IFC-BRIDGE & IFC for Roads

Bridge: Île de Ré (FRANCE)
Construction: Bouygues TP
Photo: Pleiades satellite (CNES)

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BuildingSmart Infrastructure Room
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V-Con Use Case 1 - Geometry

1. Traffic or infrastructure aging problems
2. New network connection requirement or improvement of existing connection
3. Spatial plan for (re)new connection. Alignments, crossings, traffic objectives, functional requirements
4. **Tender specifications, contractual elements**
5. Road design proposal
6. Road design approval
7. Road building progress data
8. Road building progress approval
9. **Road as-built data**
10. **Road as-built approved data**
V-Con - 3 Models Architecture

BIM World (Design & Build)

GIS World (Program, Operate & maintenance)
IFC-Bridge

Is this a physical element, or rather a grouping (or spatial group)?

IfcBridge

IfcBridgeElement

IfcBridgePart

Stay cables

Pylon

Deck

Segment

Element of pylon

Element of Deck

IfcTendon (Pre-stressed technology)

IfcProfileDef

(Transversal cut)

(concrete)

(steel)
Predefined types vs. external local types

Current IFC-Bridge model proposes some Predefined enumeration types.
- Revision in progress with IFC-Bridge/openINFRA group
- Predefined types shall be used for static and common types, accepted “worldwide”

For local purposes, some types defined in external catalogs (ex: bSDD) can be defined using the **ObjectType** attribute of the **IfcObject** abstract supertype.
In that case, the PredefinedType enumeration value shall be set to « USERDEFINED ».
Bridge Physical Elements

3D Geometry, material, assignment to bridge spatial structure, etc. is provided here
Bridge Element Components

- **IfcElementComponent**
  - **IfcCivilElementPart**
  - **IfcBridgeElementPart**
  - **IfcBridgeElement**
    - **PartTypeEnum**
      - **IfcBridgeMechanical**
        - **RoleType**

- **IfcVoidingFeature**
  - **PredefinedType**
    - **IfcVoidingFeatureTypeEnum**

Any bridge sub component, a picture with examples would be nice. Temporary elements.
Bridge reinforcement elements

IFCSHAREDCOMPONENTELEMENTS.IfcElementComponent

IfcReinforcingBar

IfcTendon

IfcTendonAnchor

IfcTendonSheath

*Bouygues: “Not sufficient for bridges.” Adding IfcBridgeTendon?

proposed entity for IFC-Bridge
Alignment for bridge
- for referencing purpose
- for logical positioning
  (but always Cartesian x/y/z location for 3D geometry)
Civil Engineering Reference Alignment Curves

- **3D curve alignment**

- **Horizontal alignment**

- **Vertical alignment**

A way for mapping LandXML alignment (including stations)
Usage of IfcSectionedSpine

- **IfcBridgeElement**
- **IfcProductDefinitionShape**
  - **Representations L[1:?]**
  - **IfcShapeRepresentation**
    - **Items S[1:?]**
    - **IfcReferenceSectionedSpine**
      - **CrossSectionPositionsL[2:?]**
      - **SpineCurve**
      - **CrossSections L[2:?]**
      - **IfcCompositeCurve**
      - **IfcProfileDef**
      - **IfcAxis2Placement3D**

Shall be the same as the **IfcAlignmentCurve3D:Curve3D**
Linear Placement

- linear placement always with x/y/z Cartesian placement
- in addition an “distance along” relative to alignment
Using annotations for cross sections representations (2D approach)

- how to define the origin (also in GIS coordinates)?
Example with offset
Example with rotated sections
Clothoid constant (A) is defined so that the curvilinear abscissa (L) is defined relatively to the current radius (R) with the following formula: 

\[ L = \frac{A^2}{R} \]
Proposal for IFC for Roads

• Extension of IFC-Bridge
  – For sharing common civil engineering features, geometry and alignment

• With new IFC entities for mapping with CityGML Transportation Objects (static part)

• + dynamic part based on:
  – International, European, National object types / libraries
    • From SWE/TRV
    • From RWS/COINS
    • Others (bSDD….)
Fig. 57: Representations of *TransportationComplex* (from left to right: examples of road, track, rail, and square) (source: Rheinmetall Defence Electronics).
CityGML – Transportation Objects
Fig. 59: UML diagram of the transportation model in CityGML. Prefixes are used to indicate XML namespaces associated with model elements. Element names without a prefix are defined within the CityGML Transportation module.
CityGML – Transportation Objects – LODs → IFC

**Situation**

- **LOD 0**
  - TransportationComplex provides linear network with line objects
  - Line objects

- **LOD 1**
  - TransportationComplex provides surface geometry describing the actual shape of the object
  - TransportaionComplex (Surface geometry)
  - Terrain surface

- **LOD 2 - 4**
  - Surface geometry is divided thematically into TrafficAreas, like
    - Traffic – cars
    - Traffic – emergency lane
    - Traffic – restricted area
    - Auxiliary - grass

- **LOD 5 ... (IFC)**

- **Design & Build data**
  - (incl. structure, pavement, layers, ...)

**Notes**

- only surfaces on top of the road
- volumes & solids, under the road
IfcTransportationObject - IfcRoad

Legend:
- **Existing IFC4 Entities**
- **New Static part → EXPRESS** Proposed New civil engineering or road entity
- **Dynamic part : → to be defined within IFD/bSDD**

Possible connection with citygml:TransportationObject
Possible connection with citygml:AuxiliaryTrafficArea
Possible connection with citygml:TransportationObject
Possible connection with citygml:AuxiliaryTrafficArea
IfcRoadStructureElement

IfcTransportationObject can be composed of IfcBridgeElement, IfcRoadStructureElement…

Pavement, sidewalk, sub-structures, layers….
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