

FLH Standard Criteria Files

Section 13 –

Cut/Fill Slope Selection Criteria Files

fh_ss3.x08

This criteria file 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
- 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)

define variables that must be assigned values in the input data file:

"cut slope 1" thru "cut slope 9" (e.g., 4 = 1:4 slope up and away from centerline)
"cut height 1" thru "cut height 9"
"fill slope 1" thru "fill slope 9" (e.g., 5 = -1:5 slope down and away from centerline)
"fill height 1" thru "fill height 9"
"ditch foreslope slope lt" (e.g., 4 = -1:4 slope down and away from centerline)
"ditch foreslope dist lt"
"ditch foreslope slope rt" (e.g., 4 = -1:4 slope down and away from centerline)
"ditch foreslope dist rt"
"flat bottom ditch width lt"
"flat bottom ditch width rt"
"flat bottom tolerance"
"daylight slope" (e.g., either -10 or -1:10 yields the same slope)
"daylight width"

define_dgn variables that must be assigned values in the input data file:

"rock"

Variables that must be defined in exceptions data file:

None

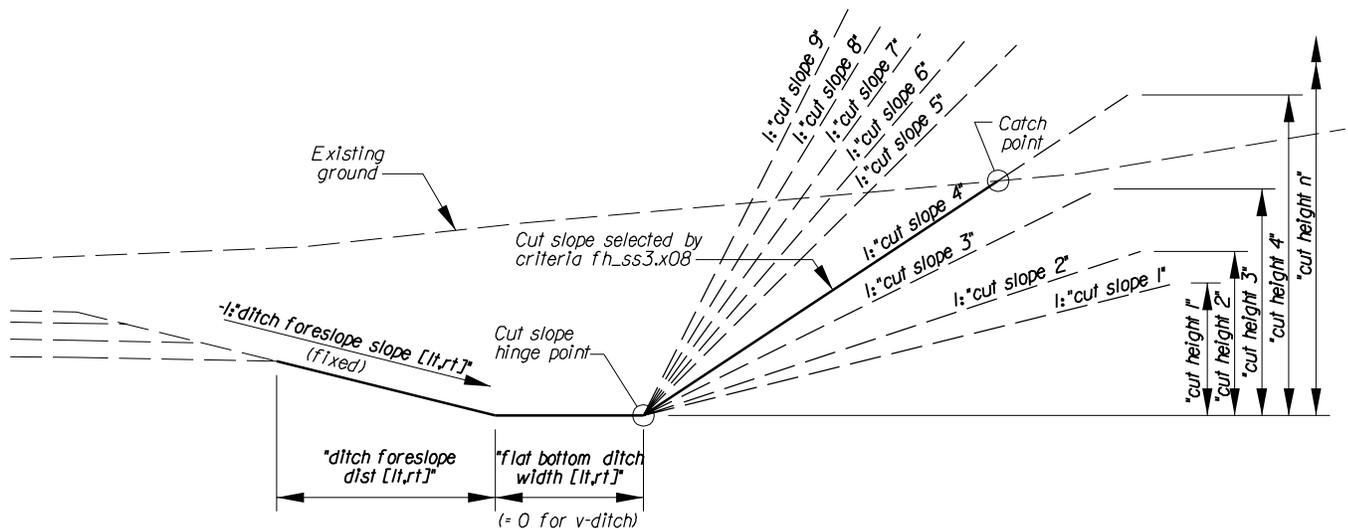
General notes for fh_ss3.x08:

1. All of the variables listed above must be defined in the proposed cross-section input file when fh_ss3.x08 is used. Even if a variable refers to a feature that won't be used, it still must be defined in the input file. In addition to the required variables listed above, there are several optional variables that the user may define in the input file to take advantage of optional features available in fh_ss3.x08 such as benched cut slopes or compound cut slopes. These optional variables are listed in the sections below.
2. All nine "cut slope n"/"cut height n" pairs and all nine "fill slope n"/"fill height n" pairs must be defined in the proposed cross-section input file, even if the user doesn't need to use all of them to

define all the design cut/fill slopes.

3. "cut slope [1-9]" values are the RUN portion of a 1:RUN slope. For example, if "cut slope 1" is assigned a value of 4.00 in the proposed cross-section input file, then the first cut slope checked will be a 1:4 slope up and away from the roadway centerline. The "cut slope [1-9]" values should be defined so that they always go from flatter to steeper slopes.
4. The "cut height [1-9]" values are the maximum vertical height above the ditch hinge point for the corresponding cut slope. If "cut slope n" doesn't catch the existing ground within this height, then "cut slope n+1" is checked, etc., until a cut slope is found that catches within the specified height.
5. The typical slope selection process defined by the "cut slope n"/"cut height n" pairs can be overridden with the `_d_cut_slope_lt` and `_d_cut_slope_rt` in the exceptions data file (for fixed cut slope ratios within a station range) or with the `_d_bench_lt` and `_d_bench_rt` variables in the exceptions data file (for a benched cut within a station range).
6. "fill slope [1-9]" values are the RUN portion of a -1:RUN slope. For example, if "fill slope 1" is assigned a value of 5.00 in the proposed cross-section input file, then the first cut slope checked will be a 1:5 slope down and away from the roadway centerline. (Notice that this is the opposite how the cut slopes are defined, and also the opposite of the normal GEOPAK sign convention for slopes.)

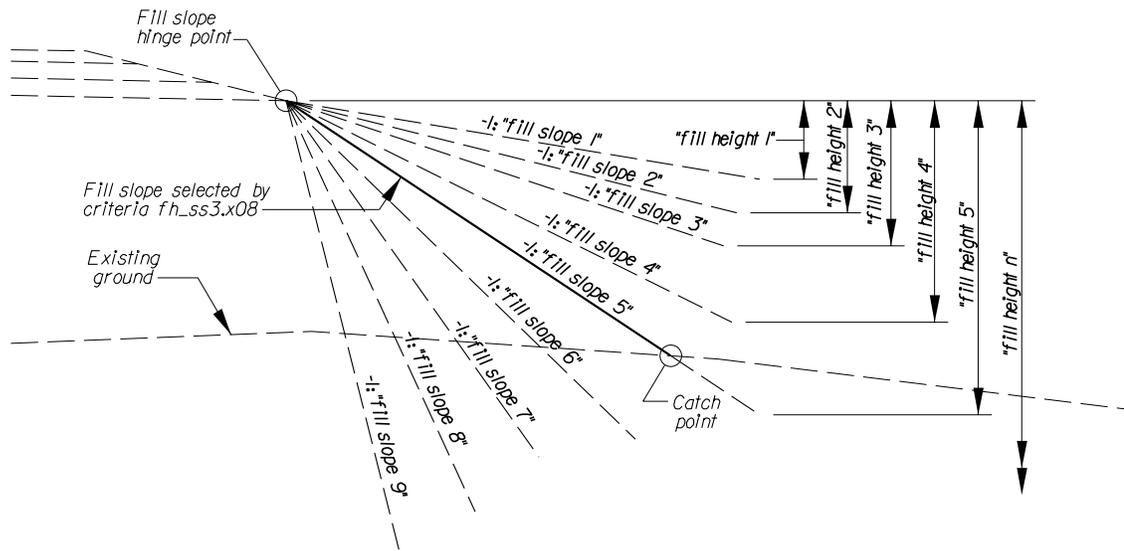
Typical Cut Slope Selection Details for fh_ss3.x08



Notes for typical cut slope selection:

1. There are nine "cut slope n"/"cut height n" pairs, and all nine pairs must be defined in the proposed cross-section input file, even if the user doesn't need to use all of them to define all the design cut slopes.
2. "cut slope [1-9]" values are the RUN portion of a 1:RUN slope. For example, if "cut slope 1" is assigned a value of 4.00 in the proposed cross-section input file, then the first cut slope checked will be a 1:4 slope up and away from the roadway centerline. The "cut slope [1-9]" values should be defined so that they always go from flatter to steeper slopes.
3. The "cut height [1-9]" values are the maximum vertical height above the ditch hinge point for the corresponding cut slope. If "cut slope n" doesn't catch the existing ground within this height, then "cut slope n+1" is checked, etc., until a cut slope is found that catches within the specified height.
4. The typical cut slope selection process defined by the "cut slope n"/"cut height n" pairs can be overridden with the `_d_cut_slope_lt` and `_d_cut_slope_rt` in the exceptions data file (for fixed cut slope ratios within a station range) or with the `_d_bench_lt` and `_d_bench_rt` variables in the exceptions data file (for a benched cut within a station range).

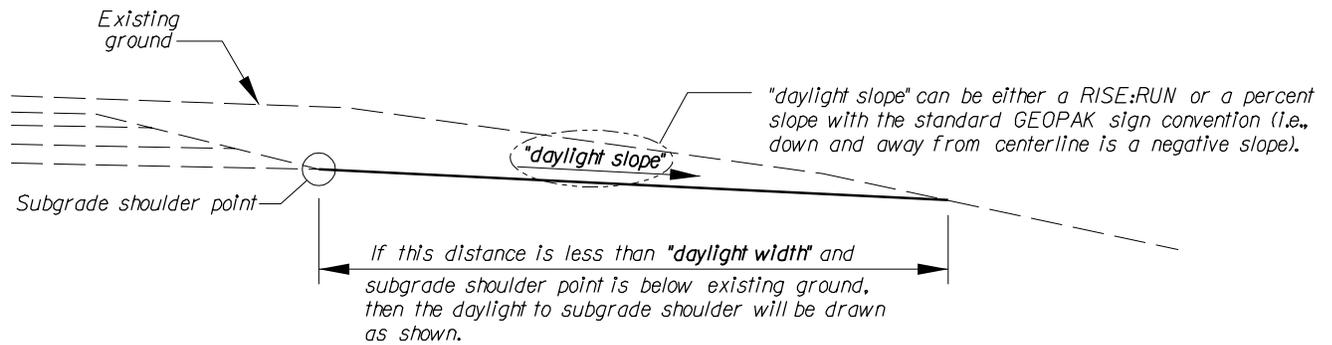
Typical Fill Slope Selection Details for fh_ss3.x08



Notes for typical fill slope selection:

1. There are nine "fill slope n"/"fill height n" pairs, and all nine pairs must be defined in the proposed cross-section input file, even if the user doesn't need all of them to define all the design fill slopes.
2. "fill slope [1-9]" values are a single number corresponding to the RUN portion of a -1:RUN slope. For example, if "fill slope 1" is assigned a value of 4.00 in the proposed cross-section input file, then first fill slope checked will be a -1:4 slope down and away from the roadway centerline. The "fill slope [1-9]" values should be defined so that they always go from flatter to steeper slopes.
3. The "fill height [1-9]" values are the maximum vertical distance below the subgrade shoulder point for the corresponding fill slope. If "fill slope n" doesn't catch the existing ground within this height, then "fill slope n+1" is checked, etc., until a fill slope is found that catches within the specified height.
4. The typical fill slope selection process defined by the "fill slope n"/"fill height n" pairs can be overridden with the `_d_fill_slope_lt` and `_d_fill_slope_rt` in the exceptions data file for fixed fill slope ratios within a station range.

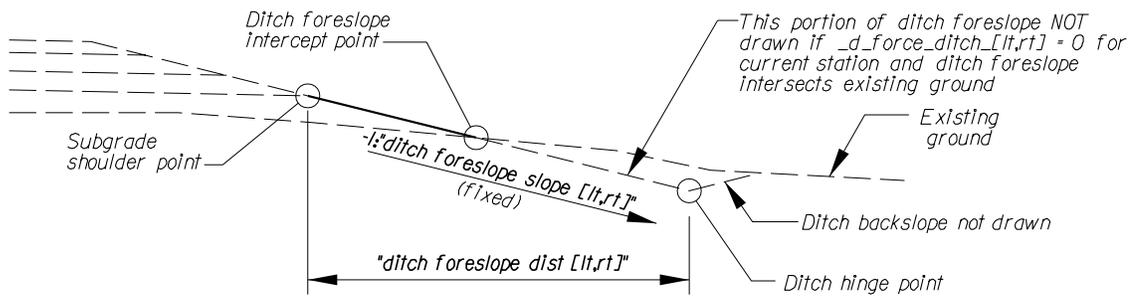
Daylight to Shoulder Details for fh_ss3.x08



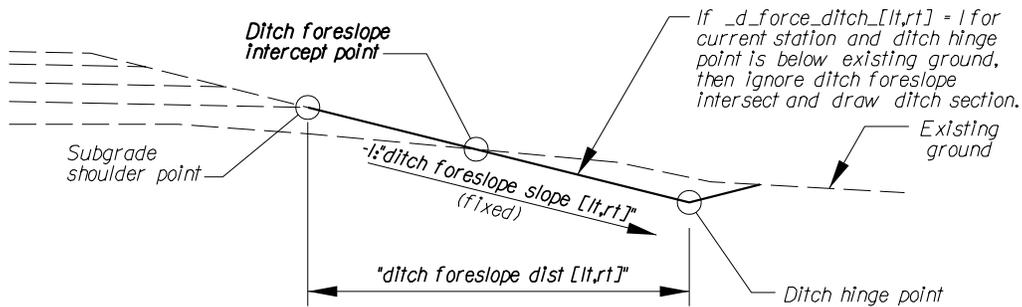
Notes for daylight to shoulder:

1. "daylight slope" can be either a RISE:RUN or a percent slope with the standard GEOPAK sign convention of down and away from centerline is a negative slope.
2. Notice that the user can effectively eliminate all daylights by setting the "daylight width" define variable to a small value (e.g., 0.01).

Ditch Foreslope Intercept Details for fh_ss3.x08



CASE 1 $_d_force_ditch_ [lt,rt] = 0$
(default)



CASE 2 $_d_force_ditch_ [lt,rt] = 1$

Notes for ditch foreslope intercept:

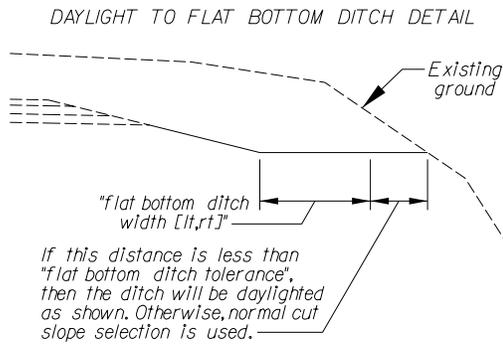
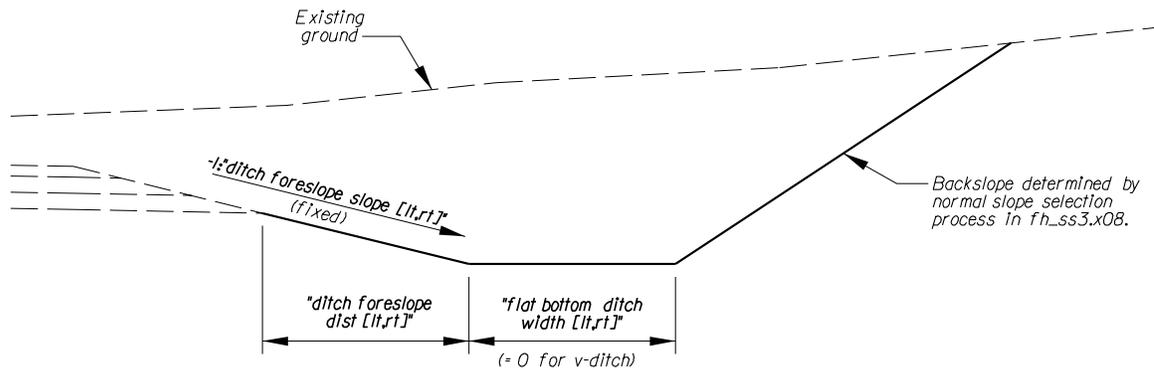
1. The ditch foreslope intercept feature is turned on by default (i.e., Case 1 above). The user may optionally turn this feature off for station ranges by setting $_d_force_ditch_lt$ and/or $_d_force_ditch_rt$ to 1 in the exceptions data file. For example,

```
if sta >= 1+000 r 1 and sta <= 2+000 r 1 then
{
  _d_force_ditch_lt = 1
}
```

in the exceptions data file would turn off the ditch foreslope intercept feature on the left side from Sta. 1+000 thru 2+000.

2. When the ditch foreslope option is turned on (Case 1), it will be drawn only if the following conditions are met:
 - ditch hinge point is below existing ground
 - ditch foreslope intersects existing ground between subgrade shoulder hinge point and ditch hinge point
 - elevation of ditch foreslope intercept point is lower than the elevation of existing ground above the ditch hinge point

Flat Bottom Ditch Details for fh_ss3.x08



Notes for flat bottom ditch:

1. "ditch foreslope lt" and "ditch foreslope rt" are single numbers corresponding to the RUN portion of a -1:RUN slope designation.
2. To use a v-ditch rather than a flat bottom ditch, define "flat bottom ditch width lt" and "flat bottom ditch width rt" to be 0 in the input file.
3. Flat bottom ditch can't be toggled on and off for station ranges. If "flat bottom ditch width lt" or "flat bottom ditch width rt" is defined in the input file as anything other than 0, then flat bottom ditch will be drawn for all cut sections on that side.
4. The bottom of the flat bottom ditch is always drawn horizontally.
5. To avoid getting any daylights to the flat bottom ditch, set "flat bottom ditch tolerance" to a large value (e.g., 100) in the input file.

Fixed Cut/Fill Slope Details for fh_ss3.x08

1. Station ranges for fixed cut or fill slopes are specified in the exception data file. These fixed cut/fill slopes override the normal slope selection process.

2. Four variables are used in the exceptions data file to define fixed slopes:

_d_cut_slope_lt
_d_cut_slope_rt
_d_fill_slope_lt
_d_fill_slope_rt

The values assigned to these variables in the exceptions data file are the RUN portion of a 1:RUN fixed cut slope or a -1:RUN fixed fill slope.

3. If the user specifies a fixed cut or fill slope that doesn't catch at a particular station, then a note to that effect is placed on the cross-section and the criteria reverts back to using the normal slope selection process to find a catch for that cross-section.

4. For example, if the user wanted to use a fixed cut slope of 4:1 on the right side from 5+000 thru 5+100, and a fixed fill slope of 1:1.5 on the left side from 10+000 thru 10+140, then the following lines would appear in the exceptions data file:

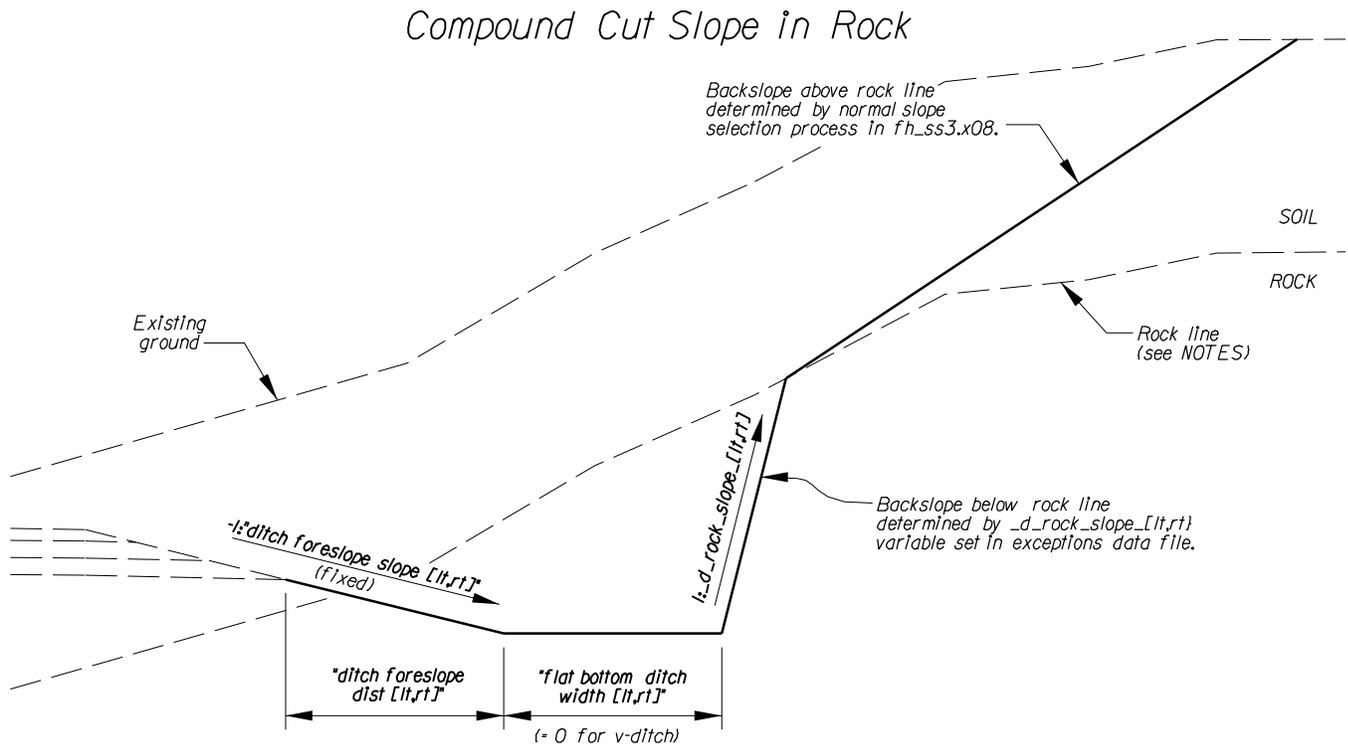
if sta >= 5+000 r 1 and sta < 5+100 r1 then

{
_d_cut_slope_rt = 0.25
}

if sta >= 10+000 r 1 and sta < 10+140 r1 then

{
_d_cut_slope_lt = 1.5
}

Compound Cut Slopes in Rock Details for fh_ss3.x08



All the following variables are optional. If the user doesn't want to use the special compound cut slope in rock feature, then none of these variables need be defined in the proposed cross-section input file or the exceptions data file.

define variables that must be assigned values in the input data file:

None

define_dgn variables that must be assigned values in the input data file:

"rock"

Variables that must be defined in exceptions data file:

_d_rock_slope_lt
_d_rock_slope_rt

Notes for special compound cut slope in rock:

1. The purpose of this option is to draw compound cut slopes in areas where there is a rock layer with soil overburden. The cut slope in rock is set to a user defined fixed value; the cut slope in the overburden is variable using the normal slope selection criteria.
2. The top of the rock layer must be drawn into the cross-section dgn file before the proposed cross-sections run. The rock layer can be drawn manually using MicroStation, or if it's a fixed depth below the existing ground it can be drawn in a separate preprocessing run using criteria file

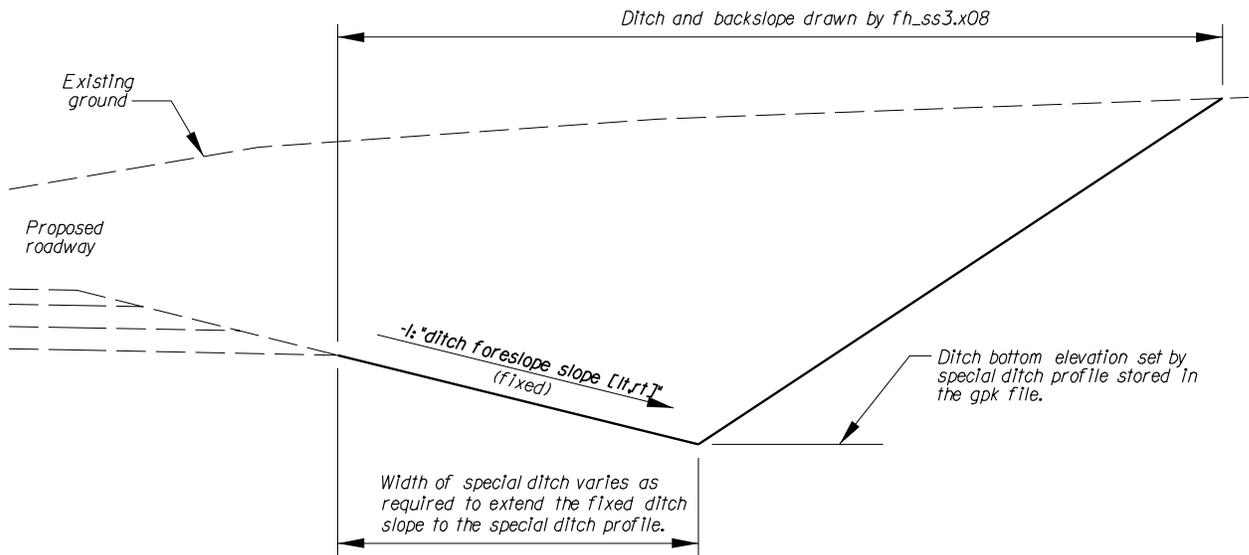
Compound Cut Slopes in Rock Details for fh_ss3.x08

fhex_fea.x08.

3. Station ranges where the special compound rock cut slope is used are set with the variables `_d_rock_slope_lt` and `_d_rock_slope_rt` variables in the exceptions data file.
4. Variables `_d_rock_slope_lt` and `_d_rock_slope_rt` should be defined in the exceptions data file as a single number representing the RUN portion of a 1:RUN slope specification. For example, if the user wants to use a 4:1 rock slope on the left side from station 1+000 thru 2+000 then the following lines would appear in the exceptions data file:

```
if sta >= 1+000 r 1 and sta <= 2+000 r 1 then
{
  _d_rock_slope_lt = 0.25
}
```
5. Notice that just because a rock line is drawn on the cross-section doesn't necessarily mean that compound cut slopes will be used (the station range for those cross-sections must be defined in the exceptions data file also). And conversely, just because a special compound rock cut slope is called for in the exceptions data file doesn't mean it will be drawn on the cross-sections (the rock line must be drawn onto the cross-sections for the station range also).
6. The `define_dgn` variable "rock" refers to the level/symbology of the line(s) drawn in the cross-section `dgn` file representing the top of the rock layer. (Contrast this to the typical use of `define_dgn` variables where they refer to lines drawn in a plan view `dgn` files.)
7. The standard level/symbology for the "rock" in XS `dgn` lines is `lv=57 co=57`.

Special Ditch Profile Details for fh_ss3.x08



The define variables "LT PROF" and "RT PROF" are optional. If the user doesn't want to use the special ditch profile feature, then these variables should not be defined in the proposed cross-section input file.

define variables that must be assigned values in the input data file:

- "LT PROF" (optional)
- "RT PROF" (optional)

define_dgn variables that must be assigned values in the input data file:

None

Variables that must be defined in exceptions data file:

None

Notes for special ditch profile:

1. The station range and elevation of special ditch(es) drawn with this option are both defined by profile(s) stored into the gpk file from COGO (or the GEOPAK Vertical Alignment Generator).
2. The stationing of the special ditch profile stored in the gpk file must match the roadway stationing, including region number. For example, if the designer wants a special ditch that goes from Sta. 5+000 r 3 thru Sta. 5+500 r 3 on the roadway stationing, then the ditch profile stored into the gpk file must begin at Sta 5+000 r 3 (not "no region" or "r 1" or "r 2") and must end at Sta 5+500 r 3 (same comments).
3. The names of the COGO profiles for the special ditch are referenced in the define "LT PROF" and define "RT PROF" statements in the proposed cross-section input file. For example, if the designer wanted special ditch profiles from elevation 233.00 at Sta. 1+000 to elevation 235.00 at Sta. 1+500 on the left side, from elevation 242.00 at Sta. 2+000 to elevation 244.00 at Sta. 2+300

Special Ditch Profile Details for fh_ss3.x08

also on the left side, and from elevation 234.00 at Sta. 1+200 to elevation 235.00 at Sta. 1+600 on the right side, then the following actions would be required:

- a. Store profiles into the gpk file for each of the three special ditches using the following series of COGO commands:

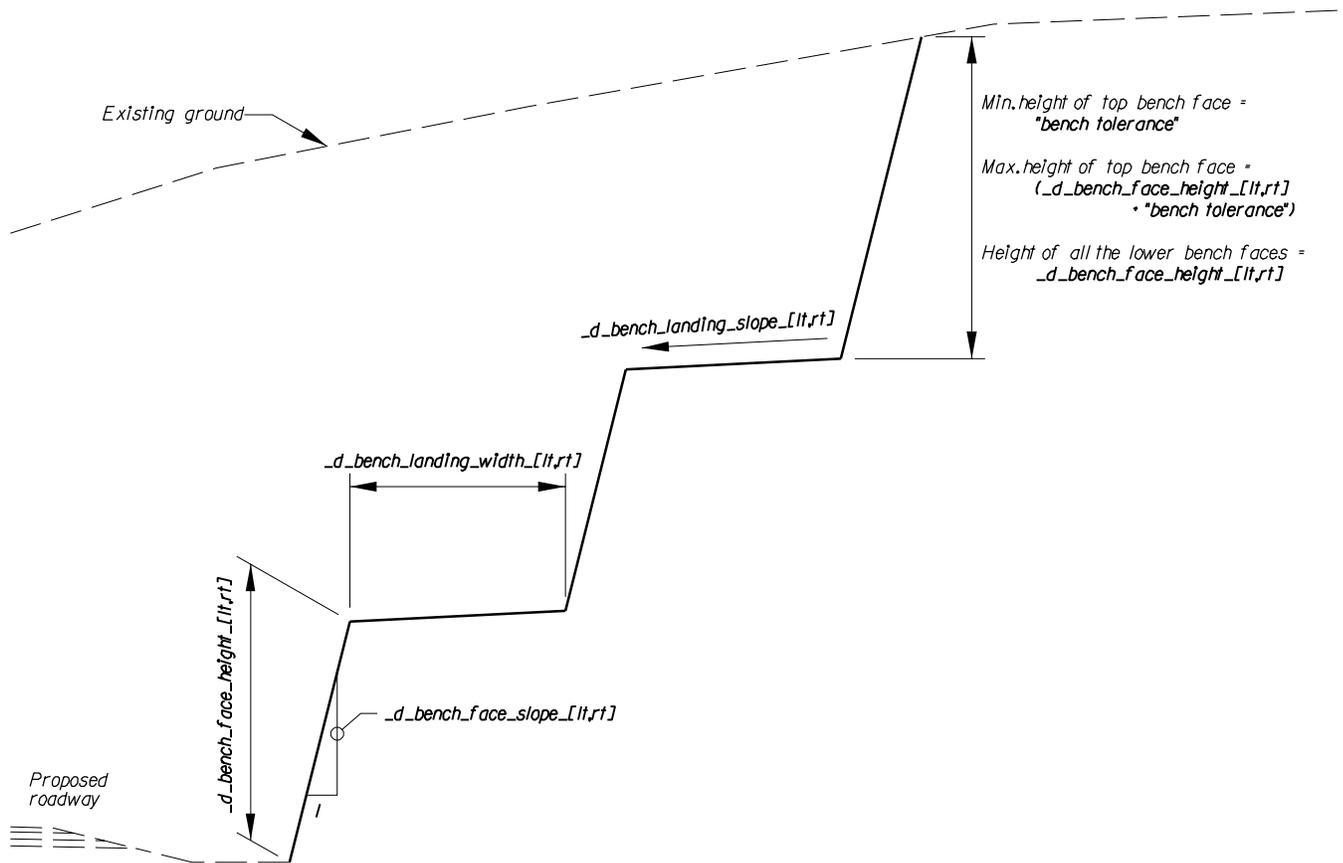
```
S PRO LTDITCH1  
VPI 1 S 1+000 E 233.00  
VPI 2 S 1+500 E 235.00  
END PRO  
STO PRO LTDITCH2  
VPI 1 S 2+000 E 242.00  
VPI 2 S 2+300 E 244.00  
END PRO  
STO PRO RTDITCH  
VPI 1 S 1+200 E 234.00  
VPI 2 S 1+600 E 235.00  
END PRO
```

- b. Include the following lines in the proposed cross-section input file:

```
define "LT PROF" ltditch1, ltditch2  
define "RT PROF" rtditch
```

4. The "ditch foreslope slope lt" and "ditch foreslope slope rt" define variables are the same ones that are used to draw the "typical" ditches.
5. It is possible, although not recommended, to override the "ditch foreslope slope [lt,rt]" variables for station ranges within a project by using the variables `_d_ditch_foreslope_lt` and `_d_ditch_foreslope_rt` in the exceptions data file. (Where `_d_ditch_foreslope_[lt,rt]` is a single number corresponding to the RUN portion of a -1:RUN slope specification.)

Cut Slope Benching Details for fh_ss3.x08



Cut slope benching is optional. If the user doesn't want to use cut slope benching, then these variables should not be defined in the proposed cross-section input file and exceptions data file. On the other hand, if cut slope benching is used, then all these variables must be defined.

define variables that must be assigned values in the input data file:

"bench tolerance"

define_dgn variables that must be assigned values in the input data file:

None

Variables that must be defined in exceptions data file:

- _d_bench_face_height_lt
- _d_bench_face_height_rt
- _d_bench_face_slope_lt
- _d_bench_face_slope_rt
- _d_bench_landing_slope_lt
- _d_bench_landing_slope_rt
- _d_bench_landing_width_lt

Cut Slope Benching Details for fh_ss3.x08

`_d_bench_landing_width_rt`

Notes for cut slope benching:

1. Station ranges for cut slope benching are set in the exceptions data file.
2. The "bench tolerance" variable effects the height of the top bench face only; the face heights of all benches below the top one are set with the `_d_bench_face_height_[lt,rt]` variables. The face height of the top bench is variable and can range between a minimum height of "bench tolerance" and a maximum height of "bench tolerance" + `_d_bench_face_height_[lt,rt]`.
3. The value of the `_d_bench_face_slope_[lt,rt]` variable is the RISE portion of a RISE:1 slope specification. For example, a value of 4 will result in a 4:1 RISE:RUN bench face slope.
4. The `_d_bench_landing_slope_[lt,rt]` variable can be either a RISE:RUN slope specification or a percent slope. For example, either 1:20 or 5 will result in a bench sloping in towards the roadway at a 5% slope.
5. The following is an example of the statements that would appear in the exceptions data file to produce cut slope benching between 1+000 and 1+500 on the left side and between 2+000 and 2+300 on the right side:

```
if sta >= 1+000 r 1 and sta <= 1+500 r 1 then
```

```
{  
  _d_bench_lt = 1  
  _d_bench_face_slope_lt = 4  
  _d_bench_face_height_lt = 3.00  
  _d_bench_landing_slope_lt = 5  
  _d_bench_landing_width_lt = 2.00  
}
```

```
if sta >= 2+000 r 1 and sta <= 2+300 r 1 then
```

```
{  
  _d_bench_rt = 1  
  _d_bench_face_slope_rt = 10  
  _d_bench_face_height_rt = 3.50  
  _d_bench_landing_slope_rt = 5  
  _d_bench_landing_width_rt = 1.50  
}
```

6. Fill slope benching is not currently supported by fh_ss3.x08. Criteria file fh_specdit1.x08 may be used to create fills with a single bench.