

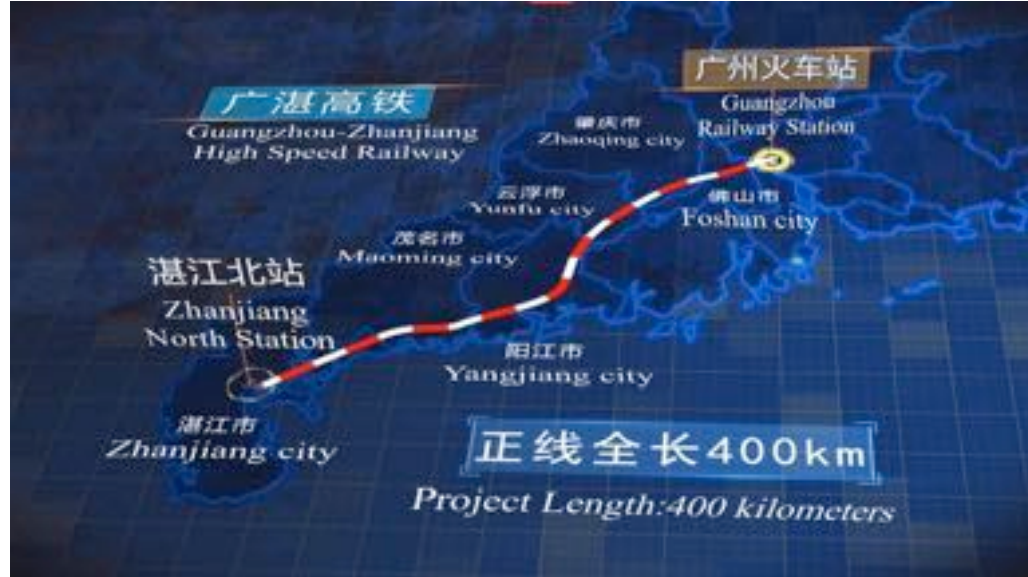


Application of openBIM in the Design and Delivery of Guangzhou-Zhanjiang High-speed Railway

Category: Design for Infrastructure using openBIM

Submitting Party: China Railway Design Corporation

Project Overview



Strategic Objectives

Primary

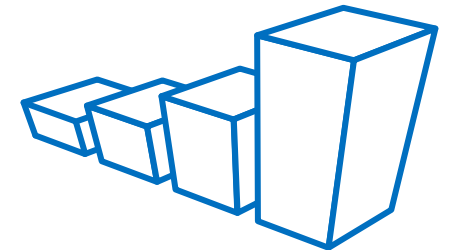
Through the application of BIM technology in the whole process of design and construction, the construction efficiency, quality and safety of the project will be improved.

Intermediate

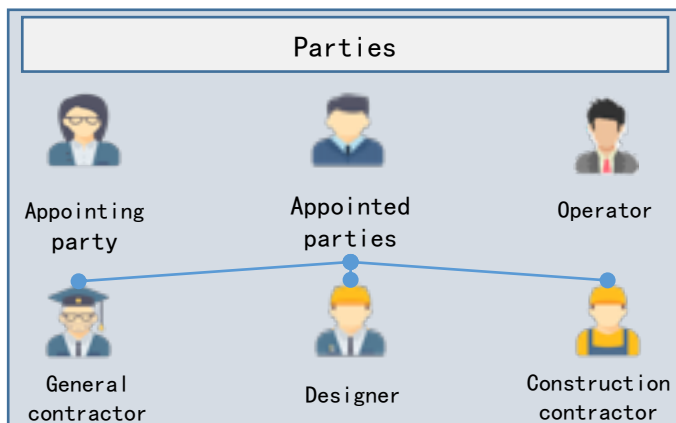
Research the technical and management issues of the integrated application of BIM in railway design and construction, and cultivate the ecosystem of BIM application in railway.

Advanced

Realize the "one model the whole life cycle" digital application of "all domains and all phases" in design, optimization, construction, management, operation and maintenance.



Project Stakeholders



China Railway Design Corporation



广东广湛铁路有限责任公司

Guangdong Guangzhan Railway Co., Ltd



中铁广州工程局集团有限公司

China Railway Guangzhou Engineering Group Co., Ltd



中铁十四局集团有限公司

CHINA RAILWAY 14TH BUREAU GROUP CORPORATION LIMITED



中国中铁二局集团有限公司

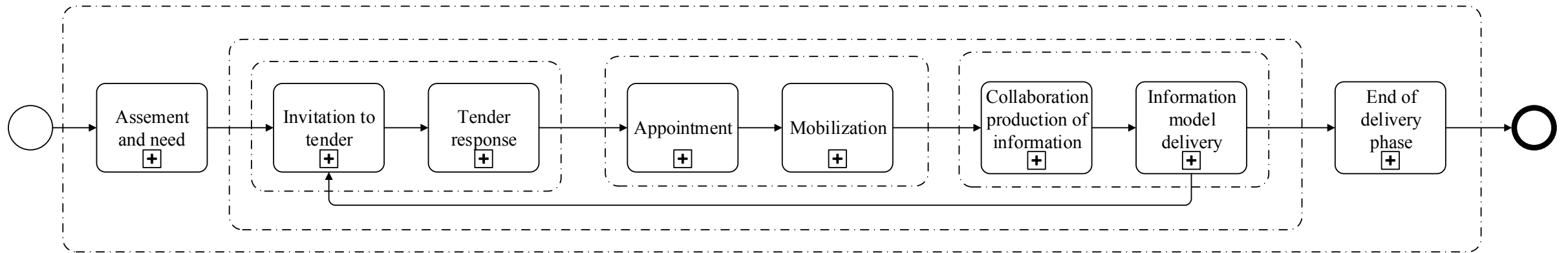
CHINA RAILWAY NO.2 ENGINEERING GROUP CO.,LTD.

Highlights

A BIM Execution Plan (BEP) plan of the project was developed based on ISO 19650 and openBIM standards which were applied throughout the whole process of design, review and delivery to realize fully digital exchange of design information.

- In the planning phase, the ISO 19650 process was adopted to collect the information requirements of the main stakeholders such as the appointing party, the general contractor and construction contractors. A two-level CDE platform for design and construction was innovatively developed to meet the requirements of collaboration, while ensuring that BIM data can be compatibly transferred to the construction phase and the construction management platform.
- Based on the IFC standard and the MVD theory, we developed a IFC data review tool to visually analyze the IFC types, properties and relationships, and innovatively implemented solutions for automatic semantic completion and correction of the data of IFC4 and IFC2x3.
- Based on the BCF standard, a software to capture and manage design issues was developed to realize collaborative review of BIM models across multiple participants and software platforms.

ISO 19650 used



Information Management Process

ISO 19650 used

Establish information requirements

Contract Agreement



Signature of the Appointing Party



Information Requirements



The contractor shall **establish a BIM and information system in accordance with the relevant requirements of the developer or the supervisory parties (including the China National Railway Group (former China Railway Corporation)), actively conduct the scientific and technological innovation of this project.** Following the relevant requirements of BIM and information system management, relevant professionals should be well equipped for implementation. Related information should be shared with the developer or supervisor through the CDE, and the information system of the contractor must meet the requirements for connection with the developer and its superior and the supervisor.



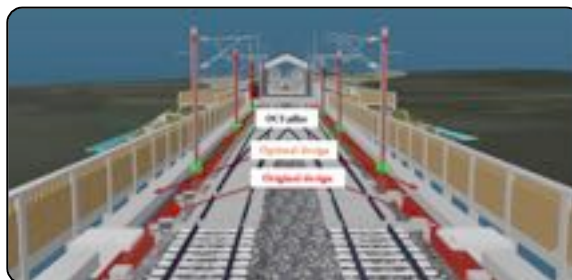
ISO 19650 used



Information



Standard



Design Implementation



Delivery

2020

2021

2021

2021年

2022

2023

2024

2025

BEP



Design



Construction Implementation



Completion



ISO 19650 used

Establish responsibility matrix

Content	Parties	Appointed Parties				
	Appointing Party	China Railway Design Corporation (General Contractor)	China Railway Design Corporation (Design)	China Railway 14th Bureau Group Corporation Limited (Construction)	China Railway Guangzhou Engineering Group Co.,Ltd (Construction)	China Railway No.2 Engineering Group Co.Ltd (Construction)
Design of GZZQ-1 Section	Guangdong Guangzhan Railway Co., Ltd (Owner)	A	C	I	I	I
Design of GZZQ-3 Section	R/A	A	C	I	I	I
Design of GZZQ-10 Section	R/A	A	C	I	I	I
Construction of GZZQ-1 Section	R/A	A	I	C	C	C
Construction of GZZQ-3 Section	R/A	A	I	C	C	C
Construction of GZZQ-10 Section	R/A	A	I	C	C	C

R—Responsible A—Accountable C—Consulted I—Informed

ISO 19650 used

Parties

Introduction of Process Maps:

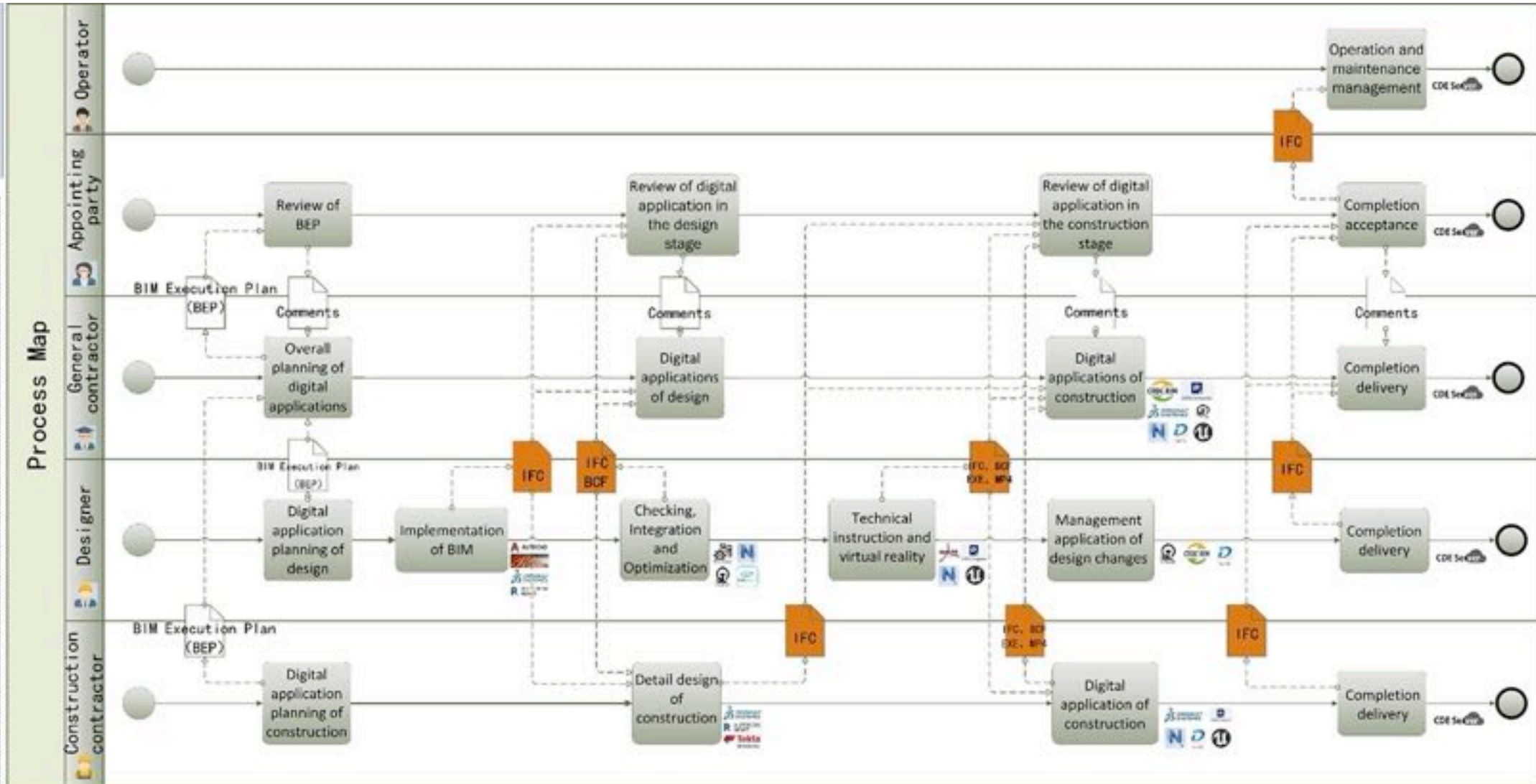
The project is carried out following ISO 19650 standard processes. First, determine the information requirements of the appointing party and the lead appointed parties, and establish a common data environment (CDE) as the information and data center. All parties work around the needs of the appointing party. The appointing party entrusts the general contractor to be responsible for the specific implementation of the digital work.

Focusing on the needs of the appointing party, the general contractor formulates a BEP, and coordinates the collaboration of the appointed parties involved in the design, construction, and completion delivery stages.

The designer, entrusted by the general contractor, completes the digital design of the project, carries out digital applications such as design inspection, system integration inspection, technical instruction, virtual reality, and design changes, and finally delivers the completed assets of design.

Under the entrustment of the general contractor, the construction contractor undertakes the designer's model, completes the construction in-depth design, carries out digital applications such as steel structure optimization, tunnel shield segment layout, construction disclosure, and construction organization arrangement, and finally delivers the completed construction assets.

The operator is the final user of the project, responsible for receiving and inspecting the completed assets provided by the appointing party, building an asset operation and maintenance management platform, and carrying out asset operation and maintenance.



ISO 19650 used

Establish information delivery planning and milestones

ID	任务名称	开始时间	完成	持续时间	2021年 06月				2021年 07月			2021年 08月				2021年 09月					
					6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	9/19	9/26
1	广湛全线BIM设计工期排布	2021/6/1	2021/9/30	122天																	
2	段落1: 第三施工坐标系DK147+100~DK198+700 (长51.596km)	2021/6/1	2021/6/27	27天																	
3	总骨架与现状建模	2021/6/1	2021/6/22	22天																	
4	站前建模	2021/6/3	2021/6/22	20天																	
5	站后建模	2021/6/3	2021/6/27	25天																	
6	段落2: 第二施工坐标系: DK129+300~DK147+100 (长17.796km)	2021/6/5	2021/7/2	28天																	
7	总骨架与现状建模	2021/6/5	2021/7/2	28天																	
8	站前建模	2021/6/9	2021/7/2	24天																	
9	站后建模	2021/6/10	2021/7/2	23天																	
10	段落3: 第一施工坐标系: DK24+300~DK50+328.089 (含广州枢纽)	2021/6/7	2021/7/12	36天																	
11	总骨架与现状建模	2021/6/7	2021/7/12	36天																	
12	站前建模	2021/6/12	2021/7/12	31天																	
13	站后建模	2021/6/13	2021/7/12	30天																	
14	段落4: 第四施工坐标系: DK198+700~DK317+500 (长99.546km)	2021/6/9	2021/8/11	64天																	
15	总骨架与现状建模	2021/6/9	2021/8/11	64天																	
16	站前建模	2021/6/18	2021/8/11	55天																	
17	站后建模	2021/6/16	2021/8/11	57天																	
18	段落5: 第五施工坐标系: DK317+500~DK399+300 (长81.872km)	2021/6/13	2021/9/10	90天																	
19	总骨架与现状建模	2021/6/13	2021/9/10	90天																	
20	站前建模	2021/7/2	2021/9/10	71天																	
21	站后建模	2021/6/21	2021/9/10	82天																	
22	段落6: 第六施工坐标系: DK399+300~DK420+191 (含湛江枢纽)	2021/6/17	2021/9/30	106天																	
23	总骨架与现状建模	2021/6/17	2021/9/15	91天																	
24	站前建模	2021/7/13	2021/9/25	75天																	
25	站后建模	2021/6/26	2021/9/30	97天																	

ISO 19650 used

Establish BIM execution plan



Geology



Subgrade



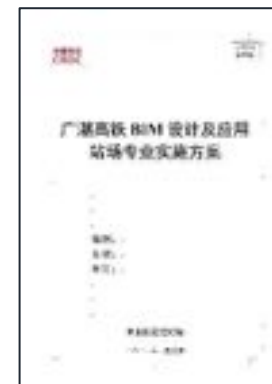
Bridge



Tunnel



Alignment



Station



Track



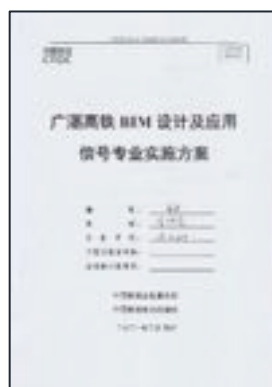
Rolling stock



Drainage



Telecommunication



Signal

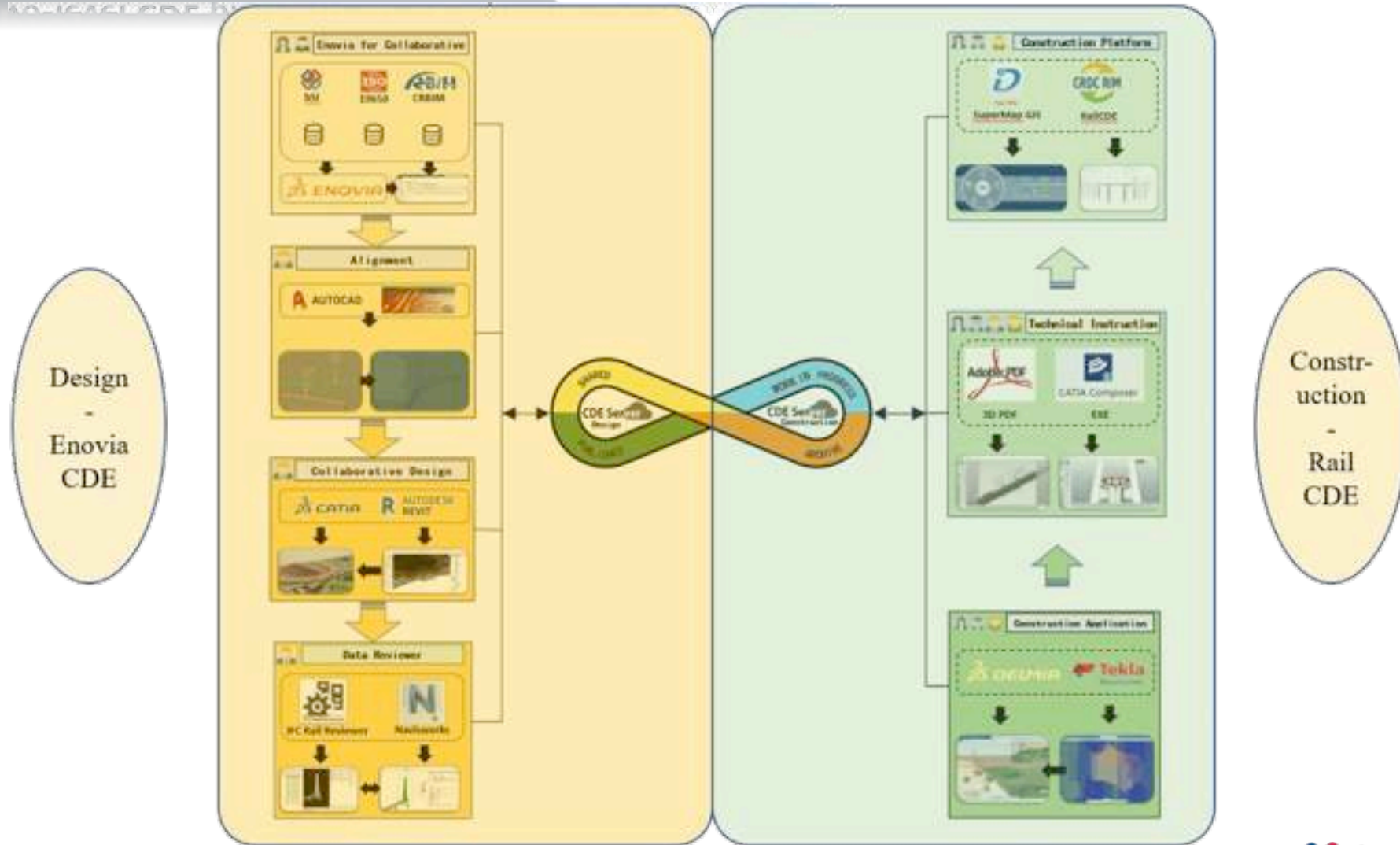


Energy



ISO 19650 used

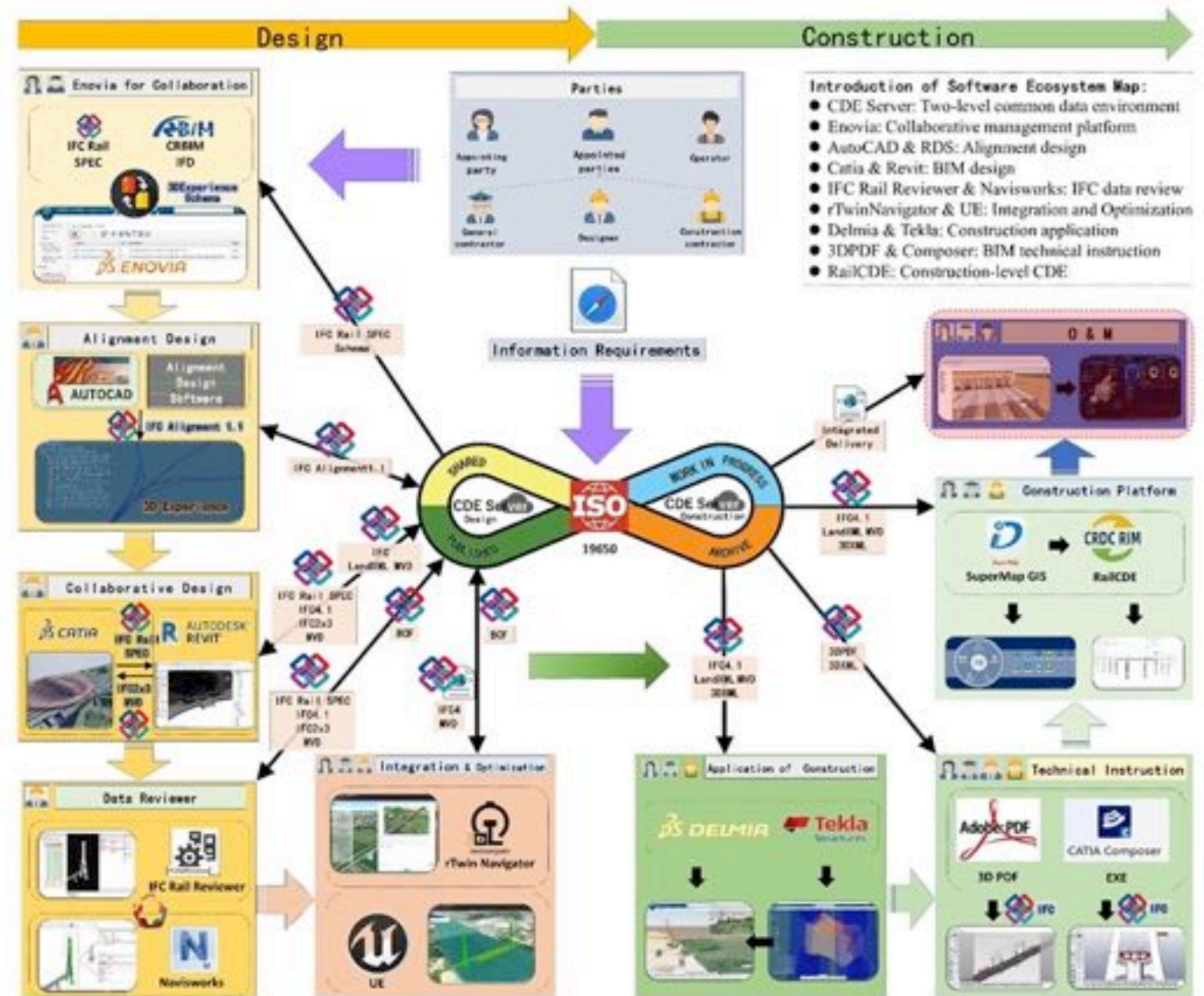
Establish the project's two-level CDE



openBIM used

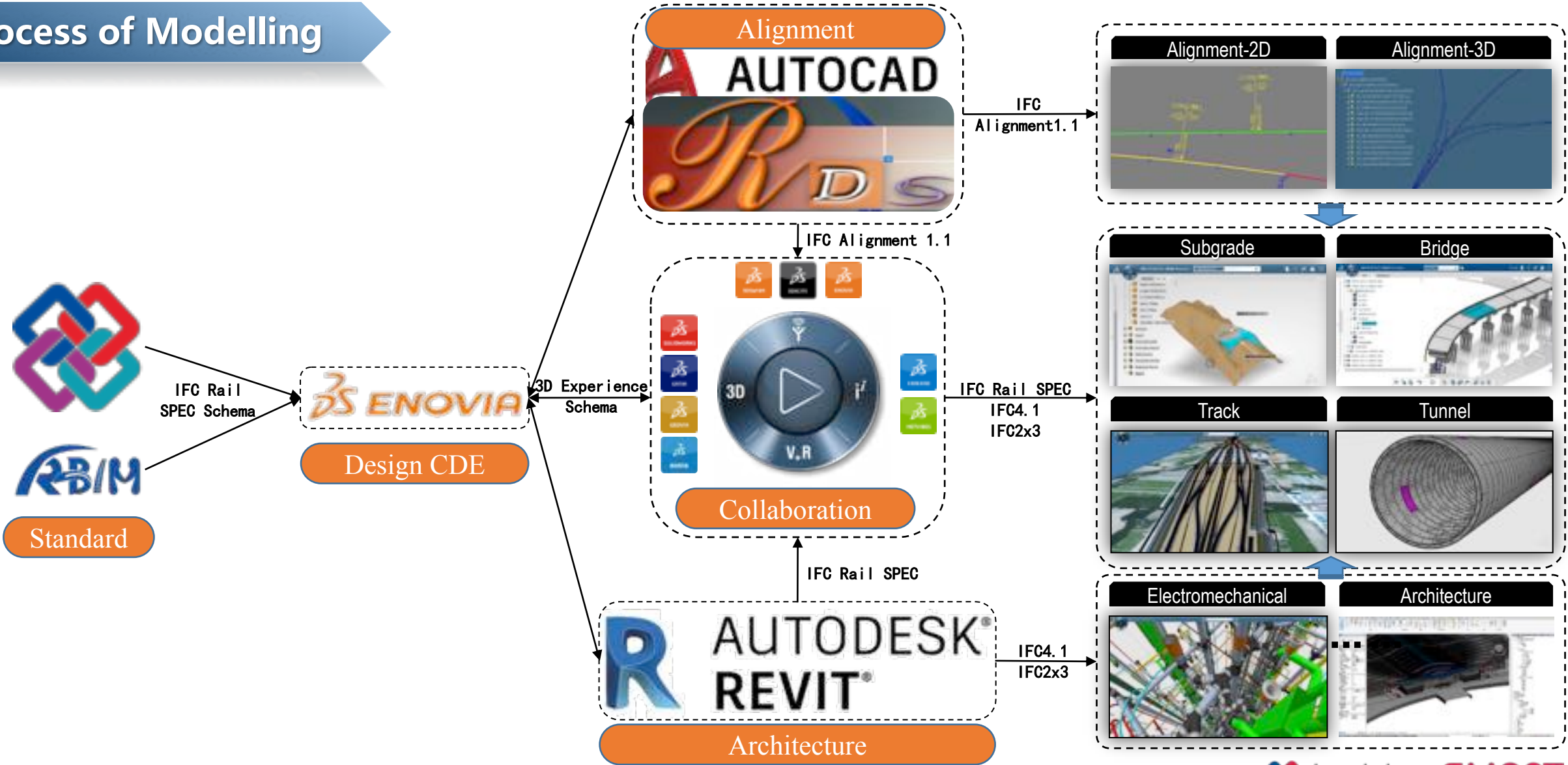
Software Ecosystem Map

- CDE Server: Two-level common data environment
- Enovia: CDE for collaborative design
- AutoCAD & RDS: Alignment design
- Catia & Revit: BIM design
- IFC Rail Reviewer & Navisworks: IFC file review
- rTwin & UE: BIM integration and optimization
- Delmia & Tekla: Construction application
- 3DPDF & Composer: BIM technical instruction
- RailCDE: CDE for construction management



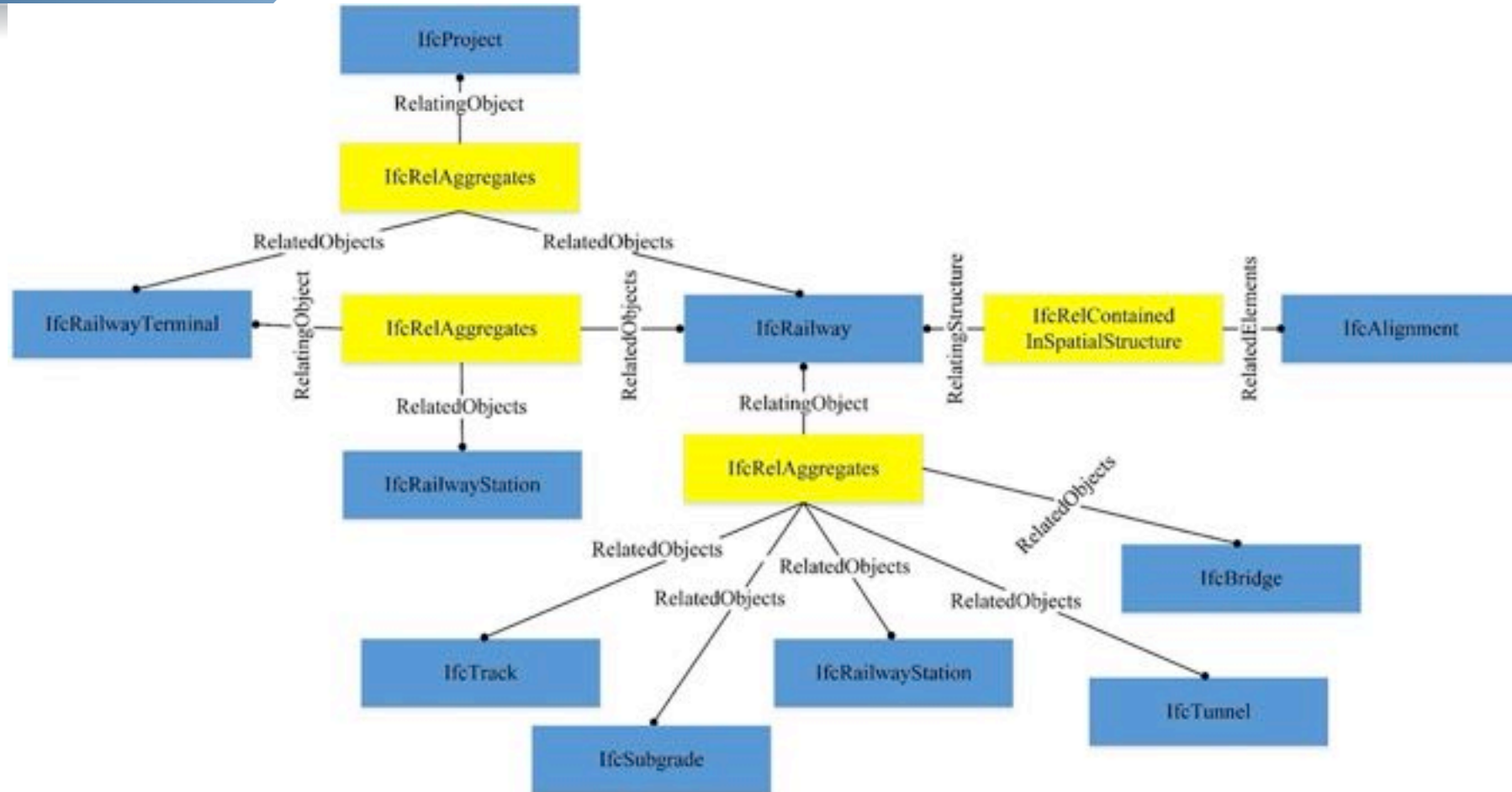
openBIM used

Process of Modelling



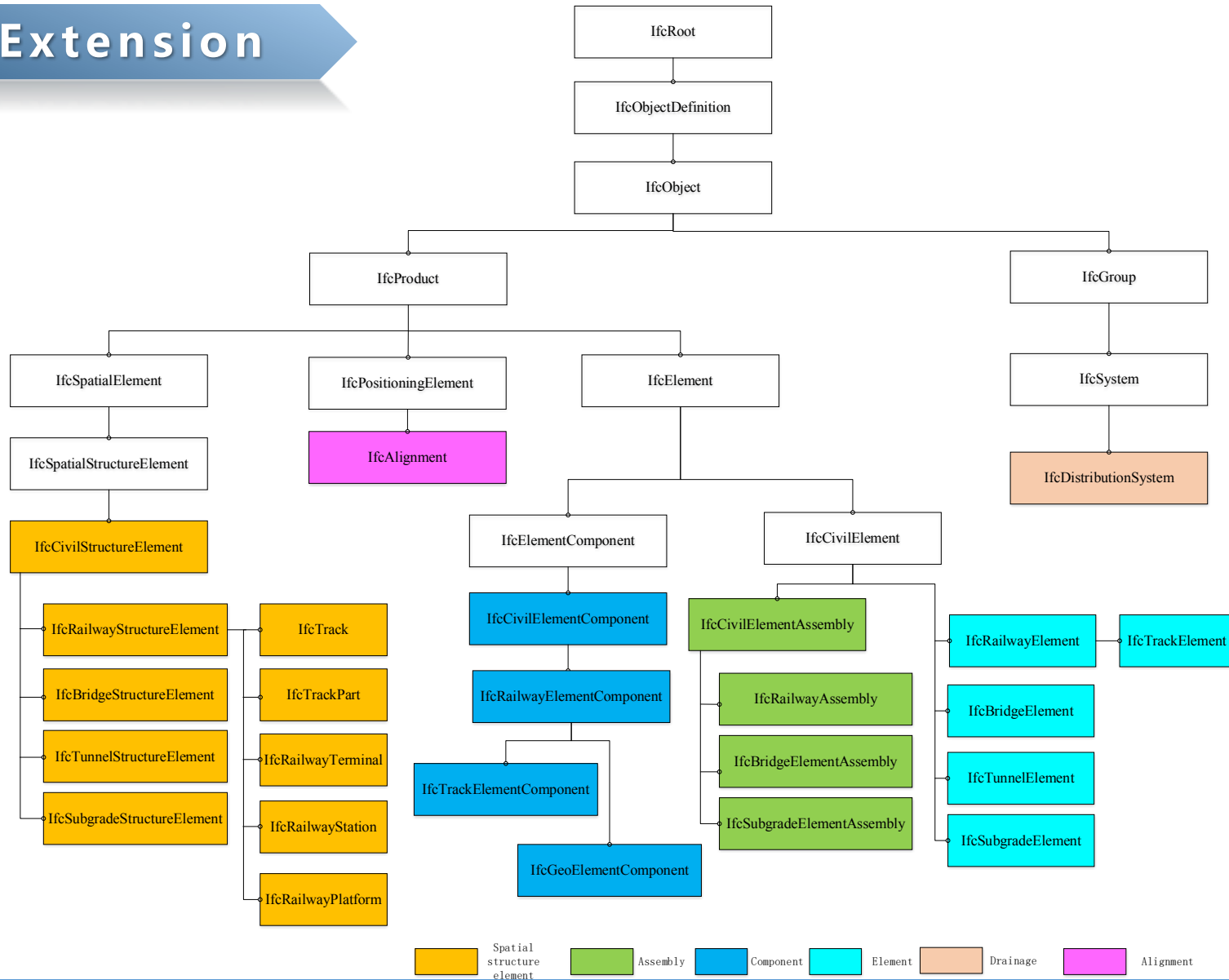
openBIM used

IFC-Spatial Extension



openBIM used

IFC-Entity Extension

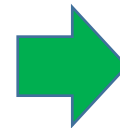


openBIM used

IFC to Metadata

- Create mapping of IFC data to metadata

```
ENTITY IfcTrack
  SUBTYPE OF (IfcRailwayStructureElement)
    PreDefinedType : IfcTrackTypeEnum;
    RouteDirectionType : IfcTrackRouteDi;
    RouteFunctionType : IfcTrackRouteFun
  END_ENTITY;
ENTITY IfcTrackPart
  SUBTYPE OF (IfcRailwayStructureElement)
    PreDefinedType : IfcTrackPartStructu;
    FunctionType : IfcTrackPartFunctionT
  END_ENTITY;
ENTITY IfcTrackElement
  SUPERTYPE OF (ONEOF
    (IfcTrackRail, IfcTrackFastening, Ifc
    cTrackConcreteSlab, IfcTrackIsolatio
    n, IfcTrackAdjustmentLayer, IfcTrackB
    BallastLayer, IfcTrackExpansionJoint)
  SUBTYPE OF (IfcRailwayElement);
  END_ENTITY;
ENTITY IfcTrackRail
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType : IfcTrackRailTypeEnu
  END_ENTITY;
ENTITY IfcTrackFastening
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType : IfcTrackFasteningEl;
    StructureType: IfcTrackFasteningStru
  END_ENTITY;
ENTITY IfcTrackSleeper
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType : IfcTrackSleeperType
  END_ENTITY;
ENTITY IfcTrackSlab
  SUBTYPE OF (IfcTrackElement);
    PreDefinedType : IfcTrackSlabTypeEnu
```

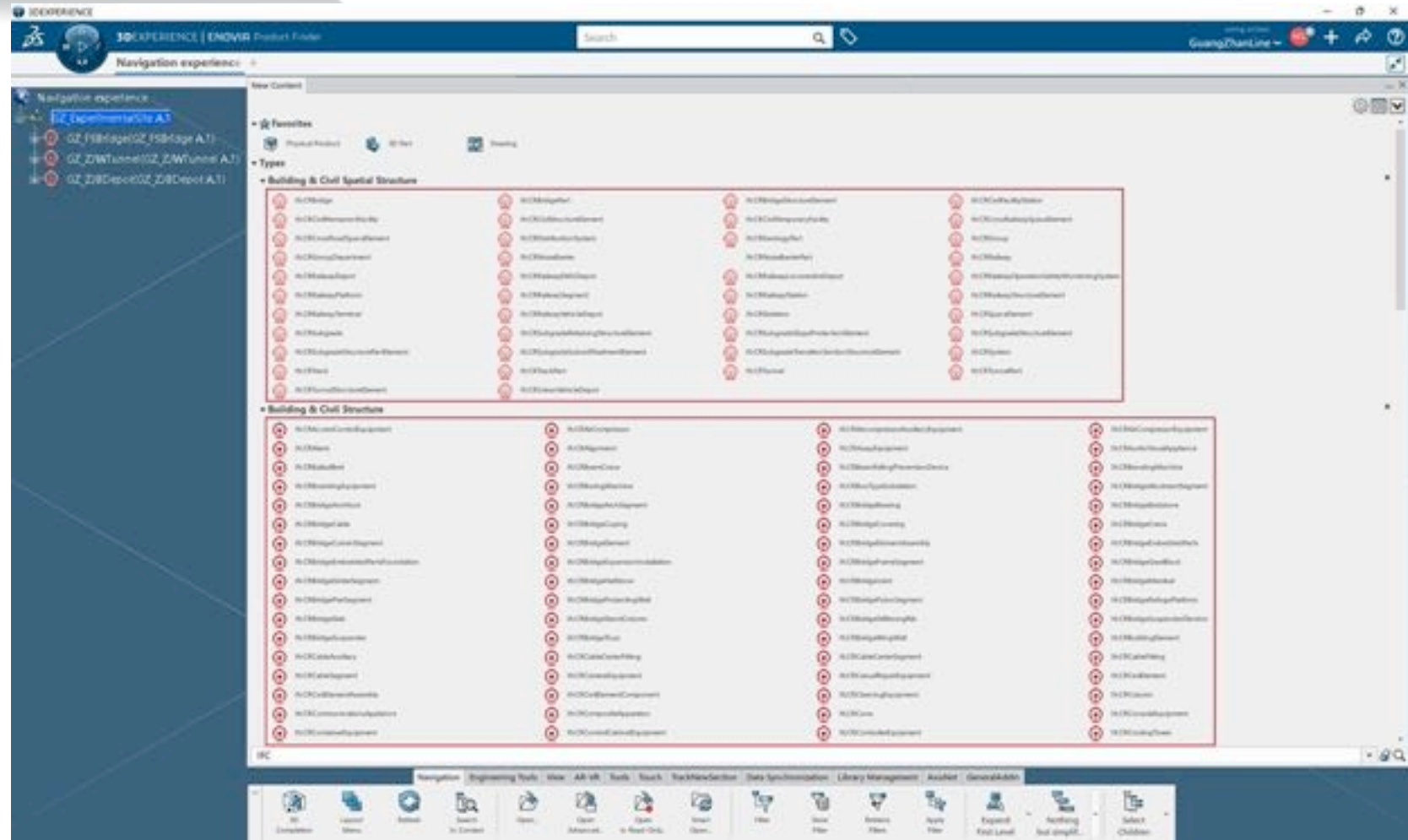


```
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  SuperName="IfcRailwayStructureElement"
  Abstract="No"
  Uuid="2f3379a1-5686-4403-89b9-7bff0ef1de67"
  CreateInstName="TrackType"
>
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  </CAAComment>
  <Simple
    Name="IfcTrackType"
    Type="String"
    DefaultValue="MAINTRACK"
    Uuid="6bf490d8-a4b5-465c-8399-44b9a631f603"
    Protection="Free"
    PLMImpacting="No"
  >
    <Range>
      <Equal>CATCHSIDING</Equal>
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      <Equal>SWITCHINGLEAD</Equal>
      <Equal>ROLLINGFORBIDDENTRACK</Equal>
      <Equal>CONNECTINGLINE</Equal>
      <Equal>LOCOMOTIVERUNNINGTRACK</Equal>
      <Equal>LOCOMOTIVEHOLDTRACK</Equal>
      <Equal>ROLLINGTRACK</Equal>
      <Equal>LOCOMOTIVESERVICETRACK</Equal>
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      <Equal>USERDEFINED</Equal>
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      <Equal>MAINTRACK</Equal>
      <Equal>CLASSIFICATIONTRACK</Equal>
      <Equal>FREIGHTTRACK</Equal>
```

openBIM used

IFC-Deployment in software

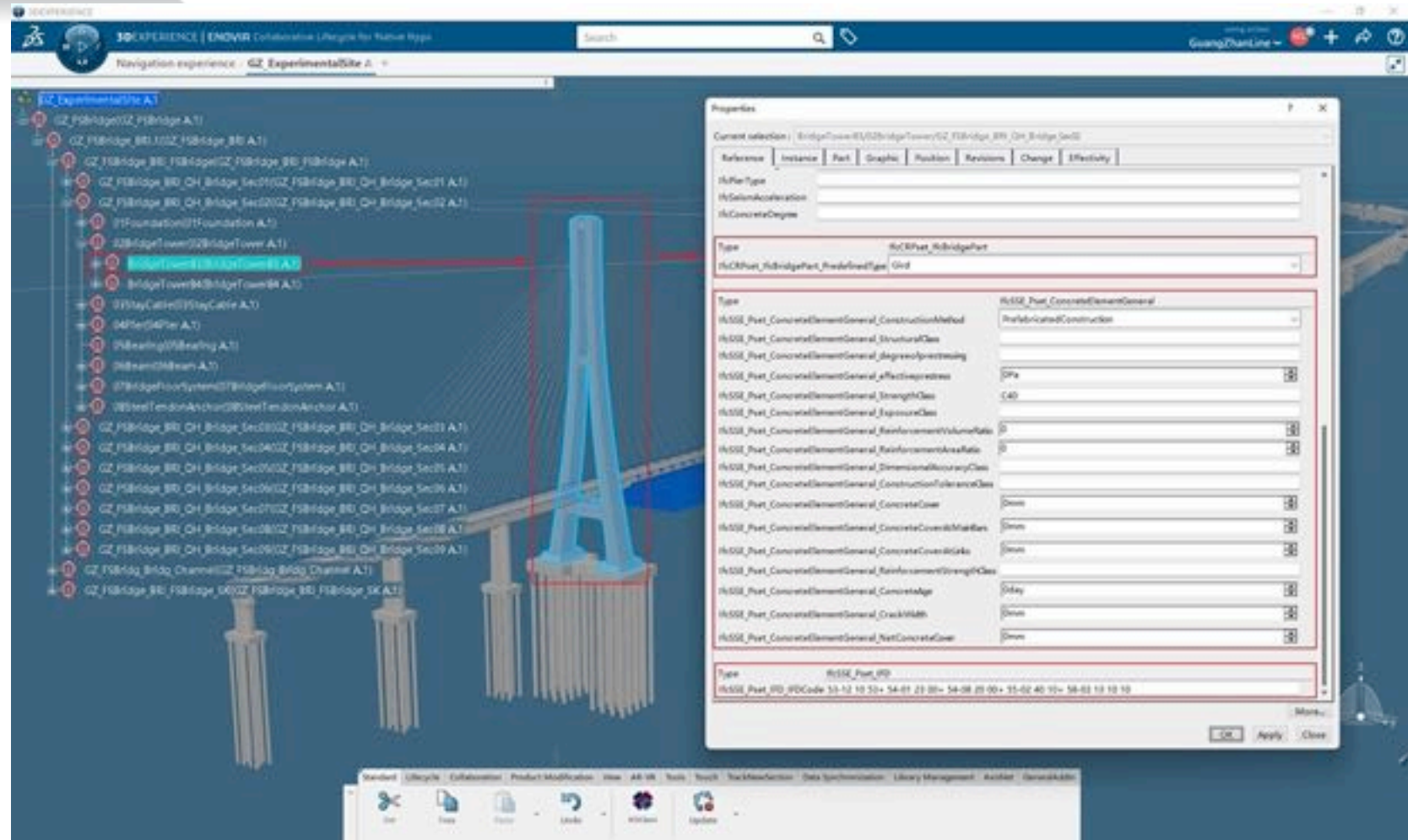
- Deployment of 413 IFC entities
- Deployment of 802 IFC Psets



openBIM used

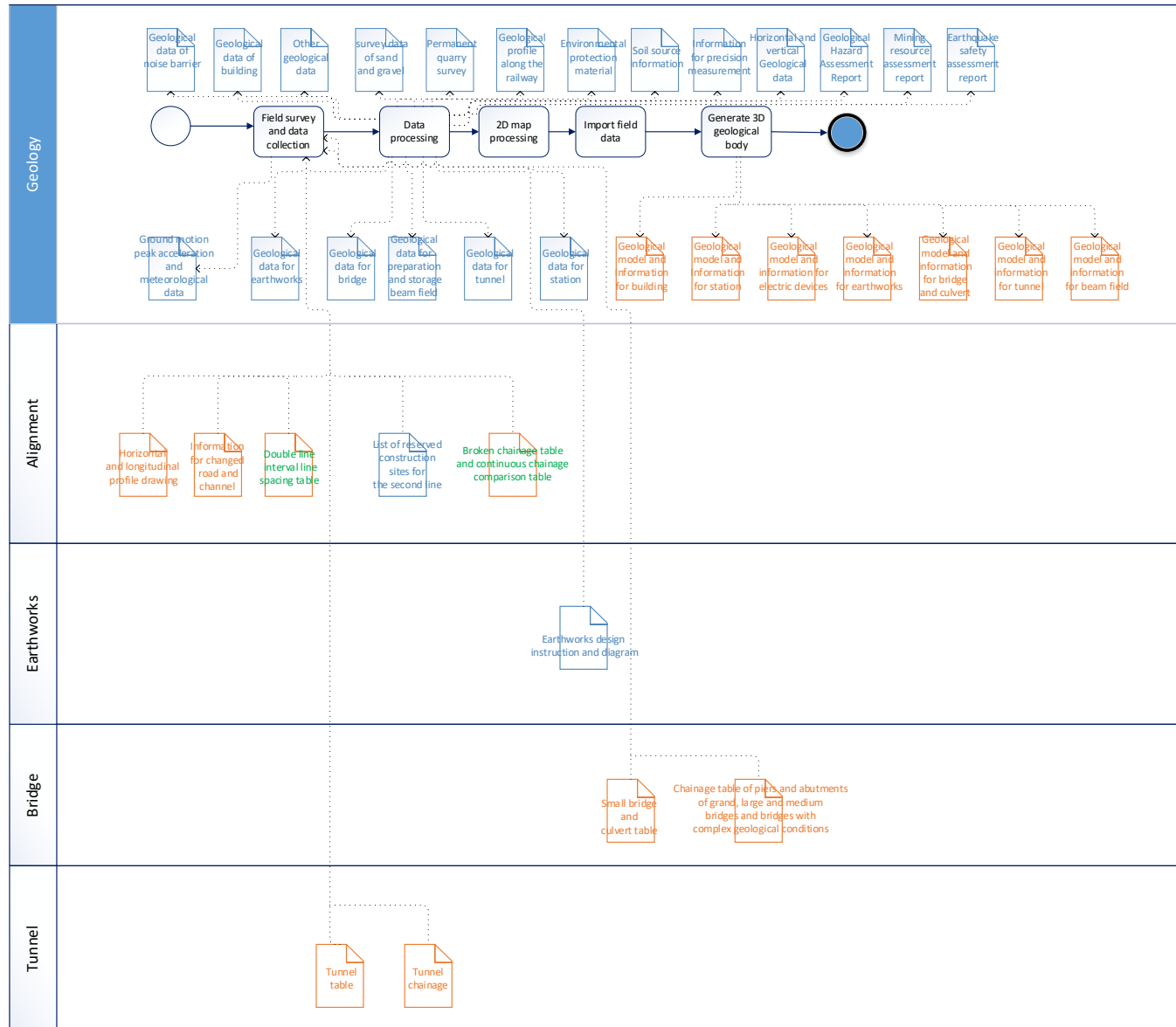
IFC-Information Model

- Create BIM models
- Mount the property sets on the BIM models



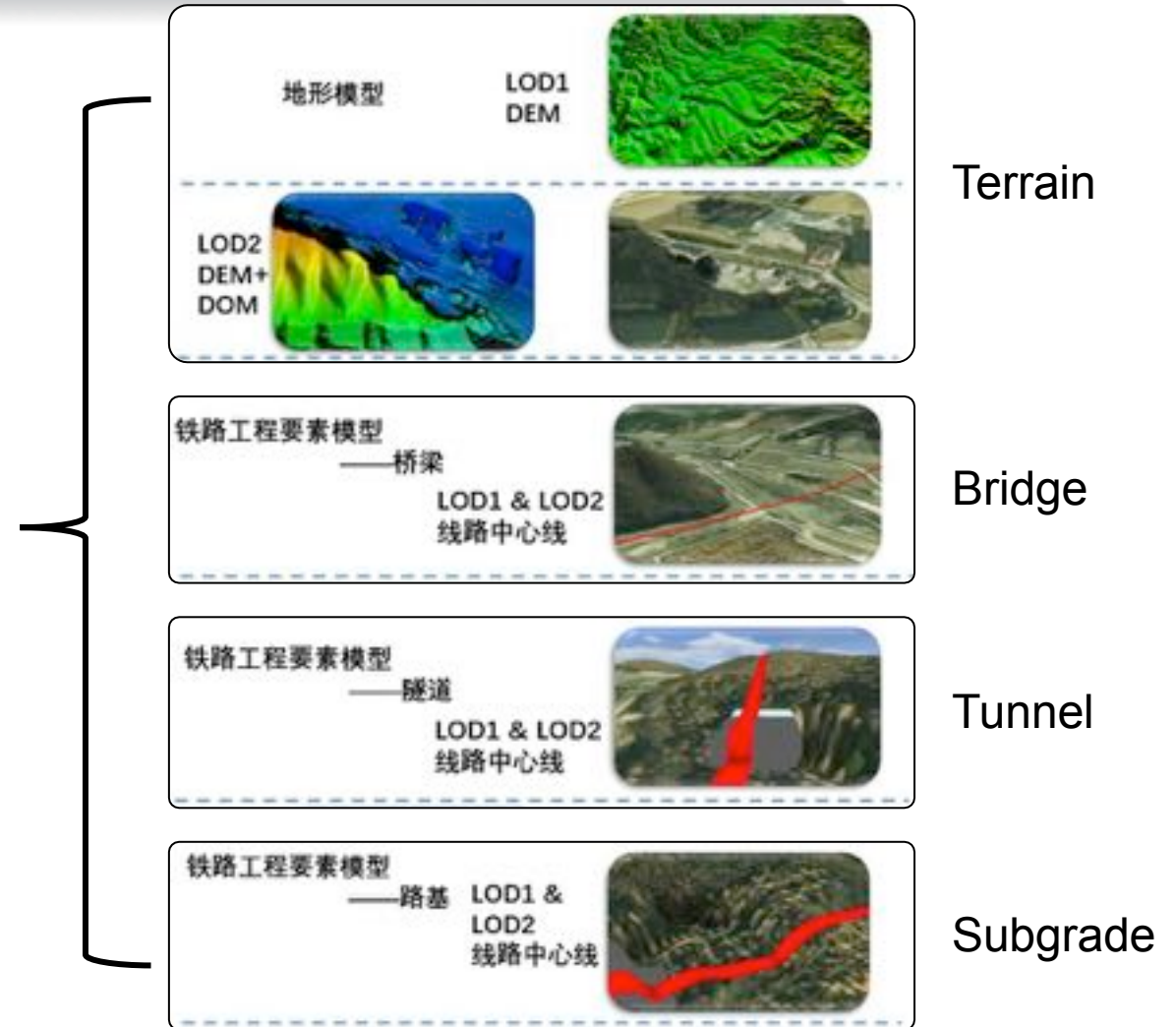
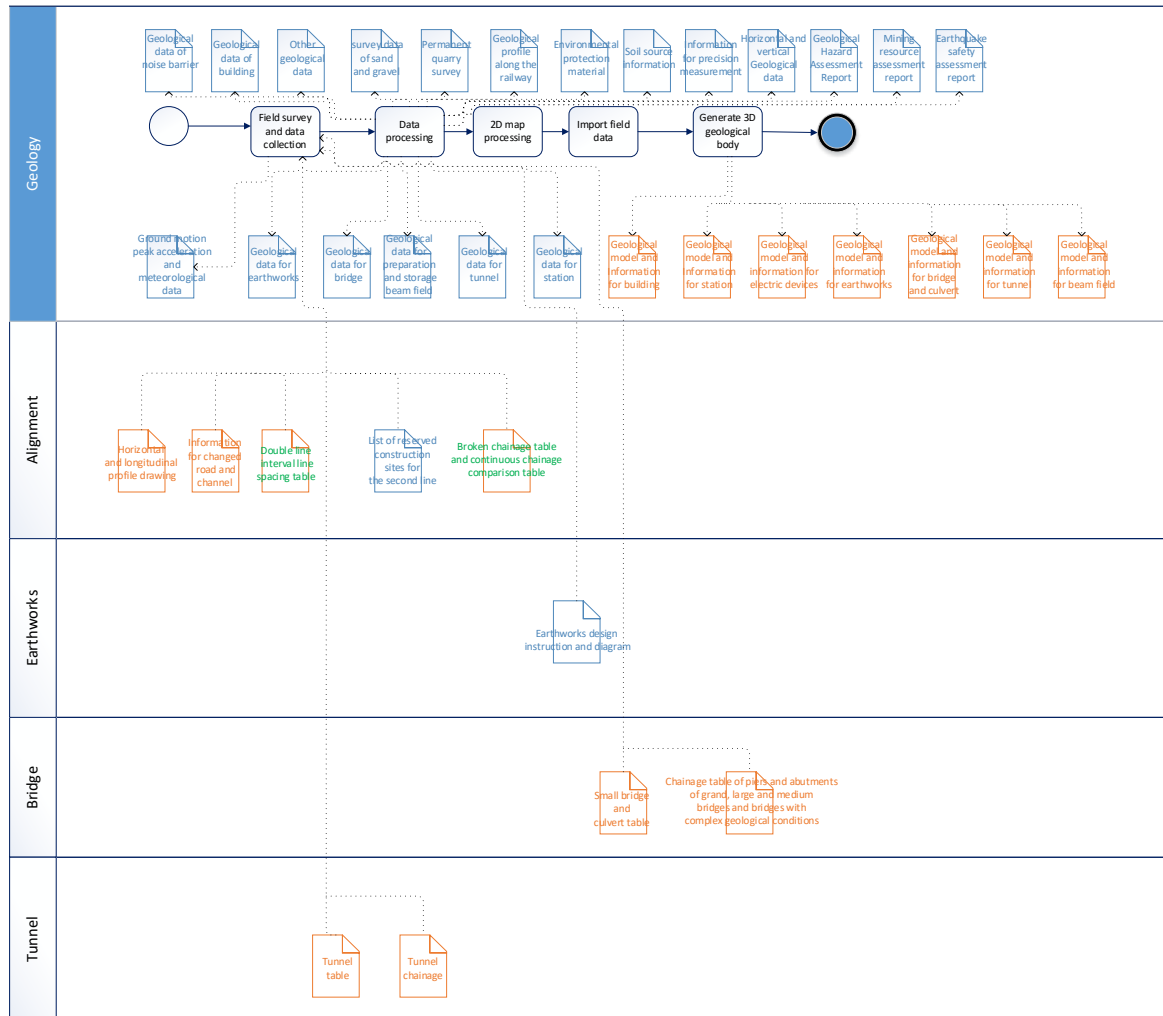
openBIM used

IDM



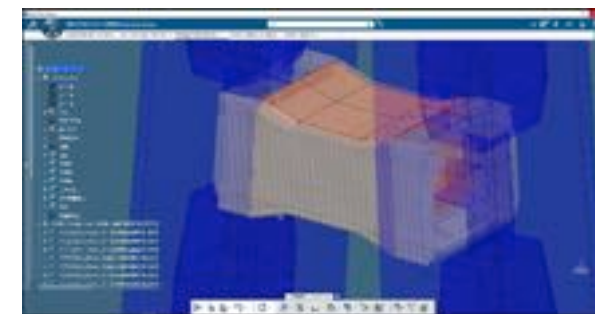
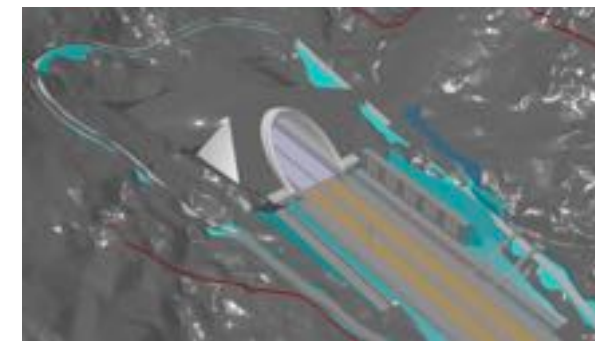
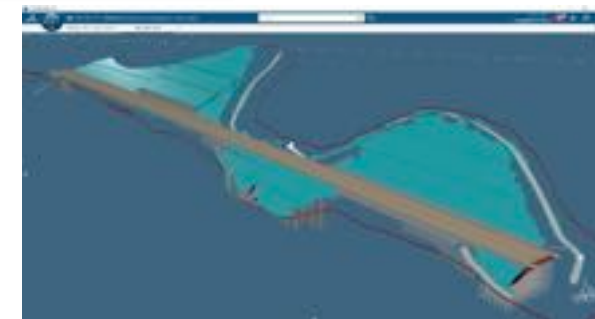
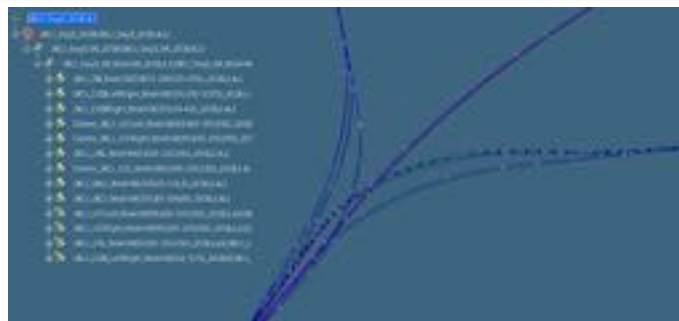
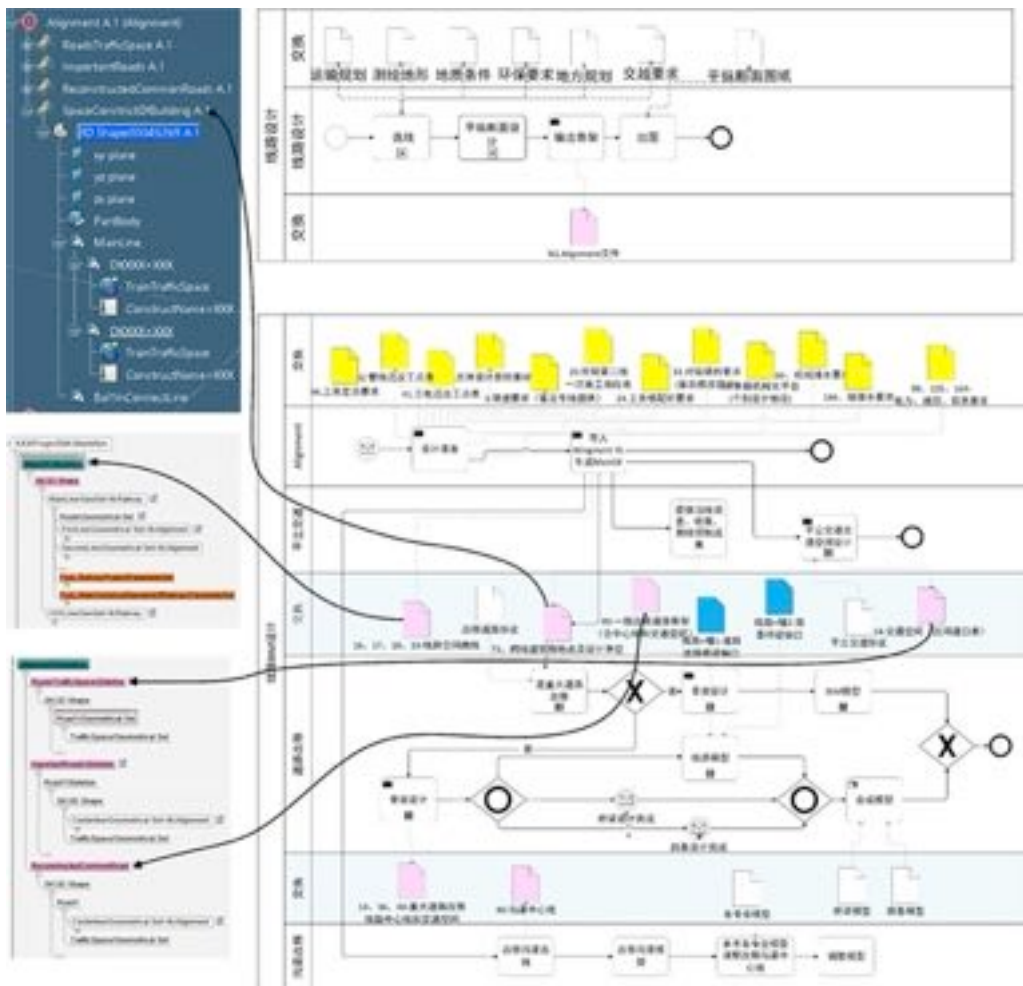
openBIM used

Generate information & Information model review (LOD 1~2)



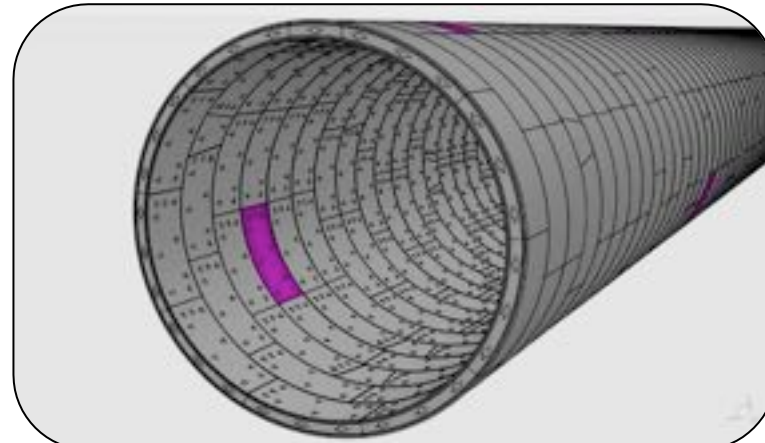
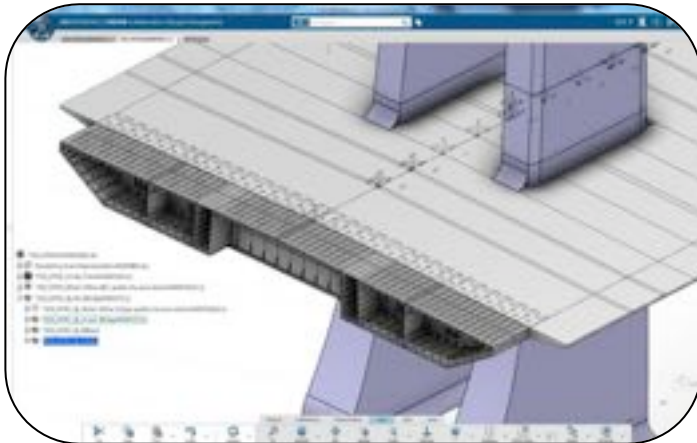
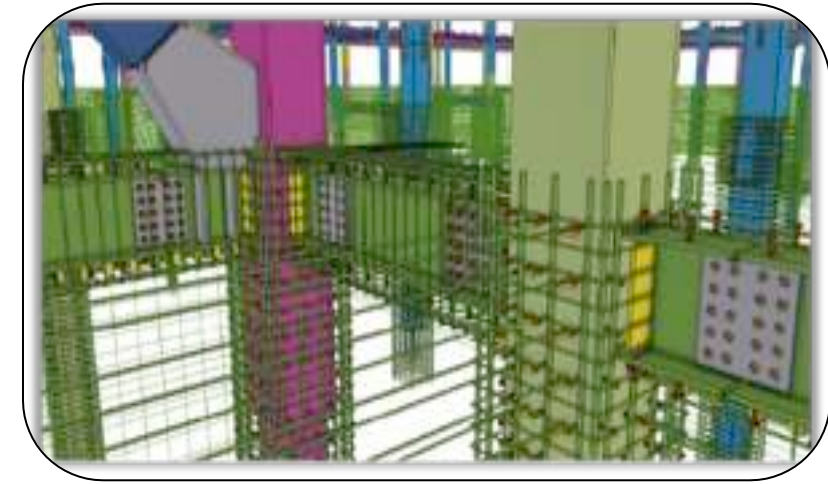
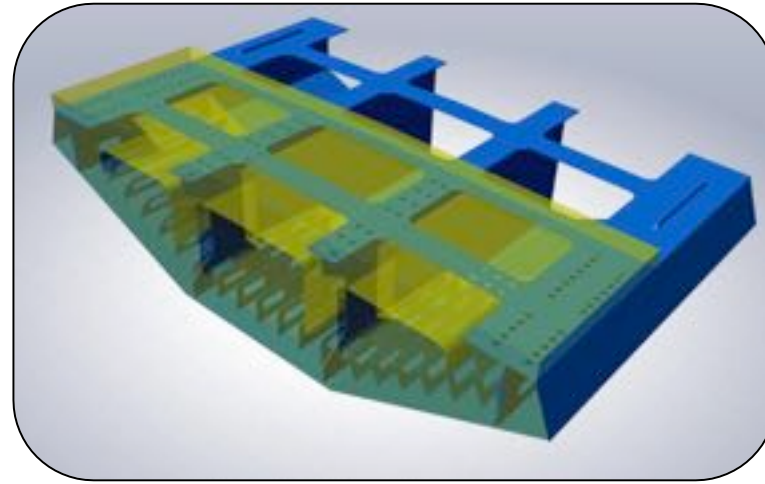
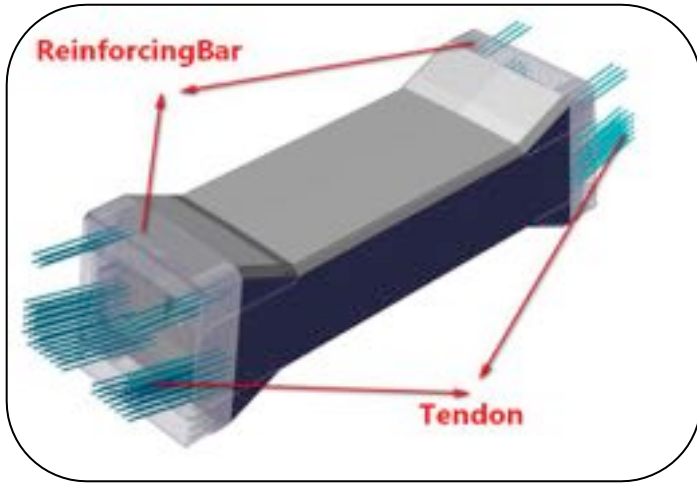
openBIM used

Generate information & Information model review (LOD 3)



openBIM used

Generate information & Information model review (LOD 4)



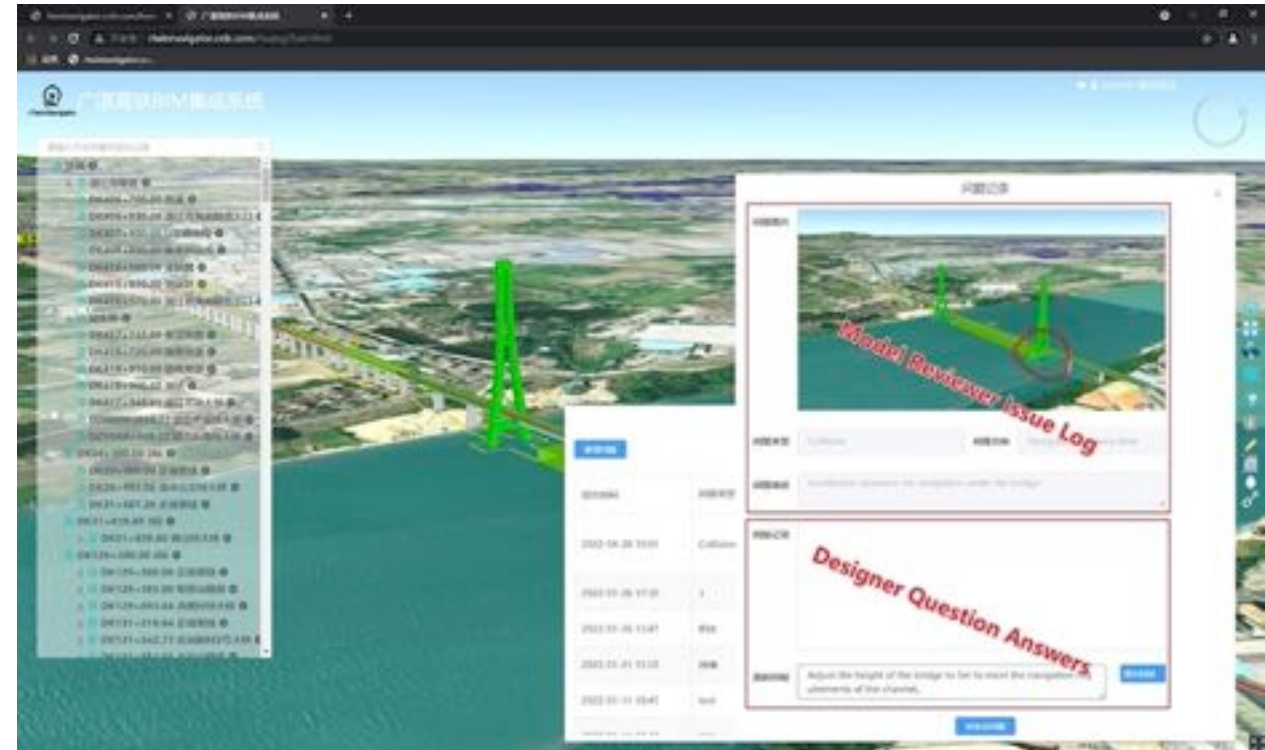
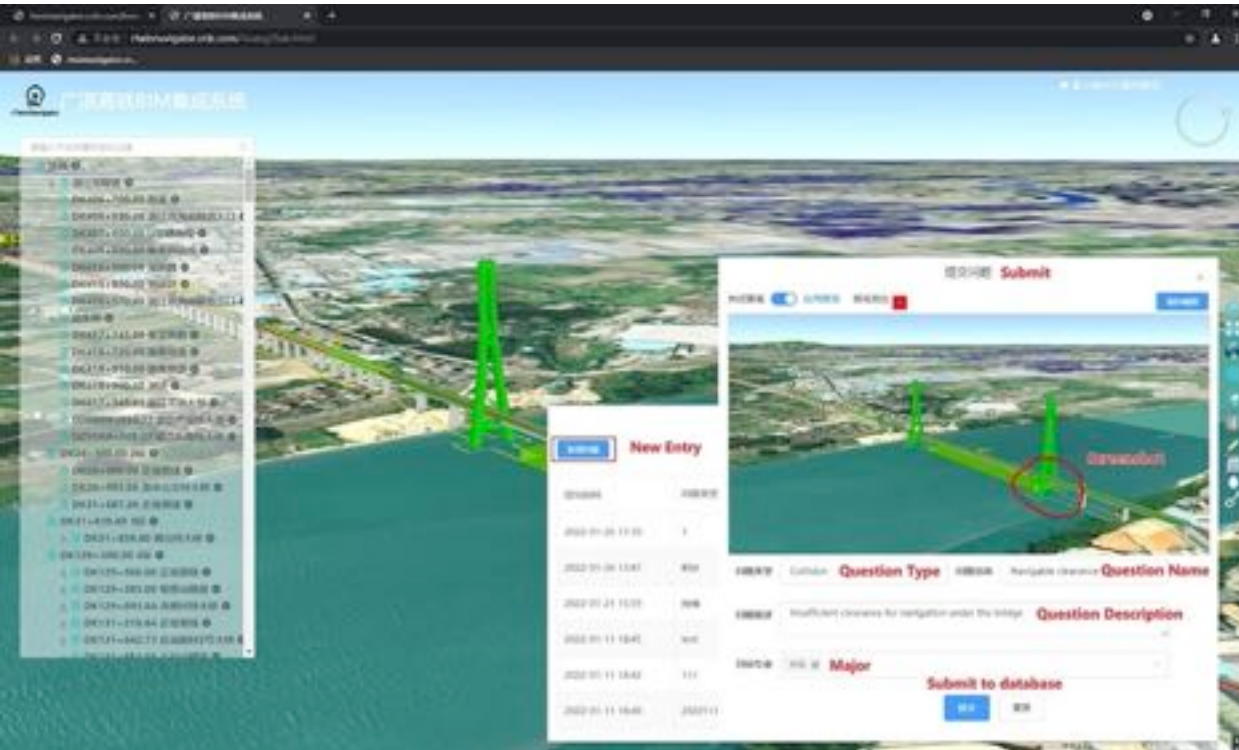
openBIM used

BCF-BIM Collaboration Format

Reviewer



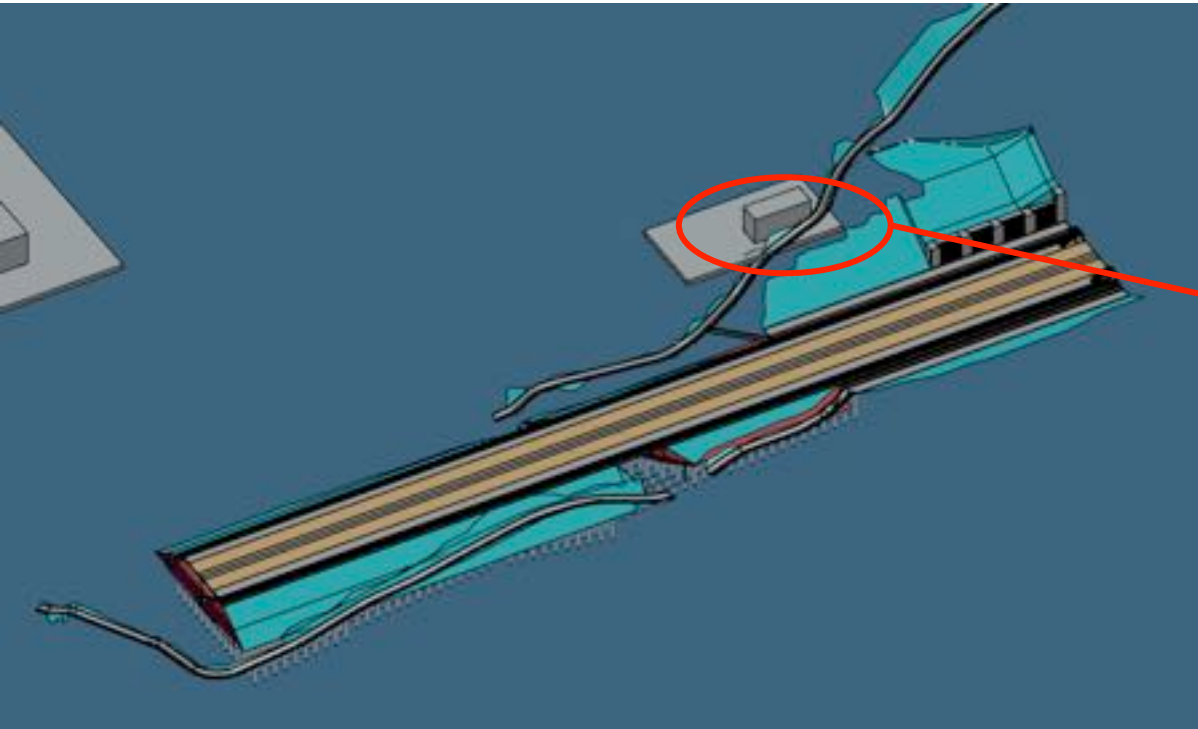
Designer



openBIM used

BCF-BIM Collaboration issues-Drainage optimization

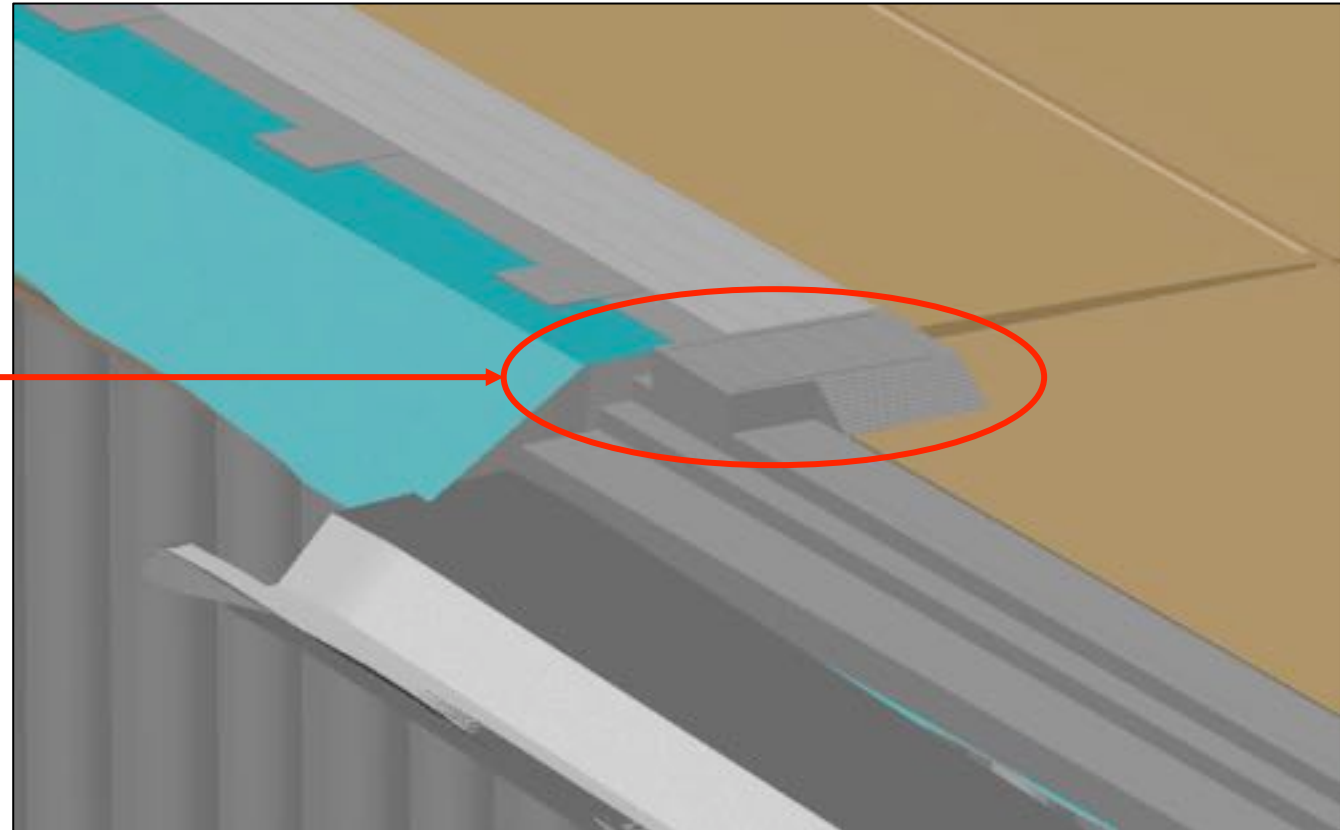
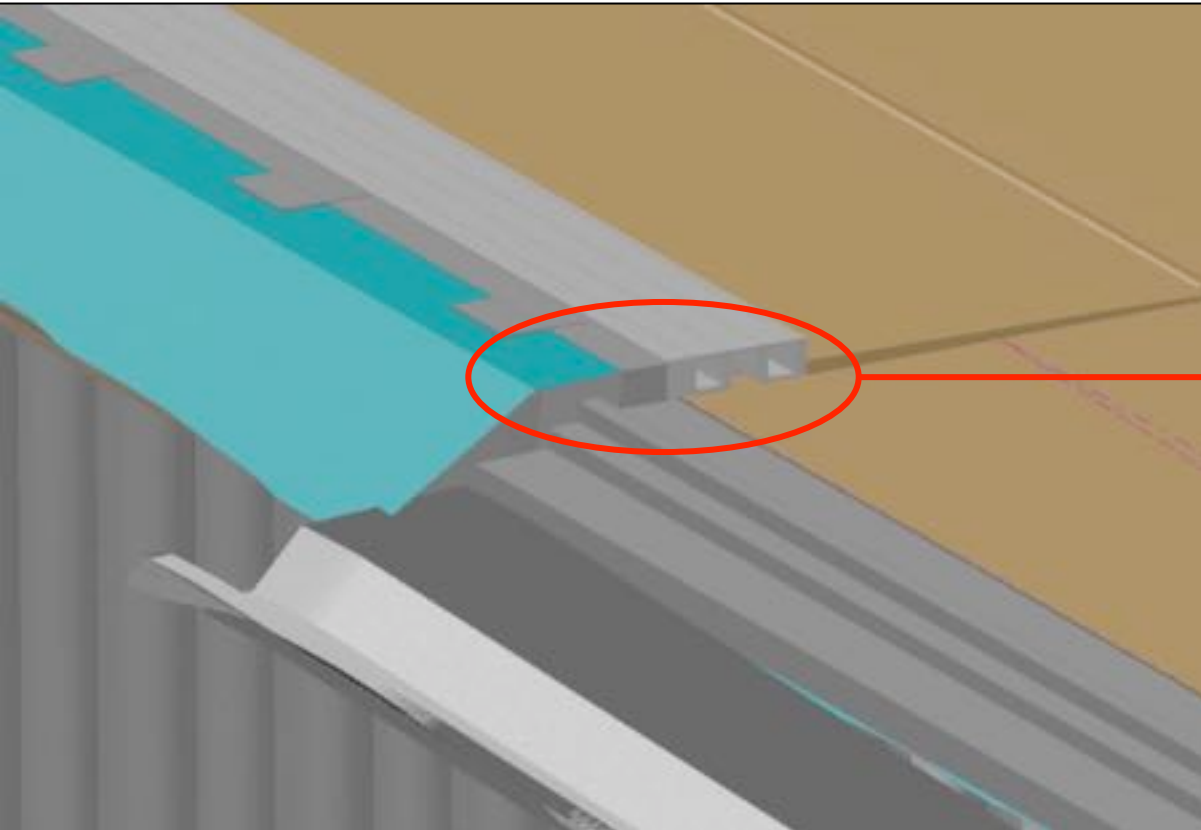
- Conflict between original site and drainage.
- New site bypasses drainage.



openBIM used

BCF-BIM Collaboration issues-Interface Optimization

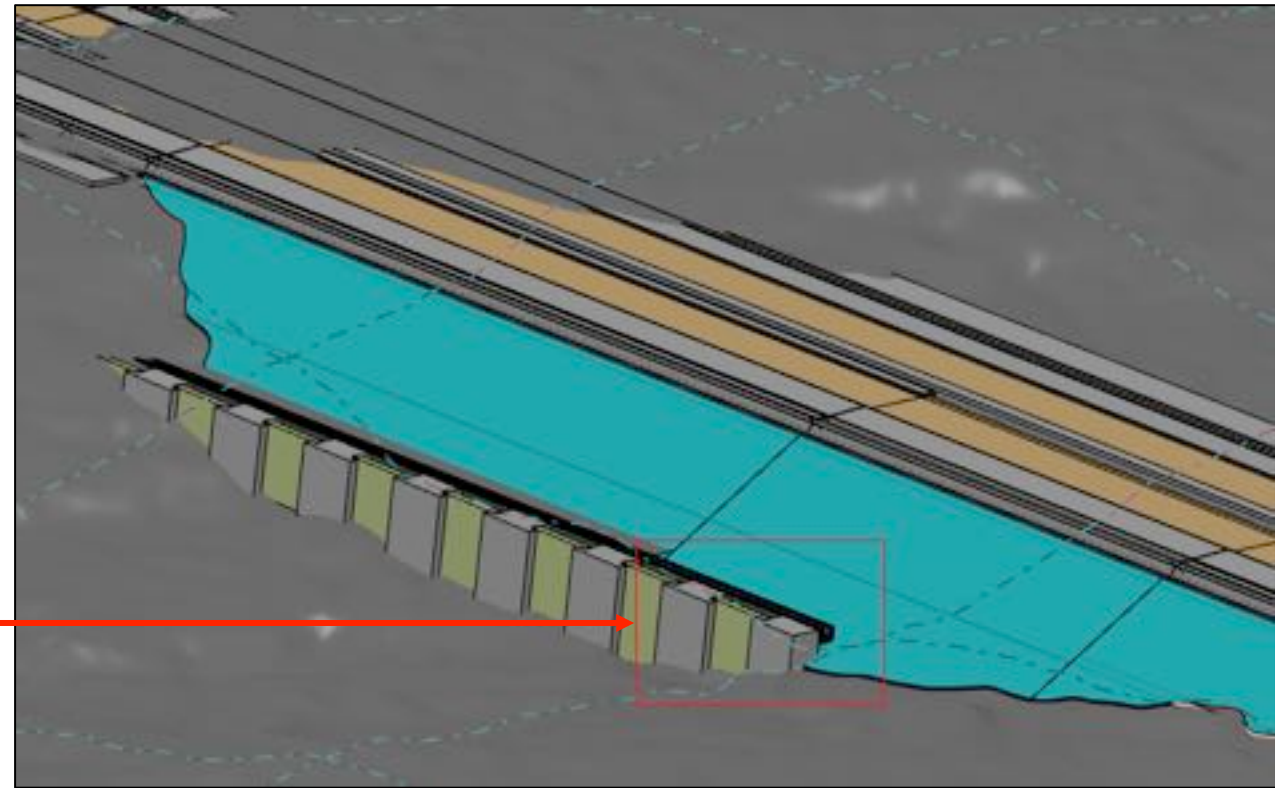
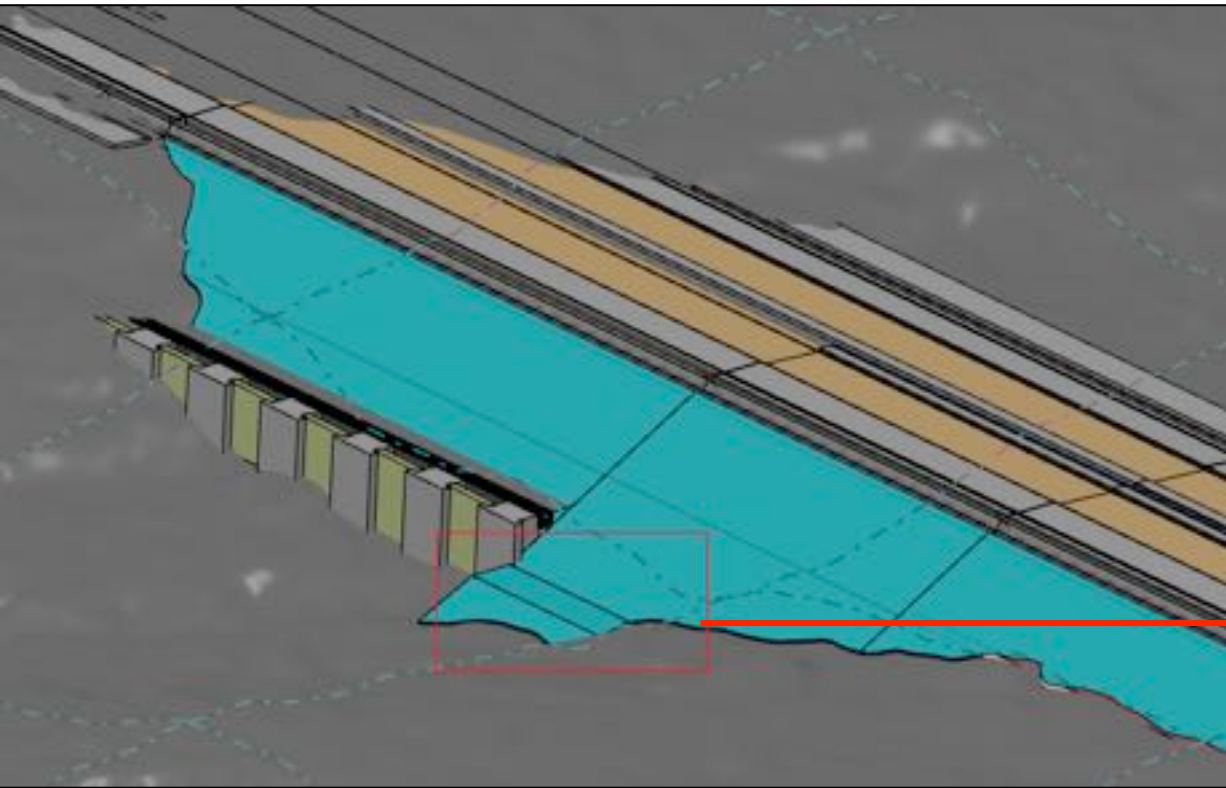
- Optimization of Subgrade and Bridge interface design.



openBIM used

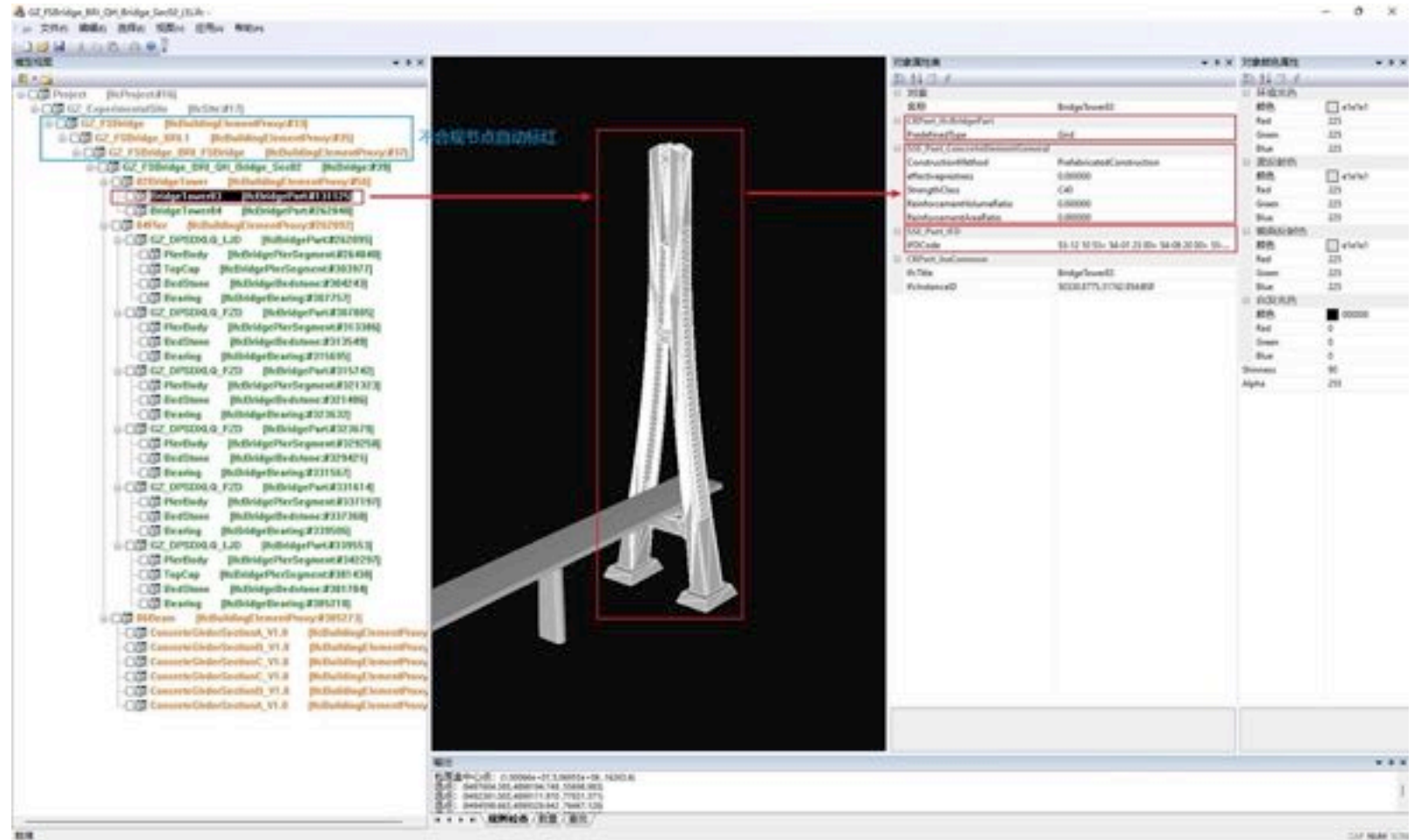
BCF-BIM Collaboration issues-Collision optimization

- Optimization of Subgrade retaining wall.



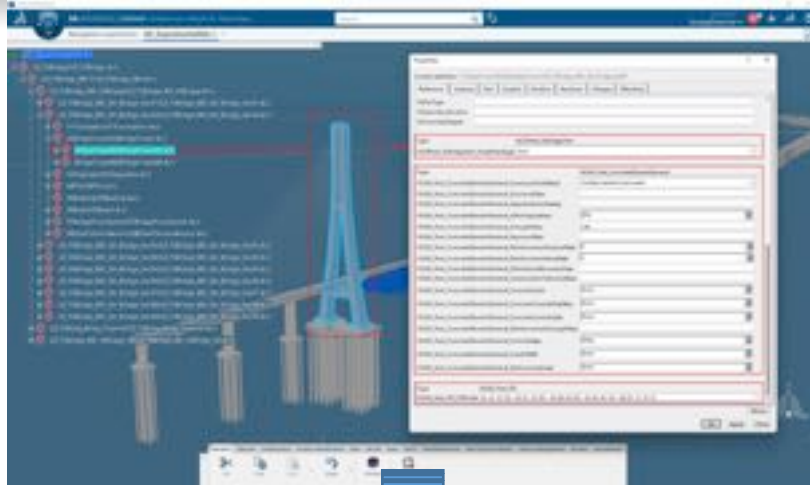
Information Model Delivery

Information model checking

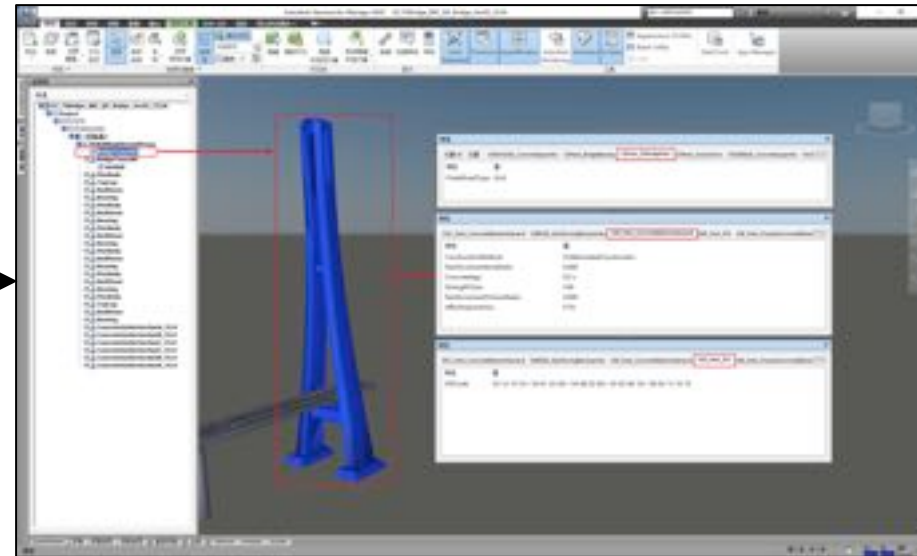
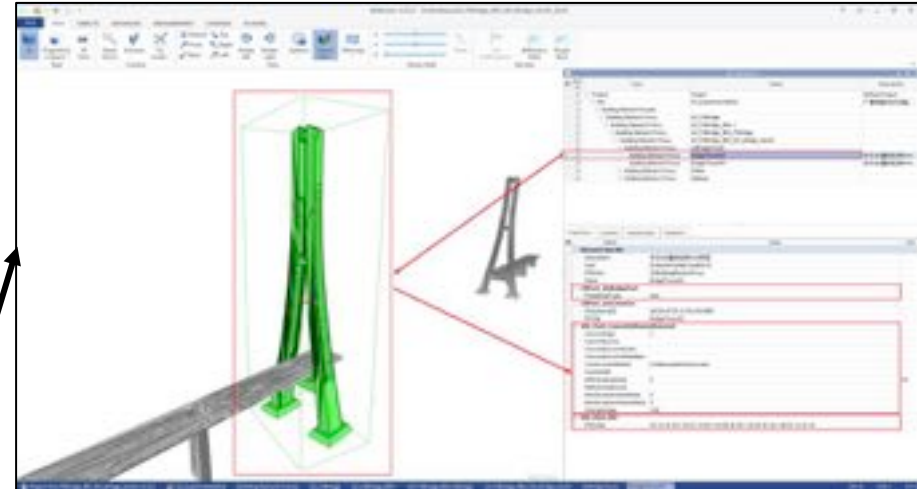


Information Model Delivery

Submit information model

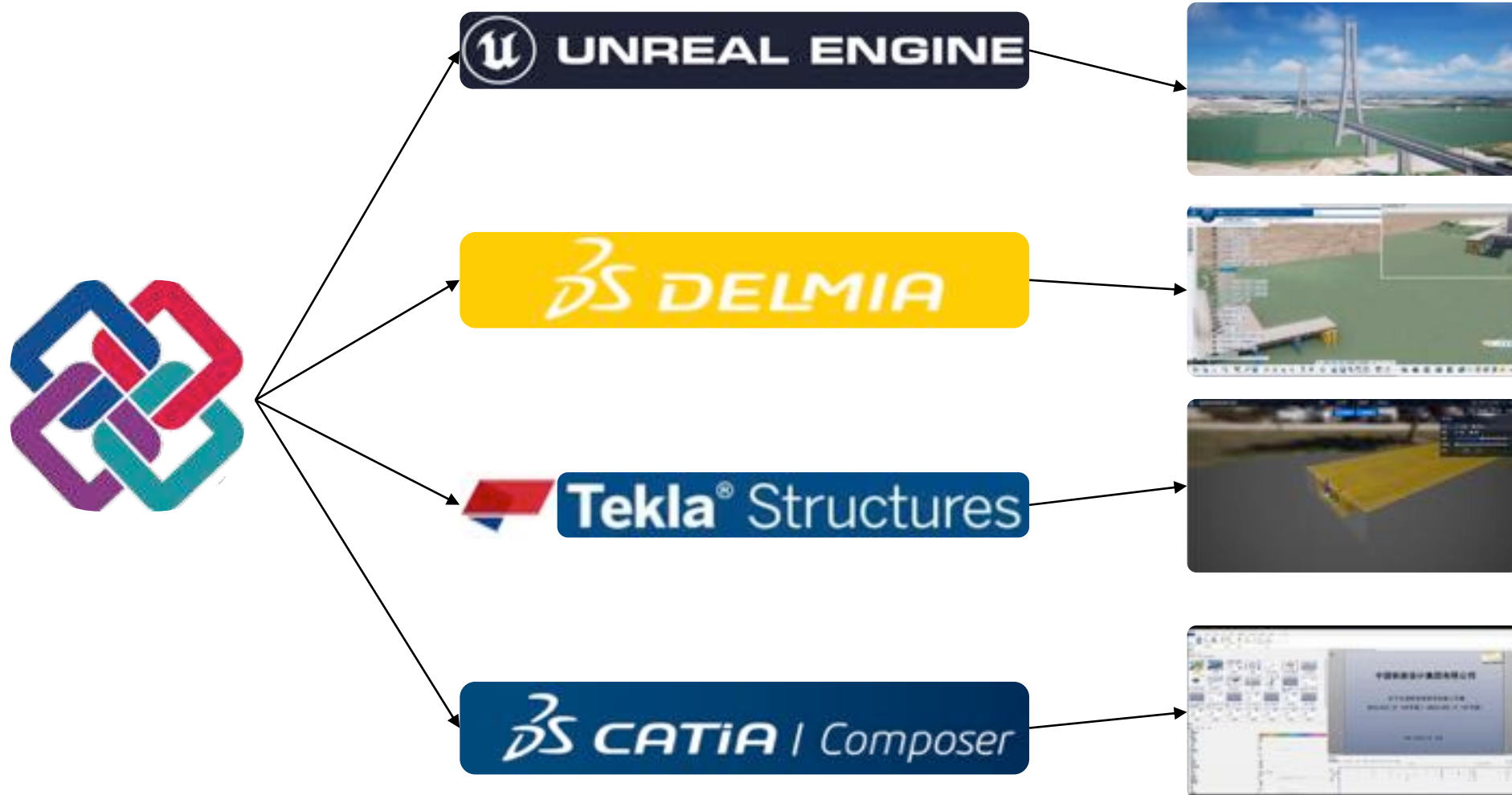


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3	1.3	1.3.1	1.3.1.1	1.3.1.1	1.3.1.1
4	1.4	1.4.1	1.4.1.1	1.4.1.1	1.4.1.1
5	1.5	1.5.1	1.5.1.1	1.5.1.1	1.5.1.1
6	1.6	1.6.1	1.6.1.1	1.6.1.1	1.6.1.1
7	1.7	1.7.1	1.7.1.1	1.7.1.1	1.7.1.1
8	1.8	1.8.1	1.8.1.1	1.8.1.1	1.8.1.1
9	1.9	1.9.1	1.9.1.1	1.9.1.1	1.9.1.1
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25	1.25	1.25.1	1.25.1.1	1.25.1.1	1.25.1.1
26	1.26	1.26.1	1.26.1.1	1.26.1.1	1.26.1.1
27	1.27	1.27.1	1.27.1.1	1.27.1.1	1.27.1.1
28	1.28	1.28.1	1.28.1.1	1.28.1.1	1.28.1.1
29	1.29	1.29.1	1.29.1.1	1.29.1.1	1.29.1.1
30	1.30	1.30.1	1.30.1.1	1.30.1.1	1.30.1.1
31	1.31	1.31.1	1.31.1.1	1.31.1.1	1.31.1.1
32	1.32	1.32.1	1.32.1.1	1.32.1.1	1.32.1.1
33	1.33	1.33.1	1.33.1.1	1.33.1.1	1.33.1.1
34	1.34	1.34.1	1.34.1.1	1.34.1.1	1.34.1.1
35	1.35	1.35.1	1.35.1.1	1.35.1.1	1.35.1.1
36	1.36	1.36.1	1.36.1.1	1.36.1.1	1.36.1.1
37	1.37	1.37.1	1.37.1.1	1.37.1.1	1.37.1.1
38	1.38	1.38.1	1.38.1.1	1.38.1.1	1.38.1.1
39	1.39	1.39.1	1.39.1.1	1.39.1.1	1.39.1.1
40	1.40	1.40.1	1.40.1.1	1.40.1.1	1.40.1.1
41	1.41	1.41.1	1.41.1.1	1.41.1.1	1.41.1.1
42	1.42	1.42.1	1.42.1.1	1.42.1.1	1.42.1.1
43	1.43	1.43.1	1.43.1.1	1.43.1.1	1.43.1.1
44	1.44	1.44.1	1.44.1.1	1.44.1.1	1.44.1.1
45	1.45	1.45.1	1.45.1.1	1.45.1.1	1.45.1.1
46	1.46	1.46.1	1.46.1.1	1.46.1.1	1.46.1.1
47	1.47	1.47.1	1.47.1.1	1.47.1.1	1.47.1.1
48	1.48	1.48.1	1.48.1.1	1.48.1.1	1.48.1.1
49	1.49	1.49.1	1.49.1.1	1.49.1.1	1.49.1.1
50	1.50	1.50.1	1.50.1.1	1.50.1.1	1.50.1.1
51	1.51	1.51.1	1.51.1.1	1.51.1.1	1.51.1.1
52	1.52	1.52.1	1.52.1.1	1.52.1.1	1.52.1.1
53	1.53	1.53.1	1.53.1.1	1.53.1.1	1.53.1.1
54	1.54	1.54.1	1.54.1.1	1.54.1.1	1.54.1.1
55	1.55	1.55.1	1.55.1.1	1.55.1.1	1.55.1.1
56	1.56	1.56.1	1.56.1.1	1.56.1.1	1.56.1.1
57	1.57	1.57.1	1.57.1.1	1.57.1.1	1.57.1.1
58	1.58	1.58.1	1.58.1.1	1.58.1.1	1.58.1.1
59	1.59	1.59.1	1.59.1.1	1.59.1.1	1.59.1.1
60	1.60	1.60.1	1.60.1.1	1.60.1.1	1.60.1.1
61	1.61	1.61.1	1.61.1.1	1.61.1.1	1.61.1.1
62	1.62	1.62.1	1.62.1.1	1.62.1.1	1.62.1.1
63	1.63	1.63.1	1.63.1.1	1.63.1.1	1.63.1.1
64	1.64	1.64.1	1.64.1.1	1.64.1.1	1.64.1.1
65	1.65	1.65.1	1.65.1.1	1.65.1.1	1.65.1.1
66	1.66	1.66.1	1.66.1.1	1.66.1.1	1.66.1.1
67	1.67	1.67.1	1.67.1.1	1.67.1.1	1.67.1.1
68	1.68	1.68.1	1.68.1.1	1.68.1.1	1.68.1.1
69	1.69	1.69.1	1.69.1.1	1.69.1.1	1.69.1.1
70	1.70	1.70.1	1.70.1.1	1.70.1.1	1.70.1.1
71	1.71	1.71.1	1.71.1.1	1.71.1.1	1.71.1.1
72	1.72	1.72.1	1.72.1.1	1.72.1.1	1.72.1.1
73	1.73	1.73.1	1.73.1.1	1.73.1.1	1.73.1.1
74	1.74	1.74.1	1.74.1.1	1.74.1.1	1.74.1.1
75	1.75	1.75.1	1.75.1.1	1.75.1.1	1.75.1.1
76	1.76	1.76.1	1.76.1.1	1.76.1.1	1.76.1.1
77	1.77	1.77.1	1.77.1.1	1.77.1.1	1.77.1.1
78	1.78	1.78.1	1.78.1.1	1.78.1.1	1.78.1.1
79	1.79	1.79.1	1.79.1.1	1.79.1.1	1.79.1.1
80	1.80	1.80.1	1.80.1.1	1.80.1.1	1.80.1.1
81	1.81	1.81.1	1.81.1.1	1.81.1.1	1.81.1.1
82	1.82	1.82.1	1.82.1.1	1.82.1.1	1.82.1.1
83	1.83	1.83.1	1.83.1.1	1.83.1.1	1.83.1.1
84	1.84	1.84.1	1.84.1.1	1.84.1.1	1.84.1.1
85	1.85	1.85.1	1.85.1.1	1.85.1.1	1.85.1.1
86	1.86	1.86.1	1.86.1.1	1.86.1.1	1.86.1.1
87	1.87	1.87.1	1.87.1.1	1.87.1.1	1.87.1.1
88	1.88	1.88.1	1.88.1.1	1.88.1.1	1.88.1.1
89	1.89	1.89.1	1.89.1.1	1.89.1.1	1.89.1.1
90	1.90	1.90.1	1.90.1.1	1.90.1.1	1.90.1.1
91	1.91	1.91.1	1.91.1.1	1.91.1.1	1.91.1.1
92	1.92	1.92.1	1.92.1.1	1.92.1.1	1.92.1.1
93	1.93	1.93.1	1.93.1.1	1.93.1.1	1.93.1.1
94	1.94	1.94.1	1.94.1.1	1.94.1.1	1.94.1.1
95	1.95	1.95.1	1.95.1.1	1.95.1.1	1.95.1.1
96	1.96	1.96.1	1.96.1.1	1.96.1.1	1.96.1.1
97	1.97	1.97.1	1.97.1.1	1.97.1.1	1.97.1.1
98	1.98	1.98.1	1.98.1.1	1.98.1.1	1.98.1.1
99	1.99	1.99.1	1.99.1.1	1.99.1.1	1.99.1.1
100	2.00	2.00.1	2.00.1.1	2.00.1.1	2.00.1.1



Information Model Delivery

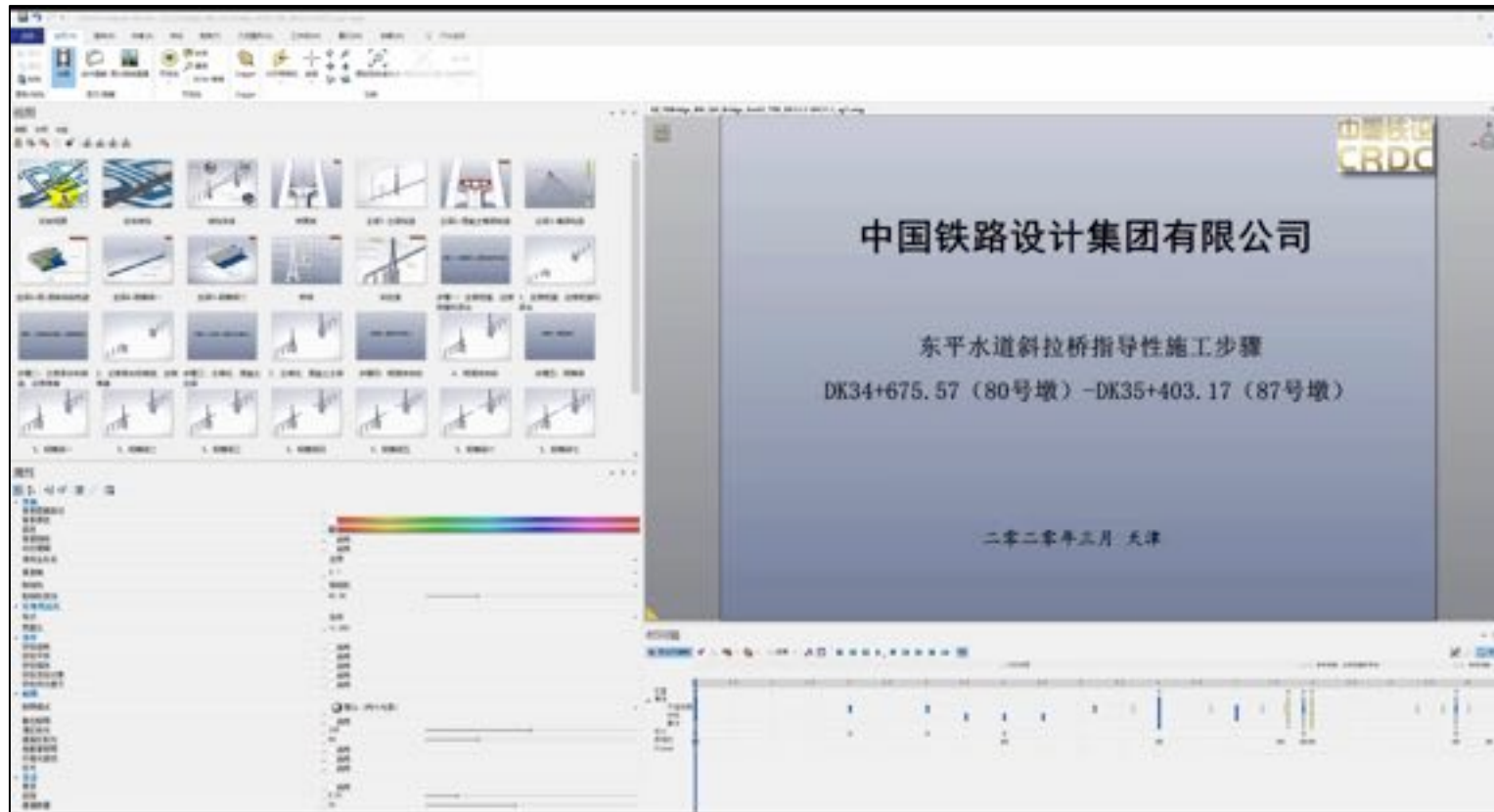
Information model transfer



Information Model Delivery

Information model transfer and digital delivery-EXE

- Composer was used to compile EXE program of "3D Design Instructions for Railway Engineering", which helps users to have a comprehensive understanding of the project without the need for third-party software.



Information Model Delivery

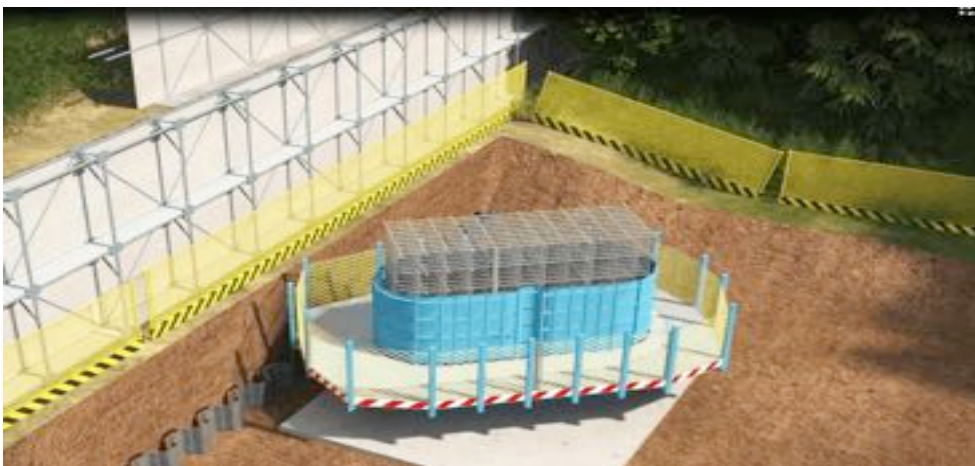
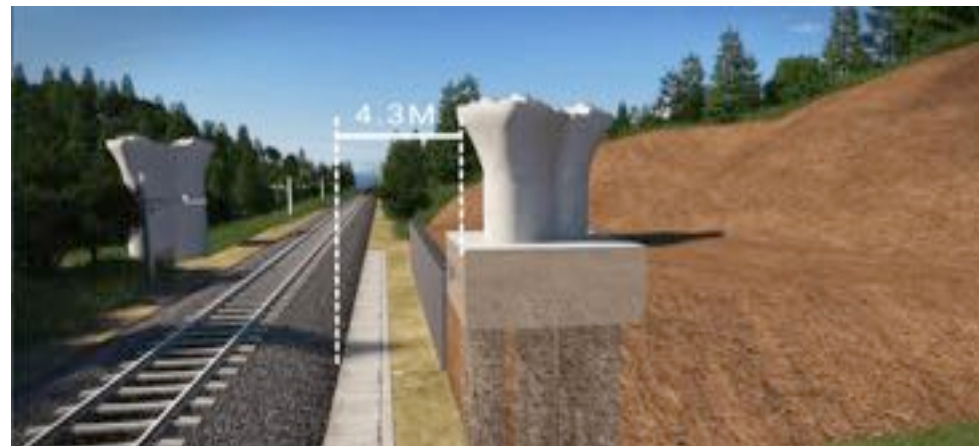
Information model transfer and digital delivery-3D PDF

- Importing the BIM model into 3DPDF is an innovative attempt. Information model was embedded in the PDF file and realize the interactive experience of the 3D model in the 2D file.



Information Model Delivery

Information model transfer and digital delivery-Virtual construction



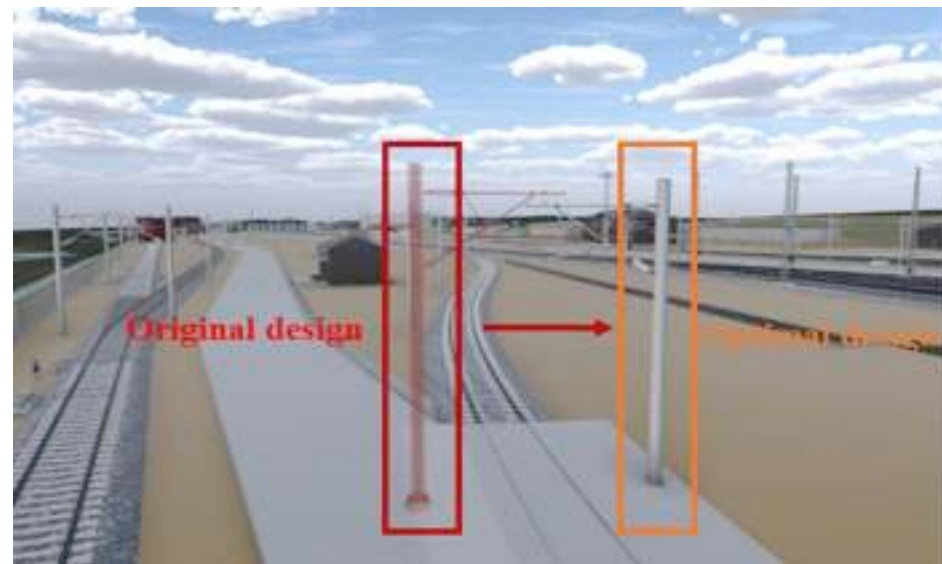
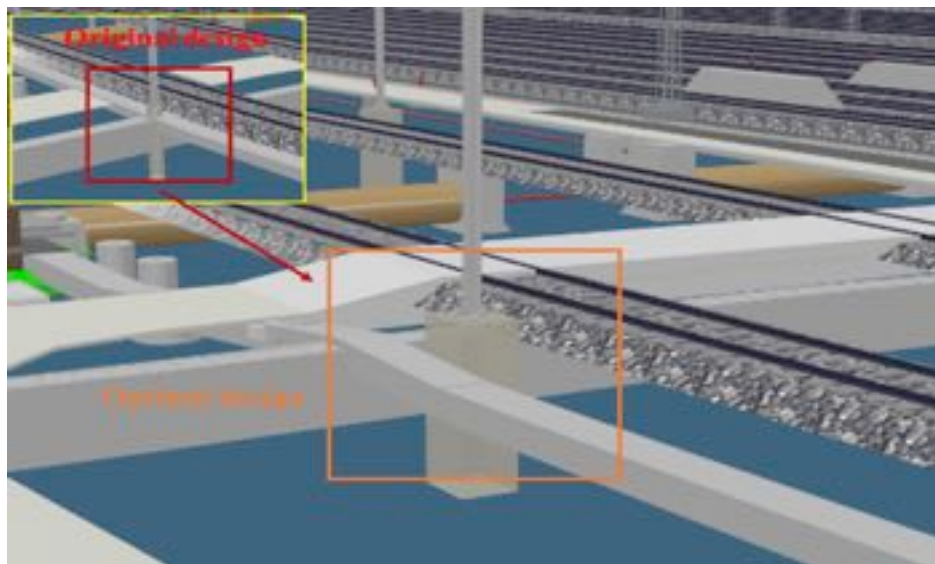
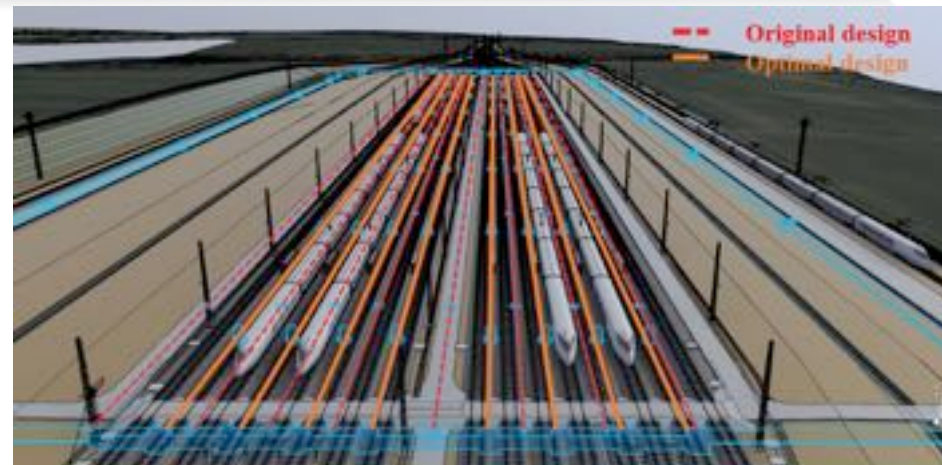
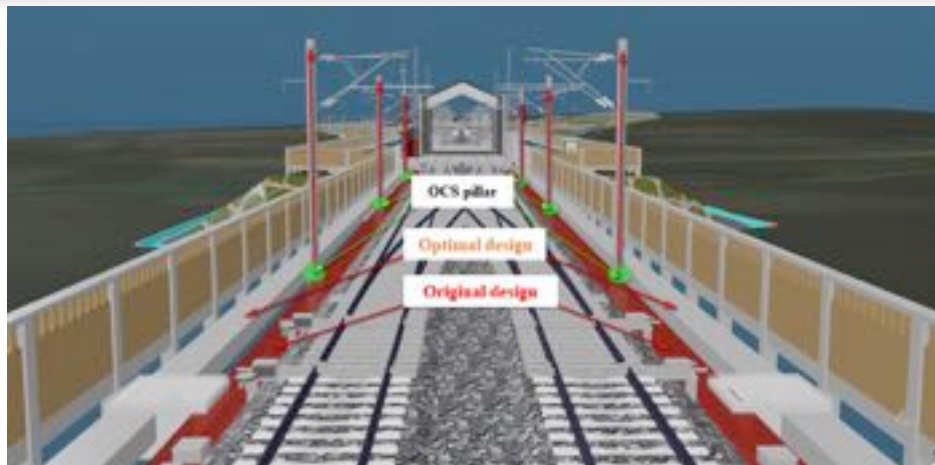
Information Model Delivery

Information model transfer and digital delivery-VR



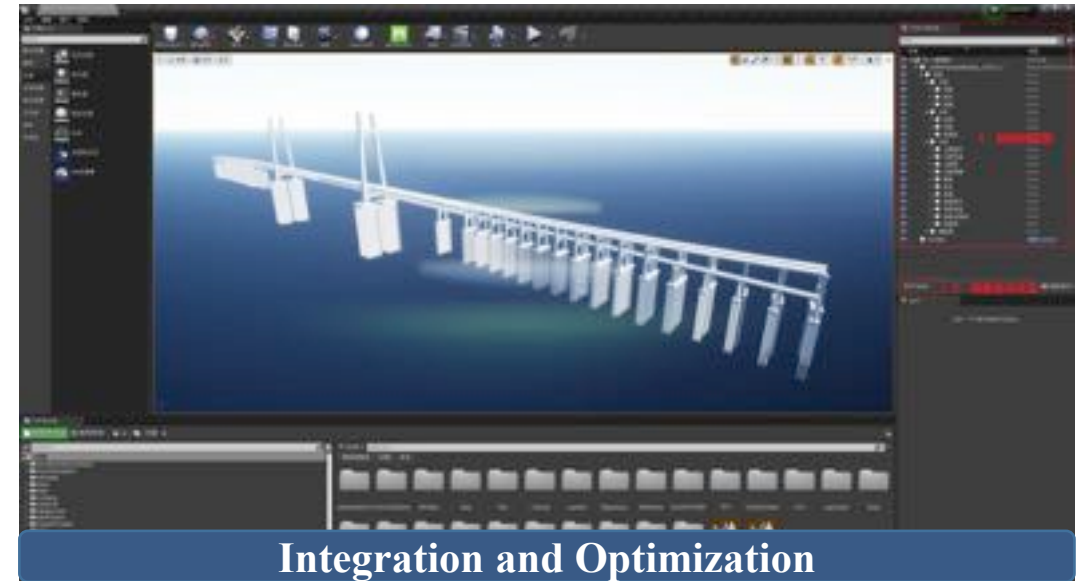
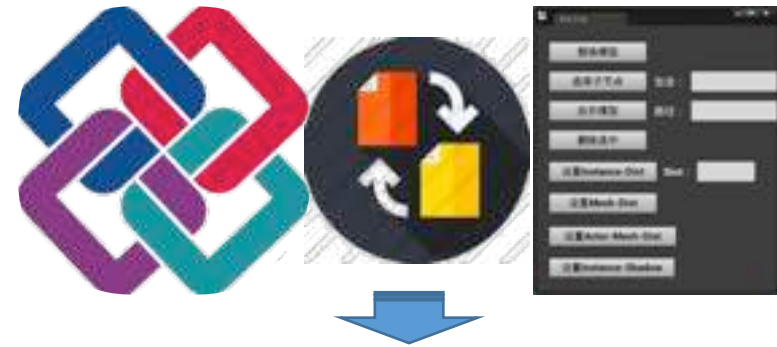
openBIM Use Cases

Comprehensive pipeline collision detection and optimization



openBIM Use Cases

Engineering visualization based on virtual reality



openBIM Use Cases

Intelligent management in tunnel construction





Thank you!