FIG WARSAW CONGRESS 2022
XXVII FIG CONGRESS
11–15 SEPTEMBER 2022
Warsaw, Poland
Volunteering for the future – Geospatial excellence for a better living

Workshops: Extracting Geospatial information from IFC using Python

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Agenda

- Introduction
- BIM and GIS
- Challenges
- Python and Ifcopenshell
- Case studies in Python
  - #1 Georeference model
  - #2 Extracting geospatial information
  - #3 Saving to GIS/Survey formats
- Summary

BIM and GIS

Criteria	BIM	GIS
Application	information management during object life cycle - 3D model and metadata	create, store, manage, analysys, share of spatial data
Level of detail	single component of object	object
Scope of information	object and individual information from the environment	surroundings of the object
Standards	IFC, ISO-19650, ISO-16739	CityGML, WMS, WFC, WCS, LandXML, ISO 191XX
Location	local*	global
Geometric representation	CSG (Constructive Solid Geometry), Swept Solid	B-Rep

Why integrate?

2 + 2 = 5

BIM GIS synergy and complementarity

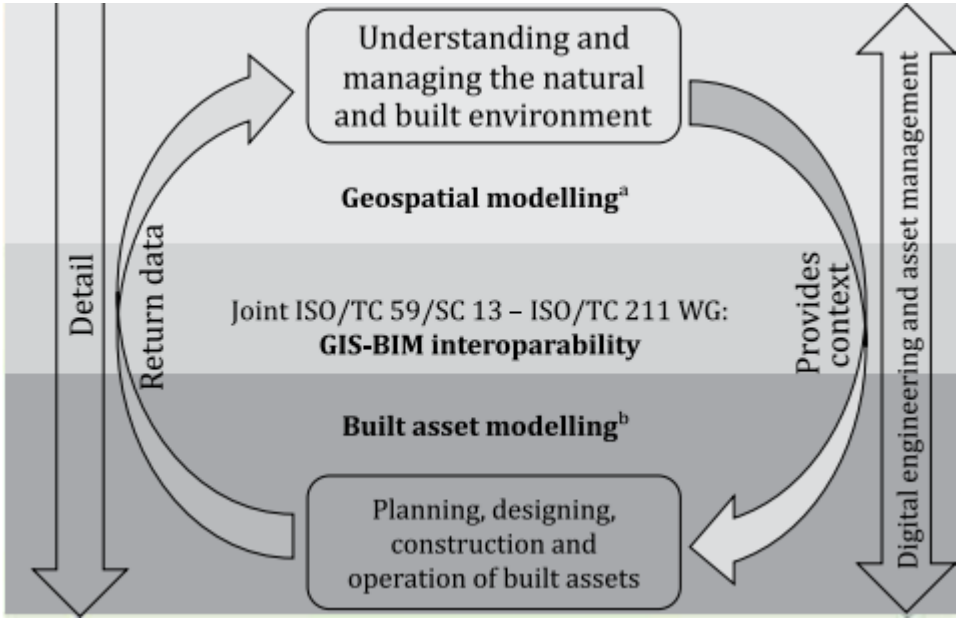
BIM and GIS

ISO

JWG 14: ISO/TC 59/SC 13 and ISO/TC 211 BIM&GIS interoperability

ISO/TR 23262:2021 – GIS (geospatial) / BIM interoperability

GIS



ISO/TC 211: ISO 19101, ISO 19103, ISO 19104, ISO 19105, ISO 19106, ISO 19107, ISO 19108, ISO 19109, ISO 19110, ISO 19111, ISO 19136, ISO 19150

ISO/TS 19166:2021 – Geographic information – BIM to GIS conceptual mapping (B2GM)

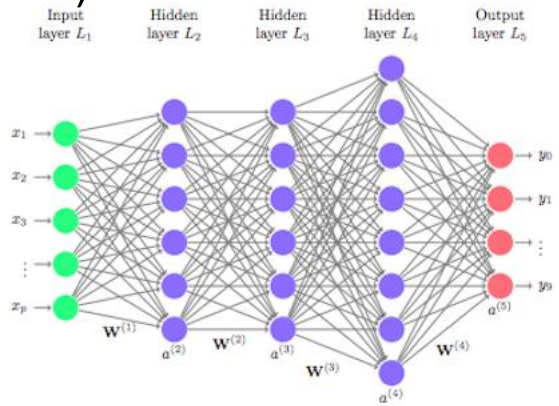
ISO/TC 59/SC 13: ISO 16739-1, ISO 29481, ISO 19650, ISO 12006

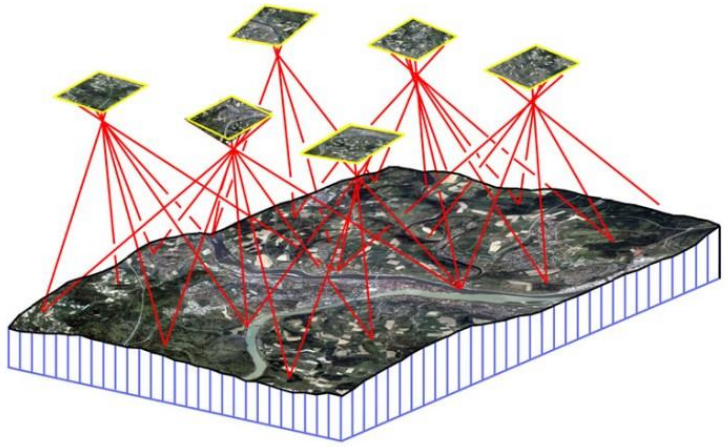
BIM

BIM and surveyor

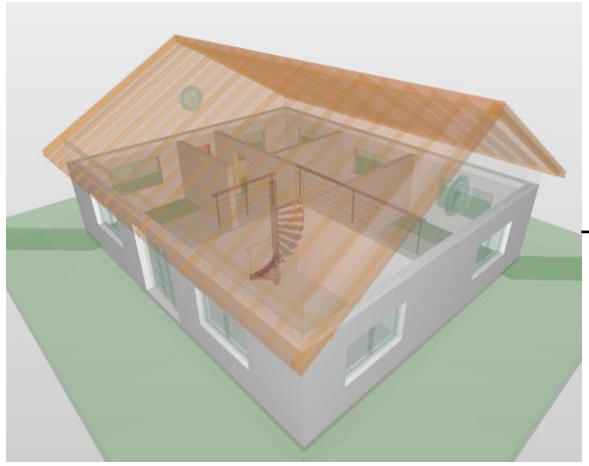
NEW:

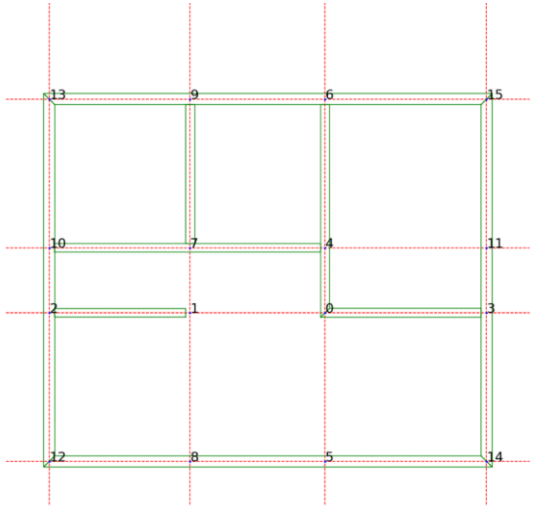
- Tools - UAV, UGV, Satellite, Laser Scanners etc.
- Data – Big Data, different formats, data fusion
- Tasks (or the same but performed differently)
- Methods/algorithms (DL/ML)





Scan2BIM





BIM and surveyor

NEW:

- Tools - UAV, UGV, Satellite, Laser Scanners etc.
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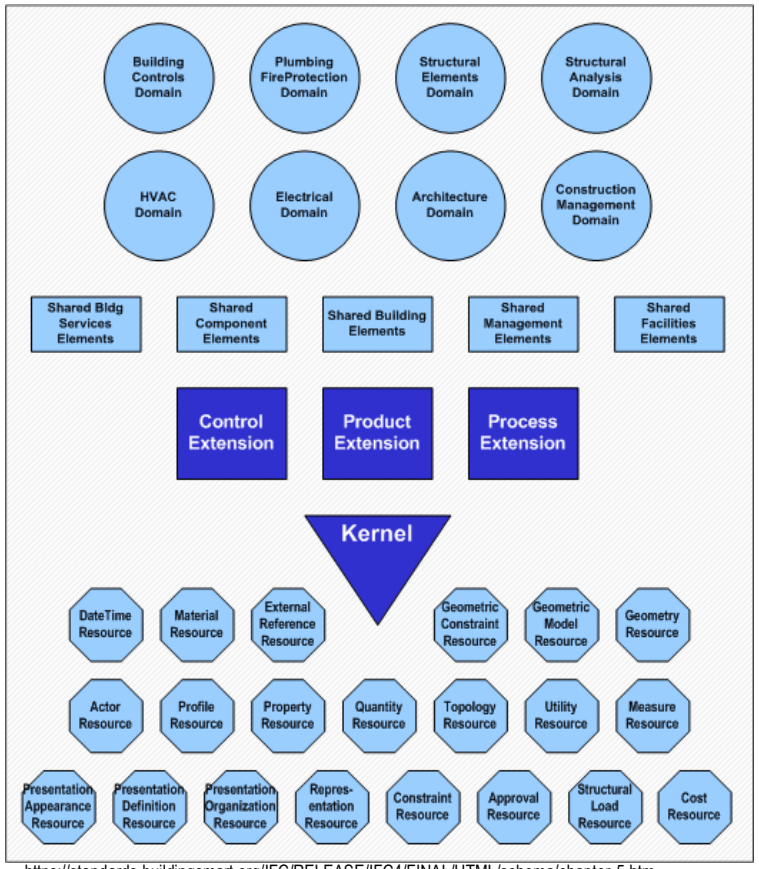
More?

Szymon Glinka, **Tomasz Owerko** and ***Karolina Tomaszkiewicz*** (Poland): Information Exchange Using the Open IFC Format from a Surveyor's Perspective (11472)

INVITE!

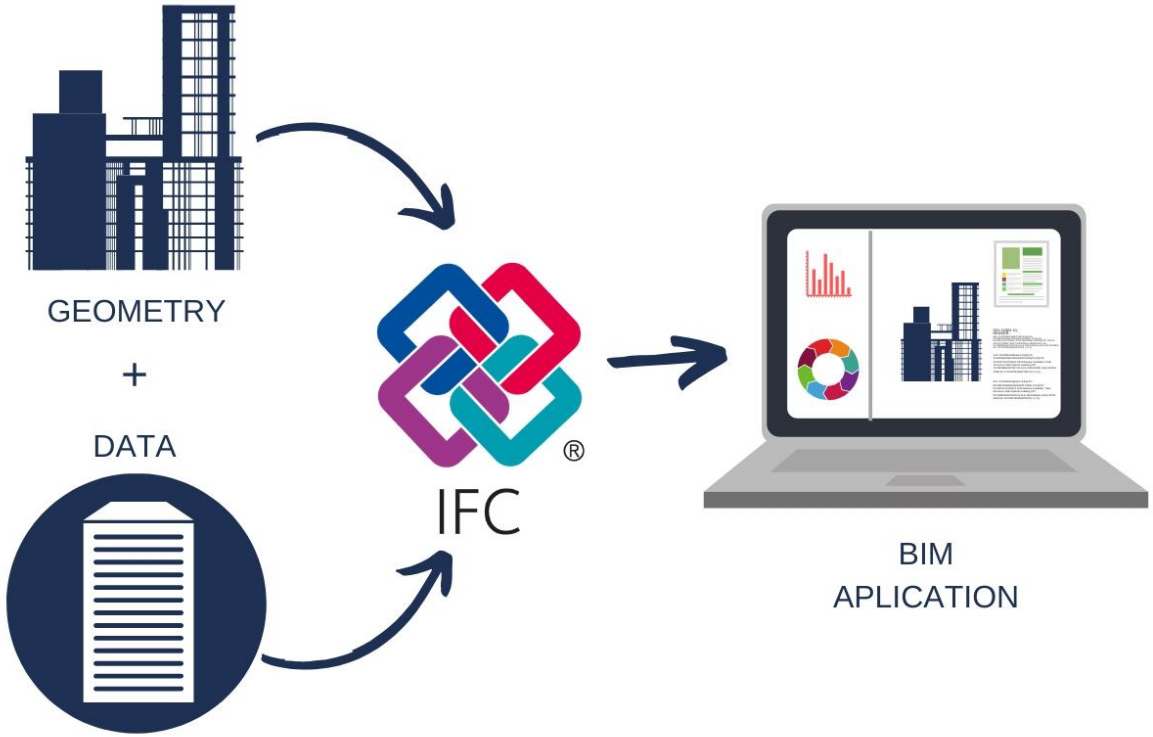
Wednesday,
14 September
16:30–18:00
Poplar/Alder, DoubleTree by Hilton

IFC



https://standards.buildingsmart.org/IFC/RELEASE/IFC4/FINAL/HTML/schema/chapter-5.htm

IFC – Industry Foundation Classes (ISO 16739-2018) – common AEC language

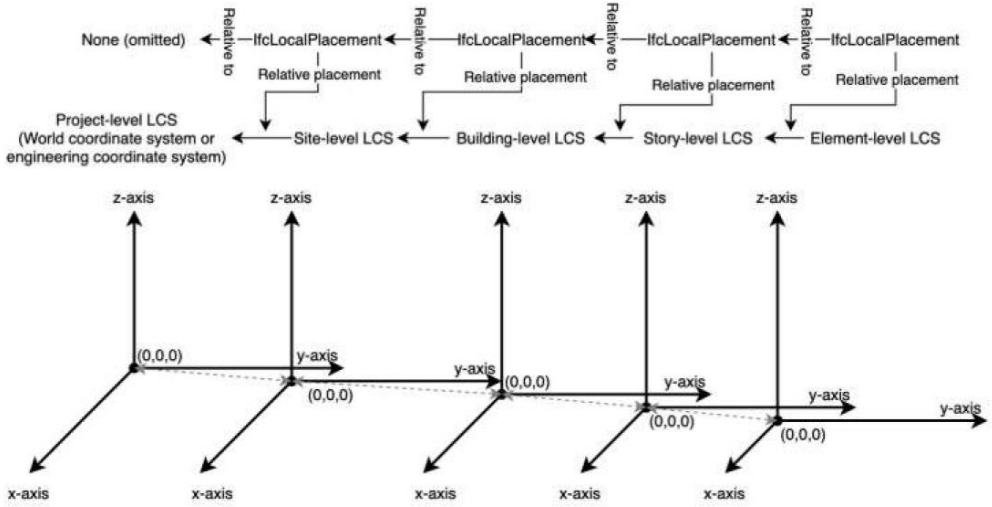


https://bimcorner.com/everything-worth-knowing-about-the-ifc-format/

Challenges

Basic:

- Georeferencing

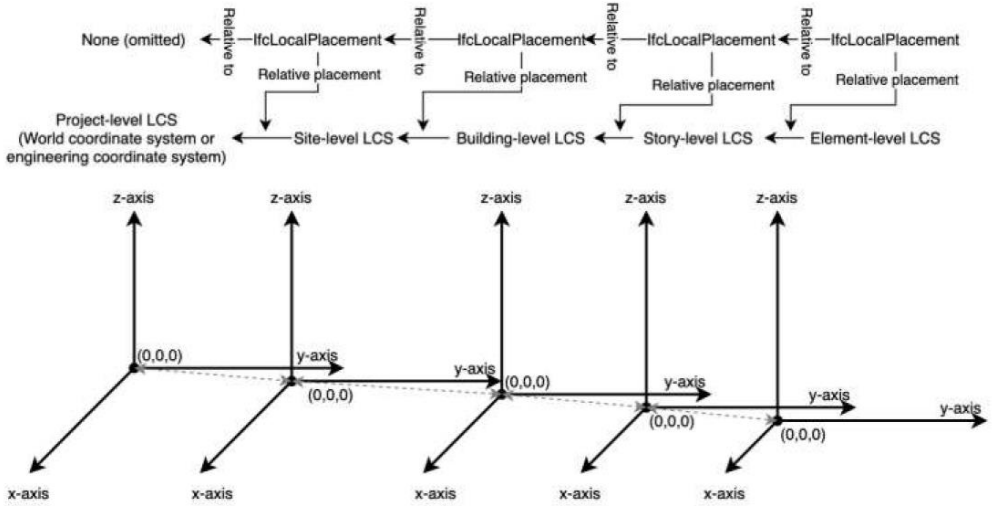


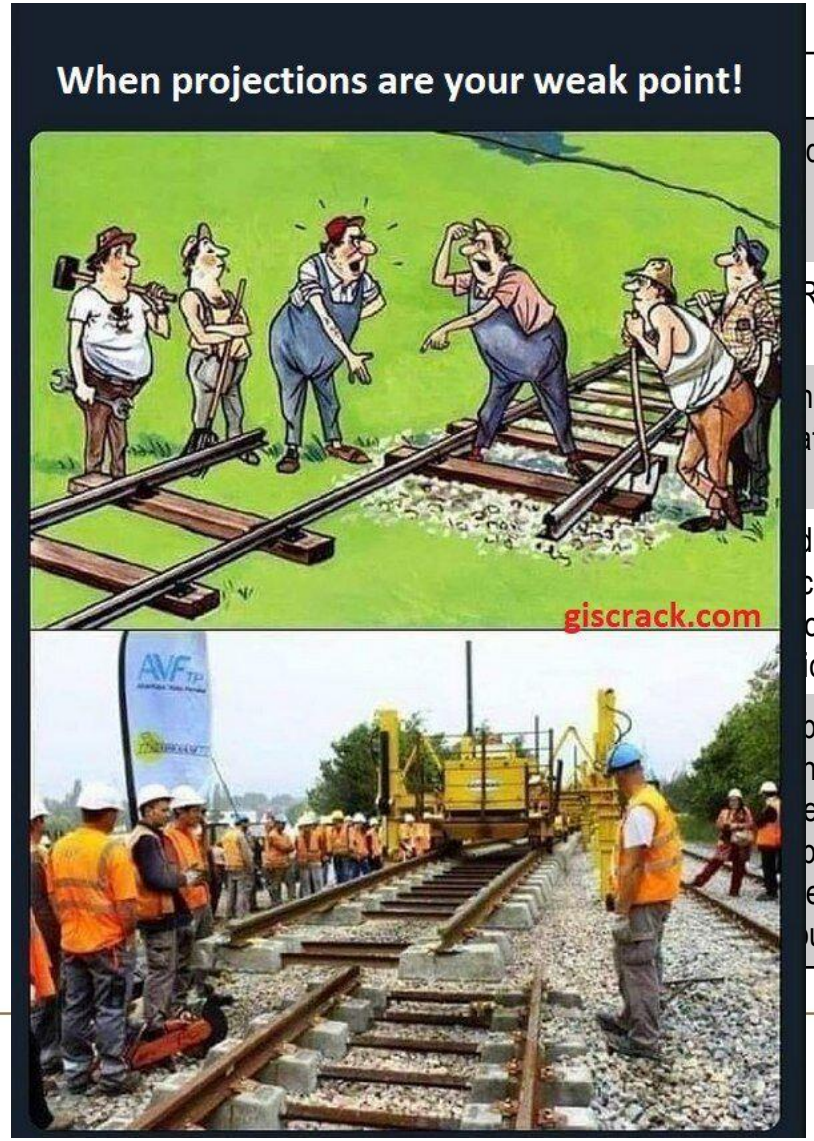
LoGeoRef	CRS	Klasy IFC
LoGeoRef10	No CRS, approximate location based on address	IfcPostalAddress referenced by IfcSite or IfcBuilding
LoGeoRef20	WGS84 EPSG:4326	Attributes: RefLatitude, RefLongitude, RefElevation of IfcSite
LoGeoRef30	Any CRS (no definition in file)	IfcCartesianPoint (reference point), IfcDirection (stores rotation relative to the project or global north) refer to IfcSite
LoGeoRef40	Any CRS (no definition in file)	WorldCoordinateSystem attribute storing the coordinates of the reference point in any CRS and the TrueNorth direction. Both of these are stored in the IfcGeometricRepresentationContext.
LoGeoRef50	Any CRS defined using EPSG	Reference point coordinates stored in IfcMapConversion using Eastings, Northings and OrthogonalHeight attributes for global height. Rotation for the XY plane, stored using the XAxisAbscissa and XAxisOrdinate attributes. The CRS applied is defined by the IfcProjectedCRS attribute in the Name attribute using the relevant EPSG code.

Challenges

Basic:

- Georeferencing





dress referenced by IfcSite or IfcBuilding

RefLatitude, RefLongitude, RefElevation klasy

nPoint (reference point), IfcDirection (stores ative to the project or global north) refer to

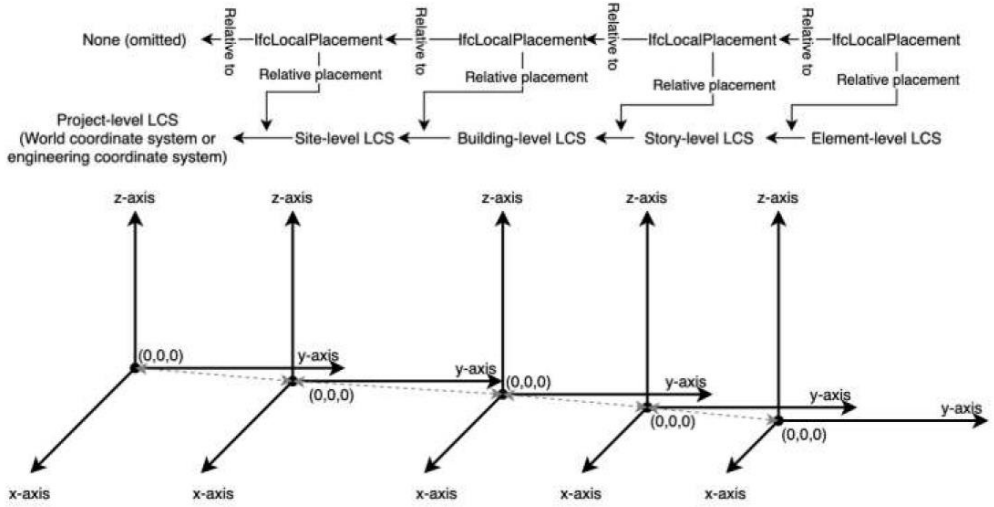
dinateSystem attribute storing the coordinates of ce point in any CRS and the TrueNorth oth of these are stored in the cRepresentationContext.

point coordinates stored in IfcMapConversion ngs, Northings and OrthogonalHeight attributes eight. Rotation for the XY plane, stored using oscissa and XAxisOrdinate attributes. The CRS efined by the IfcProjectedCRS attribute in the ute using the relevant EPSG code.

Challenges

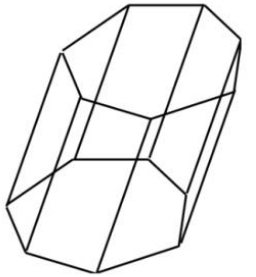
Basic:

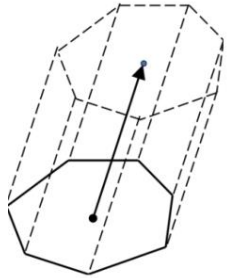
- Extracting geospatial data (geometry)

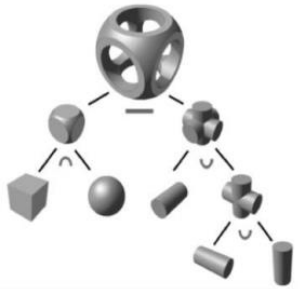


implicit vs explicit

Type	
Point	2 or 3 dimensional point(s)
PointCloud	3 dimensional points prepresented by a point list
Curve	2 or 3 dimensional curve(s)
Curve2D	2 dimensional curve(s)
Curve3D	3 dimensional curve(s)
Surface	2 or 3 dimensional surface(s)
Surface2D	2 dimensional surface(s) (a region on ground view)
Surface3D	3 dimensional surface(s)
FillArea	2D region(s) represented as a filled area (hatching)
Text	text defined as text literals
AdvancedSurface	3 dimensional b-spline surface(s)
GeometricSet	points, curves, surfaces (2 or 3 dimensional)
GeometricCurveSet	points, curves (2 or 3 dimensional)
Annotation2D	points, curves (2 or 3 dimensional), hatches and text (2 dimensional)
SurfaceModel	face based and shell based surface model(s), or tessellated surface model(s)
Tessellation	tessellated surface representation(s) only
SolidModel	including swept solid, Boolean results and Brep bodies; more specific types are:
SweptSolid	swept area solids, by extrusion and revolution, excluding tapered sweeps
AdvancedSweptSolid	swept area solids created by sweeping a profile along a directrix, and tapered sweeps
Brep	faceted Brep's with and without voids
AdvancedBrep	Brep's based on advanced faces, with b-spline surface geometry, with and without void
CSG	Boolean results of operations between solid models, half spaces and Boolean results
Clipping	Boolean differences between swept area solids, half spaces and Boolean results
additional types	some additional representation types are provided:
BoundingBox	simplistic 3D representation by a bounding box
SectionedSpine	cross section based representation of a spine curve and planar cross sections. It can re
LightSource	light source with (depending on type) position, orientation, light colour, intensity and atte
MappedRepresentation	representation based on mapped item(s), referring to a representation map. Note: it car


(a) B-Rep


(b) Swept solid


(c) CSG

Challenges

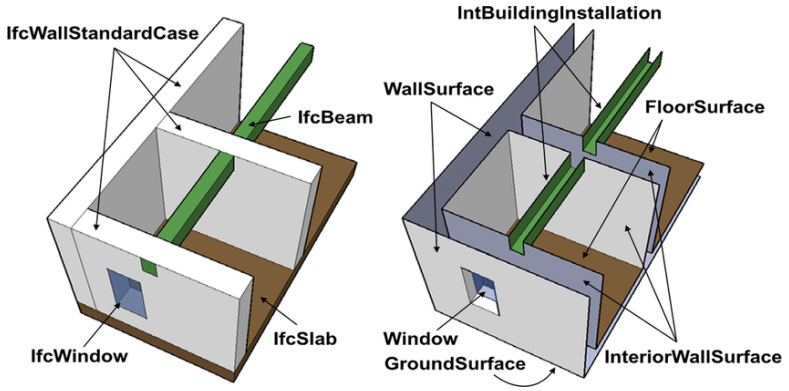
Basic:

- Saving in GIS/Survey Formats

BIM

IFC
dot.bim
…

CONVERSION/TRANSLATION



GIS

CityGML
CityJSON
SHP
LandXML
…

Python and IfcOpenShell

http://ifcopenshell.org/

https://github.com/IfcOpenShell/IfcOpenShell

Case studies

- #1 Georeference model
- #2 Extracting geospatial information
- #3 Saving to GIS/Surveyors formats

LIVE

Thank you for your attention!

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Akademia Górniczo-Hutnicza im. Stanisława Staszica w Krakowie