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SeeBridge
Semantic Enrichment Engine for Bridges

SeeBridge
Demonstration Workshops

Host	Location	Date
GDOT	Atlanta	25th September 2017
Netivei Israel	Tel Aviv	18th September 2017
University of Cambridge	Cambridge	18th September 2017
BAST	Munich	25th September 2017

Program

Time	Content	Responsible Presenter
9:00	Welcome and introduction	Rafael Sacks
9:10	Motivation	Amir Kedar
9:25	Background	Ling Ma
9:50	Vision - Why use BIM for Bridge Management Systems?	Andre Borrmann and Amir Kedar
10:15	Walk-through of the SeeBridge process	Alistair Wells, Habib Fathi, Patricio Vela, Ruodan Lu, Uri Kattel and Philipp Huethwohl
11:30	Hands on demo	Raz Yosef and Philipp Huethwohl
12:15	Where are we today ?	Rafael Sacks
12:35	Q & A	
13:00	Close & Lunch?	

Walk-through of the SeeBridge process
3 Semantic enrichment of bridge models

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- Goals
- Define input and output
- Technology, processing, requirements
- Results achieved
- Limitations

Why do we need semantic enrichment for bridge models?

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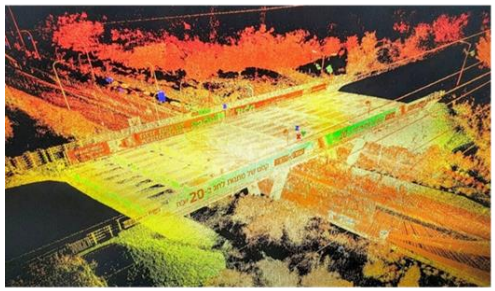
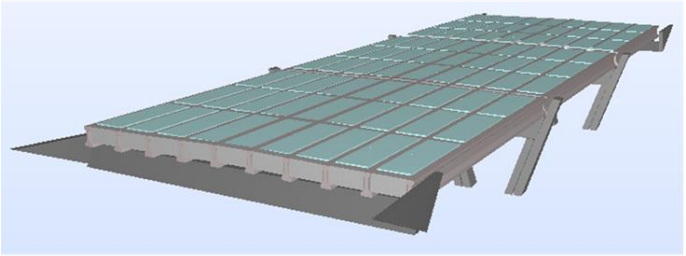
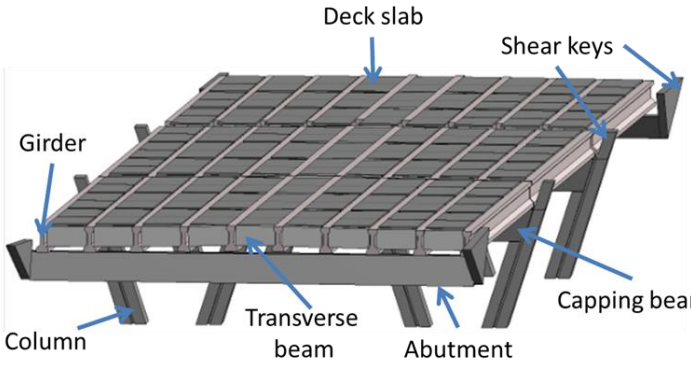


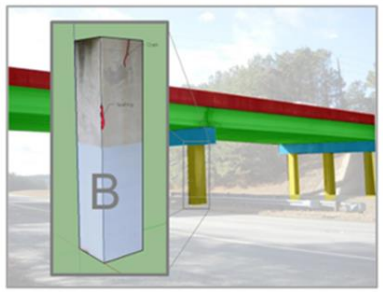
3D reconstruction



Semantic enrichment



Defect identification & modeling



Why do we need semantic enrichment for bridge models?

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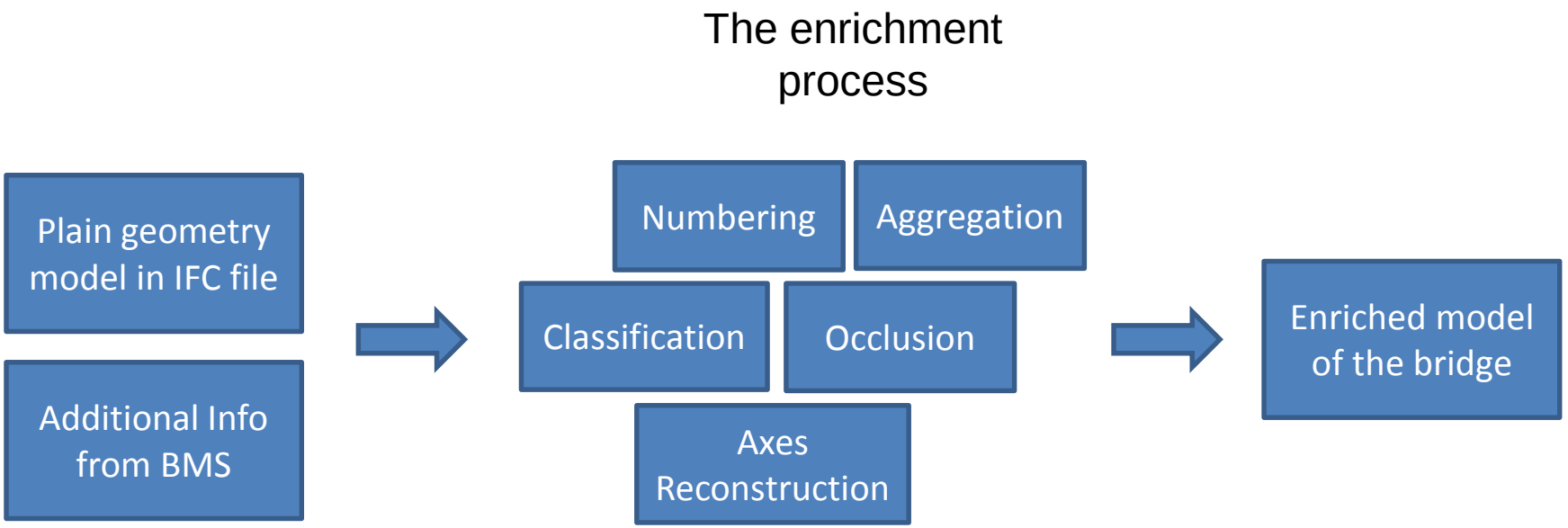
Semantic enrichment of building models refers to the automatic or semi-automatic addition of meaningful information to a digital model of a building or other structure by software that can deduce new information by processing rules or by applying machine-learning (Bloch et al. 2017)

Belsky, M., Sacks, R., and Brilakis, I. (2016). "Semantic Enrichment for Building Information Modeling." *Computer-Aided Civil and Infrastructure Engineering*, 31(4), 261-274.

Semantic Enrichment



Input - plain geometry

- Proper modeling or reconstruction
  - Extrusion / B-REP geometry
  - Overlapping of objects
  - Partition to separate objects
  - Slab surface curvature modeling
- Compliance with the IFC structure

Before enrichment

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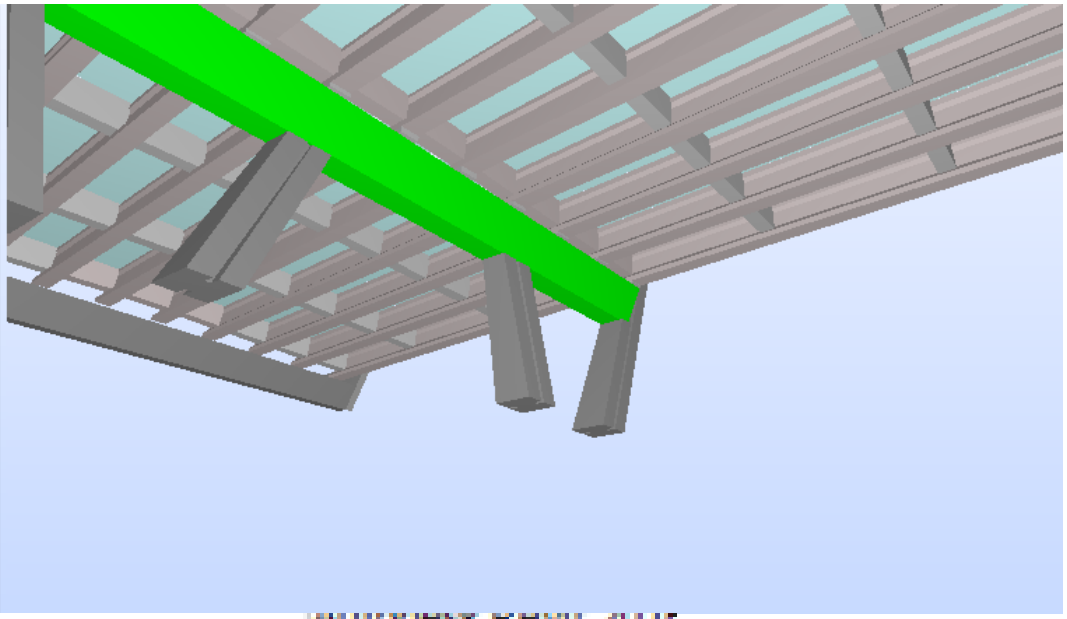
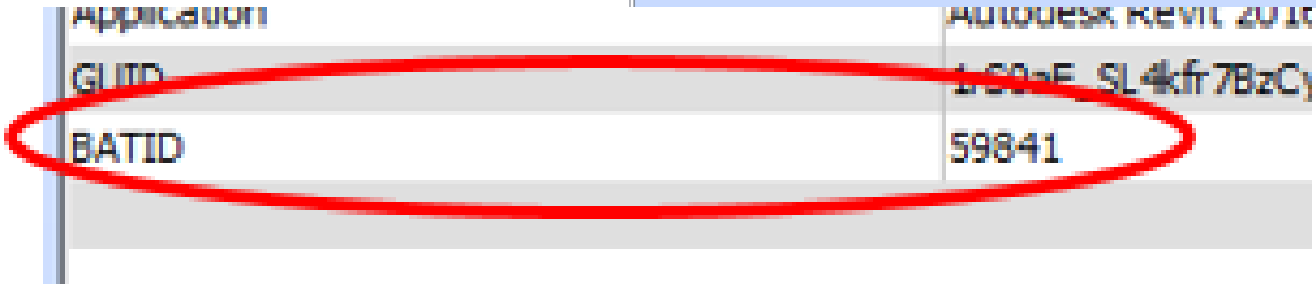
Info

Object.b.10

Identification | Location | Quantities | Relations | Classification | Hyperlinks

Property	Value
Model	HaifaBridgeFixed
Discipline	Architectural
Name	Mass 4:Mass 4:59841
Phase	
Type	Mass 4
Description	
Material	
Layer	A-MASS-____-OTLN
System	
Geometry	Boundary Representation
Application	Autodesk Revit 2016 (ENU)
GUID	1$0aE_SL4kfr7BzCyii7b
BATID	59841





BMS input

- Excel input
- “Bridge” object

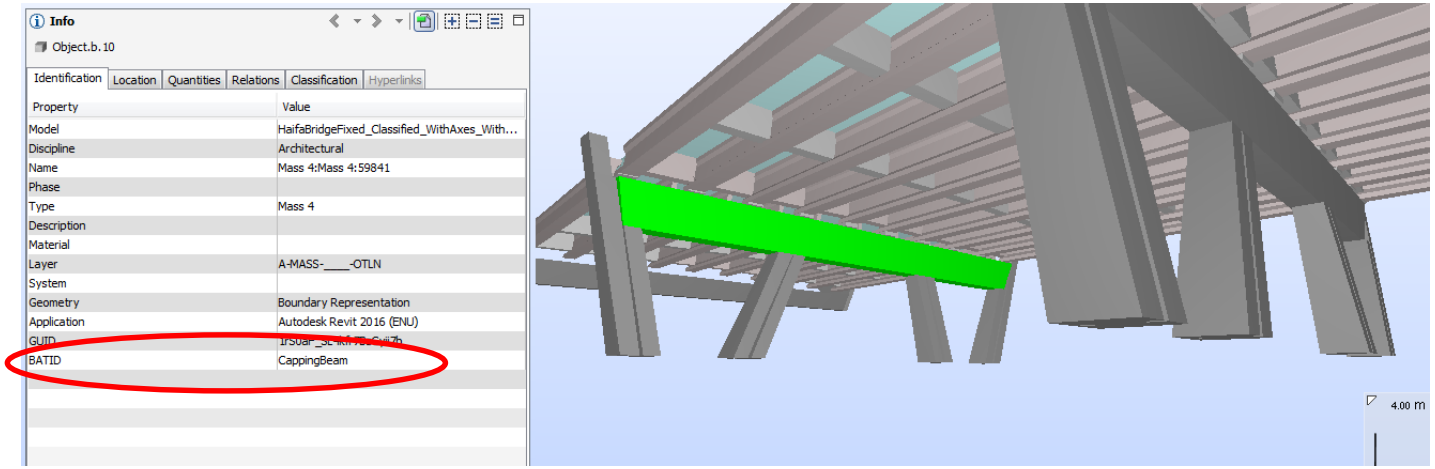
Appendix B – SeeBridge bridge Identification data list

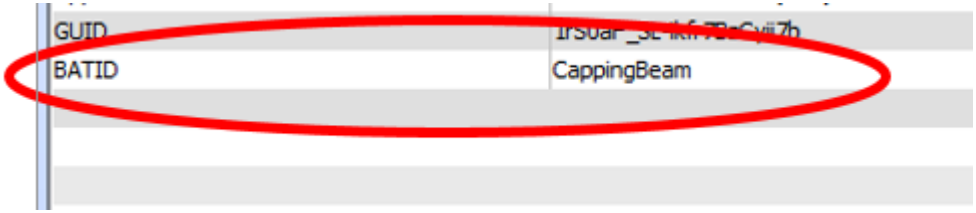
Note: This table contains Bridge data items only and should be read together with the "Guide for Documenting Bridges

item No.	Description	Item Type	Unit	Potentially identifiable		Value
1 General Identification Data						
1.1	Structure number	Predefined format		-	S-BRG-00200200	
1.2	Structure Name	Predefined format		-	גשר רכב-0079-000+0605-02/00	
1.3	Structure Identification Mark	Predefined format		Yes (if exist)	S-BRG-00200200-0079	
1.4	General Description	Text		-	גשר רכב עפק מעל כביש 79 גשר בקרית ביאליק	Afek road bridge above route 79 in Kiryat Bialik
1.5	Region	select from pre-defined list		-	מרחב צפון	Northen region
1.5.1	Reserve			-		
1.6	Road Number	RRRR road no.		-	79	
1.6.1	Belong to street name	Text		-		
1.6.2	Near building No.	NNNNNN		-		
1.7	Linear reference point	KKK.MMMM		-		
1.7.1	Nearby Junction (for city area only)	Text		-		
1.7.2	Distance from nearest Junction [m]	XXXXX	[m]	-		
1.10	Northern Ordinate N	NNNNNN	[m]	-	750008	
1.11	Eastern Ordinate E	EEEEEE	[m]	-	209443	
2 General Classification Data						
2.1	Primary Classification Group	select from pre-defined list		-	BRG	
2.2	Secondary Classification Group	select from pre-defined list		-	VBG	
2.3	Road Classification	select from pre-defined list		-	דרך ראשית דו מסלולית	main road 2 lanes
2.4	Emergency Classification	select from pre-defined list		-	לא	
2.5	Built by	select from pre-defined list		-	מע"צ - יחידת הסמך ההיסטורית	"MAATZ"
2.6	Ownership	select from pre-defined list		-	נתיבי ישראל	Netivei Israel
2.7	Maintenance Responsibility	select from pre-defined list		-	נתיבי ישראל	Netivei Israel
2.8	Toll Road Indication*	Yes/No		-	לא	no
2.9	Abnormal Loads Route*	Yes/No		-	לא	no
2.10	Historical Significance*	select from pre-defined list		-	לא	no
2.11	Temporary Structure*	select from pre-defined list		-	לא	no

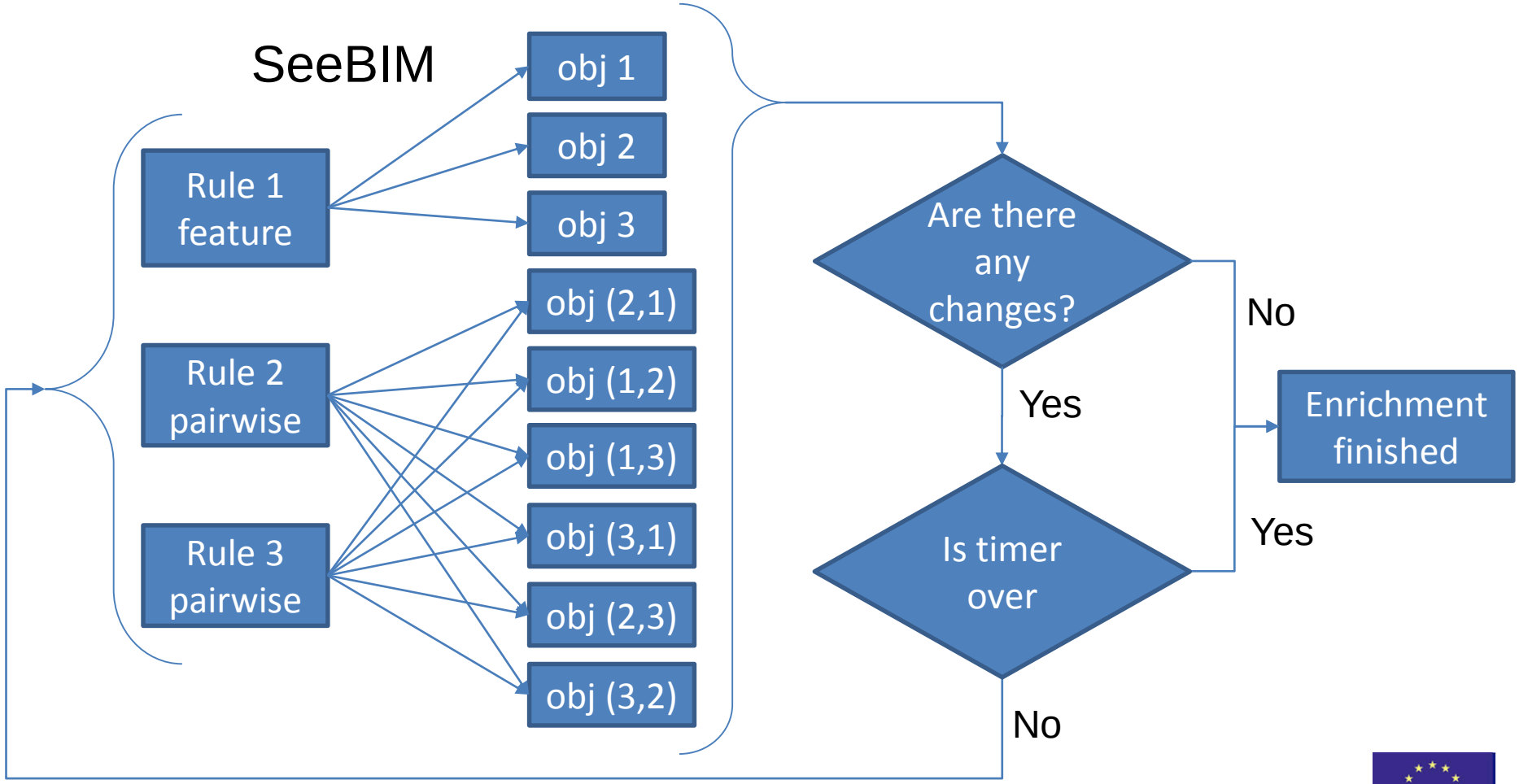
Enriched model

- Compliance with the IFC structure





How can we perform semantic enrichment?



SeeBIM 2.0

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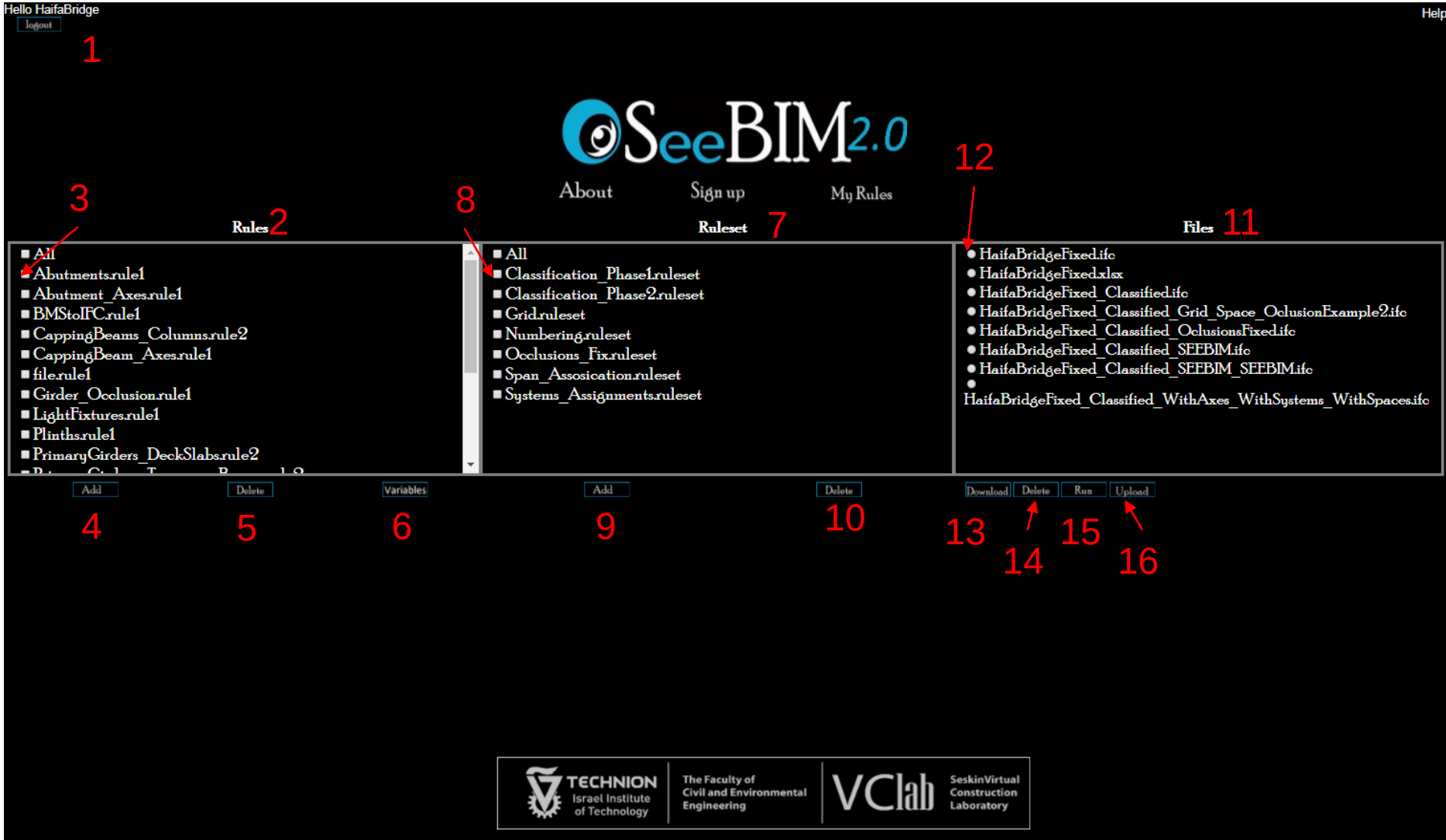

TECHNION Israel Institute of Technology | The Faculty of Civil and Environmental Engineering | VCLab SeskinVirtual Construction Laboratory

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Classification: Identifying objects

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- Rule sets
  - Pairwise rules
  - Feature rules
  - Rules based on previously acquired knowledge
- Redundancy of pairwise rules
- Loops
- False positive classification

Classification: Identifying objects

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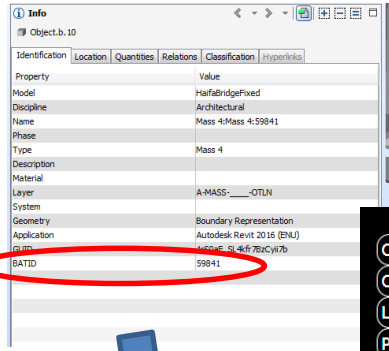

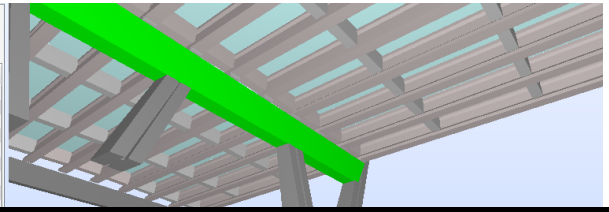

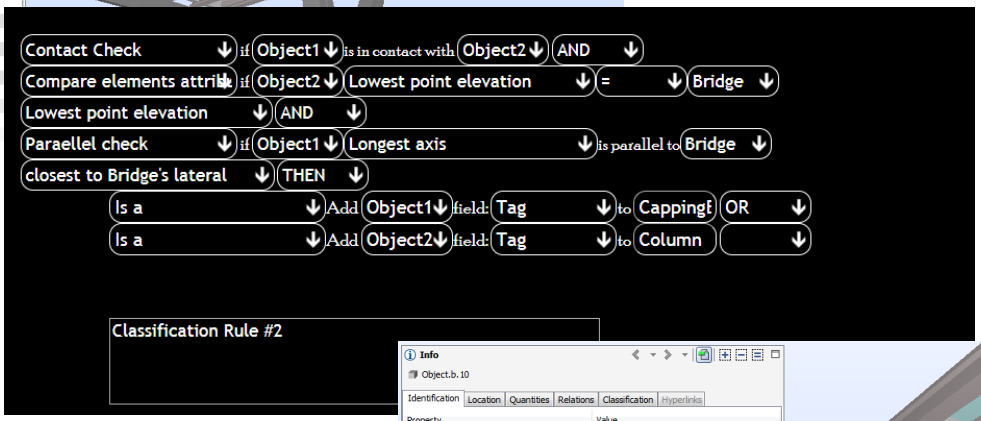

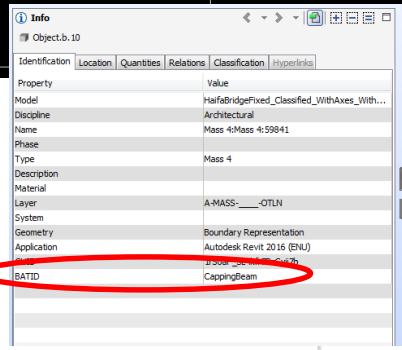

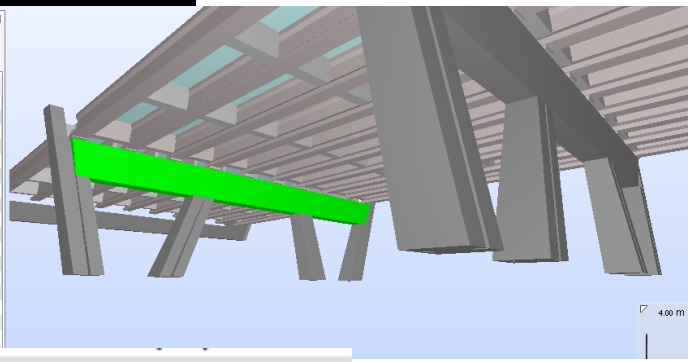

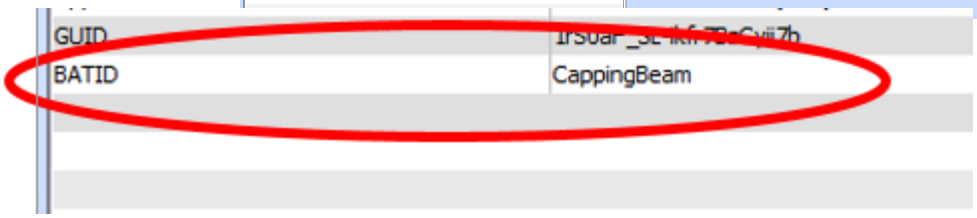

Aggregation: grouping objects

- Types of groups
  - Functional systems
    - e.g. structure, lighting , safety, drainage etc.
  - Mutually exclusive subsystems
    - e.g. superstructure and substructure.
  - Concept groups
    - e.g. span between axes A and B

Aggregation: grouping objects

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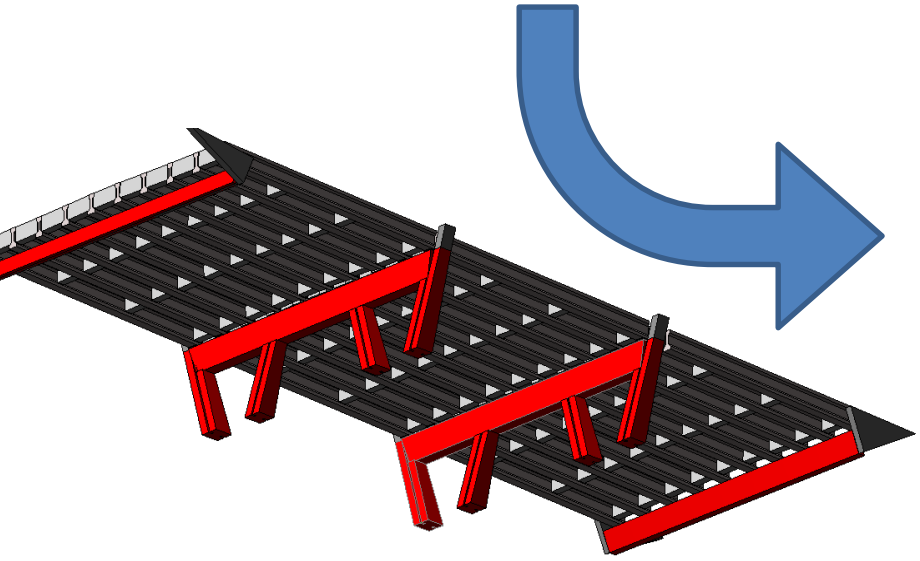
System CappingBeam.rule1

Field Check if Object1 Tag equals CappingB
THEN
Assign To System Object1 to Superstr

Comments



Model Tree

- HaifaBridgeFixed_Classified_SEEBIM
  - System
    - System.20 : Superstructure
      - Object.b.9
      - Object.b.10
    - System.22 : Substructure
      - Object.b.2
      - Object.b.5
      - Object.b.6
      - Object.b.11
      - Object.b.12
      - Object.b.13
      - Object.b.14
      - Object.b.15
  - IFCSITE
    - Haifa Bridge 79
      - Beam
      - Light Fixture
      - Object
      - Slab
      - Wall

Reconstruction of axes

- Longitudinal and lateral axes
- Longitudinal curvature of multi-span bridges

Reconstruction of axes

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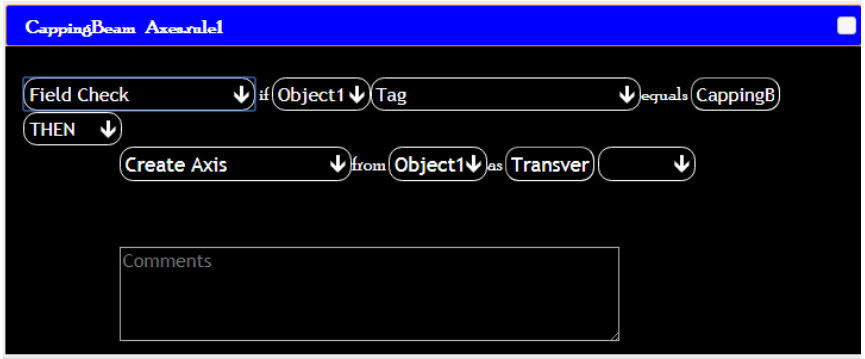
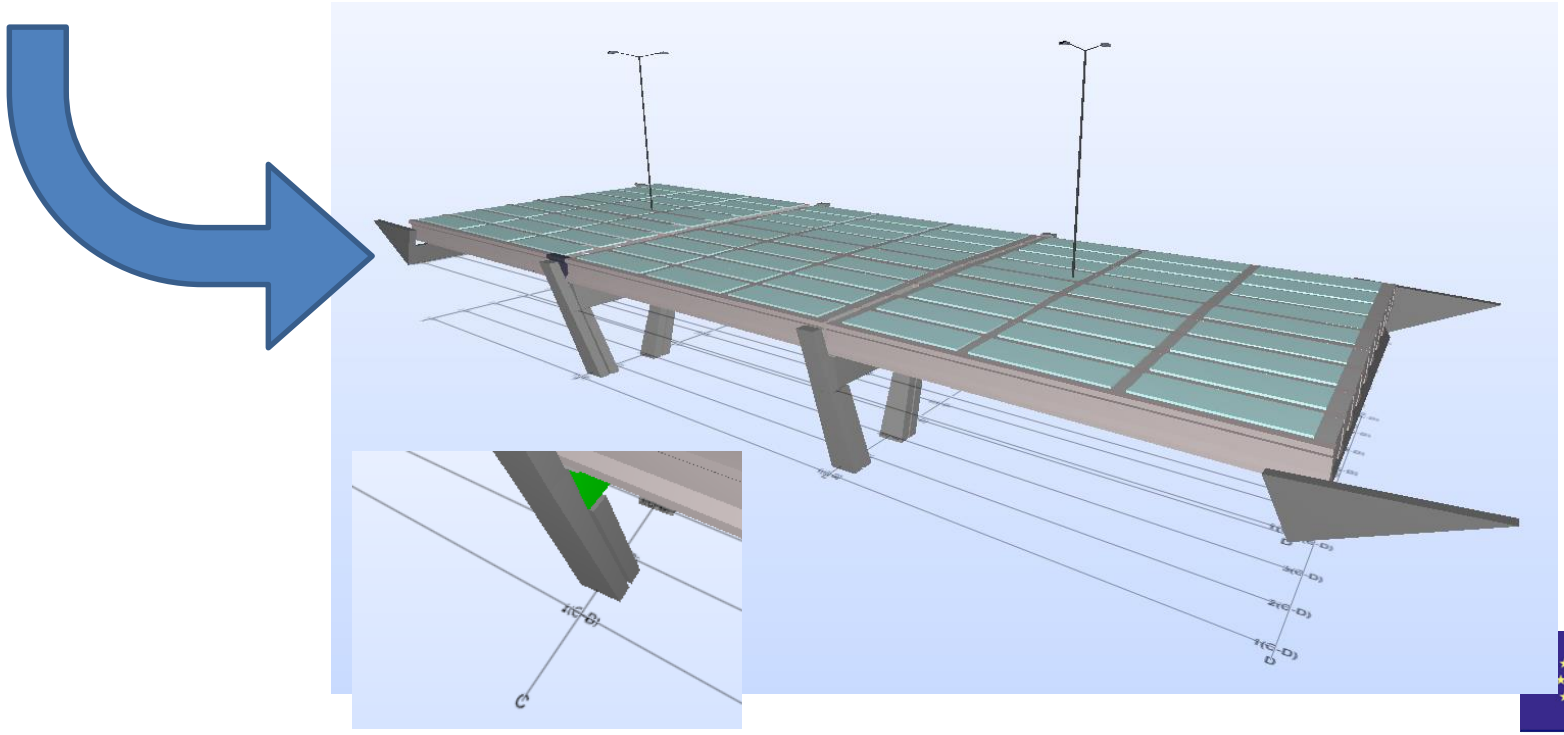
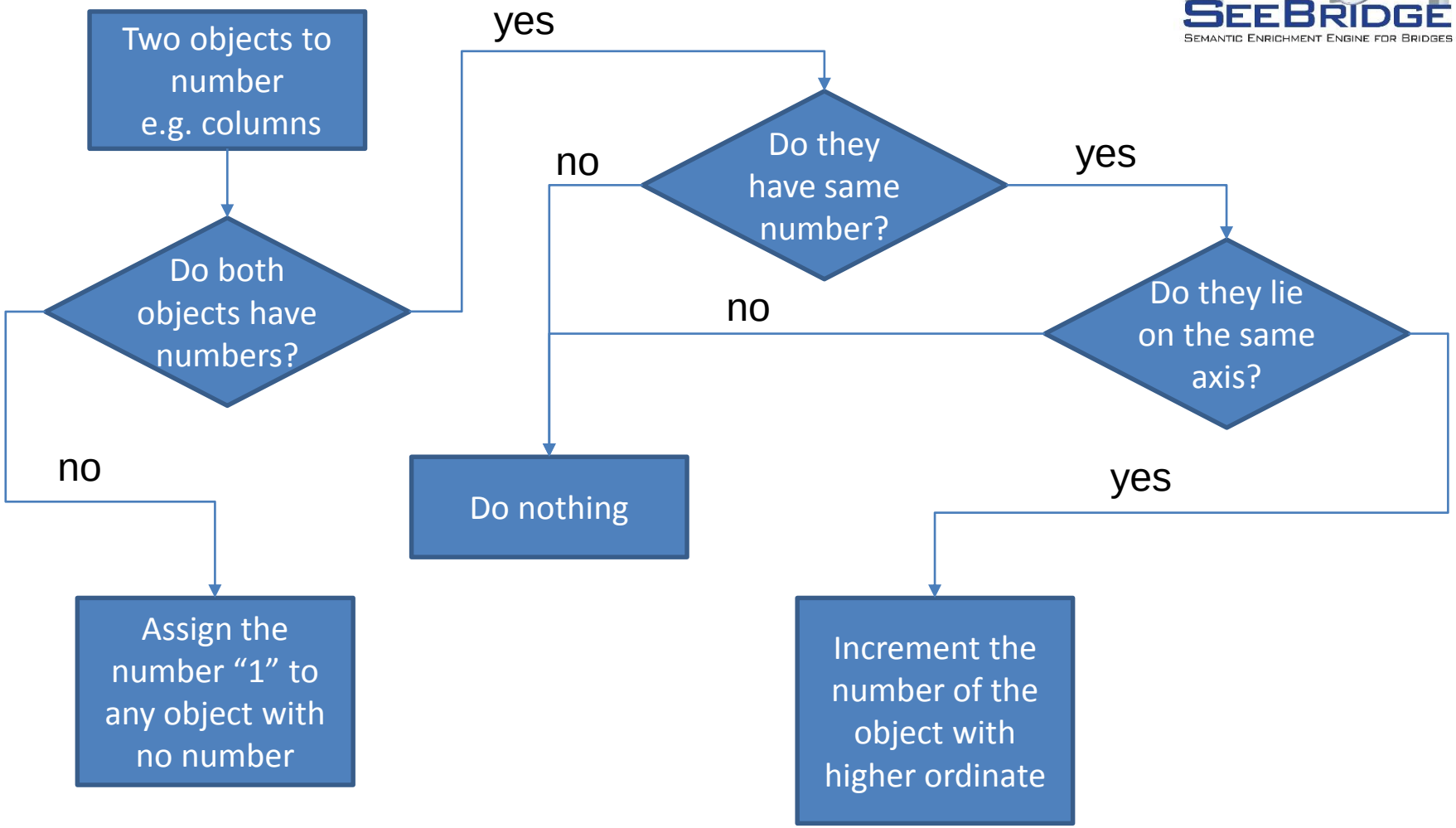




Numbering of objects

- Absence of global variable and sorting loop
- Objects to number

Numbering algorithm



Numbering of objects

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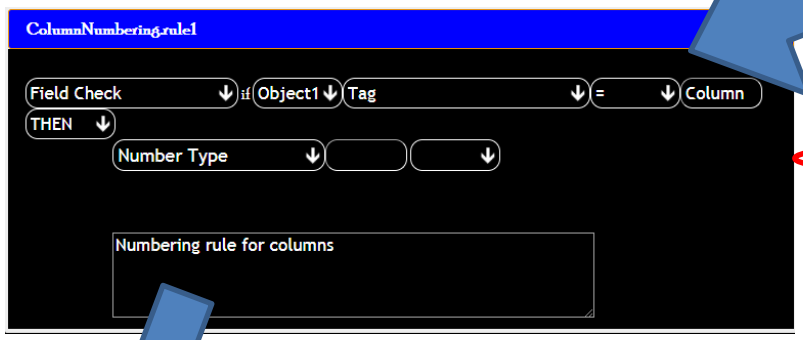

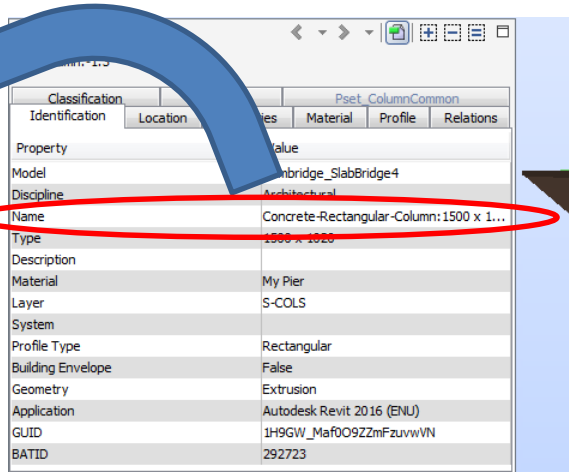

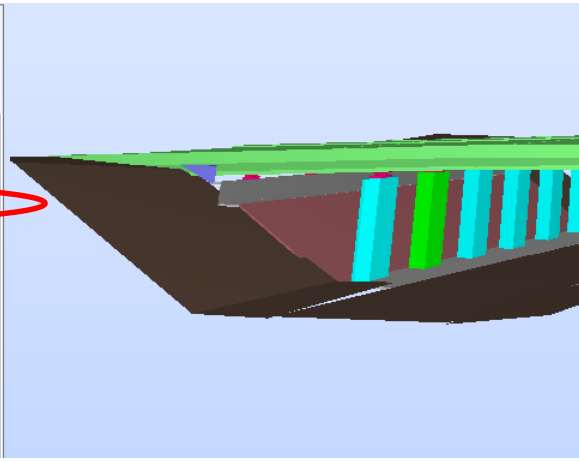

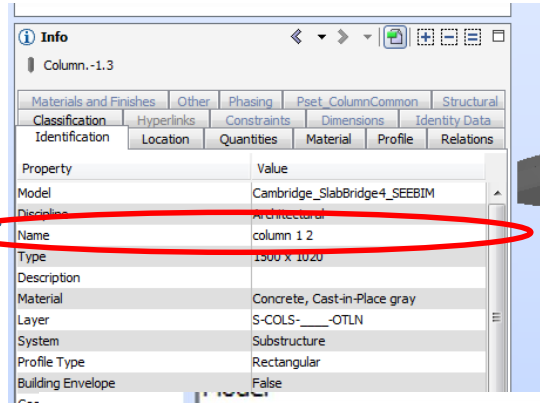

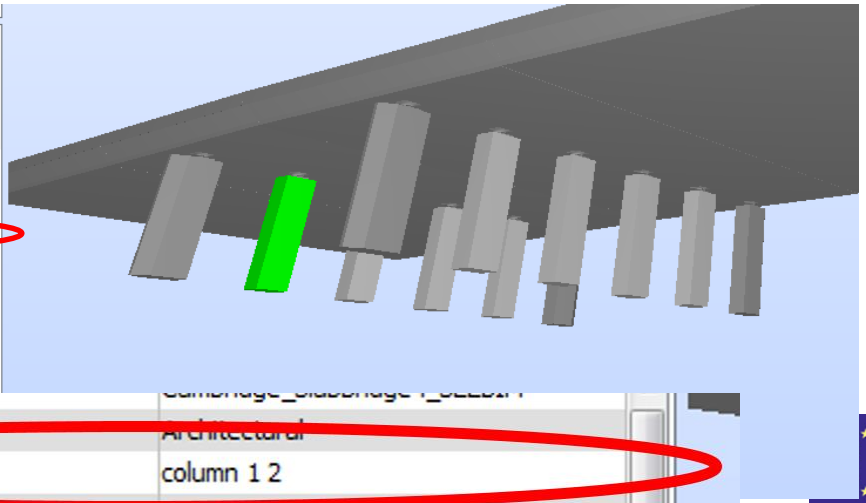

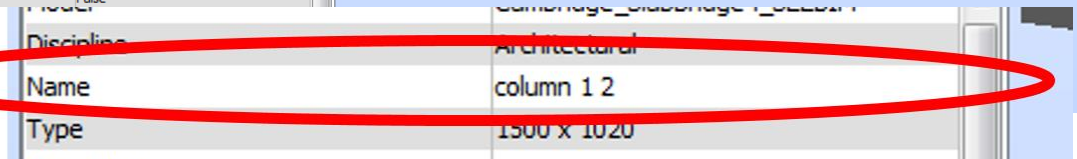

Occlusion: repairing geometry

- Lengthening the occluded beams
- Inserting “placeholders” for missing objects
- Recreating deck structure

Occlusion: repairing geometry

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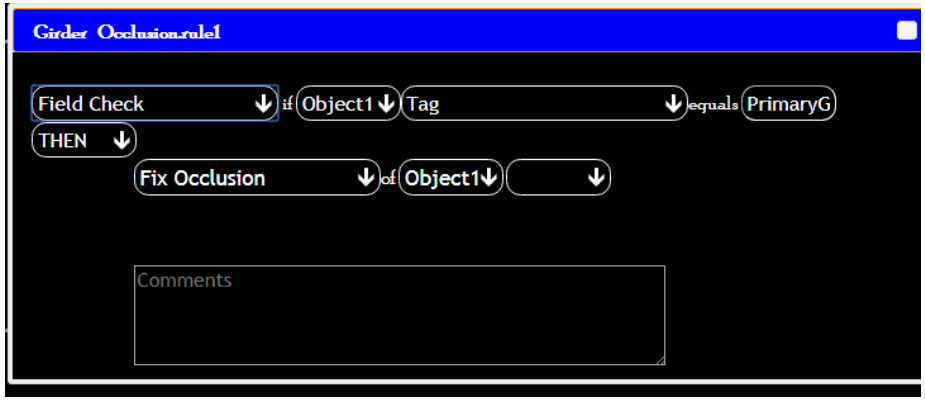
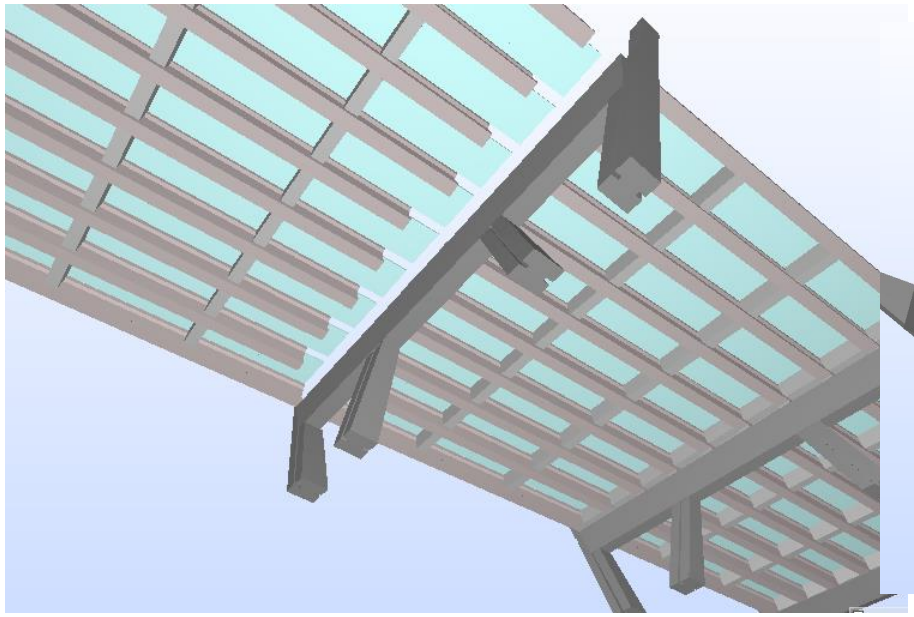
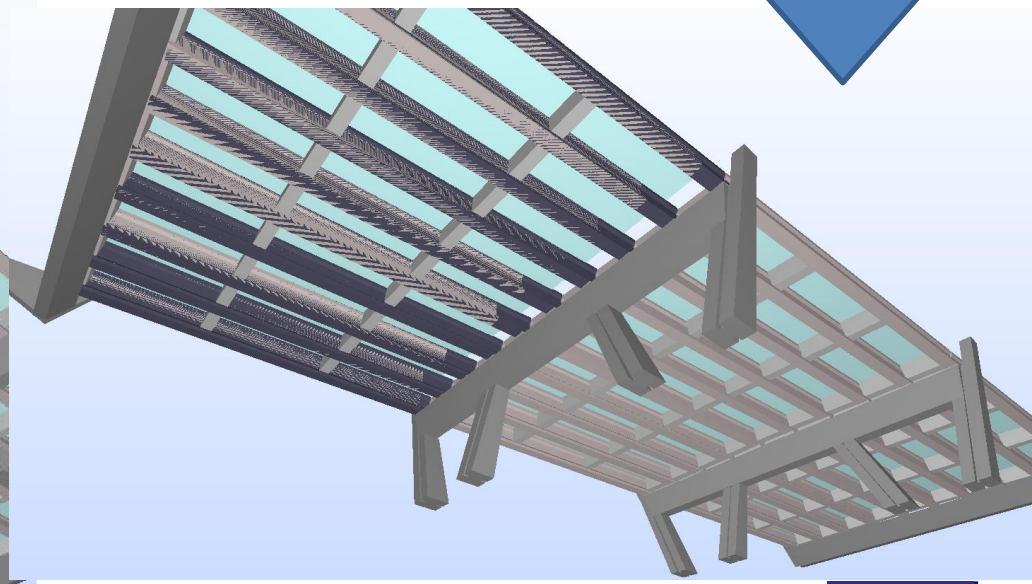
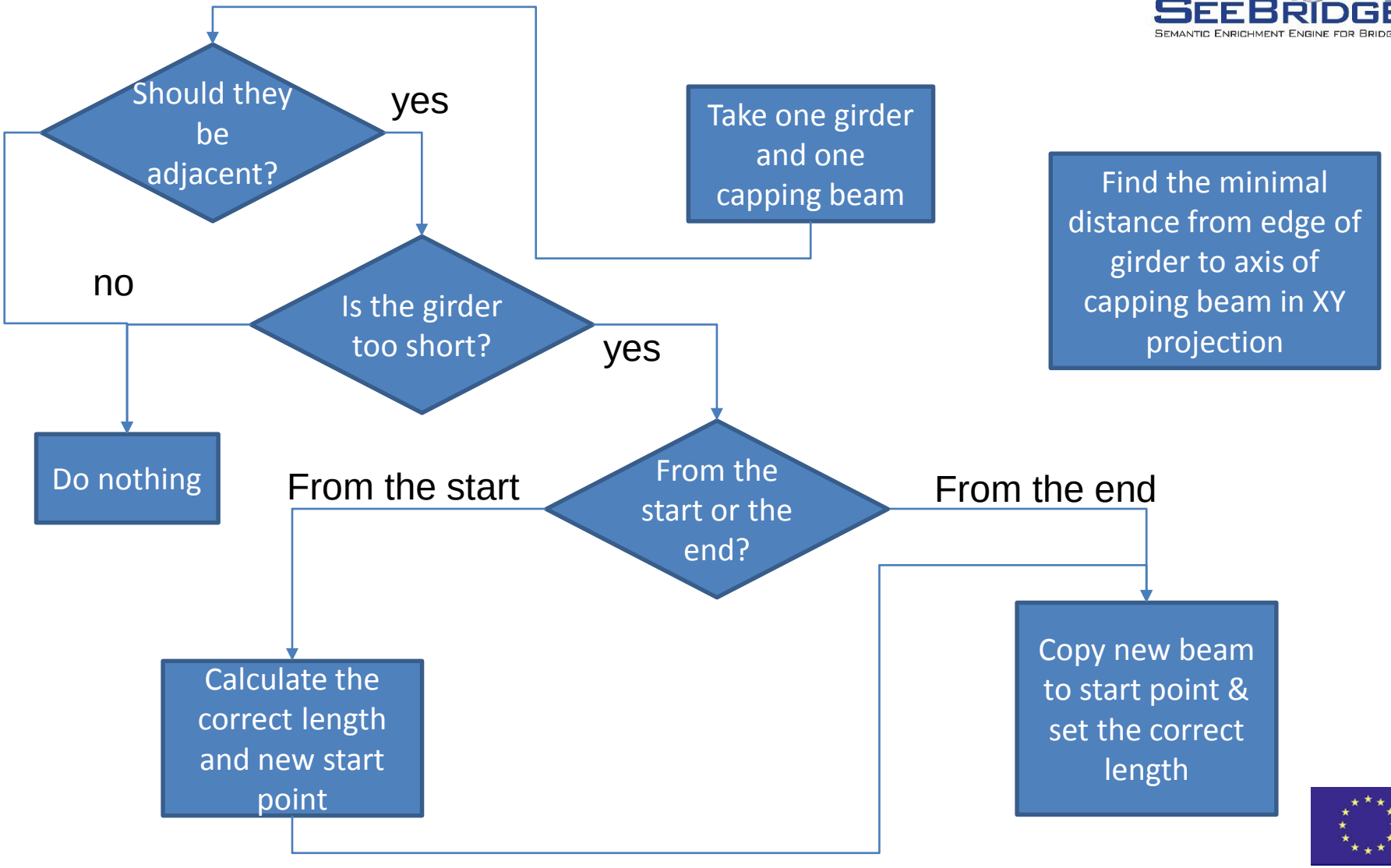






Girder lengthening algorithm to the capping beam



Output model

- IFC and MVD compliance
- Post processor

Limitations

- Redundancy of the rules
- Focus on main objects
- Unifying objects
- Curved axes

Summary

- Why do we need semantic enrichment?
- How do we do it?
- What aspects do we enrich?
- What is the result?

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Questions?