ACE Structural Engineering Applications LLC
ACE FrameWorks Utilities
Slab, Plate & Grating on Steel Beams/Grids/Lines Documentation

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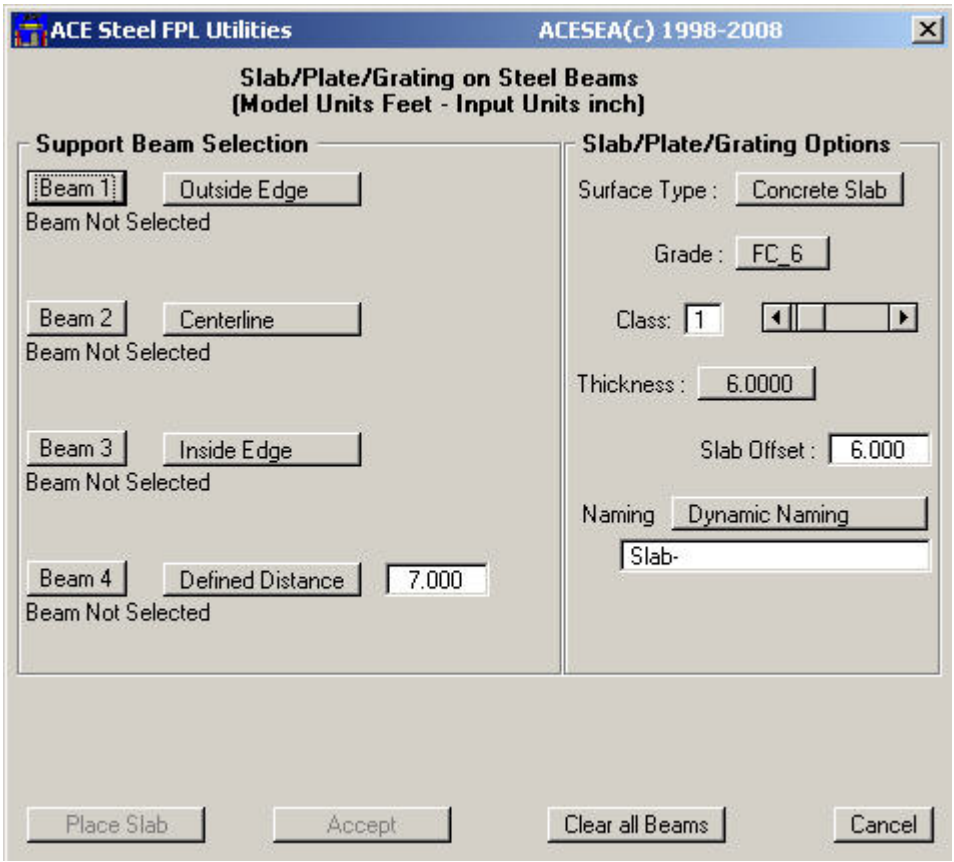
Slab Plate & Grating on Steel Beams/Grids/Lines (ACE_SPG.MA)

(Versions - FWP 3.1.x.x/3.2.x.x rel 2.0.6 & FWP 7.0.x.x rel 7.0.6 & FWP 7.1/7.2/7.3 rel 6.0.6 & FWP 8.0.x.x rel 8.0.6 & FWP 9.0.x.x rel 9.0.6 & FWP 10.0.x.x rel 10.0.6 & FWP 11.0.x.x rel 11.0.6 & FWP 12.0.x.x rel 12.0.6)

The *Slab Plate Grating on Steel Beams/Grids/Lines* application simplifies the placement of surfaces, which can be a concrete slab, steel plate or steel grating represented by a FrameWorks "slab element". The utility allows four beams and/or FWP grids and or MicroStation lines to be selected as a boundary definition for the surface. The inset or outset from the beam/grid/line centerline to the edge of the surface may be to the edge of the steel beam flange (for beams only) or may be a defined distance for beams or grid/lines. A positive definition will cause the slab surface area to increase. The beams and/or grids/lines must be horizontal (flat). The four beams/grids/lines should be picked in either clockwise or counter clockwise order. The slab may be offset from the TOS point of the beams/grids/lines. The assumption is made that all beams are placed by cardinal point 8 (top center). The beams/grids/lines must all be at the same elevation and every beam/grid/line must intersect the neighboring beams/grids/lines. Lines must be MicroStation type 3 lines (not linestrings).



Slab, Plate & Grating on Steel Beams - Primary Dialog Box

The utility has internal defaults for all the items shown on the dialog box above. The defaults may be overridden with user definable defaults by using a definition file, which is discussed in detail later in this document.

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Slab, Plate & Grating on Steel Beams/Grids/Lines - Variables and Options

The Slab Plate & Grating application, ACE_SPG.MA, has been designed to allow greatly facilitate the placement of surfaces. This FrameWorks Plus FPL application is limited to a single surface supported on four beam and/or grids/lines, which form a 4-sided polygon:

- Beam1(Bm1) through Beam4(Bm4) parameters
  - Button to select a support beam or grid line or line
  - Offset placement option (Outside edge, center, inside edge, or defined distance)
  - Defined offset distance if defined distance is active
- Option Button to select surface (Concrete Slab, Steel Plate & Steel Grating) & parameters
  - Option Button to select Grade (per surface type)
    - Up to 10 grade choices
    - Grade choices are user definable via definition file
  - Option Button to select Thickness (per surface type)
    - Up to 9 thickness choices
    - Thickness choices are user definable via definition file
    - A specified thickness may be keyed in at run time
  - Slider/Keyin to select class (0 to 9) (per surface type)
  - Surface Elevation Offset (per surface type)
- Naming Option Parameters
  - Naming can be dynamic, constant, constant w/ FWP ID or FQP autoname
  - Toggle for Mbr_ID suffix w/ dynamic naming
  - Name Input keyin field for dynamic or constant naming

Surface Naming

The surface placed consists of one FrameWorks solid (slab type) element and may be named depending upon the naming option selected. The name may be a constant name or it may be a prefix with the FrameWorks solid member ID (FWP ID) appended as a suffix. The default prefix is SPG, however a different prefix may be specified in the definition file or supplied at runtime. Other naming options include: dynamic naming at placement time: a constant specified name; or FrameWorks normal naming for individual components (autoname). Dynamic naming allows the name to be selected (or remain the last name selected) at placement time with or without appending the FWP ID to the name.

Subsequently a sample definitions file is shown with expanded explanation.

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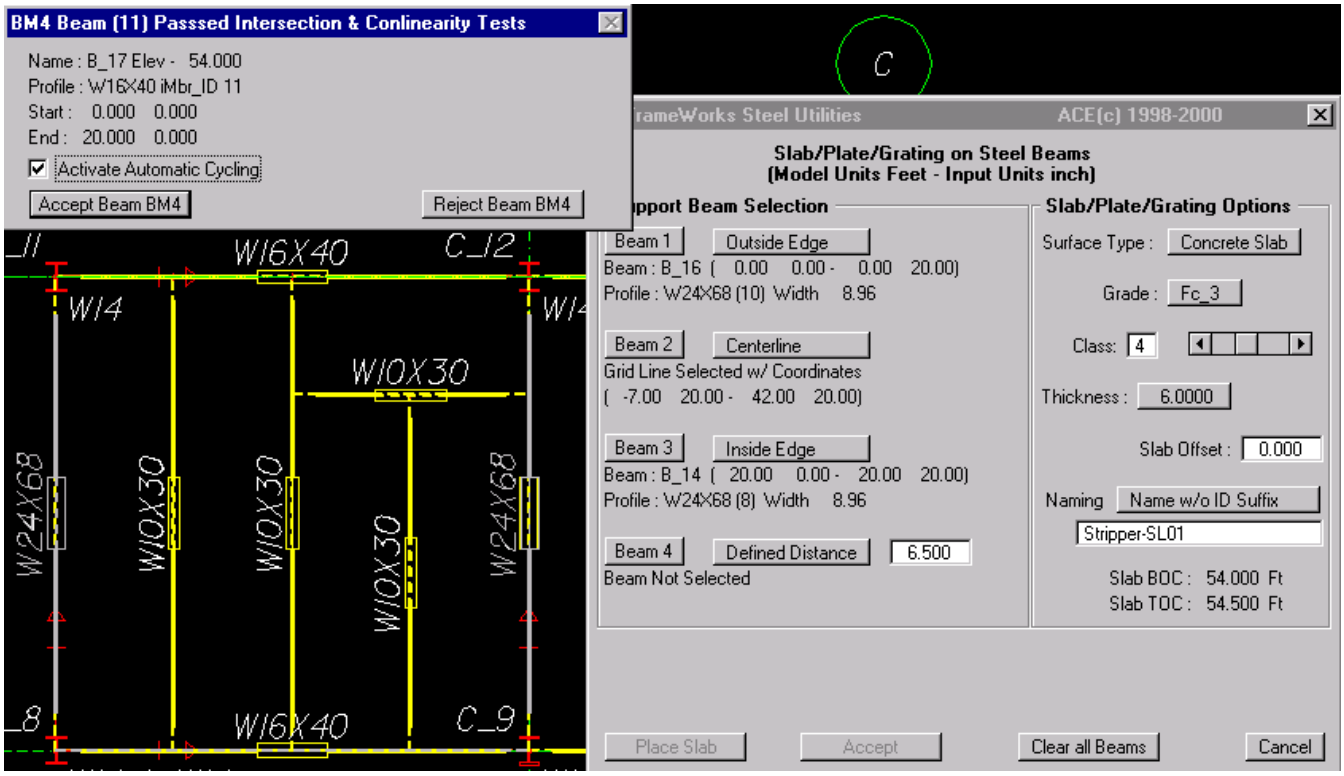
Slab, Plate & Grating on Beams/Grids/Lines - Basic Operation

The process of placing a surface is initiated by selecting the supporting beams/grids/lines. As previously mentioned the beams/grids/lines must be selected in either a clockwise or a counterclockwise order. The detailed beam/grid/line checks are discussed in the next section. The easiest way to start the beam selection process is to start by pressing the Beam1 button. Select a beam and the accept/reject beam dialog box shows. "Automatic Cycling" is active by default and may be toggled off. With automatic cycling on, the application will expect the selection of beams in numerical order until all four beams are selected. The beams do not have to be selected in any specific order. The beams/grids/lines can be selected in any order, however the four beams must form a four-sided polygon surface (beam 1 must intersect beams 2 & 4, beam 2 must intersect beams 1 & 3, beam 3 must intersect beams 4 & 2 and beam 4 must intersect beams 3 & 1). For each beam selected, the accept/reject dialog box shows it's name, TOS elevation, profile name, FWP_ID, and the start & end x & y coordinates. For each grid or line selected, the accept/reject dialog box shows the grid or line's start & end coordinates.



In the figure above, three beams (actually two beams and a grid) have been selected and the fourth beam/grid/line is in the process of being selected. As each beam/grid/line is selected a set of intersection, co linearity & planarity checks are performed. If the beam/grid/line passes all checks, the accept/reject dialog box above is presented. If the beam/grid/line is accepted, data about the beam/grid/line is written on primary dialog box below the Beam# in question. Once four beams/grids/lines are successfully selected, the "Accept" button is available. The results of pressing accept are shown and discussed on the next page. The page continues with a discussion of the intersection, co linearity & planarity checks.

Intersection, Co linearity & Planarity Checks for beams, grids & lines

Whenever a beam/grid/line is selected or reselected, it goes through the following checks.

1. The beam must be flat (i.e. start & end Z coordinates must be equal)
2. Beam1 must intersect Beam2 & Beam4 (Beam2 must intersect Beam3 & Beam1 etc)
3. Beam1 must not be collinear with Beam3 (Beam 2 must note be collinear with Beam4)
4. All beam coordinates must form a single plane.

Slab, Plate & Grating on Beams/Grids/Lines - Basic Operation (continued)

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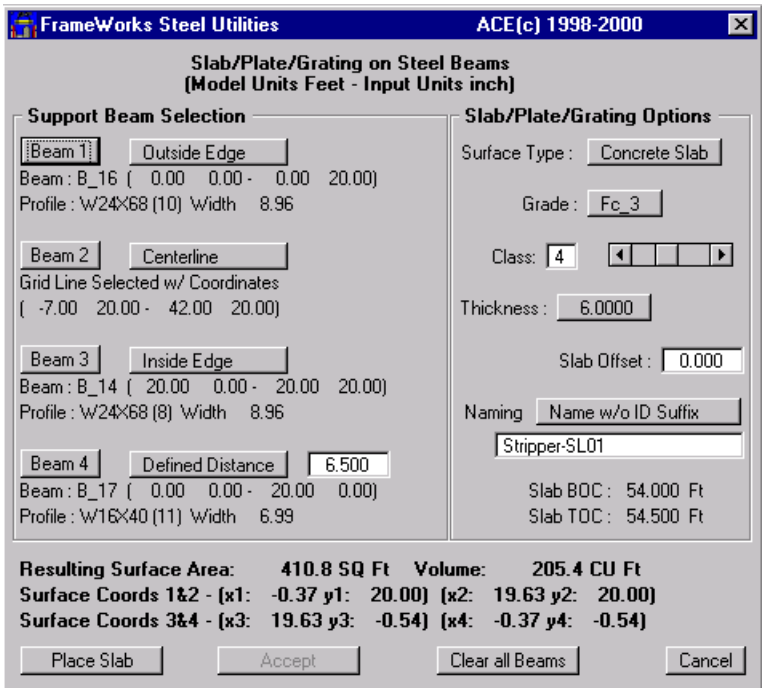
Once four beams/grids/lines have been selected, the “Accept” button lights up. When the accept button is pressed, the surface coordinates are computed and a MicroStation element is temporarily placed. The surface, area, volume and coordinates are shown on the primary dialog box and the “Place” button lights up. When the Place button is pressed, a FrameWorks solid element (slab type) will be placed, the MicroStation elements will be deleted and beams/grids/lines as well as other data will be cleared on the primary dialog box.



Before placement, any of the items on the dialog box may be changed. For instance a beam/grid/line may be reselected, the limits of the surface may be changed, the surface type may be changed, the surface thickness may be changed, ... etc. If any items are changed, “Place” is un-highlighted, the MicroStation element is deleted, “Accept” is re-highlighted if 4 beams/grids are selected. When proper settings are established, the “Place” button may be pressed to place the surface as a FrameWorks solid (slab element).

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Definitions File

Due to the dissimilar nature of the variables in the steel utilities, each steel utility has a separate definition (DEF) file. While each file is distinctly different, each file is similar in the basic method of definition. Each definition file may optionally be controlled with either of two environment variables. Thus a project specific definition file for each project may be easily specified. The environment variables may be specified in numerous ways (similar to any MicroStation variable), however the utilization of a project.pcf is highly recommended. Environment variable definition is discussed in detail in the installation notes provided with the ACE FrameWorks utilities. The default name and location for the definition file for this utility are: C:\ACE_SPG.DEF. A directory for the definition file may be specified with the environment variable ACE_DEF_PATH (will look in specified path for file ACE_SPG.DEF). A complete name and location of a definition file may be also specified with the environment variable ACE_SPG_DEF. The first valid definition file found is utilized. The search for a definition file happens in the following order or priority:

1. If the variable ACE_SPG_DEF is specified, the named file at this location will be used if found.
2. If the variable ACE_DEF_PATH is specified and ACE_SPG.DEF is found in this directory, it is used.
3. If there is a c:\ace_spg.def file it is utilized.
4. If none of the above, internal program defaults are utilized – a warning message will be displayed. (if environment variables in 1 and/or 2 above are specified and corresponding DEF file is not found, a warning is displayed)

A sample default file is provided in later sections of this document. Toward the end of this document, the commands for the definition file are outlined in detail.

Due to the complex nature of the variables, the steel definition files allow the specification of units (either Metric (mm) or English (inch) for this application). Thus a given default file may be utilized in either a Metric or English project. The units may be changed throughout the definition file. If units are not specified, it is assumed that the definition file units match the units of the model (feet/inch-English & meters/mm-Metric). If units are defined and they do not match the model, the variables after the units command are converted to match the model units.

Sample Definitions File

Typical Definition File:

```
UNIts  ENGlish
GRA SLA 4    FC_3  FC_4  FC_5  FC_6
GRA PLA 3    A36      A42      A50
GRA GRA 1    A36
TKS SLA 5    3   4   5   6   8
TKS PLA 3    .25   .375    .5
TKS GRA 1    1.0
BMS BM1 1    6.0
BMS BM2 2    4.0
BMS BM3 3    5.0
BMS BM4 4    7.0
SUR SLA FC_3     1   5.0 6.0
SUR PLA A42  2    .375     0.0
SUR GRA A36  3    1.5 .125
NAME     DYNamic      Slab-
```

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Definitions File - Command Definition

- **Valid Primary Keyword Commands: (UNI, BMS, GRA, TKS, SUR, NAME)**
- **Each record must begin with a valid primary keyword or it is ignored**
- **All records that start with a blank are considered comments**
- **The commands/keywords (records) may be placed in any order however the order is significant**
- **All values for a given command must be defined in order shown above. If default values are acceptable, only the changed values must be given. However all values up to that point must be defined whether changed or not.**
- **The components of a given command (record) must all be present and in the order shown**
- **The units command is special and my be repeated and located as required. While commands may be in any order, it should be obvious that the location of the units command is extremely important.**
- **By default application looks for C:\ACE_SPG.DEF definition file**
- **Definition file path may be defined with environment variable ACE__DEF_PATH**
- **ACE_DEF_PATH=d:\mydir**
  (the DEF file ACE_SPG.DEF will be looked for in the directory d:\mydir)
- **Definition file may be defined with environment variable ACE_SPG_DEF**
- **ACE_SPG_DEF = d:\mydir\mydef_file** ***(highest priority definition)***
  (the DEF file mydef_file will be looked for in the directory d:\mydir)
- **NOTE: Components shown in bold may only be specified in the definitions file**

UNIT Command - Units Command (optional command)

UNIT {UNITTYPE}

where :

{UNITTYPE} May be ENGlish or METric

All input for the application is in inches for English units and mm for metric units.
If units is not specified it is assumed that the units match the current model units.
Units may be changed at any time but be aware that the properties (in attached library) for the member specified must match the current model units.

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Definitions File - Command Definition (con'd)

BMS Command - Beam Support Command defines support beam parameters

BMS sBm iPlace_opt fDistance

where :

sBm : Beam **BM1**, **BM2**, **BM3**, or **BM4**.

iPlace_opt **:** Default placement option (valid options 1 - 4)

1 - Outside Edge
2 - Centerline
3 - Inside Edge
4 - Defined

fDistance **:** Default distance to surface edge to beam/grid centerline when defined
(a positive value will always increase both the surface area and volume of the surface)

GRA Command - Grade Command defines grade options

GRA sSurface iGrades sGrade1 ... sGraden

where

sSurface : Surface type : **SLA** (Concrete Slab), **PLA** (steel plate) or **GRA**(steel grating) (default value - SLA)

iGrades : The number of grade values for this surface type (Maximum of 10 grades).
(default value - 3,2,2 for surfaces SLA, PLA, GRA)

sGrade1 : Grade definition (24 character max - should also be defined in FrameWorks)

sGraden : Last grade definition (Maximum of 10 grades n <= 10).

TKS Command - Thickness Command defines thickness options

TKS sSurface iTks sTks1 ... sTksn

where

sSurface : Surface type : SLA (Concrete Slab), PLA (steel plate) or GRA(steel grating) (default value - SLA)

iTks : The number of thickness values for this surface type (Maximum of 9 thickness values).
(default value - 3,2,2 for surfaces SLA, PLA, GRA)

fTks1 : First thickness definition

fTksn : Last thickness definition (Maximum of 9 thickness values n <= 9).

SUR Command - Surface Command defines standard values for surfaces

SUR sSurface sGrade iClass fTk fOffset

where

sSurface : Surface type : SLA (Concrete Slab), PLA (steel plate) or GRA(steel grating) (default value - SLA)

sGrade : Default Grade value (must match value in GRA definition or 1st Grade option is displayed)

iClass : Default Class value (0 <= iClass <= 9)

fTk : Default Thickness (fTK > 0) (if matches a thickness definition it is displayed)

fOffset : Distance from Beam/Grid TOS to surface BOC/BOS (Positive is up)

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Definitions File - Command Definition (con'd)

NGP Command - Named Group Command defines namedgroups

(Optional command to define named groups)

NGP iNGP_slab iNGP_plate iNGP_grating

where

iNGP_slab	**:** Named group for slab surfaces (default -1 which is none)
iNGP_plate	**:** Named group for plate surfaces (default -1 which is none)
iNGP_grating	**:** Named group for grating surfaces (default -1 which is none)

NOTE: Namedgroups are defined globally for a project. The iNGP_xxx value is an integer value that corresponds to the index of the global namedgroups. The first namedgroup is 0, the next is 1 and so on up to a maximum integer value of the number of namedgroups minus one. If a name group does not exist for the integer value specified, the member type in question will simply not be placed in a named group. A value of –1 specifies that the member type in question is not to be put in a namedgroup. In FWP namedgroups are specified by an alpha name so be careful when selecting integers. **SOLID NAMEDGROUPS ARE FUNCTIONAL with FWP version 7.00.00.17 and later.**

NAME Command - Name Command defines method of naming components

NAME {NAME_OPTION} name_prefix

where

{NAME_OPTION} : Keyword - must be AUT or SPE or DYN or CON

SPEcified : Use the supplied name and append the member ID for surface placed
Thus each surface will have a different name
(This is the default option with the name "SPG")

DYNamic : At placement time will display last name used with following options
1) option to supply a new name
2) option to request that member ID for surface placed be appended
Thus each surface will have a different name
3) option to abort placement

AUTo : FrameWorks assigns names by type and sequence number
(name_prefix not required or utilized)

CONstant : Use this name for all surfaces

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LOG FILES

All applications can write log files if the environment variable ACE_DUMP is set to 1. There have been reports that some sites lock the C root drive and under certain conditions a locked C drive can cause a system fault 5.

All applications have been modified to warn of a locked drive/file and then gracefully exit. All applications now look for the environment variable ACE_LOG_PATH. If it is found, that is the directory where the log files will be placed. If the directory is locked or non-existent or if file is locked a warning will be given and the C drive will be tried. If it is locked or the file is locked a warning will be given and application will gracefully exit.

Usage of the variable ACE_LOG_PATH to control log file locations is similar to ACE_DEF_PATH to control DEF files. However there is one very important difference: ACE_LOG_PATH should NEVER point to a network drive (this is highly recommended for ACE_DEF_PATH). Everyone writes to the same named log file and if they are on a network drive there will be bad consequences. ALWAYS point ACE_LOG_PATH to a local drive (perhaps a temp off C root).