NEMETSCHEK Scia

IFC

IFC file format extension

Scia Engineer

IFC file format extension

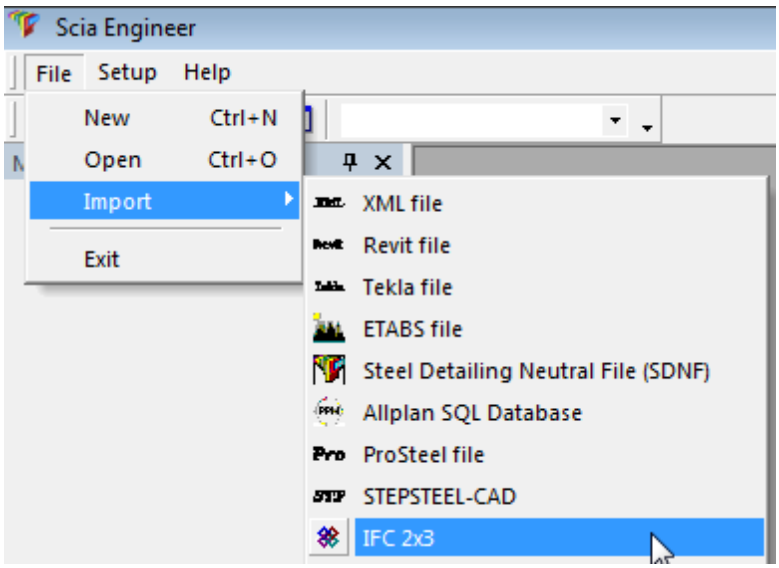
Industry Foundation Classes (IFC) is a universal open text file format which has a big importance in BIM (Building information modelling) - both for vendors and their customers. This format allows for quick data exchange between different applications and thus it saves the precious time of engineers. Scia Engineer supports the current release version IFC2x3 TC1, model view definition: Coordination View 2.0. The range of supported entities is described in the following text.

IFCzip file format

Scia Engineersupports both plain IFC and IFCzip for export and import. IFCzip file format is zipped plain IFC. The packing and unpacking during export and import is done automatically by Scia Engineer. During import it is automatically recognized if it is the plain IFC or the zipped one. ,Therefore the same function is used for import of plain IFC and IFCzip.

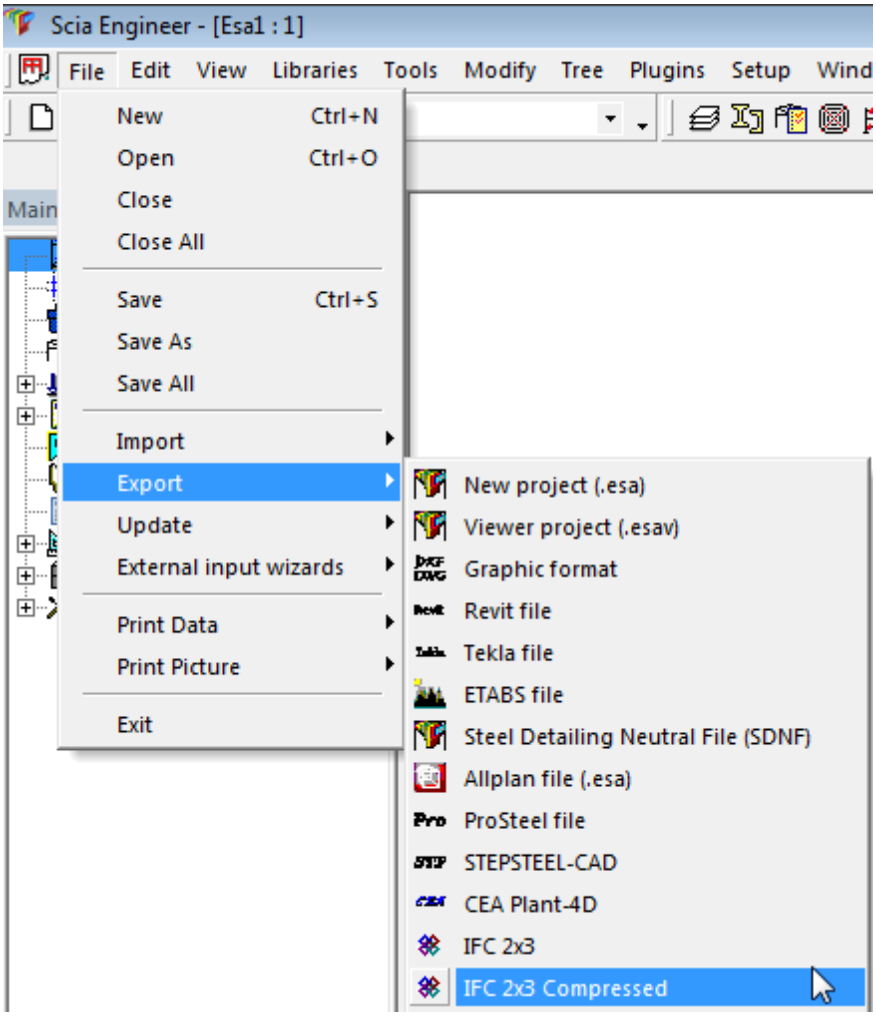
Import

Go to File > Import > IFC2x3.



Export

Go to File > Export > IFC 2x3 Compressed.

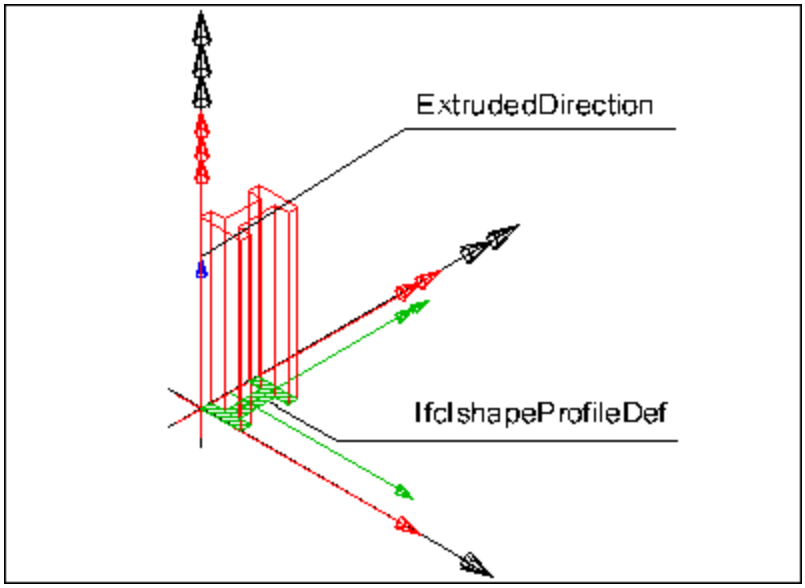


Shape representations

Each element which is graphically displayed has at least one shape representation. In Scia Engineer only the first one is taken into account during import. The main supported Solid model shape representation is following:

SweptSolid

an area which is swept by extrusion along a curve.



Brep

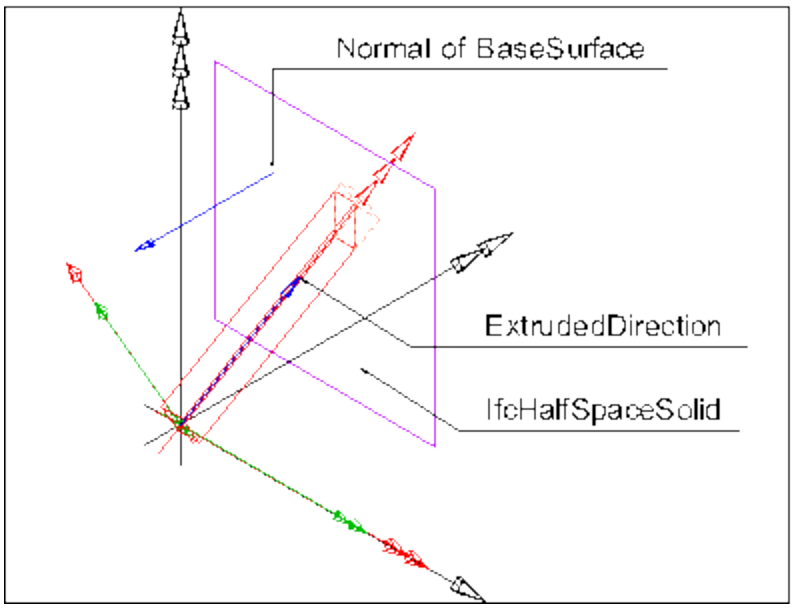
a solid consisting from planar faces.

CSG

a result of Boolean operation between solid models.

Clipping

a difference created between swept area solids.

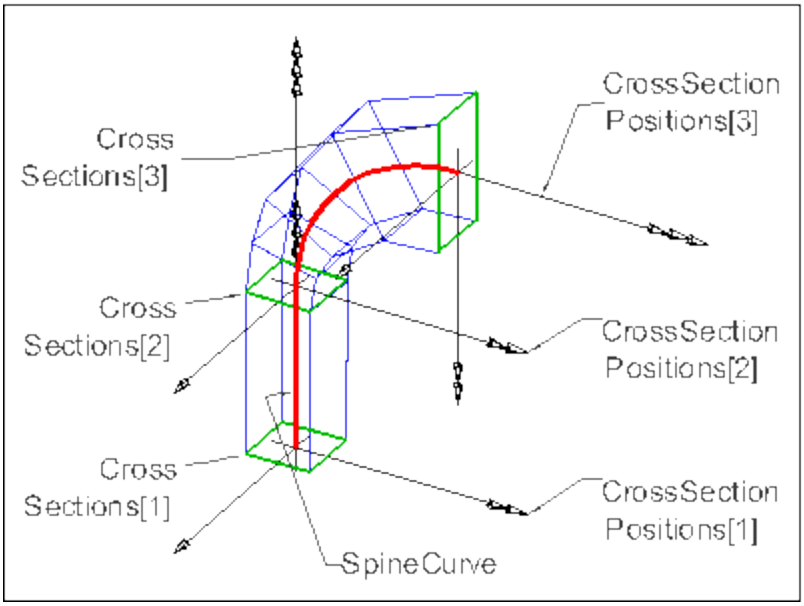


AdvancedSweptSolid

a profile which is swept along a curve.

SectionedSpine

a solid created by interpolation between two defined profiles.



MappedRepresentation

defines mapped items, a copy of the same elements.

Supported elements

Building storeys

The current Scia Engineer version fully supports export and import of building storeys. If storeys are defined in a project then all members are assigned to the storey in which they are located. If a member is allocated in more storeys then it is exported only to the first one. If a member is allocated to no storey, then it is assigned to the building itself. In case no storey exists in the project, no building storey is exported to the IFC file and all members are assigned to the building.

During import to Scia Engineer native storeys are generated using the elevations defined in the IFC file. If no elevation is defined then storeys are generated using the placement defined in the IFC file. In case building storeys are mixed with defined and non-defined elevations the result may be unexpected.

Line grid

Only circular and rectangular 2D line grid and rectangular 3D line grid are exported. The rectangular 3D line grid is exported as a set of 2D line grids because the IFC file format does not support 3D grid. Import of line grids is not supported.

CAD layer

Scia Engineer supports export and import of CAD layer for many elements. The following table says the rules:

Scia Engineer element	CAD layers
1D members (beams, columns)	by definition in the project
2D member (walls, slabs)	by definition in the project
1D reinforcement	by layer of the 1D member
2D reinforcement	by layer of the 2D member
free bars	by definition in the project
tendons	by definition in the project
footing	the first one defined in Layer man-

Scia Engineer element	CAD layers
	ager
plates	by layer of the 1D member
mechanical fasteners	by layer of the 1D member

All elements mentioned in the table above are exported with coloured geometric presentation. The colour is by defined layer.

Material

If the material names in an IFC file are not in accordance with code names it is necessary to define a material conversion table in the Import dialogue. For the first opening of a file with defined material table there is button [Choose file…]. For following modifications, button [Edit] is available. The file has *.con file extension and it is a plain text file, for example:

```
[materials]
;
Concrete1=C12/15
Concrete2=C25/30
```

The first name is the name of material in the IFC file and the second name is code name of material which is used in Scia Engineer. It is necessary to respect all characters.

1D members

For export of beams and columns Scia Engineersupports SweptSolid, Clipping, SectionedSpine representation and Brep. For import SweptSolid, Clipping, Brep and CSG representations are supported. In the following table on the left side there is a list of 1D member geometry shape in Scia Engineer and on the right side a list of supported representations for the particular geometry shape.

1D member geometry shape	Supported representations for export
straight prismatic beam	SweptSolid or Brep
straight prismatic beam with defined structural shape	Clipping or Brep
haunched and arbitrary beam	Brep or SectionedSpine
curved beam	Brep only

If a beam has a chamfer Ry or Rz defined in the structure model then the beam is exported with Clipping representation.

The default rules for import of entities with different representations are the following:.

Supported representation for import	Element in Scia Engineer
SweptSolid	native element which is possible to modified
Clipping	native element with defined general structural model
Brep	general volumes
CSG	general volumes

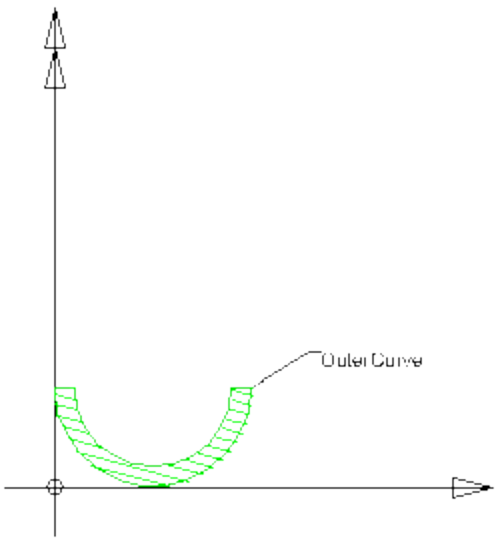
The following table defines rules for export and import of 1D members with different CAD type.

CAD type in Scia Engineer	exported to IFC	import to Scia Engineer
general	IfcMember, object type member	general
beam	IfcBeam	beam
column	IfcColumn	column
gable column	IfcColumn	column
secondary column	IfcColumn	column
rafter	IfcMember, object type rafter	rafter
purlin	IfcMember, object type purlin	purlin
roof bracing	IfcMember, object type brace	wall bracing
wall bracing	IfcMember, object type brace	wall bracing
girt	IfcMember, object type member	general
truss chord	IfcMember, object type member	general
truss diagonal	IfcMember, object type member	general
beam slab	IfcMember, object type member	general
plate rib	IfcMember, object type member	general
composite beam rib	IfcMember, object type member	general

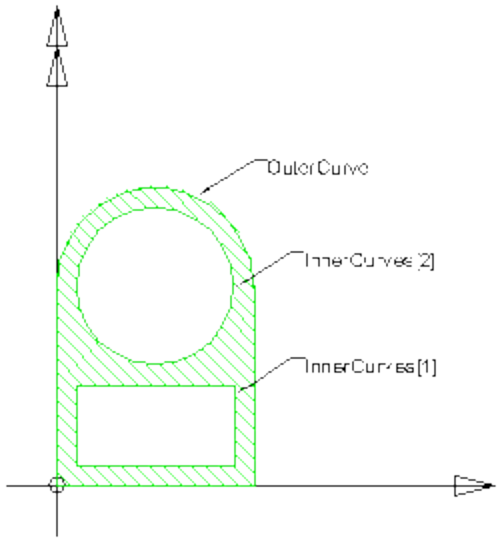
Supported profiles

Scia Engineer supports following IFC classes for profile definition:

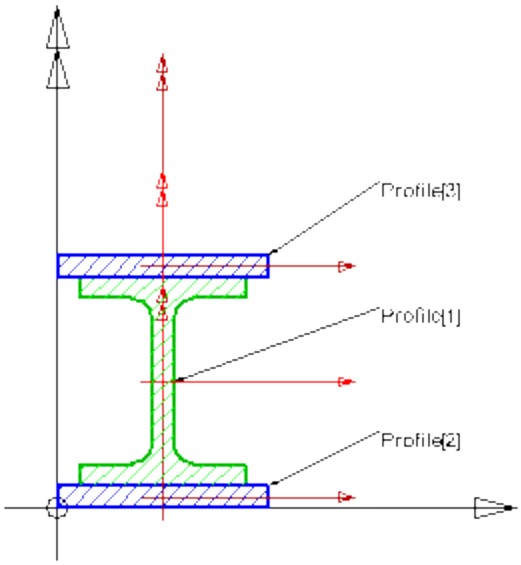
IfcArbitraryClosedProfileDef



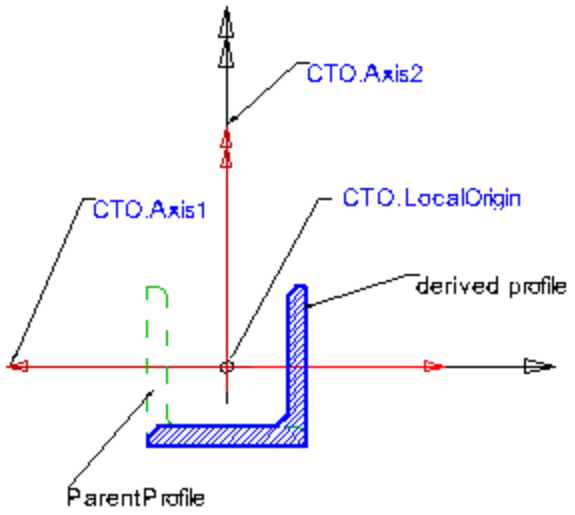
IfcArbitraryClosedProfileDefWithVoids



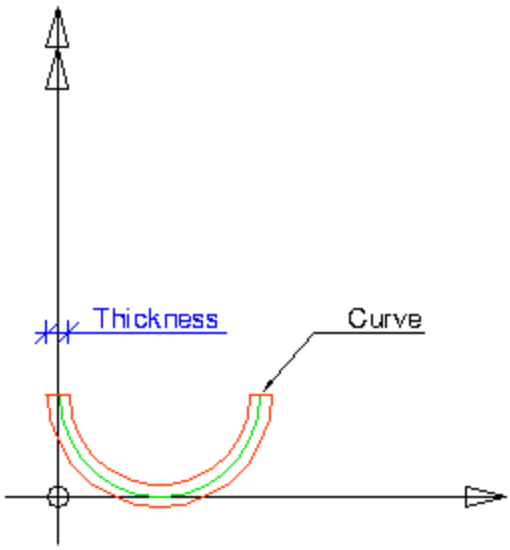
IfcCompositeProfileDef



IfcDerivedProfileDef

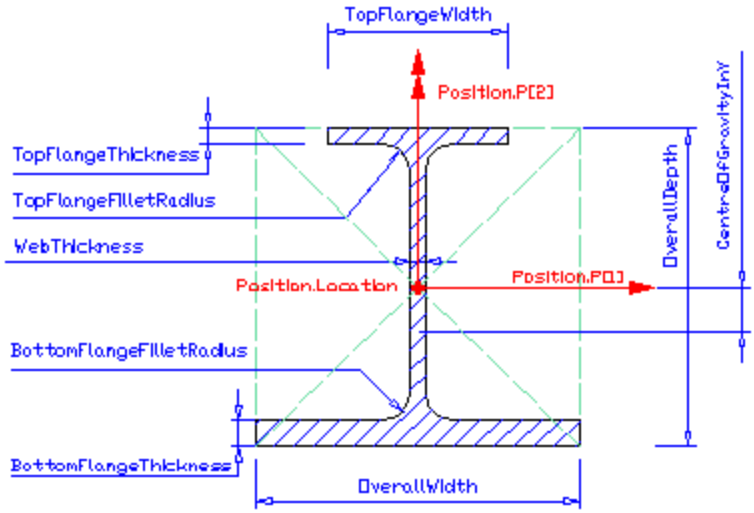


IfcCenterLineProfileDef

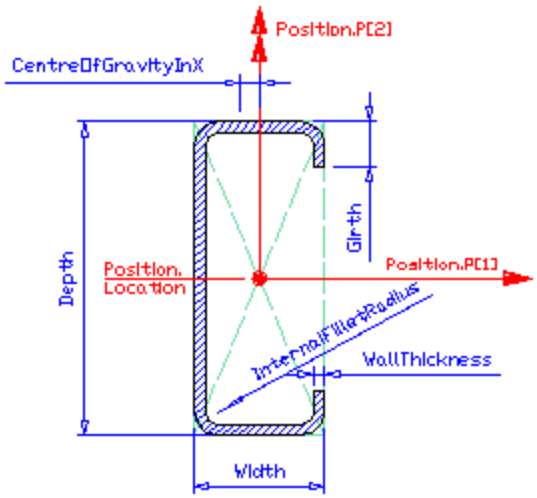


Parameterized profiles

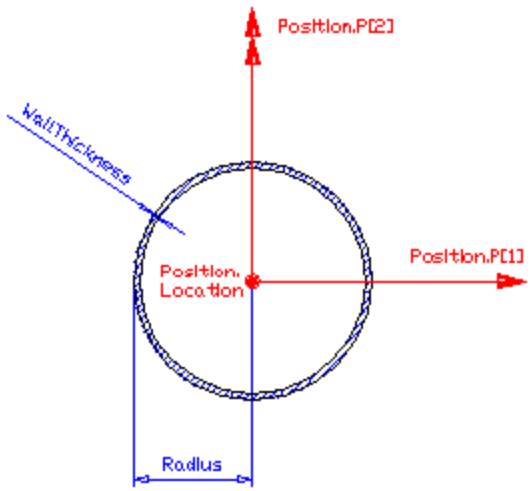
IfcAsymetricIShapeProfileDef



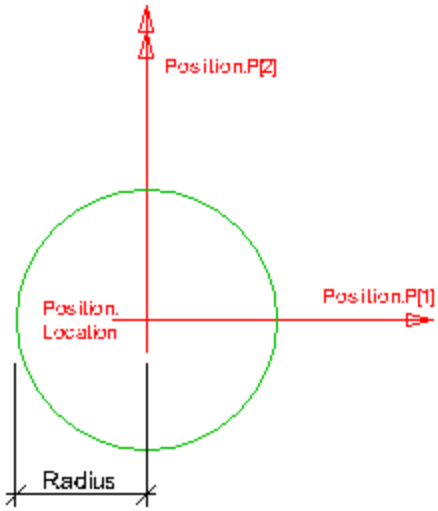
IfcCShapeProfileDef



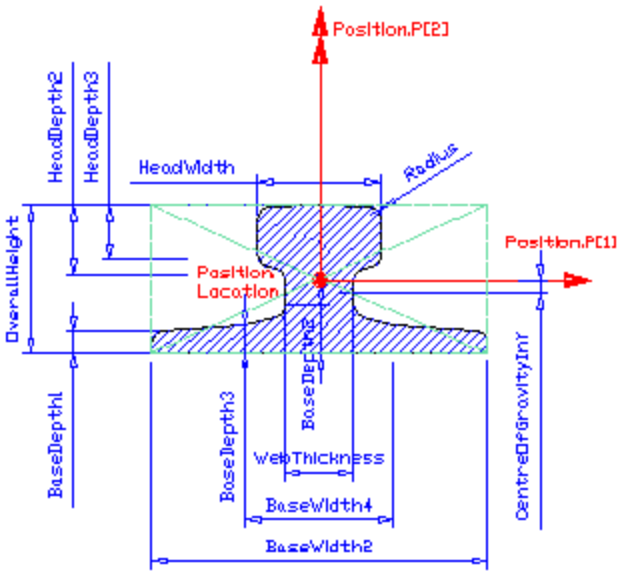
IfcCircleHollowProfileDef



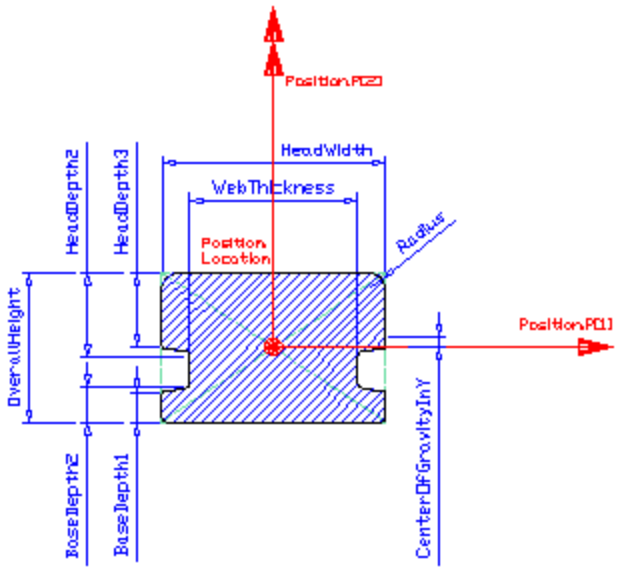
IfcCircleProfileDef



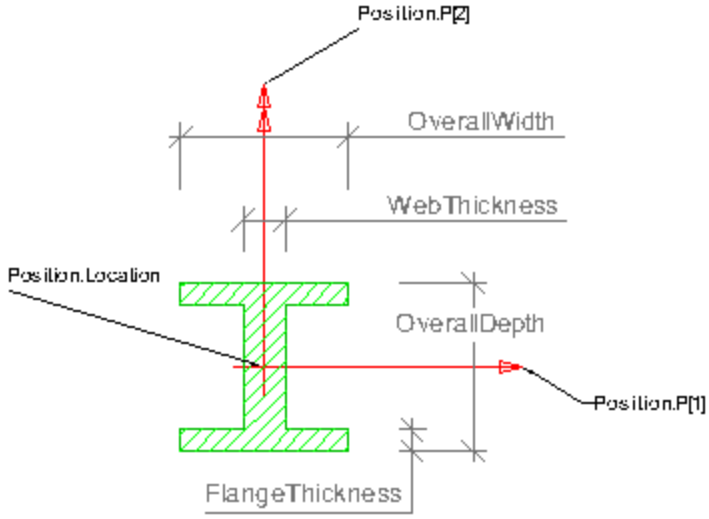
IfcCraneRailAShapeProfileDef



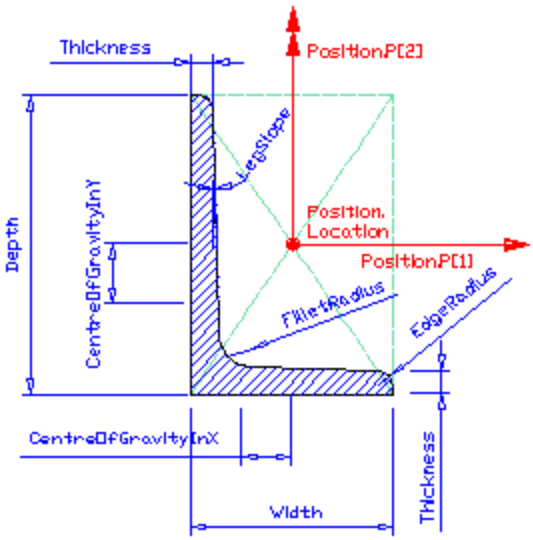
IfcCraneRailFShapeProfileDef



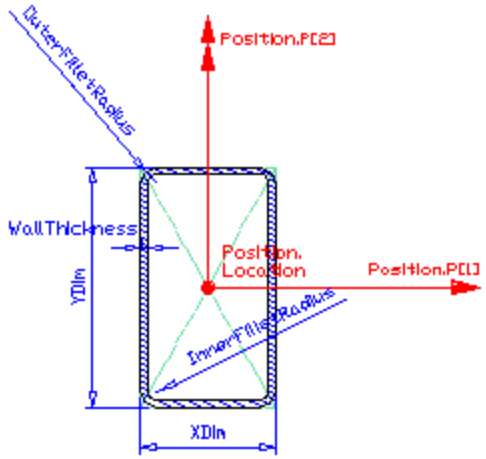
IfcIShapeProfileDef



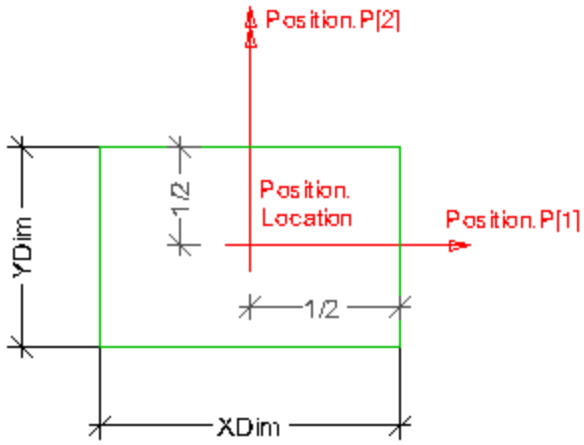
IfcLShapeProfileDef



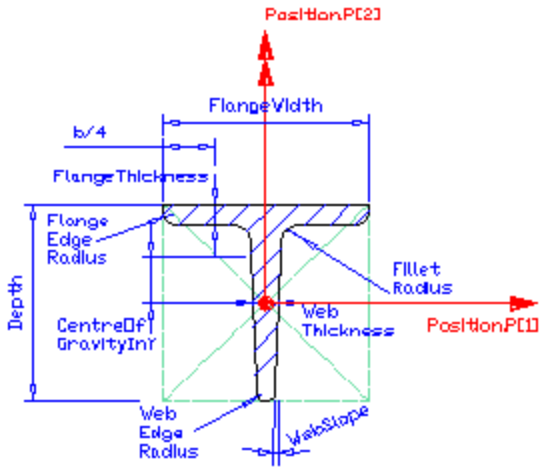
IfcRectangleHollowProfileDef



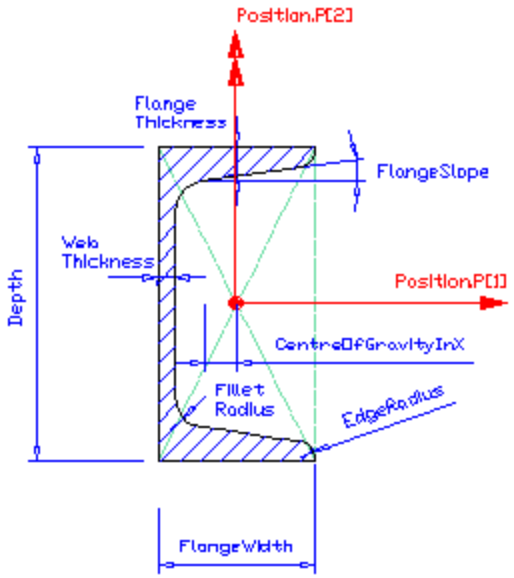
IfcRectangleProfileDef



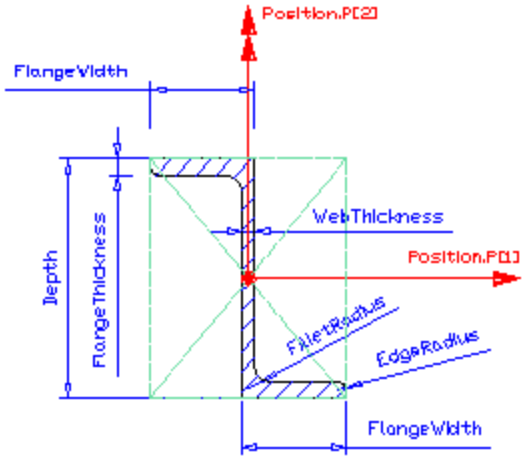
IfcTShapeProfielDef



IfcUShapeProfileDef



IfcZShapeProfileDef



Export of profiles

Following tables gives an overview how profiles from Scia Engineer are exported.

Profile Library	IFC class
Profile Library (I section): H, HD, HE, HEA, HEB, HEC, HEM, HG, HHD, HL, HM, HN, HP, HT, HW, IPE,ITM, M, PEA, RSJ, UB, UBP,UC, UKB, UKBP, UKC, W	IfclShapeProfileDef
Profile Library (I section): I, INP, IPN, ISHB, ISJB, ISLB, ISMB, ISSC, ISWB, J, S	IfcArbitraryClosedProfileDef
Profile Library (rectangular hollowed section): CFRH, F, HSS, J, MSH, QRO, RHS, RHSCF,RRK, RRO, RRW, SHS, SHSCF, VHP	IfcRectangleHollowProfileDef
Profile Library (L section):HFLeq, HFLue, ISEA, ISUA,L, LA, LNPeq, LNPue, LS, RSEA, RSUA,UKA	IfcLShapeProfileDef
Profile Library (circular hollowed section): CFCHS, CHS, CHSCF, HSS, LCHS, MSRR, PIPE, RO, ROR, Y	IfcCircleHollowProfielDef
Profile Library (channel section): ISMCP, PFC, U(CH), UAP, UKPFC, UPE	IfcUShapeProfileDef
Profile Library (channel section): C, CH, ISJC, ISLC, ISMC, MC, RSC, U, UE,UNP, UPN	IfcArbitraryClosedProfileDef
Profile Library (T section): HEAT, HEBT, HEMT IPET, MT, TM, TN, TPS, TW, UBT, UCT, UKT, WT	IfcTShapeProfileDef
ProfileLibrary (T section): ST, T, TB, TPB, TPH,	IfcArbitraryProfileDef
Profile Library (rectangular section): BRFL, FL, FLA, FLB, KSN, S, VKT,	IfcRectangleProfileDef
Profile Library (circular section): RD, RND	IfcCircleProfileDef
Profile Library (asymmetrical I section): ASB, YPY	IfcAsym-metriclShapeProfileDef
Profile Library (cold-formed section):CFLeq, CFLue, KL, CFUeq, CFUue, KU, SADEFU, T(SSMA), CFZ, KZ, CFOmega, KH, E, SADEFCP, SADEFZ, Z, A, B, MBA, MBB, S, SADEFS, C(HHM), MBC, SADEFSP, SADEFSE, SADEFSEP, Z(AISI), Z(ICEC), S(FRISO)	IfcArbitraryclosedProfileDef
Profile Library (cold-formed section): C(AISI), C(ICEC), C(MET), CFC, KC, S(SSMA), SADEFC,	IfcCShapeProfile Def
Profile Library (cold-formed section):SADEFIP,SADEFISP	IfcCompositeProfileDef
Profile Library (Z section): Z, ZNP	IfcZShapeProfileDef
Profile Library (rail section): KSA, SA	IfcCraneRailAShapeProfiledef
Profile Library (rail section): SF	IfcCraneRailFShapeProfileDef

Concrete profiles	
rectangle, Ing, Tg, Lg, oval	IfcArbitraryClosedProfileDef
circle	IfcCircleProfileDef

Geometric Shapes	
Ing	IfclShapeProfileDef
Igh, oval, Lg, X, Polygon	IfcArbitraryClosedProfileDef
rectangle	IfcRectangleProfileDef
circle	IfcCircleProfiledef
Tg	IfcTShapeProfileDef
Ug	IfcUShapeProfileDef
Tube	IfcCircleHollowProfileDef
Z	IfcZShapeProfileDef
O	IfcRectangleHolloeProfileDef
C	IfcCShapeProfileDef
O asymmetric	IfcArbitraryProfileDefWithVoids

Pairs	
all sections	IfcCompositeProfileDef
Closed	
all except Polygon with hole	IfcCompositeProfileDef
Polygon with hole	IfcAr-bitraryProfileDefWithVoids
Haunched	
all sections	IfcCompositeProfileDef
Welded	
all sections	IfcCompositeProfileDef
Sheet welded	
all sections	IfcCompositeProfileDef
Build-in	
all sections	IfcCompositeProfiledef
Thin-walled geometric	
I, Angle, Channel, T, full rectangular, Asymmetric I, Rolled Z, Cold formed channel section, Cold formed C section, Cold formed Z section	IfcAr-bitraryClosedProfileDef

Pairs	
RHS, CHS,	IfcArbitraryProfileDefWithVoids
full circle	IfcCircleProfileDef
Precast	
Precast 1, Precast 3, Precast 4, Precast 5, Precast 7	IfcCompositeProfileDef
Precast 2, VSTI - Precast 6	IfcArbitraryClosedProfileDef
Bridges	
Slab 1, Slab 2, Double T1, Double T2, Single T,Trough cross-section, Trough gider, V-girder, I, I-girder, Haunched beam or slab	IfcArbitraryClosedProfileDef
T with composite deck, Trough cross-sectioon with composite deck, Trough girder with composite deck, Trough girder with concrete fill, V-girder with composite deck, V girder with concrete fill, I with composite deck, I-girder with composite deck	IfcCompositeProfileDef
Box girder, Twin box girder	IfcArbitraryProfileDefWithVoids
Composed	
all sections	IfcCompositeProfileDef

General	
polygon, thin walled	IfcArbitraryClosedProfileDef
polygon with opening	IfcArbitraryProfileDefWithVoids

Numerical profiles have no surface thus they cannot be supported for model view definition CV2.0.

Import of profiles

If the name of cross-section from Profile library is found then it is linked to the Scia Engineer database automatically. The following table says the rules for import of profiles whose names are not recognized:

classes in IFC	imported in Scia Engineer as
IfcArbitraryClosedProfileDef, IfcArbitraryProfileDefWithVoids, IfcDerivedProfileDef, IfclShapeProfileDef (with fillet radius filled), IfcRectangleHollowProfileDef (with inner and outer fillet radius), IfcLShapeProfileDef , IfcTShapeProfileDef (with filet radius filled), IfcAsymmetricIShapeProfileDef, IfcCShapeProfileDef (with internal fillet radius filled), IfcZShapeProfileDef (with filler and edge radius filled), IfcCraneRailAShapeProfileDef, IfcCraneRailFShapeProfileDef	General cross-section (polygon)
IfclShapeProfileDef (fillet radius is zero)	Geometric shapes - Ing
IfcCircleHollowProfileDef	Geometric shapes - Tube

classes in IFC	imported in Scia Engineer as
IfcUShapeProfileDef	Geometric shapes - Ug
IfcTShapeProfileDef (fillet radius is zero)	Geometric shapes - Tg
IfcRectangleProfileDef	Geometric shapes - Rectangle
IfcCircleProfileDef	Geometric shapes - Circle
IfcCShapeProfileDef (internal fillet radius is zero)	Geometric shapes - C
IfcZShapeProfileDef (fillet and edge radius is zero)	Geometric shapes - Z
IfcRectangleHollowProfileDef (inner and outer fillet radius is zero)	Geometric shapes - O
IfcCenterLineProfileDef	General cross-section (thin-walled)

1D member opening

All openings in 1D members are exported as IfcOpeningElement with a parametric or general profile. If the repetition is set all openings are exported as separated objects. Mapped representation is not supported in the current version.

Scia Engineer supports import of IfcOpeningElement with SweptSolid representation in 1D member with SweptSolid representation as a native opening.

2D members

For export of straight and circular arc walls and flat plates Scia Engineersupports SweptSolid representation and Brep. Structural shape of 2D members is not taken in account for export with SweptSolid representation. Curved walls and shells are exported always as Brep. For import SweptSolid, Clipping, Brep and CSG representation are supported. In the following table on the left side there is a list of shape representations in IFC file and on the right side a brief description of the result in Scia Engineer after import.

Shape representation	result in Scia Engineer
SweptSolid	native flat plates and walls; analysis and structural shape are the same
Clipping	native flat plates and walls; structural shape includes the clipped shape
Brep	general volumes
CSG	general volumes

In the following table there is written a rule for object export and import:

export of 2D member of type	IFC object	import to Scia Engineer as
wall (rectangular, 4 edged)	IfcWallStandardCase	wall
plate, shell, non-rectangular wall	IfcSlab	plate
general volume	IfcWall	wall

Openings and subregions

Openings and subregions are exported as IfcOpeningElement of type opening or recess. The subregion thickness has to be lower than the thickness of the main slab/wall. In case the subregion is thicker than the slab/wall, the subregion is not taken in account and the model is exported without the subregion.

All IfcOpeningElement defined with SweptSolid representation in flat walls and slabs are imported correctly as native Scia Engineer openings or subregions. If opening elements are defined as Brep no opening is imported in the analysis shape but in most cases the opening should be included in general structural shape.

When the opening in 2D member is modelled as cut-out no opening element is exported. It means for SweptSolid representation an entire input member is exported (without cut-outs), for Brep the correct shape (with cut-outs) is exported.

Steel connection parts

Scia Engineer supports export of flat steel connection parts, cleats and stiffeners to IFC like independent plates (IfcPlate), an information about a weld (IfcFastener entity) and bolts (IfcMechanicalFastener entity). Each plate has assigned a material which is defined in Scia Engineer. Plates are exported as Sweptsolid or Brep whereas bolts only as Brep. All bolts in a bolt assembly are defined as mapped items.

List of plates:

top, bottom and diagonal stiffeners,

end , buckling and base plates,

haunch,

web doubler,

flange wideners, etc.

Concrete reinforcement

The default export of concrete reinforcement and free bars is by means of AdvancedSweptSolid representation. In case user selects export as Brep all reinforcement is exported with boundary representation.

1D zone concrete reinforcement is exported with overlapped anchorage. It can caus a problem during import to some other application. Work around for this case is to explode the reinforcement into free bars.

Concrete 1D member reinforcement and free bars are always exported as IfcReinforcingBar. Free bars which have defined a repetition and stirrups are exported as one reinforcing bar with mapped items. Reinforcement 2D is always exported as IfcReinforcingMesh.

Both IfcReinforcingBar and IfcReinforcingMesh defined with AdvancedSweptSolid representation are imported into Scia Engineer as free bars. If the reinforcing bar or mesh have defined mapped items, all mapped items with the same geometry and distances are imported as a free bar with correct repetition. If reinforcing bar or mesh is defined as Brep then they are imported only as general volumes.

Tendons

Internal and free tendons can be exported as AdvancedSweptSolid or Brep. For import as native Scia Engineer element only AdvancedSweptSolid representation is supported. Tendon with Brep is imported as a general volume.

In IFC it is not possible to defined neither the number of tendon elements in a tendon nor the number of tendons in a group. The diameter of tendon is taken from Prestressing strand material properties. As a result, each tendon is exported with the calculated diameter from the sum of the number of tendon elements in the tendon and the number of tendons in the group, but during import only the diameter which is in the material properties is taken in account (i.e. the diameter of a tendon element).

Footing

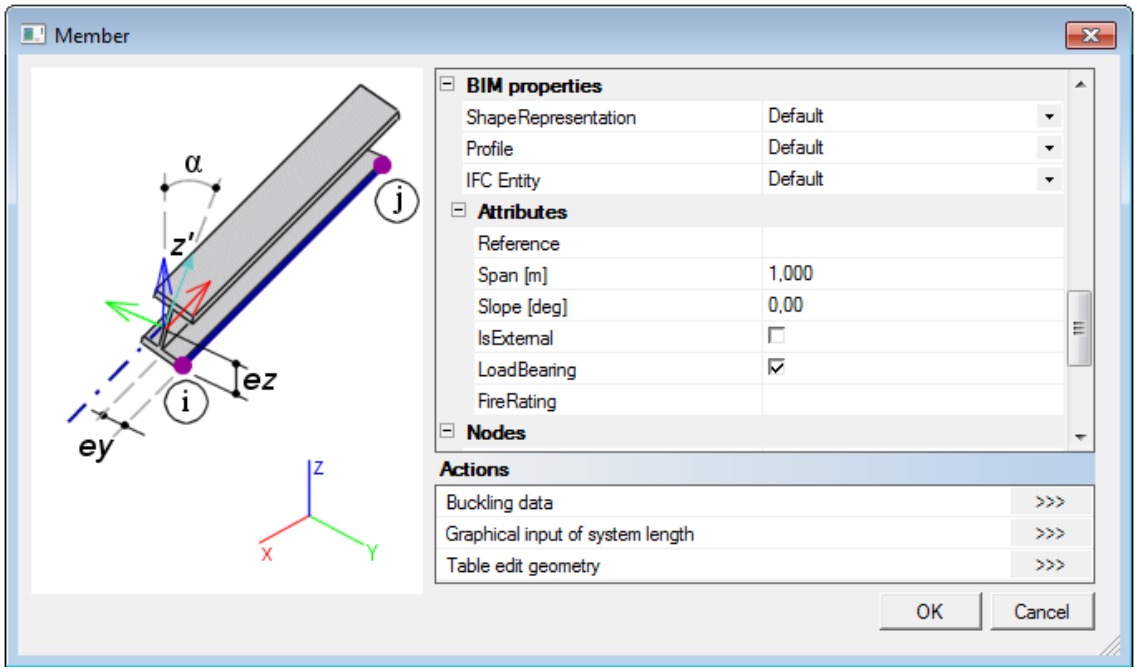
Supports of type Foundation pad are exported into IFC file as IfcFooting element. The supported representation is only Brep. All footings are imported to Scia Engineer as general volumes.

Attributes

Scia Engineer supports export of defined attributes from service Attributes for 1D and 2D members, reinforcement, tendons and footings. All attributes are exported as a property set named "User defined". Import of user defined property set is not supported.

BIM properties

BIM properties is a new functionality which is switched on as default after IFC file import. If it is ON a new group BIM properties is shown in 1D and 2D member properties and in a general volume properties. It has two main parts. The first one is advanced options for export of particular elements. The other one is a subgroup Attributes.



The advanced export options are different for different elements, e.g. Profile item is only for straight 1D members with SweptSolid geometry. The element is exported using the setting in the BIM properties instead of by rules defined in the export dialogue. If the value is set to default it means the element is exported by rules defined in the export dialogue.

ShapeRepresetation - a selection of shape representation for a particular entity which has to be exported with different representation than it is set in export dialogue.

Profile - a selection of a way how the profile is exported. The particular beam is exported with profile type which is defined in BIM properties instead of the global setting in the export dialogue.

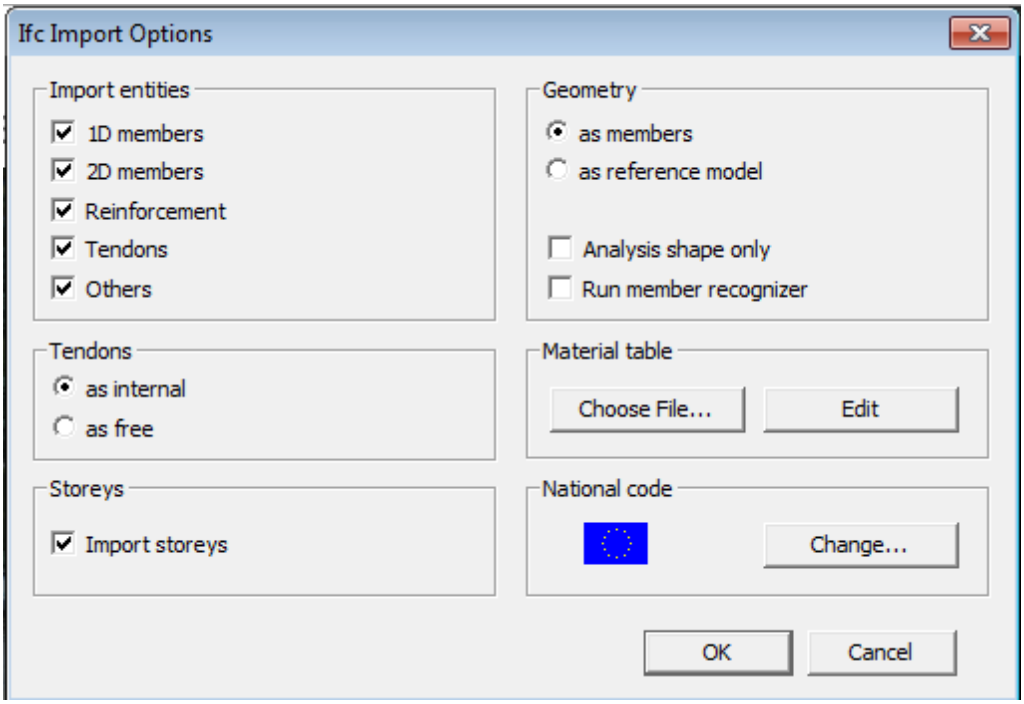
IFC Entity - an option for changing object type, e.g. shell is exported as Ifcslab by default but a user wants to export it as IfcWall.

Attributes

One of a way how to give different additional information of an entity in IFC file format is to attach “PropertySet”.“Common Property Set” means a set of properties for particular entities which are defined in IFC2x3 specification. The name of set is given as Pset_*Common where * is an entity for which the set is defined, e.g. Pset_BeamCommon for beams.Scia Engineer supports “Common Property Set” for all 1D members exported as IfcBeam, IfcMember or IfcColumn, all 2D members exported as IfcWallStandardCase of IfcSlab and all general volumes exported as IfcWall.

Import dialogue

Scia Engineer offers few options how to import an IFC model. A user can choose which objects will be imported and how. In this chapter all options of import are described.



Import entities

1D members - if ON all beams (IfcBeam), members (IfcMember) and columns (IfcColumn) are imported. If OFF no beam, member or column is imported.

2D members - if ON all walls (IfcWallStandardCase and IfcWall) and slabs (IfcSlab) are imported. If OFF no wall or slab is imported.

Reinforcement - if ON all reinforcement (IfcReinforcingBar and IfcReinforcingMesh) is imported. If OFF no reinforcement is imported.

Tendons - if ON all tendons (IfcTendon) are imported according to setting in Tendons group. If OFF the group Tendons is disabled and no tendon is imported.

Others - if ON all other objects (IfcFooting, IfcMechanicalFastener, IfcPlate, etc.) which are usually imported as general volumes are imported. If OFF no other object than they are mentioned above are imported.

Tendons

as internal - all IfcTendon elements defined in IFC file are imported as Scia Engineer native internal tendons.

as free - all IfcTendon elements defined in IFC file are imported as Scia Engineer native free tendons.

Storeys

Import storeys - if ON all building storeys (IfcBuildingStorey) are imported as Scia Engineer storeys. If OFF no storey is imported.

Geometry

as members - all supported members with SweptSolid representation are imported as Scia Engineer native objects.

as reference model - all objects are imported as general volumes.

Analysis shape only - if ON all elements are imported without clipping. If OFF a full structural shape of model is imported. Creating of structural shape can take a lot of time. This option is recommended if a user need only model for analysis.

Run member recognizer - if ON after importing of IFC file on background a member recognizer is run and all supported members (beams, columns, walls and slabs) which are imported as general volumes the recognizer tries to convert into native elements. After conversion a report with a result is shown.

Material table

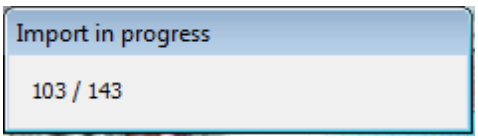
See explained above.

National code

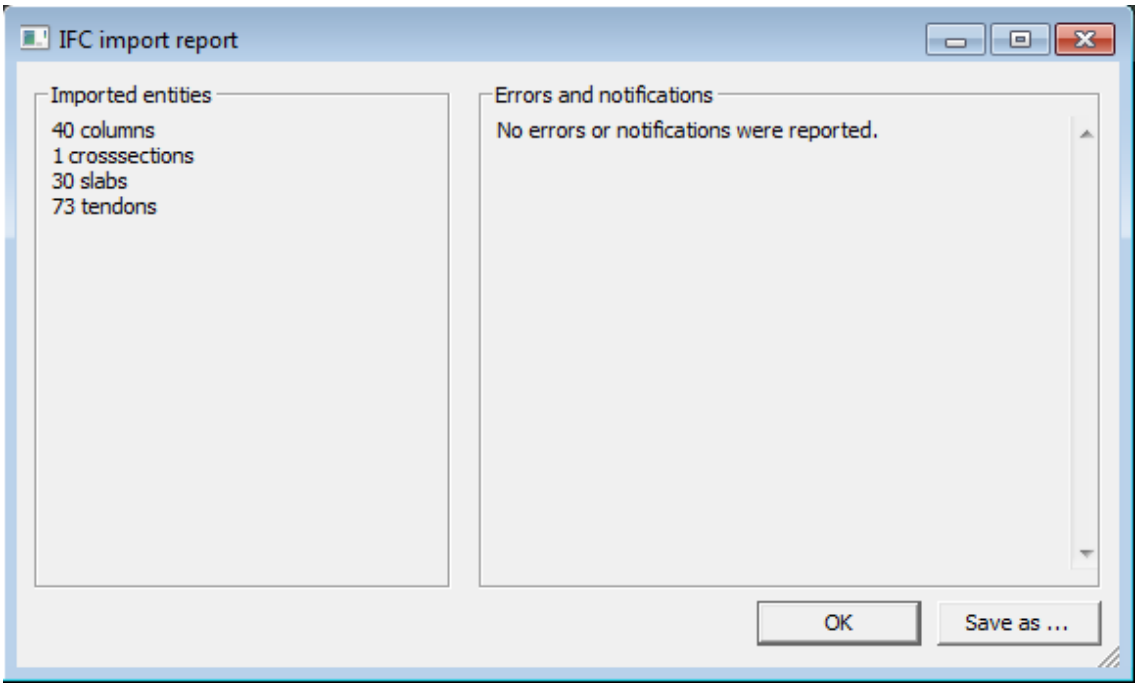
As IFC file does not specify any code it is necessary to select it before the import. An actual adjusted code is displayed with a national flag. If you want to change it press the button [Change...].

Import procedure

After confirmation of the Ifc Import Options dialogue a progress bar with number of total elements and already imported elements is shown.



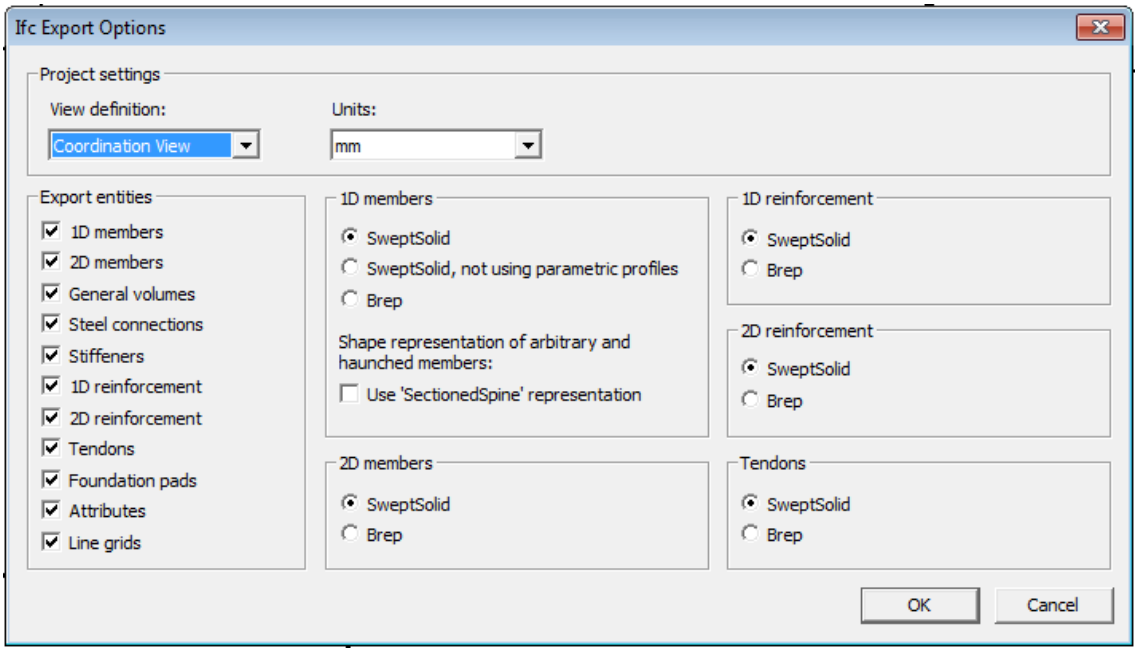
At the end a report of import is displayed.



On the left side there is a list of imported objects with their quantity. On the right side there is a place for errors and notifications if they are any.

Export dialog

Scia Engineer offers several options how to export model to IFC file. A user can choose which objects will be exported and how. In this chapter all options of export are described.



Project settings

View definition - Scia Engineer currently supports only Coordination View.

Units - an option for setting a unit for length, the most common used units for export are millimetres.

Export entities

1D members - if ON all beams and columns are exported to IFC file. If OFF no beam or column is exported.

2D members - if ON all walls, plates and shells are exported to IFC file. If OFF no wall, plate or shell is exported.

General volumes - if ON all general volumes are exported to IFC file. If OFF no general volumes is exported.

Steel connections - if ON all steel connection plates and bolts are exported to IFC file. If OFF no steel connection parts or bolts are exported.

Stiffeners - if ON all beam stiffeners are exported to IFC file. If OFF no stiffener is exported.

1D reinforcement - if ON 1D member reinforcing bars and free bars are exported to IFC file. If OFF no reinforcing bar or free bar is exported.

2D reinforcement - if ON 2D member reinforcement is exported to IFC file. If OFF no reinforcing mesh is exported.

Tendons - if ON internal and free tendons are exported to IFC file. If OFF no tendon is exported.

Foundation pads - if ON all foundation pads are exported to IFC file. If OFF no foundation pad is exported.

Attributes - if ON IFC attributes (common property sets) and Scia Engineer attributes are exported to IFC file. If OFF no attribute is exported.

Line grids - if ON all line grids defined in the project are exported to IFC file. If OFF no line grid is exported.

1D members

Sweptsolid - all straight prismatic beams are exported with a profile and its extrusion. If possible, the profile is exported as parametric one.

SweptSolid, not using parametric profiles - all straight prismatic beams are exported with a profile and its extrusion. All parametric profile are exported as closed arbitrary one.

Brep - all beams are exported as faced solids where no information about profile and length is.

Use "SectionedSpine" representation - if ON all haunched and arbitrary members are exported as solids interpolated between two defined profiles. If OFF all haunched and arbitrary profile are exported as Brep.

SectionedSpine representation is not included in Coordination View 2.0.

2D members

SweptSolid - all 2D members are exported with their geometry and thickness.

Brep - all 2D members are exported as faced solids where no information about member dimensions is.

1D reinforcement

SweptSolid - all 1D member concrete reinforcement and free bars are exported with AdvancedSweptSolid representation.

Brep - all 1D reinforcing bars and free bars are exported as faced solids where no information about diameter and distances between bars is.

2D reinforcement

SweptSolid - all 2D member concrete reinforcement is exported with AdvancedSweptSolid representation.

Brep - all 2D reinforcement is exported as faced solids where no information about diameter and distances between bars is.

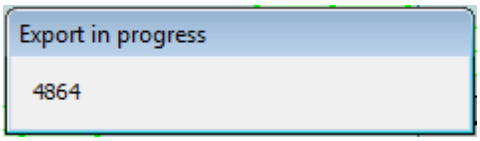
Tendons

SweptSolid - all internal and free tendons are exported with AdvancedSweptSolid representation.

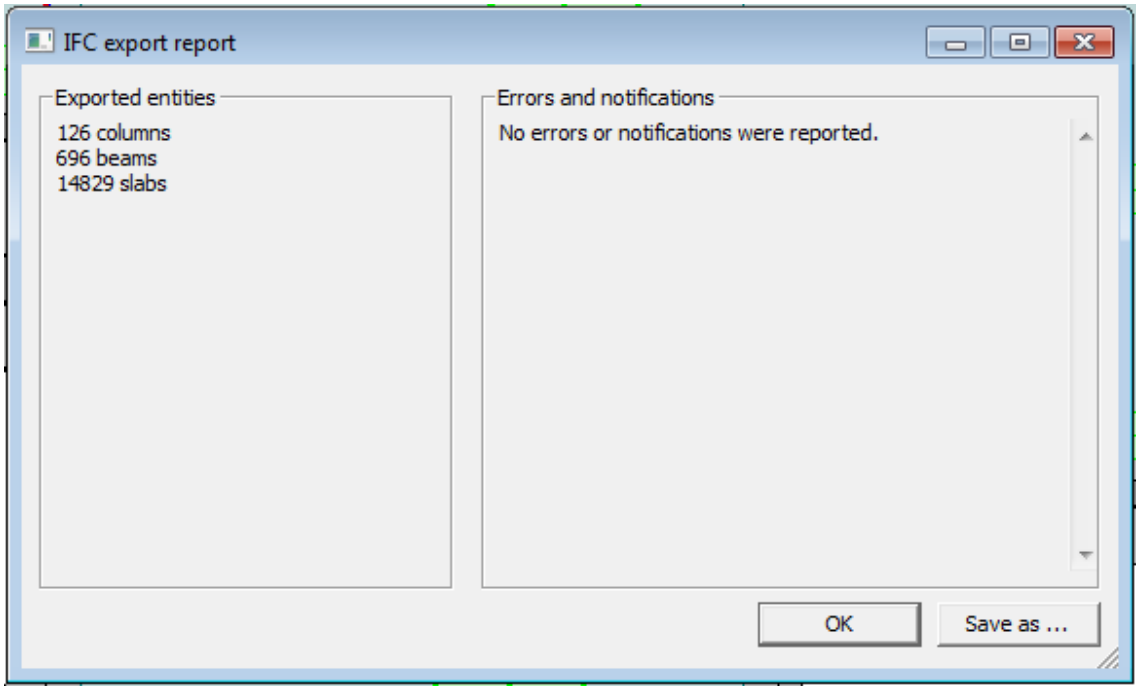
Brep - all internal and free tendons are exported as faced solids where no information about diameter and distances between bars is.

Export procedure

After a confirmation of Ifc Export Options dialog a progress bar with number of already exported elements is shown.



At the end a report of export is displayed.



On the left side there is a list of exported objects with their quantity. On the right side there is a place for errors and notifications if they are any.