Technische Universität Berlin
Geodäsie und Geoinformationstechnik

The Industry Foundation Classes (IFC) – ready for indoor cadastre ?

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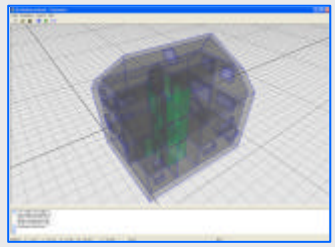
Motivation 1

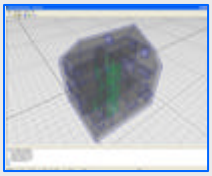
Computer aided building information system that supports engineering survey data acquisition and adjustment techniques



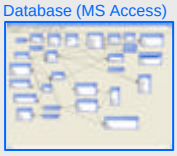
Motivation 1

internal data management

application



Database (MS Access)



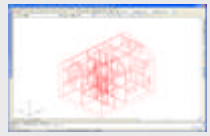
XML

Motivation 1

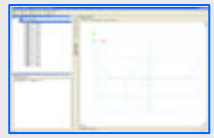
data exchange

application

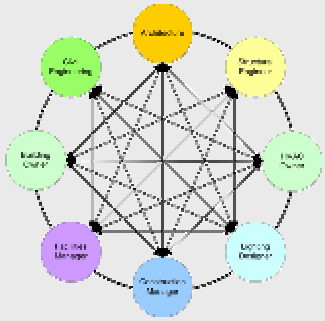
DXF (AutoCAD)



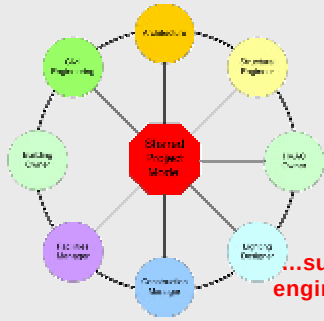
IFC (Industry Foundation Classes)



Motivation 2



Motivation 2



...surveying engineer ???

Outline

- The organisation: IAI
- The Implementer view
  - Architecture
  - Languages
  - Geometric Representation
- The GIS view
- The Surveyors view
- Outlook
- Conclusion

IFC organisation

- Designed and maintained by the International Alliance for Interoperability (IAI) www.iai-international.org
- Software vendors, technical associations, academic institutions, government agencies…
- More than 19 countries, more than 600 member companies
- ISO Public Available Specification ISO/PAS 16739
- IFC is a global effort !

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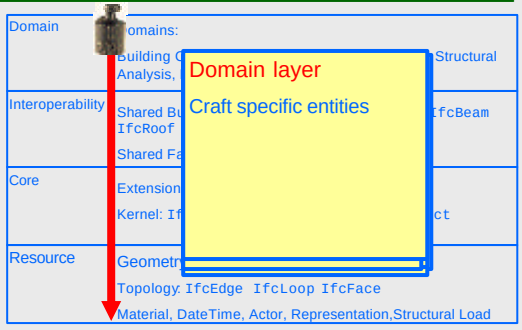
IFC architecture



IFC languages

data model

- EXPRESS
- EXPRESS-G
- XML Schema

data

- STEP physical file
- XML

IFC languages

data model

- EXPRESS
- EXPRESS-G
- XML Schema

```
ENTITY IfcWall

SUPERTYPE OF (IfcWallStandardCase)
SUBTYPE OF (IfcBuildingElement);

END_ENTITY;
```

data

- STEP physical file
- XML

IFC languages

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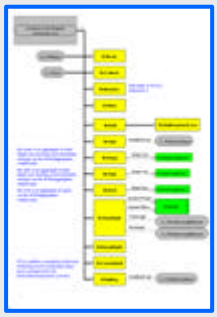

IFC languages

data model

- EXPRESS
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- XML Schema

data

- STEP physical file
- XML

```
<xs:element
 name="IfcWall"
 type="ifc:IfcWall"
 nillable="true"/>

<xs:complexType name="IfcWall">
 <xs:complexContent>
  <xs:extension
        base="ifc:IfcBuildingElement"/>
  </xs:complexContent>
</xs:complexType>
```


IFC languages

data model

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data

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```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION
(('Testfile'));
FILE_NAME(('example_file'));
FILE_SCHEMA
(('example_schema'));
ENDSEC;
DATA;
#1 = POINT (10.0, 5.0, $);
#2 = POINT (10.0, 15.0, $);
#3 = POINT (30.0, 10.0, $);
#4 = TRIANGLE(#1, #2, #3);
#ENDSEC;
#END-ISO-21;
```


IFC languages

data model

- EXPRESS
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data

- STEP physical file
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```
<IfcFaceOuterBound id="1015">
 <Bound>
 <IfcLoop xsi:nil="true" ref="1014" />
 </Bound>

 <Orientation>true</Orientation>
</IfcFaceOuterBound>

<IfcFace id="1016">
  <Bounds ex:cType="set">
  <IfcFaceBound ex:pos="0" xsi:nil="true"
ref="1015" />
  </Bounds>
</IfcFace>
```


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IFC Geometric Representation

Model:

CSG

Extrusion/Rotation

Geometric Set

B-Rep

...

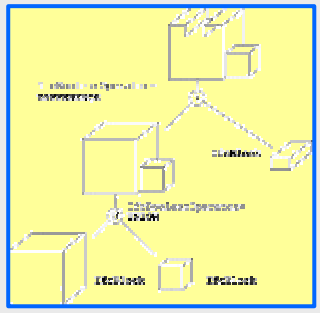
Items:

Points

Curves

Surfaces

...



IFC Geometric Representation

Model:
CSG
Extrusion/Rotation
Geometric Set
B-Rep
…
Items:
Points
Curves
Surfaces
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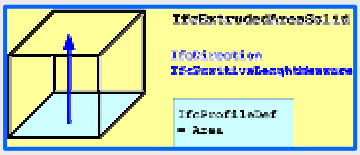

IFC Geometric Representation

Model:
CSG
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Geometric Set
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…
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Points
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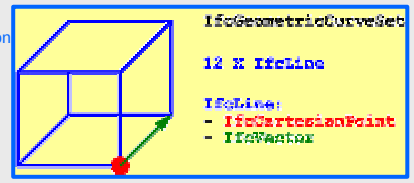

IFC Geometric Representation

Model:
CSG
Extrusion/Rotation
Geometric Set
B-Rep
…
Items:
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Surfaces
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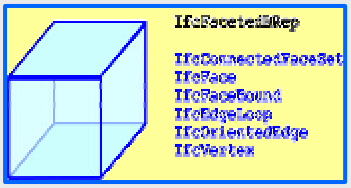
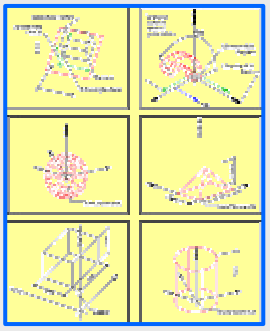


IFC Geometric Representation

Model:
CSG
Extrusion/Rotation
Geometric Set
B-Rep
… !!!!
Items:
Points
Curves
Surfaces
…



IFC Geometric Representation

Model:
CSG
Extrusion/Rotation
Geometric Set
B-Rep
…
Items:
Points
Curves
Surfaces
…

IfcPoint
IfcCartesianPoint, IfcPointOnCurve, IfcPointOnSurface

IfcCurve
IfcBoundedCurve (IfcCompositeCurve, IfcPolyline, IfcTrimmedCurve, IfcBSplineCurve)
IfcConic (IfcCircle, IfcEllipse)
IfcLine (IfcOffsetCurve2D, IfcOffsetCurve3D)

IfcSurface
IfcElementarySurface : (IfcPlane=
IfcSweptSurface: (IfcSurfaceOfRevolution IfcSurfaceOfLinearExtrusion)
IfcBoundedSurface : (IfcCurveBoundedPlane, IfcRectangularTrimmedSurface)

IFC Geometric Representation

IFC offers a great number of parameterisation models

Export:
It is easy to find a parameterization that fits well with the applications internal geometry model.

☺

Import:
Any possible parameterisation has to be implemented and mapped to the applications internal geometry model.

☹

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The GIS view

GIS

Geographic Information System

Observation
B-Rep
GML

AEC

Architecture Engineering and Construction

Construction
CSG
IFC

The GIS view

GIS

OGC:
CAD-GIS Interoperability WG
CityGML Level 4

AEC

IAI:
IFG (IFC for GIS) WG

Goal:
Seamless integration of building data and geospatial data and vice versa

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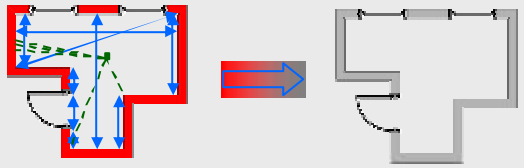
The Surveyors view

Indoor cadastre

- Analogy: Geometric Survey for Land Registration and GIS
- Context: Building Information System / As build documentation
- Idea: Storing geodetic observation as primary data in order to document a correct engineering survey and applying adjustment calculations.
- Benefit: Ability to deal with accuracy and reliability. Controlled and faster data acquisition for facility management.
- Aim: Providing the geometrical and topological framework for thematic building data.

The Surveyors view



Measurement Unit :
- Measurement value and uncertainty
- Redundant observations
- Documentation of survey
- Applying Adjustment Techniques

CAD/BIM :
- No measurement values
- No accuracy information
- No reliability information

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Outlook: IFC survey domain

- Domain Group: Defining the requirements and "test scenarios"
  - Units
  - Raw Observation Value
  - Reduced Observations
  - Observation Topology
  - Measures for accuracy and reliability
  - .....
- Technical Experts: Specification and integration of the "survey domain" following the IFC concepts and using already existing data types.
- Implementation Experts: Software vendors providing "pilot implementations" and commercial software.

Conclusion

- IFC are a complex data model with consequent modelling rules
- The model is good for topological and geometric representation of buildings
- IFC is object oriented and hence extensible
- It is not possible to store survey data
- Pre-processed measurements can be exported to IFC
- An IFC survey domain would make engineering surveyors be part of the IFC community
- http://www.iai-international.org/

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Thank you !

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