



Table of Contents

CHAPTER 18: CROSS SECTIONS	1
Overview	1
Input Files	1
Required files	4
Criteria Files	5
WORKFLOW 1: PROCESS CROSS SECTIONS	9
Cross Section Navigator	10
WORKFLOW 2: CROSS SECTION NAVIGATOR	10



Chapter 18: Cross Sections

Overview

Proposed Cross sections are used to determine the limits of construction, earthwork, construction staking reports, and 3D modeling. It is very important that they are drawn consistently and to the standards outlined in this chapter. GEOPAK uses a combination of criteria files and input files to draw proposed cross sections, as well as placing data such as proposed and existing ROW lines, utilities, and other miscellaneous data. Criteria files are incredibly powerful and can be used to plot almost anything desired into proposed cross sections. Criteria files contain a group of if/then tests that can analyze different situations to determine the proper way to draw the cross sections. For example, criteria can be used to determine the depth of cut or fill and apply different slopes to each different cut/fill depth. These criteria files are grouped by an input file that also dictates the design drawings and variables to be used when creating the proposed cross sections. By using this method, these variables allow for the same criteria files to be used on multiple projects, simply changing variables rather than re-writing criteria each time. This chapter will describe the input and criteria files specific to CFLHD and how to use each one.

Input Files

The input file has two parts; the first defines the graphical elements to look for and allows the user to set variables, such as pavement thickness, various slopes, etc. which are specific to each project. The second part dictates which criteria files will be used for the type of road being designed. CFLHD provides the user with a standard input file (prxs_m10.inp for Metric projects, Prxs_e10.inp for U.S. Customary Units projects) at the beginning of each project. This input file will have all the variables and elements the criteria files will need. In order to use the standard input file to draw proposed cross-sections, the user will need to modify the input file, but should not delete any variables or element definitions. The criteria files will ignore any unnecessary information.



Variables within CFLHD criteria files are consistent with the CFLHD standards for file naming convention and the leveling standard. Failure to adhere to the CADD standards in any way could result in the criteria files missing important information.

Modify the first section of the standard input file as outlined below. Each set of variable and element definitions has a header which details what those variables define and which criteria files use those variables. Refer to the online criteria documentation (www.cflhd.gov > Design Resources > GEOPAK and Cadd Support > Criteria Files X10) to determine what to use for each variable. As long as the elements in the



design files were drawn to these CADD standards, the only change needed in the define_dgn portions is the file name and path.

```
/******  
/**** ENGLISH Proposed Cross-Section Input File *****/  
/******  
  
/* quiet */  
  
/******  
/**** Roadway structural section layers *****/ HEADER  
/******  
  
/* fh_pavuc.x10 */  
  define "number of layers" 2  
  define "pave layer 1 thickness" 0.25  
  define "pave layer 2 thickness" 0.50  
  define "pave layer 3 thickness" 0  
  define "pave layer 4 thickness" 0  
  define "pave layer 5 thickness" 0  
  define "first full length layer" 1  
  
/******  
/**** Traveled way widening *****/  
/******  
  
define_dgn "edge travel way" \  
  dgn = PLAN.DGN CHANGE FILE NAME AND PATH  
  
  lv = 49  co = 18 DO NOT CHANGE LEVEL OR COLOR
```



Notice, in the example above, comments are delineated by /* at the beginning of each comment line, and by */ to close a comment. It helps to use as many comments as possible when creating input files or criteria files. This helps future users to understand how these files were created.

The second part sets up the files that geopak will use to determine where to find the superelevation shapes, existing cross sections, patterns, criteria, and the file to put the proposed sections in. For the shape file definition, the only changes will be the file name and color. The shapes should always be on level 63, They can be on different colors since there is the possibility of shapes for multiple alignments in the same file. The only change to the existing cross section file definition is the file name.

```
/***** Defines where and how to find the shapes *****/  
shape dgn = PLAN.DGN CHANGE FILE NAME AND PATH  
shape set  
  type = cmp_shape  
  lv = 63  
  co = 1,6
```



Patterns are defined next. Most CFLHD projects use pattern by dgn to define the locations of the cross sections. The items that need to be modified are the file name, job number, baseline name, and color. There is the option to define the patterns by station. This is usually not used so it is commented out.

```

/***** Pattern by dgn *****/
pattern dgn = PLAN.DGN      CHANGE FILE NAME AND PATH
pattern set
  job number = ZZZ          CHANGE JOB NUMBER
  baseline = CHAIN_NAME     CHANGE CHAIN NAME
  horiz scale = 10
  vert scale = 10
  type = line, line_string
  lv = 50
  co = 0                    CHANGE COLOR

/***** Pattern by station *****/
/*                             BEGIN COMMENT
pattern by station
pattern set
  job number = ZZZ
  baseline = CHAIN_NAME
  horiz scale = 10
  vert scale = 10
  begin station = 10+00 r 1
  end station = 20+00 r 1
  even
  lt = 100
  rt = 100
/*                             END COMMENT
```

The last set of definitions defines the chain, profile and criteria to use. The chain and profile need to be the same as defined on the superelevation shapes that were used. All criteria files that CFLHD uses are in the list of criteria files. They are listed in the order they need to be in to work properly. If you do not need to use a criteria file, comment it out.

```

criteria for shape cluster
  shape cluster baseline = CHAIN_NAME  CHANGE CHAIN NAME
  shape cluster profile = PROFILE_NAME CHANGE PROFILE NAME
  shape cluster tie      = 0
```



side slope lt

```
include L:\criteria\defaults.x10
include EXCEPT_E10.DAT
include L:\criteria\fh_pavuc.x10
include L:\criteria\fh_eop.x10
/* include L:\criteria\fh_wide.x10 */      COMMENT OUT UNUSED
/* include L:\criteria\fh_sh1.x10 */     CRITERIA
```

The plot parameters, pavement thickness, and do not fill gaps lines do not need to be modified. The last change that needs to be made is the write xs into dgn. This file should be the same as the existing cross section drawing.

plot parameters

lines

```
lv=61 co=2 wt=1 lc=0
```

text

```
lv=61 co=6 th=0.1 tw=0.1 just=lb ft=23
```

pavement thickness = 0

do not fill gaps between clusters

```
write xs into dgn = XS.DGN      CHANGE FILE NAME AND PATH
```

Required files

At a minimum, the following files are required:

- **defaults.x10**
 - This file sets the default settings and variables for the criteria files. These values will be overwritten by your project specific entries. No need to modify this file.
- **except.dat**
 - This file allows you to change any variable for a station range. For example: there is a location on the project that has a rock cut. You can specify a steeper cut slope for a specific station range. An example of the except.dat file is shown below.
- One criteria file for each of the following elements is always needed:
 - Pavement
 - Edge of Pavement



- Shoulder
- Fore Slope
- Side Slope

You should not need to modify any of these files for a standard roadway. You can modify the **except.dat** file if you need to apply a specific action to a specific station range. If you do not need to use the **except.dat** file for a station range, simply leave it in and do not modify it. As you can see, from the example below, all of the lines are commented out. However, the criteria files are looking for this file and GEOPAK will stop if it does not find it. The header describes the capabilities of this file.

This is an example of the except.dat file.

```
/******  
/* CUT SLOPE LEFT EXCEPTIONS (fh_ss3.x10) */  
/* */  
/* Set _d_cut_slope_lt equal to the fixed cut slope you want on */  
/* the left side within the station range */  
/* */  
/* _d_cut_slope_lt = 1.5:1 will give you a fixed 1.5:1 cut slope */  
/******  
  
/* if sta >= 3+50 r 1 and sta < 4+50 r 1 then  
  {  
    _d_cut_slope_lt = 1.5:1  
  }*/
```

Criteria Files

CFLHD has created all the criteria files that a typical job will need. Below is a list of available criteria files, with links to each at the CFLHD web site. For internal use, the input files should point to the correct network directory to find each criteria file that is needed. For consultants, you will need to download the criteria files, then change the path in the input file to match the downloaded location.

The criteria files are located on the CFLHD network at:

L:\Criteria

Or on the CFLHD website at the following link:

http://www.cflhd.gov/cadd/criteria/x10/downloads/criteria_x10.zip

The table below gives a simple list of name and description. Clicking on the link will take you to the CFLHD web site where you will find detailed descriptions and sketches for each criteria file. Use this information to determine which criteria files are the correct ones for your project.



Criteria File	Description
Roadway Structural section	
fh_pavuc.x10	Draws all the pavement and base course layers within the limits of the superelevation shapes.
fh_eop.x10	Draws pavement structure widening outside of the superelevation shapes.
Paved Ditch	
fh_pavd1.x10	Station ranges for paved ditch set in exceptions data file. Fixed paved ditch width.
fh_pavd2.x10	Station ranges for paved ditch set by "paved ditch in dgn" line drawn in plan view dgn. Fixed paved ditch width.
fh_pavd3.x10	Station ranges and paved ditch width set by "paved ditch in dgn" line in plan view dgn file.
Foreslope	
fh_fs1.x10	Draws fixed slope foreslope including base course and pavement layers. Foreslope width is the same with or without guardrail.
fh_fs2.x10	Draws fixed width foreslope including base course and pavement layers. Foreslope width is the same with or without guardrail.
fh_fs3.x10	Draws fixed slope foreslope including base course and pavement layers. Foreslope width for cross-sections with guardrail will have a different slope than cross-sections without guardrail.
fh_fs5.x10	Draws fixed width foreslope including base course and pavement layers. Foreslope width for cross-sections with guardrail will be different from the foreslope width for cross-sections without guardrail.
fh_fs6.x10	Draws fixed width foreslope including base course and pavement layers. Foreslope width for cross-sections with guardrail will be different from the foreslope width for cross-sections without guardrail. For cross-sections without guardrail, the pavement layer daylight to the foreslope; for cross-sections with guardrail with guardrail, the pavement layer is terminated at the face of the guardrail post. (Must be used with shoulder criteria fh_sh6.x10.)
Concrete fill walls	
c_cwal1d.x10	Cantilever concrete fill wall plus associated excavation and backfill. Uses lines in plan view dgn file to set station ranges and offset.
c_cwal1s.x10	Cantilever concrete fill wall plus associated excavation and backfill. Uses exceptions data file to set station ranges and side of roadway.
c_zwald.x10	Cantilever concrete fill "zee" wall plus associated excavation and backfill. Uses lines in plan view dgn file to set station ranges and offset.
Cross section annotation	
fh_cl.x10	Places miscellaneous notes on the proposed cross-section.
fh_gr.x10	Places guardrail cells on the proposed cross-sections.
fh_x_lim.x10	Places excavation limit lines on the proposed cross-sections.
fh_mark.x10	Places witness lines with labels on the proposed cross-sections showing the location of lines drawn in a plan view dgn file representing a planimetric feature.
fh_mark6.x10	Places witness lines with labels on the proposed cross-sections showing the location of lines drawn in a plan view dgn file representing up to a maximum of six different planimetric features.
addtext.x10	Marks additional red/blue top points for unusually wide cross-sections.
Shoulders	
fh_sh1.x10	Fixed shoulder slope as specified by user. (Shoulder slope is automatically adjusted if necessary to not exceed 8% rollover from travel lane to shoulder). Shoulder width set by a line drawn in plan view dgn file. If line representing shoulder width isn't found in plan view dgn, then use default shoulder width. Undercut layers parallel to shoulder finish grade.
fh_sh2.x10	Fixed shoulder slope as specified by user. (Shoulder slope is automatically adjusted if necessary to not exceed 8% rollover from travel lane to shoulder). Shoulder width set by a line drawn in plan view dgn file. If line representing shoulder width isn't found in plan view dgn, then use default shoulder width. Undercut layers parallel to travel lane slope (rather than shoulder slope). Used in EFL primarily.



Criteria File	Description
fh_sh3.x10	Shoulder slope is always the same as the travel lane slope. Shoulder width set by a line drawn in plan view dgn file. If line representing shoulder width isn't found in plan view dgn, then use default shoulder width. Undercut layers parallel to shoulder finish grade.
fh_sh4.x10	Shoulder slope is fixed (8% maximum rollover is not checked). Shoulder width set by a line drawn in plan view dgn file. If line representing shoulder width isn't found in plan view dgn, then use default shoulder width. Undercut layers parallel to travel lane slope (rather than shoulder slope). Used in EFL primarily.
fh_sh6.x10	Identical to fh_sh3.x10 except that if a "guardrail in dgn" line is found then the pavement layer is terminated at the guardrail. Otherwise pavement layer daylights to foreslope. Shoulder slope is always the same as the travel lane slope. Shoulder width set by a line drawn in plan view dgn file. If line representing shoulder width isn't found in plan view dgn, then use default shoulder width. Undercut layers parallel to shoulder finish grade.
Curb / Curb & Gutter	
c_crb1d.x10	Full depth concrete curb plus base course layers (if any) under curb. Uses lines drawn in plan view dgn file to set station ranges for curb and to locate offset for outside face of curb.
c_crb1s.x10	Full depth concrete curb plus base course layers (if any) under curb. Uses exceptions data file to set station ranges for curb.
c_crb2d.x10	Concrete curb/gutter plus base course layers (if any) under curb/gutter. Uses lines drawn in plan view dgn file to set station ranges for curb/gutter and to locate offset for outside face of curb.
c_crb2s.x10	Concrete curb/gutter plus base course layers (if any) under curb/gutter. Uses exceptions data file to set station ranges for curb.
c_crb3d.x10	Asphalt curb plus base course layers (if any) under curb. Uses lines drawn in plan view dgn file to set station ranges for curb and to locate offset for outside face of curb.
c_crb3s.x10	Asphalt curb plus base course layers (if any) under curb. Uses exceptions data file to set station ranges for curb.
c_crb4s.x10	Widens pavement a fixed distance, then draws curb and curb backfill, pavement and base course layers under curb, roadway foreslope. Station ranges for curb set using the exceptions data file. Combines the functionality of a typical curb criteria with the functionality of a roadway widening criteria and a foreslope criteria.
c_crbkfd.x10	Draws backfill embankment behind curb. Uses "in dgn" line for station ranges and hinge point offset from roadway centerline.
c_crbkfs.x10	Draws backfill embankment behind curb. Station ranges set in exceptions data file.
Cut/fill slopes	
fh_ss3.x10	Draws the cut/fill slopes from the subgrade shoulder point out to the catch point. Specifically, this criteria can draw the following cases:
	"typical" cut/fill slope selection
	fixed cut or fill slopes for station ranges within a project (optional)
	cut or fill slopes that vary uniformly over station ranges within a project (optional)
	different ditch foreslope widths and/or slopes on left and right sides
	ditch foreslope widths and/or slopes that change with station range
	special ditch profiles (optional)
	flat bottom ditches with different widths on left and right sides
	daylight to shoulder cut slopes
	ditch foreslope intercept fill slopes
	forced ditches in areas where ditch foreslope intercepts are not wanted
	cut slope benching (optional)
	compound cut slopes in cross-sections with defined material layers (optional)
MSE Walls	



Criteria File	Description
fh_wall4.x10	MSE wall including roadway foreslope and associated special excavation and backfill. Station range(s) for wall set in exceptions data file. Offset to face of wall is a fixed distance from pavement shoulder point. Conforms to CFL standard practice.
fh_wall4w.x10	MSE wall including roadway foreslope and associated special excavation and backfill. Station range(s) for wall set in exceptions data file. Offset to face of wall is a fixed distance from pavement shoulder point. Conforms to WFL standard practice.
fh_wall5.x10	MSE wall including roadway foreslope and associated special excavation and backfill. Station range(s) for the wall and offset from roadway shoulder to the wall face are set by line drawn in plan view dgn. Conforms to CFL standard practice.
c_wall9d.x10	MSE wall including roadway foreslope and associated special excavation and backfill. Option for either one- or two-tier wall configuration at any x-section. Station ranges, distance from centerline, and one- or two-tier configuration set with lines drawn in plan view dgn. Top of wall elevation set with COGO profile. Compound slope from pavement to top of wall.
Special Earthwork	
fhex_fea.x10	Topsoil, existing pavement, and rock layer limits.
fh_subx2.x10	Subexcavation limits.
fh_x_lim.x10	Excavation limits LT and RT.
c_rkbt1d.x10	Rock buttress plus associated excavation and backfill. Uses line(s) in plan view dgn file to set station ranges and side of roadway.
c_rkbt1s.x10	Rock buttress plus associated excavation and backfill. Uses exceptions data file to set station ranges and side of roadway.
Special Shoulder Widening	
fh_wide.x10	Draws up to a maximum of six different fixed slope shoulder widenings. Each of the six widenings has its own fixed slope. Station range for each widening set using lines drawn in plan view dgn file. Widening widths are set by the same lines drawn in plan view dgn file. Undercut layers parallel to shoulder finish grade.
addlanes.x10	Draws the structural section for lane(s) that are to be added onto the shoulder of an existing roadway without reconstructing the existing travel lanes. (e.g., a right turn lane).
Sidewalk	
c_wlk1d.x10	Sidewalk pavement layer plus an optional base course layer. Station range(s) for sidewalk set by lines drawn in plan view dgn file. Variable sidewalk width set by lines drawn in plan view dgn file. (CFL only)
c_wlk1s.x10	Sidewalk pavement layer plus an optional base course layer. Station range(s) for sidewalk set in exceptions data file. Fixed width sidewalk. (CFL only)
c_wlk2d.x10	Urban sidewalk or sidewalk plus parkway. Outside edge of sidewalk is forced to match existing ground so that no additional cut/fill is required outside the sidewalk. Inside edge of sidewalk ties to top of curb. Width of and station range(s) for the sidewalk are set by lines drawn in plan view dgn file. Draws sidewalk pavement layer plus an optional base course layer plus optional parkway between sidewalk and roadway curb. (CFL only)
Concrete Cut Wall	
fh_walcd.x10	Cut wall plus associated excavation and backfill. Uses lines in plan view dgn file to set station ranges and side of roadway.
fh_walcs.x10	Cut wall plus associated excavation and backfill. Uses exceptions data file to set station ranges and side of roadway.
Guardwalls	
c_gwall2s.x10	FLH metric standard precast concrete guardwall (618M) and stone masonry guardwall (620M). Guardwall, guardwall footing, backfill and foreslope behind wall. Uses station ranges specified in exceptions data file to locate guardwall.



Criteria File	Description
c_gwall3d.x10	Guardwall, guardwall footing, backfill and foreslope behind wall. Uses lines drawn in plan view dgn file to locate guardwall. Closes off base course layers with vertical lines at inside face wall if necessary.
c_gwall3s.x10	Guardwall, guardwall footing, backfill and foreslope behind wall. Uses station ranges specified in exceptions data file to locate guardwall. Closes off base course layers with vertical lines at inside face wall if necessary.
3 Port Criteria	
Draw Clearing Limits Into Plan View	
Draws clearing limit lines into a plan view dgn file based on the information from a standard Geopak clearing report.	
Draw Clearing Limits Into Cross-Sections and Create Staking Report	
Draws clearing limit lines into a cross-section dgn file and also creates an ASCII NEZ-Station clearing limits staking report. The distance left and right of centerline for the clearing limit lines is based on the information from a standard Geopak clearing report.	
Compare Surveyed Points to TIN Surface	
Compares the elevations of a set of surveyed points to the surface of a tin file and reports the results both graphically and in an ASCII file.	
Draw Curve Widening Lines Into Plan View	
Draws curve widening lines into a plan view design file based on AASHTO 2001 Green Book Exhibit 3-51. The curve widening lines are used by the standard criteria files to widen the pavement in proposed cross-sections.	
Draw Slope Stake Report Cross-Sections	
Draws lines representing the information from the FHWA slope staking report onto proposed cross-sections to aid in spot checking.	
Draw Red/Blue Top Report Cross-Sections	
Draws lines representing the information from the FHWA red/blue top reports onto proposed cross-sections to aid in spot checking.	
Draw Milepost Stationing in Plan View	
Draws milepost stationing consisting of a tick mark plus the corresponding text "MP x.x" every 0.1 mile along a baseline chain.	

Table 18-1: Criteria File List

Follow Workflow 1 below to process the proposed cross sections:

Workflow 1: Process Cross Sections

1. *Select Applications>GEOPAK ROAD>Cross Sections>Process Cross Sections, or select the process cross sections icon  from the GEOPAK Road toolbar.*

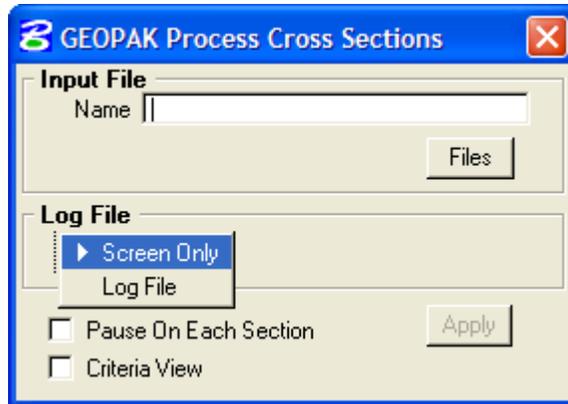


Figure 18-1: Process Cross Sections

2. *In the Input File section type the name of the cross section input file or press the Files button and select the input file.*
3. *In the Log File section you may select to display the output to the screen, or to create a log file, which is a history of the process.*



A Log file is not necessary unless the cross sections are not processing properly and you are looking for the location of the problem. You can also mark the Pause On Each Section to help you determine where a problem may occur.

4. *Press the Apply button to process sections.*

Cross Section Navigator

Now that you have completed the cross section run, you will want to view them. The cross section navigator is a tool that makes the viewing of cross sections much easier.

Workflow 2: Cross Section Navigator

1. *Select Applications>GEOPAK ROAD>Cross Sections>Navigator, or select the process cross-sections icon  from the GEOPAK Road toolbar.*



Figure 18-2: Cross Section Navigator

2. *Navigator will automatically center the first cross section found, using the station on the cross section cells.*



3. Use the arrows  to move up or down station through the cross sections. You can also use the pull down menu to go to a specific cross section.