4 CONFERENZA NAZIONALE

31 MARZO
1 APRILE
2021
ROMA

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BIM e l'evoluzione digitale nell'industria delle costruzioni

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IFC Bridge Italia

Rachele A. Bernardello

Università degli Studi di Padova

Laureata in Ingegneria Edile - Architettura con una tesi sulla descrizione computazionale del degrado in manufatti infrastrutturali in muratura, partecipa poi a due assegni di ricerca.

Dottoranda presso l'Università degli Studi di Padova con una tesi sulle procedure di gestione e recupero di ponti esistenti attraverso processi BIM e openBIM. Svolge inoltre attività di formazione aziendale sui processi BIM basati su standard IFC.

Ha partecipato attivamente al gruppo di lavoro IFC Bridge Italia come responsabile del caso studio del ponte in muratura.

LIM.lab/ Università degli Studi di Padova

HISTORY OF IFC BRIDGE

How to request and produce interoperable bridge models

IFC Bridge Italy

Creation year	2017	2018	2019	2020	2020
Version	IFC 4	IFC 4.1	IFC 4.2	IFC 4.3	IFC 4.3
Status	*ISO*	*Approved*	*Withdrawn*	*Candidate*	*Candidate*

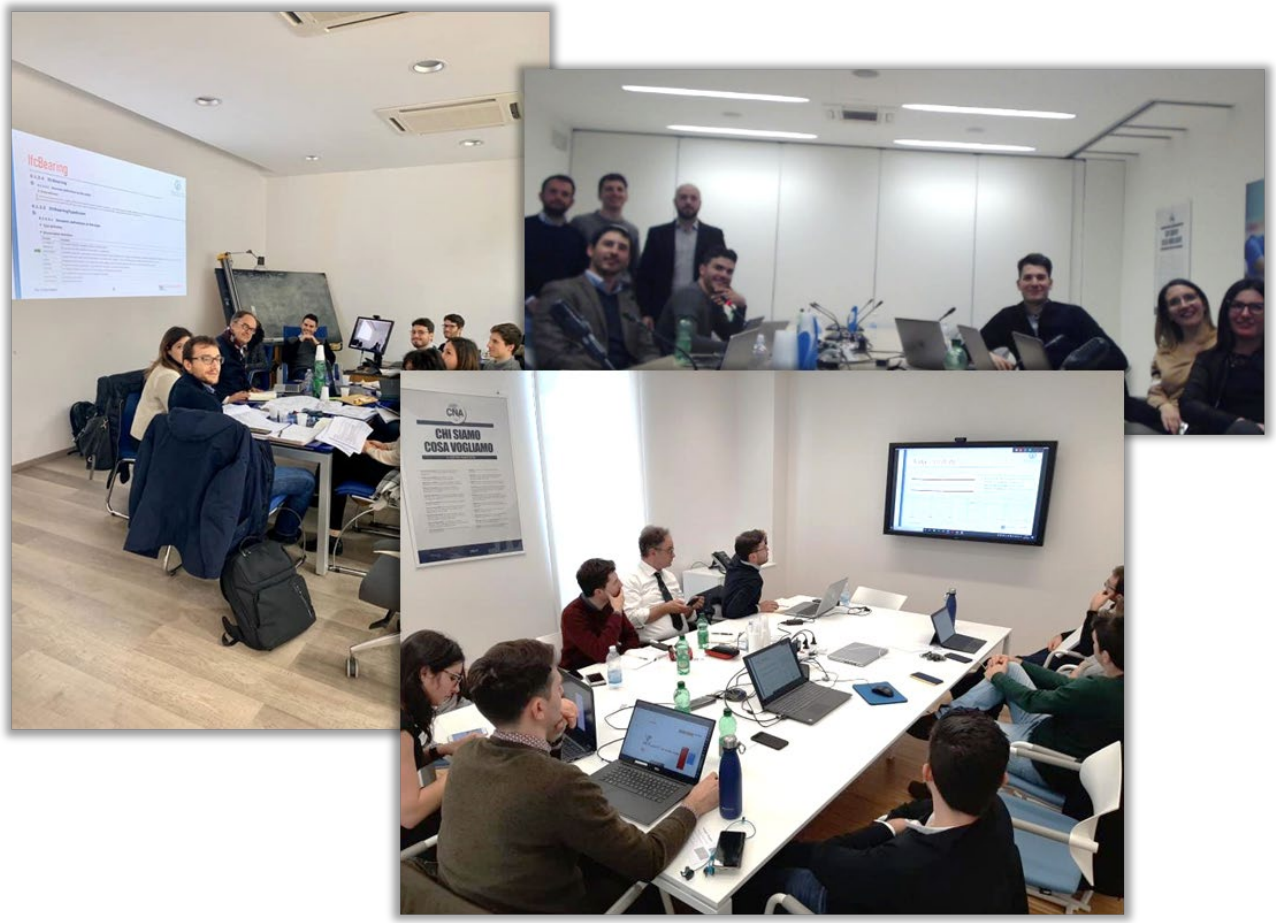
IFC Infra deployment …

IFCRail International

IFCBridge International

IFC for roads, railways, ports and waterways

IFC for bridge



Member type	Contribution
Stakeholders	Casi studio
Universities	conoscenza di IFC
Bridge designers	modellazione
SW vendors	sperimentazione
Consultants	metodologia

obiettivi

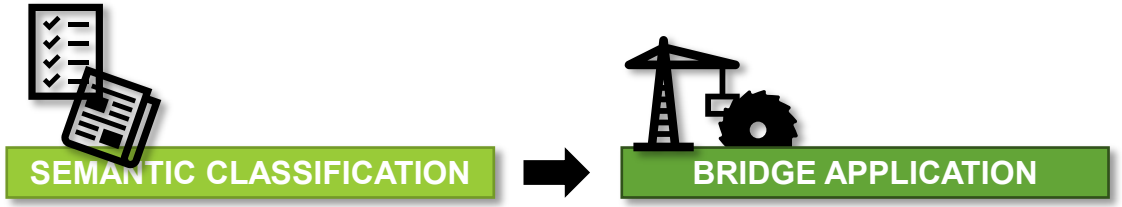
- Analizzare e comprendere ciò che è stato introdotto con IFC Bridge International
- Testare le applicazioni dello standard a dei ricorrenti casi italiani
  - Tipi di ponti
  - BIM uses
- Identificare prolemi, soluzioni, possibule miglioramenti dello standard
- Riportare I risultati
  - In un contesto internazionale : webinar + spazio in IFC
  - In un contesto nazionale: pubblicazione report + conferenze
- Studio di strategie per soddisfare i requisiti informativi anche con gli attuali software e IFC 4

Opportunità

- Consapevole utilizzo dello standard
- Reale e controllata applicazione nel processo infrastrutturale
- Personalizzazione dei P-set

focus su usi pratici

- Impiego pratico di IFC
- Richieste degli stakeholder



IFC Knowledge

- HTML
- IfcBridge Project Documentation

Case studies

- Masonry bridge
- Girder bridge

Software

- Midas CIM
- Autodesk Revit
- Trimble Tekla

metodologia

1. Studio e comprensione dello standard e delle nuove entità proposte in IFC 4.3
2. Identificazione di due casi studio (due ponti) e relativi utilizzi del modello – *model use* – da testare

fase preliminare

3. Riconoscimento degli elementi IFC nei due casi studio
4. Redazione di un piano di modellazione per soddisfare i *model use*
5. Modellazione dei due ponti con più software

classificazione

6. Mappatura verso lo standard IFC e pubblicazione modelli
7. Produzione di un report che formalizza e misura i problemi riscontrati e le soluzioni proposte
8. Documentazione pubblica che formalizza l'intero processo

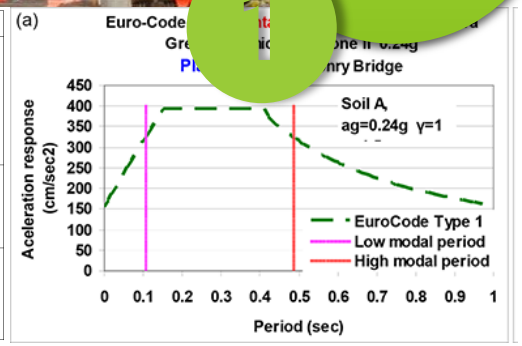
report

Identificazione di due casi studio e *model use*

ITALIAN SCENARIO

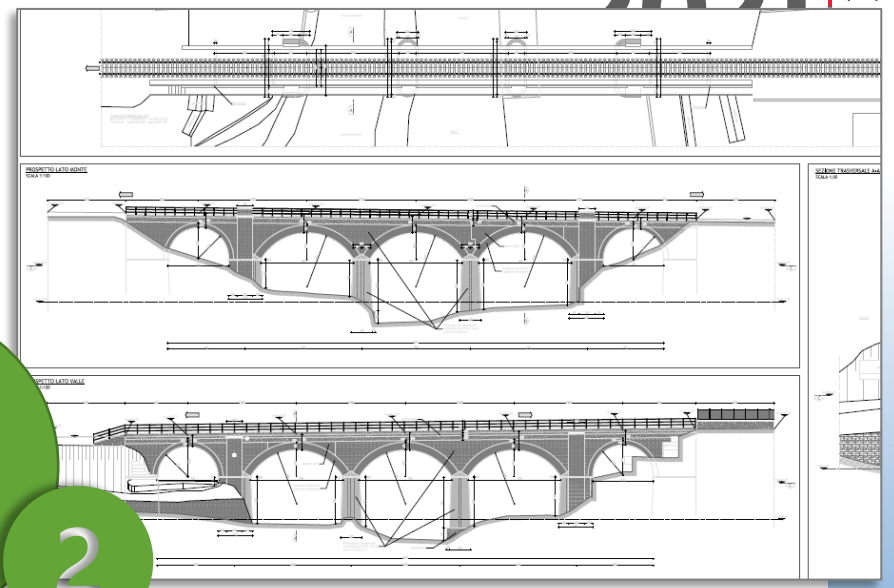
1

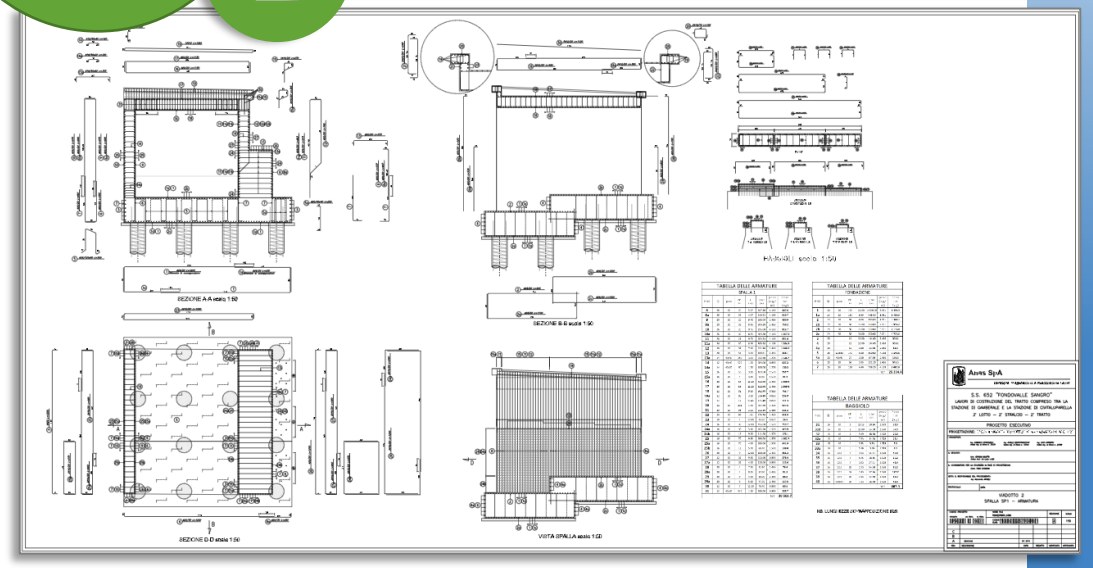
No	Use case	Description	Purpose	IFC exchange scenario	Required geometry representation	Required semantic information	Priority	Complexity	MVD
12	Design-to-Design (full model logic)	Exchange of fully parametric description of bridge between two distinct design applications	within the same design phase, design models are exchanged between different design applications, model remains fully modifiable, all model logic is transferred	Design application to design application	Advanced BRep (NURBS), Fully parametric model information containing model logic, constraints and dependencies	All information entered in the design application	medium	high	Bridge Design Transfer View
13	Design-to-Construction	Handover from Design Phase to Construction Phase	Bridge Model is handed over from designer to Contractor for bidding and for actual construction	Design application to Tendering application and/or Review application	Faceted BRep, Sweep Geometry where suitable (Deck, Rebar, Boring Piles etc), potentially based on alignment	Material information Product information etc.	high	medium	Alignment-based Bridge Reference View
14	Structural Analysis incl. Structural Dynamics, Fluid-Structure Interaction, etc.	Structural analysis of bridges, tunnels, retaining walls	Ensure stability of the structures	Design application to structural analysis application	Procedural Description (Sweep and CSG) and/or Analytical Model	Loads, Material properties	medium	medium - high	Bridge Structural View



COMMON BRIDGES

2



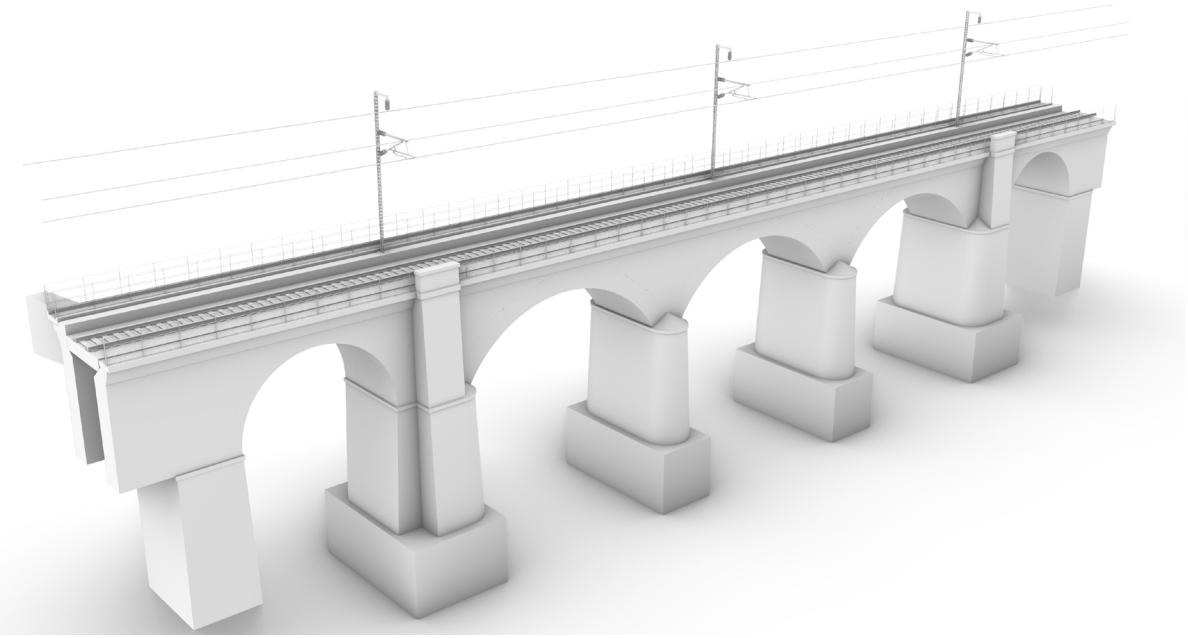


casi studio

caso A

ponte ad arco in muratura

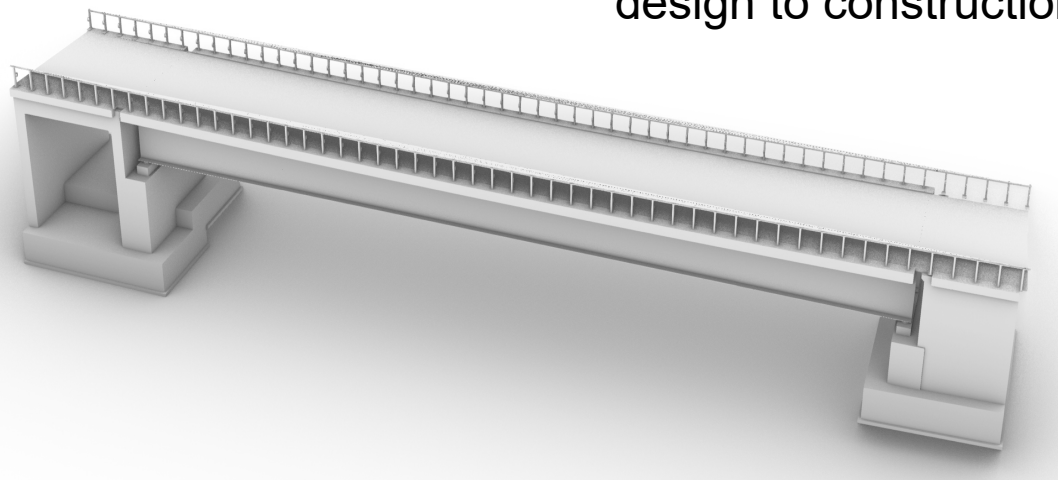
esistente - mappatura stato di fatto



caso B

ponte a travata misto

design to construction



Images credits R. Bernardello | A. Basso – Dicea, UNIPD

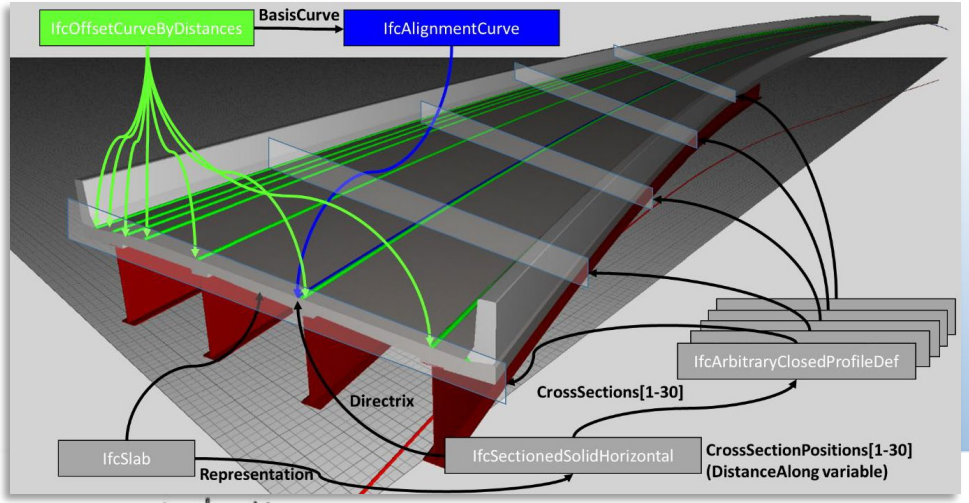
Strategy vs expected results

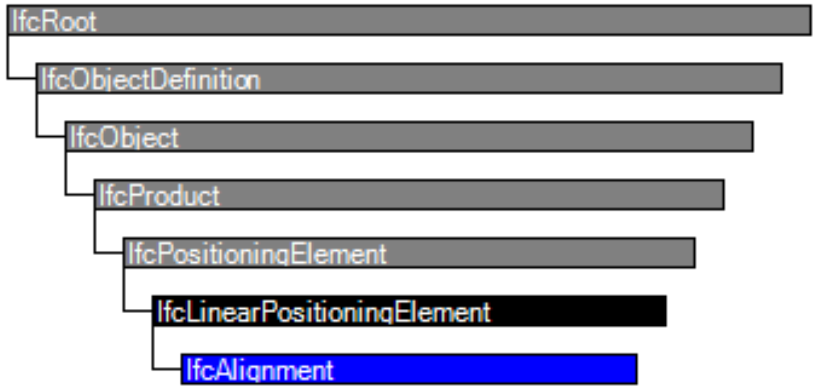
	CASE STUDY "A"	CASE STUDY "B"
Owner	RFI Italian railway network manager	ANAS Italian government-owned company deputed to the construction and maintenance of Italian motorways and state highways
Bridge type	Arched bridge	Girder bridge
Construction type	Masonry	Slab-girder bridge
Superstructure geometry	Straight	(slightly) In curve
Materials	Masonry	Steel-Concrete
Condition	Existing	To be built
Model use cases	Degradation analysis	Design to construction
Modelling strategy	**A model used to identify the condition of the asset**	**Comparative approach between three different BIM authoring tools**
Modelling time	20 days	20 days
Software tested	1	3
Expected results	**Classes representation of complex elements (i.e., vaults). Relations between BIM-objects and condition.**	**Comparison between the IFC files exported from the different tools. Detailed model ready for tendering.**

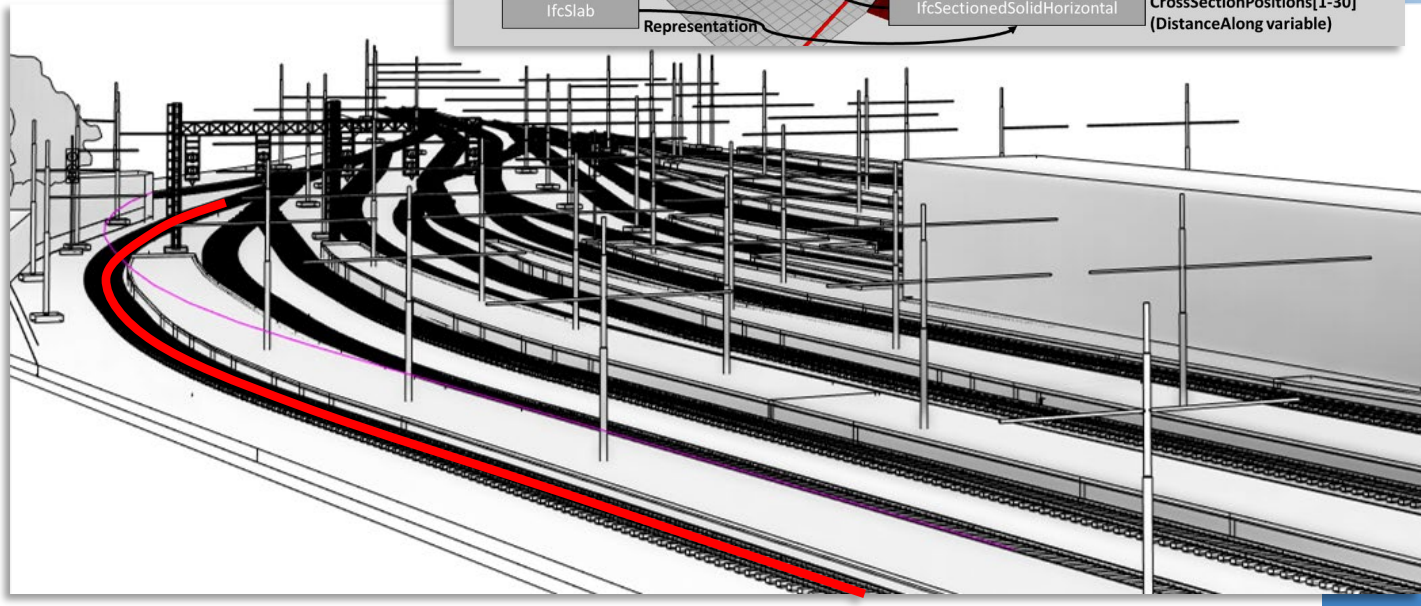
Alignment

According to the client, in the first phase the Alignment placement of the bridge components is avoid.

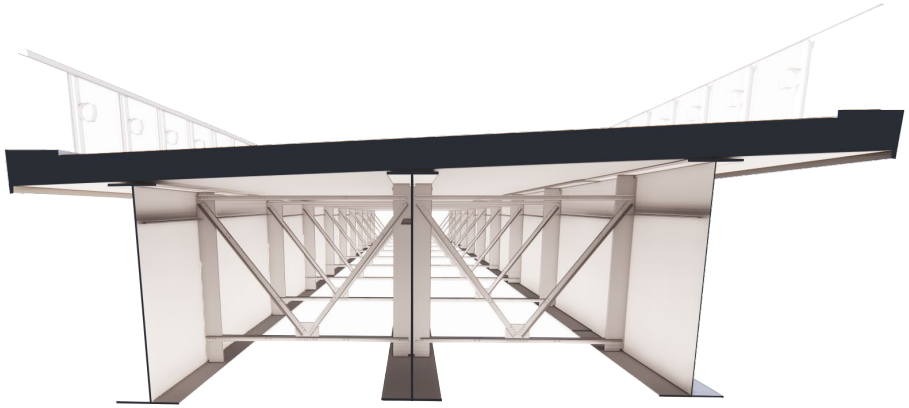
It was more important to focus on the occurrences classification and the Spatial structure organisation

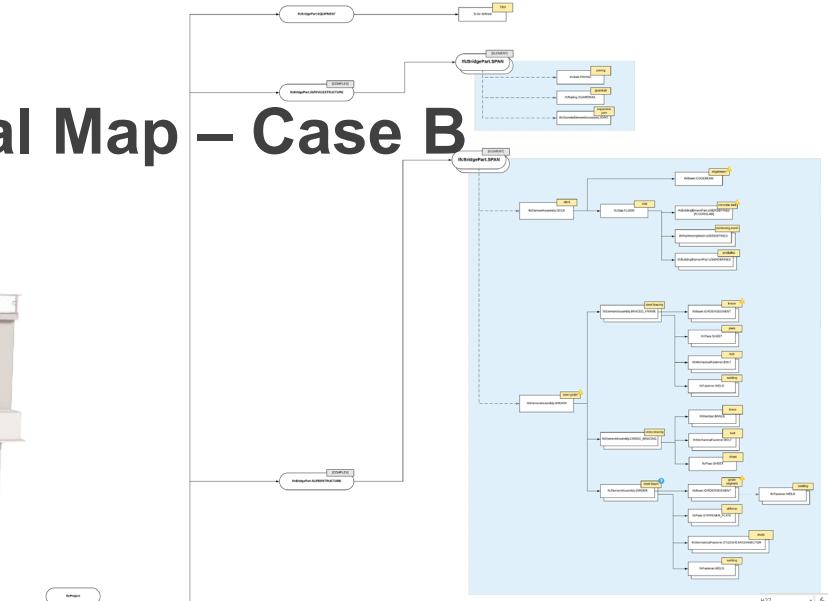


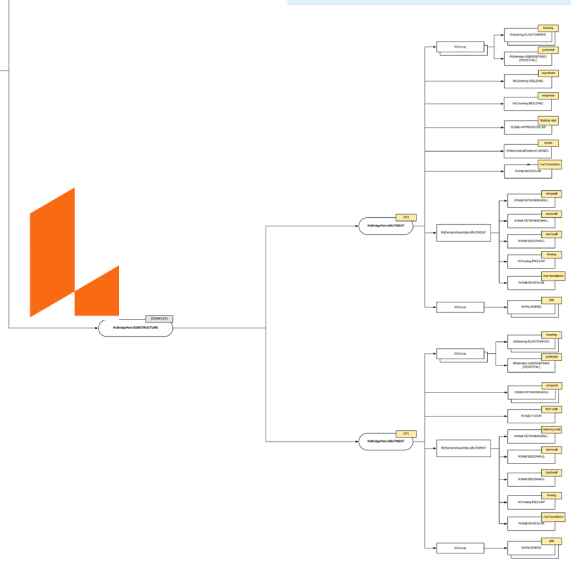


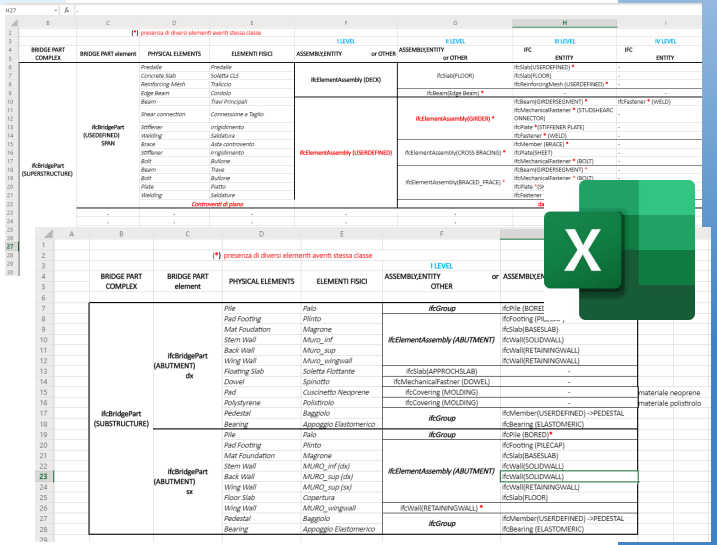


Tools: Bridge and Conceptual Map – Case B



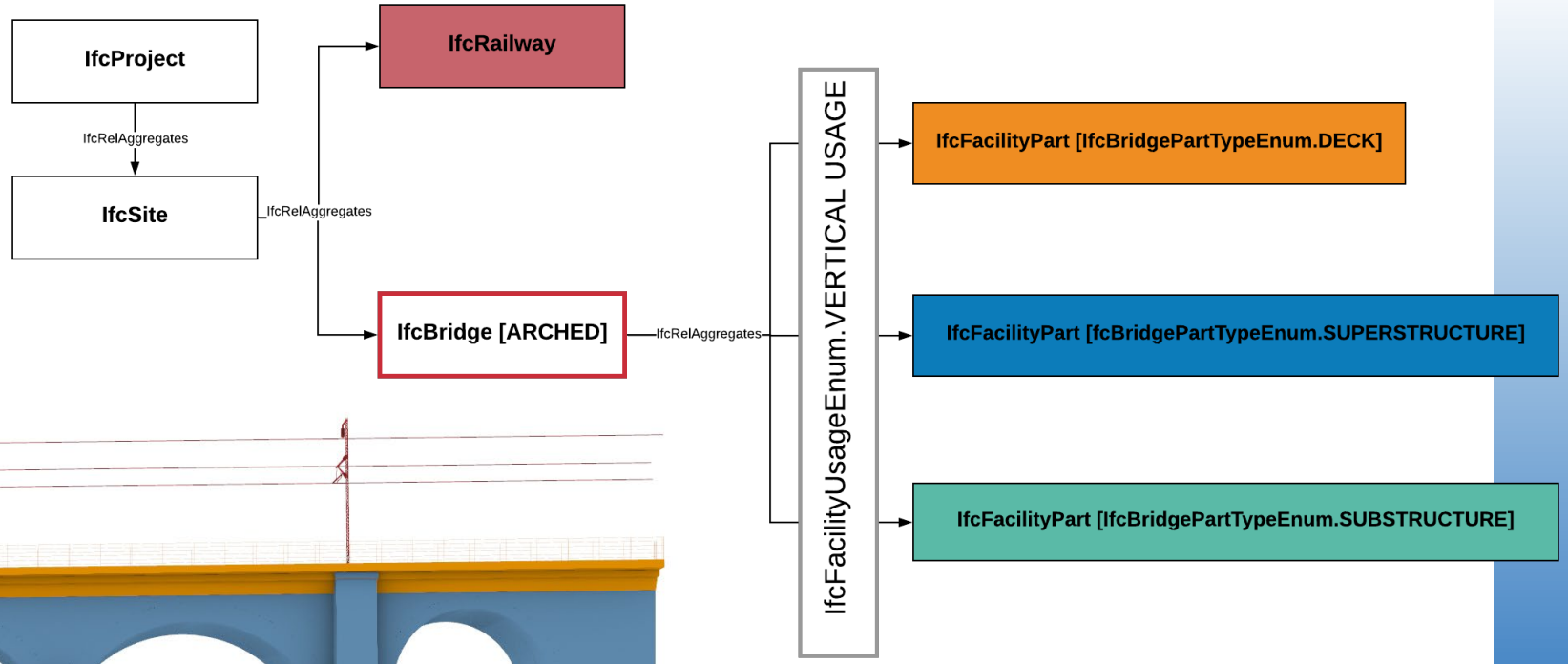


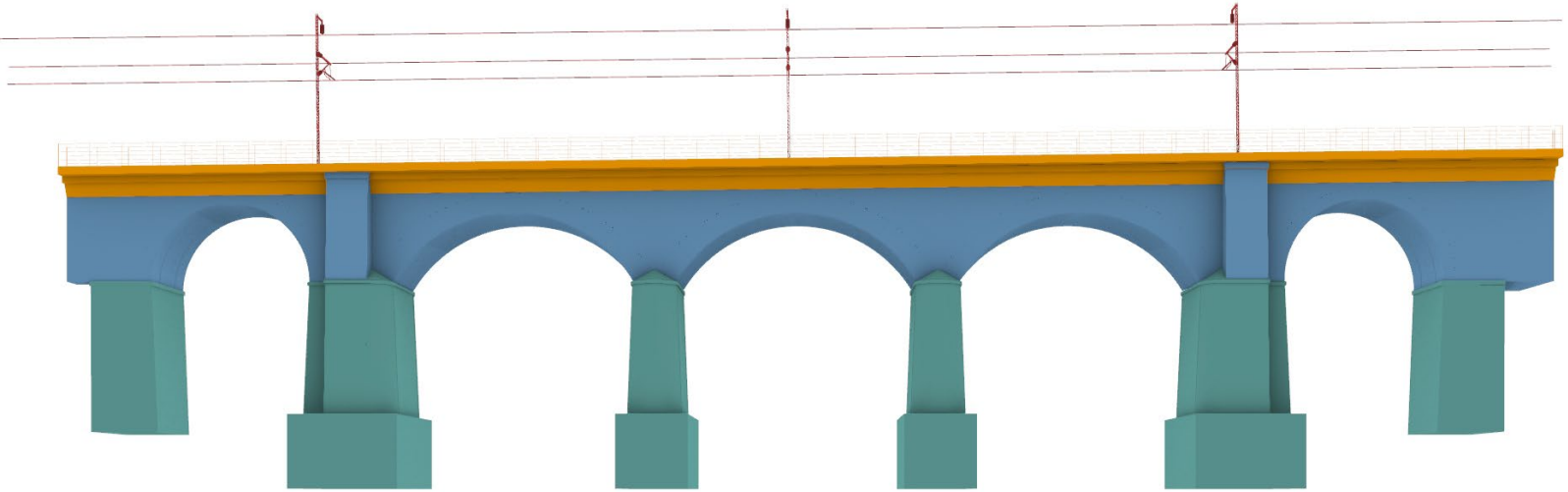




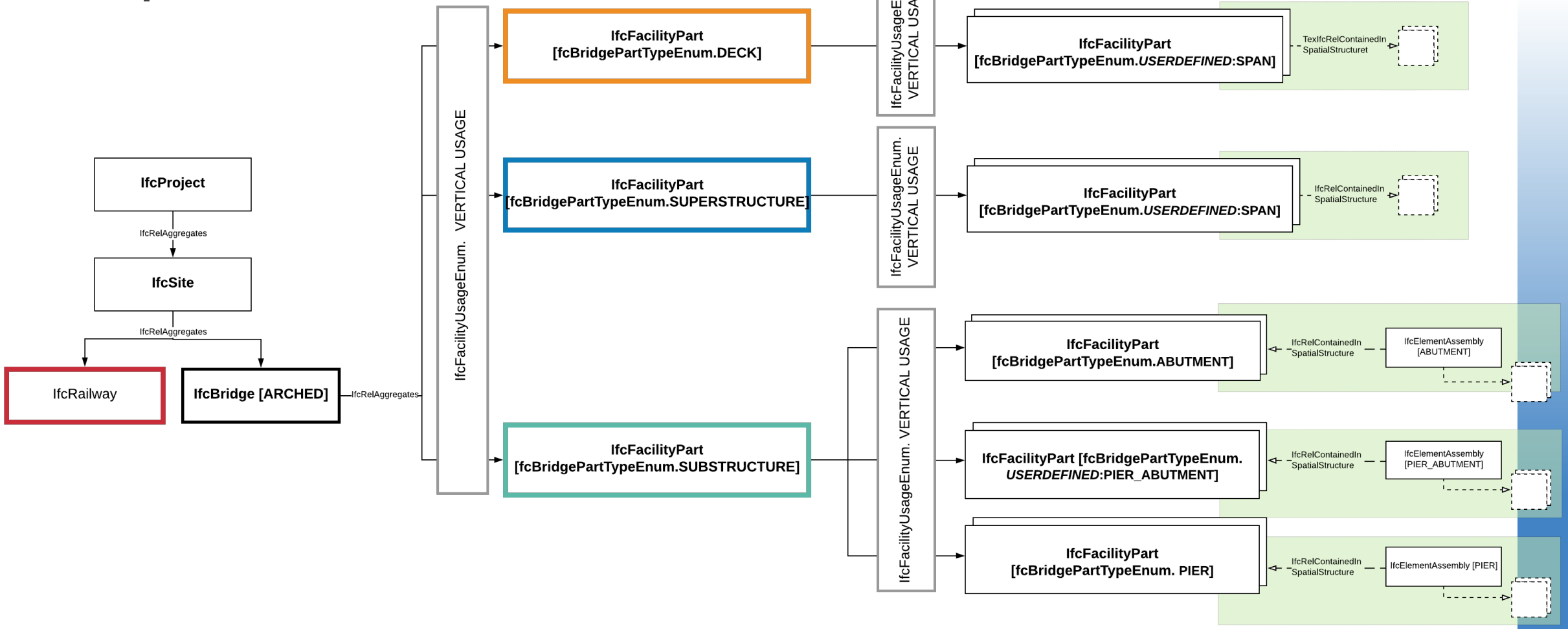
Images credits A. Basso – Dicea, UNIPD | A. Ciccone Dist, UNINA
Rachele A. Bernardello, LIM.lab – Dicea – Unipd

Spatial brakedown: IfcFacility

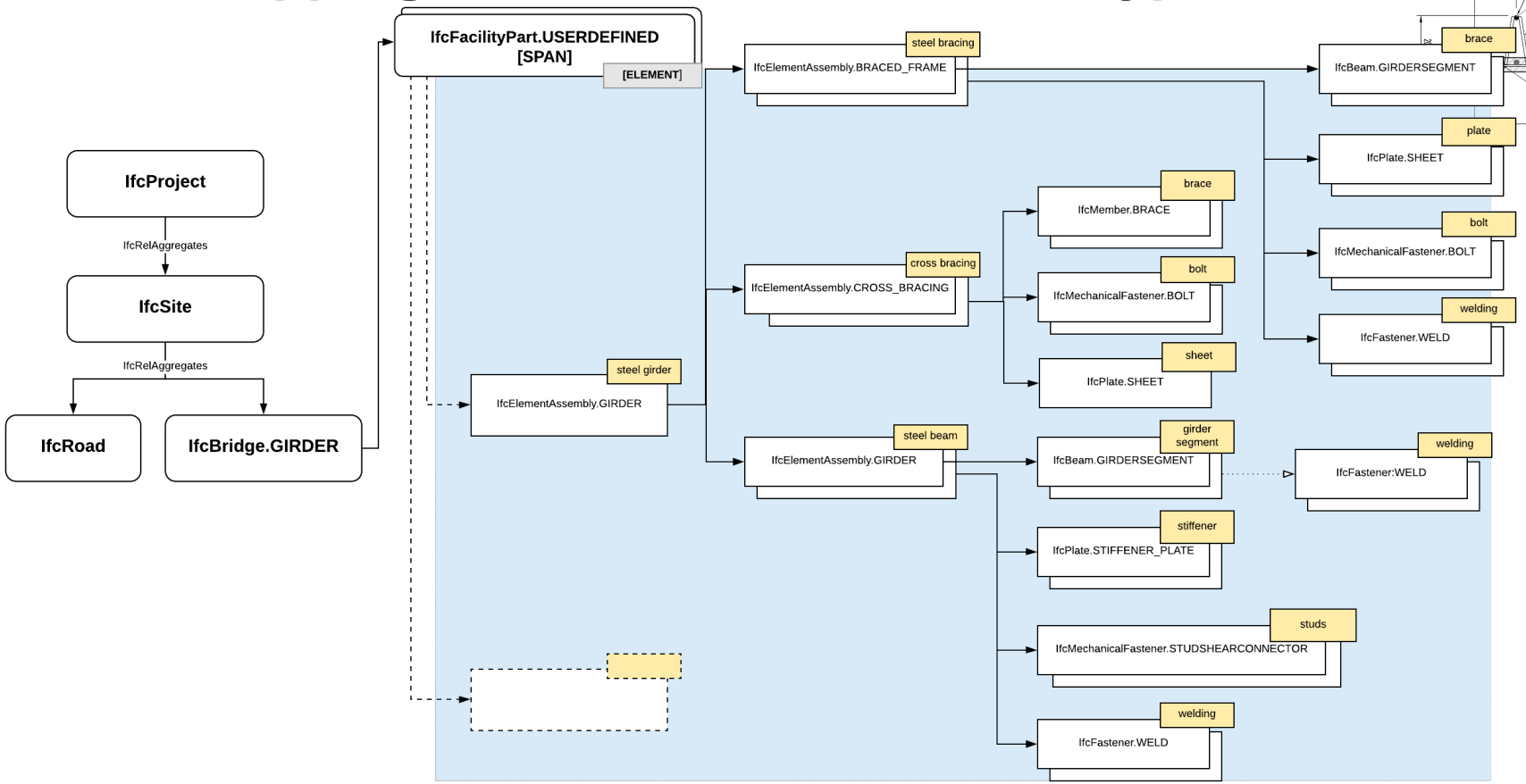


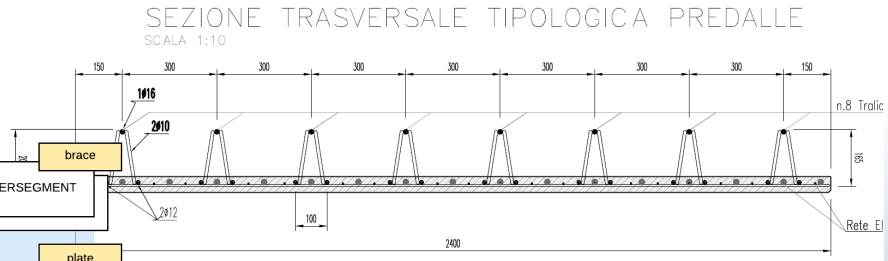


IfcSpatialStructureElement



Mapping Classes and PredefinedType





Semantic schema Girder

IFC Bridge Italia

Images credits R.A. Bernardello | A. Basso – Dicea, UNIPD
Rachele A. Bernardello, LIM.lab – Dicea – Unipd

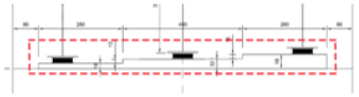
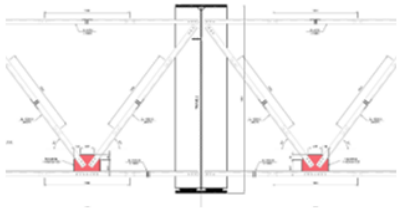
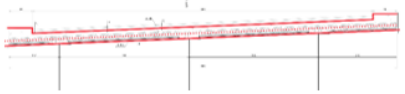
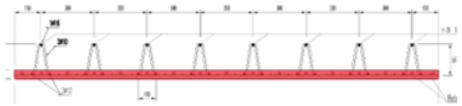
Issues

Some of the issues are in common between the two case studies, some others are linked to the bridge type.

The key issues are following proposed, and the others are deeply exposed in the attached document.

Due to the intrinsic differences between the marked problems, they are organised in three main parts

1. **IFC classification issues**
2. **Modelling issues**
3. **Others IFC related (like geometry export, etc.)**

Code		IMAGE	PROBLEM	SOLUTION
ANAS	B03		How to treat the assembly of the pedestal and the bearing? Should it be associated to the IfcElementAssembly of the Pier/Abutment or should be treated separately	Use the IfcGroup this way each element maintains its own position reference since the pedestal and the bearings can have different position
ANAS	B06		To define the connecting plate of a crossbracing the IfcDiscreteAccessory. ANCHORPLATE definition is too restricting since it is specified that is embedded into a concrete element. Modifying its definition makes it very similar to the definition of IfcPlate.SHEET	Using directly the IfcPlate.SHEET even if it might be too generic
[illegible]	B07		How to define a floor when is not strictly organized into separable layers (inhomogeneous stratigraphy)	Use either another IfcElementAssembly for the whole deck for the various elements or an IfcSlab.FLOOR referencing its components as IfcBuildingElementPart
[illegible]	B08		The categorization of the predalles component and in a broader scope, the categorization of a load bearing panel	Create a new IfcSlabTypeEnum called "predalle"

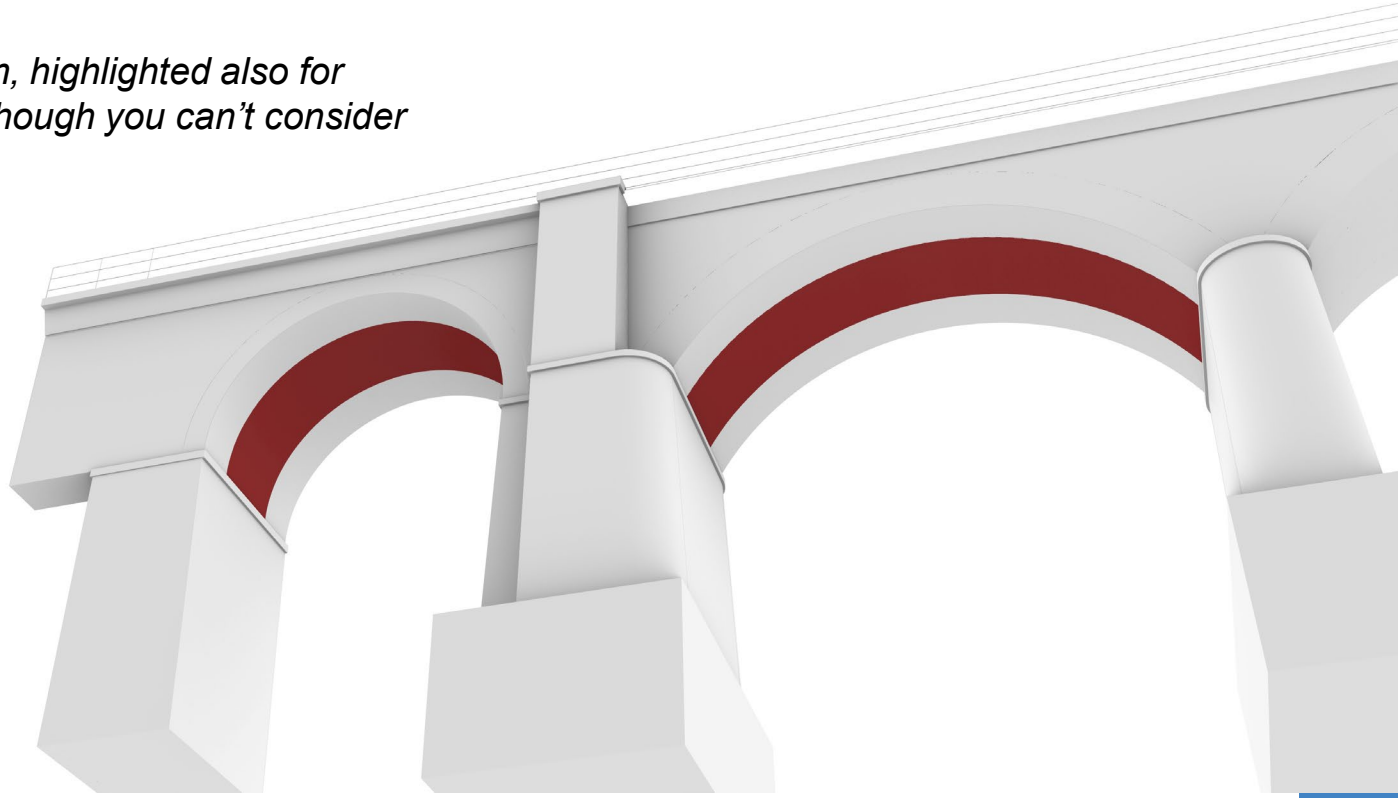
Vault

Problem

How to classify the vault of a masonry bridge.
The class for non-planar structure is missed. The problem, highlighted also for buildings, is when the vault is a partitioning not a roof, although you can't consider it as slab.

Solution

1. **IfcSlab_enum userdefined VAULT (/DOMED)**
2. IfcRoof.BARREL_ROOF (/RAINBOW_ROOF)
3. IfcElementAssembly enum VAULT (/DOMED)



Images credits R. Bernardello – Dicea, UNIPD
Rachele A. Bernardello, LIM.lab – Dicea – Unipd

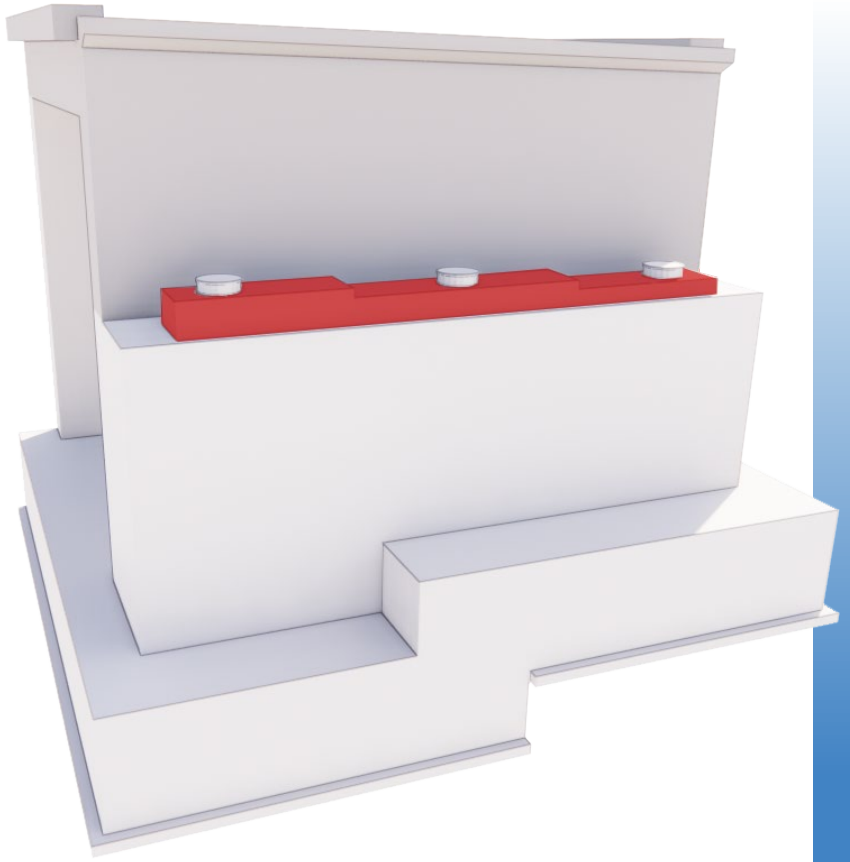
Pedestal

Problem

How to categorize the pedestal since its shape is not univocally defined (in some cases can resemble a column, in other a beam)

Solution

By elimination, we propose to categorize it as **IfcMember** with a new userdefined TypeEnum called "*pedestal*"



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pubblicazioni

Pubblicazione online e documenti scaricabili degli output prodotti

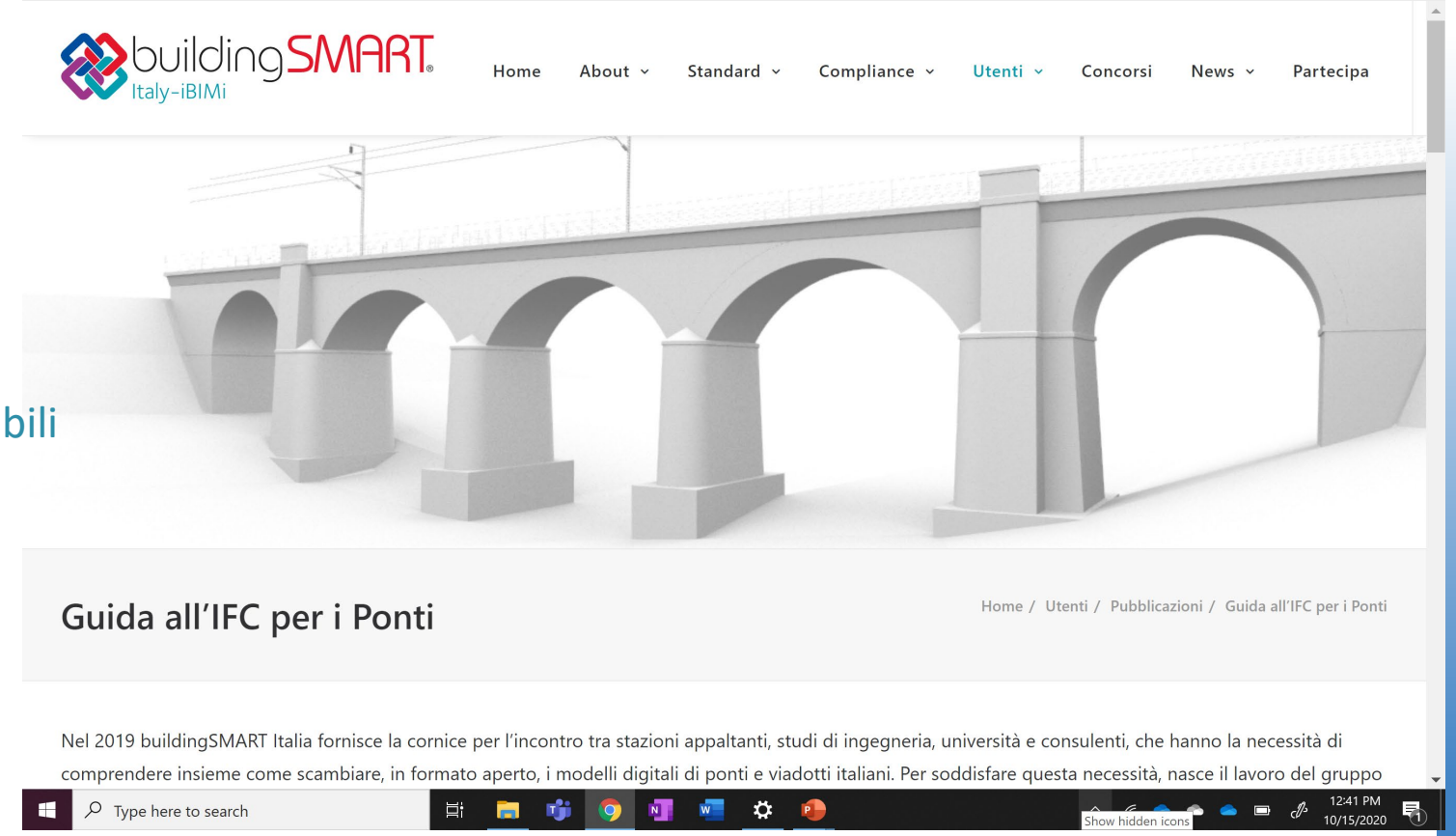
Linea guida di applicazione dell'IFC a ponti e viadotti

Modelli openBIM navigabili e interrogabili

Problematiche riscontrate e soluzioni

Casi studio nel dettaglio

Video di esportazione



www.buildingsmartitalia.org/utenti/pubblicazioni/guida-ifc-per-i-ponti/

Linea guida di applicazione.

Introduzione

Apparato metodologico

IFC

Casi d'uso

Struttura spaziale

Componenti

Problematiche

Conclusioni

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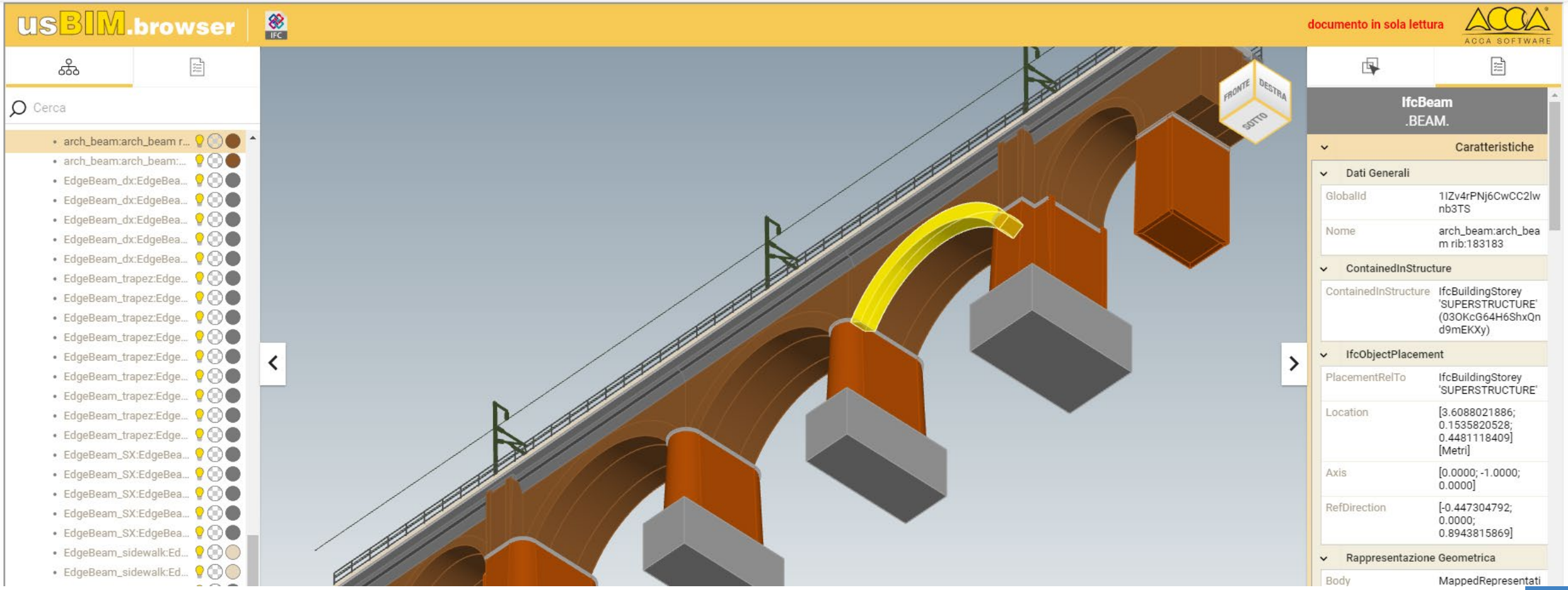

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usBIM.browser — documento in sola lettura — ACCA SOFTWARE

Cerca

- Beam-1036
- Beam-242
- Beam-1037
- Beam-1038
- Beam-1039
- Beam-1040
- Beam-243
- Beam-1041
- Beam-1042
- Beam-1043
- Beam-1044
- Beam-1045
- IfcColumn
  - Columns
  - Column-542
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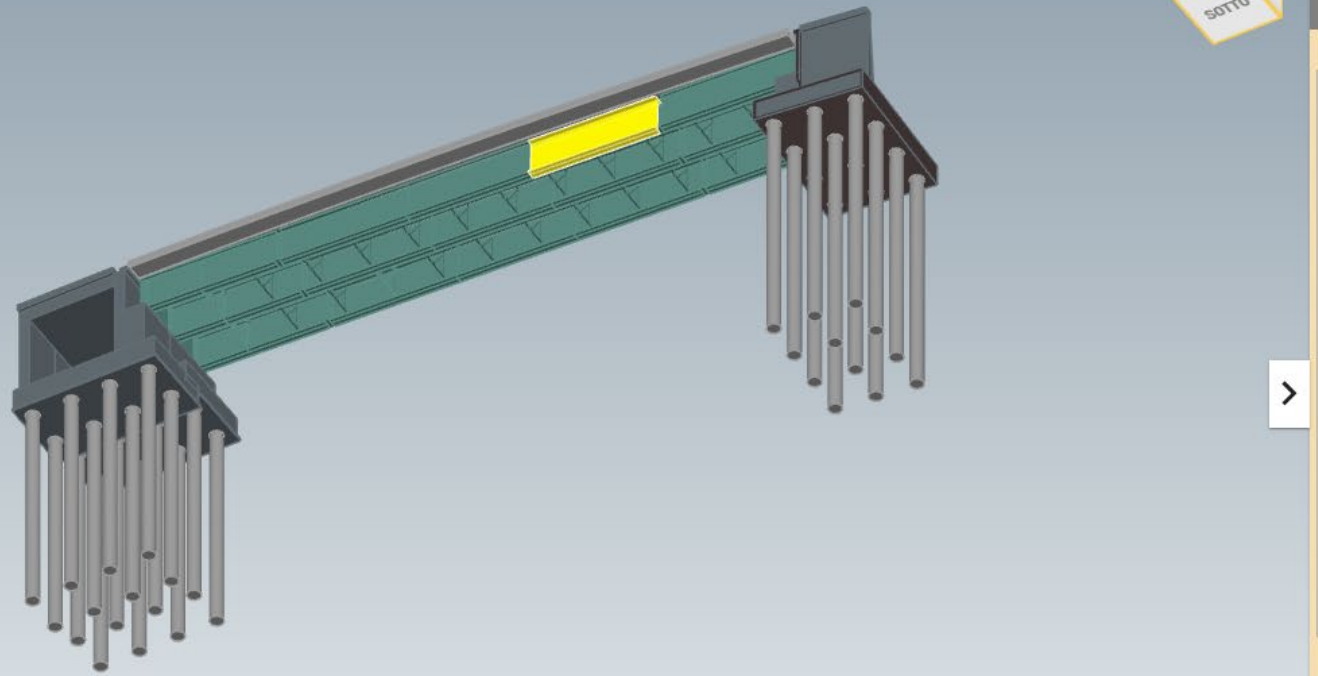


IfcBeam
.BEAM.

Caratteristiche

Dati Generali

GlobalId	0L$5rnEP5DFO9zZXaLCGS7
Nome	Beam-1036

Decomposes

RelatingObject	IfcBeam 'Beams' (0dicXDT7b5w8GHxESQNtU$)

IfcObjectPlacement

PlacementRelTo	<Absolute>
Location	[0.0000; 0.0000; 0.0000] [Metri]
Axis	[0.0000; 0.0000; 1.0000]
RefDirection	[1.0000; 0.0000; 0.0000]

Rappresentazione Geometrica

Body	SweptSolid

Materiale

IfcMaterial

Nome	SS400

3. Configuring software

Autodesk Revit

Midas CIM

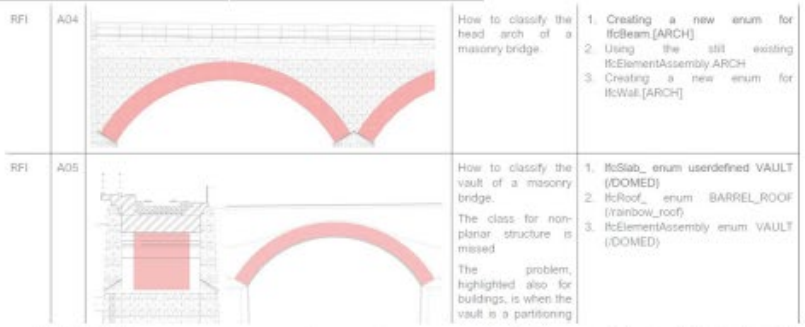
Trimble Tekla Structures

Feedback

Bridge

buildingSMART International

Domain Expert	Data available
Chapter work Italy	PDF documents, schema feedback
MINnd work Bridge	PDF documents, bridge requirements



How to classify the head arch of a masonry bridge.

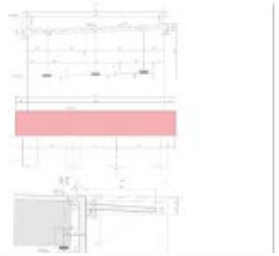
1. Creating a new enum for IfcBeam.[ARCH]
2. Using the still existing IfcElementAssembly.ARCH
3. Creating a new enum for IfcWall.[ARCH]

How to classify the vault of a masonry bridge.

The class for non-planar structure is missed

The problem, highlighted also for buildings, is when the vault is a partitionning

1. IfcSlab_ enum userdefined VAULT (/DOMED)
2. IfcRoof_ enum BARREL_ROOF (/rainbow_roof)
3. IfcElementAssembly enum VAULT (/DOMED)



1. The footing component is defined as IfcFooting.pilecap but its definition is not well suited to describe it.
2. Also the definition IfcSlab.baseslab can be suited to this purpose but work on the definition needs to be done too.

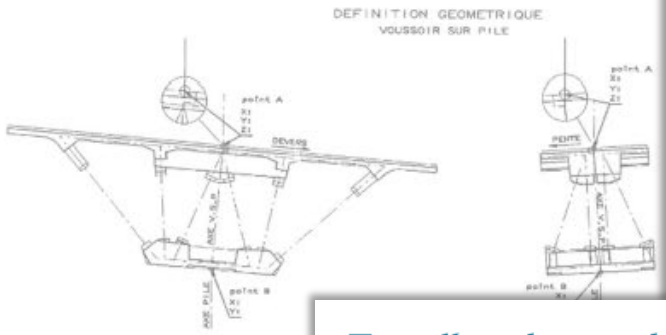
1. Update the definition as "An element that transfers the load from a column or a group of columns or a wall to pile or group of piles"
2. Update the definition as "The slab is used to represent a floor slab against the ground (and thereby being a part of the foundation)"

Introduction

This document describe elementary informations which must be included in a bridge model. It is based on a real project. Next chapters refer to usual plan types.

Each information refers to a specific model object.

Setting out



Category

Objecttype

Group

Property

Property

Property

Property

Property

Feedback on the recent works of Building Smart Italy

CAGNON Valentin — Cerema DtecITM

First of all thank you for the work carried out on the complex subject of the bim work of art.

As the work is very complete, this document will not deal with all the points mentioned but only those of which we can have a critical mind.

classification to IFC 4.3 RC2

Classificazione

- Nome
- Tipo
- …

IFC 4.3 RC.2

- Class
- PredefinedType
- Attribute
- Relation
- …

Future steps

1. Definire una classificazione implementabile poi tramite specifici plug-in per l'export in 4.3
2. Verificare i data model per supportare altri tipi di ponte
3. Armonizzare i property set per i ponti con gli standard nazionali
4. Armonizzare lo sforzo fatto con IFC for Roads e Railways

Grazie per l'attenzione

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https://www.linkedin.com/in/rachele-bernardello/

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