

DXF Import and Export for EASE 4.4

Revision 4.03

EASE 4 allows both the import and export of model information using the AutoCAD DXF file format. The module used for this capability is called **EASE Import / Export**.

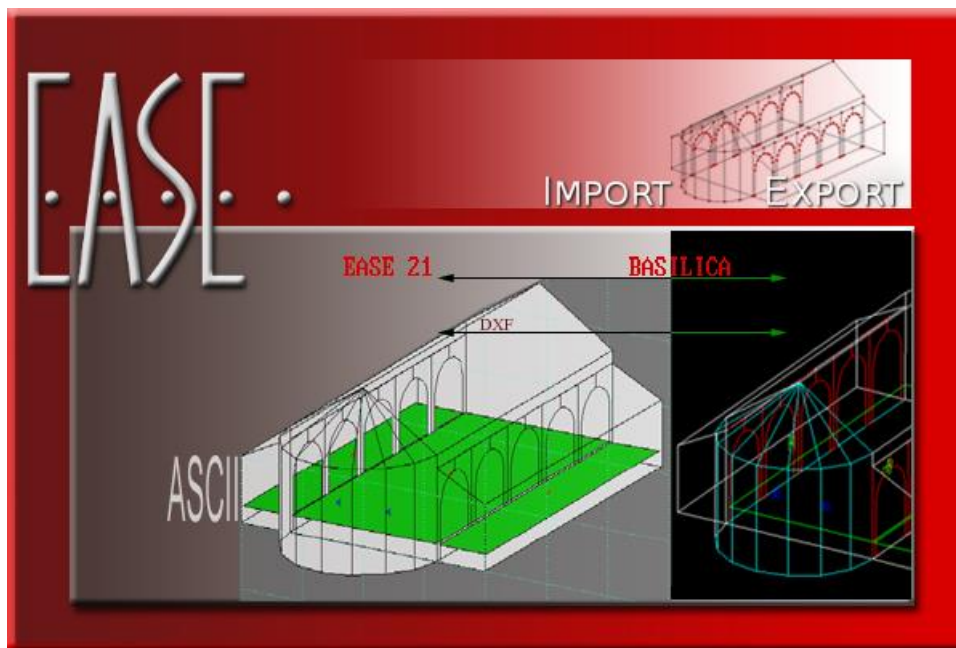


Figure 1: EASE 4 Import / Export Opening Screen

The following topics are covered in this application note:

- 1) **Import DXF** from the EASE Import / Export Tools menu.
(See 'Import of an AutoCAD DXF file into an Ease 4 Project file' on page 1)
- 2) **Export DXF** from the EASE Import / Export Tools menu.
(See 'Export of an Ease 4 Project to an AutoCAD DXF file' on page 9.)

Import of an AutoCAD DXF file into an Ease 4 Project file

You can import a DXF file created with AutoCAD or other programs. 'Import DXF' reads AutoCAD geometry data, which includes lines, 2D & 3D polylines, 2D solids, 3D faces, circles, and arcs. 'Import DXF' cannot import regions or 3D solids. Use the AutoCAD FREEZE command or turn OFF the layer of entities that you do not want to import into EASE. AutoCAD blocks can only be imported as EASE Loudspeakers, Listener Seats, Lamps, and IR Emitters. These blocks should be placed on suitable layers. (See 'Loudspeakers, Listener Seats, Lamps, and IR Emitters' on page 8)

All EASE 4 elements can be represented in AutoCAD and then be imported via a DXF file. This includes Edges, Faces, Audience Areas, Loudspeakers, Listener Seats, Lamps, and IR Emitters.

Placing entities on specially named layers for each wall material can be used to assign the EASE Material.

Note: Any AutoCAD entities that are not handled by the 'Import DXF' command should be converted to a less complex representation in your CAD program. The AutoCAD EXPLODE command should be used to simplify entities such as blocks, meshes, 3D objects, or other complex components. Blocks may need to be exploded multiple times if they have other blocks embedded in them. (Do not EXPLODE the blocks used for EASE Loudspeakers, Listener Seats, Lamps, and IR Emitters, however.)

Some hints for AutoCAD Users

If a new drawing of a room is being created in AutoCAD, it is preferable to draw the room using AutoCAD 3D SOLIDS. The special shapes of the room elements are then made with the commands UNION, SUBTRACT, INTERSECT, SLICE and INTERFERE.

You then can use the AutoCAD FBXEXPORT command to create a 3DS Max file. Then you create a new drawing and use the AutoCAD FBXIMPORT command to create a file that uses the entities stored in the 3DS Max file.

Note: If this new drawing contains any mesh or surface entities, you will need to use the AutoCAD EXPLODE command to simplify them. If you want to import materials, please sort the faces to the right layers with the right layer names.

Now save the drawing in DXF format. This file will now only contain entities that can all be imported by EASE.

If you don't want to do that procedure with FBX export, you will have to explode the BOXes and WEDGEs and 3D SOLIDS to LINES. Do not use 3D SOLIDS with round faces (SPHERE, CYLINDER, CONE or TORUS), because those solids explode to BODYs, which cannot be imported into EASE with the current converter. The same is true for EXTRUDED round 2D elements and REVOLVED 3D SOLIDS.

Another very good (maybe the best) idea is to use the commands for 3D SURFACES in AutoCAD: BOX, WEDGE, PYRAMID, CONE, SPHERE, DOME, DISH, TORUS, 3DMESH, REVSURF (revolved surface), TABSURF (tabulated surface), RULESURF (ruled surface) and EDGESURF (edge surface). These commands make nets of polylines with selectable MESH density. Now all curves are approximated by plane areas. The command EXPLODE will then produce the 3DFACES.

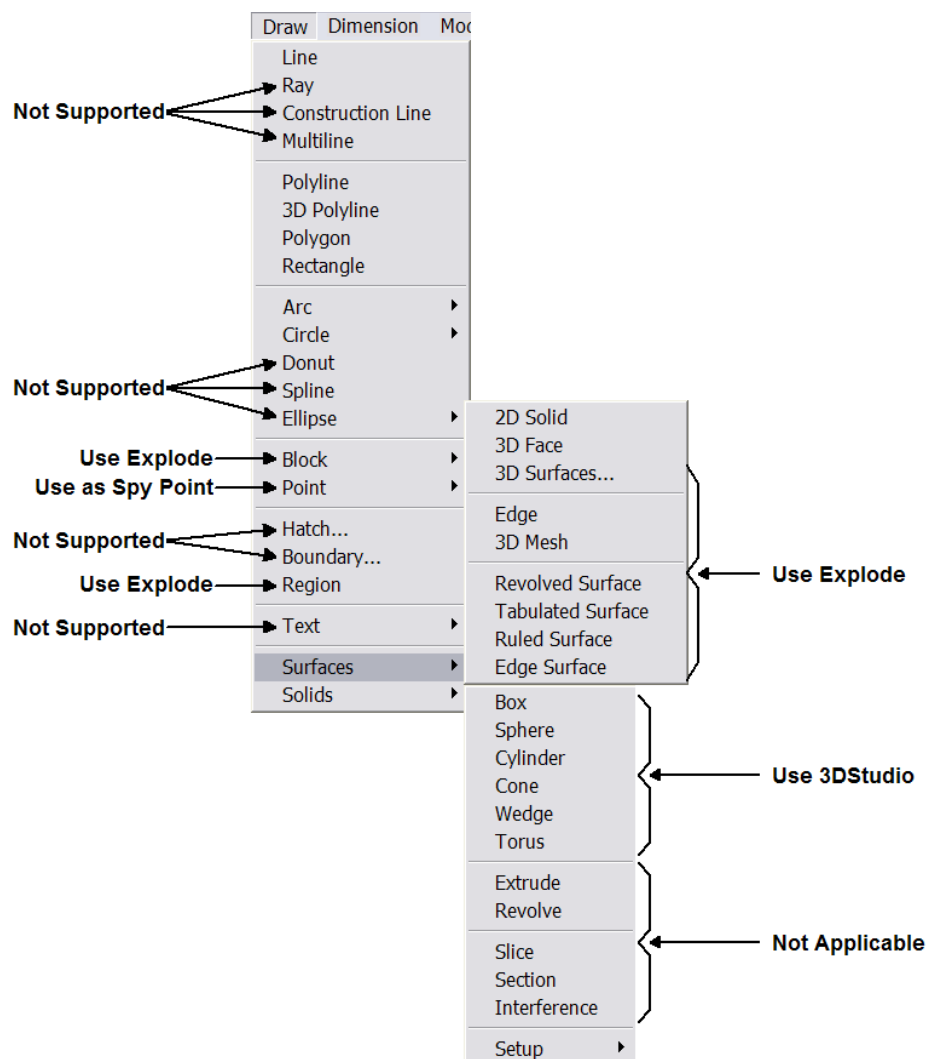


Figure 2: AutoCAD Draw Menu with Surfaces and Solids Submenus

If you are not sure what kind of elements you have in your drawing and how many of them, use the AutoLISP command SSX. In the AutoCAD drawing, type SSX and then don't pick an element, use the ENTER key. Next, type E for element and then the name of the element you are interested in, for instance BODY, BLOCK and so on. After the final ENTER the number of those elements in the drawing is output. If you pick one element from the display after typing SSX, the type of the element is explored. Alternatively, you can use the "Property"-window, to analyze your drawing.

There are some additional programs, like "3D Studio (MAX)" (*.3DS) or "Corel Dream 3D" (*.D3D or *.RD4) which have a DXF export of 3D faces, which also produce no problems for DXF Import in EASE 4.

Some hints, if you do not have AutoCAD

In the case you are an EASE user and have received a DXF file from somewhere, you may not know anything about the included elements, but you want to import it into EASE. In this case, try the following steps.

To get a fast impression of the contents of the DXF 'black box', use the DXF Import and do not choose any of the check boxes in the dialog. In addition, you should type zero for the 'Vertex Snap Distance' to maintain all the original coordinates. This will make the import routine faster. After importing into EASE, have a look at the contents and make the first decisions.

Do you think that the DXF should contain more objects (maybe, because it is a big file)? Then try at first the option "Include 'off' and 'frozen' Layers". Do you see more objects now?

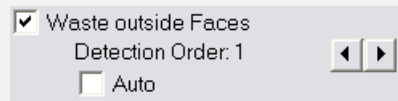
Second, decide if the coordinates have the right numbers. If not, try to change the unit-conversion or the scale value in the DXF Import window. (U.S. Architectural units are, by default, inches in AutoCAD.)

Suggested solutions for unexpected DXF Import results

Problem with Import	Solution
Only one side of the room is imported	- Select <input checked="" type="checkbox"/> Add symmetrical Entities
Many Edges , but few Faces	- Select <input checked="" type="checkbox"/> Closed multiple Lines to Faces
Many small Faces	- Select <input checked="" type="checkbox"/> Collect scattered Faces
Some Faces look incomplete	- Select <input checked="" type="checkbox"/> Overlap Test
Some Faces intersect other Faces without a common edge	- Select <input checked="" type="checkbox"/> Cut intersecting Faces
Too many small Faces	- Increase the value for Plane Face Tolerance
Some Face edges have too many Vertices	- Select <input checked="" type="checkbox"/> Straighten Border of Faces - Increase the value for Vertex Snap Distance
Some Face edges are not straight	- Select <input checked="" type="checkbox"/> Straighten Border of Faces
There are gaps between Face edges	- Increase the value for Vertex Snap Distance
Front and Rear Faces of thin walls end up as a single Face	- Decrease the value for Vertex Snap Distance - Perhaps divide the drawing into multiple parts
A small column has the wrong number of Faces	- Change the value for Min. Circle Sectors
Large circular walls have too many Faces	- Increase the value for Max. Arc Sector Length

There are **Faces** that do not belong to the room

- Try to delete them, if you have AutoCAD
- Select



and start with a low number for **Detection Order**
(Also see Spy-Points below)

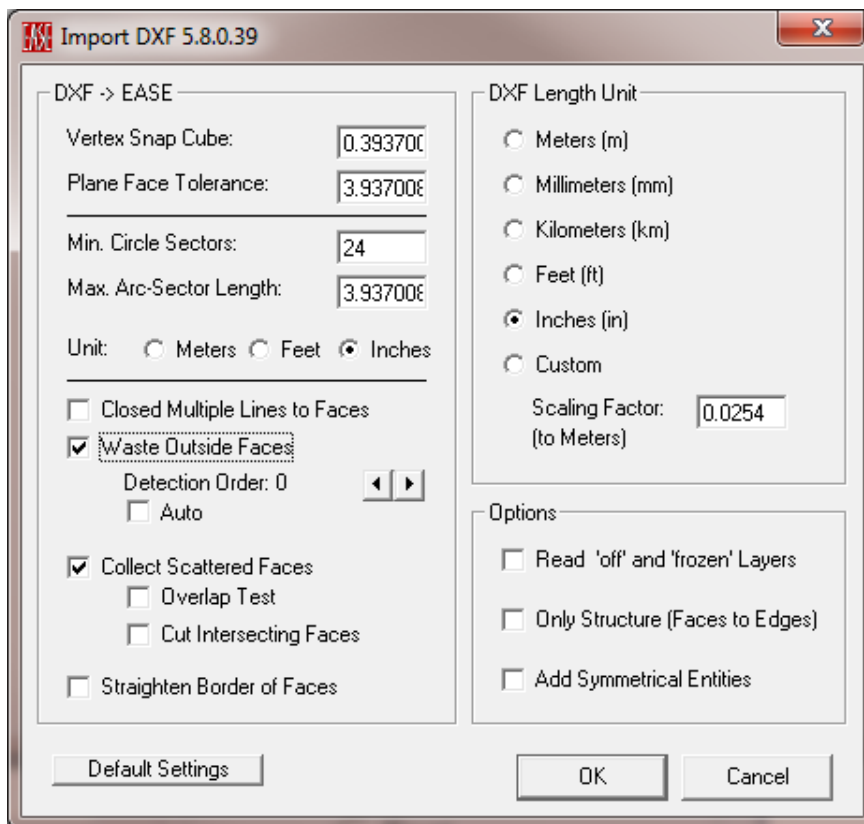


Figure 3: Import DXF dialog box

Import DXF Details

The following EASE items will be created using the listed AutoCAD entities in the DXF file.

Faces and Edges:

For Edges, the EASE item color is from the AutoCAD Entity color. Faces will use the following to select the color and material to be used:

AutoCAD Layer Name starts with "EASE-\$"

- the AutoCAD Entity color is the default
 - Face is one-fold
 - EASE Face material is taken from the AutoCAD Layer Name (the part following the \$ sign), EASE Face color is the EASE default color
 - EASE Rear material is the EASE default material
 - EASE Rear color is the EASE default color
- the AutoCAD Entity color is any other color
 - Face is two-fold
 - EASE Face material is taken from the AutoCAD Layer Name (the part following the \$ sign), EASE Face color is the EASE default color
 - EASE Rear material uses the AutoCAD Entity color to select the EASE material
 - EASE Rear color is the AutoCAD Entity color

AutoCAD Layer Name starts with “EASE”

- Face is two-fold
- EASE Face material uses the AutoCAD Layer color to select the EASE material
- EASE Face color is the AutoCAD Layer color
- EASE Rear material uses the AutoCAD Entity color to select the EASE material
- EASE Rear color is the AutoCAD Entity color

Any other AutoCAD Layer Name

- the AutoCAD Layer color is the default, and the AutoCAD Entity color is the default
 - Face is one-fold
 - EASE Face material is the EASE default material (ABSORBER)
 - EASE Face color is the EASE default color
 - EASE Rear material is the EASE default material (ABSORBER)
 - EASE Rear color is the EASE default color
- the AutoCAD Layer color is the default, and the AutoCAD Entity color is any color except the default
 - Face is one-fold
 - EASE Face material uses the AutoCAD Entity color to select the EASE material
 - EASE Face color is the AutoCAD Entity color
 - EASE Rear material is the EASE default material (ABSORBER)
 - EASE Rear color is the EASE default color
- the AutoCAD Layer color is any color except the default, and the AutoCAD Entity color is the default
 - Face is one-fold
 - EASE Face material uses the AutoCAD Layer color to select the EASE material
 - EASE Face color is the AutoCAD Layer color
 - EASE Rear material is the EASE default material (ABSORBER)
 - EASE Rear color is the EASE default
- the AutoCAD Layer color is any color except the default, and the AutoCAD Entity color is any color except the default
 - Face is two-fold
 - EASE Face material uses the AutoCAD Layer color to select the EASE material
 - EASE Face color is the AutoCAD Layer color

- EASE Rear material uses the AutoCAD Entity color to select the EASE material
- EASE Rear color is the AutoCAD Entity color

The EASE entities will be determined as follows:

- 2D Lines [LINE]
 - Closed multiple Lines to Faces
 - Entered as an individual Edge
 - With thickness: entered as a quadrangle Face
 - Closed multiple Lines to Faces
 - Connected lines that build a planar closed loop, entered as a single Face
 - With Thickness: several Faces create an enclosed body (with floor and ceiling)
- 2D and 2D Polylines [PLINE and 3DPOLY]
 - Closed multiple Lines to Faces
 - Not closed: entered as individual Edges
 - Included arcs are converted to lines (see below: ARC)
 - Not closed PLINE with thickness: create several Faces
 - Closed multiple Lines to Faces
 - Closed: treated like connected lines: entered as a single Face
 - Included arcs are converted to lines (see below: ARC)
 - Closed PLINE with thickness: several Faces create an enclosed body (with floor and ceiling)
 - 3DPOLY that is planar: entered as a single Face, otherwise it is cut into multiple planar Faces
- 3DFACE
 - 3DFACE that is planar will be entered as a quadrangle Face
 - If the quadrangle is not planar, it will be divided into 2 triangular Faces
- CIRCLE

Converted to a polygon using the number of edges determined by the values entered for Min. Circle Sectors and Max. Arc-Sectors Length in the Import DXF dialog window.

 - Entered as a single Face
 - With thickness: several Faces create an enclosed body (with floor and ceiling)
- ARC

Converted to a polygon using the number of edges determined by the values entered for Min. Circle Sectors and Max. Arc-Sectors Length in the Import DXF dialog window.

 - Entered as multiple Edges
- 2D Solids [SOLID]
 - Entered as a quadrangle Face
 - With thickness: several Faces create an enclosed body (with floor and ceiling)
- TRACE
 - Entered as a single Face
 - With thickness: several Faces create an enclosed body (with floor and ceiling)

Audience Areas

These entities will only be created as EASE Audience Area if they are located on the EASE-AREAS AutoCAD layer. They will be created as EASE Faces or Edges as above if not.

The EASE item color is from the AutoCAD Entity color.

- 2D Lines [LINE]
 - 4 connected lines that build a planar closed loop: entered as a single Audience Area
- 2D AND 3D POLYLINES [PLINE and 3DPOLY]
 - Treated like connected lines: entered as a single Audience Area
 - Included arcs are converted to lines
- 3DFACE
 - 3DFACE that is planar will be entered as a quadrangle Audience Area
- CIRCLE

Converted to a 4-sided polygon using the first 4 edges determined by the values entered for Min. Circle Sectors and Max. Arc-Sectors Length in the Import DXF dialog window.

 - Entered as a single Audience Area

Loudspeakers, Listener Seats, Lamps, and IR Emitters

- BLOCK insert

To read BLOCK inserts as EASE elements, they must reside on a layer with a name that starts with EASE and then an arbitrary character (normally '-'). The next two characters (shown in **bold** below) decide if and to what kind of EASE item the BLOCK will be converted.

○ SP eakers or LO udspeakers	▶ Loudspeaker
○ S eats	▶ Listener Seat
○ LA mps or LI ght	▶ Lamp
○ IR (infrared) or EM itter or RA diator or MO dulator	▶ IR Emitter

Ease reads the positions and the orientation (angles) of the BLOCK inserts and enters these values into the property sheet for the EASE item. The entities that form the BLOCK and display the cases (shapes) are not used. The name of the block is used to select the correct entry from the appropriate EASE database.

The EASE item color is from the AutoCAD Entity color.

Spy-Points

A spy-point is a source of detection-rays for a special ray-tracing algorithm used to determine where the inside of the room is located. They are used when the Waste outside Faces checkbox is selected.

For very complex projects, it is strongly recommended that many spy-points be placed strategically in the AutoCAD drawing. Place at least one in every corridor or adjacent room connected by an open window. In this case, you can choose a low Detection Order of 0 or 1 and the time for the ray-tracing will be acceptable.

Note: If you are unable to manipulate the DXF with AutoCAD, you will not be able to set appropriate spy-points. The automatically set spy-point is in the geometrical center of all elements in the DXF file. Therefore, you cannot be sure that this point will be inside the room to analyze!

Also, for the first pass, do not choose a high 'Detection Order' or 'Auto' if the project has very many faces and you do not have much time! On the other hand, with this option you have the additional advantage that this routine will align all faces and will find two-fold faces.

- POINT

To read a POINT as an EASE Spy-Point, it must reside on a layer with a name that starts with EASE-SPY.

Export of an Ease 4 Project to an AutoCAD DXF file

You can export an EASE 4 Project model to a DXF file that can be opened with AutoCAD. Export DXF writes EASE model data, which includes Edges, Faces, Areas, Loudspeakers, Seats, Lamps, and Emitters. Export DXF cannot export Textures. AutoCAD blocks are created for EASE Loudspeakers, Seats, Lamps, and Emitters. These blocks will be placed on specially named layers. (See paragraph BLOCK (*Block Insert*) on page 11)

The EASE Material name will be used to create an AutoCAD layer for each set of faces that use the same wall material. The face color will also be assigned to assist with the later Import of the DXF file back into EASE.

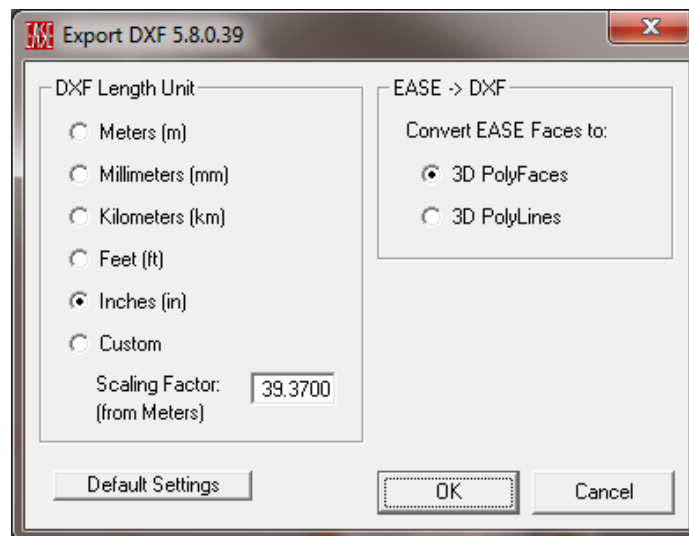


Figure 4: Export DXF dialog box

Export DXF Details

EASE will create separate AutoCAD layers for EASE items according to the following:

- EASE-\$XYZ ▶ Face
Where XYZ is the EASE Wall Material label for the Front Face.
- EASE-AREAS ▶ Audience Area
- EASE-EDGES ▶ Edge
- EASE-SPEAKERS ▶ Loudspeaker
- EASE-SEATS ▶ Listener Seat
- EASE-LAMPS ▶ Lamp
- EASE-IR ▶ IR Emitter or Radiator or Modulator

The AutoCAD Color used for the Face (EASE-\$XYZ) layers will be the color of the Front Face in EASE. All of the other layers will use the default AutoCAD color.

To visualize the room in AutoCAD you can use the command REGION. AutoCAD converts closed 2D and exploded planar 3D polylines in the selection set to separate regions and then converts polylines and lines to

form closed planar loops (outer boundaries and holes of a region). This will allow the use of the AutoCAD commands HIDE or RENDER to create shaded views.

Faces in EASE are allowed to be non-planar as long as the variation in the vertices of the face are less than the tolerance value set in EASE Options. There are three options for the export of the coordinates for EASE Faces. 3D Faces (Triangles) and Convert Faces to Exact Planes (2D Polylines) will allow AutoCAD to render all of the entities.

Faces to	Advantages	Disadvantages	Best for use when
Wireframe-type			
2D Polylines	<ul style="list-style-type: none"> - Exact planes - Fully convertible to Regions (Render) [use MakeRegions.lsp] 	<ul style="list-style-type: none"> - Changing of Vertex locations - Possible visible gaps, if plane tolerance in EASE is large 	<ul style="list-style-type: none"> - Render in AutoCAD is needed, but you want to avoid a lot of triangles
3D Polylines	<ul style="list-style-type: none"> - Exact transfer of EASE model - Vertices (Coordinate locations) - Faces (Number of edges) 	<ul style="list-style-type: none"> - Not renderable (if not plane, not convertible to Regions) 	<ul style="list-style-type: none"> - Changes are made in CAD for Import into EASE
Face-type			
3D Faces	<ul style="list-style-type: none"> - Exact transfer of EASE Vertices - Immediately Render 	<ul style="list-style-type: none"> - Number of Faces increases (Triangles) - EASE Import needs calculation time for "Collected scattered Faces" 	<ul style="list-style-type: none"> - Render in AutoCAD is desired

Note: 2D Polylines will force the coordinates into a planar polyline, creating slightly different vertices that may show as gaps in the AutoCAD rendering.

The remaining option, 3D Polylines under Faces with EASE Coordinates will create entities that will not be rendered in AutoCAD if the coordinates are non-planar. This option will maintain the structure of the EASE Faces and the exact vertex coordinates, however.

The following AutoCAD entities will be created in the DXF file using the listed EASE items.

3DPOLY (3D Polylines)

- FACE
 - Placed on the EASE-\$XYZ layer (Where XYZ is the EASE Wall Material for the Front Face)
 - AutoCAD Layer color is from the EASE item color for the Front Face
 - One-fold face: AutoCAD Entity color is the default AutoCAD color (7)
 - Two-fold face: AutoCAD Entity color is from the EASE item color for the Rear Face

- AUDIENCE AREA
 - Placed on the EASE-AREAS layer
 - AutoCAD Entity color is from the EASE item color

3DFACE (Triangular 3D Faces)

- FACE
 - Placed on the EASE-\$XYZ layer (Where XYZ is the EASE Wall Material for the Front Face)
 - AutoCAD Layer color is from the EASE item color for the Front Face
 - One-fold face: AutoCAD Entity color is the default AutoCAD color (7)
 - Two-fold face: AutoCAD Entity color is from the EASE item color for the Rear Face

PLINE (2D Polylines)

- FACE
 - Placed on the EASE-\$XYZ layer (Where XYZ is the EASE Wall Material for the Front Face)
 - AutoCAD Layer color is from the EASE item color for the Front Face
 - One-fold face: AutoCAD Entity color is the default AutoCAD color (7)
 - Two-fold face: AutoCAD Entity color is from the EASE item color for the Rear Face

LINE (3D Lines)

- EDGE
 - Placed on the EASE-EDGES layer
 - AutoCAD Entity color is from the EASE item color

BLOCK (Block Insert)

- LOUDSPEAKER
 - Placed on the EASE-SPEAKERS layer
 - AutoCAD Entity color is from the EASE Loudspeaker Color
 - AutoCAD BLOCK Name is from the EASE Loudspeaker Speaker Model
- LISTENER SEAT
 - Placed on the EASE-SEATS layer
 - AutoCAD Entity color is from the EASE Listener Seat Color
 - AutoCAD BLOCK Name is always SEAT
- LAMP
 - Placed on the EASE-LAMPS layer
 - AutoCAD Entity color is from the EASE Lamp Color
 - AutoCAD BLOCK Name is from the EASE Lamp Light Source
- IR EMITTER
 - Placed on the EASE-IR layer
 - AutoCAD Entity color is from the EASE IR Emitter Color
 - AutoCAD BLOCK Name is from the EASE IR Emitter Radiator