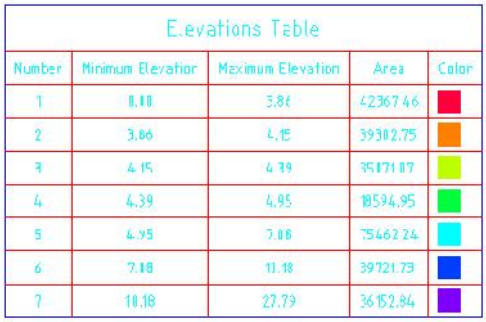
		

4.2 Elevation Analysis

Usage : To determine the different height/elevation in the project area.

No.	Descriptions	Commands/Remarks
1.	Goto OGL Surface Properties.	+Surfaces > RC "OGL from POINT" > Surface Properties... 
2.	Running and applying the Elevation analysis onto OGL surface. Note : • Double-Click (DC) to change the values for Minimum Elevation and Maximum Elevation. • DC to change the Color Scheme.	

3.	Applying the Elevation Banding (2D) styles	
4.	Generating the Legend of Elevation Analysis.	
5.	Put the mouse cursor in the drawing & select “Elevations”.	
6.	Select “Dynamic” behavior.	

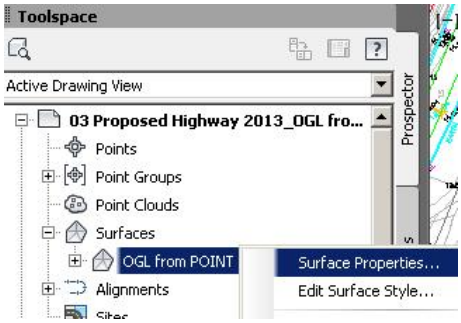
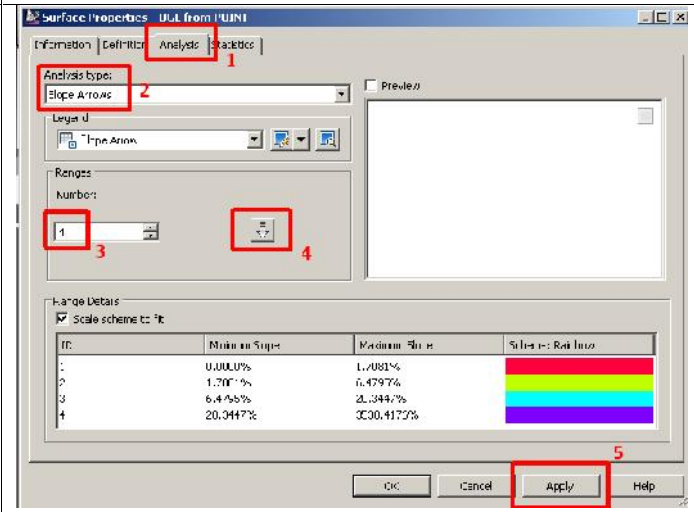
7.	Click at any empty space in the drawing.	

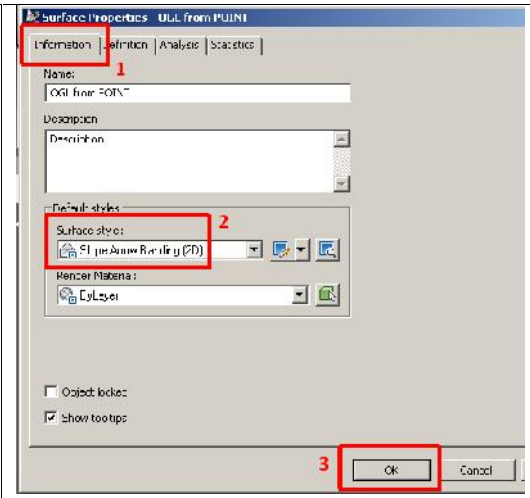
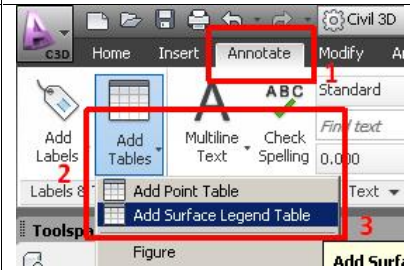
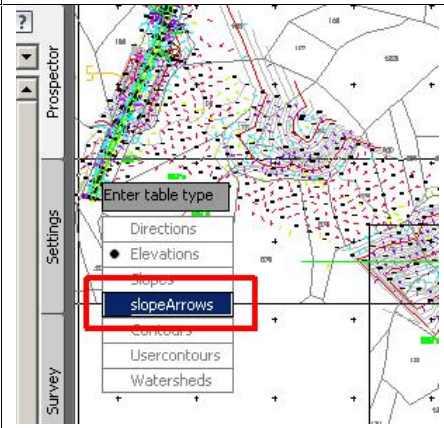
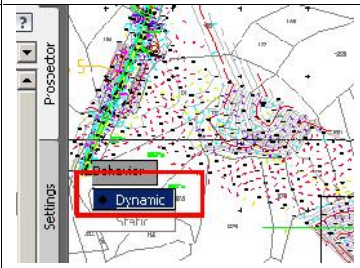
Elevations Table

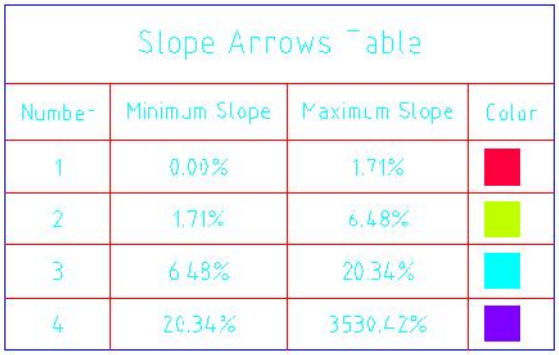
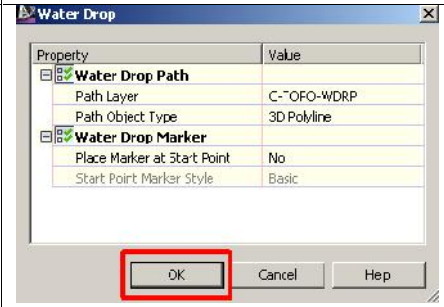
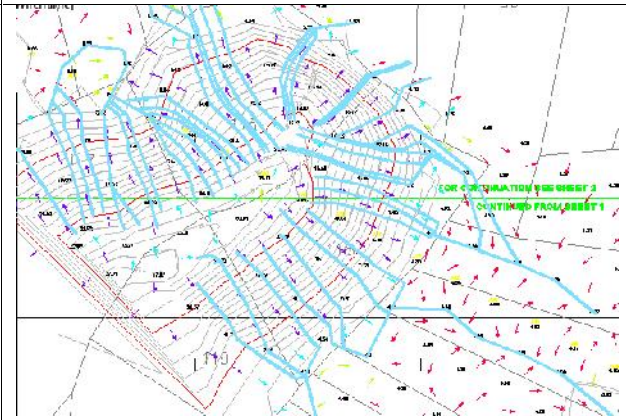
Number	Minimum Elevation	Maximum Elevation	Area	Color
1	0.00	3.86	42367.46	
2	3.86	4.15	39302.75	
3	4.15	4.39	35171.07	
4	4.39	4.95	18594.95	
5	4.95	7.08	75462.24	
6	7.08	10.18	39721.73	
7	10.18	27.79	36152.84	

4.3 Slope Arrows Analysis

Usage : To determine the natural/gravitational flow of surface runoff.

No.	Descriptions	Commands/Remarks
1.	Goto OGL Surface Properties.	+Surfaces > RC "OGL from POINT" > Surface Properties... 
2.	Running and applying the Slope Arrows analysis onto OGL surface. Note : • Double-Click (DC) to change the values for Minimum Slope and Maximum Slope. • DC to change the Color Scheme.	

3.	Applying the Slope Arrow Banding (2D) styles	
4.	Generating the Legend of Slope Arrow Analysis.	
5.	Put the mouse cursor in the drawing & select “slopeArrows”.	
6.	Select “Dynamic” behavior.	

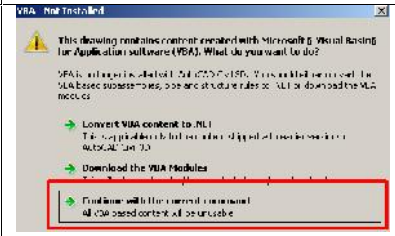
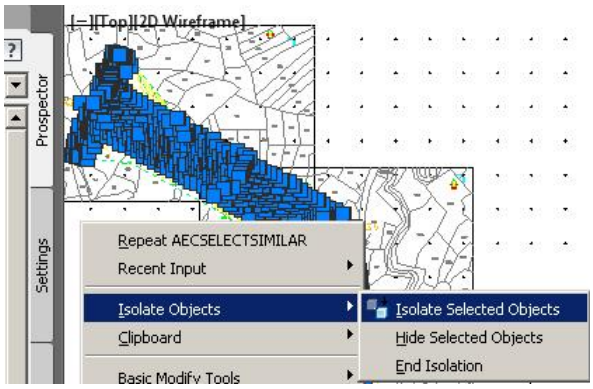
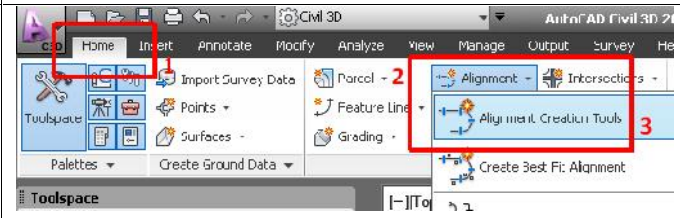
7.	Click at any empty space in the drawing.	
8.	Regenerate the drawing.	"REA"
9.	Perform Water Drop analysis. (Optional).	
10.	Select "OK".	
11.	Click continuously at any high points / peak of any hills/mountains. Note: If the Water Drop lines do not appear, run "REA" command.	
12.	The Water Drop Analysis explains the potential water/surface run-off path for that particular surface. Hence, we can estimate the potential water collection point for that surface/site.	
13.	Zoom Extents & Refresh drawing.	• "ZE" • "REA"
14.	Saving drawing.	"Save As" filename "*04 Proposed Highway 2013_Analysis.dwg*".
15.	Close the drawing and application.	

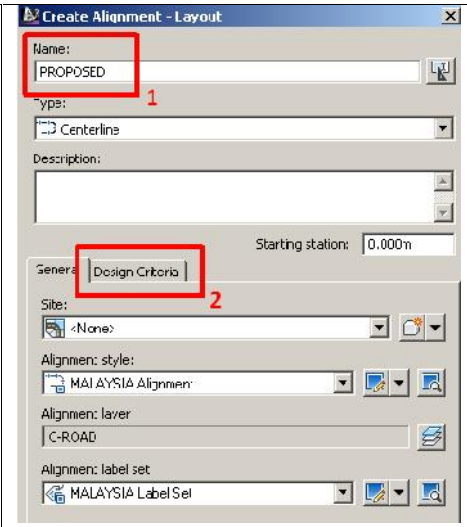
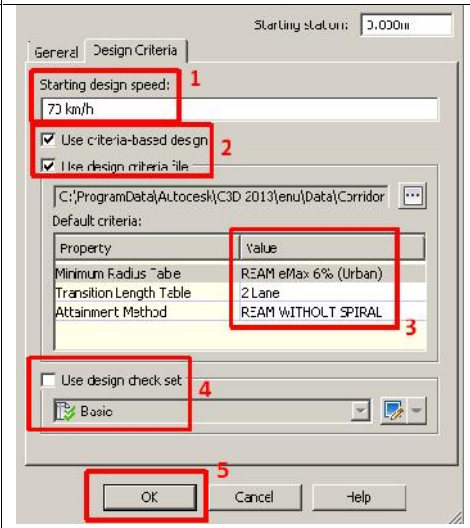
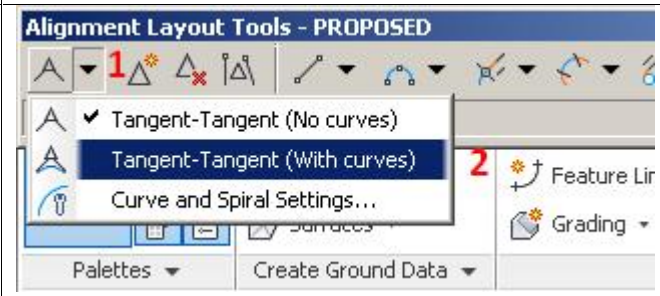
CHAPTER 5 : ALIGNMENT DESIGN

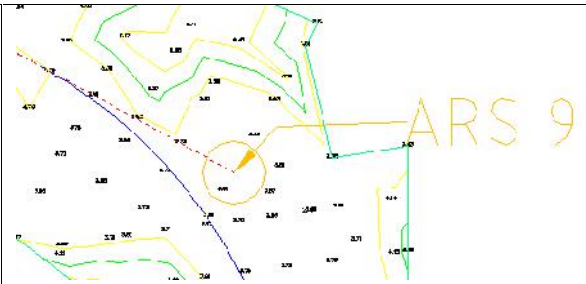
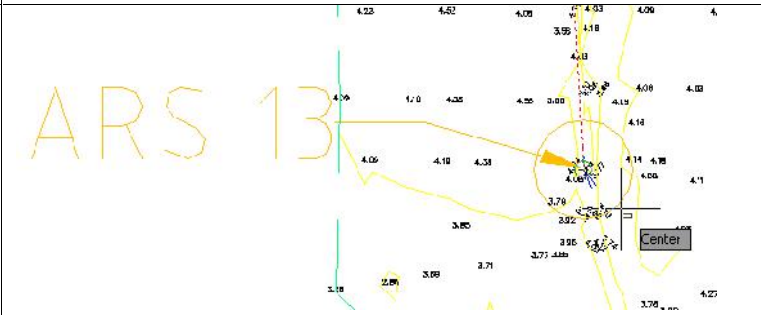
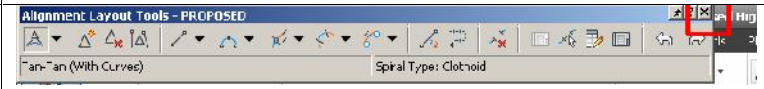
This chapter will demonstrate step-by-step approach to :

- Creating Horizontal Alignment
- Editing Horizontal Alignment
- Labelling Alignment Control Plan

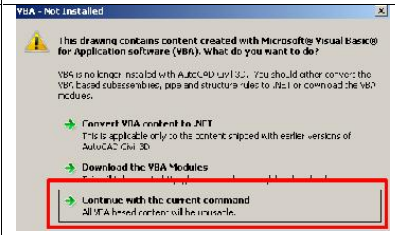
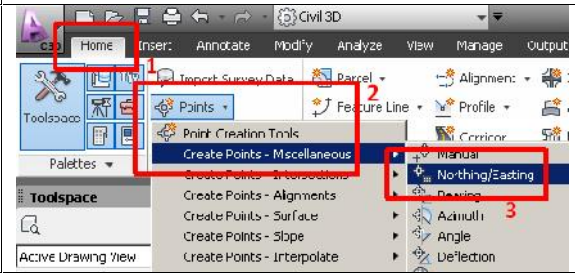
5.1 Creating Horizontal Alignment

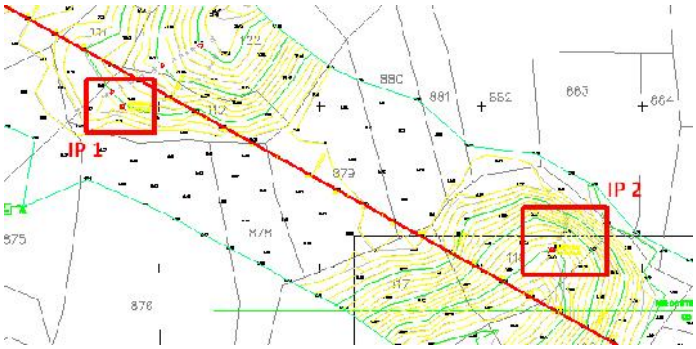
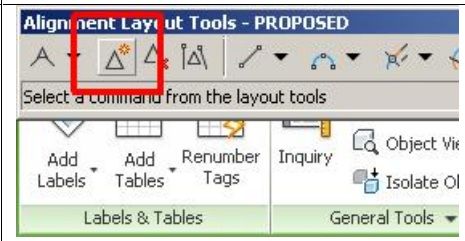
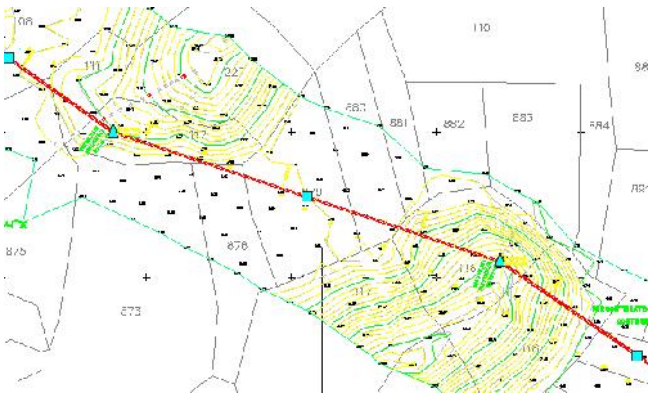
No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename “05 Proposed Highway 2013_Alignment.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Simplify the model space.	Select the following objects in the drawing area: • OGL Surface, • ARS 5 text, leader line and circle indicator. • Any spot level text.
4.	Isolate the objects.	RC > Select Similar > RC > Isolate Objects > Isolate Selected Objects 
5.	Run “Alignment Creation Tools” command.	

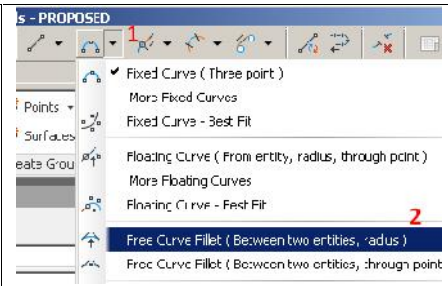
6.	Give a dedicated name for the alignment, say “PROPOSED”. Select “Design Criteria” tab.	
7.	• Enter design speed (say 70km/h). • Activate “Use criteria-based design”. • Activate “Use design criteria file”. • Select the appropriate Attainment Method. • **Un**check “Use design check set”.	
8.	Ensure OSNAP is set to CENTER only.	
9.	Click the drop-down icon > run “Tangent-Tangent (With curves).	
10.	Zoom and OSNAP-click at ARS 5.	

11.	Zoom and OSNAP-click at ARS 9	
12.	Zoom and OSNAP-click at ARS 13	
13.	• Hit ENTER keyboard. • Close the Alignment toolbar.	
14.	Close the drawing without saving.	

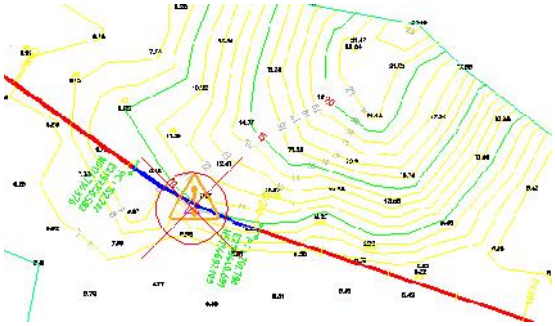
5.2 Editing Horizontal Alignment

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "06 Proposed Highway 2013_Alignment Editing.dwg"
2.	Ignore "VBA – Not Installed" message. Select "Continue with the current command".	
3.	Adding IP points.	

		In the command line, enter the followings: IP 1 : N = 517 47 00; E = 219 33 77 IP 2 : N = 517 46 11; E = 219 36 44
4.	Terminate the command.	Hit ESCAPE keyboard twice. Close the “Create Point” toolbar. 
5.	Select the alignment in the drawing.	Ensure OSNAP is set to “Node”.
6.	Run “Geometry Editor” command.	
7.	Select “Insert PI” icon.	
8.	Selecting desired IPs.	• Click at both nodes of IP 1 and IP 2. • Hit ESCAPE keyboard twice to end the command. 
9.	Adding circular curve at IP 1.	• Zoom to IP 1 area. • Run the “Free Curve Fillet” command.



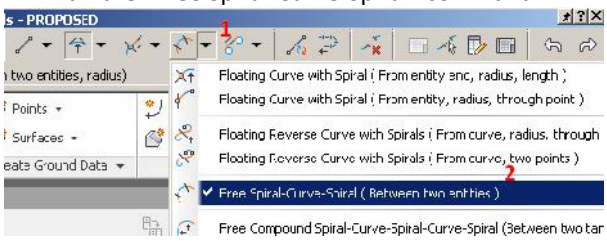
- Click tangent line BEFORE IP 1.
- Click tangent line AFTER IP 1.
- Solution angle = Lessthan180.
- Radius = 170
- ESCAPE keyboard twice to end command.
- A warning symbol will appear at IP 1 as shown below.



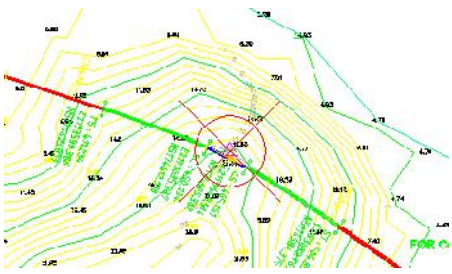
We shall remedy this later.

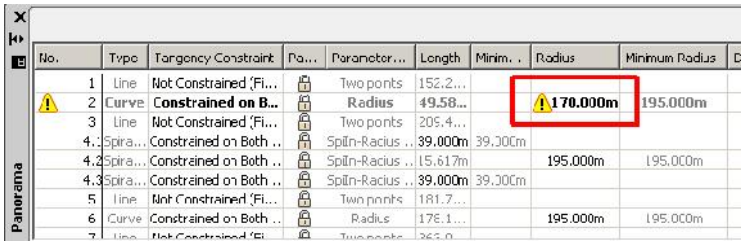
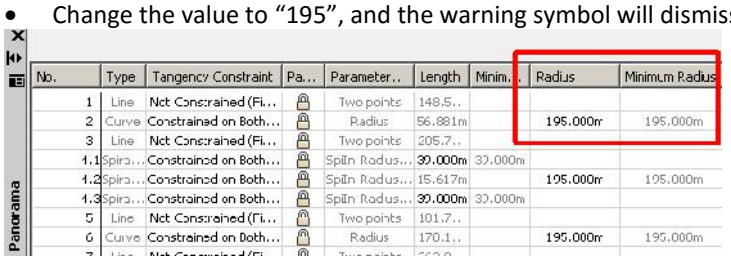
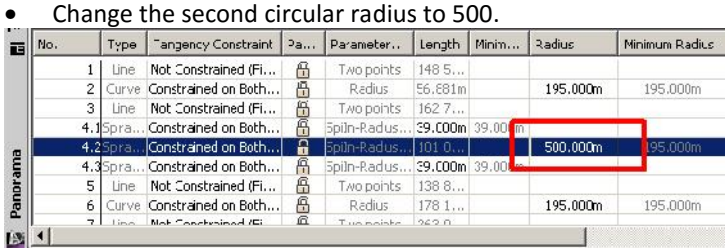
10. Adding transition spiral and circular curve at IP 2.

- Zoom to IP 2 area.
- Run the “Free Spiral-Curve-Spiral” command.



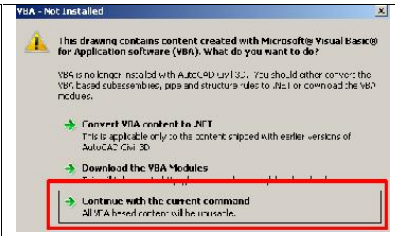
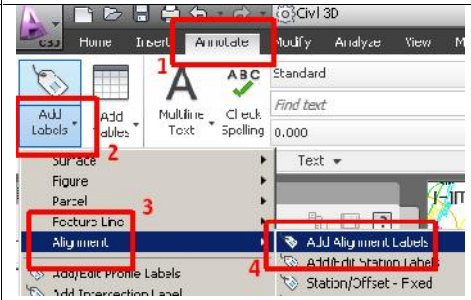
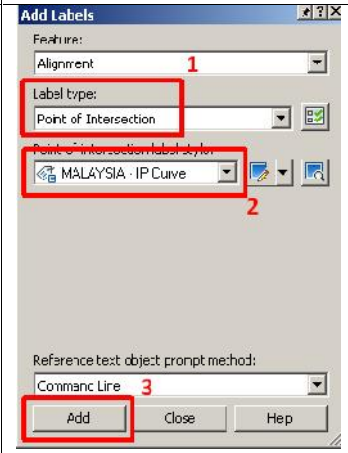
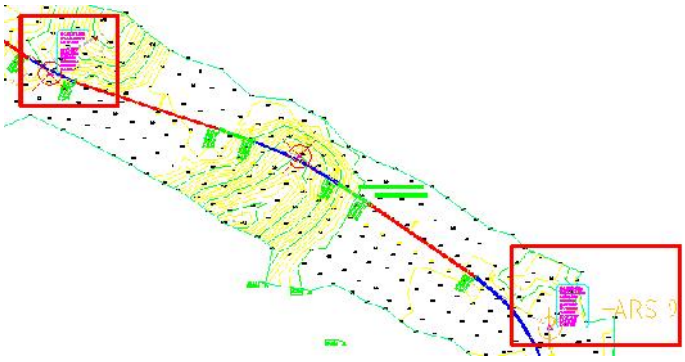
- Click tangent line BEFORE IP 2.
- Click tangent line AFTER IP 2.
- Solution angle = Lessthan180.
- Radius = 195
- Spiral-in length = 39
- Spiral-out length = 39
- ESCAPE keyboard twice to end command.

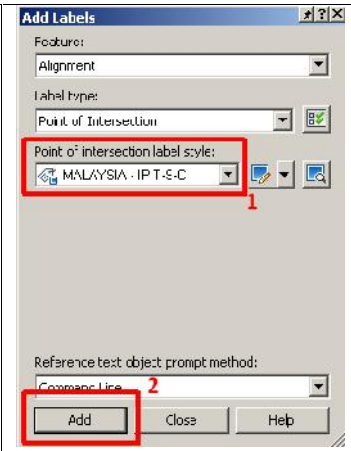
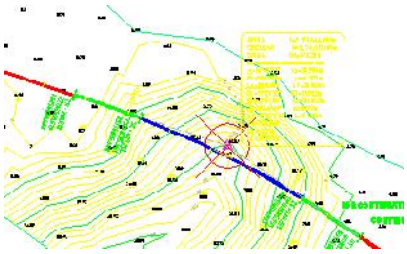


11.	Return back to IP 1 in order to rectify the alignment warning symbol.	• Zoom to IP 1 area. • Run the "Alignment Grid View" command.  • Notice the warning symbol for violating "Minimum Radius" at 70km/hr design speed. Therefore, Double-Click the 170m radius value.  • Change the value to "195", and the warning symbol will dismiss. 
12.	Adjusting other values.	• Change the second circular radius to 500. 
13.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
14.	Close the drawing.	Do not save.

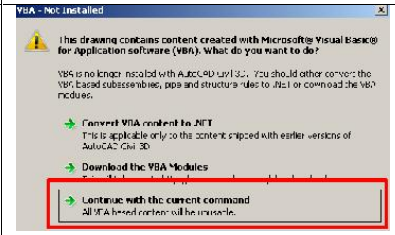
5.3 Alignment Labelling : Control Plan

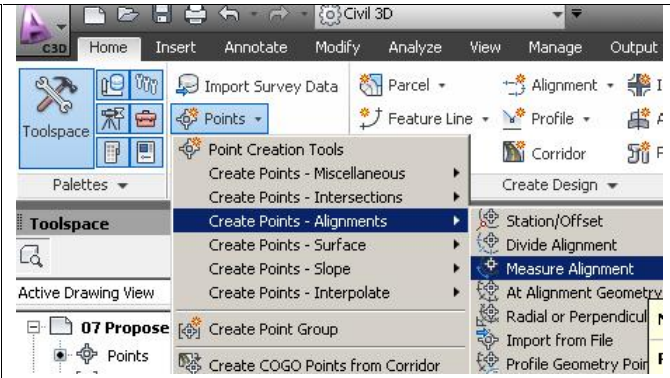
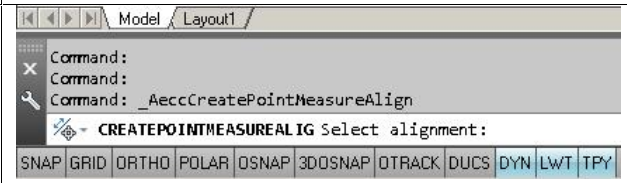
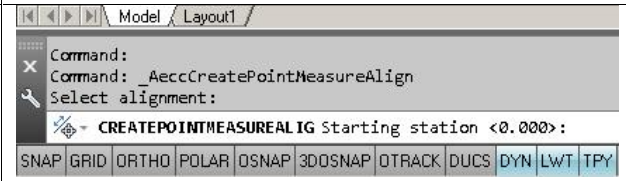
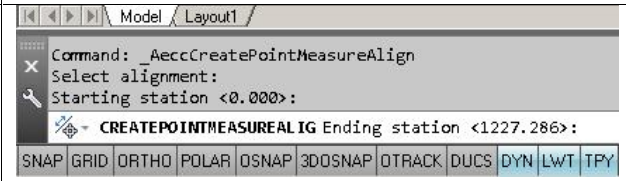
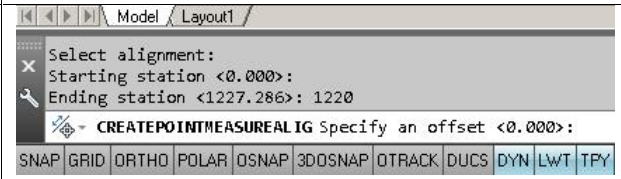
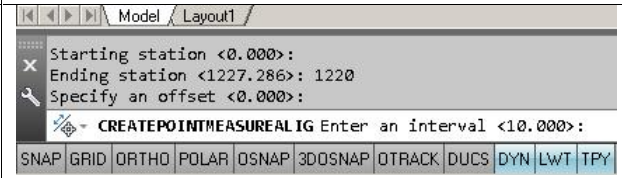
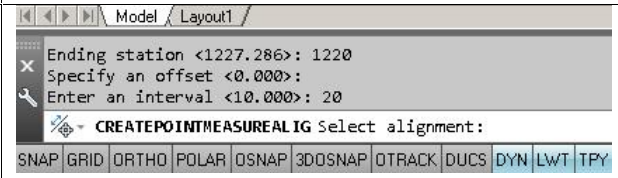
No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename "07 Proposed Highway 2013_Alignment Control Plan.dwg"

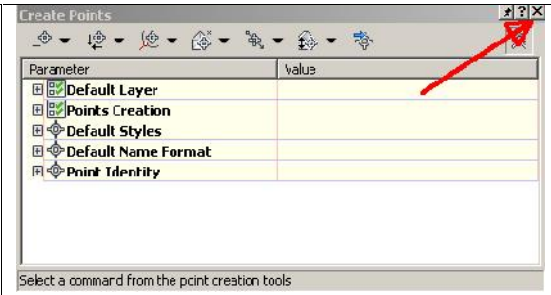
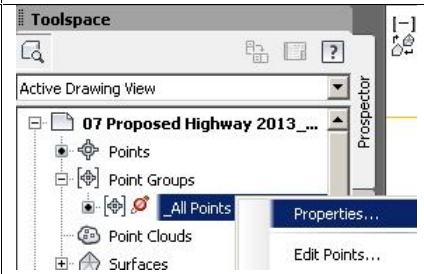
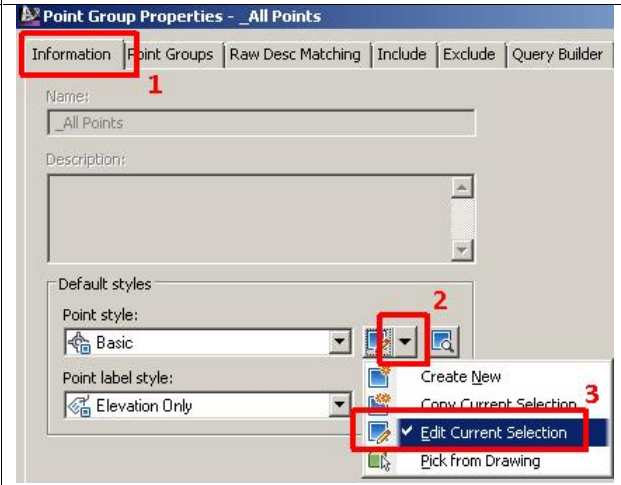
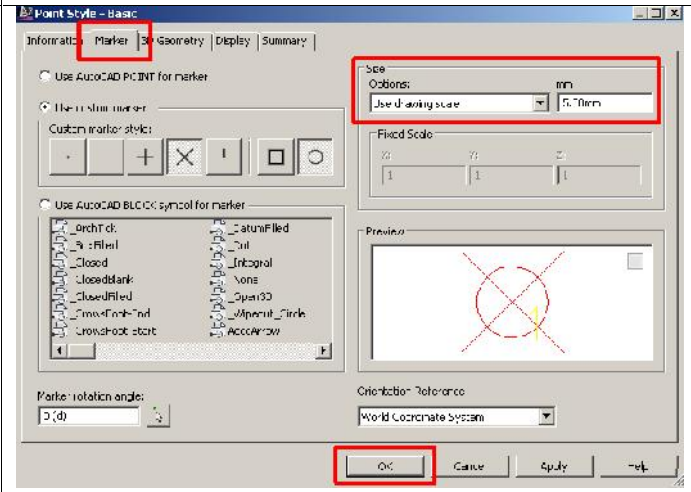
2.	Ignore "VBA – Not Installed" message. Select "Continue with the current command".	
3.	Labelling Circular Curve Control Plan	
4.	• Label type = Point of Intersection • Label style = MALAYSIA – IP Curve	
5.	Select the desired IP that has Circular Curves ONLY.	• Click at blue-colour Circular Curves at IP 1 and IP 3. 

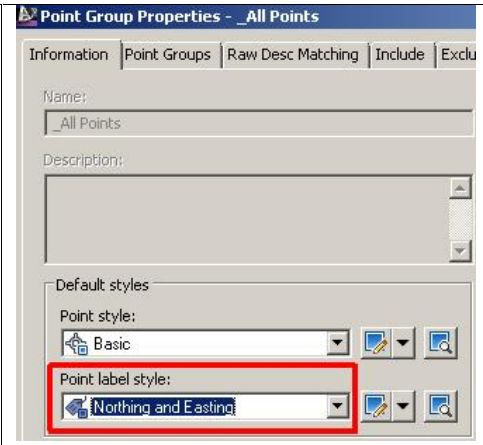
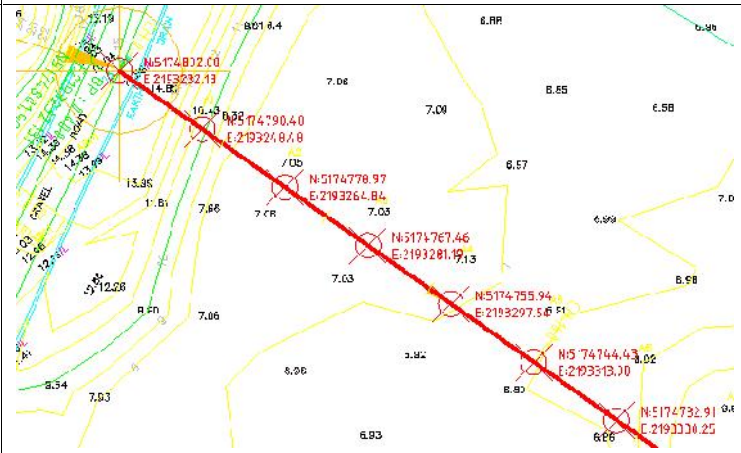
6.	Label style = MALAYSIA – IP T-S-C	
7.	Select the desired IP that has Transition Curves ONLY.	Click at blue-colour Transition Curve at IP 2. 
8.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
9.	Close the drawing.	Do not save.

5.4 Alignment Labelling : Fixed Interval Coordinates

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename "07 Proposed Highway 2013_Alignment Control Plan.dwg"
2.	Ignore "VBA – Not Installed" message. Select "Continue with the current command".	

3.	Goto "Home" tab > Points > Create Points – Alignments > Measure Alignment.	
4.	Command line prompts "Select Alignment". Just click the alignment in the model space.	
5.	Command line prompts "Starting station <0.000>". Just ENTER keyboard.	
6.	Command line prompts "Ending station <1227.286>". Key in the round-**down** value of the end chainage. In this example, we will round-down to 1220. So, type in "1220" and hit ENTER.	
7.	Command line prompts "Specify an offset <0.000>". Just hit ENTER keyboard.	
8.	Command line prompts "Enter an interval <10.000>". Type in your desired value. In this example, we will type in "20" and hit ENTER.	
9.	Command line prompts "Select Alignment". Just hit ESCAPE keyboard to end the command.	

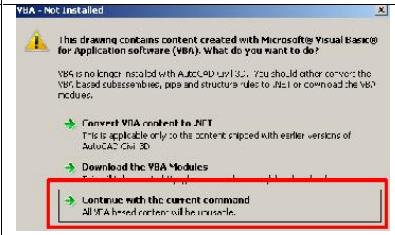
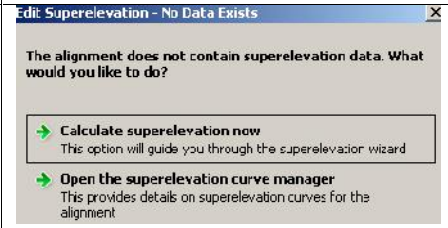
10.	You may close the "Create Points" dialog box. The points are now shown along the alignment. Next is to resize the points and label them accordingly.	
11.	"Prospector" tab > Points Groups > RC "_All Points" > Properties…	
12.	Information tab > Edit Current Selection.	
13.	• Goto "Marker" tab. • Verify the highlighted value. • Click OK.	

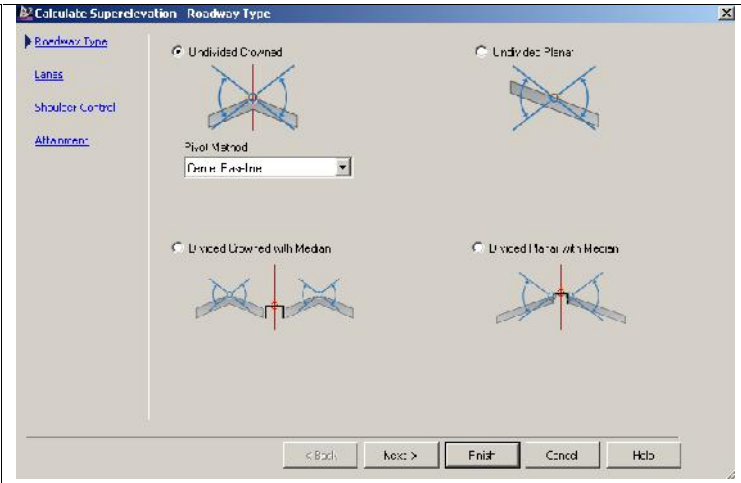
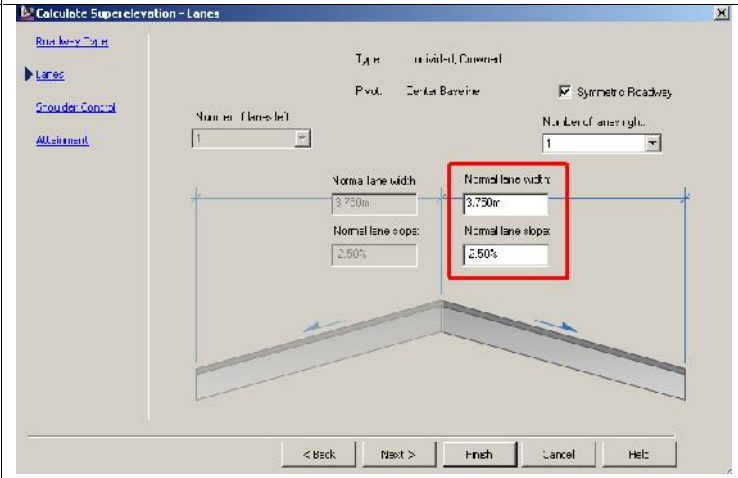
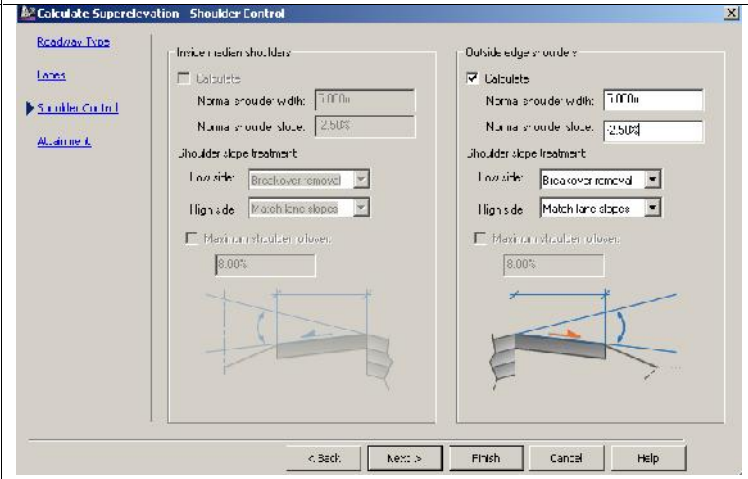
14.	Back to "Information" tab, change the Point label style to "Northing and Easting", and click OK.	
15.	The alignment now is labelled with fixed interval CoGo points having Northing and Easting coordinates.	
16.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
17.	Close the drawing.	Do not save.

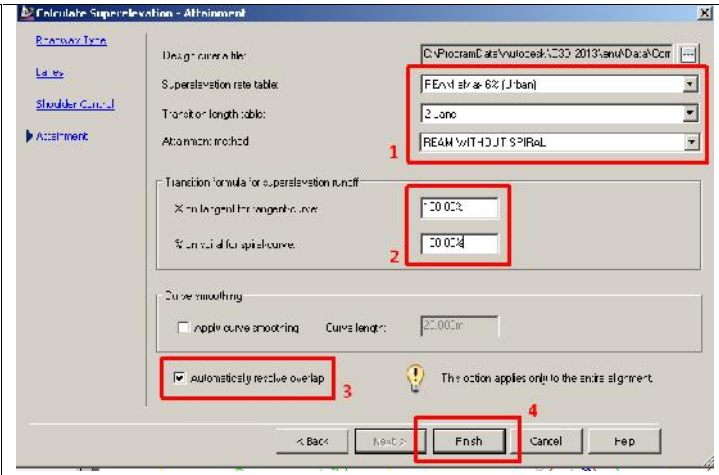
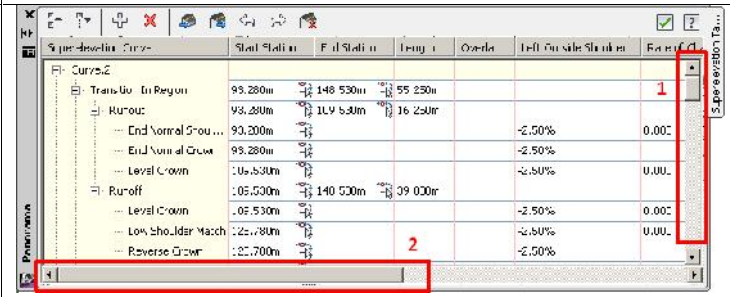
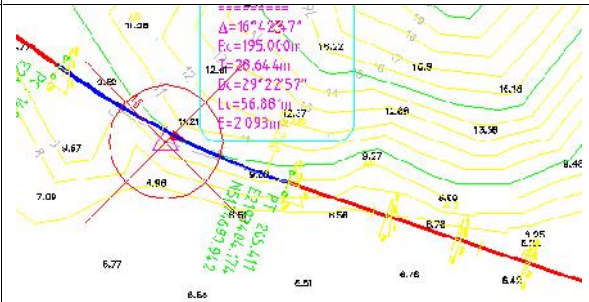
CHAPTER 6 : SUPERELEVATION DESIGN

This chapter will demonstrate step-by-step approach to design superelevation for circular curves and transition curves.

6.1 Creating Superelevation

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “08 Proposed Highway 2013_Superelevation.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Select the desired alignment.	Click the alignment.
4.	Run the “Calculate/Edit Superelevation” command.	
5.	Run the “Calculate superelevation now”.	

6.	• Select the desired Roadway Type • Click “Next”.	
7.	• Normal lane width = 3.75m • Normal lane slope = -2.5% • Click “Next”.	
8.	• Setup the desired shoulder parameters. • Click “Next”.	

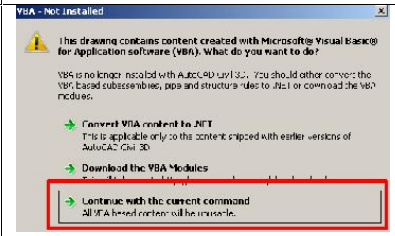
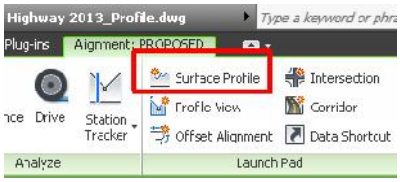
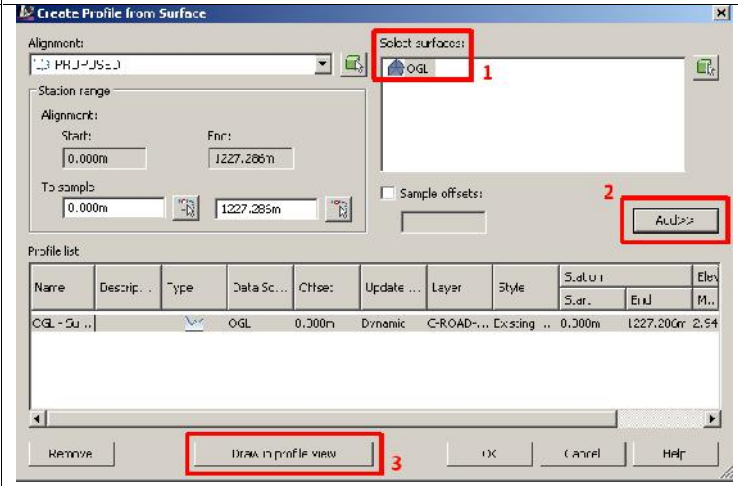
9.	• Setup the desired attainment parameters. • Click “Finish”.	
10.	Scroll up-down and left-right to see all calculated Superelevation values. You may change the values by Double-Click the cells.	 • Close the Superelevation table.
11.	The Superelevation wedges are printed along the alignment.	
12.	Close all windows, Zoom Extents and regenerate the drawing.	“ZE” & “REA”.
13.	Close the drawing.	Do not save.

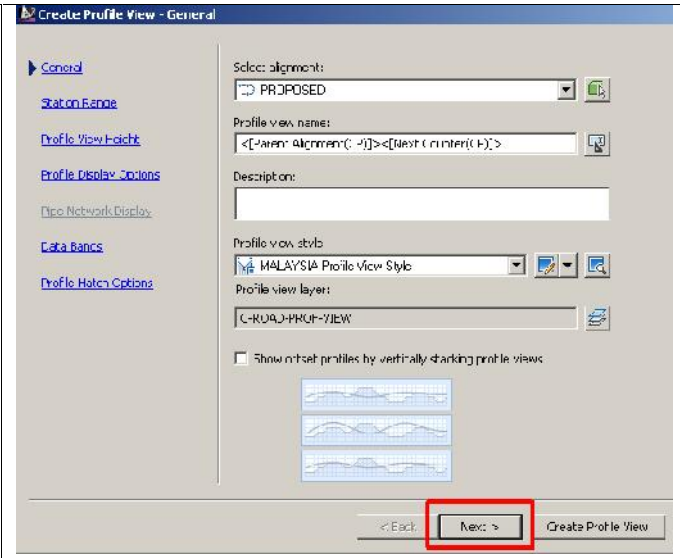
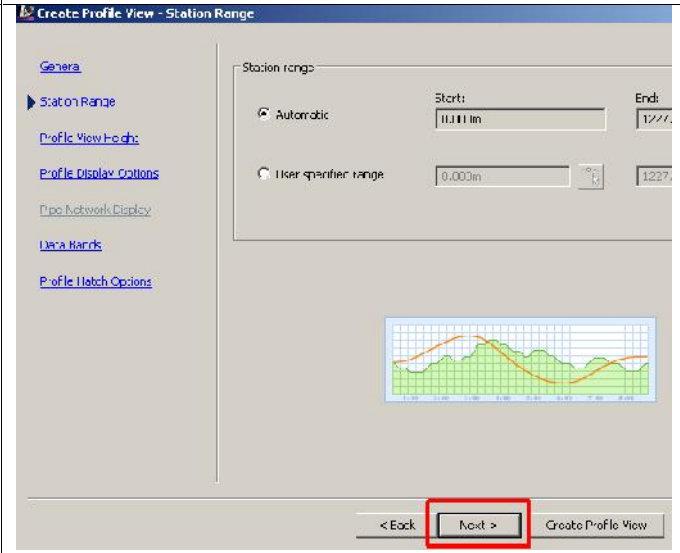
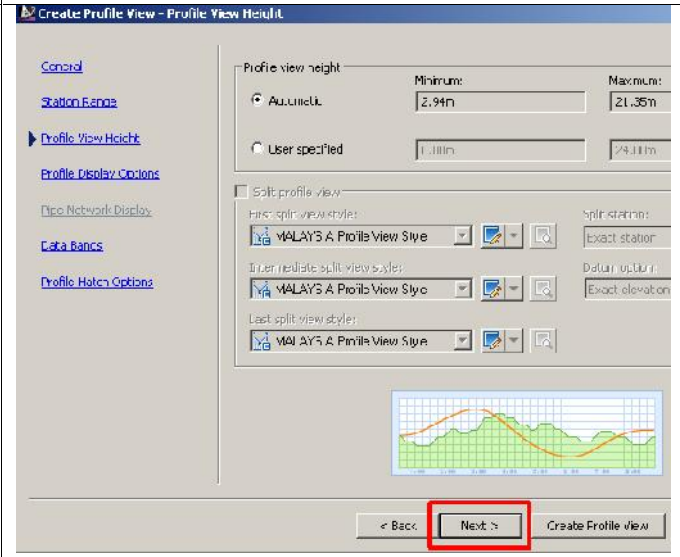
CHAPTER 7 : PROFILE DESIGN

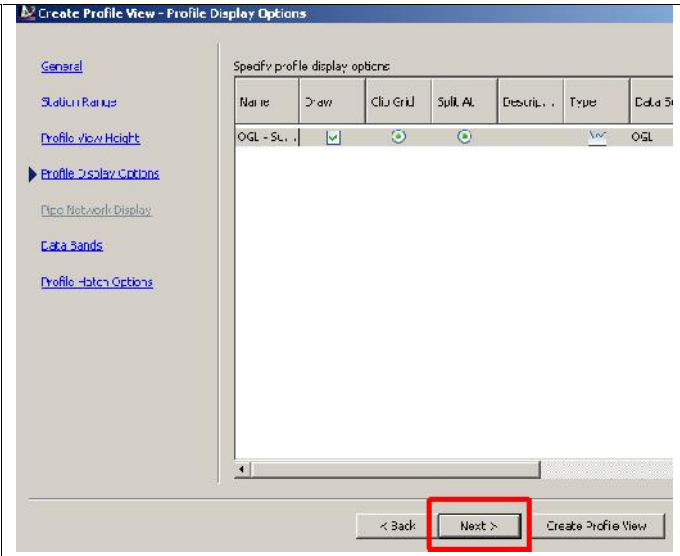
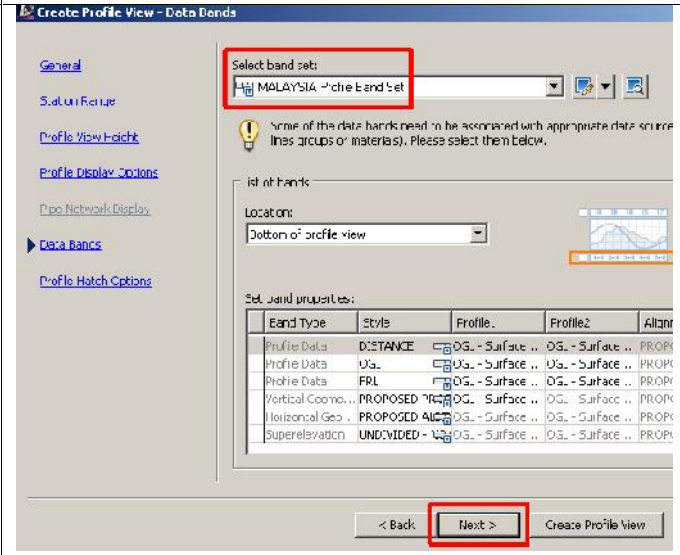
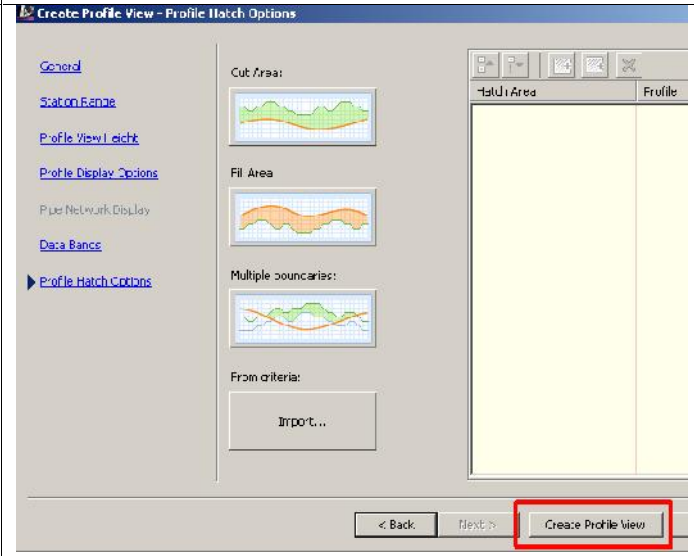
Profile is also known as Longitudinal Section. This chapter will demonstrate step-by-step approach to :

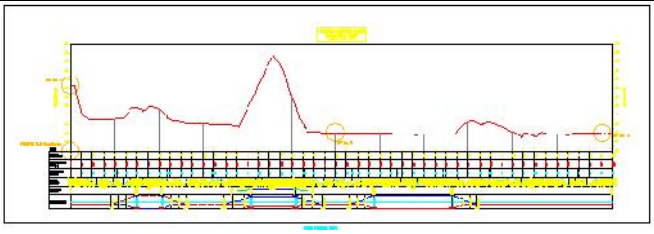
- Creating OGL profile.
- Generating PROPOSED profile.
- Editing PROPOSED profile.

7.1 Creating Profile

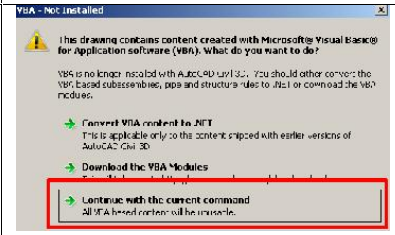
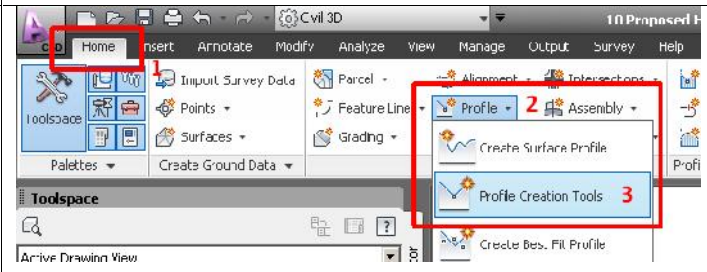
No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “09 Proposed Highway 2013_Profile.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Select the alignment.	Run the “Surface Profile” command. 
4.	• Surfaces = OGL • Click “Add>>” button • Click “Draw in profile view” button.	

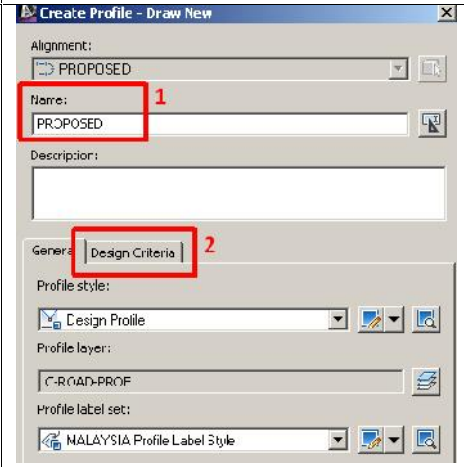
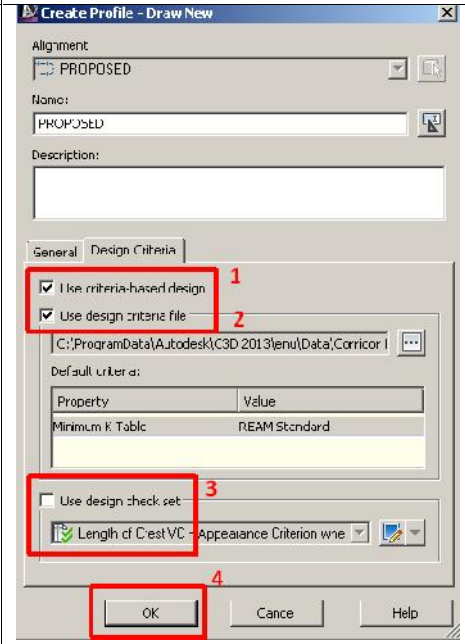
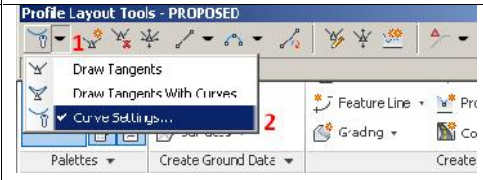
5.	In General parameters, just hit “Next>”.	
6.	In Station Range parameters, just hit “Next>”.	
7.	In Profile View Height parameters, just hit “Next>”.	

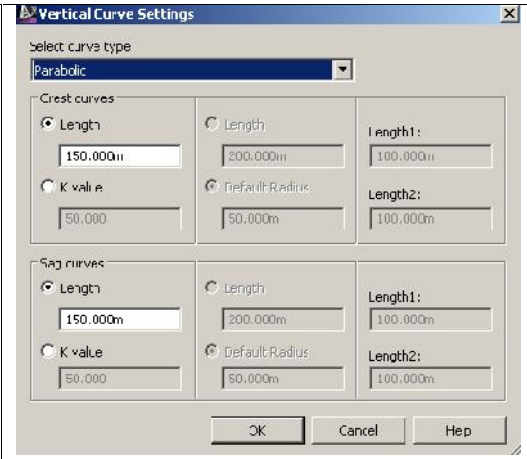
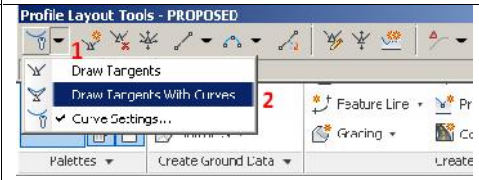
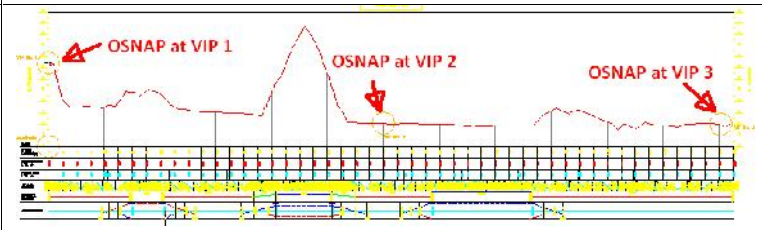
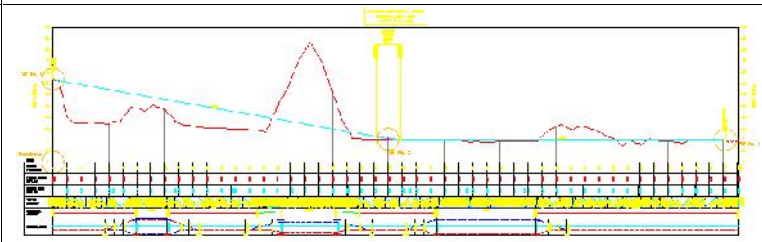
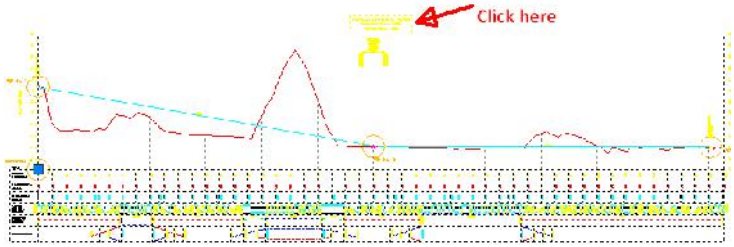
8.	In Profile Display Options parameters, just hit “Next>”.	
9.	In Data Bands parameters: • Band set = MALAYSIA Profile Band Set. • “Next>”. Note: If the MALAYSIA Profile Band Set is not available, please refer to CHAPTER 1, Section 1.2.1 of this Manual.	
10.	In Profile Hatch Options parameters, hit “Create Profile View” button.	

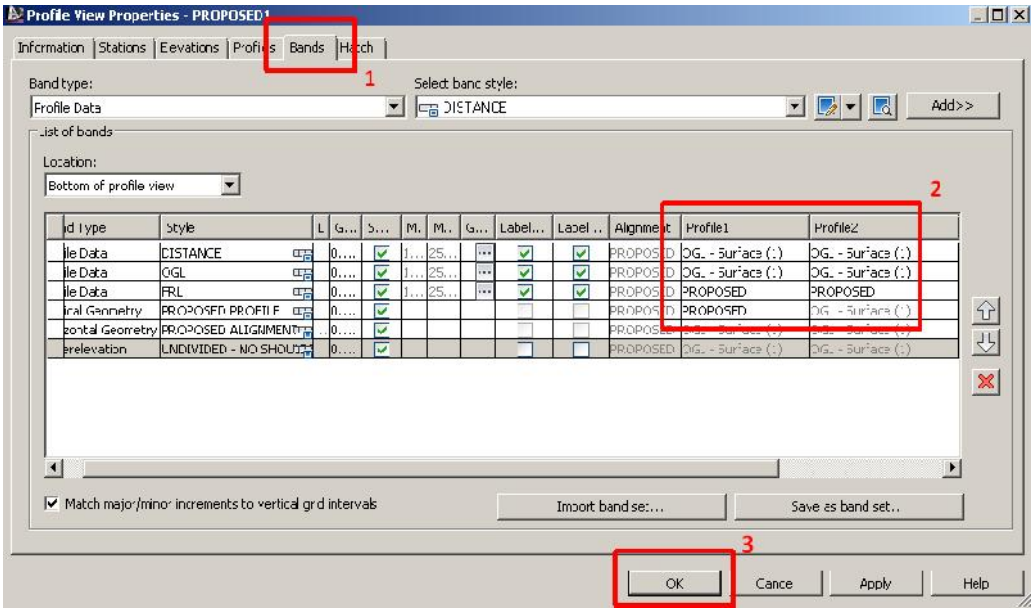
11.	• Ensure OSNAP is set to "Center" ONLY. • Click at the "Profile 0,0 Coordinate" marker. Note : You can place the Profile anywhere in the drawing.	
12.	A Profile View is drawn accordingly.	
13.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
14.	Close the drawing.	Do not save.

7.2 Generating PROPOSED Profile

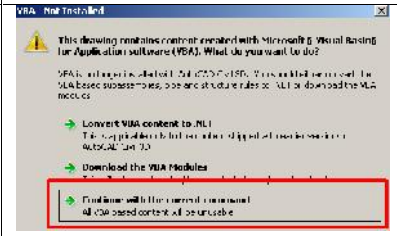
No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename "10 Proposed Highway 2013_PROPOSED Profile.dwg"
2.	Ignore "VBA – Not Installed" message. Select "Continue with the current command".	
3.	Goto Home tab > Profile > Profile Creation Tools.	

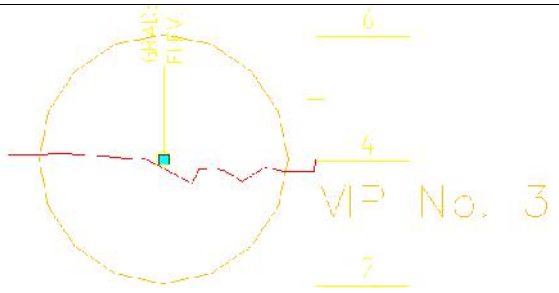
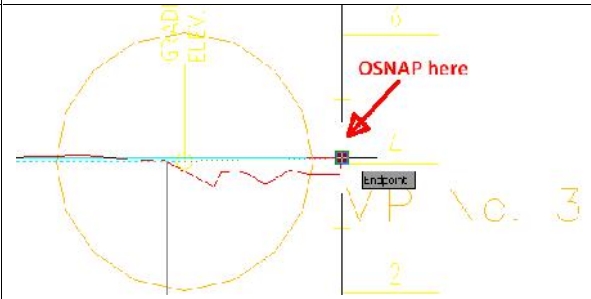
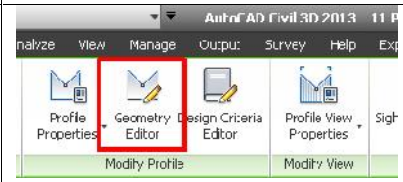
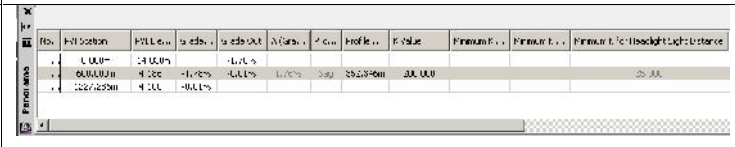
4.	Click the Title of the Profile View.	
5.	• Give a unique name for the PROPOSED profile. • Click “Design Criteria” tab.	
6.	• Activate “Use criteria-based design” • Activate “Use design criteria file” • Un-check “Use design check set” • Hit “OK”.	
7.	Run the “Curve Settings…” command.	

8.	• Enter the required parameters. • Hit "OK".	
9.	Run the "Draw Tangents With Curves" command.	
10.	• Zoom to the Profile View. • Ensure OSNAP is set to "CENTER". • Click at VIP 1, then, VIP 2, and finally VIP 3.	
11.	ESCAPE keyboard to end the command.	
12.	Select the title of the Profile View.	
13.	Run the "Profile View Properties" command.	

14.	Change the settings as shown below: 	
15.	The Profile View is updated.	Hit ESCAPE keyboard to end the command.
16.	Close all windows, Zoom Extents and regenerate the drawing.	“ZE” & “REA”.
17.	Close the drawing.	Do not save.

7.3 Editing PROPOSED Profile

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “11 Proposed Highway 2013_Profile Editing.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	

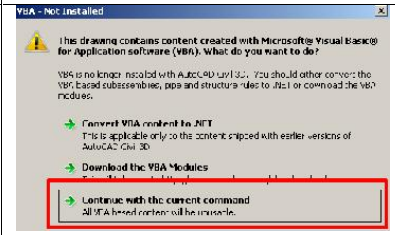
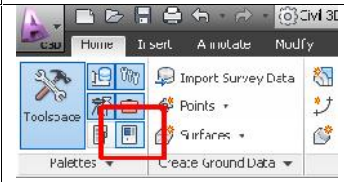
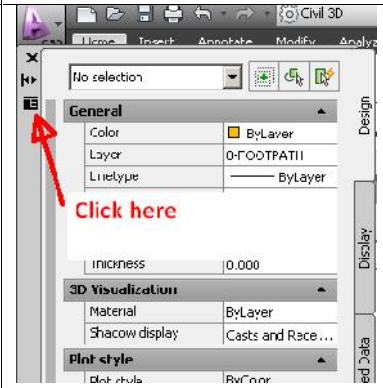
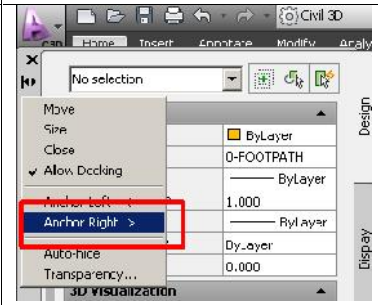
3.	• Zoom to VIP 3. • Click the PROPOSED profile line.	
4.	• Click the square-cyan-grip.	
5.	• Ensure OSNAP is set to "ENDPOINT" ONLY. • OSNAP at the end of OGL Profile line. • Hit ESCAPE to end the command.	
6.	• Select the PROPOSED Profile line. • Run the "Geometry Editor" command.	
7.	Select the "Profile Grid View" icon.	
8.	Double-Click the K-value that is violated.	
9.	• Change K-value to "200". • The warning symbol is dismissed.	
10.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
11.	Close the drawing.	Do not save.

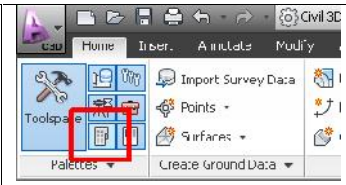
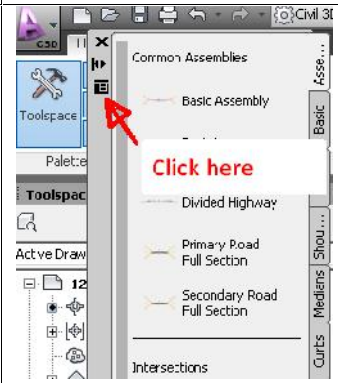
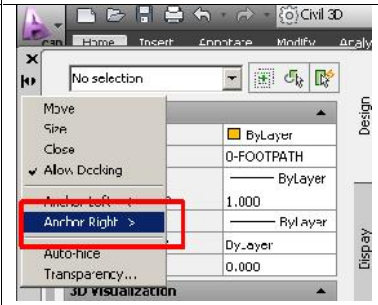
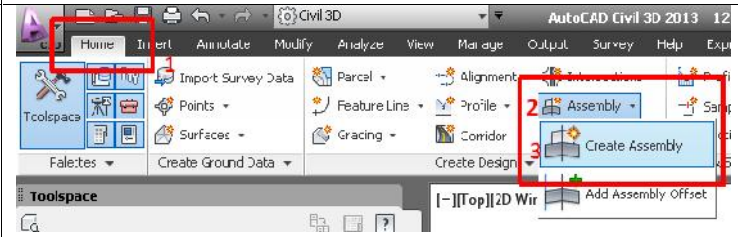
CHAPTER 8 : ASSEMBLY DESIGN

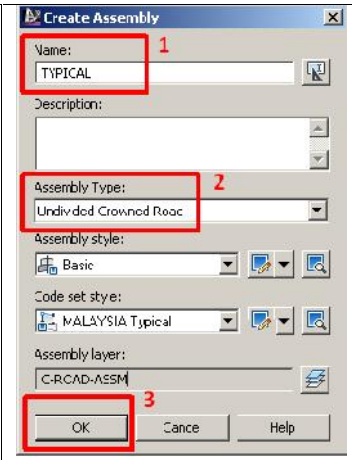
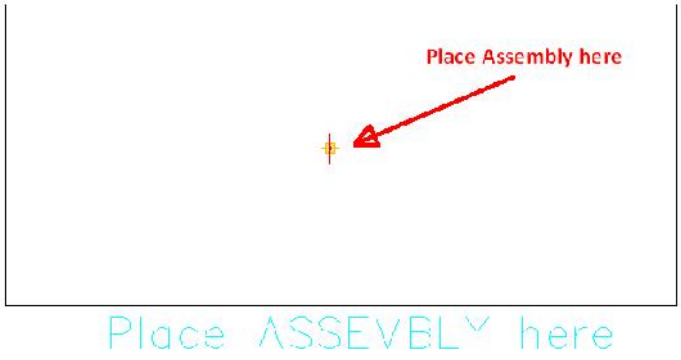
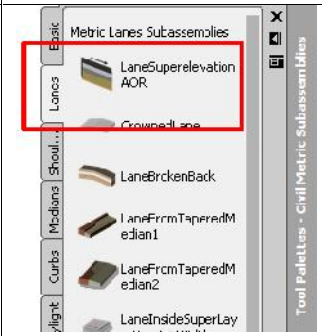
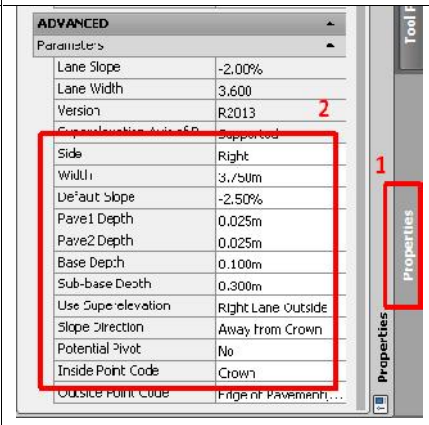
Assembly is also known as Typical section/detailing of the road. This chapter will demonstrate step-by-step approach to :

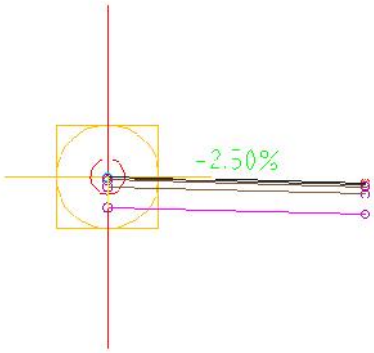
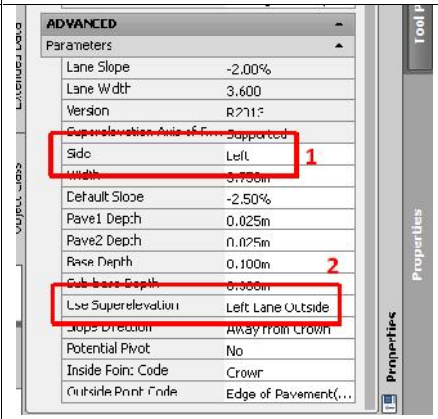
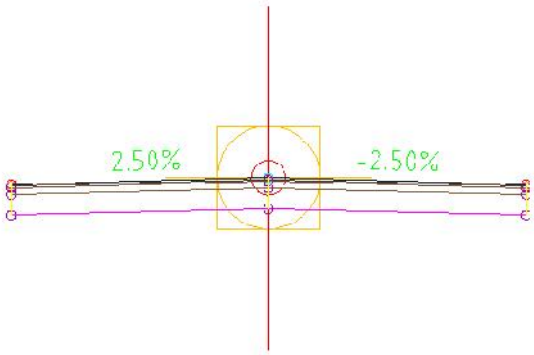
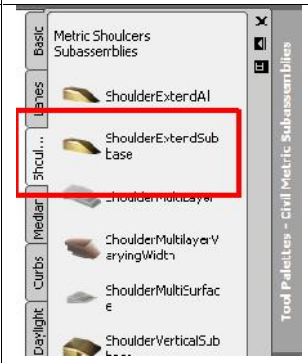
- Creating Assembly from various sub-assembly objects.

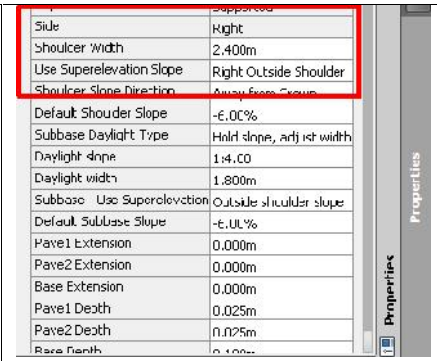
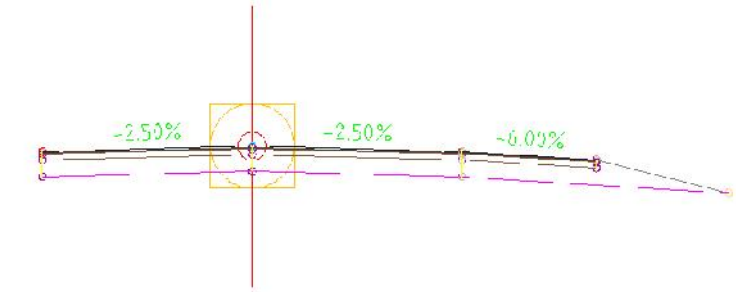
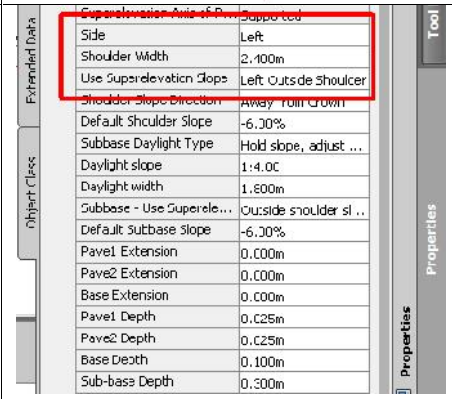
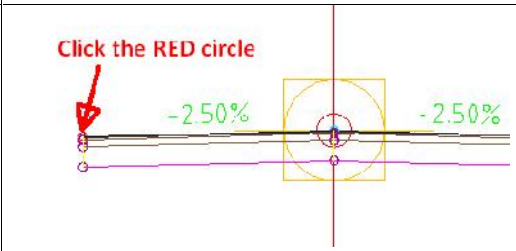
8.1 Creating Assembly

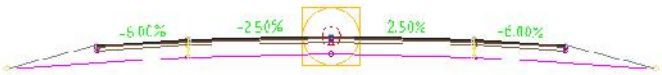
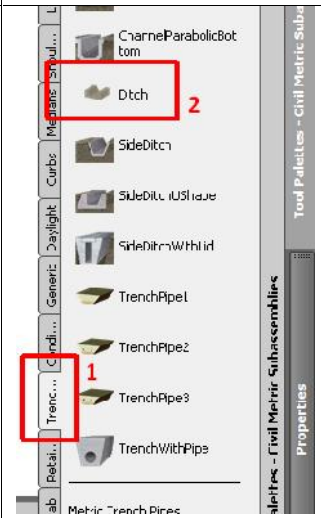
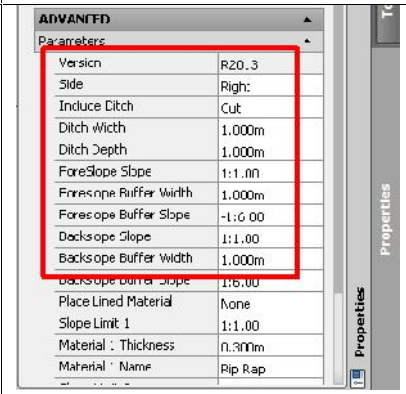
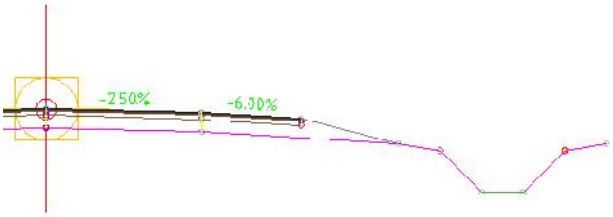
No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “12 Proposed Highway 2013_Assembly.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Home tab > “Properties” icon.	
4.	Click the “black-cabinet” icon.	
5.	Select “Anchor Right >” command. The “Properties” panel will be placed at the right-side of the screen. Just touch the “Properties” bar and it will auto-slide.	

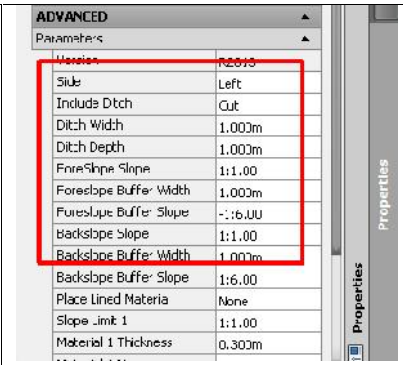
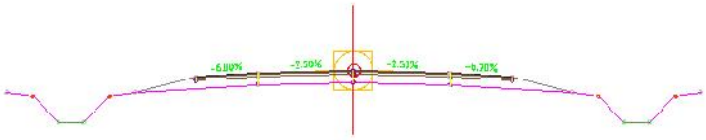
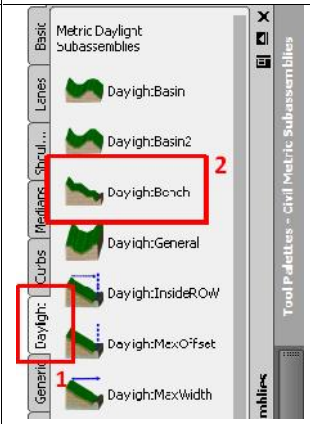
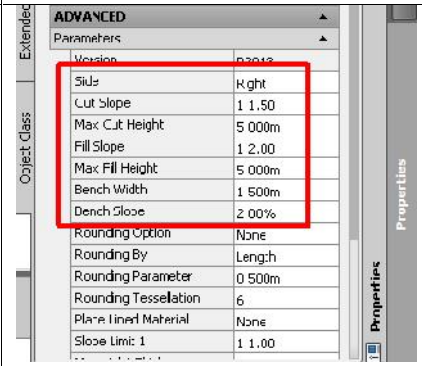
6.	Goto Home tab > “Tool Palettes” icon.	
7.	Click the “black-cabinet” icon.	
8.	Select “Anchor Right >” command. The “Tool Palettes” panel will be placed at the right-side of the screen. Just touch the “Tool Palettes” bar and it will auto-slide.	
9.	Zoom to the “Place Assembly here” area. Note: You can place the assembly anywhere in the drawing.	
10.	Home tab > Assembly > Create Assembly	

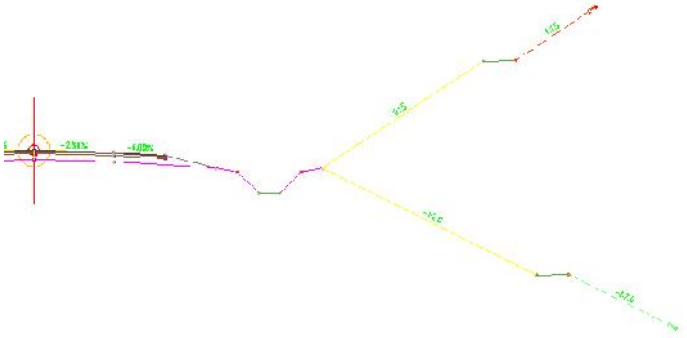
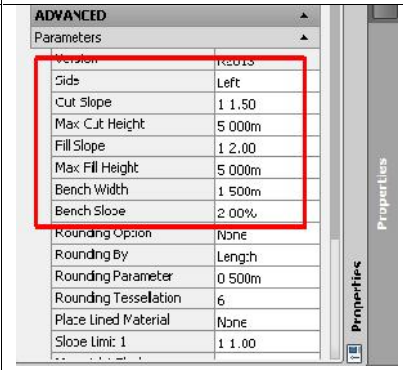
11.	Set the “Name” and “Assembly Type”.	
12.	Click anywhere in the provided box. Note: You can place the assembly anywhere in the drawing.	
13.	Tool Palettes > Lanes tab > “LaneSuperelevationAOR”.	
14.	In the Properties slider-panel, change the required parameters.	

15.	Click the “Assembly” object and the first lane on the right-side will be generated.	
16.	In the Properties slider-panel, change the required parameters as highlighted.	
17.	Click the “Assembly” object and the opposite lane on the left-side will be generated	
18.	Tool Palettes > Shoulders tab > “ShoulderExtendSubbase”.	

19.	In the Properties slider-panel, change the required parameters as highlighted.	
20.	Click at the RED circle on the right-side lane.	
21.	The right-side shoulder will be generated.	
22.	Immediately, in the Properties slider-panel, change the required parameters as highlighted.	
23.	Click at the RED circle on the left-side lane.	

24.	The left-side shoulder will be generated.	
25.	Tool Palettes > Trenches tab > “Ditch”.	
26.	Immediately, in the Properties slider-panel, change the required parameters as highlighted.	
27.	Click at the ORANGE circle on the right-side shoulder.	
28.	The right-side ditch will be generated.	

29.	Immediately, in the Properties slider-panel, change the required parameters as highlighted.	
30.	Click at the ORANGE circle on the left-side shoulder.	
31.	The left-side ditch will be generated.	
32.	Tool Palettes > Daylight tab > “DaylightBench”.	
33.	Immediately, in the Properties slider-panel, change the required parameters as highlighted.	

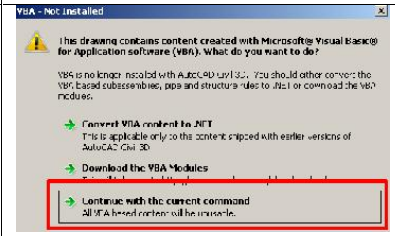
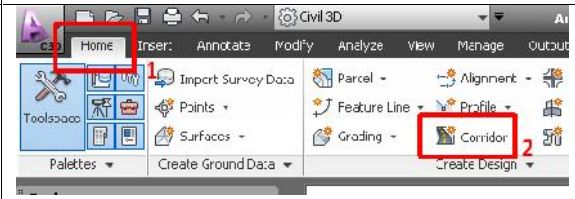
34.	Click at the GREY circle on the right-side ditch.	
35.	The right-side daylight will be generated.	
36.	Immediately, in the Properties slider-panel, change the required parameters as highlighted.	
37.	Click at the GREY circle on the left-side ditch	
38.	The left-side daylight will be generated.	
39.	Hit ESCAPE keyboard to end the command.	
40.	Close all windows, Zoom Extents and regenerate the drawing.	“ZE” & “REA”.
41.	Close the drawing.	Do not save.

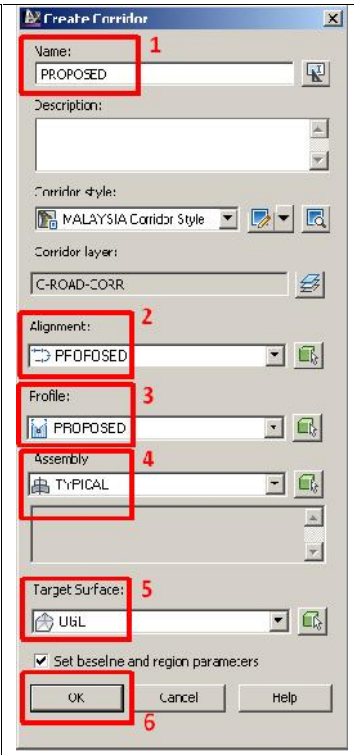
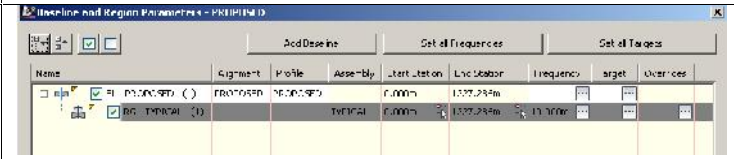
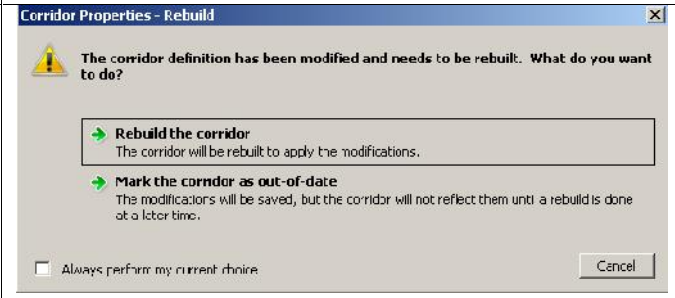
CHAPTER 9 : CORRIDOR DESIGN

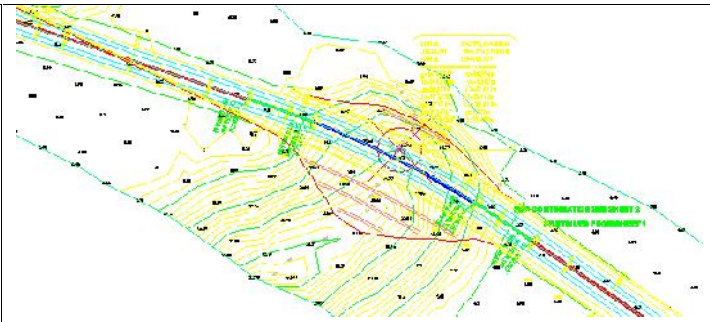
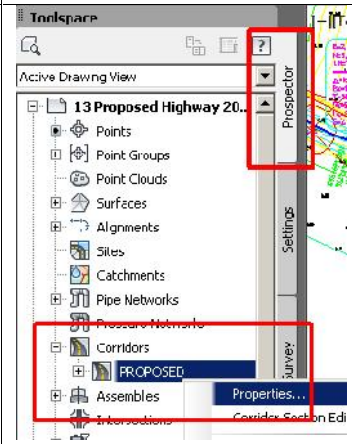
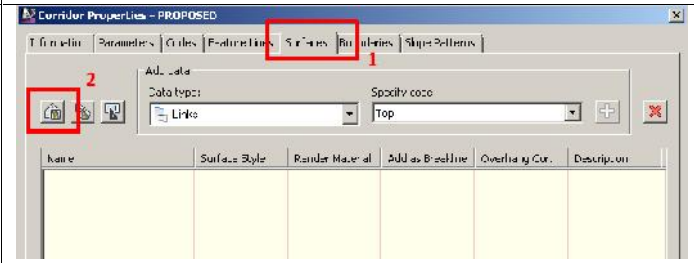
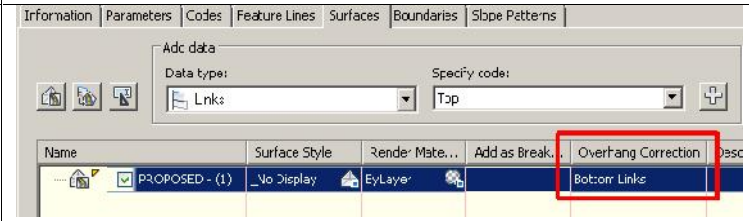
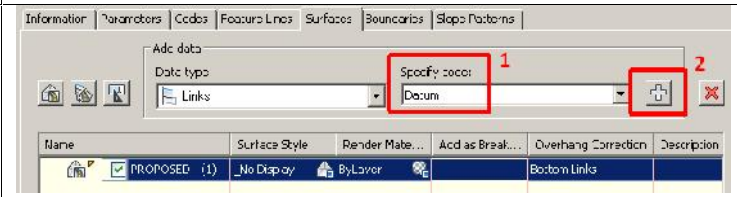
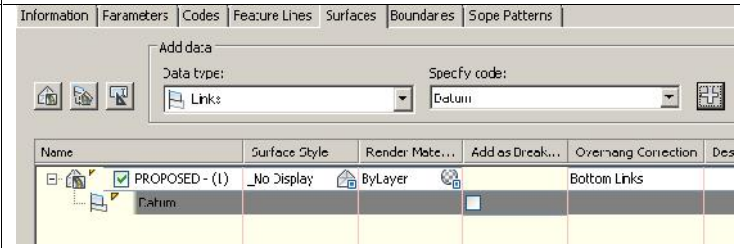
Corridor will combine alignment, proposed profile and assembly to generate 3D road model. This chapter will demonstrate step-by-step approach to :

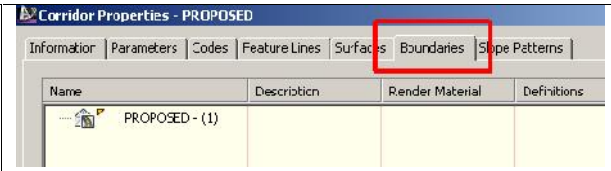
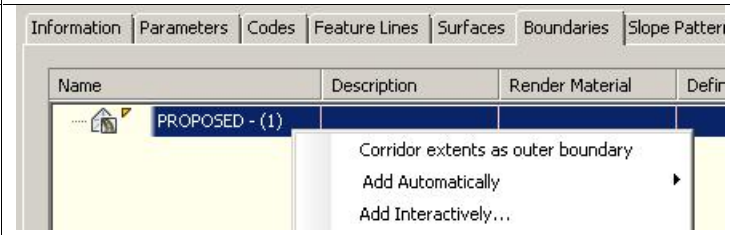
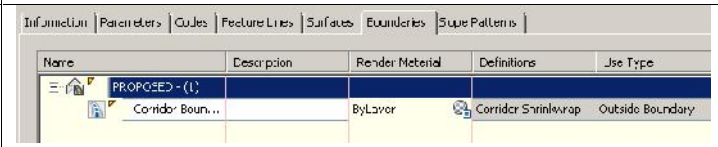
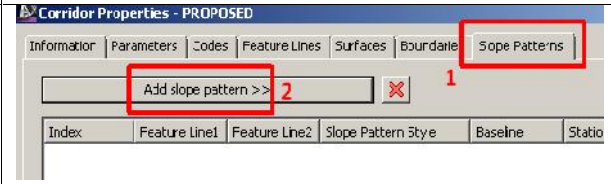
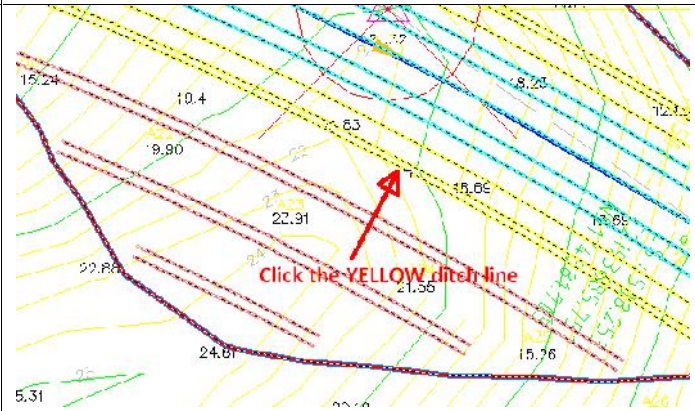
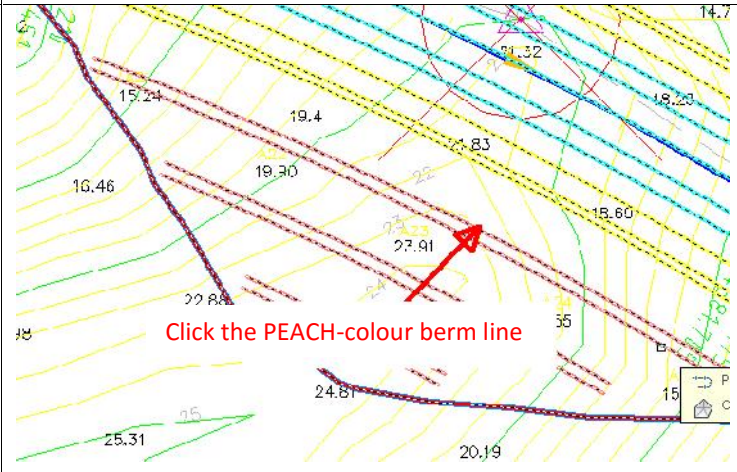
- Creating Corridor from alignment, proposed profile and typical assembly.

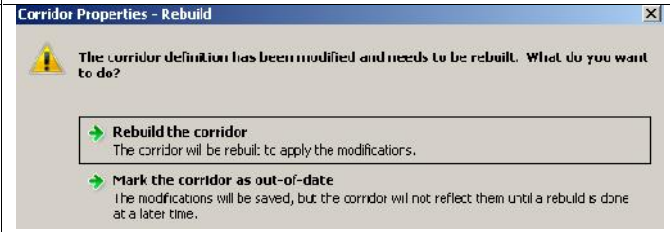
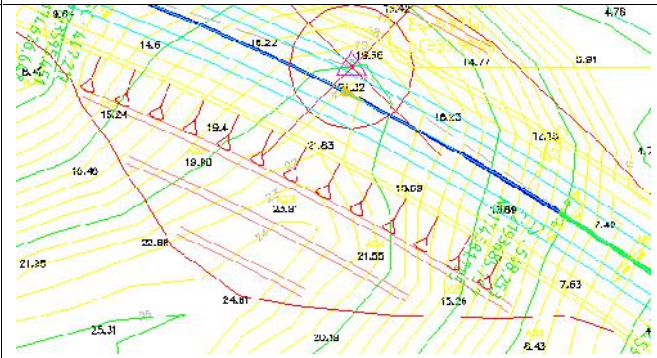
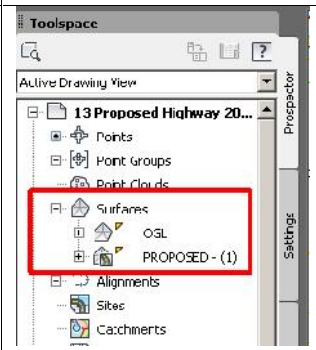
9.1 Creating Corridor

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “13 Proposed Highway 2013_Corridor.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Home tab > Corridor	

4.	Update the highlighted parameters.	
5.	Verify the parameters > OK .	
6.	Select the “Rebuild the corridor” command.	
7.	Note: If you received warning report, please check that the corridor is NOT generated beyond the OGL surface. The warning is due to insufficient OGL surface to generate the slopes/daylight along the corridor. To solve this problem, you may need to: • Enlarge the OGL surface by adding more survey data (RECOMMENDED), or • Adjust the alignment. **<u>If the alignment is adjusted</u>**, please ensure to re-design/update the followings: • Superelevation • Proposed profile • Corridor Parameters (in Corridor Properties command).	

8.	The complete corridor is generated.	
9.	Prospector tab > Corridors > RC "PROPOSED" > Properties…	
10.	Surfaces tab > Create a corridor surface	
11.	Change the "Overhang Correction" to "Bottom Links".	
12.	• Specify code = Datum. • Hit the PLUS symbol icon.	
13.	The "Datum" links code will be placed under PROPOSED – (1) corridor surface data.	

14.	Goto “Boundaries” tab.	
15.	Right-click ”PROPOSED – (1)” > Corridor extents as outer boundary”.	
16.	The corridor surface boundary is generated.	
17.	Goto “Slope Patterns” tab > Add slope pattern	
18.	Click at the YELLOW ditch line.	
19.	Click at the PEACH-colour berm line.	

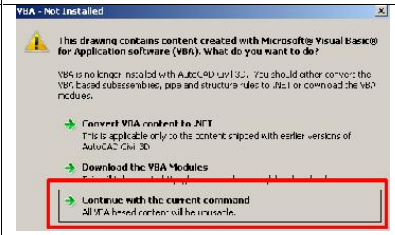
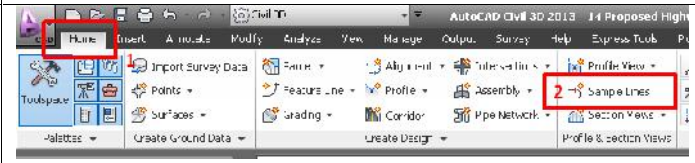
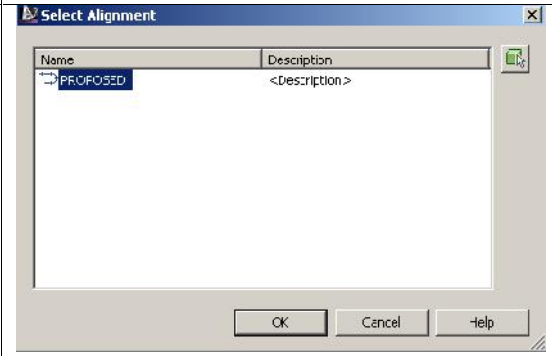
20.	• The first Index will be generated. • Click OK.	 Note: You may need to adjust the "Station Start" and "Station End" column values for all other Indexes depending on the location of cut and fill areas along the corridor.
21.	Select "Rebuild the corridor" command.	
22.	The "tadpoles" slope pattern is generated along the benching.	
23.	Finally, verify the corridor surface [ie. PROPOSED – (1)] has been generated as highlighted.	
24.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
25.	Close the drawing.	Do not save.

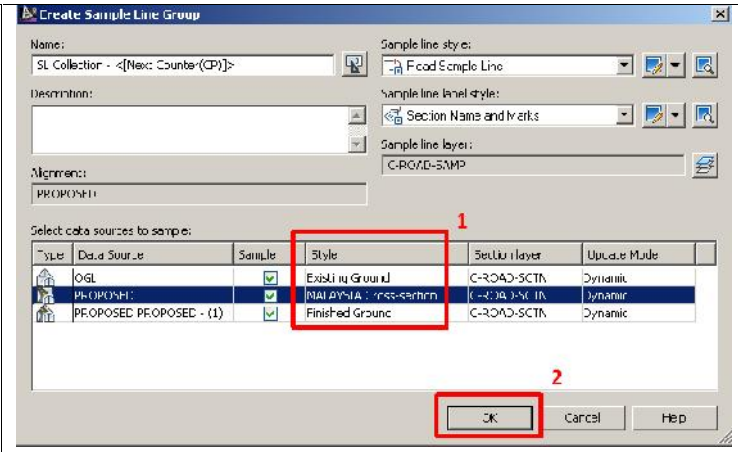
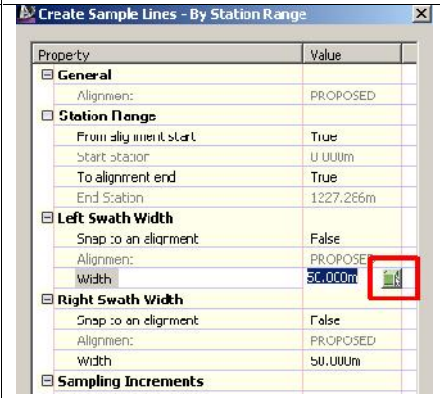
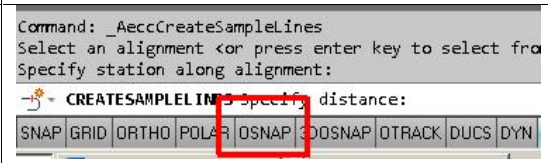
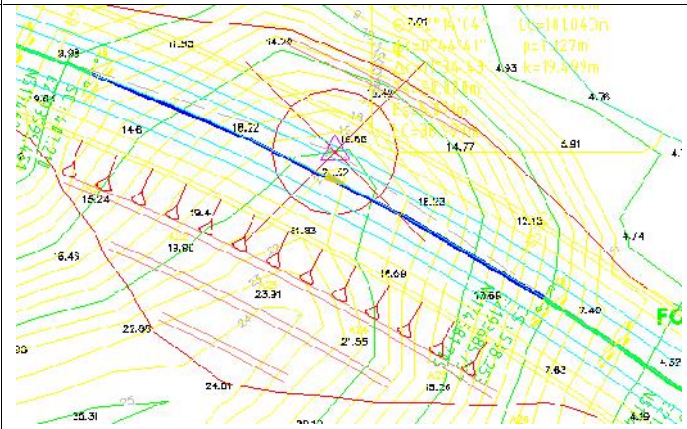
CHAPTER 10 : SAMPLE LINES

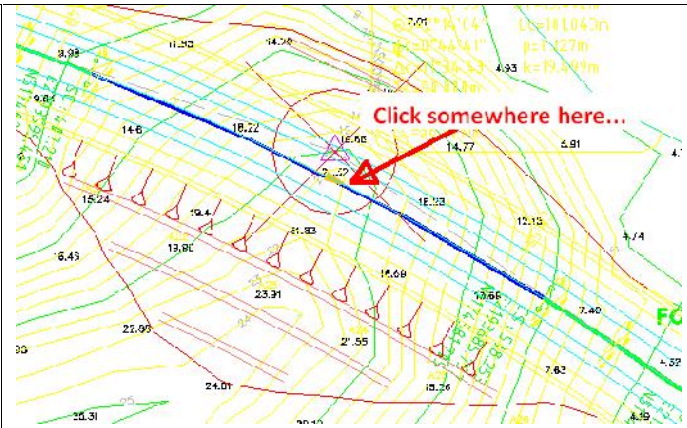
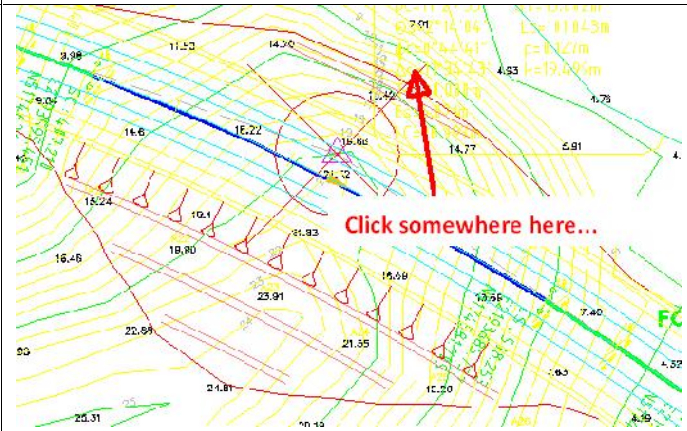
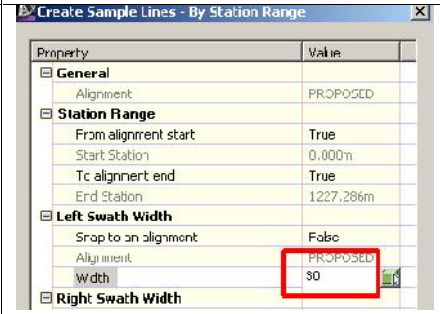
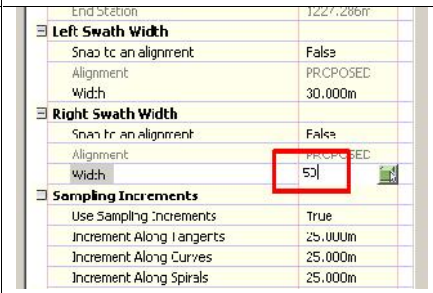
Sample Lines is used to generate volume calculation (based on Average End Area method) as well as preparation for Cross-Section drawings. This chapter will demonstrate step-by-step approach to :

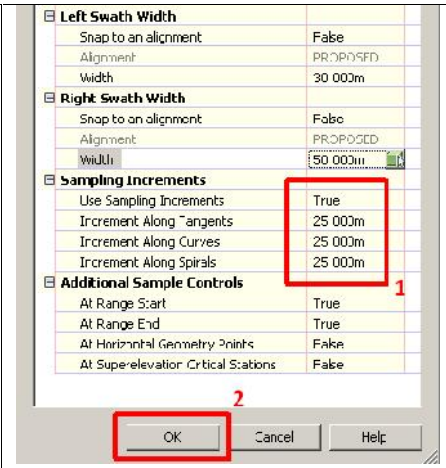
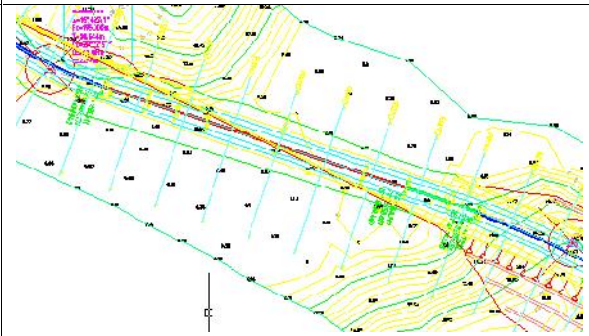
- Creating Sample Lines along the proposed corridor.

10.1 Creating Sample Lines

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “14 Proposed Highway 2013_Sample Lines.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Home tab > Sample Lines	
4.	Hit ENTER keyboard.	
5.	• Select the desired alignment. • Hit “OK”.	

6.	• Change the "Style" column values as highlighted. • Hit "OK".	
7.	Click the drop-down icon and run "By range of stations…" command.	
8.	For LEFT Swath Width, • Click the "50.000m" value. • Click the GREEN-colour cube. Note: Pay attention on the direction of the alignment. The LEFT and RIGHT swath width is depending on the direction of alignment.	
9.	Turn OFF OSNAP setting.	
10.	Zoom at the WIDEST corridor area.	

11.	Click near the alignment.	
12.	Click near the daylight area.	
13.	Round-up the Width value. For this case, the rounded value is “30”.	
14.	Repeat steps “ 8 “ to “ 13 “ for RIGHT Swath Width value.	

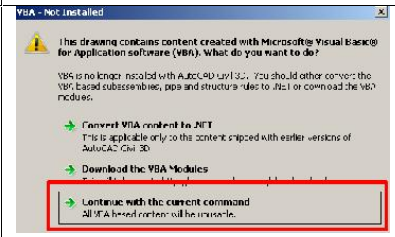
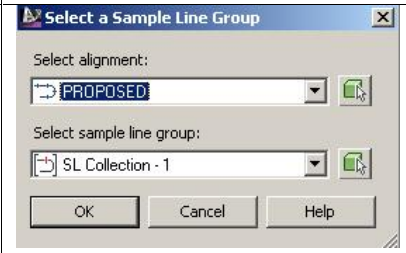
15.	• Change the Sampling Increments value to desired intervals. Note : This value will be used for volume calculation (based on Average End Area Method) and generating cross-section detailing. • Hit “OK”.	
16.	• Place the mouse cursor in the drawing area. • Hit ENTER keyboard. • The Sample Lines is generated.	
17.	Close all windows, Zoom Extents and regenerate the drawing.	“ZE” & “REA”.
18.	Close the drawing.	Do not save.

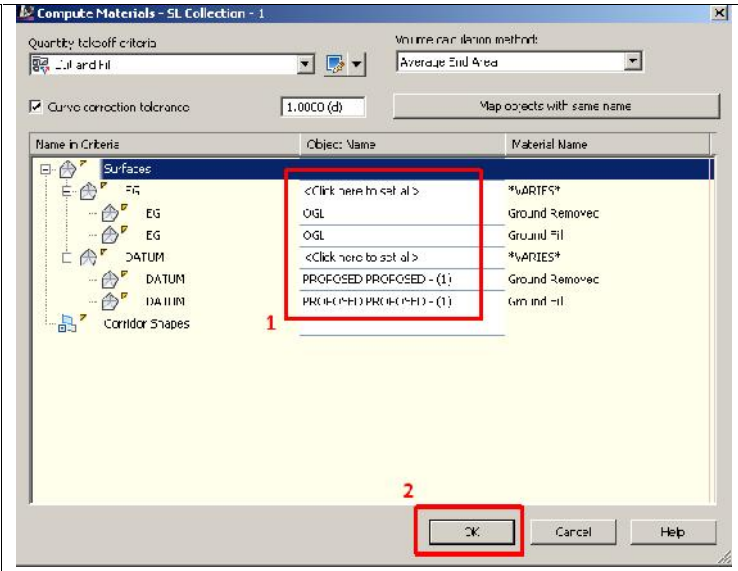
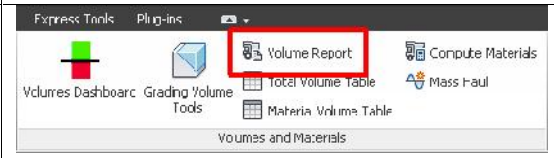
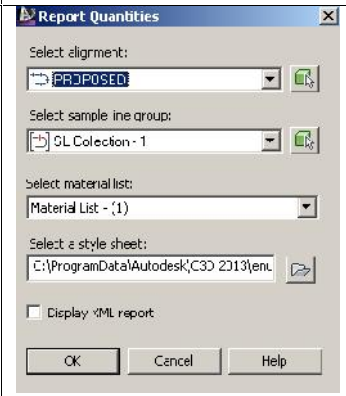
CHAPTER 11 : VOLUME CALCULATION

This chapter will demonstrate step-by-step approach to Generate Volume Calculation based on:

- Cross-section Method (a.k.a. Average End Area Method).
- TIN Volume Surface Method.

11.1 Cross-Section Method

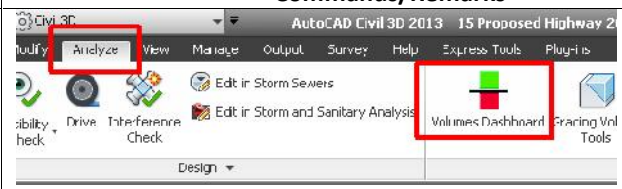
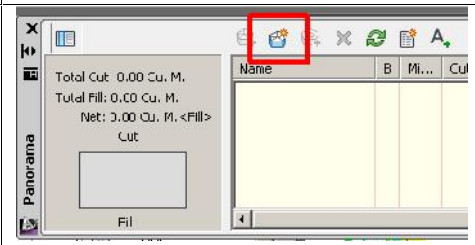
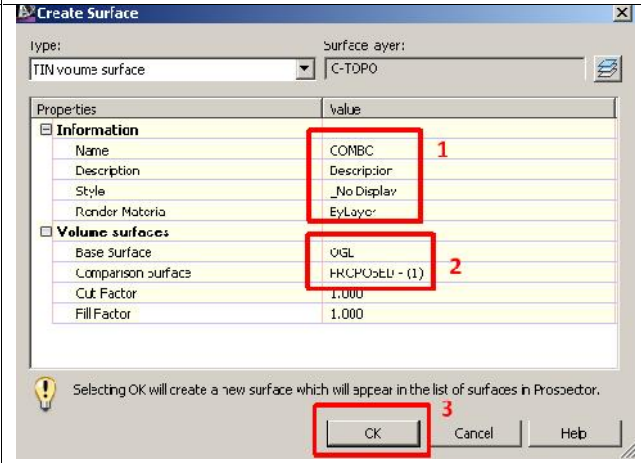
No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “15 Proposed Highway 2013_Volume.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Analyze tab > Compute Materials.	
4.	• Select the desired Alignment and Sample Line Group. • Hit “OK”.	

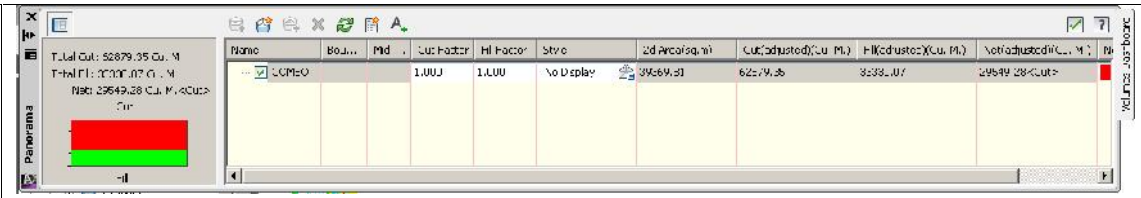
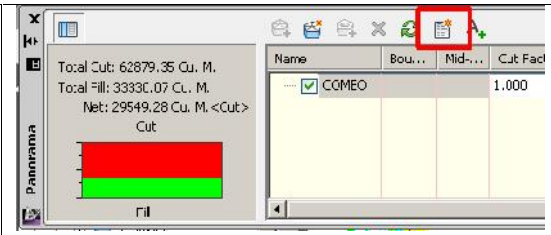
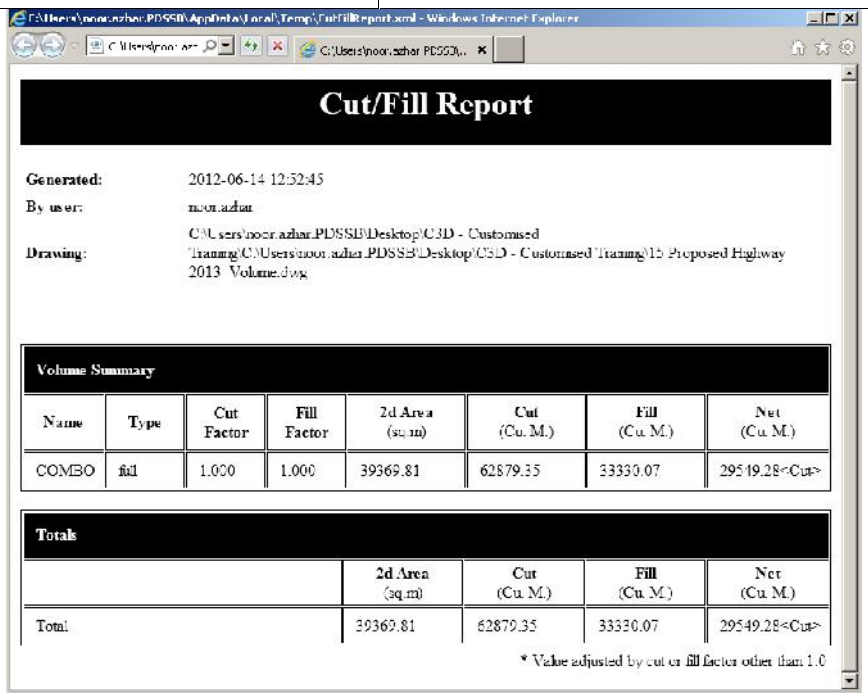
5.	• Change the Object Name values as per highlighted. • Hit “OK”.	
6.	Goto Analyze tab > Volume Report.	
7.	Just hit “OK”.	
8.	Hit “Yes”.	

9.	The Volume Report will be generated in Internet Explorer application. You may need to copy-paste into Microsoft Word or Excel to produce proper volume report format.	**Volume Report** **Project: C:\Users\noor.azhar.PDSSB\Desktop\C3D - Customised Training\15 Proposed Highway 2013_Volume.dwg** Alignment: PROPOSED Sample Line Group: SL Collection - 1 Start Sta: 0+000.000 End Sta: 1+227.286

Station	Cut Area (Sq.m.)	Cut Volume (Cu.m.)	Reusable Volume (Cu.m.)	Fill Area (Sq.m.)	Fill Volume (Cu.m.)	Cum. Cut Vol. (Cu.m.)	Cum. Reusable Vol. (Cu.m.)	Cum. Fill Vol. (Cu.m.)	Cum. Net Vol. (Cu.m.)
0+000.000	21.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0+025.000	0.00	266.17	266.17	135.54	1694.31	266.17	266.17	1694.31	1428.13
0+050.000	0.00	0.00	0.00	185.47	4012.68	266.17	266.17	5706.99	-5440.81
0+075.000	0.00	0.02	0.02	167.13	4407.51	266.19	266.19	10114.50	-9848.30
0+100.000	0.00	0.02	0.02	153.79	4011.55	266.21	266.21	14126.05	-13859.83
0+125.000	0.00	0.00	0.00	108.98	3284.69	266.21	266.21	17410.74	-17144.52

11.2 TIN Volume Surface Method

No.	Descriptions	Commands/Remarks
1.	Goto Analyze tab > Volumes Dashboard	
2.	Run the “Create new volume surface” command.	
3.	• Change the values as highlighted. • Hit “OK”.	

4.	 The TIN volume result is presented in Panorama floating window.	
5.	Run the "Generate Cut/Fill report" command.	
6.	 The Cut/Fill Report will be generated in Internet Explorer application.	
7.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
8.	Close the drawing.	Do not save.

Cut/Fill Report

Generated: 2012-06-14 12:52:45

By user: noor.azhar

Drawing: C:\Users\noor.azhar.PDSSB\Desktop\C3D - Customised Training\C:\Users\noor.azhar.PDSSB\Desktop\C3D - Customised Training\15 Proposed Highway 2013 Volume.dwg

Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
COMBO	fill	1.000	1.000	39369.81	62879.35	33330.07	29549.28<Cut>

Totals

	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
Total	39369.81	62879.35	33330.07	29549.28<Cut>

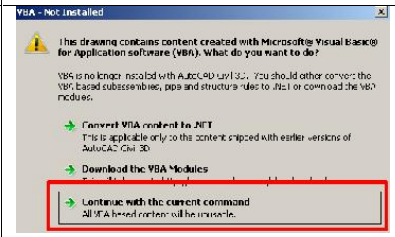
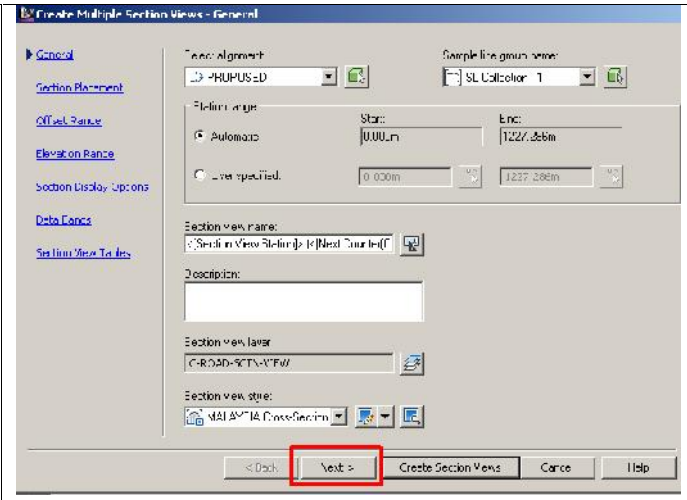
* Value adjusted by cut or fill factor other than 1.0

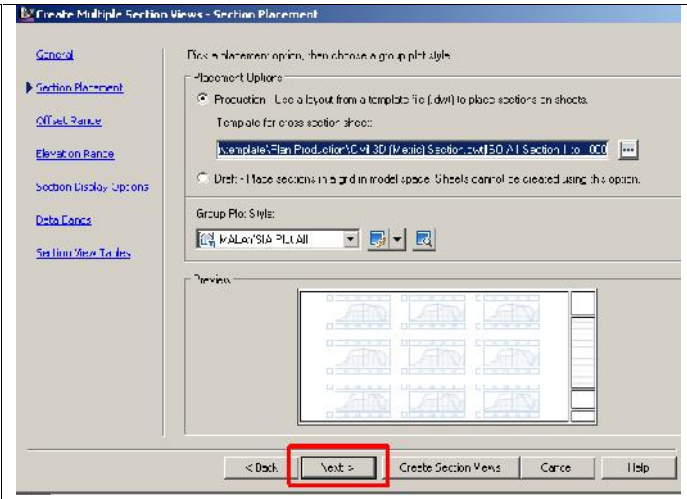
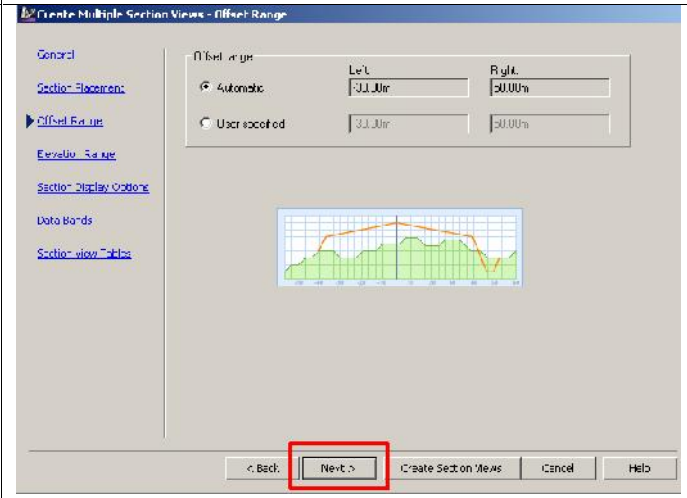
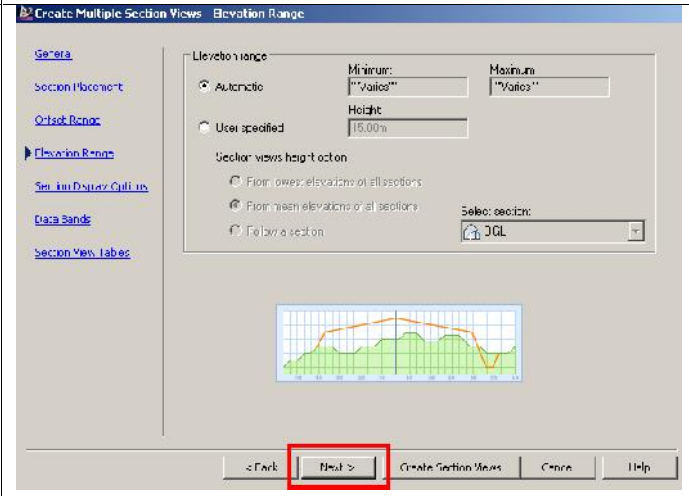
CHAPTER 12 : CROSS-SECTION DETAILING

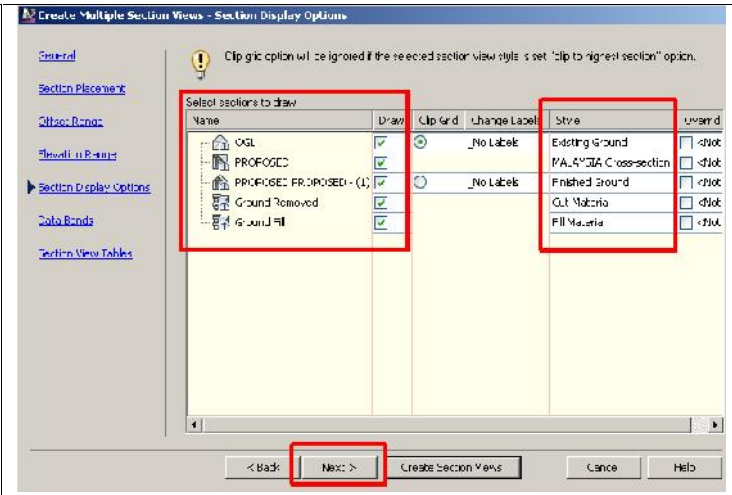
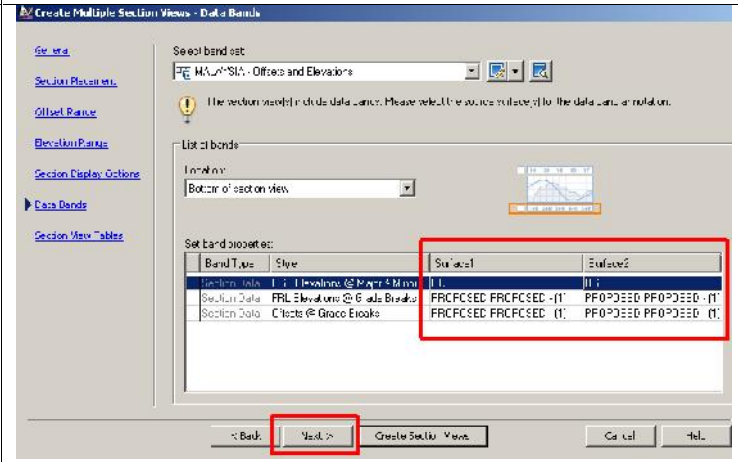
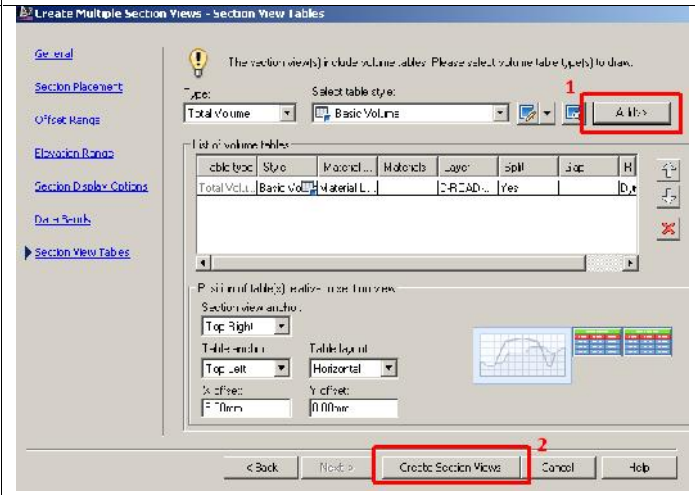
This chapter will demonstrate step-by-step approach to :

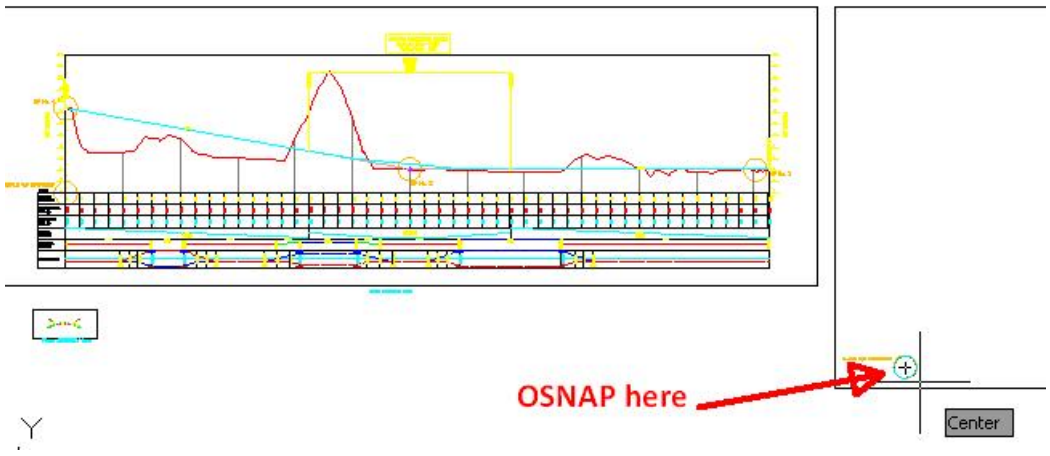
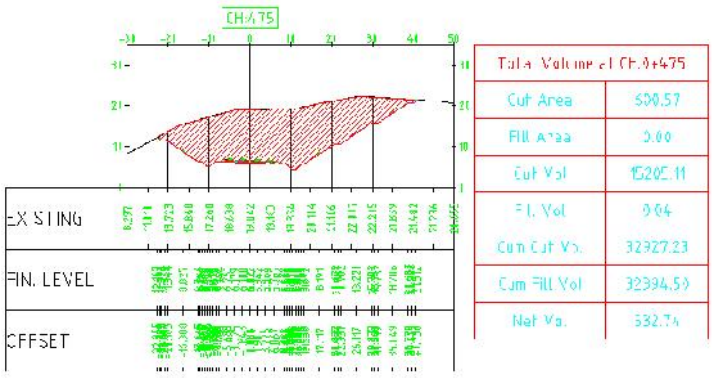
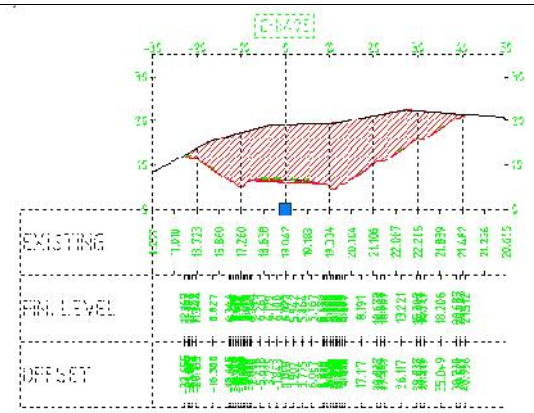
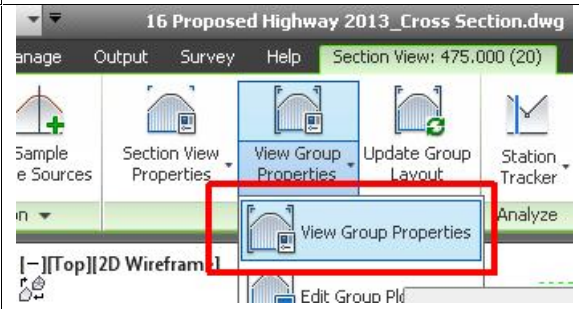
- Auto-generate cross-section detailing at certain intervals.

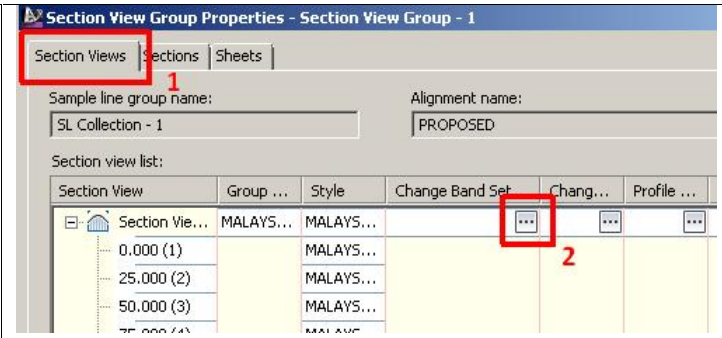
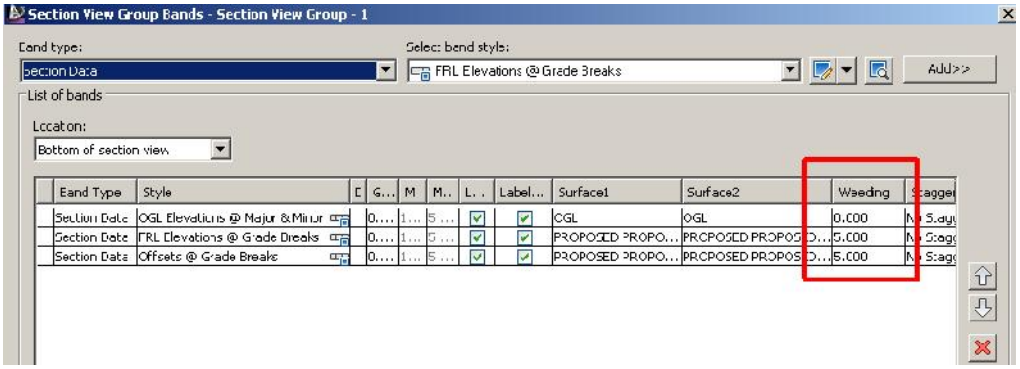
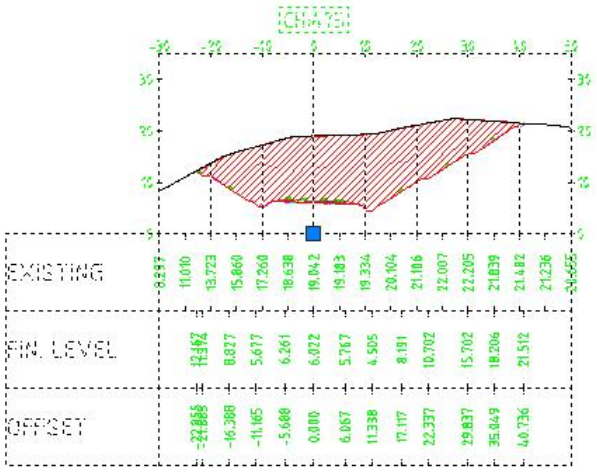
12.1 Creating Multiple Cross-Sections

No.	Descriptions	Commands/Remarks
1.	Open the drawing or continue from previous drawing.	 Browse to filename “16 Proposed Highway 2013_Cross Section.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Home tab > Section Views > Create Multiple Views 	
4.	Click “Next”.		

5.	Click “Next”.	
6.	Click “Next”.	
7.	Click “Next”.	

8.	Ensure the section names and styles as displayed. Click “Next”.	
9.	Ensure the “Surface1” and “Surface2” columns as displayed. Click “Next”. Note: If you do not see “PROPOSED” data, please delete the sample lines and re-create sample lines again.	
10.	• Click “Add>>” button. • Click “Create Section Views”.	

11.		
12.	A sample of Cross Section Views. We shall improve the Finished Level and Offset bands to reduce data.	
13.	Select any Section View.	
14.	On the ribbon menu, select “View Group Properties”.	

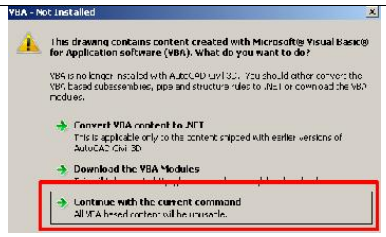
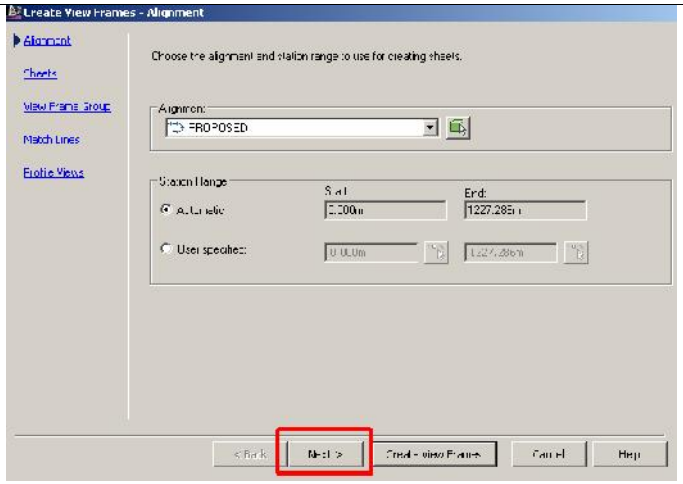
15.	Goto "Section Views" tab > under "Change Band Set" column, click the ellipse button.	
16.	Change the "Weeding" column as displayed:  Note : You may try bigger or smaller value to adjust the weeding parameter.	
17.	Click "OK" all the way.	
18.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
19.	Close the drawing.	Do not save.

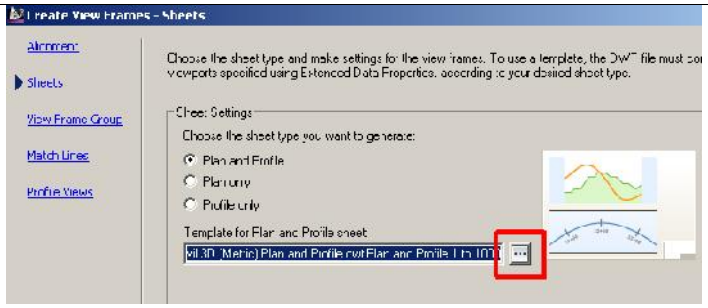
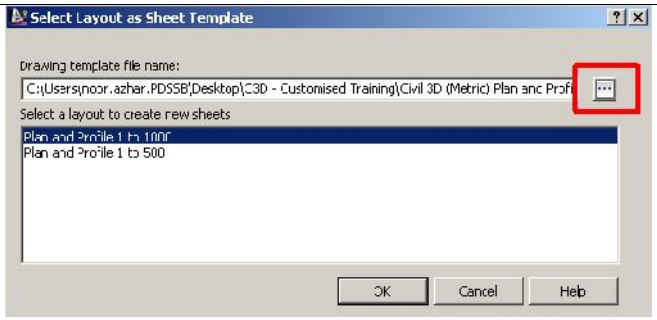
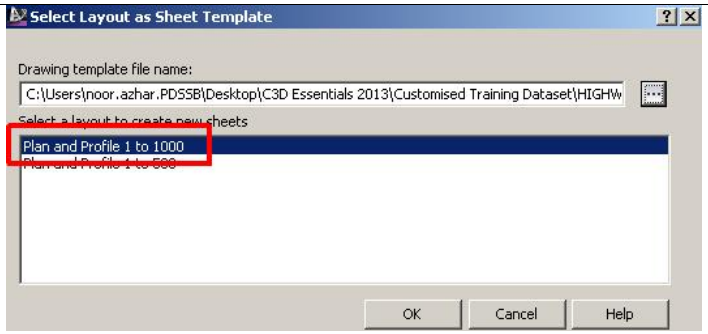
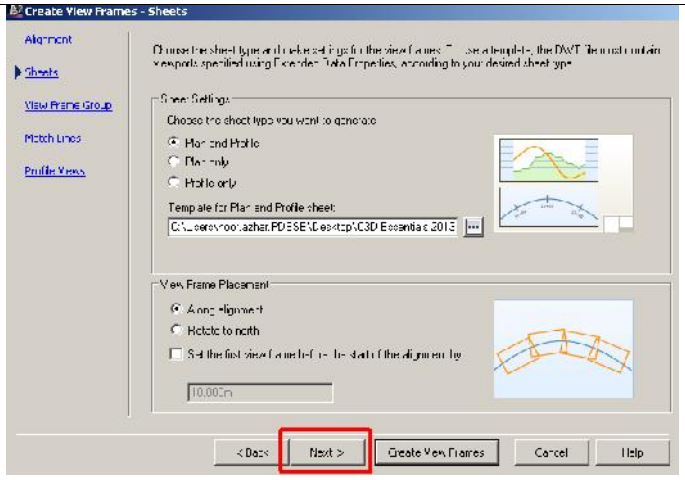
CHAPTER 13 : PLAN PRODUCTION

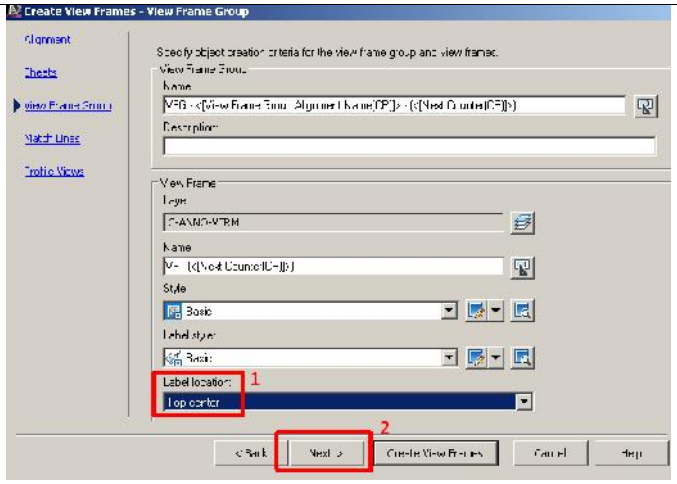
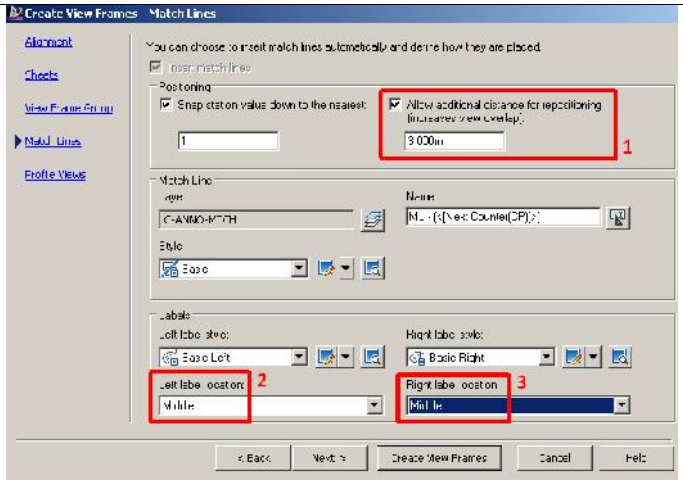
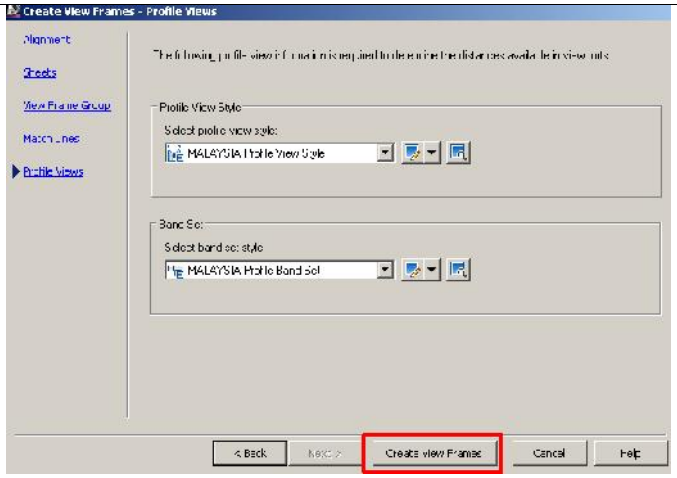
This chapter will demonstrate step-by-step approach to :

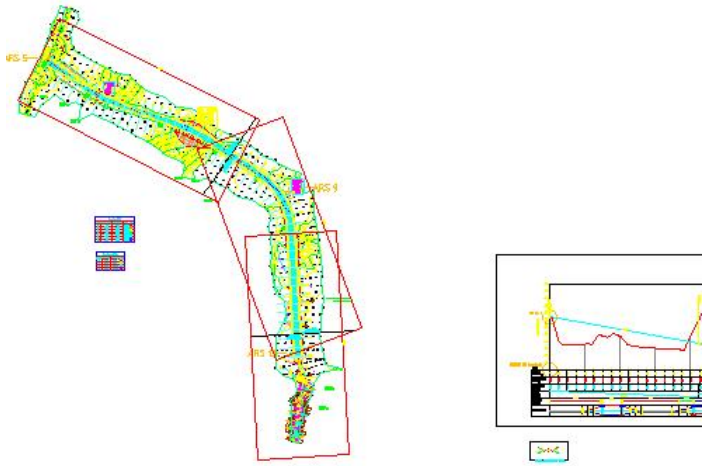
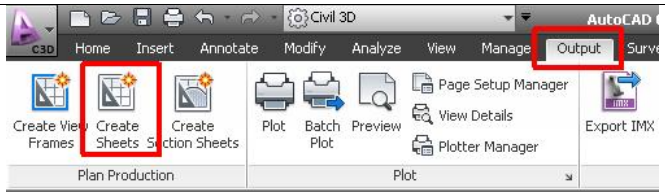
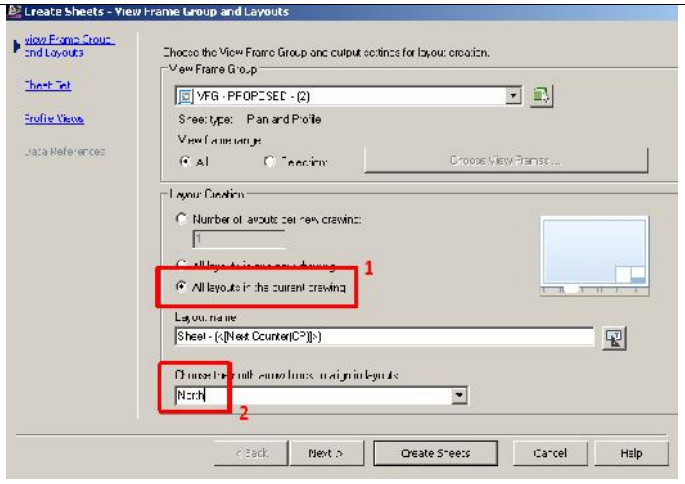
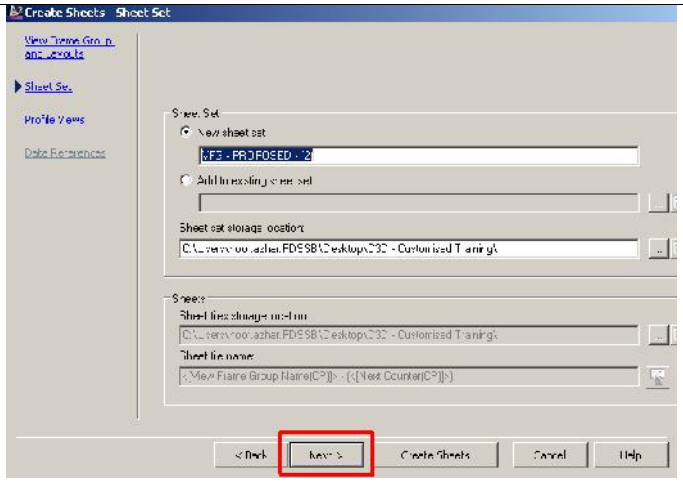
- Create construction plans.

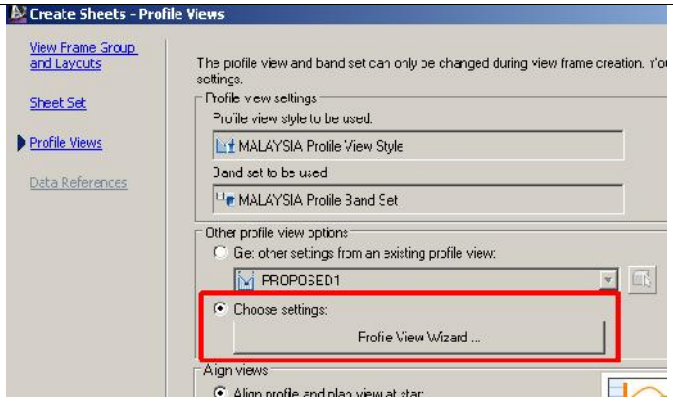
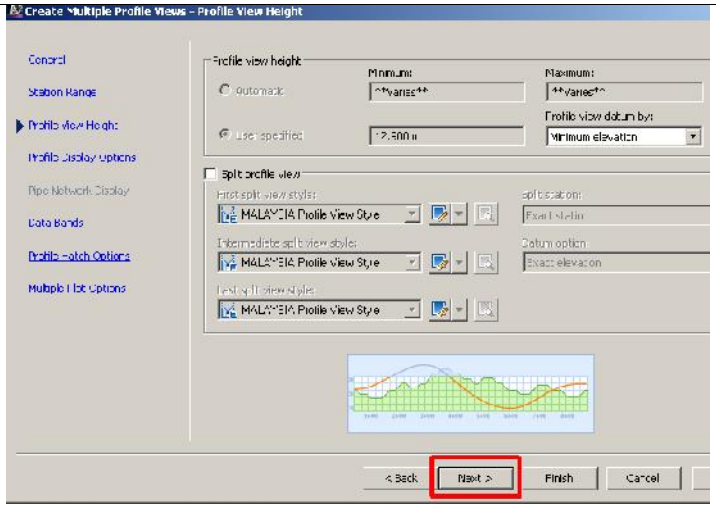
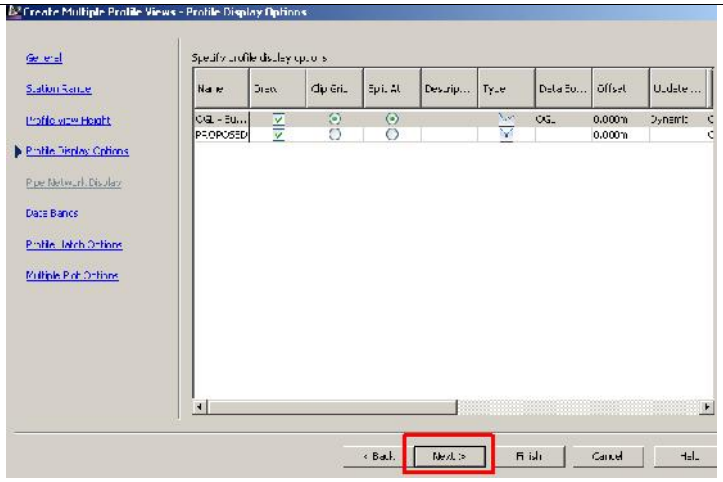
13.1 Creating Multiple View Frames and Sheets

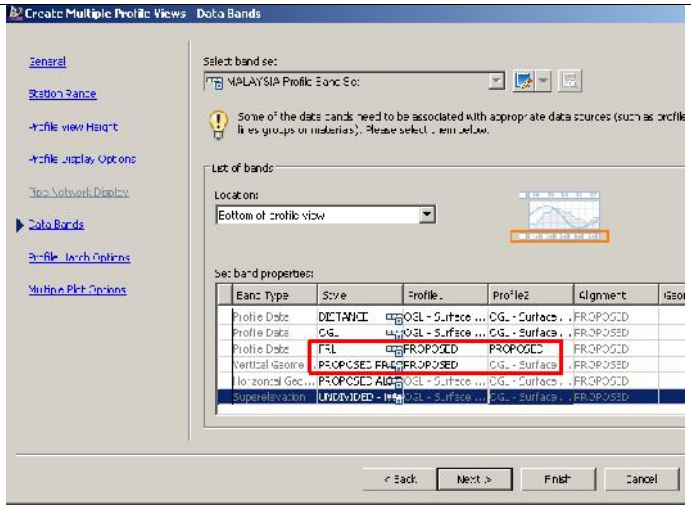
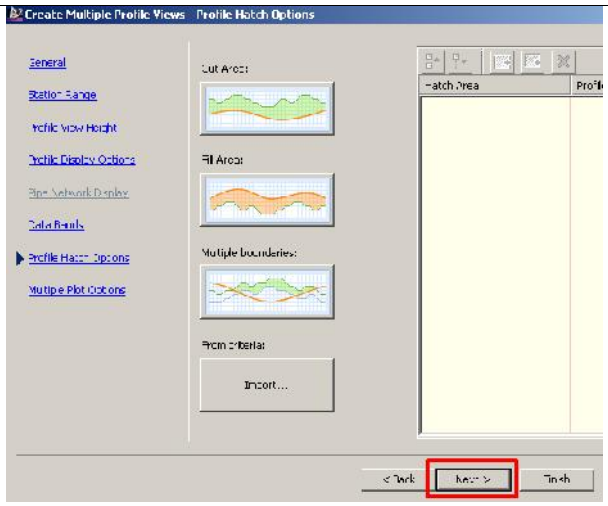
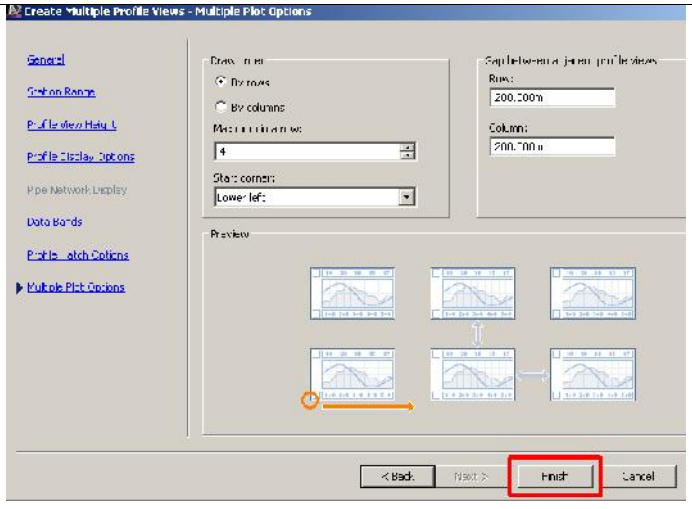
No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename “18 Proposed Highway 2013_Plotting.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Goto Output tab > Create View Frames 	
4.	Hit “Next” button.		

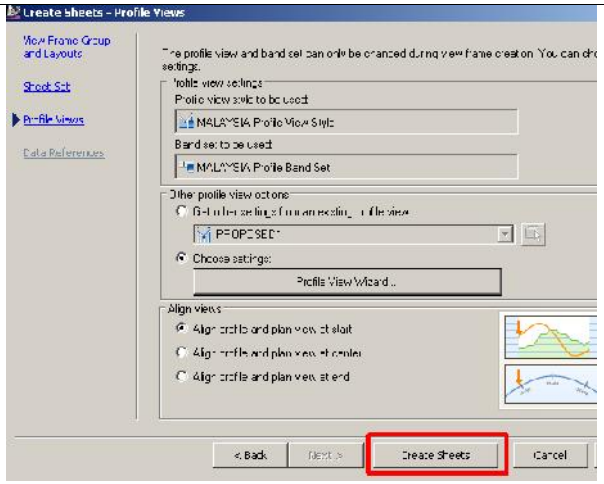
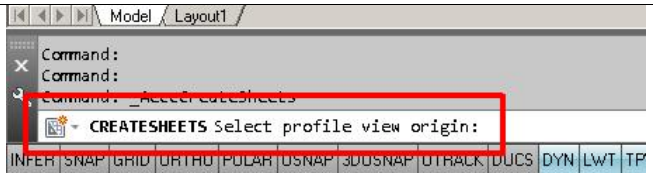
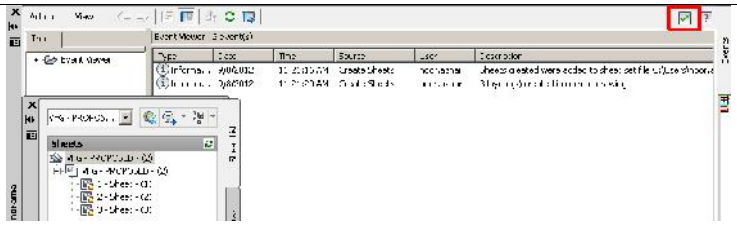
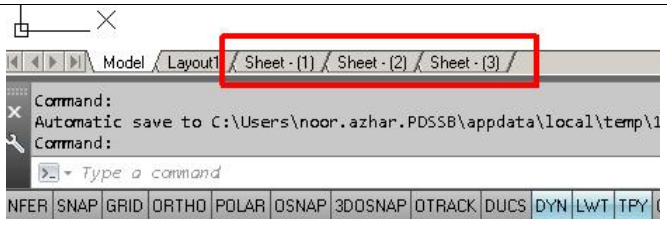
5.	Click the “ellipsis” button.	
6.	Click the “ellipsis” button, again.	
7.	Browse to the “..\C3D Essentials 20xx \ 03 INTENSIVE COURSEWARE \ ROAD WATER WASTEWATER” folder, and select the “Civil 3D 20xx JKR Plan and Profile.dwt” template. Then, hit the “Open” button.	
8.	Ensure to select “Plan and Profile 1 to 1000” setting. Then, hit “OK”.	
9.	Click “Next”.	

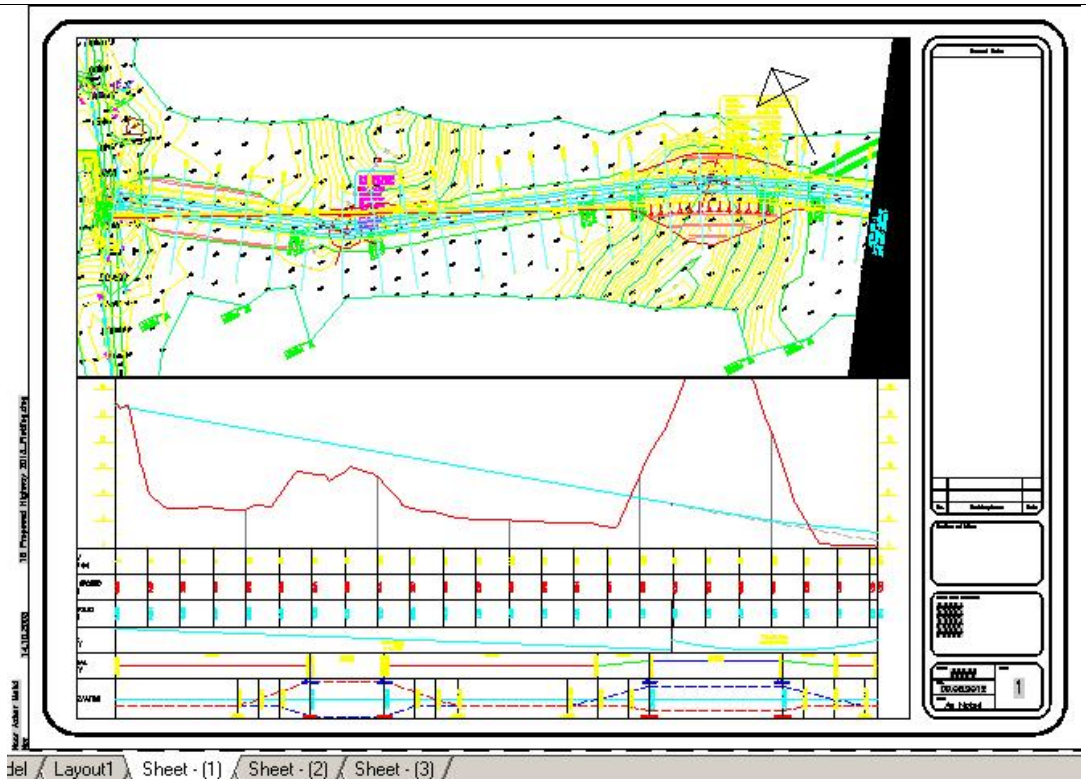
10.	Label location = “Top center”. Then, hit “Next”.	
11.	• Set the “Allow additional distance for repositioning” to 3.000m • Left label location = Middle • Right label location = Middle • Hit “Next” button.	
12.	Click “Create View Frames” button.	

13.	You should see three borders/view frames along the corridor.	
14.	Goto Output tab > Create Sheets	
15.	• Layout Creation = All layouts in the current drawing • The north arrow = North • Hit “Next” button.	
16.	Hit “Next” button.	

17.	Select the “Profile View Wizard…” button.	
18.	Hit “Next”.	
19.	Hit “Next”.	

20.	• Change the "Profile1" and "Profile2" columns as shown. • Hit "Next" button.	
21.	Hit "Next".	
22.	Hit "Finish".	

23.	Click “Create Sheets”.	
24.	Hit “OK”.	
25.	The command line will prompt, “Select profile view origin:”.	
26.	Just select anywhere in the model space (find an empty spot).	
27.	Two floating windows will appear. Just close the Event Viewer report.	
28.	Near the command line, there will be a row of Sheet sets. Click any of the tab to reveal the Plan and Profile layout ready to be plotted.	

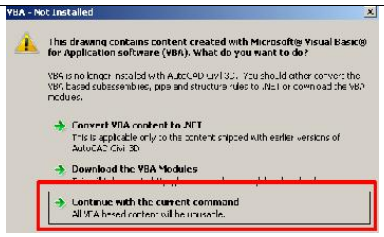
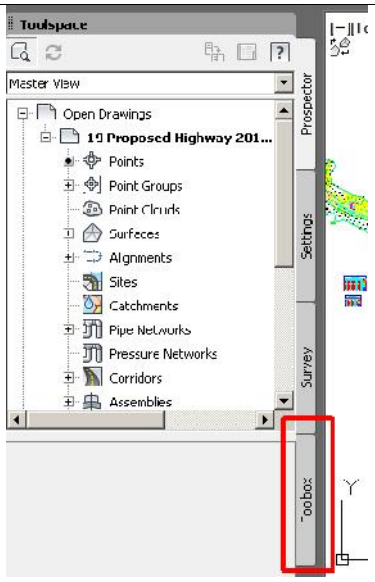
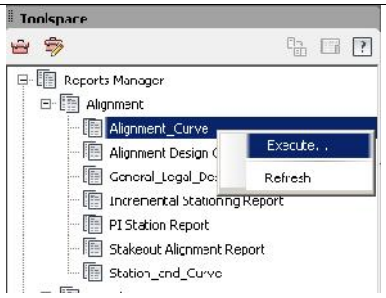
29.		
30.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
31.	Close the drawing.	Do not save.

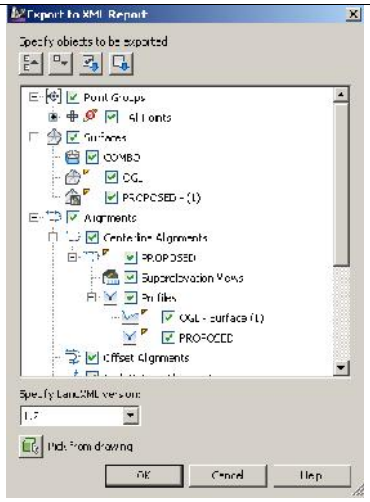
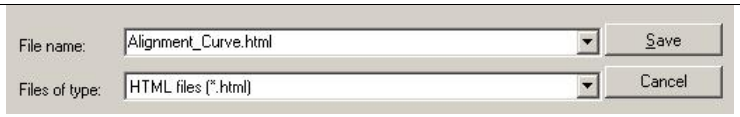
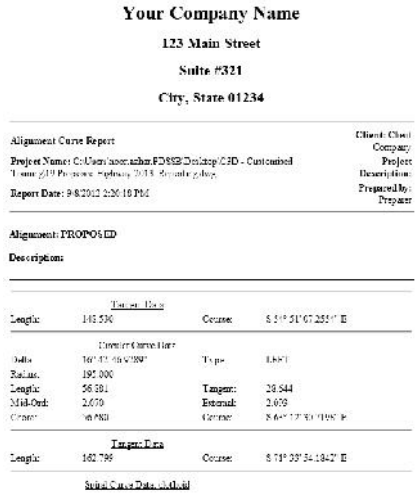
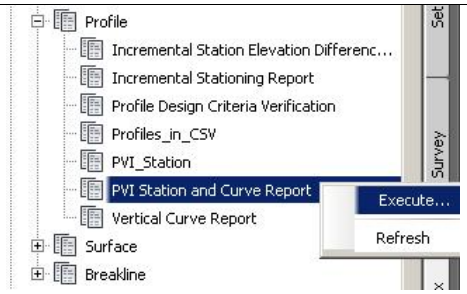
CHAPTER 14 : PRINT-OUT REPORTS

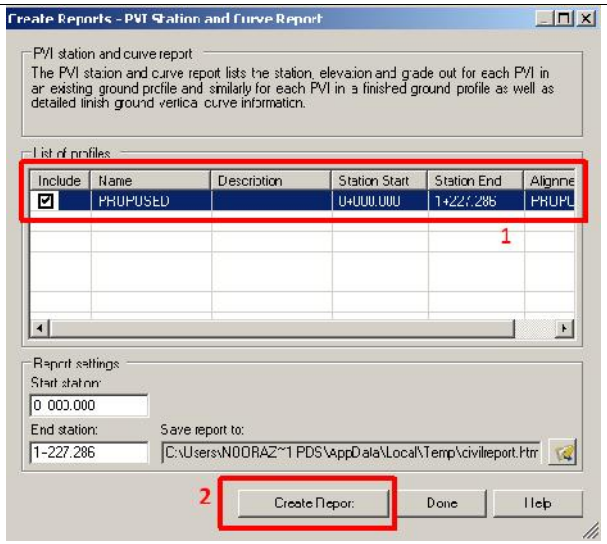
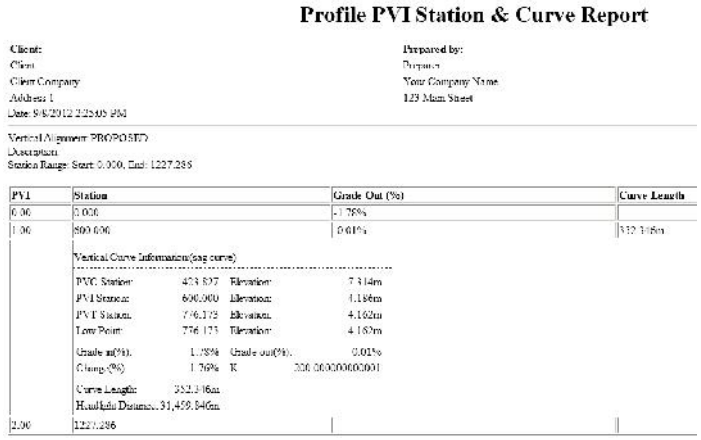
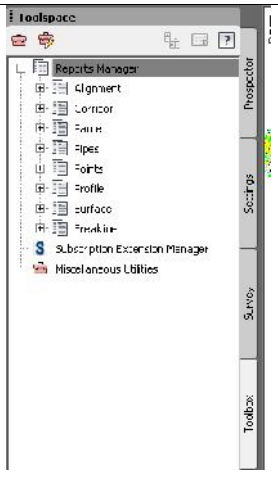
This chapter will demonstrate step-by-step approach to :

- Prepare print-out reports for proposed alignment and profile.

14.1 Generating Built-in Technical Report

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename “19 Proposed Highway 2013_Reporting.dwg”
2.	Ignore “VBA – Not Installed” message. Select “Continue with the current command”.	
3.	Activate the “Toolbox” tab.	
4.	Right-click “Alignment_Curve” > “Execute…”	

5.	Hit “OK”.	
6.	• Assign a name for the report. • Hit “Save”.	
7.	The default web browser will present the Alignment Curve report.	
8.	Right-click “PVI Station and Curve Report” > “Execute…”	

9.	• Select the alignment. • Hit the "Create Report" button.	
10.	The default web browser will present the Alignment Curve report.	
11.	You may proceed with other reports listed in the Toolbox tab.	
12.	Close all windows, Zoom Extents and regenerate the drawing.	"ZE" & "REA".
13.	Close the drawing.	Do not save.

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Intensive Training For Beginners

Water & Wastewater Module

Prepared and Conducted by:

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CHAPTER 7 : GRAVITY PIPE NETWORKS

In this chapter, we will look at modelling only. Model what? Model the pipe network for gravity-based systems. This kind of system is suitable for underground stormwater and sanitary sewer/sewerage layout.

There are two components which define a complete gravity-based pipe network, i.e. Structures and Pipes.

Structures = manholes, catch basins, inlets, joints and outlets. You may create your own Structures by using the Part Builder tool in Civil 3D.

Pipes = any type of conduit such as culverts, gas lines, or utility cables. They can be straight or curved. They can be adapted for water reticulation system too.

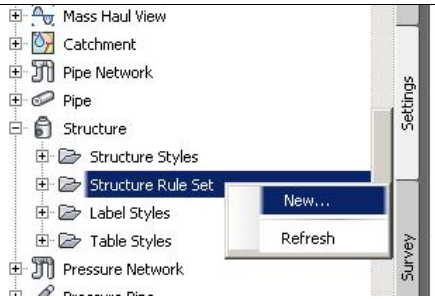
First, we will look at the workflow needed to model effective gravitational pipe networks. They are:

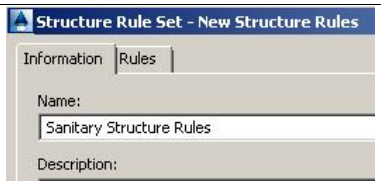
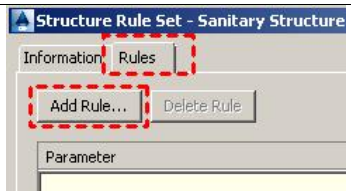
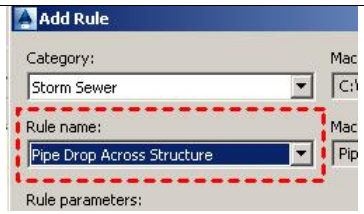
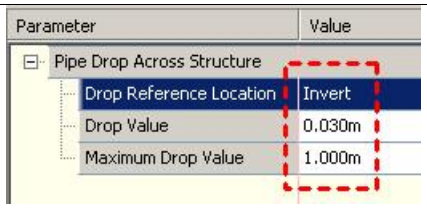
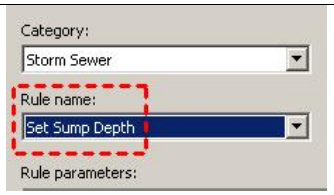
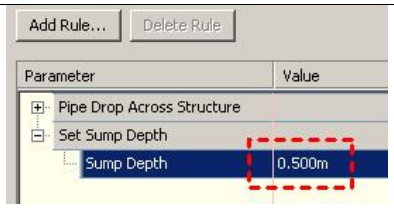
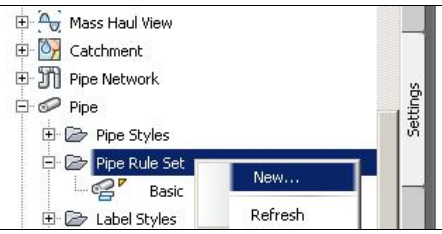
- Part Rules.
- Part Lists.
- Creating an underground Storm Drainage/Sanitary Sewer Network.
- Creating a Pipe Network.
- Editing the Pipe Network layout.
- Creating an Alignment from Network Parts.
- Drawing Parts in Profile View.
- Adding Pipe Network Labels
- Running the Interference/Clash Check.

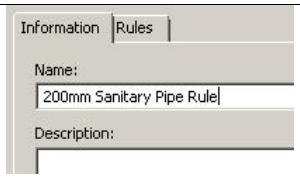
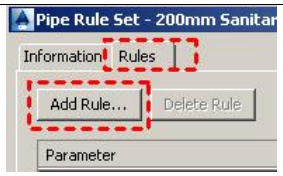
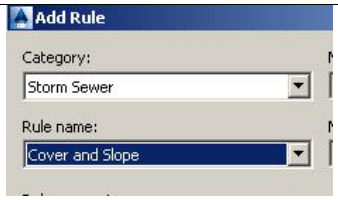
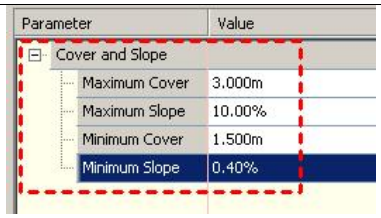
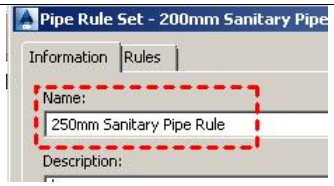
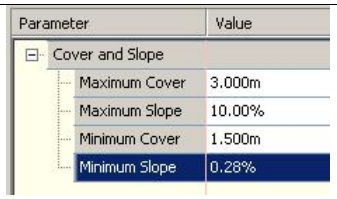
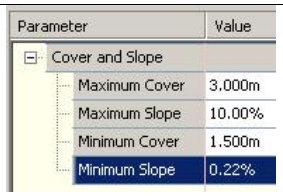
7.1 Part Rules and Part Lists

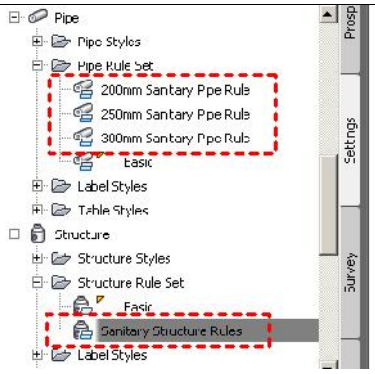
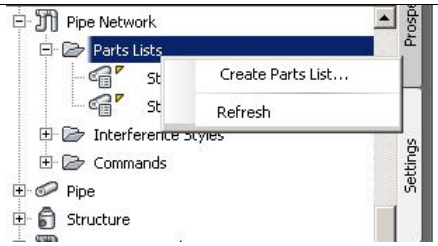
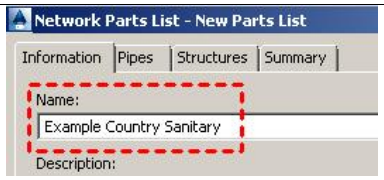
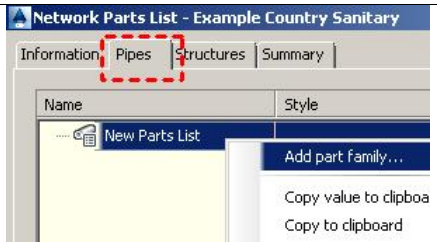
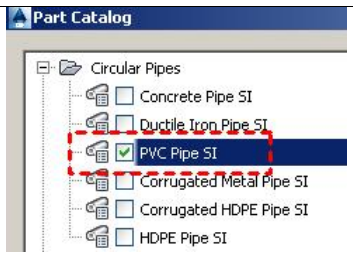
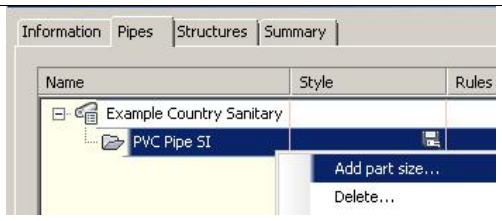
Every project will have local authority standard/requirements to control the limit/allowance of the proposed gravitational pipe design – things like minimum slope, sump depths, and pipe-invert drop across structure.

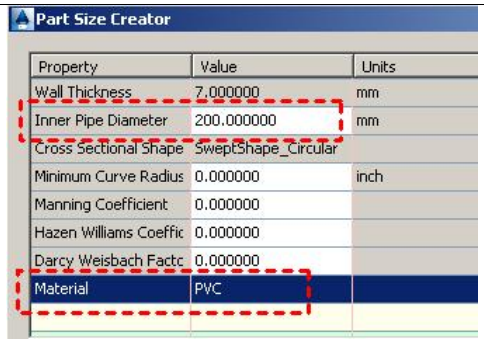
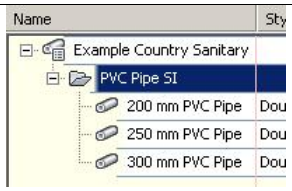
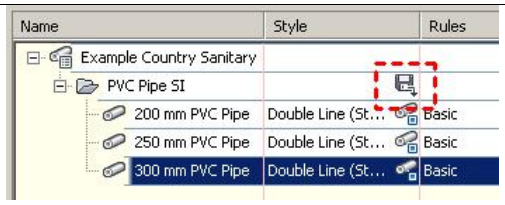
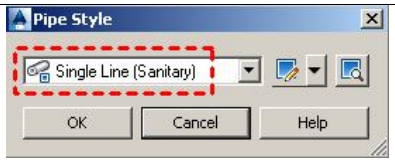
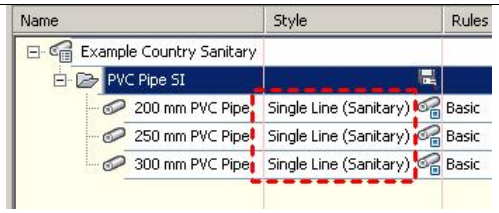
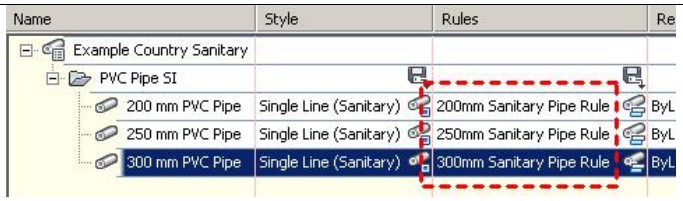
Depending on the type of network (stormwater or sewerage) and the complexity of the design, there are many different constraints on your design. Civil 3D allows you to establish structure and pipe rules that will assist in respecting these constraints during initial layout and edits.

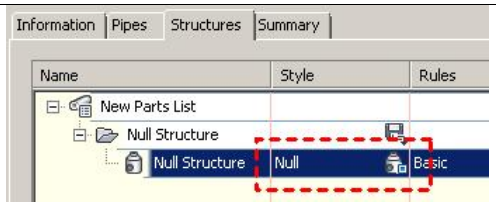
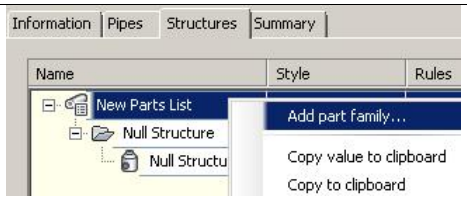
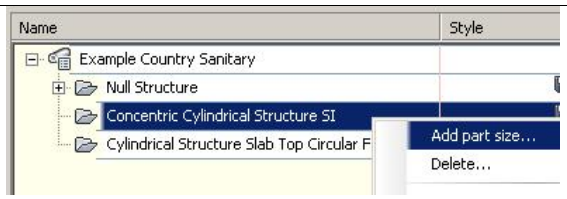
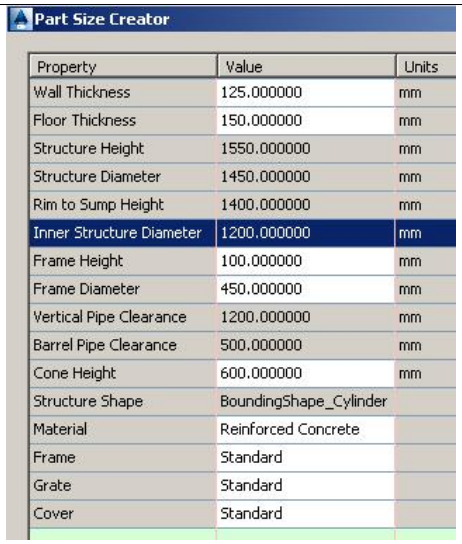
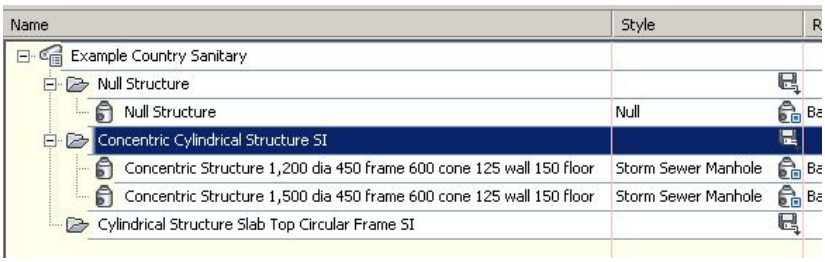
No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**31 Civil 3D Template_Rules_METRIC.dwg**"
2.	Activate "Settings" tab > Structure > RC Structure Rule Set > New…	

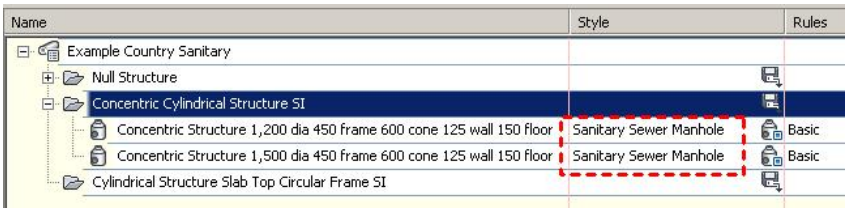
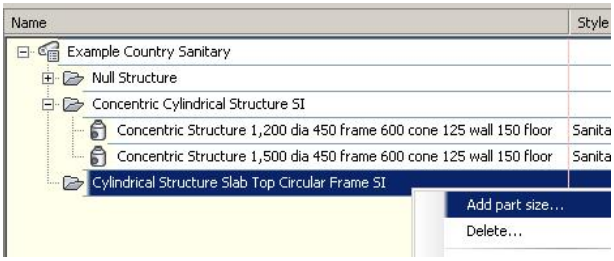
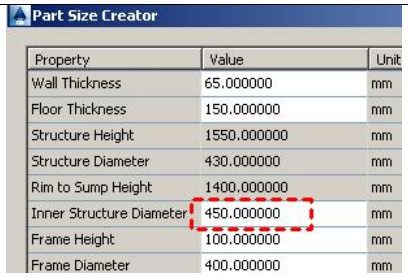
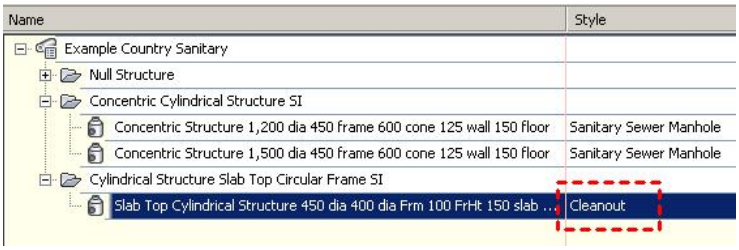
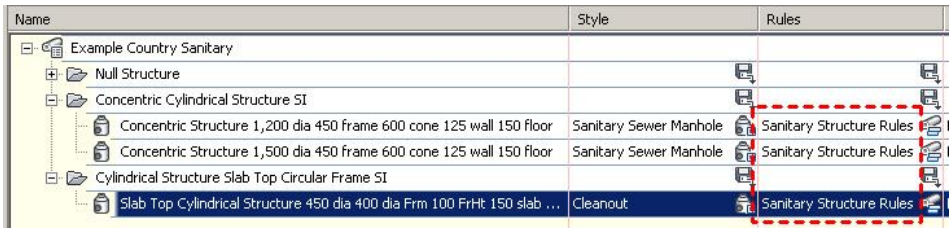
3.	Name = Sanitary Structure Rules.	
4.	Goto “Rules” tab > Add Rule…	
5.	Rule name = Pipe Drop Across Structure. Click “OK”.	
6.	Set the limit as highlighted. These parameters establish a rule that will match your hypothetical municipality’s standard (eg. Jabatan Perparitan & Pembetungan).	
7.	Goto “Rules” tab > Add Rule…	
8.	Rule name = Set Sump Depth. Click “OK”.	
9.	Set the limit as highlighted. These parameters establish a rule that will match your hypothetical municipality’s standard (eg. Jabatan Perparitan & Pembetungan). Click “OK”.	
10.	Activate “Settings” tab > Pipe > RC Pipe Rule Set > New…	

11.	Let's name it as "200mm Sanitary Pipe Rule".	
12.	Goto "Rules" tab > Add Rule…	
13.	Select "Cover and Slope" > OK	
14.	Set the limit as highlighted. These parameters establish a rule that will match your hypothetical municipality's standard (eg. Jabatan Perparitan & Pembetungan). Click "OK".	
15.	Right-click the newly created rule set > Copy…	
16.	Rename as shown.	
17.	Update the values as shown > OK.	
18.	Repeat steps 15 to 17 to generate another pipe rule 300mm as shown. Click "OK" when done.	

19.	You should now have 1 rule for Structure and 3 rules for pipe as shown.	
20.	The next step is to define the Part Lists. The Part Lists should reside in the Civil 3D template (.DWT). There is quite a bit of setup involved, and having this information in your .DWT file will ensure you do it only once.	
21.	Settings tab > Pipe Network > RC Parts Lists > Create Parts List…	
22.	Name it as shown.	
23.	Pipes tab > RC New Parts List > Add part family… The Part Catalog dialog will appear.	
24.	Let's assign "PVC Pipe SI" material for our Sanitary Sewerage Network. Click "OK".	
25.	RC "PVC Pipe SI" > Add part size…".	

26.	Update the highlighted values > OK. For "Material", you may type in your own material name. But the engineering properties is not available in Civil 3D. E.g. "Fibre-glass"; no engineering properties of fibre-glass is available in calculations later.	
27.	Repeat Steps 25 and 26 to generate for 250mm and 300mm pipes as shown.	
28.	Click the "disk" icon in the Style column.	
29.	Let's assign "Single Line (Sanitary)" style. Click "OK".	
30.	Now, all three diameters will use the same style in the drawing later.	
31.	Assign each diameter following their respective Rules as shown.	
32.	Activate the "Structures" tab. Note: Null structures are needed when two pipes are joined together without a structure.	

33.	Change the style to “Null”.	
34.	RC “New Parts Lists” > Add part family…	
35.	Let’s assign the sewerage manholes as shown. Click “OK”.	
36.	RC “Concentric Cylindrical Structure SI” > Add part size…	
37.	Verify the values > OK.	
38.	Repeat Steps 36 and 37 to generate another type of manhole shown below: 	

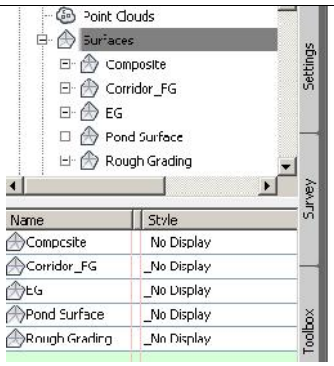
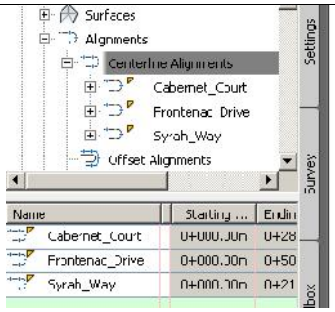
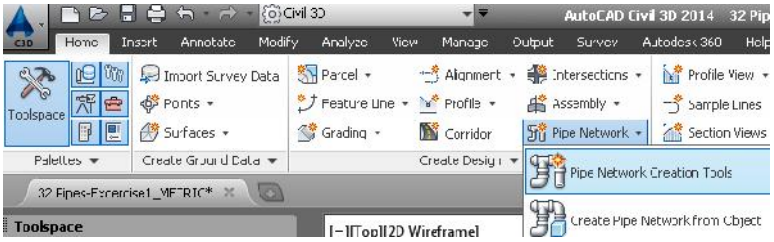
39.	Assign the style to be “Sanitary Sewer Manhole” as shown. 
40.	RC “Cylindrical Structure Slab Top Circular Frame SI” > Add part size… 
41.	Set the “Inner Structure Diameter” to “450mm”. Click “OK”. 
42.	Change the style to “Cleanout”. 
43.	Finally, set the rules as shown. 
44.	Click “OK” to complete the Parts List dialog and save the drawing to filename “**32 Pipes-Exercise1_METRIC.dwg**”.

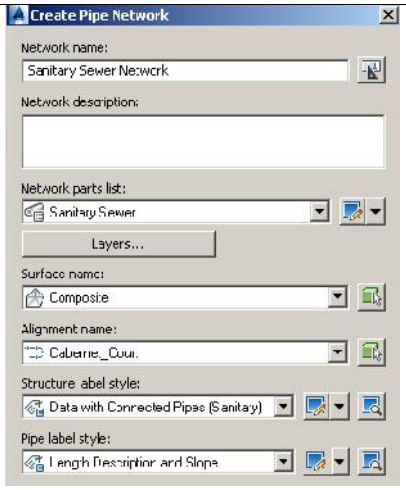
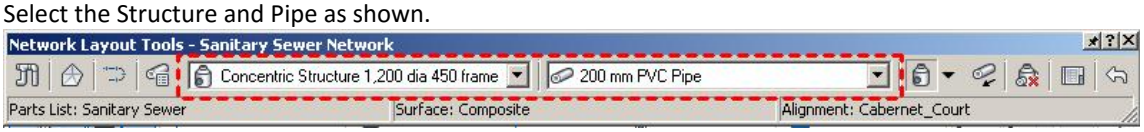
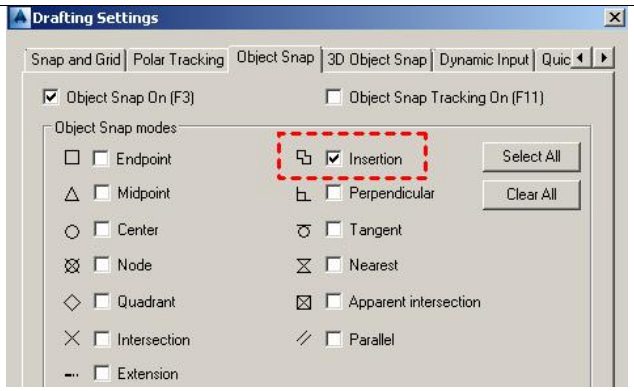
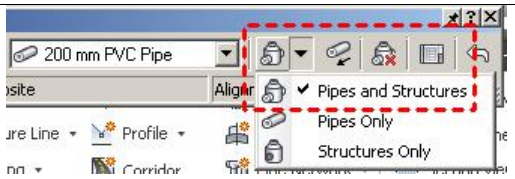
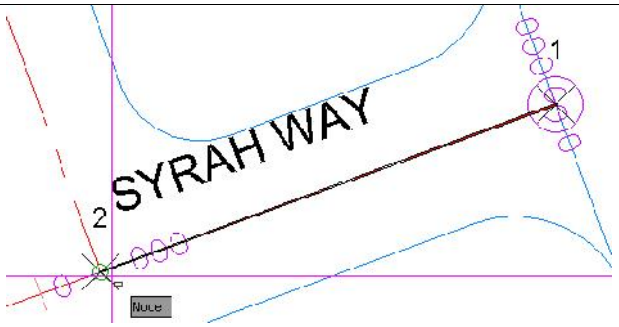
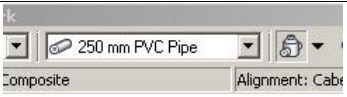
7.2 Creating a Sanitary Sewer/Sewerage/Drainage/Stormwater Gravity Network

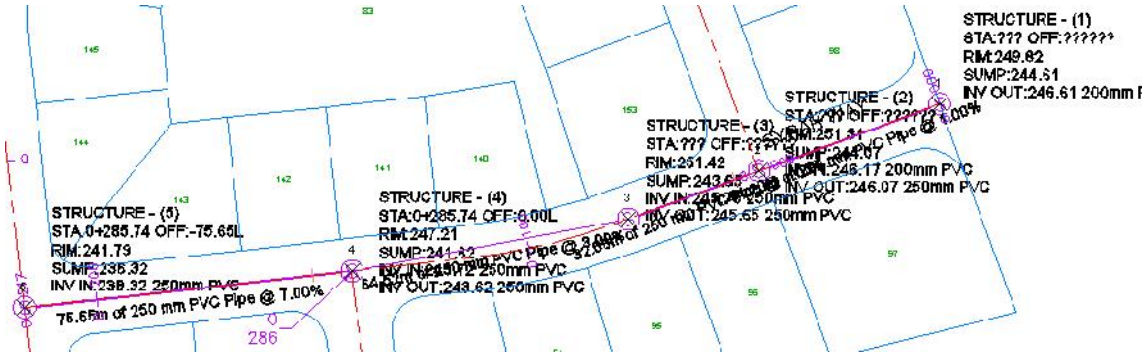
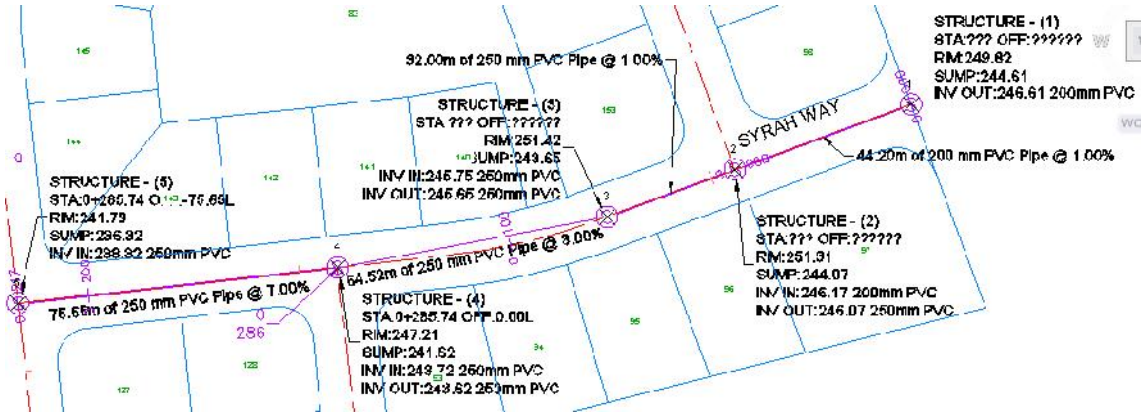
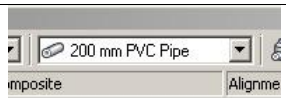
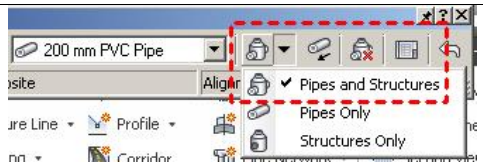
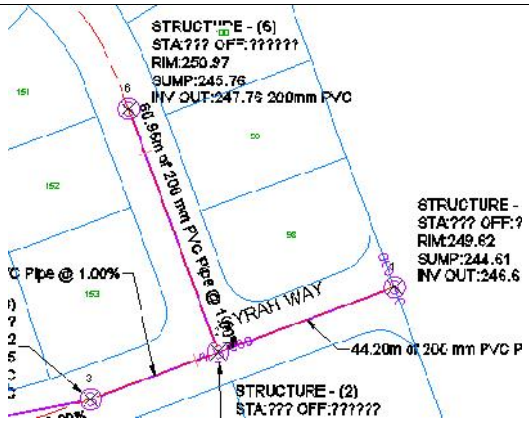
Once we have determine the Part Lists and Pipe Rules for a project, we are now ready to design, edit, and annotate a complete gravitational pipe network system.

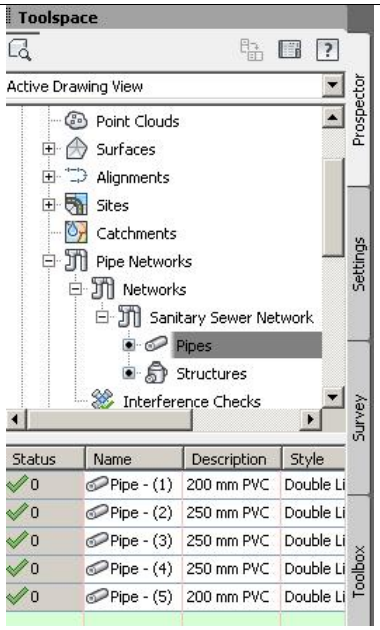
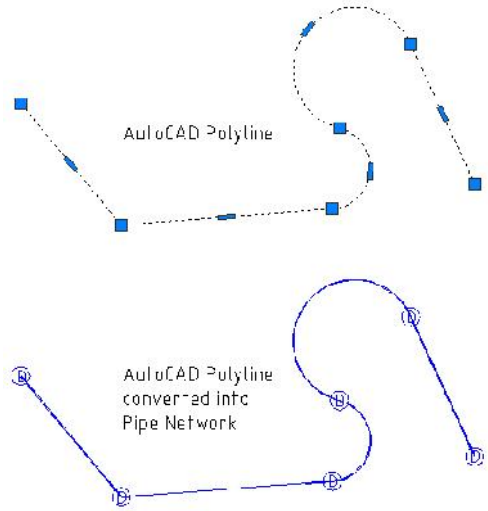
There are several ways to create gravitational pipe networks. You can do so by using the Civil 3D pipe Network Layout Tools. You can also create gravitational pipe networks from AutoCAD objects such as lines and polylines. Or, use any existing Civil 3D objects such as alignments and feature lines.

This exercise will give you hands-on experience using the Civil 3D Network Layout Tools method.

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**32 Pipes-Exercise1_METRIC.dwg**".
2.	Expand the Surfaces branch in Prospector. This drawing has several surfaces which have a "_No Display" style applied to simplify the drawing. The surface you will be working off is a composite of the existing conditions, corridor surfaces, and grading surfaces.	
3.	Notice that there are several road alignments too.	
4.	Home tab > Pipe Network > Pipe Network Creation Tools. 	

5.	Complete the dialog as below: • Network name = Sanitary Sewer Network • Part list = Sanitary Sewer • Surface = Composite • Alignment = Cabernet_Court • Structure label style = Data with Connected Pipes (Sanitary) • Pipe label style = Length Description and Slope. Click "OK".	
6.	Select the Structure and Pipe as shown.	
7.	Activate "Node" OSNAP.	
8.	Run the "Pipes and Structures" command as highlighted.	
9.	Click the "X" at point 1 and "X" at point 2 as shown.	
10.	Change the pipe to "250mm".	

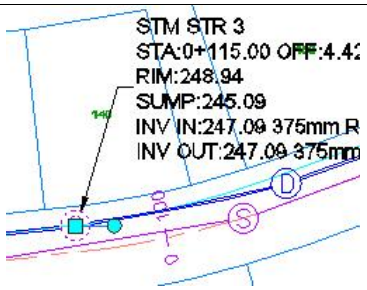
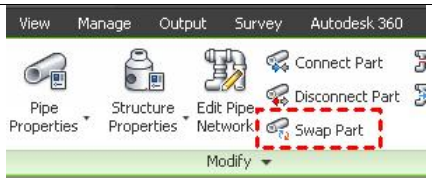
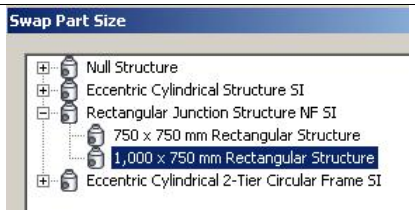
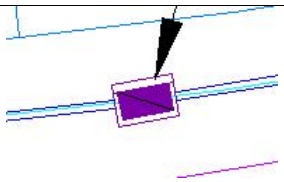
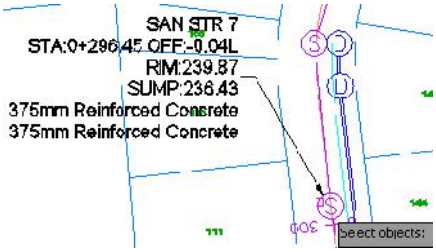
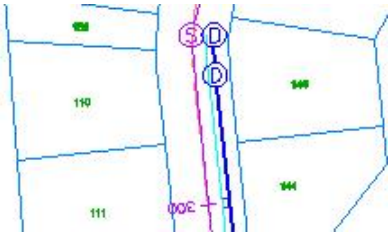
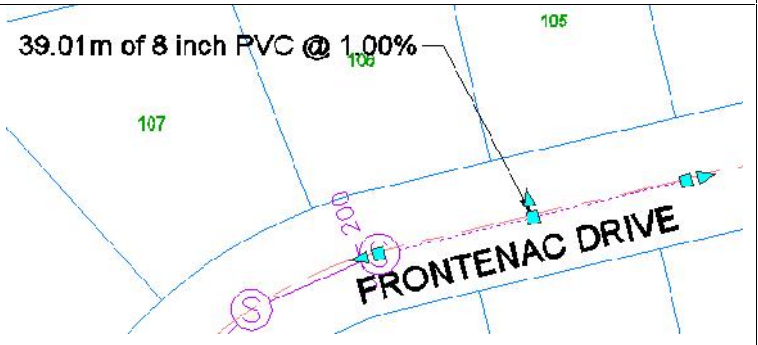
11.	Place the Structures at "X"s labelled 3, 4 and 5. Hit "ENTER" keyboard to complete the command.	
12.	Let's clean-up the labels by using the label grip to drag the label off to the side.	
13.	Change the pipe back to "200mm".	
14.	Run the "Pipes and Structures" command again.	
15.	Connect the "X" label 6 to label 2.	

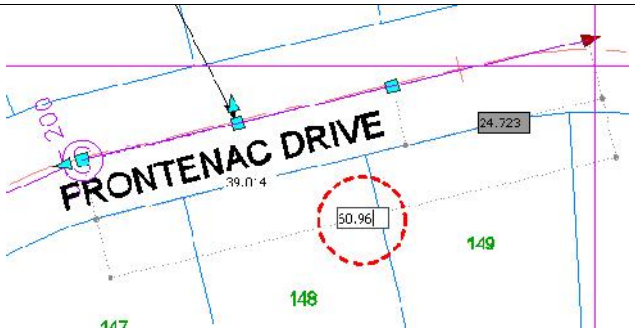
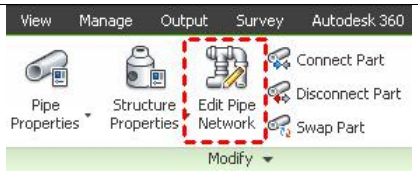
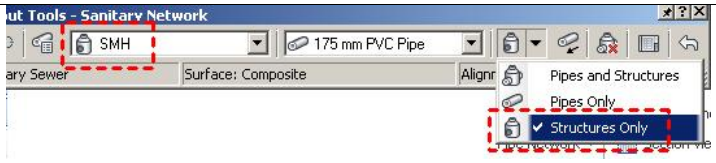
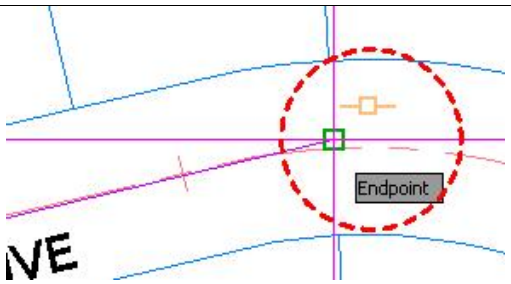
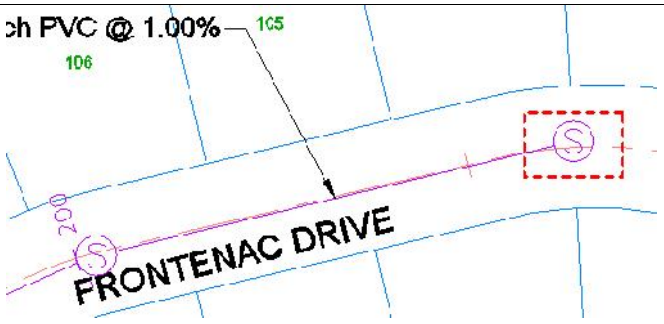
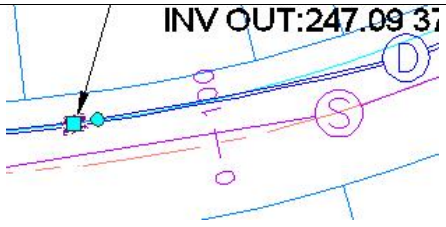
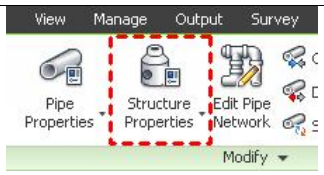
16.	In the Prospector tab, browse to the Sanitary Sewer Network list. When you click the "Pipe", the preview pane will list the pipes that you have modelled previously. If you click "Structures", the preview pane lists the manholes information.	
17.	Close the model withOUT saving.	
Generally, you may want to try converting AutoCAD polyline into Civil 3D Pipe Network as shown. The "**Create Pipe Network From Object**" command creates **a** Pipe for every linear segment of the polyline and places **a** Structure at every vertex. This option is useful for long-single run pipe network. It can't build branching networks or append objects to this network. However, once many pipe networks exist in the same model, you can merge them together using "**Merge Networks**" command.		

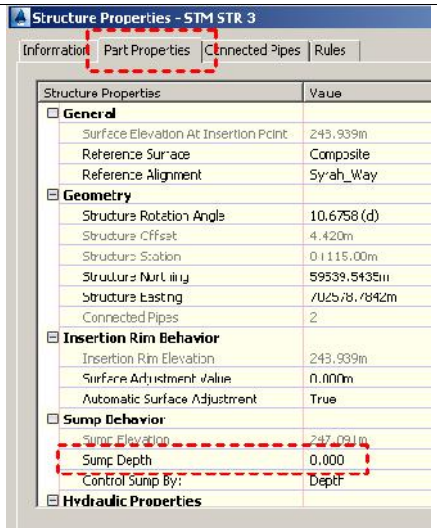
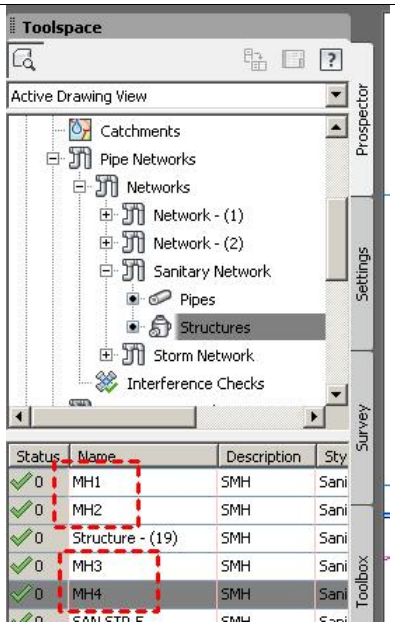
7.3 Editing Gravity Pipe Network

This exercise will give you hands-on experience in making a variety of edits to a gravitational flow of Sanitary Sewer and gravitational flow of Stormwater Drainage systems.

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**33 EditingPipesPlan_METRIC.dwg** ".

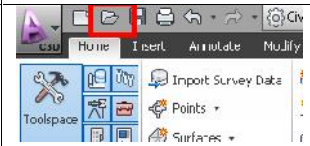
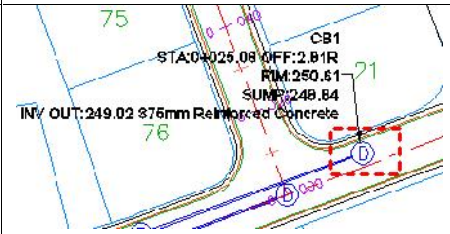
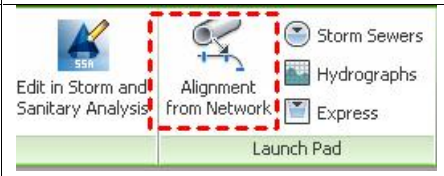
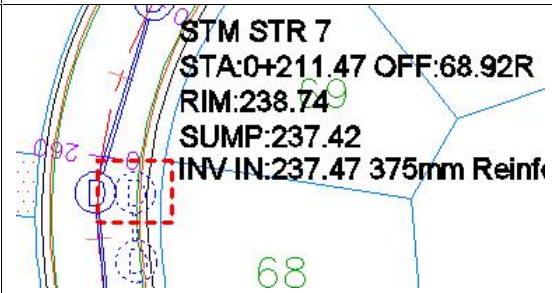
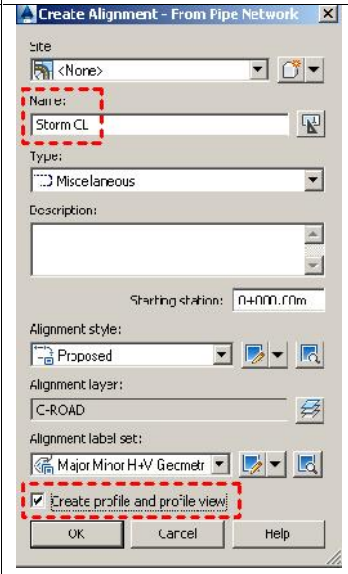
2.	Select the structure STM STR 3 icon in the drawing.	
3.	Run the “Swap Part” command.	
4.	Let’s change the catch basin to “1,000x750mm” size. Click “OK”.	
5.	A new icon is placed to represent catch basin.	
6.	Use AutoCAD Erase command to delete structure SAN STR 7.  BEFORE  AFTER	
7.	Select the sanitary sewer pipe at the north of the drawing.	

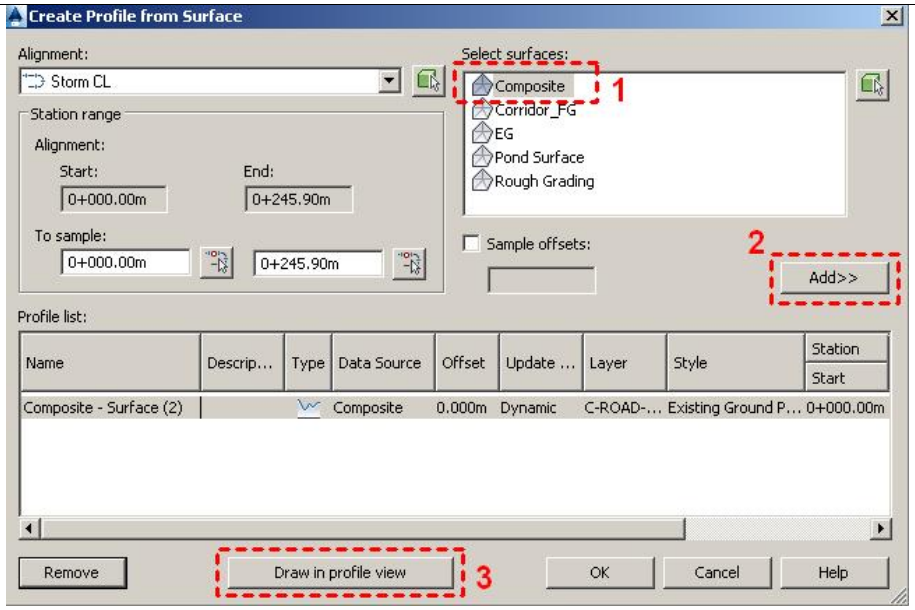
8.	• Click the cyan-colour triangular grip. • Hit the TAB keyboard. • ENTER “60.96” to change the length of the pipe. Note: The length is the effective 3D length which include the slope/gradient of the pipe.	
9.	Select any pipe in the drawing > Edit Pipe Network	
10.	• Assign “SMH” structure list. • Run the “Structure Only” command.	
11.	Click at the end of the pipe line that we have lengthened previously. Note: There is a special peach-colour grip telling you that a structure will be attached to the end of this pipe/line.	
12.	A brand new manhole has been added to the end of the pipe.	
13.	Select the STM STR 3 catch basin in the model.	
14.	Run the “Structure Properties” command.	

15.	• Goto "Part Properties" tab. • Change the Sump Depth to "0.000". • Click "OK".	
16.	Goto Prospector tab, and browse to the Structures list as shown. You may rename the each structure located in the preview pane as highlighted.	
17.	Close the drawing without saving.	

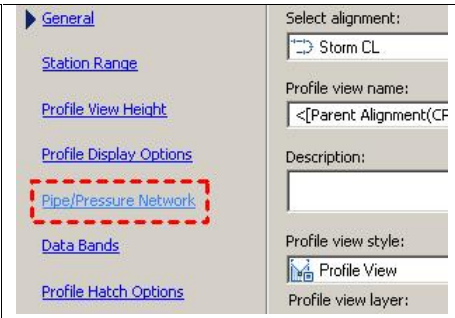
7.4 Creating an Alignment from Network Parts

On some occasions, certain legs of the pipe network require their own stationing/chainage. Perhaps most of your pipes are shown on a road profile but the legs that run offsite or through open space require their own profiles. Whatever the reason, it's often necessary to create an alignment from network parts. The next exercise will demonstrate this mission.

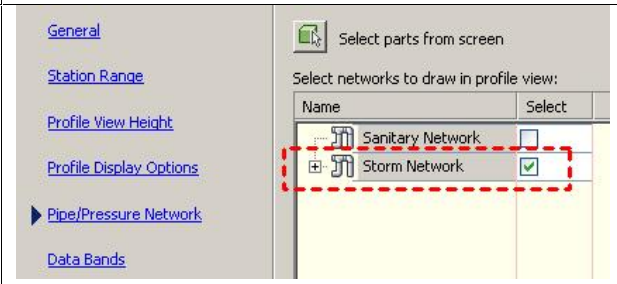
No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**34 AlignmentFromNetworkParts_METRIC.dwg**".
2.	Select the **CB1** structure.	
3.	Select "Alignment from Network" ribbon command.	
4.	Select the STM STR 7 structure > ENTER keyboard.	
5.	Name your alignment "Storm CL". Notice the "Create Profile and Profile View" is activated. Click "OK".	
6.	• Select "Composite" surface. • Click "Add". • Click "Draw In Profile View".	



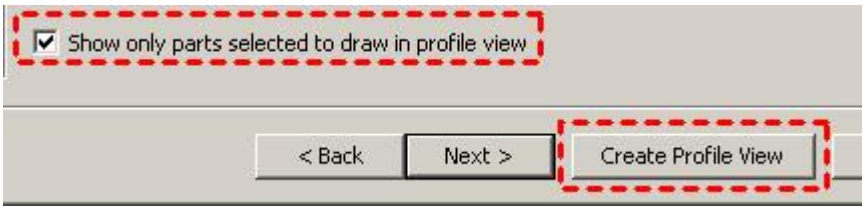
7. Jump to "Pipe/Pressure Network" link.

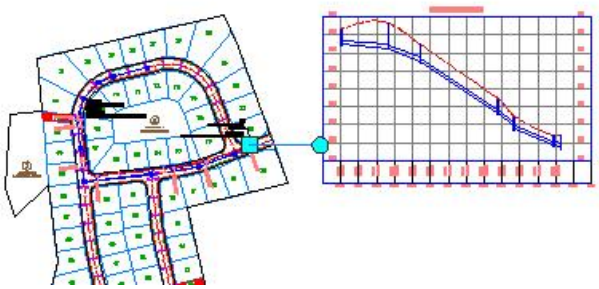


8. Ensure "Storm Network" list is activated.



9.
- Ensure "Show only parts selected to draw in profile view" is actiavted.
- Click "Create Profile View".

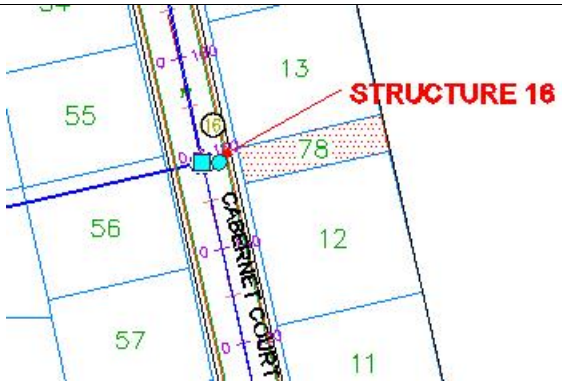
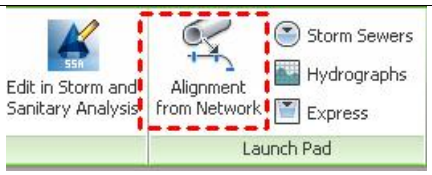


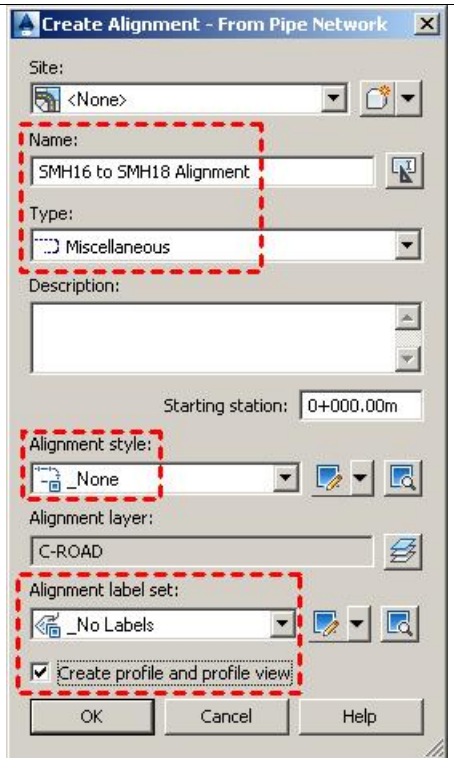
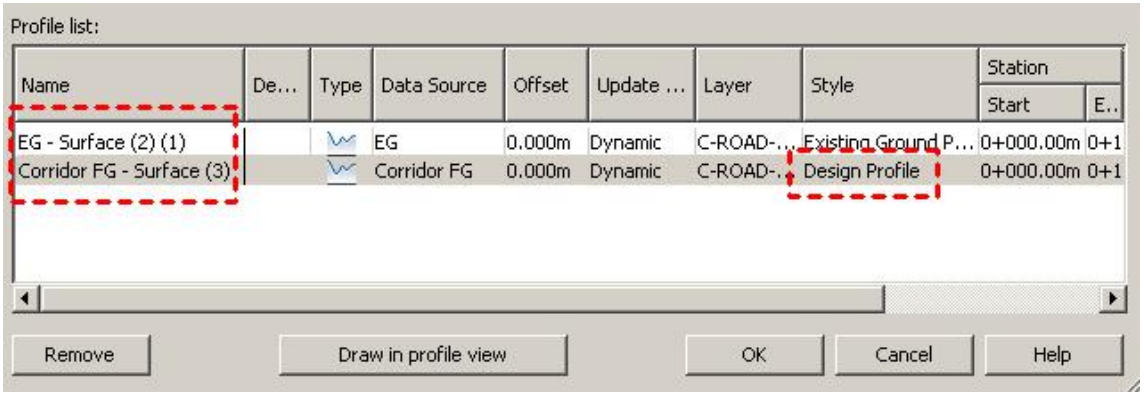
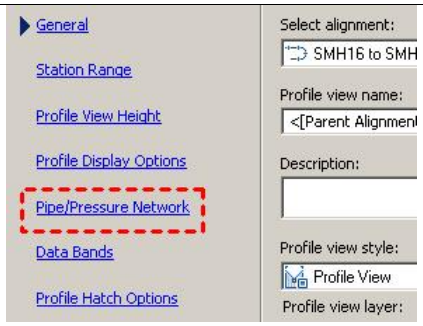
10.	Zoom out and click any empty space in the model.	
11.	Close the drawing without saving.	

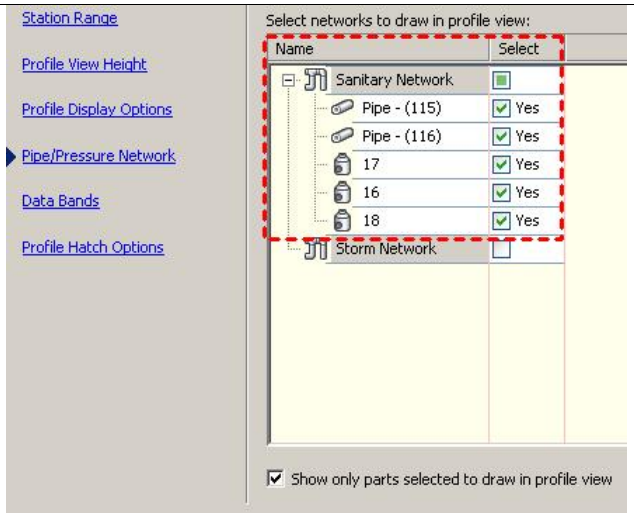
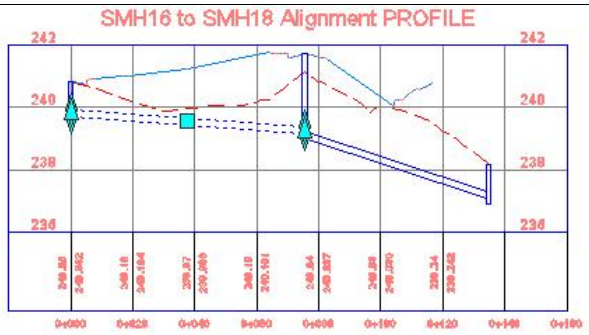
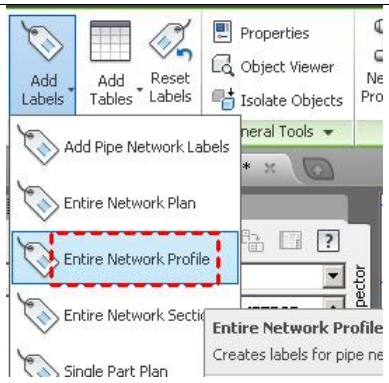
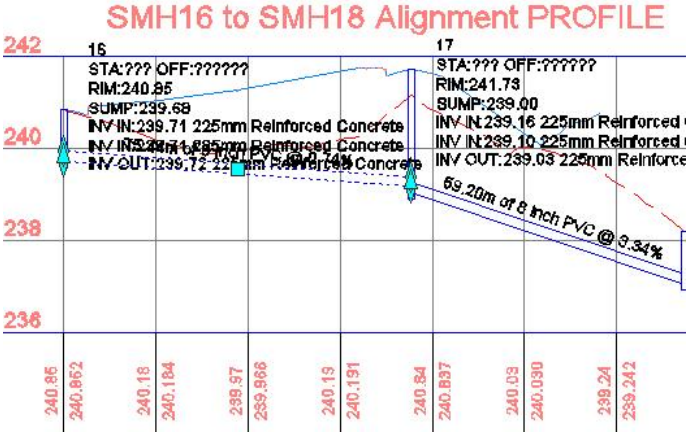
7.5 Labelling Pipe Network Profile including Crossings

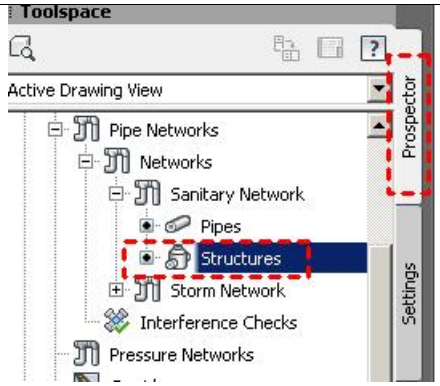
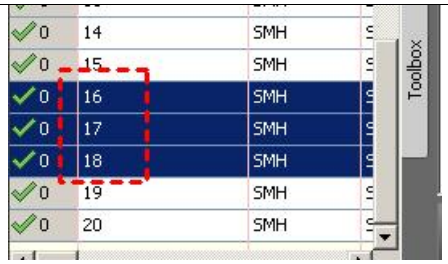
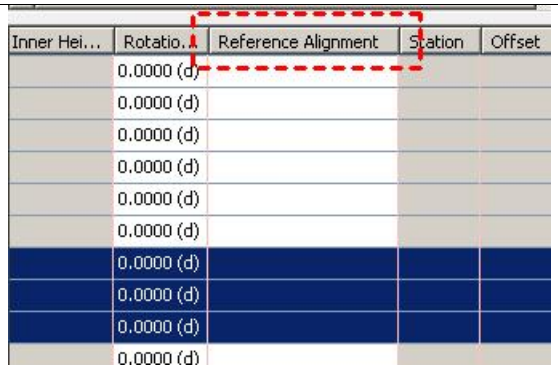
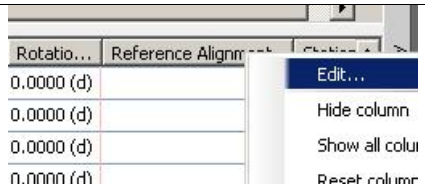
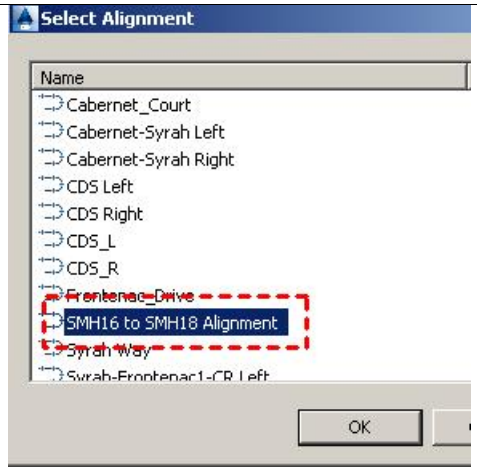
This exercise will meet the following objectives:

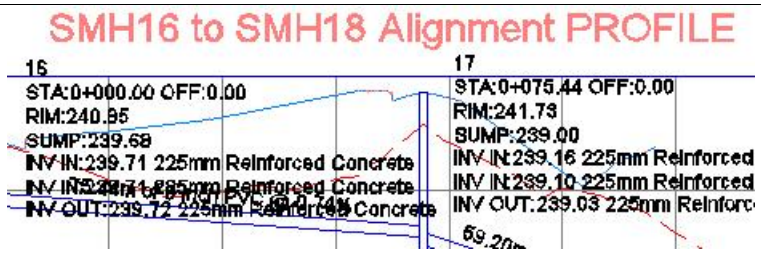
- Creating an alignment from a pipe network.
- Labelling the pipe networks in Profile View.
- Showing crossing pipe in the Profile View.

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**35 Pipes-Excercise3_METRIC.dwg**".
2.	Select the Sanitary Structure 16.	
3.	Select "Alignment from Network" ribbon command.	
4.	Select Sanitary Structure 18 > ENTER keyboard.	

5.	Verify the highlighted values > OK	
6.	• Sample the "**EG**" and "**Corridor FG**" surfaces. • Change the Style for "Corridor FG – Surface (2)" to "**Design Profile**". • Click "Draw in profile view" button.	
7.	Jump to "Pipe/Pressure Network" link.	

8.	Ensure "Yes" is selected for each pipe and structure under Sanitary Network.	
9.	Click "Create Profile View" button and place the Profile View to the right of the site plan.	
10.	Select EITHER one pipe or one structure inside the profile view.	
11.	Run the "Entire Network Profile" ribbon command.	
12.	The "STA:" and "OFF:" is missing because the alignment was created AFTER the pipe network.	

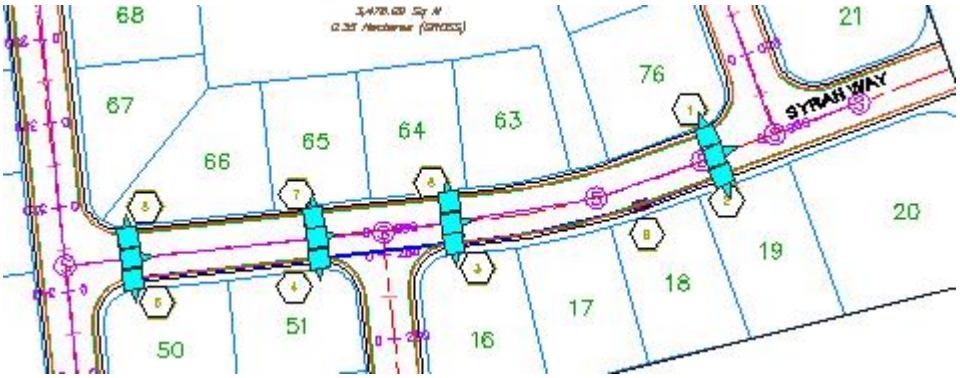
13.	Prospector > Pipe Networks > Networks > Sanitary Network > Structures.	
14.	Select Structure 16, 17 and 18.	
15.	Scroll to the right until you see the "Reference Alignment" header.	
16.	Right-click "Reference Alignment" > Edit…	
17.	Choose "SMH16 To SMH18" alignment > OK.	
18.	You may need to type REGEN ALL at the command line to see your updated structure labels.	



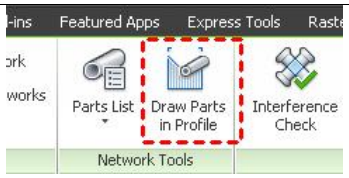
19. Our thrid objective of this exercise to to investigate the Crossing Pipe scenario. Pan your drawing until you see the Storm layout located on Syrah Way.

    The sanitary pipe network has already been laid out on the Syrah Way Profile. You want to show the four storm pipes where they crosses the sanitary so you can adjust the pipe elevations, if necessary.

20. Select all four pipes that cross perpendicular to the Syrah Way alignment.

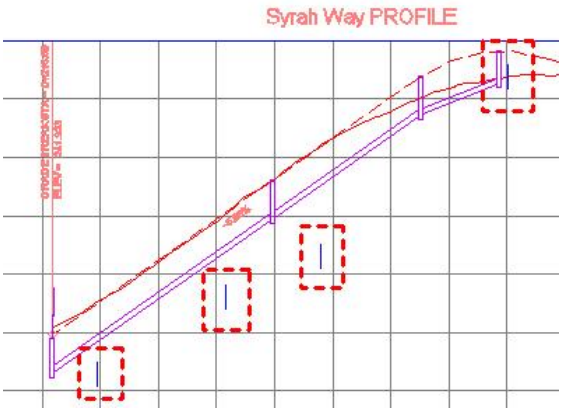


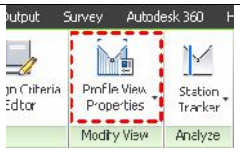
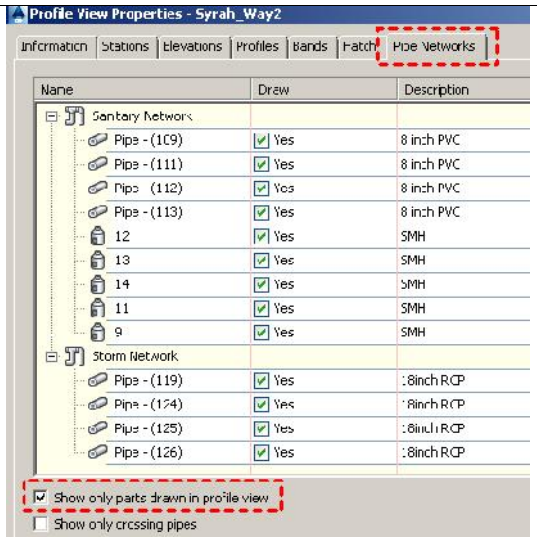
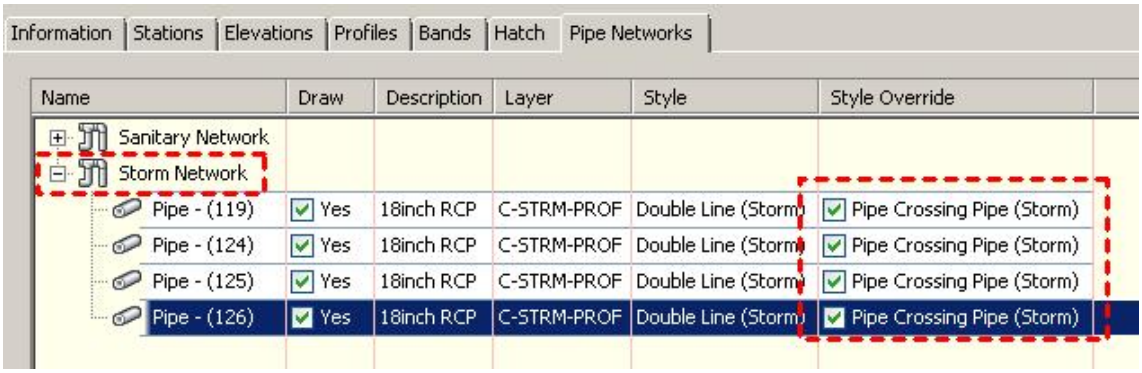
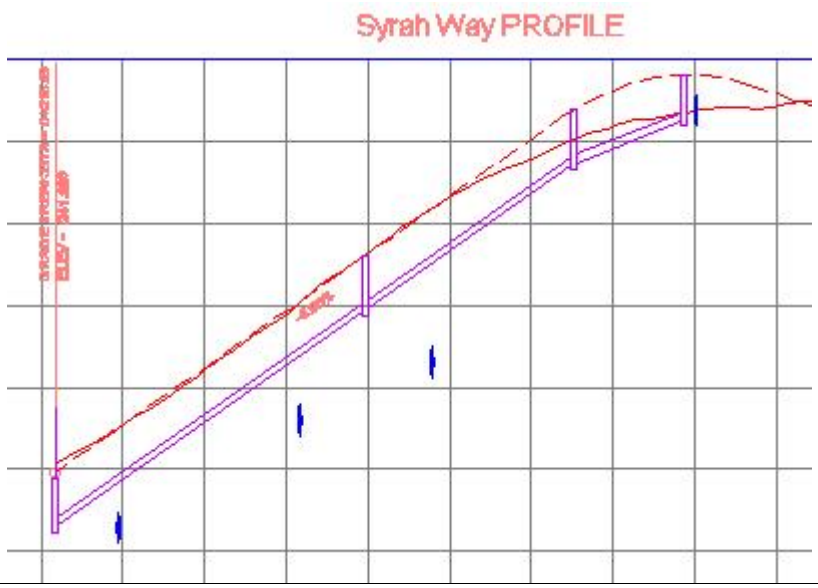
21. Run the "Draw Parts in Profile" ribbon command.



22. - Pan to the Syrah Way Profile View.
    - **Click the title of the Profile View**.

23. You should see four blue colour crossing pipes in the Syrah Way Profile.



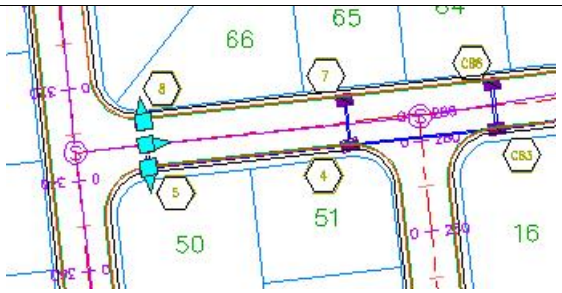
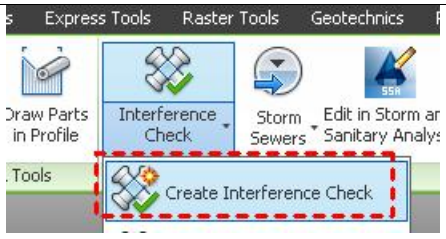
24.	• Hit ESC keyboard. • **Select the Syrah Way Profile View**. • Run the "Profile View Properties" ribbon command.	
25.	• Goto "Pipe Networks" tab. • Activate "Show only parts drawn in profile view".	
26.	Change the Crossing Pipes style as shown below: 	
27.	Click OK. Now you can see clearly whether the crossing pipes require elevation adjustment or not. 	

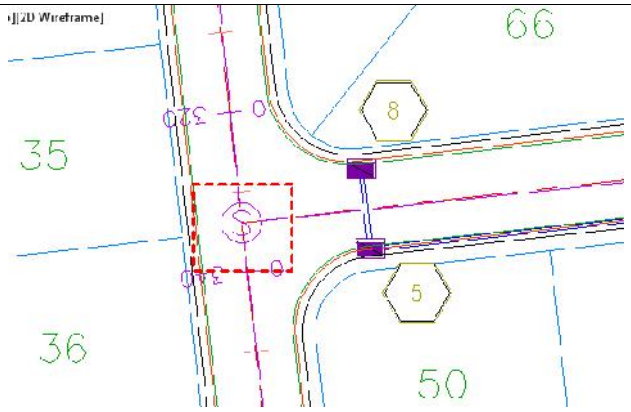
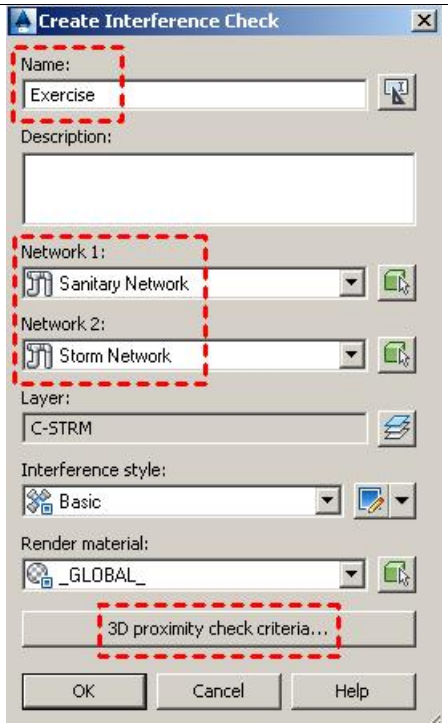
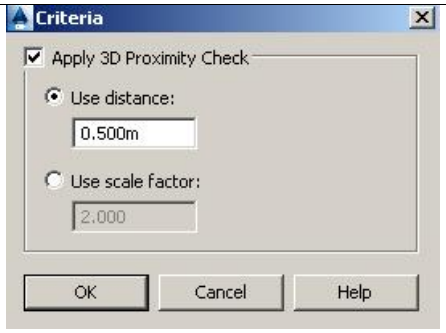
28.	Adjust the levations of the crossing pipes as needed. Close the drawing **WITHOUT** saving.

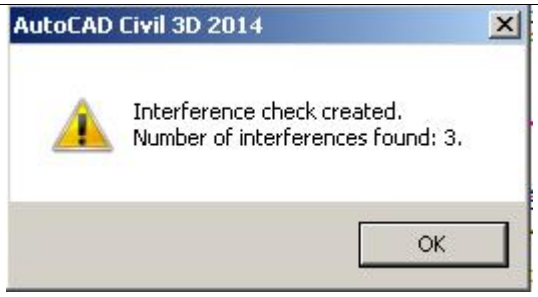
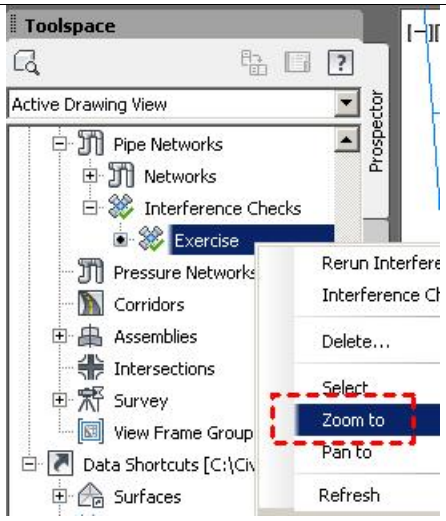
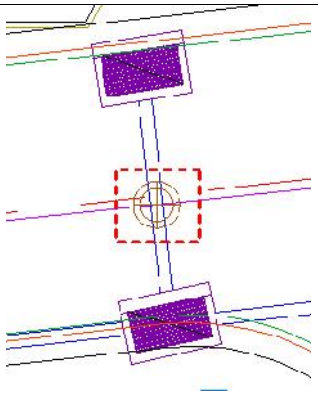
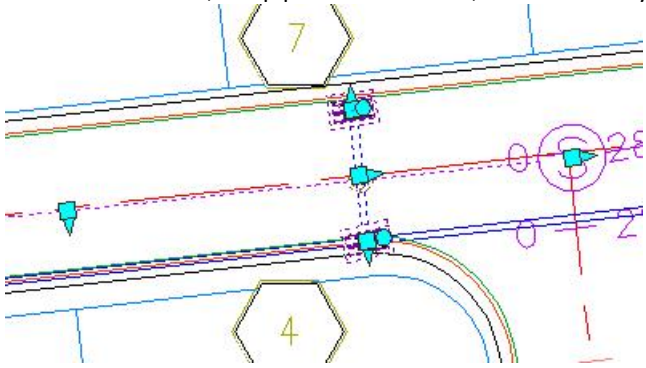
7.6 Pipe Network Interference Check

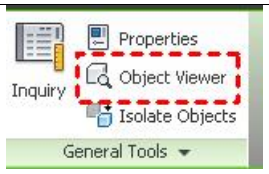
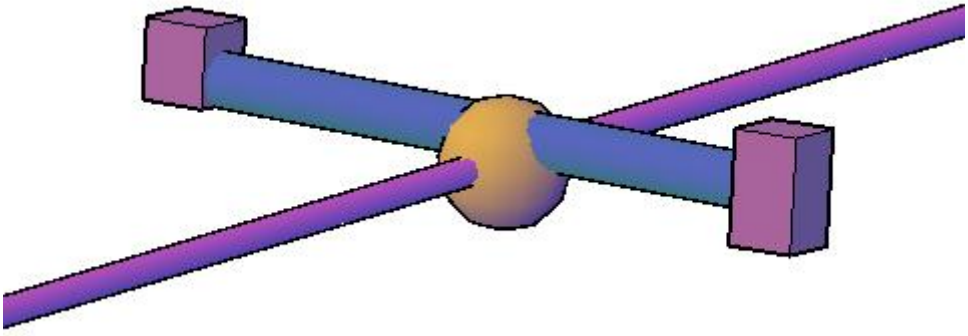
In Building Information Modeling (BIM), one of the main reason of adopting the BIM technology is to detect any clashes of components within the project boundary. This feature is popularly known as Clash Detection.

In design, you must ensure pipes and structures have appropriate separation. The following exercise will lead you through creating a pipe network and using Interference Check to scan your design for potential pipe network conflicts.

No.	Descriptions	Commands/Remarks
1.	Open the drawing. This drawing includes a sanitary sewer pipe network and a storm drainage network.	 Browse to filename "**36 Interference_METRIC.dwg**".
2.	In the drawing, select ANY part from either network. In this example, we select one of the crossing pipe (Storm drainage).	
3.	Run the "Create Interference Check" ribbon command.	

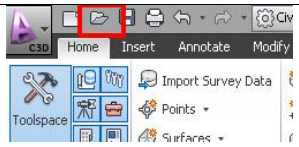
4.	Select the OTHER pipe network. In this example, we will click at one of the Sanitary Sewer structure.	
5.	• Verify the highlighted values. • Click "**3D proximity check criteria…**" button.	
6.	You're interested in finding all network parts that are within a certain tolerance of one another. In this exercise, we allow 0.5m distance. This setting creates a buffer to help find parts in all directions that might interfere. If you forget to activate "Apply 3D Proximity Check" option, you would only get "direct" physical collisions among pipe networks. Click "OK" twice to run the Intereference Check.	

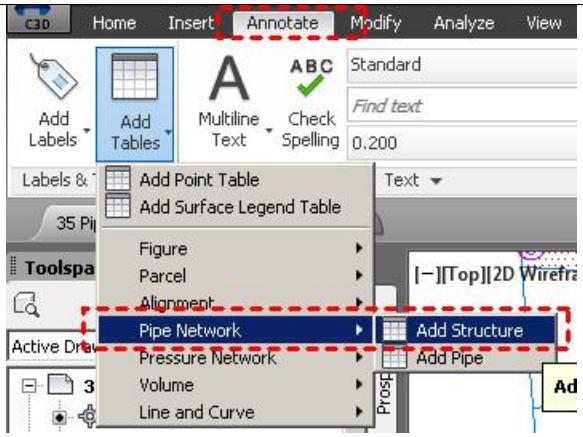
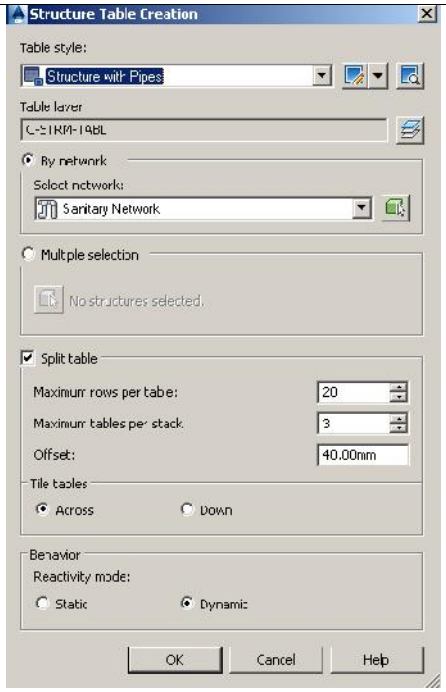
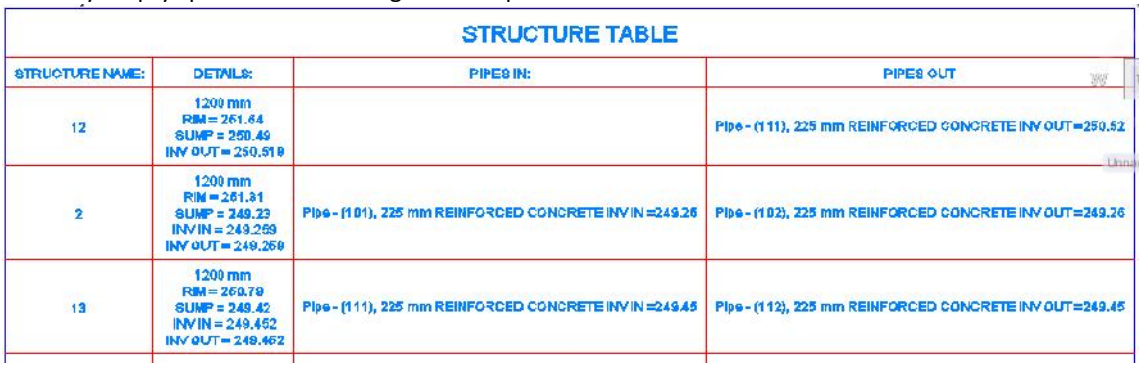
7.	A report is presented telling you that there are three clashes have been detected. Just hit OK.	
8.	Goto Prospector and right-click "Exercise" > Zoom to.	
9.	A small marker denotes where the interference occurs.	
10.	Select any one of the interference marker, the pipes that intersect, and the nearby inlets.	

11.	Run the "Object Viewer" ribbon command.	
12.	You will clearly see the interference marker (sphere-shaped) telling you that 0.5m clearance distance. So long as ANY pipes/structures **touches** this 0.5m spherical marker, they are considered as clash/interference problem. 	
13.	Close the Object Viewer mode. Close the drawing **WITHOUT** saving.	

7.7 Creating Pipe Tables

Preparing a clean construction drawing is a big challenge for infrastructure project. Would it be better to replace those engineering parameters in a tabulation format? Let's explore how to simplify the drawings using Pipe Network Table feature.

No.	Descriptions	Commands/Remarks
1.	Open the drawing. This drawing includes a sanitary sewer pipe network and a storm drainage network.	 Browse to filename "**35 Pipes-Excercise3_METRIC.dwg**".

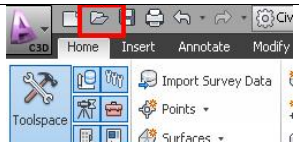
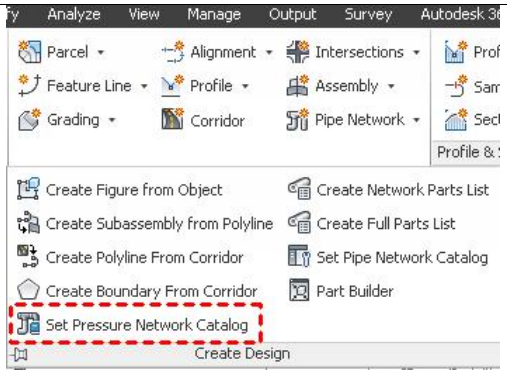
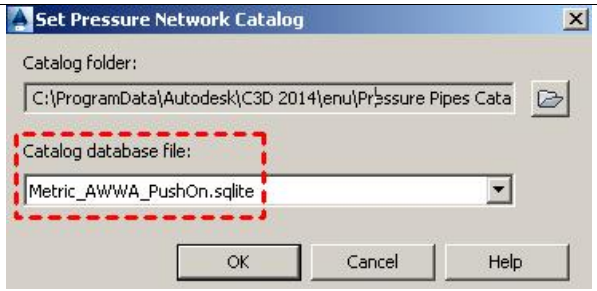
2.	Goto "Annotate" > Add Tables > Pipe Network > Add Structure.	
3.	Just hit "OK" to accept default values.	
4.	Click any empty space in the drawing. The sample Structure table is shown below:  The table creation for pipes is similar to the structure table creation process.	
5.	Close the drawing **WITHOUT** saving.	

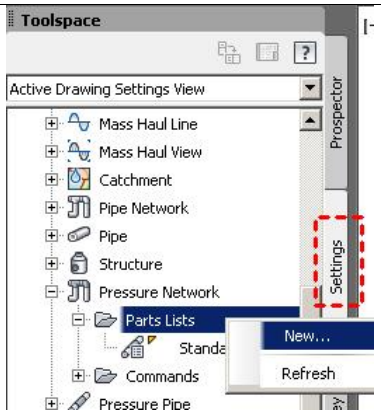
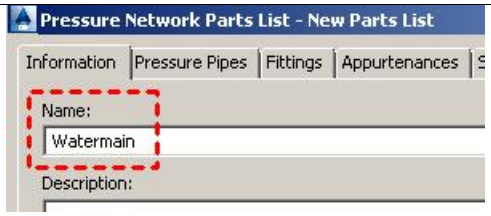
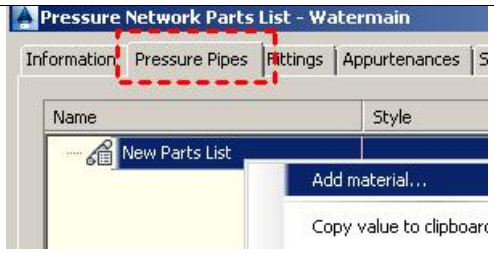
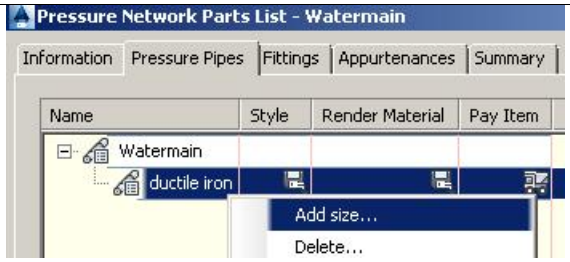
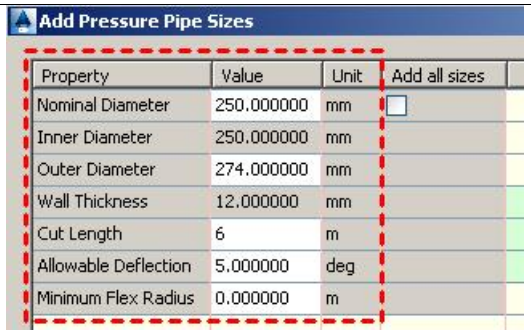
CHAPTER 8 : PRESSEURISED PIPE NETWORKS

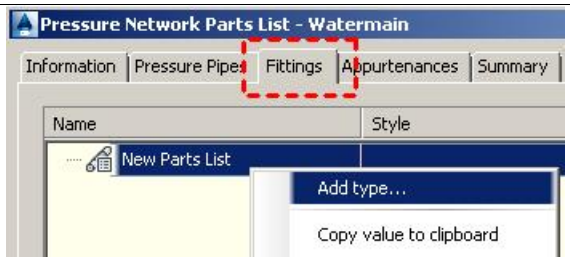
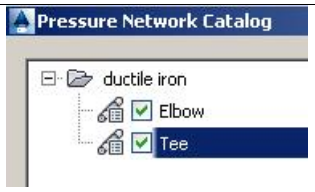
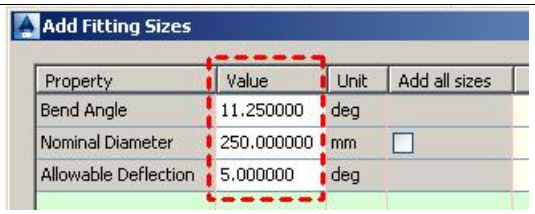
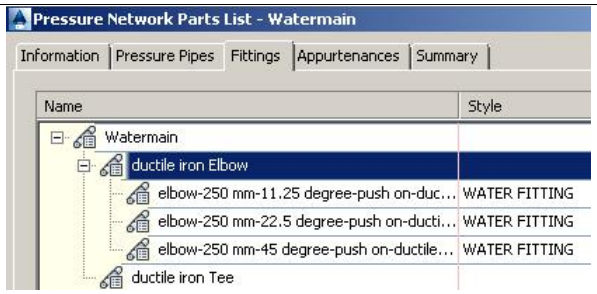
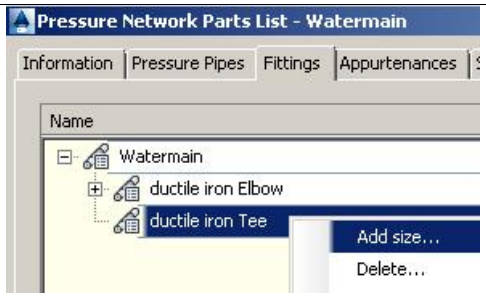
Since version 2013, AutoCAD Civil 3D has been enhanced with a brand new feature called pressure networks. Pressure pipes work differently than gravity flow pipe systems within Civil 3D. Much of the need for custom parts like valves or hydrants is eliminated with these systems.

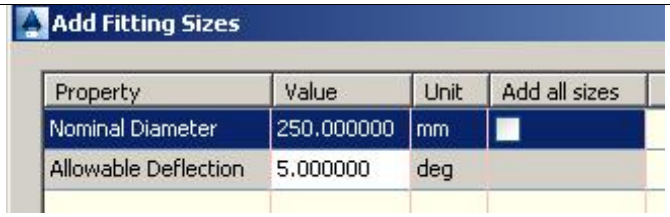
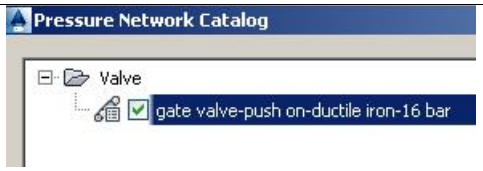
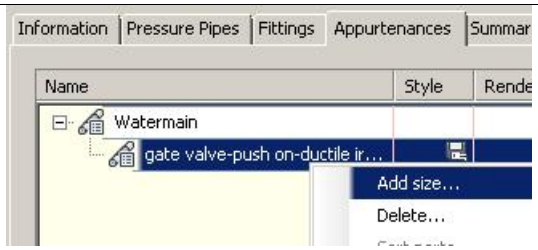
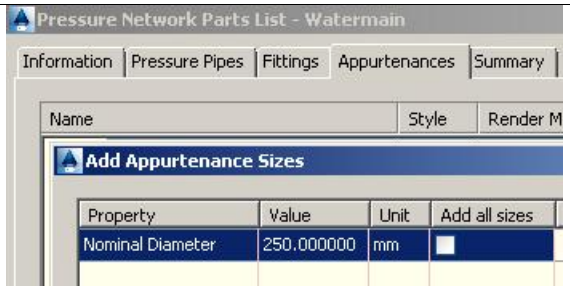
8.1 Creating Pressure Network Parts List

In the following exercise, you will create a pressure network parts list for water supply system.

No.	Descriptions	Commands/Remarks
1.	Open the drawing. This file is set up with a layer state that makes other objects grey. This will help you focus on the placement of pressure pipe networks objects.	 Browse to filename "**37 Pressure_METRIC.dwg**".
2.	Goto Home tab > Create Design > Set Pressure Network Catalog.	
3.	Verify that the Catalog Database File is set to "**Metric_AWWA_PushOn.sqlite**". Flanged join type and Mechanical join type are not supported in Civil 3D. However, the most commonly used join type in modern water supply construction is the push-on type.	

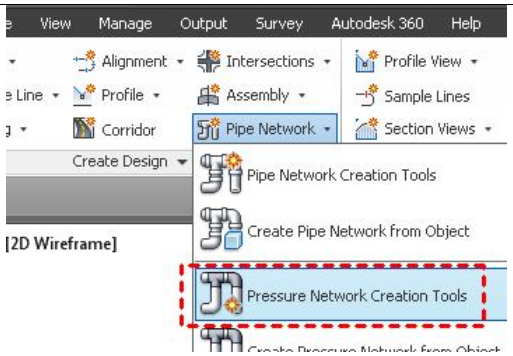
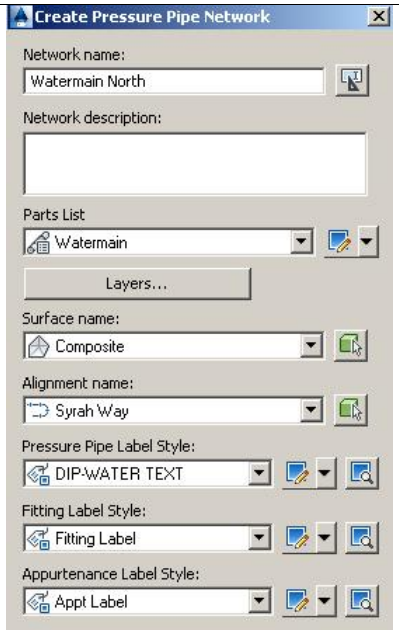
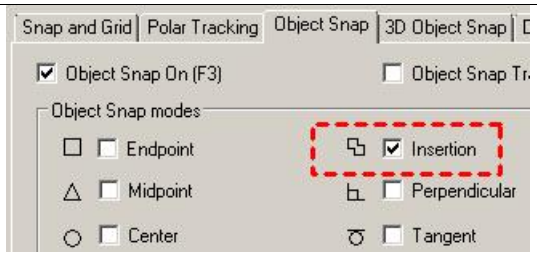
4.	Goto Settings tab > Pressure Network > RC Parts Lists > New…	
5.	Rename the Pressure Network Parts List to “**Watermain**”.	
6.	Pressure Pipes tab > RC New Parts List > Add material…	
7.	Activate “ductile iron” > OK.	
8.	Right-click “ductile iron” > Add size…	
9.	Verify the highlighted values > OK.	

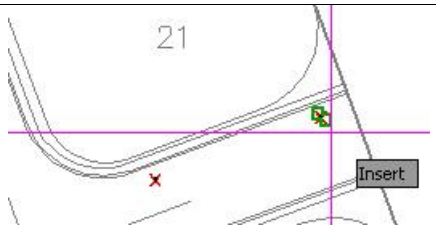
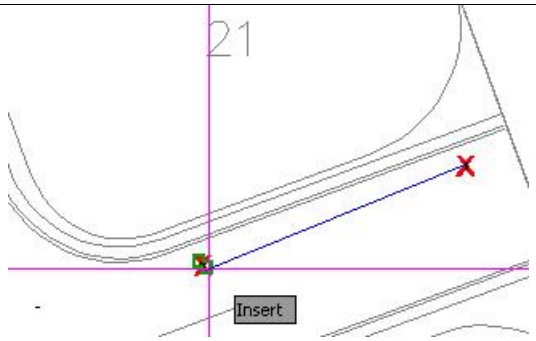
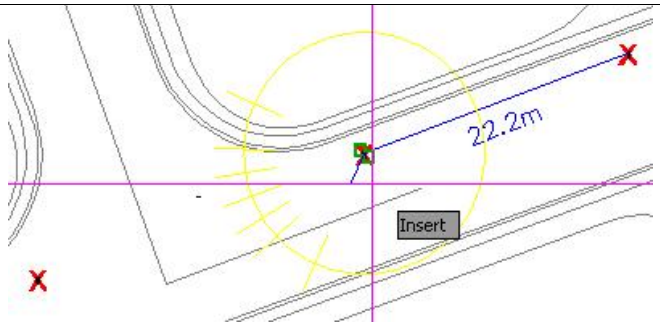
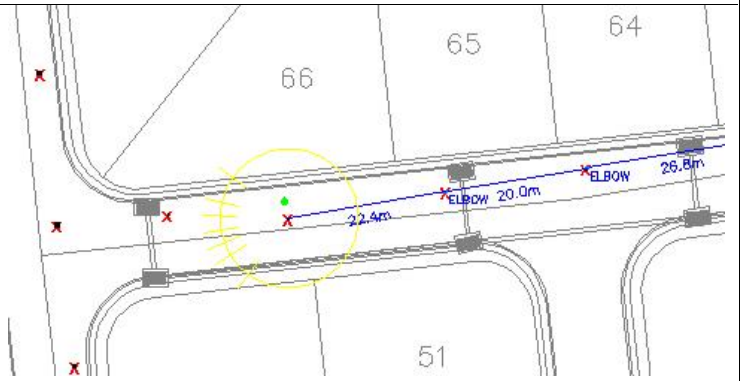
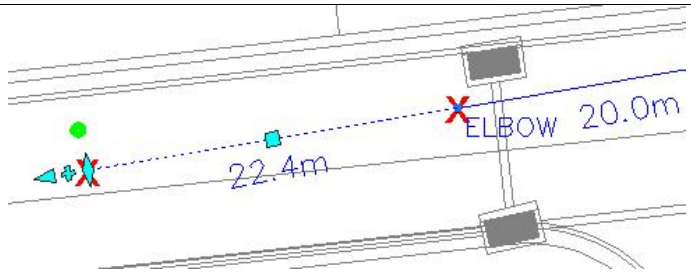
10.	Switch to "Fittings" tab > RC New Parts List > Add type…	
11.	Activate all types of fittings > OK.	
12.	RC "ductile iron Elbow" > Add size…	
13.	Set the values as highlighted > OK.	
14.	Repeat steps 12 and 13 for 22.5° and 45° bend angles elbow with the same 250mm nominal diameter and Allowable defection of 5°.	
15.	RC "ductile iron Tee" > Add size…	

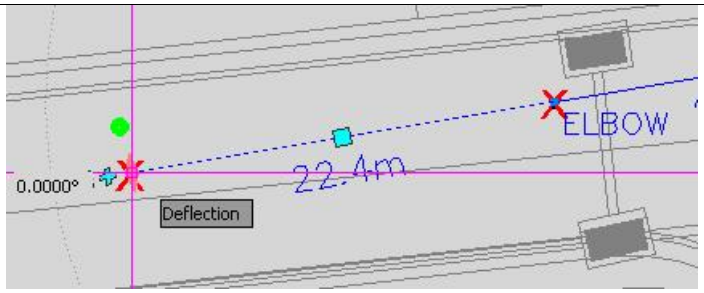
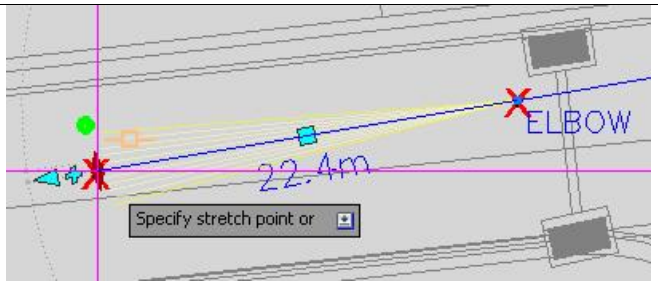
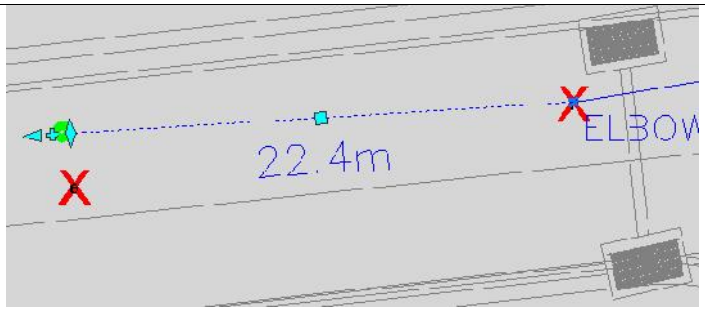
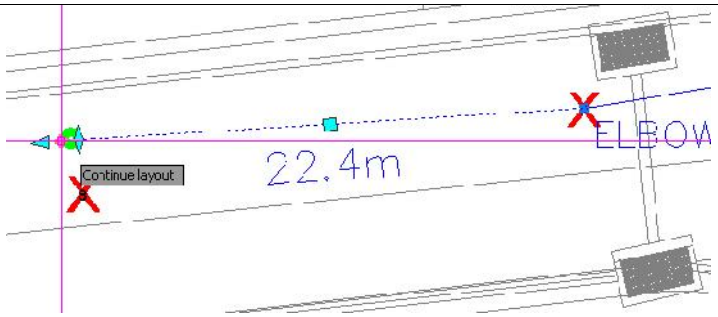
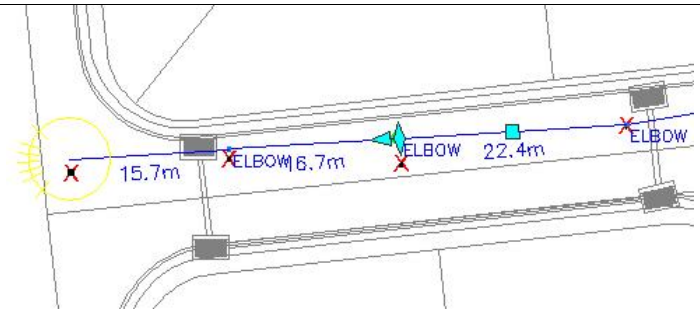
16.	Set the nominal diameter to 250mm > OK.	
17.	Switch to the Appurtenances tab > RC New Parts List > Add type…	
18.	Activate the "gate valve-push on-ductile iron-16 bar" > OK.	
19.	RC "gate valve-push on-ductile iron-16 bar" > Add size…	
20.	Set the Nominal Diameter to 250mm > OK.	
21.	Click OK again to complete the creation of the Watermain pressure network parts list. Close the drawing **WITHOUT** saving.	

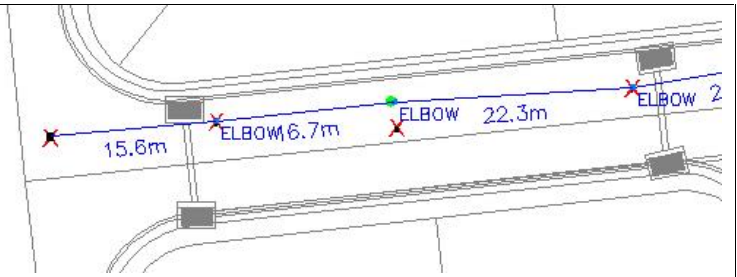
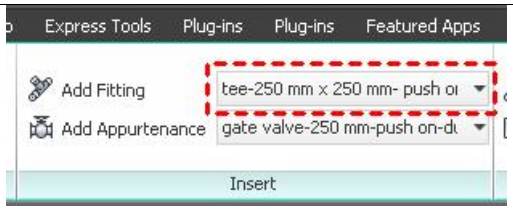
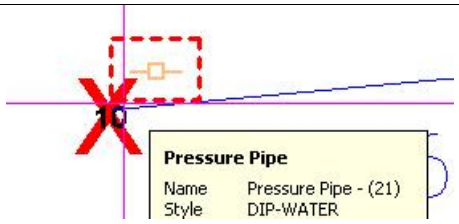
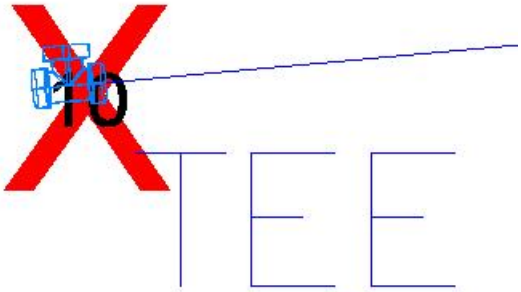
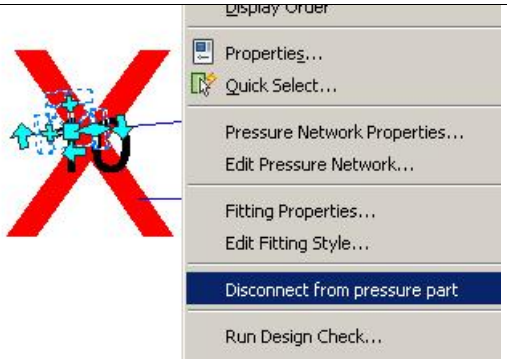
8.2 Modelling the Watermain Pressure Network

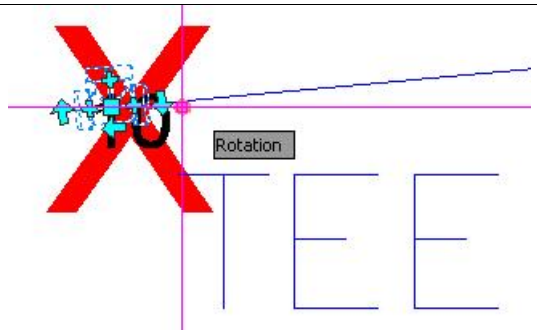
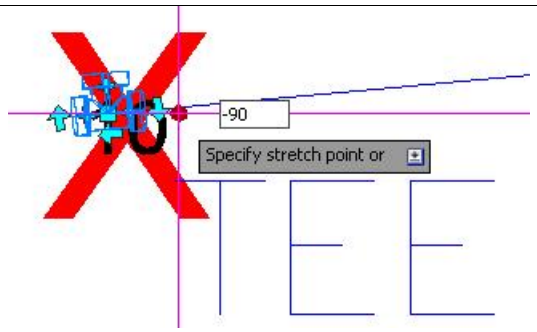
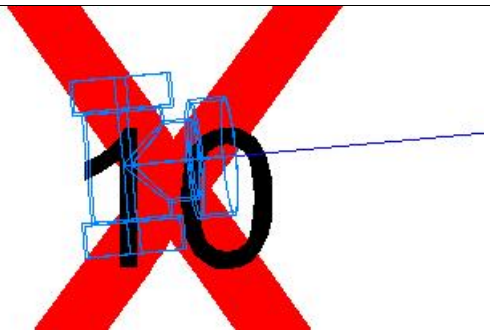
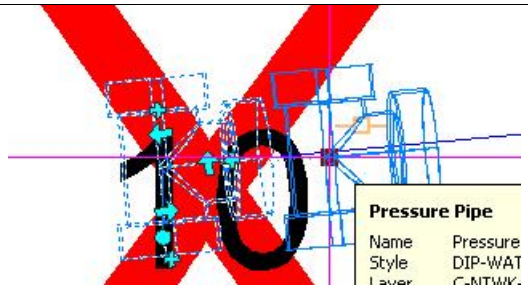
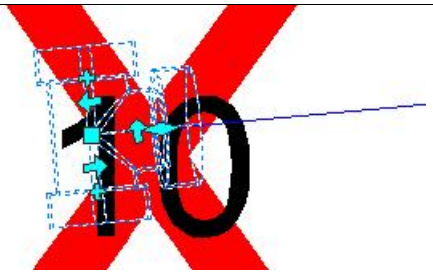
In this exercise, you will create a water supply pressurised network. Use the red-colour "X" markers in the drawing as a guide for placement, but don't worry if your pipe network is slightly off from the guides.

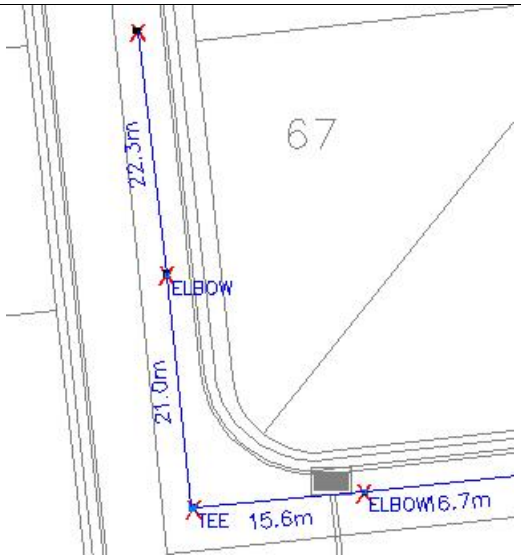
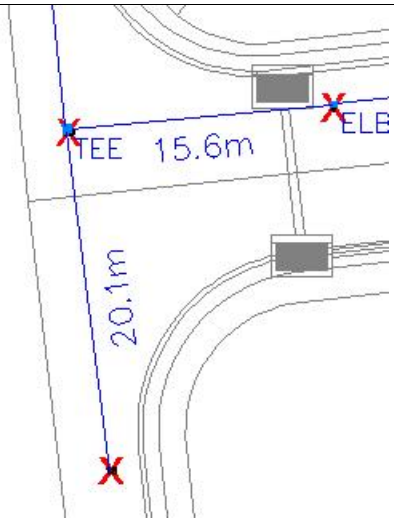
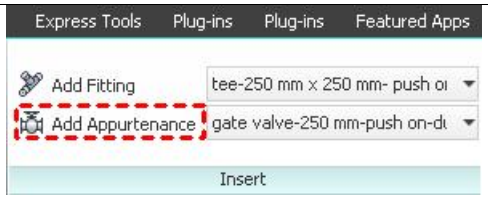
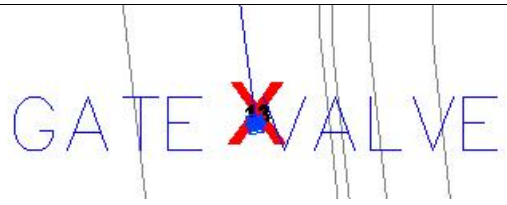
No.	Descriptions	Commands/Remarks
1.	Open the drawing. This file is set up with a layer state that makes other objects grey. This will help you focus on the placement of pressure pipe networks objects.	 Browse to filename "**38 Watermain_METRIC.dwg**".
2.	Home tab > Pipe Network > Pressure Network Creation Tools.	
3.	Set all values as shown > OK.	
4.	Set the default cover to 1.500m.	
5.	Set the OSNAP to "Insertion" only.	

6.	OSNAP at the first red-marker label 1 and click.	
7.	Place the first bend by clicking (or OSNAP) near red-marker label 2.	
8.	At the bend, you are restricted to the ALLOWABLE bending angles listed in your part network. The yellow-colour compass glyph that appears represents the elbow angles to the left and right of your pipe. If you had not included multiple elbow angles, only the default elbow angle of 11.25° would be available.	
9.	Turn off the OSNAP (i.e. press F3 keyboard).	
10.	Click the red-marker labelled 3 until labelled number 8.	
11.	Hit ESC keyboard to terminate the command.	
12.	Select pipe between label 7 & 8.	

13.	Touch the cyan-colour diamond glyph until you see the “Defection” notation. Click this diamond glyph.	
14.	Use the defection angles (yellow-projected lines) to aim at the green circle.	
15.	The pipe has been deflected to target to the green circle.	
16.	Click the “+” cyan-colour glyph to continue the layout.	
17.	Continue placing the elbow at X lael 9 and 10. From this moment, the elbows may not be placed exactly on the X-marker anymore. You can always use the glyphs to re-position the pipe location after the fact.	

18.	Hit ESC to end the command.	
19.	Change the fitting to "Tee-250mmx250mm". Then, click "Add Fitting" button.	
20.	As you hover the cursor near the end of the pipe, you will see the "Add Fitting" glyph as shown. Just click to add the Tee connection.	
21.	Hit ESC keyboard to end the command.	
22.	Click the Tee > right-click > "Disconnect from pressure part".	
23.	The command line says "Select connected pressure part:". Click the pipe before this Tee. Now that the part is disconnected, you are free to rotate it into place.	

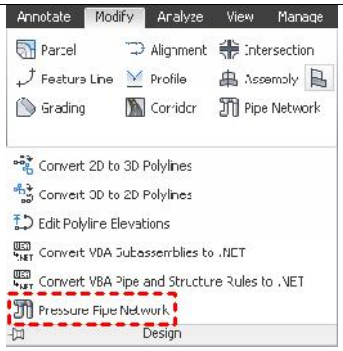
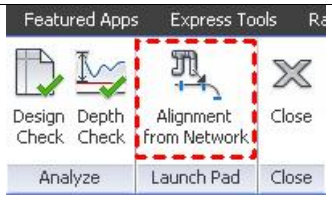
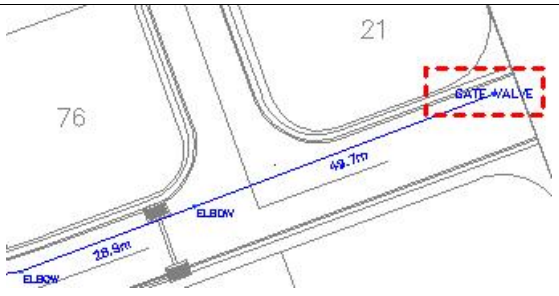
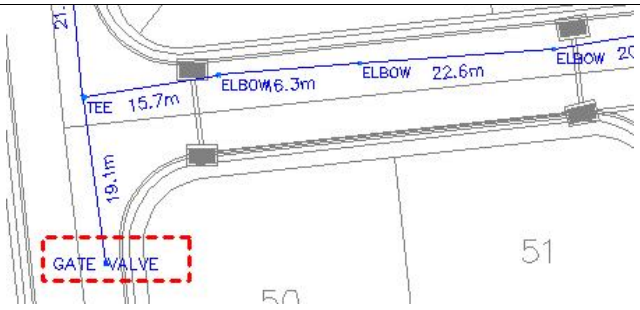
24.	Select the Tee > click at the "Rotation" cyan-colour glyph.	
25.	Enter "**-90**" at the Dynamic Input.	
26.	The Tee is now rotated to the correct position, but it must be reconnected back to the pipe.	
27.	Click the Tee > click the "Location" glyph > move the Tee until you see the connection glyph > click.	
28.	Select the Tee to reveal the grips > click the "+" glyph (North) to continue the layout.	

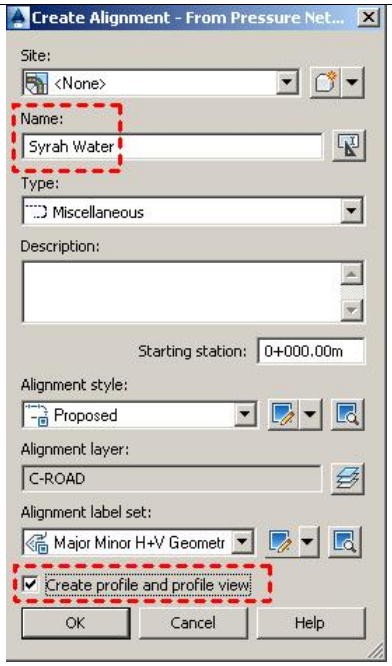
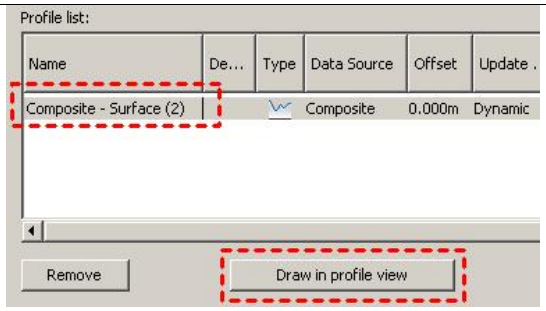
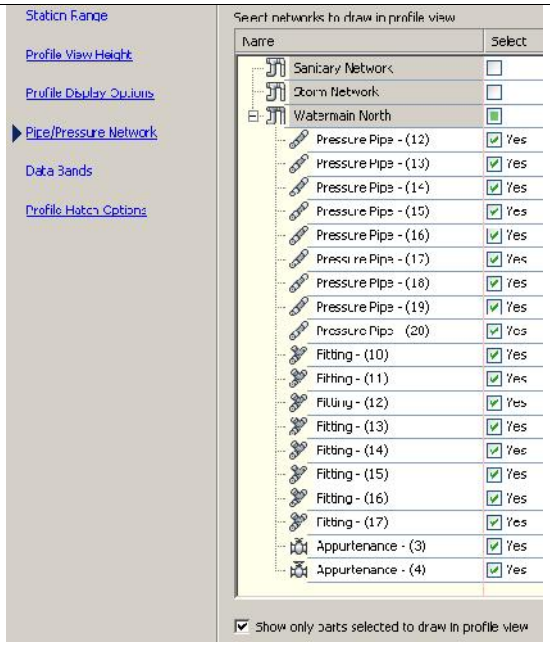
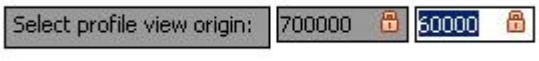
29.	Place the Tees at marker label 11 and 12. Hit ESC keyboard to end the task.	
30.	Repeat steps 28 and 29 but working towards South marker.	
31.	Click the "Add Appurtenance" ribbon command.	
32.	Place the valve at the end of both North and South end pipes.	
33.	Close the drawing **WITHOUT** saving.	

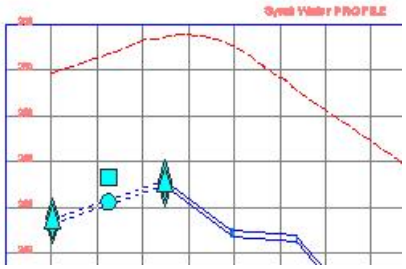
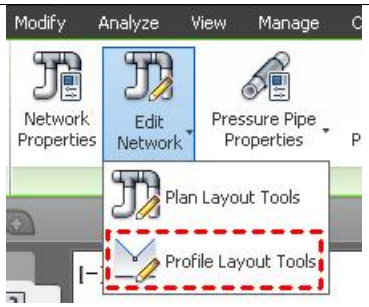
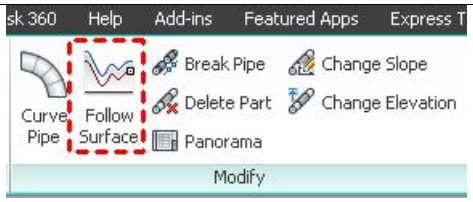
8.3 Pressure Pipe Networks in Profile View

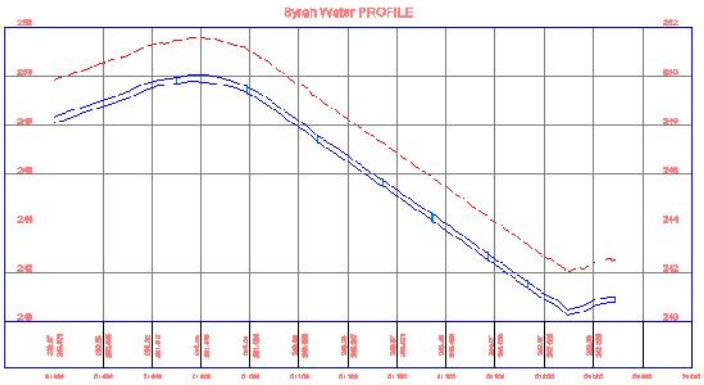
Pressure pipe networks can do things in profile view that gravity pipes cannot. With pressure pipes, the profile view can be used to add on to the pipe layout, change straight pipes to curves, and delete parts from the project altogether.

In the following exercise, you will draw the pressure pipe network in profile view and modify the layout using the "Follow Surface" command.

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**39 PressureProfile_METRIC.dwg**".
2.	Modify tab > Design > Pressure Pipe Network	
3.	Run "Alignment from Network" ribbon command.	
4.	Click the icon of Gate Valve at the far right of the drawing.	
5.	Click the southern part of the project.	

6.	Hit ENTER keyboard. Verify the highlighted values > OK.	
7.	• Add the “Composite” surface. • Click Draw in profile view.	
8.	Verify the Pipe/Pressure Network lists as per highlighted > Create Profile View.	
9.	Place the Profile View by entering coordinate (700,000, 60,000).	

10.	You should see the completed profile view in the drawing. Our next mission is to align the pressure pipes to follow the Composite/proposed surface having 1.5m depth below this surface.	
11.	Select ANY part in the Profile View.	
12.	Run the "Profile Layout Tools" ribbon command.	
13.	Run the "Follow Surface".	
14.	Click the both first and last pipe in the Profile View > ENTER	
15.	Enter "1.5" for depth below surface.	

16.	The new Profile of the pressure pipe network is displayed.	
17.	Close the drawing **WITHOUT** saving.	

8.4 Design Checks

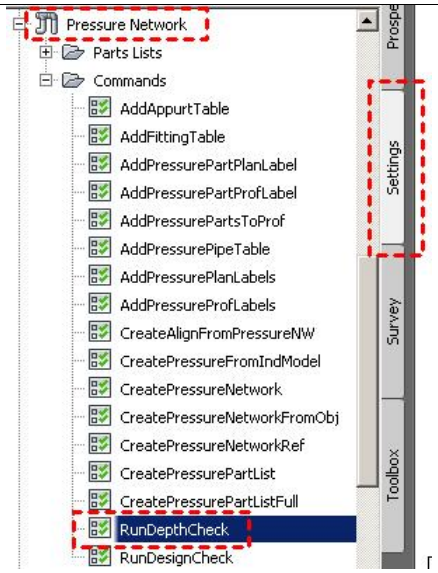
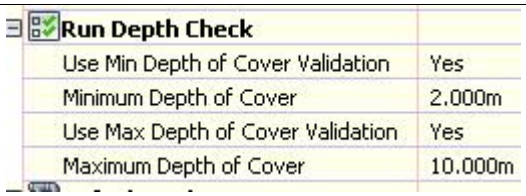
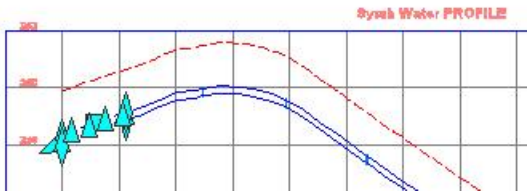
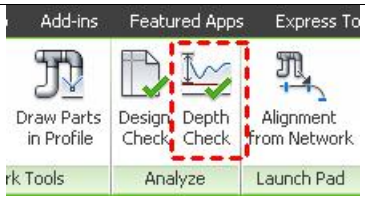
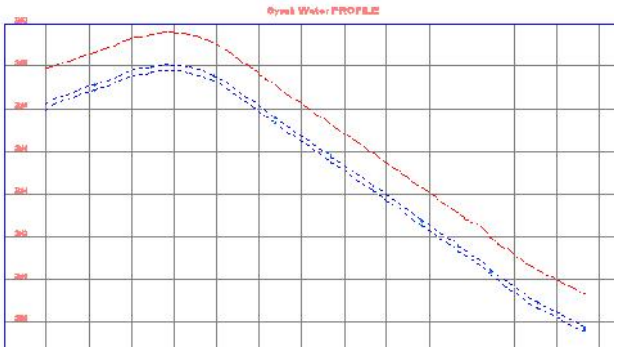
Pressure pipe networks differ from the gravitational pipe network when it comes to design check. Since the fluid in a pressure network can go uphill, the rules you saw in gravity systems no longer apply. The main concerns for a pressure system are pressure loss and depth of cover.

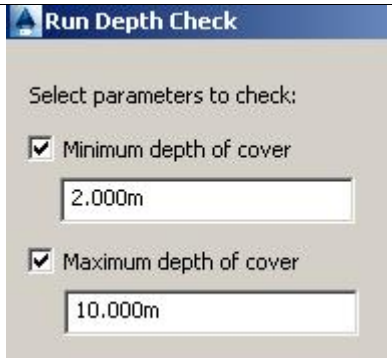
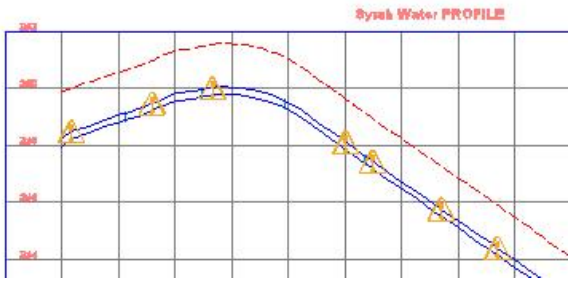
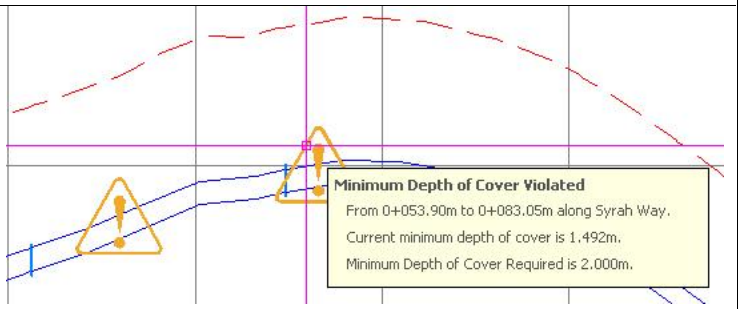
Bear in mind that Civil 3D is for modelling tool NOT analysis software. So, Civil 3D will NOT compute the pressure loss at each junction, but you can set an acceptable range of values for pipe bends and radius of curvature for curved pipes.

Design Check will check for improperly terminating pipes, mismatched pipe and fitting diameters, any curved pipe whose radius has exceeded acceptable values, and pipes that have exceeded the maximum deflection you set up in the parts list.

In the following exercise, you will modify command settings and run a depth check on the pressure pipe network.

No.	Descriptions	Commands/Remarks
1.	Open the drawing.	 Browse to filename "**40 PressureDesignCheck_METRIC.dwg**".

2.	Goto Settings tab > Pressure Network > Commands > RC RunDepthCheck > Edit Command Settings…	
3.	Verify the highlighted values > OK.	
4.	Select the far left pipe in the Profile View.	
5.	Run the “Depth Check” ribbon command.	
6.	Click the far left pipe, then far right valve > ENTER keyboard.	

7.	Verify the value > OK.	
8.	In both plan view and profile view, warning will appear if any Depth Check violations are found.	
9.	Hover over any of the warning, a yellow tooltip box will elaborate the details of the warning.	
10.	Close the drawing **WITHOUT** saving.	