Development Progress on IFC for Infrastructure

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A brief history of IFC
The IAI

1994
Autodesk creates the Industry Alliance for Interoperability.

1995
Tech demoed at A/E/C Systems 95. Membership opened to any interested parties.

1996
IAI renamed as International Alliance for Interoperability. First version of IFC published.
IFC through the years

1995: first code example
1997: IFC 1.0
1998: IFC 1.5
1999: IFC 2.0
2000: IFC 2.x
2003: IFC 2x2
2006: IFC 2x3
2005: IAI becomes buildingSMART
2013: IFC 4
What exactly is an IFC?

IFC = Industry Foundation Class

- IFC is developed by buildingSMART
- IFC is a data model to describe architectural, building and construction industry data
- IFC is platform neutral
- IFC is an open file format specification not controlled by a single party
- IFC is object-based
- IFC is an ASCII (human readable) file format
- IFC is available in many forms: IFC-SPF (STEP), IFC-XML (STEP-XML) and IFC-ZIP (compressed SPF or XML)
- IFC is an official International Standard ISO 16739-1:2018
- IFC is being modernised with ifcOWL (RDF triple language), ifcJSON (JavaScript Object Notation) and ifcHDF5 (Hierarchical Data Format v5) as trials to overcome limitations in its current forms
IFC Model View Definitions

You need 3 components for a valid IFC file: IFC Schema, IFC version, MVD. An MVD is a subset of the IFC schema, needed to satisfy one or many Exchange Requirements. The MVD must be specified during the export:
IFC 2x3 Coordination View

- targets coordination between architectural, mechanical and structural engineering tasks during the design phase.
- the shared model is supposed to be re-editable by the receiving application.
- includes the definition for spatial structure, building, and building services elements with shape representations.
- includes parametric shapes for a limited range of standard elements.
- includes ability to include non-parametric shape for all other elements,
- to which property sets, material definitions and alphanumeric information can be assigned
- round-trip scenarios are explicitly excluded

http://www.buildingsmart-tech.org/specifications/ifc-view-definition/coordination-view-v2.0/summary
IFC4 Reference View

Goal of the Reference View:
• provide building information for the widest array of software without geometry modification.
• applications such as viewing, estimating, building, operating, and other downstream analysis.

http://www.buildingsmart-tech.org/specifications/ifc-view-definition/ifc4-coordination-views/ifc4-cvs-summary
IFC4 Design Transfer View

Goal of the Design Transfer View
• to provide building information with support for editing of interconnected elements.
• applications include inserting, deleting, moving, and modifying physical building elements and spaces.
• target scenario is an architect providing building design information to an engineer where geometric modifications may need to be made.

http://www.buildingsmart-tech.org/specifications/ifc-view-definition/ifc4-coordination-views/ifc4-cvs-summary
How applicable has IFC been?

Global Average Daily Construction
2018 - 2050

RAIL
153 km

WATER & SEWAGE PIPES
32,034 km

ROADS & HIGHWAYS
3,169 km

POWERGRID**
17,476 km

URBAN BUILDINGS
13,213

Please note that rail, water & sewage pipes, roads & highways and powergrid values are inclusive of both urban and rural data.
* Commercial and residential, excl single family homes
** Including high voltage transmission lines and distribution lines

Source: Statista Calculation
IFC for Infrastructure

the missing piece
The Infrastructure Owners Perspective
buildingSMART
InfraRoom
Mission: To combine, enhance and develop open standards for intelligent data, which enable process and data integration for Infrastructure

Scope: Information exchange and process standards to support effective management of constructed built environment & linking and integrating across BIM and GIS.
bSI Standards Development Process

**Initiation**
- Activity proposal
- Project proposal
- SC consulted

**Development**
- Standard proposal
- Working Draft Standard
- Expert Panel output

**Approval**
- Candidate Standard
- Software validation
- Consensus Building evidence

**Final Standard**

Documents Standard status:
- Activity proposal
- Project proposal
- Standard proposal
- Working Draft Standard
- Candidate Standard

Weeks:
- SCE review: 1 < 4
- SC vote: 4 < 8
- SCE review: 1 < 4

IFC 4.3 Infrastructure Extensions – Deployment Work Package
Infrastructure Extensions – Overall Progress

IFC Next Generation (bSI Technical roadmap, published shortly)

IFC4.X (2022)

IFC4.3 (c2020, Standard 2021)

IFC4.2

- IFC Bridge (c2019)
  - WP3
  - WP2

- IFC Rail (c2019)
  - WP3
  - WP2

- IFC Road
  - WP3
  - WP2

- IFC Ports & Waterways
  - WP3
  - WP2

- IFC Tunnel m fl.
  - WP3
  - WP2

IFC4.1

- IFC Overall Architecture (2017)
- IFC Alignment 1.0 / 1.1 (2017)

IFC4.0

- ISO 16739 (2013)

IFC 4.3 Infrastructure Extensions – Deployment Work Package
IFC Exchange Flow Abstraction

Domain expert A → Software suite 1 → IFC file → Software suite 2 → Domain expert B

IFC 4.3 Infrastructure Extensions – Deployment Work Package
Ensuring Exchange Quality

Storyline (SL)
- Real life data exchange
- Covers 1-to-many exchanges

Unit test (UT)
- Small, atomic example
- Little-to-no overhead

Validation: do the right things
Verification: do things right

Domain expert A → Software suite 1 → IFC file → Software suite 2 → Domain expert B

IFC 4.3 Infrastructure Extensions – Deployment Work Package
IFC 4.3 Development Progress
Organisations providing scenarios

IFC Infrastructure Extensions programme

Well developed scenario

Yet to provide scenario

Ports
Bridges
Roads
Rail

Drainage

Väylävirasto
Trafikledsverket

Statens vegvesen
Norwegian Public Roads Administration

Royal HaskoningDHV
Enhancing Society Together

BIM Transportation Working Group

NetworkRail

Electronic Systems France

MTS
Schwenbenpower

Hochschule für Technik Rapperswil

COWI

TALTECH

LEDVANCE

HNTB

EIC Activities

Fair Cape Consulting

Ledvance

Vianova Systems France
Software vendor pilot implementation

IFC Infrastructure Extensions programme
Organisations providing scenarios

*IFC Railway programme*

**Illustrative scenarios**

<table>
<thead>
<tr>
<th>Rail Specific</th>
<th>Infrastructure generic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment with Cant</td>
<td>Alignment</td>
</tr>
<tr>
<td>Linear placement</td>
<td>Linear placement (point)</td>
</tr>
<tr>
<td>Swept solid geometry with cant</td>
<td>Linear span placement (From-To)</td>
</tr>
<tr>
<td>Railway spatial structure/zone</td>
<td>Linear placement – broken chainage</td>
</tr>
<tr>
<td>System functional breakdown</td>
<td>Earthworks</td>
</tr>
<tr>
<td>Wireless connectivity</td>
<td>Subgrade</td>
</tr>
<tr>
<td>Track elements</td>
<td>Drainage</td>
</tr>
<tr>
<td>Spatial elements</td>
<td>Terrain and soil models</td>
</tr>
<tr>
<td>Overhead Contact Line elements</td>
<td>Geotechnics</td>
</tr>
<tr>
<td>Telecom elements</td>
<td>System of systems</td>
</tr>
</tbody>
</table>
Software vendor pilot implementation

IFC Railway programme

additional Railway Room pilot implementation participants
IFC 4.3 Status update

As of October 2020

• IFC 4x3_RC1 (release candidate 1) needs to be revised
• On October 21st (day after this class was recorded!) an Expert Panel meeting will receive feedback on IFC4x3_RC2
• Plan is to release IFC4x3_RC2 during the buildingSMART Virtual Summit at end of October
• Schema is being revised due to:
  o concerns raised during the early extensions testing in the Railway programme
  o vendor feedback,
  o experience from production of reference files,
  o and result of survey with IFC Rail stakeholders.
  o Issues with the alignment definition were identified
  o and ongoing concerns with rail spiral support not meeting industry needs.
• This also has a consequent impact on IFC Infrastructure Extensions programme
IFC for Infrastructure and Rail - Autodesk support
Autodesk IFC for Infrastructure Support currently

IFC 2x3

IFC 4

IFC 4.1

IFC-Alignment
Autodesk IFC for Infrastructure Support currently

Design Collaboration - IFC Integration into BIM360 Design

1. Upload IFC to Docs by UI or Desktop Connector
2. Create a package in DC of IFC files and share
3. In Revit ‘Link IFC’ from Shared via Desktop Connector
Autodesk IFC for Infrastructure Support currently

IFC 4.2 (Bridge PoC using Dynamo)

... send to Revit

InfraWorks

Revit

IfcBridgeToolKit + Dynamo

FZK Viewer
Autodesk IFC for Infrastructure
Support currently
IFC 4.2 (Bridge PoC in Forge)
Autodesk IFC for Infrastructure Support currently

IFC 4.3 Ports & Waterways PoC – using IFC Revit Toolkit

GitHub
Autodesk IFC for Infrastructure and Rail
ongoing Investment

- Autodesk has an internal IFC for Infrastructure working group
- Autodesk continues to collaborate with the Technical University of Munich on IFC 4.3 PoCs
- Autodesk continues to support the IFC 4.3 deployment programme for infrastructure and rail
- Autodesk joined the Open Design Alliance (ODA) in September 2020
  - Will adopt the ODA IFC library replacing the current Jotne solution
  - Note, ODA need to implement IFC 4.3 elements before it can be used in software
- Autodesk will participate in buildingSMART IFC 4.3 finalization work
- Autodesk will engage with buildingSMART on the critical IFC 4.3 (and beyond) certification
Final Words
Get ready for IFC 4.3 and beyond

- Follow the efforts of the buildingSMART InfraRoom [https://www.buildingsmart.org/standards/rooms/infrastructure/](https://www.buildingsmart.org/standards/rooms/infrastructure/)
- Join buildingSMART International or your local Chapter [https://www.buildingsmart.org/about/get-involved/membership-and-benefits/](https://www.buildingsmart.org/about/get-involved/membership-and-benefits/)
- Perhaps participate in the IFC 4.3 deployment programme [https://www.buildingsmart.org/standards/calls-for-participation/ifcroad/](https://www.buildingsmart.org/standards/calls-for-participation/ifcroad/)
- Use Infrastructure and Rail modelling tools e.g. Civil 3D, InfraWorks or Revit to create suitable BIM candidate files
- Undertake your own trials using:
  - Revit Toolkit on Github
  - Dynamo with Revit and Civil 3D
  - Autodesk Forge
  - Project Explorer for Civil 3D
- Test IFC 4.3 when solutions become available!