Design of a Rail Maintenance Facility on Iconic Metro Project: Grand Paris Express

Louis-Marie BORIONE

BIM Manager

Class summary

In this class, we will share Systra's experience on project Building Information Modeling implementation, and show how BIM can be used for rail infrastructure design.

You will also discover how BIM can be effective for track alignment, utilities, hydrology, catenary, and telecom when interfacing with architecture, structure, and MEP (mechanical, electrical, and plumbing) services.

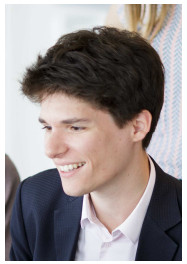
- SYSTRA Presentation
- Project Presentation
- Production Organisation
- Civil Engineering Design
- Building Design
- Coordination

Key learning objectives

At the end of this class, you will be able to:

- Discover BIM for typical rail infrastructure workflows
- Understand data exchange and interoperability between Revit and AutoCAD Civil 3D
- Learn how to implement a BIM process for a depot (industrial site, maintenance site for metro)
- Learn how to implement coordination and design reviews

In front of you today…



Louis Marie BORIONE
SYSTRA BIM Manager
SYSTRA

Lionel Fabre
Technical consultant
Autodesk

Key figures

Education :
- Civil Engineer graduated from ESTP, Paris France

Experience:
- 7 years in BIM Management and modelisation

Main Project Achievements:
- Grand Paris Express T2
- BIM for Electrification Development

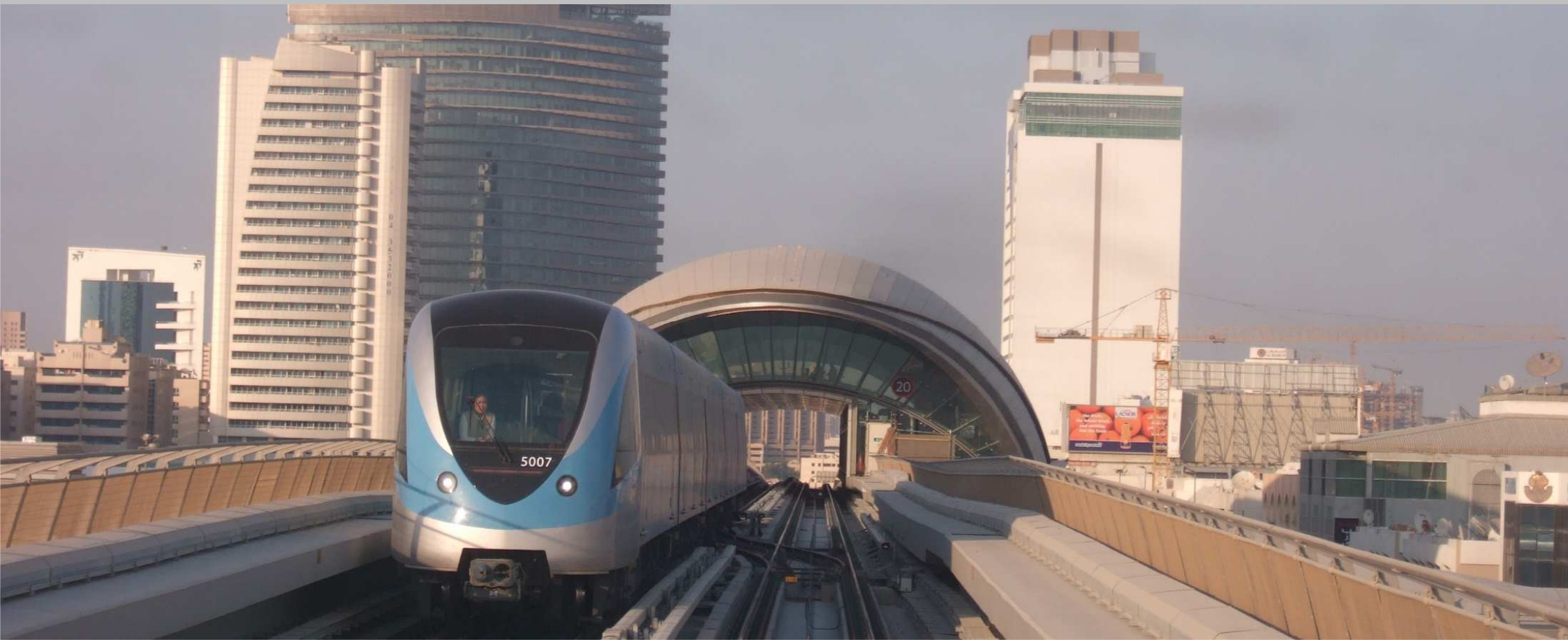
Additionnal responsabilities :
- In charge of technical BIM Support

Speaker at AU2014

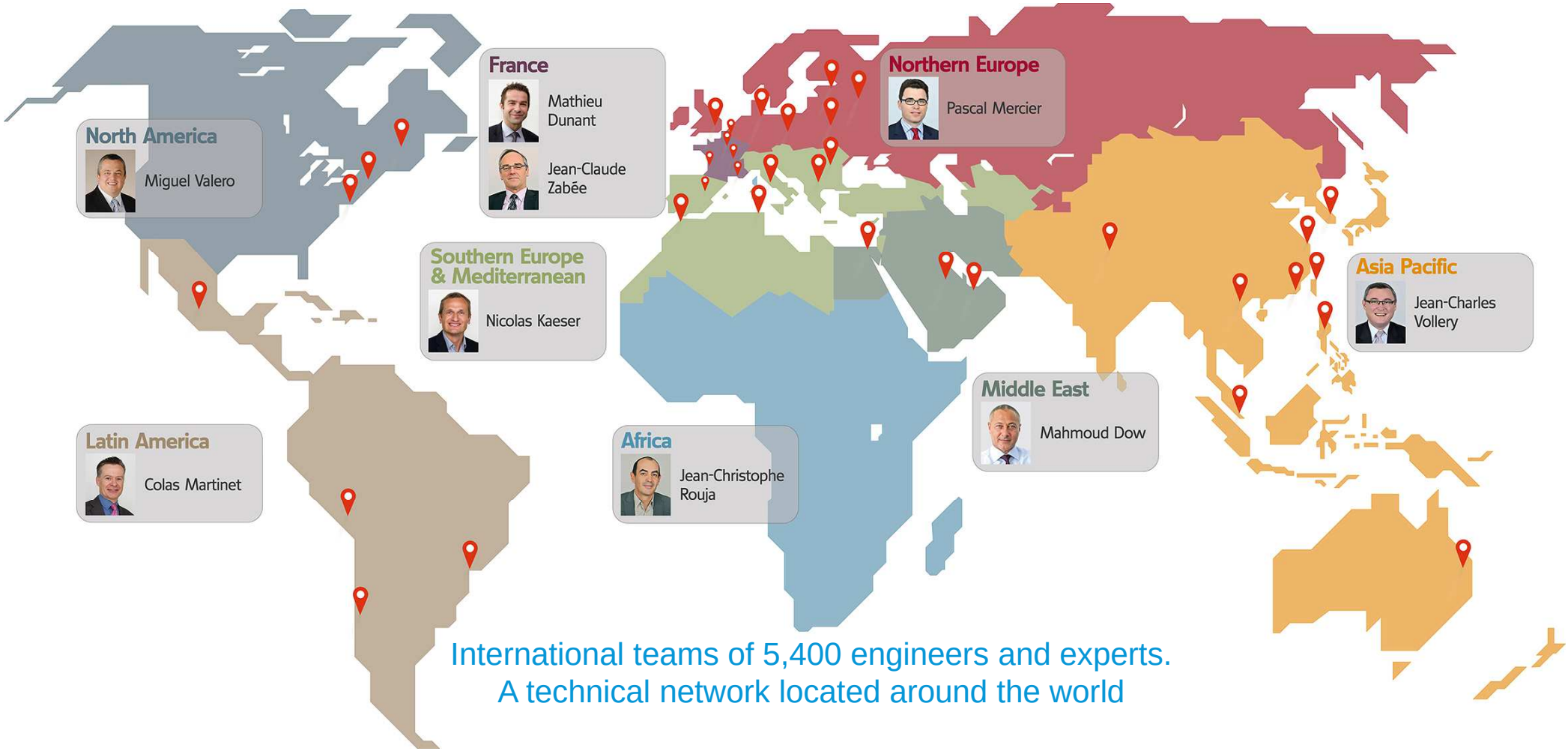
Systra Presentation

A unique, decentralized engineering model
A wealth of experience based on 60 years **of railway operations**

Key figures : **€623 million** sales turnover in 2015 ***(658 million dollars)***

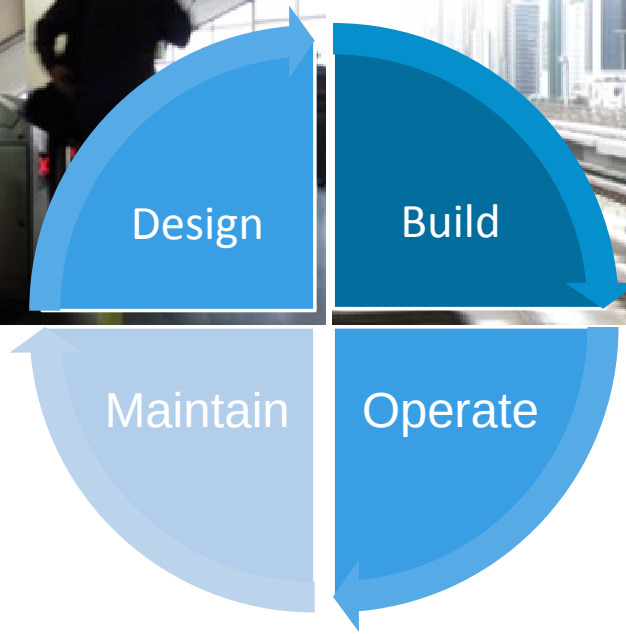


SYSTRA is active in more than 80 countries



International teams of 5,400 engineers and experts.
A technical network located around the world

SYSTRA is able to work on the whole lifecycle of a project thanks to our technical skills



SNCF and RATP, key players in the French transport sector, are SYSTRA’s main shareholders : Maintenance and Operations are in SYSTRA's DNA

SYSTRA has worked on half of the world's metro systems
SYSTRA engineering facilitates the travel of 50 million passengers per day

Paris Line 14

Dubai (red and green lines)

Santiago de Chile (lines 1, 2, 4, 5 and extensions)

Delhi, India

Makkah

Sofia Line 2, Bulgaria

High Speed Rail: SYSTRA has worked on half of the world's HSRs
500 km / h – A World Record for New High Speed Railways

East European HSR, France

Mediterranean HSR, France

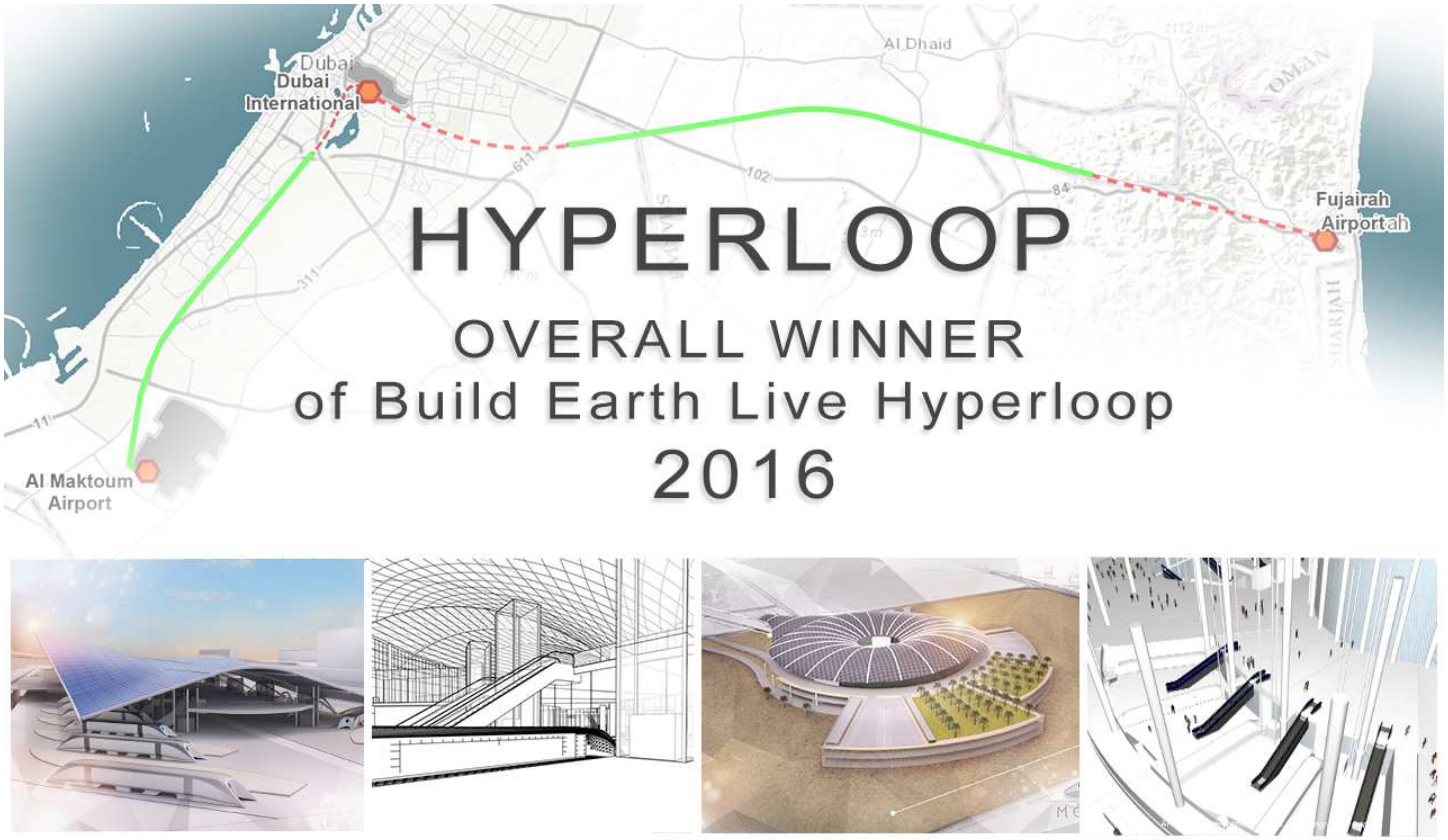
Rhin-Rhône HSR, France

Morocco, Casablanca-Tangiers

KTX, Korea

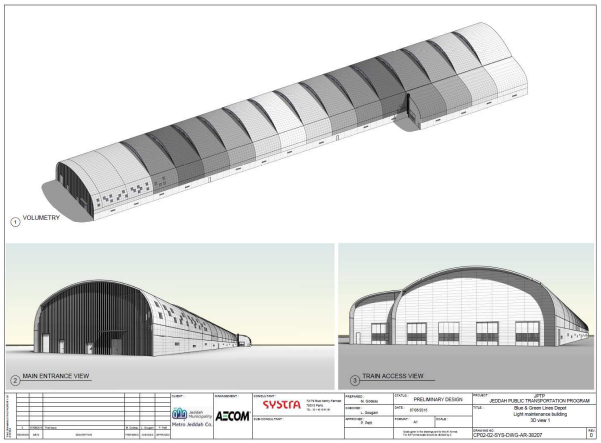
High Speed One, UK

Hyperloop BIM Station Design Competition WINNER

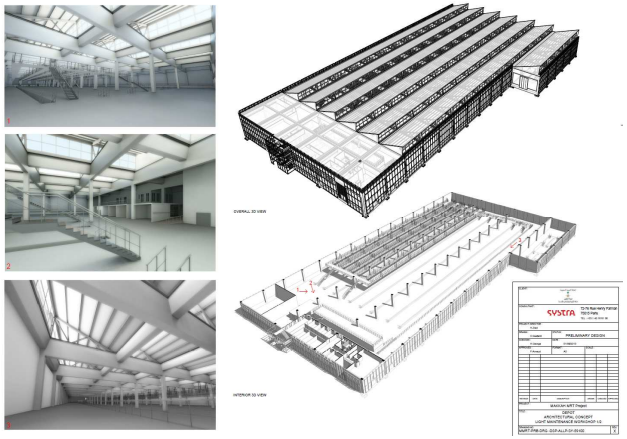


Project Presentation

Depots design by SYSTRA using BIM



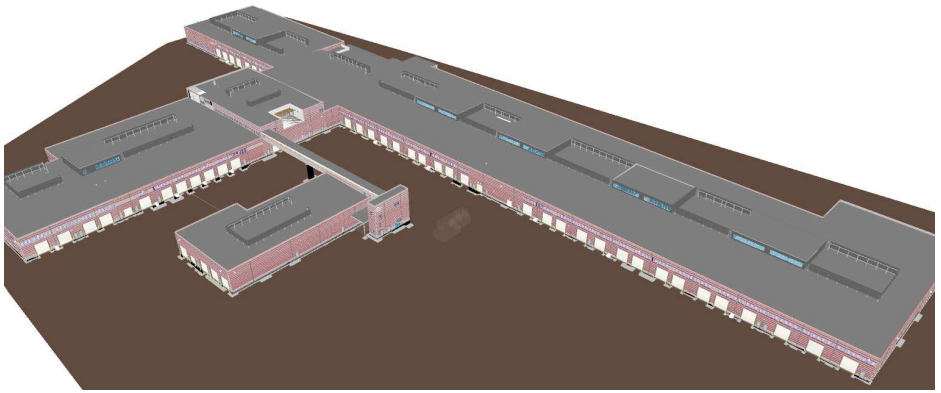
Jeddah metro maintenance building, Saudi Arabia



Mecca metro Depot, Saudi Arabia

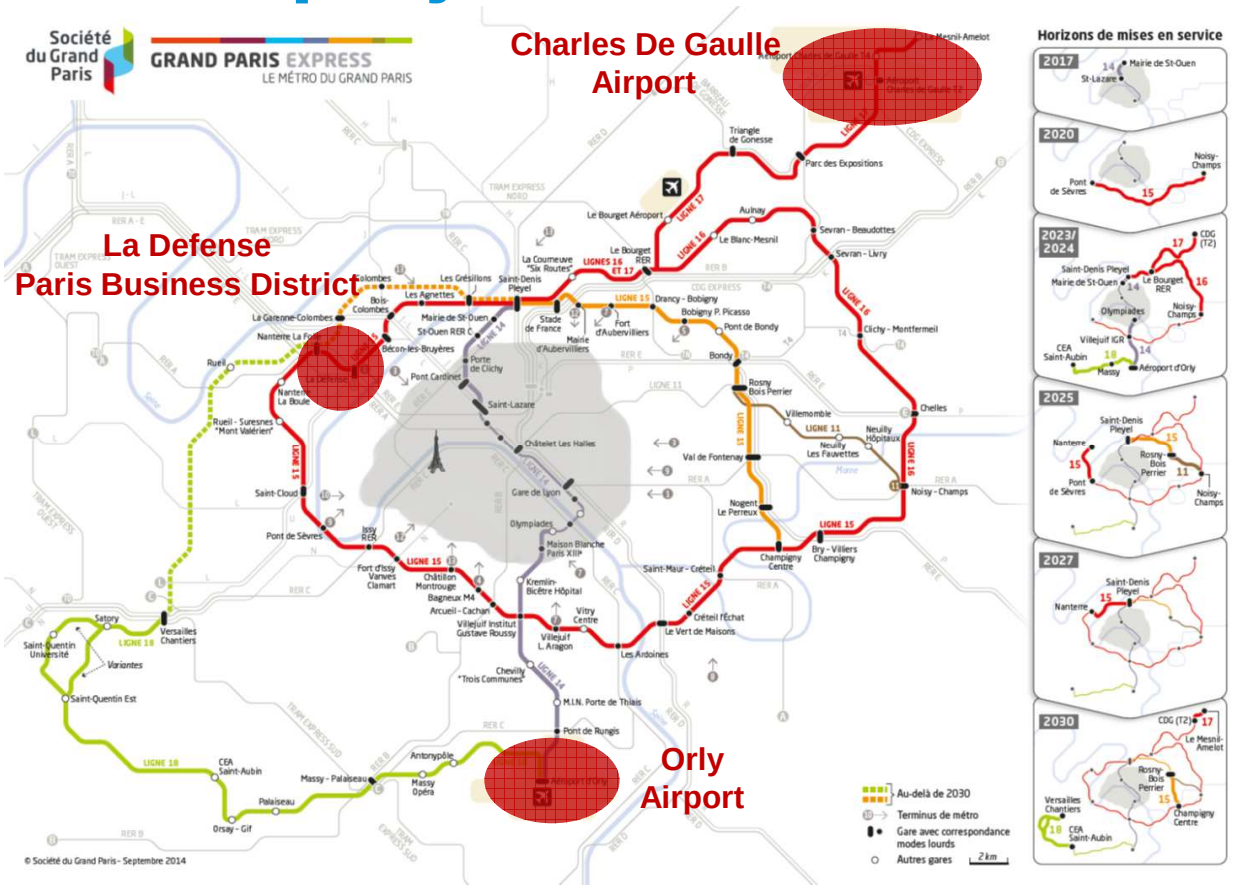
- High technical requirements
- Low architectural quality
- Industrial site far from residential district

Batna tramwat depot site, Algeria



Washington Bus depot site, USA

Grand Paris Express
Metro project around Paris



200 km new line

68 new stations

1000 engineers working on the project

24.7 billions € for investment in infrastructure

Between 15 000 and 20 000 jobs created every year

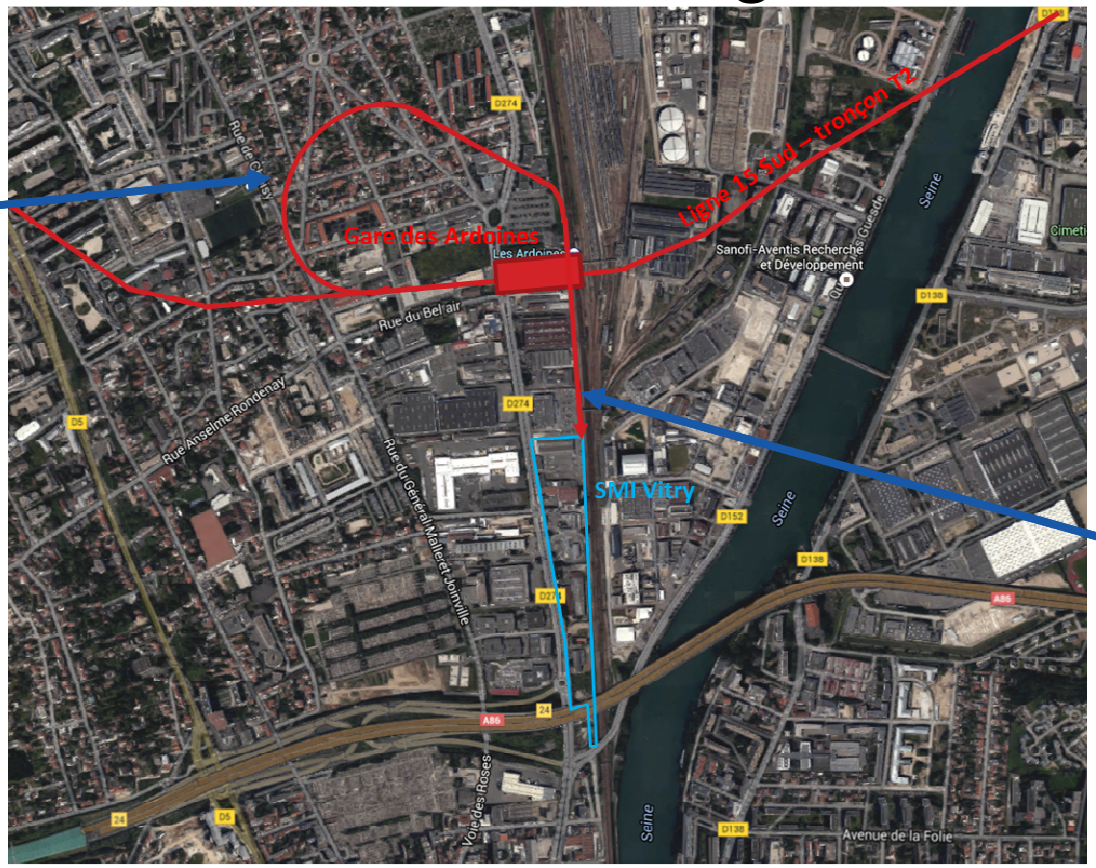
Vitry Depot - Project presentation

Geographical situation

Vitry Depot - Project presentation

Connection to alignement

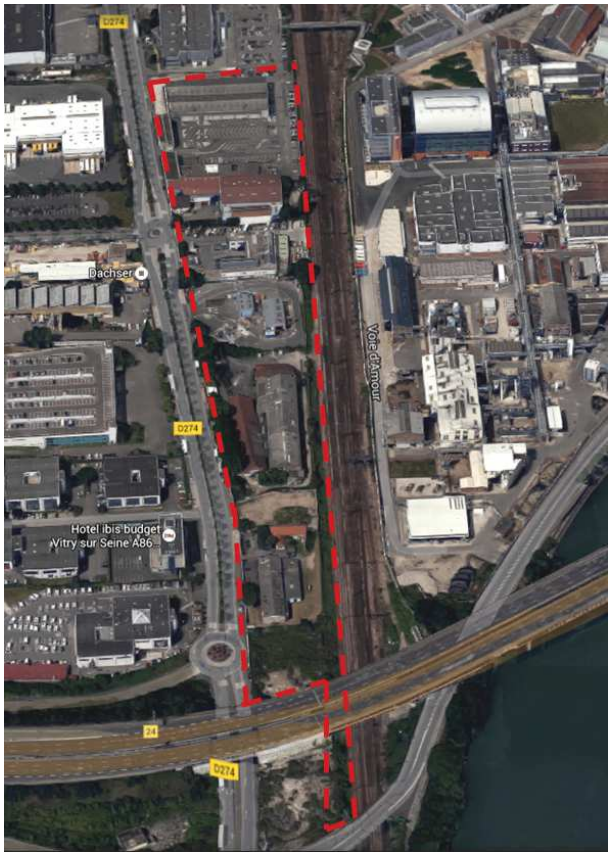
Cover
Tunnel



Open cut

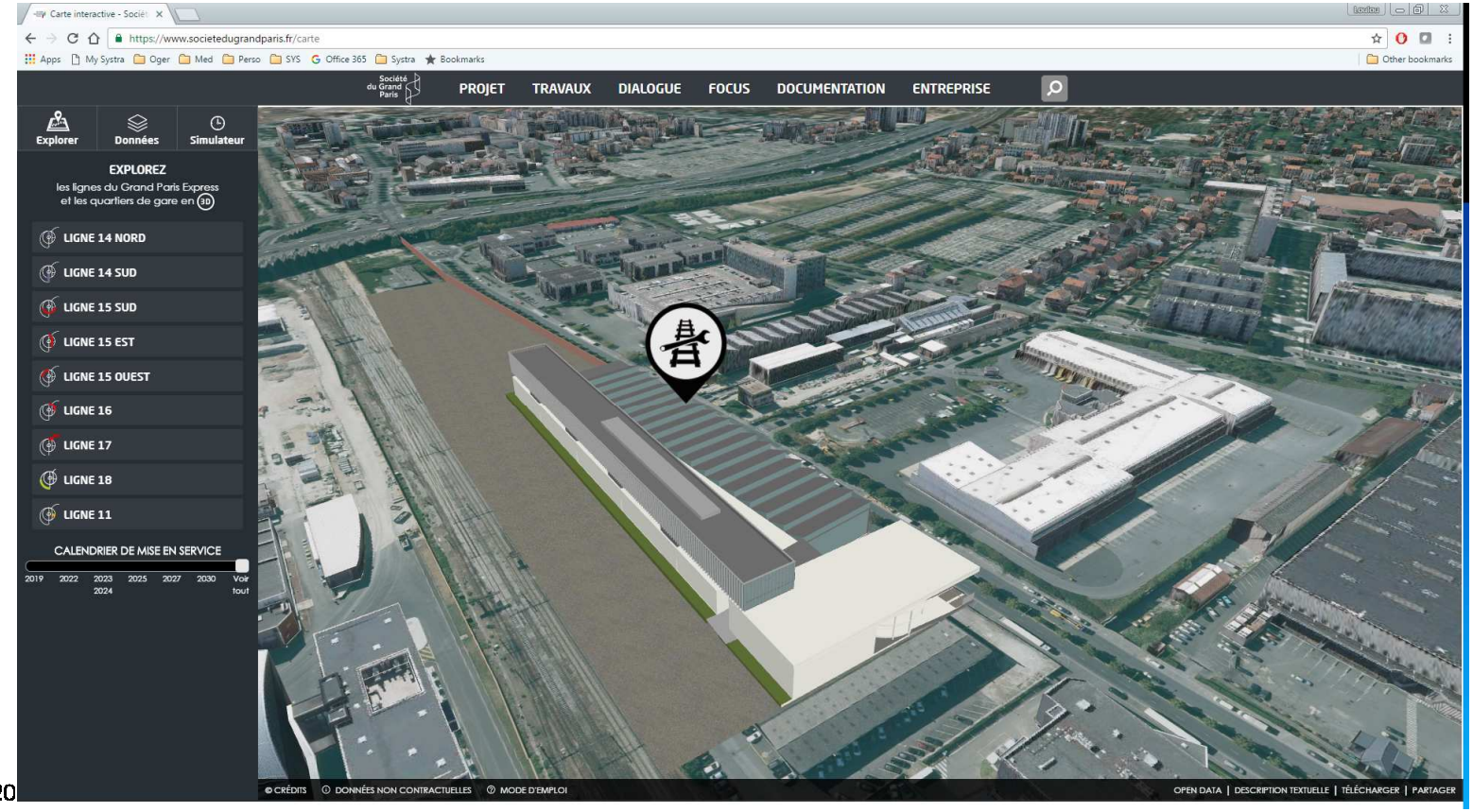
Vitry Depot - Project presentation

Aerial View

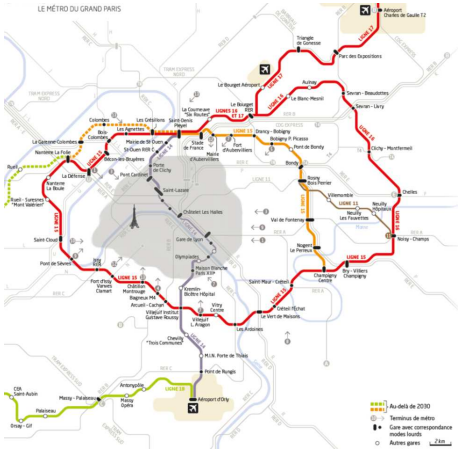


Vitry Depot - Project presentation

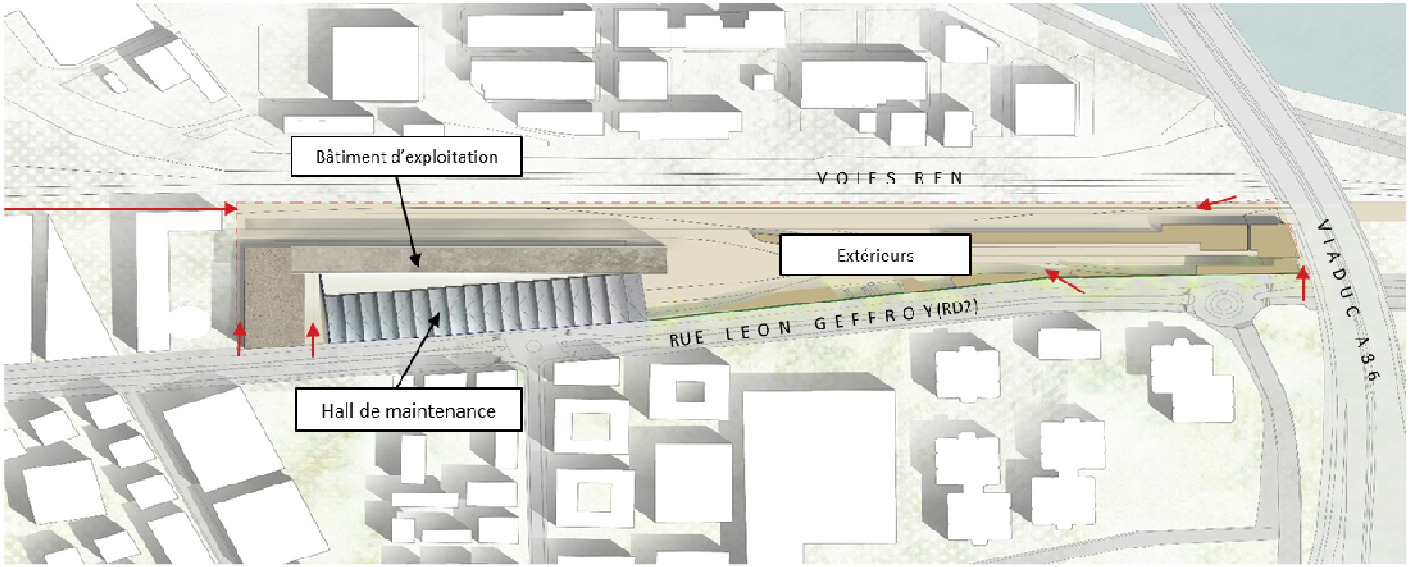
https://www.societedugrandparis.fr/carte



Vitry Depot - Project presentation



- Maintenance site for 60% of red line infrastructures
- Three main spaces:
  - Outdoor : lines, stock
  - Exploitation building : exploitation offices, parkings
  - Maintenance hall : standard and heavy maintenance



Vitry Depot - Project presentation

Project Stakeholders

> Owner :

- Société du Grand Paris (SGP)

> Client technical assistance:

- Artemis

> Designer:

- Joint venture
  - SYSTRA – Project management and Civil
  - Marc Barani – Architecture
  - Alto – Structure
  - Jacobs - MEP

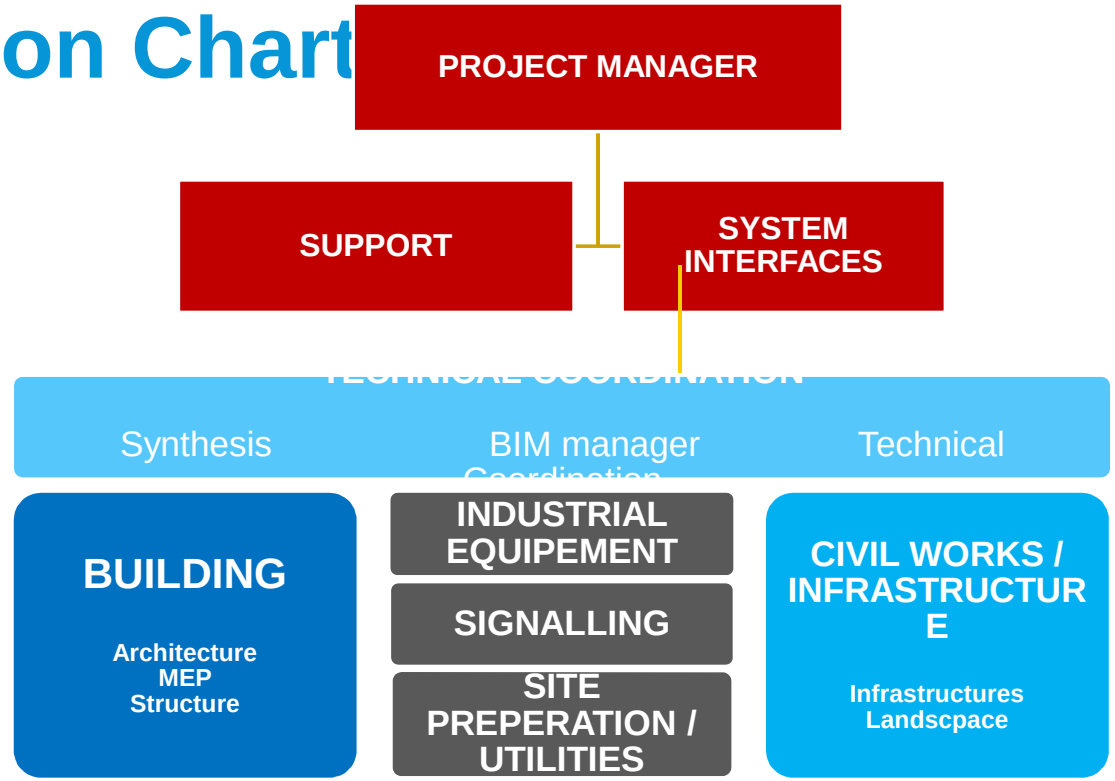
Project - BIM Objectives

- Client Objectives
  - **Project Management**
    - Decision making process
    - Design Coordination
  - **Communication**
    - Communication to public, local authorities
    - 3D website
    - Virtual reality
  - **Technical asset management**
    - As-Built model and data management at several scale:
      - Urban development
      - Line section
      - Stations
      - Equipments

- SYSTRA Objectives
  - **Drawing production**
  - **Synthesis**
  - **Quantity takeoff**

Production Organization

Organization Chart

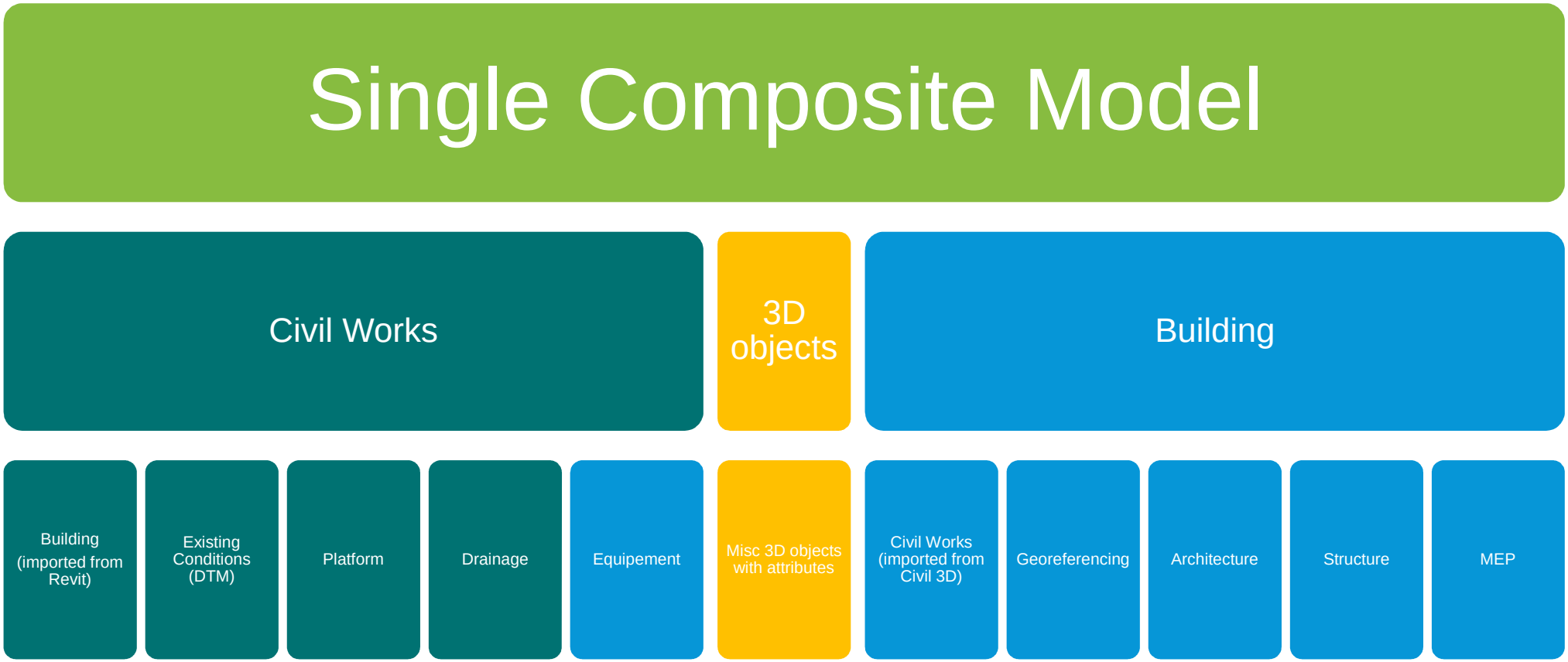


BUILDING

INFRA

Models organisation

Civil 3D | Navisworks | Revit | Autocad

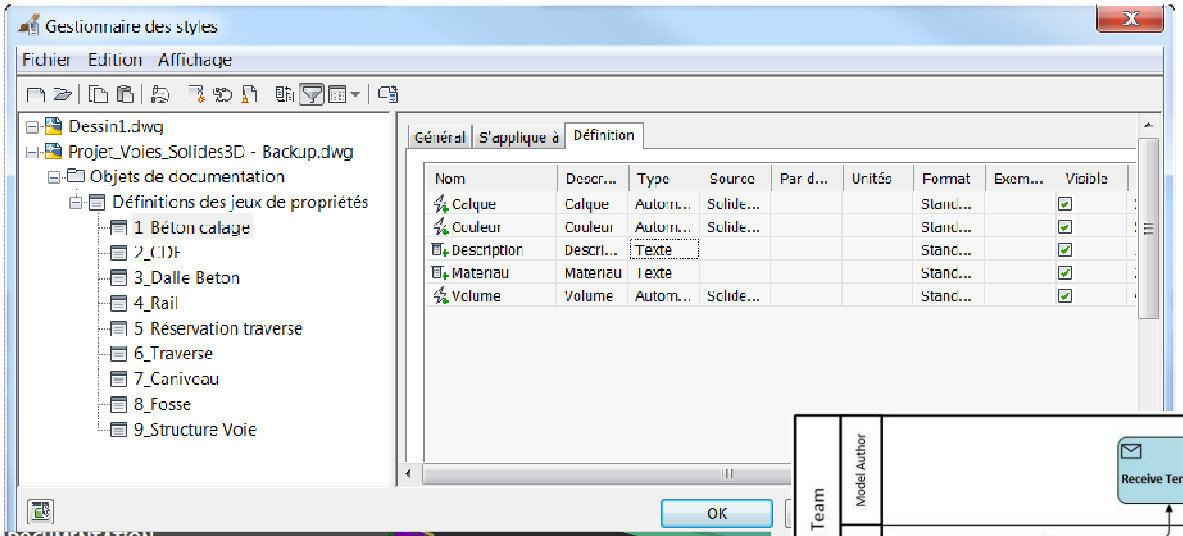


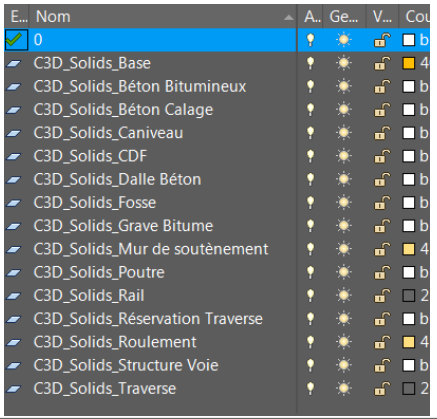
Autodesk Consulting Services

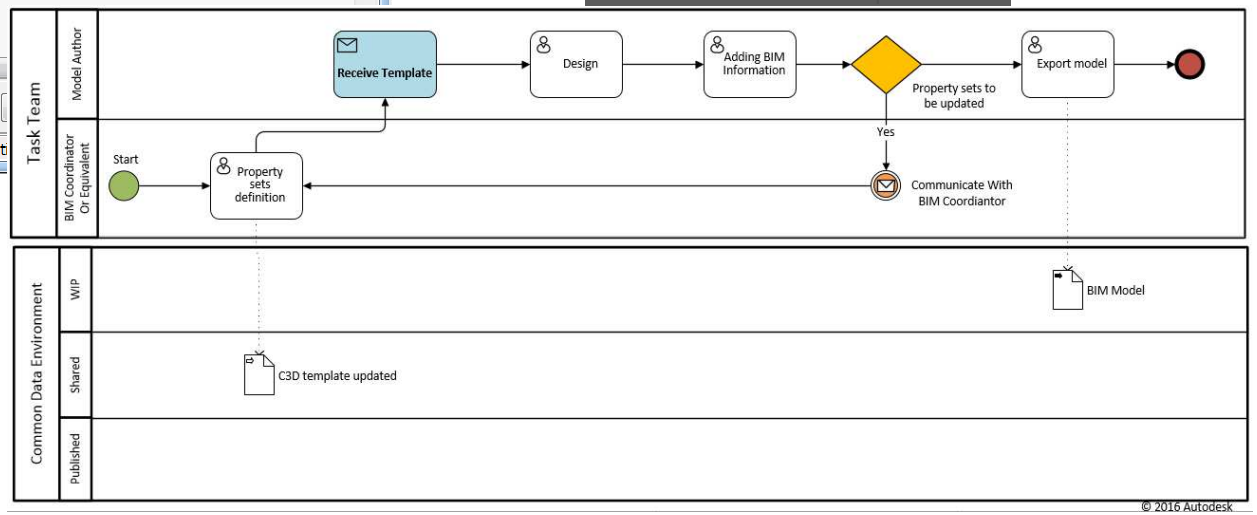
- Civil 3D Experience limited to drainage design in 2013
- First project with Civil 3D for entire infrastructure
- First depot project with BIM approach for both building and civil works
- Autodesk Consulting Services required for:
  - Training
  - Production Organisation
  - Fast track

BIM requirements

Classification, model categories and Property sets

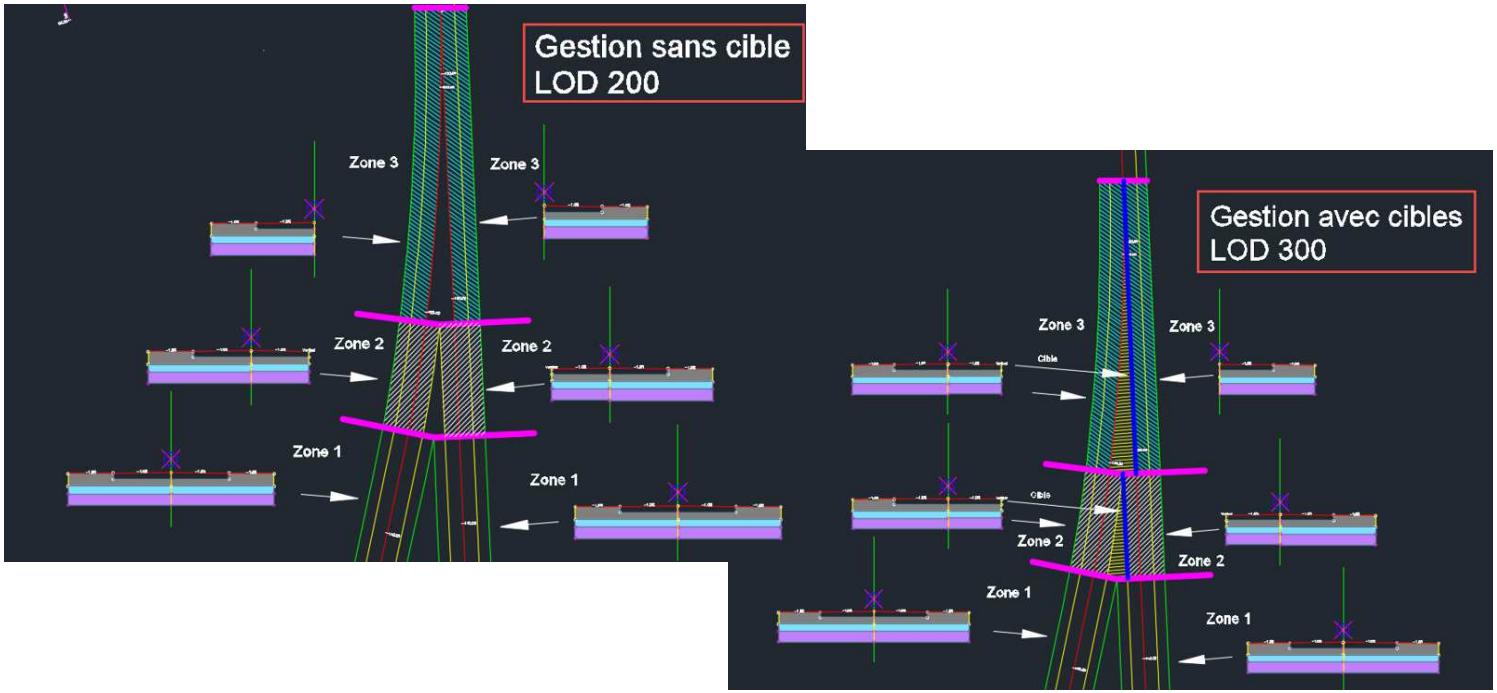






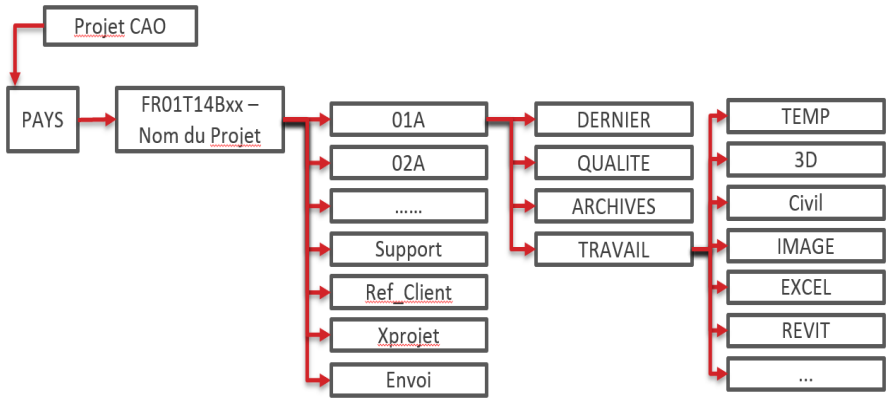
BIM requirements
LOD

- Specification of the Level of detail

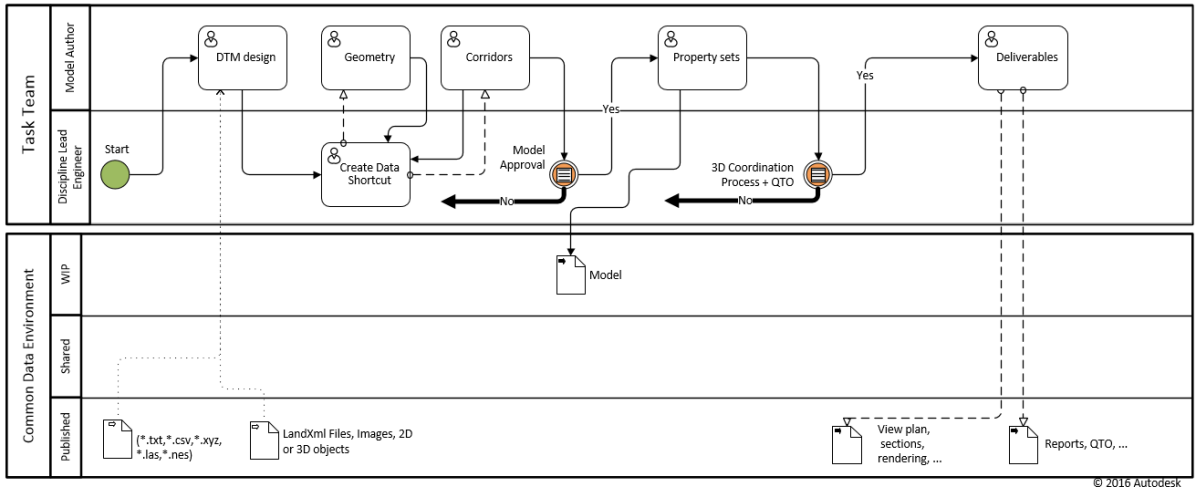


Folder structure

- Based on an internal development (iSYSTRA)
  - Improve the drawing production process
  - Ensure coherence between project & graphic aspect
  - Control the spread of deliverables (DWG)
  - Control archiving and traceability of DWG documents

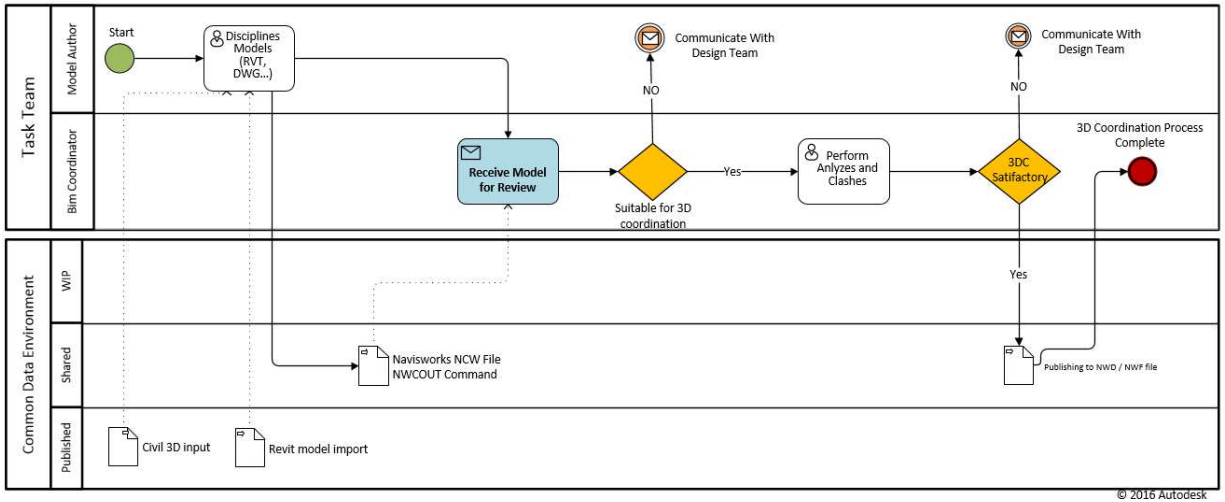


Autocad Civil 3D design & coordination workflow



Model Authoring

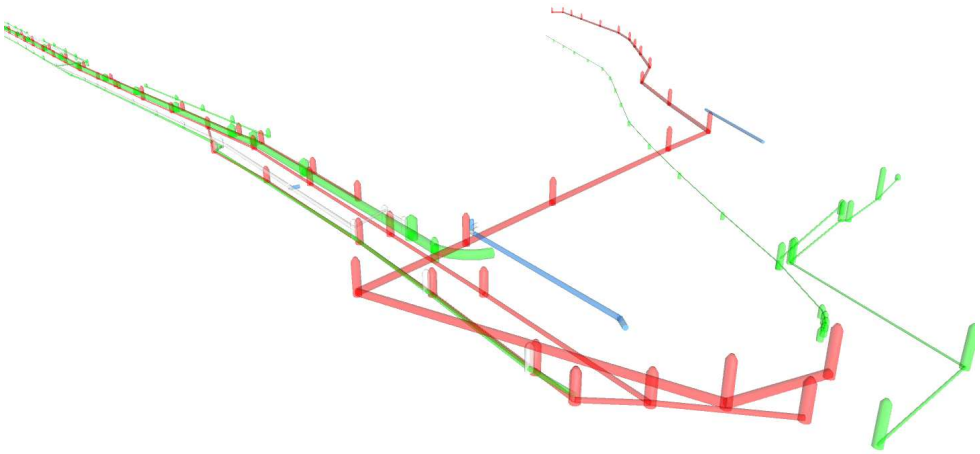
3D Coordination

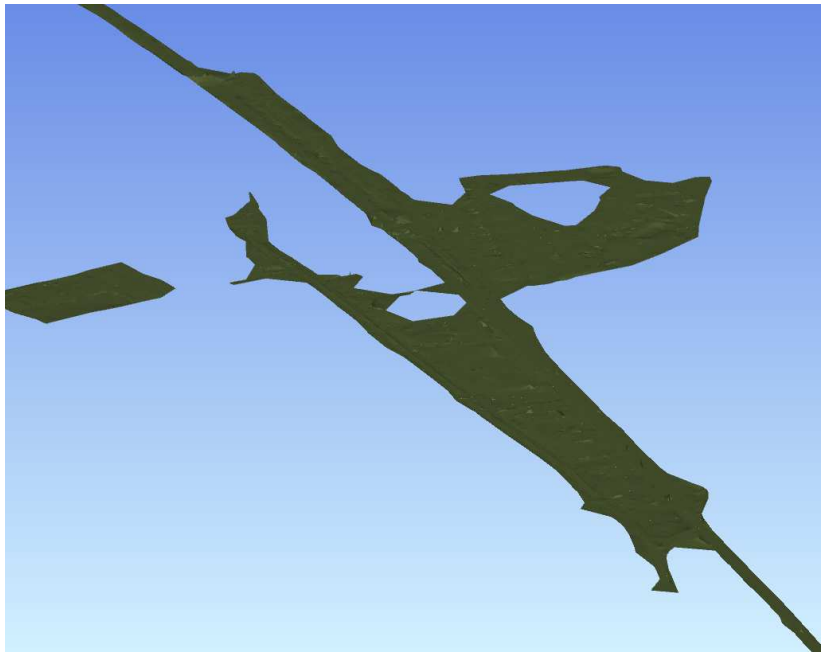


Civil Design

Design Authoring
Civil 3D

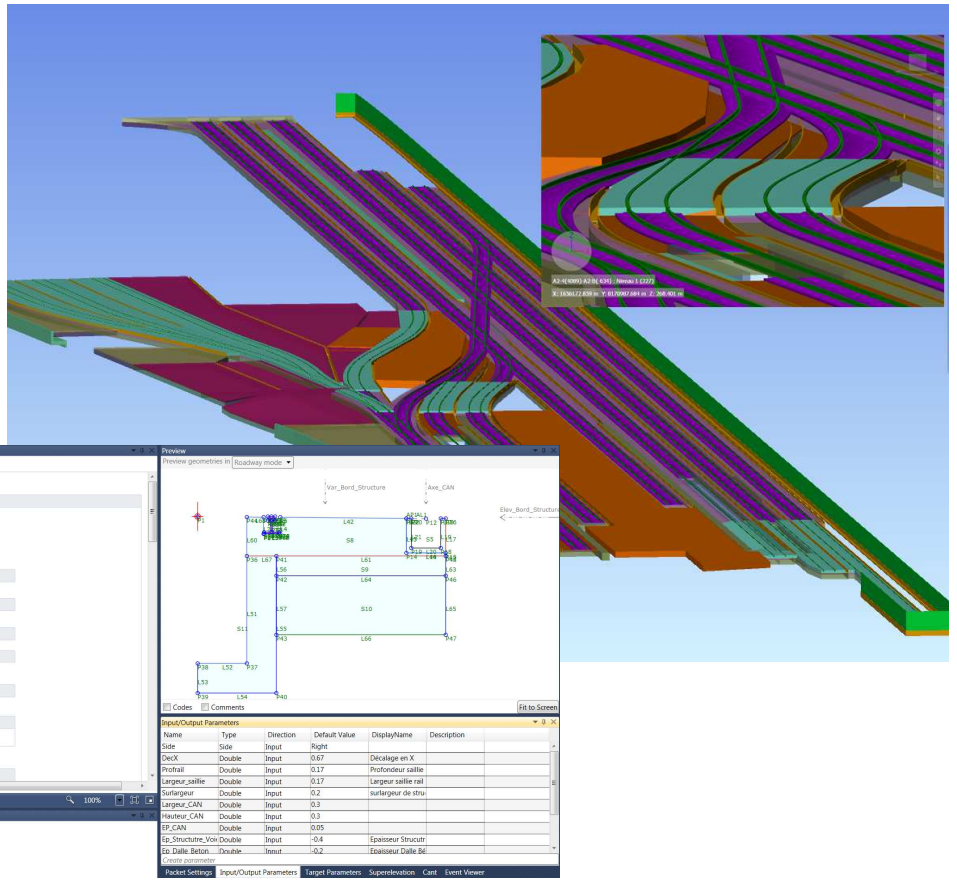
- Existing condition modelling
  - Terrain model
  - Drainage (dry & Wet utilities)

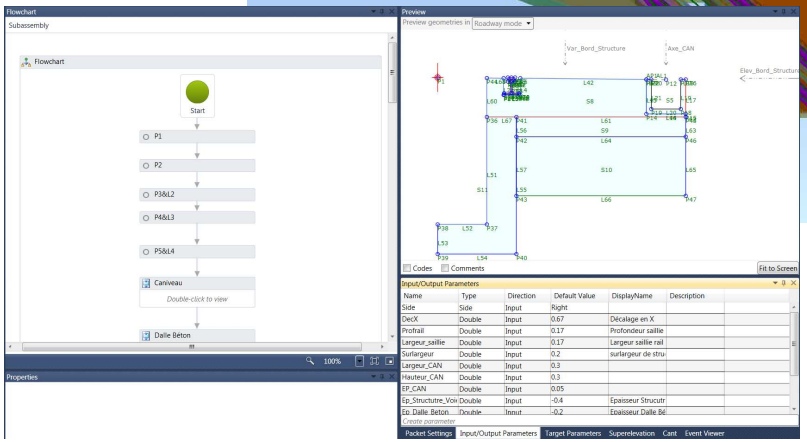




Design Authoring
Civil 3D

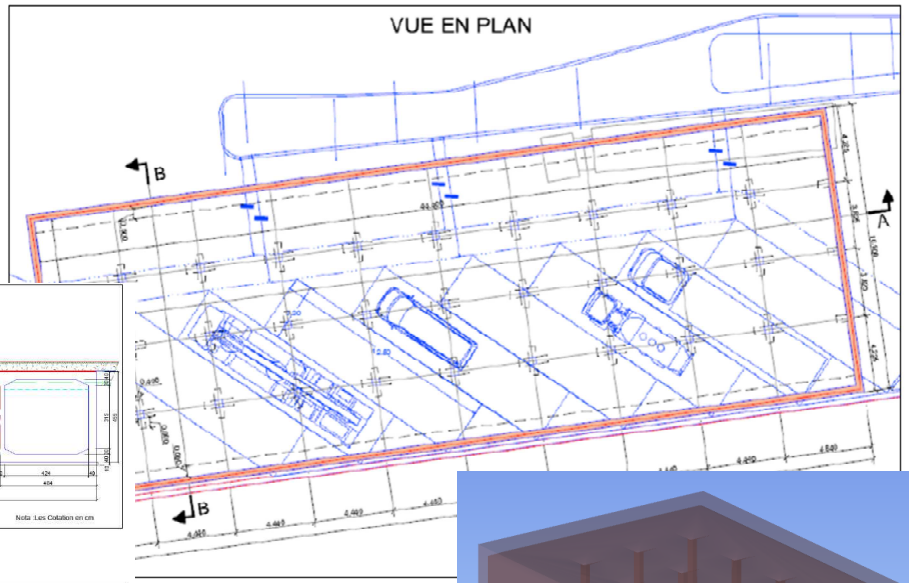
- Platform
  - Assemblies using SAC
  - 3D Solids from corridors
  - Grading

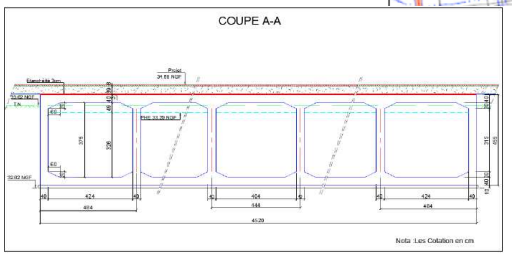


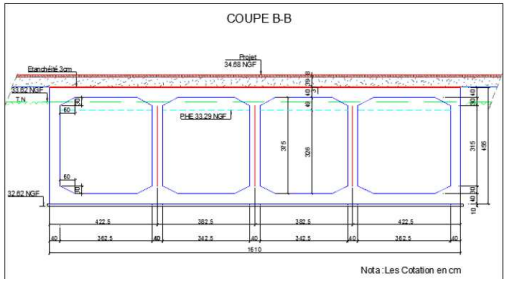


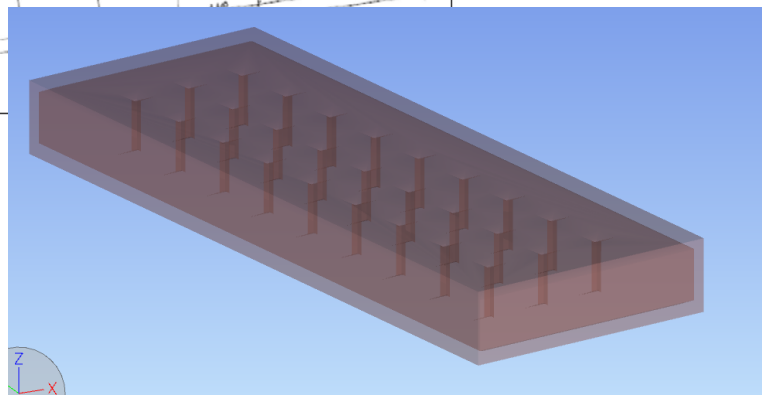
Design Authoring AutoCAD

- 3D Objects
  - Fondation
  - Reservoir
  - …



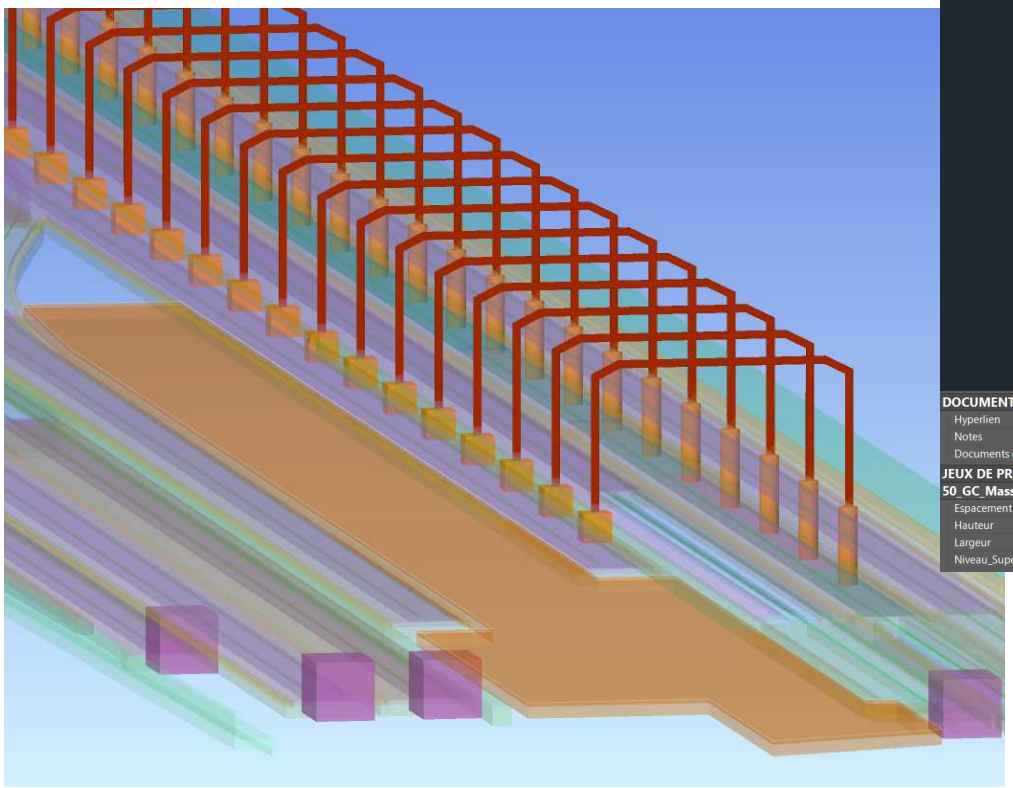


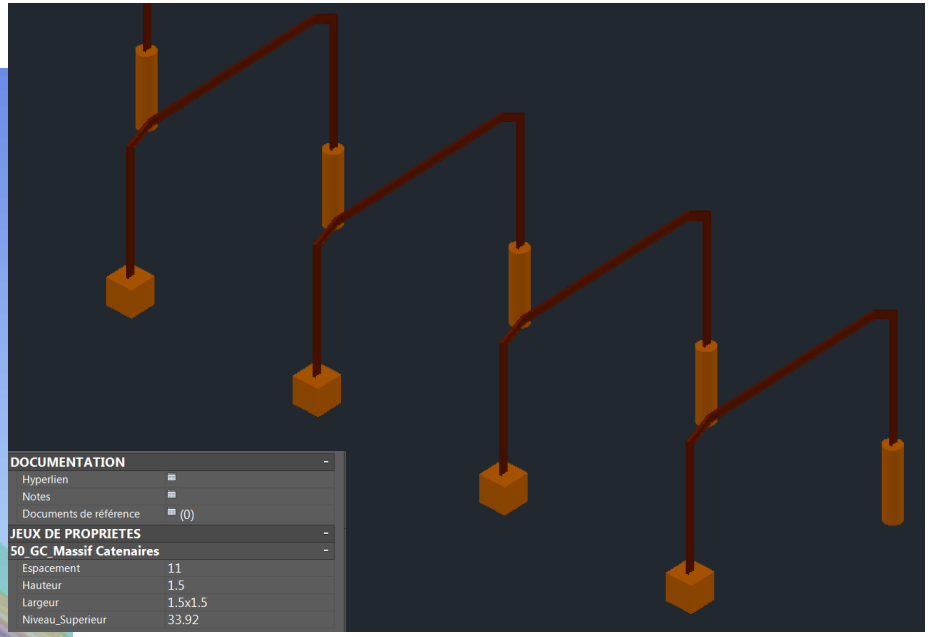




Design Authoring AutoCAD

- Catenaries design

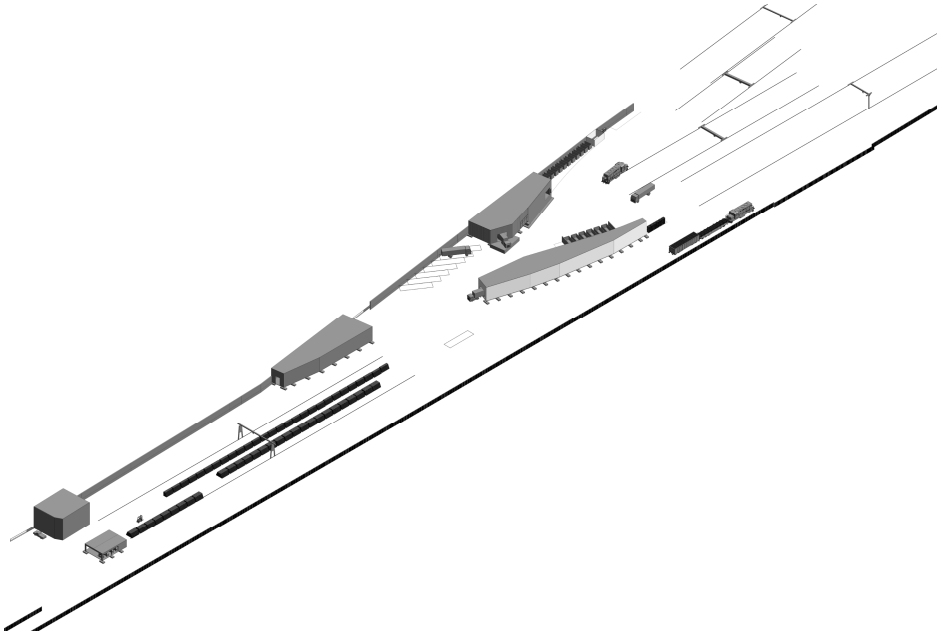


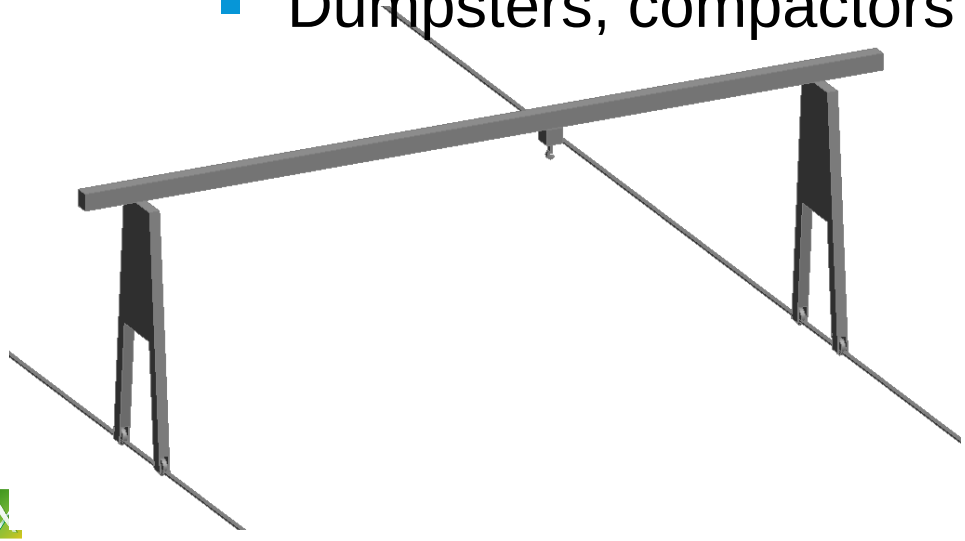


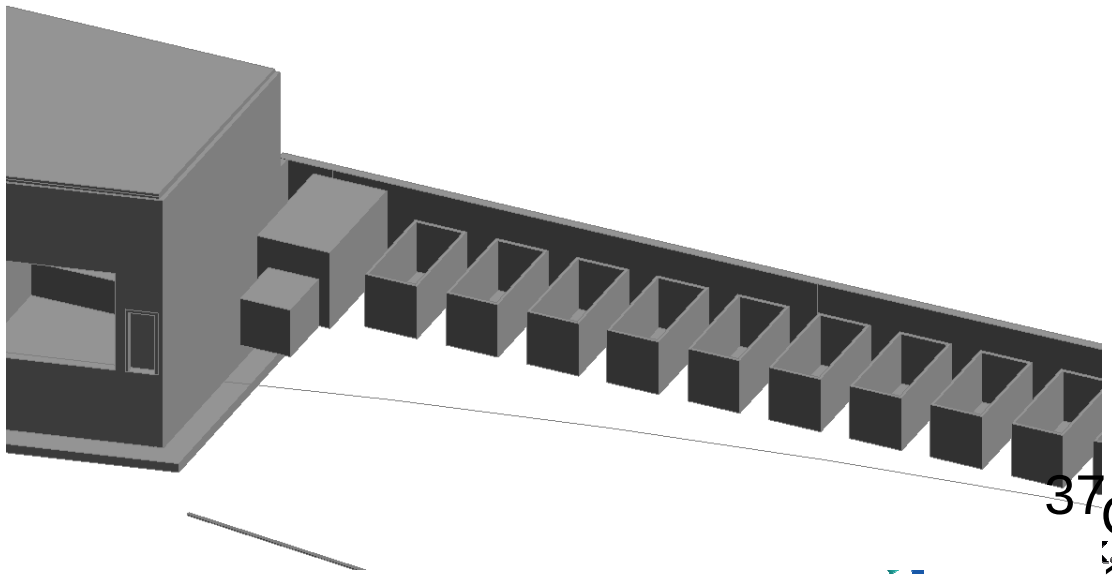
Design Authoring
Revit

Equipements model Including:

- Bridge cranes
- Work train
- Stock
- Dumpsters, compactors

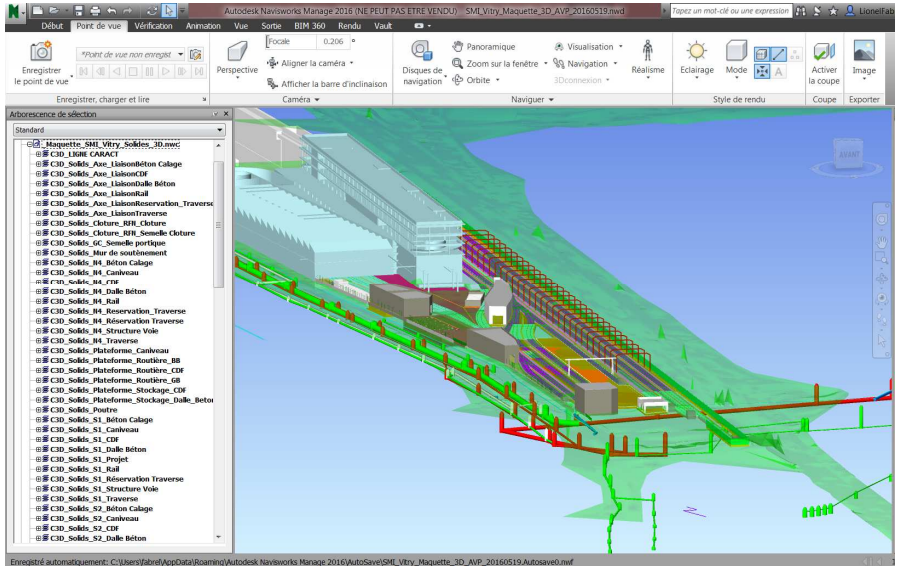


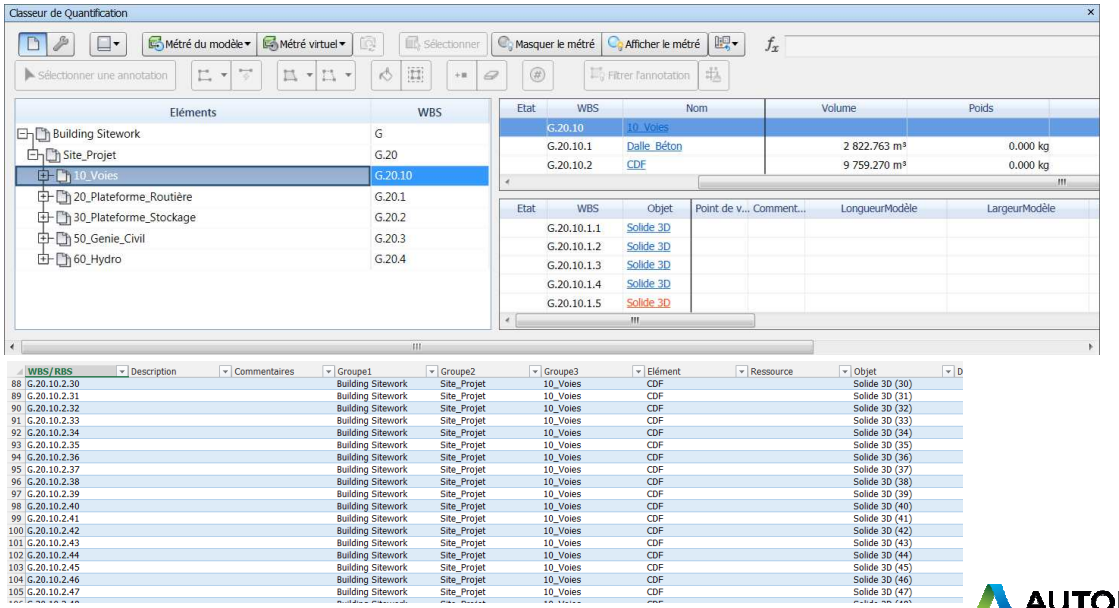




Quantity Takeoff
Navisworks

- Systra customized classification (based on uniformat)
- Using AutoCAD Civil 3D Attributes





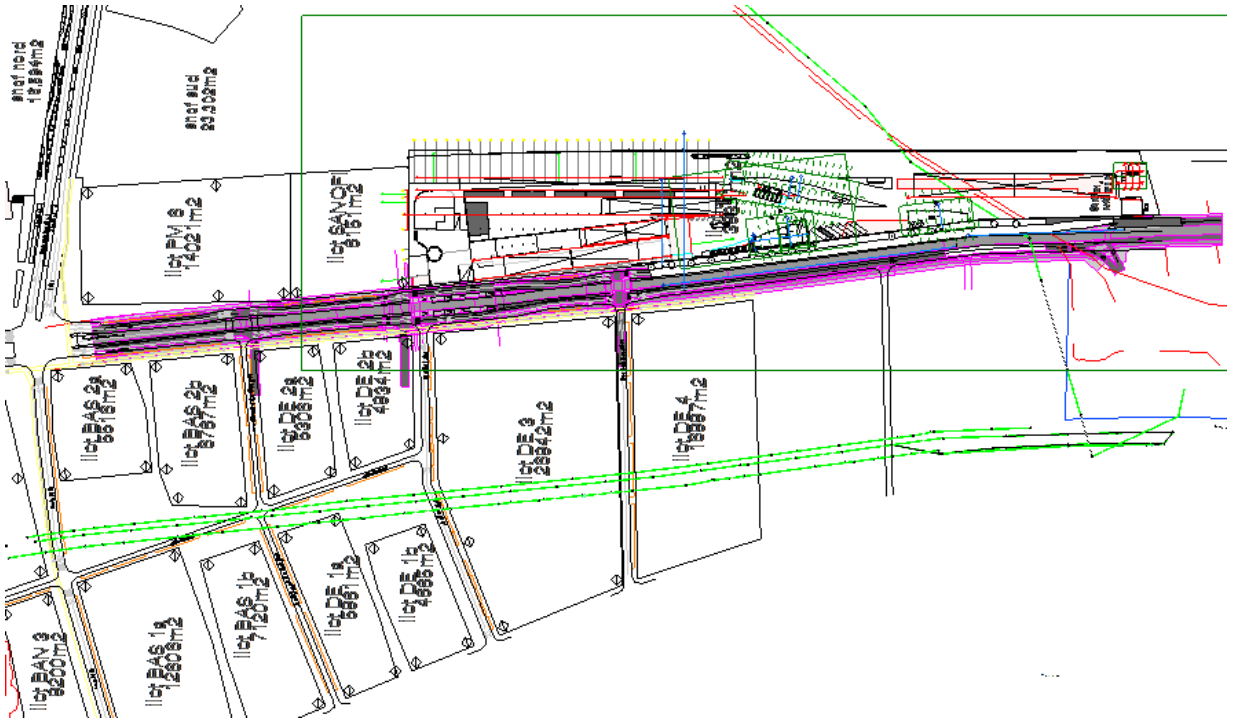
Lessons Learnt

- Data management
  - Specification of the model
  - Layer convention & folder structure
  - Data shortcut
- Possibility to model objects using different tools
- Additional non-BIM modelling
- Use of Navisworks for QTO

Building Design

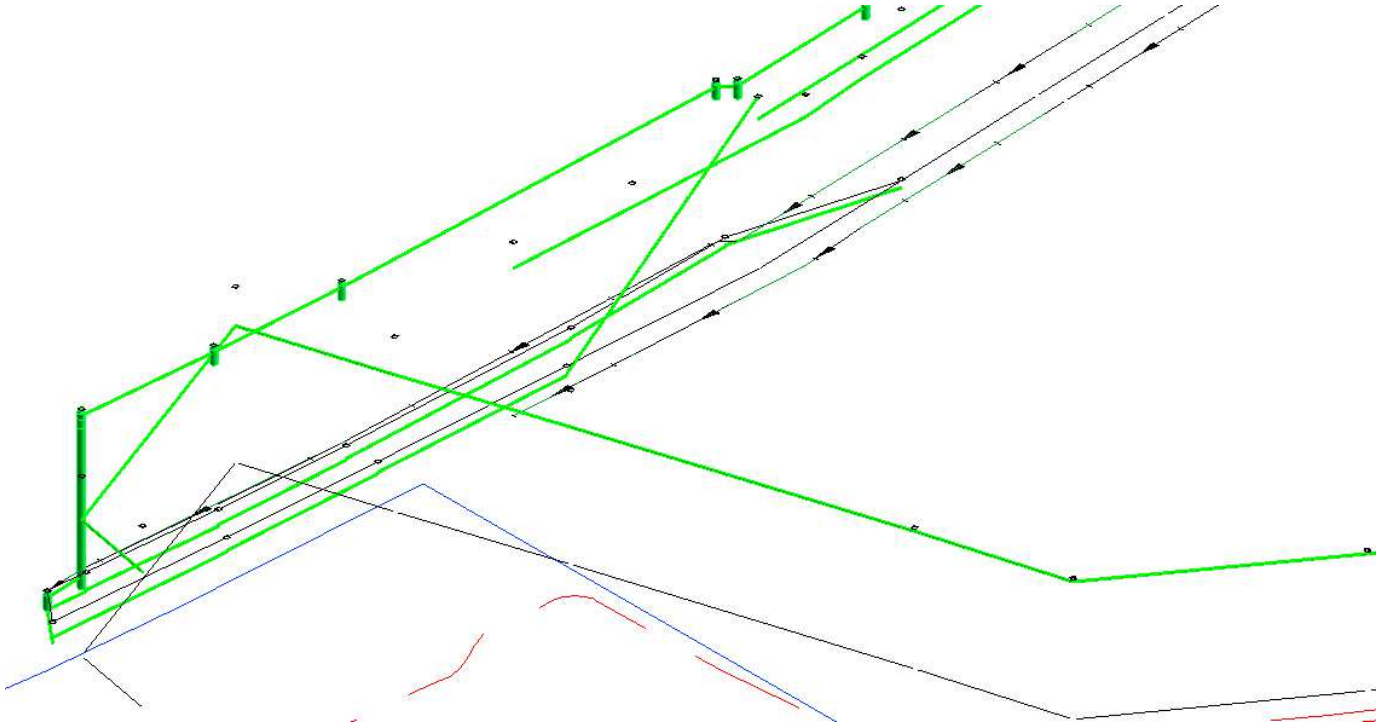
Geo referencing
Revit

- Specific Revit file for referencing DWG



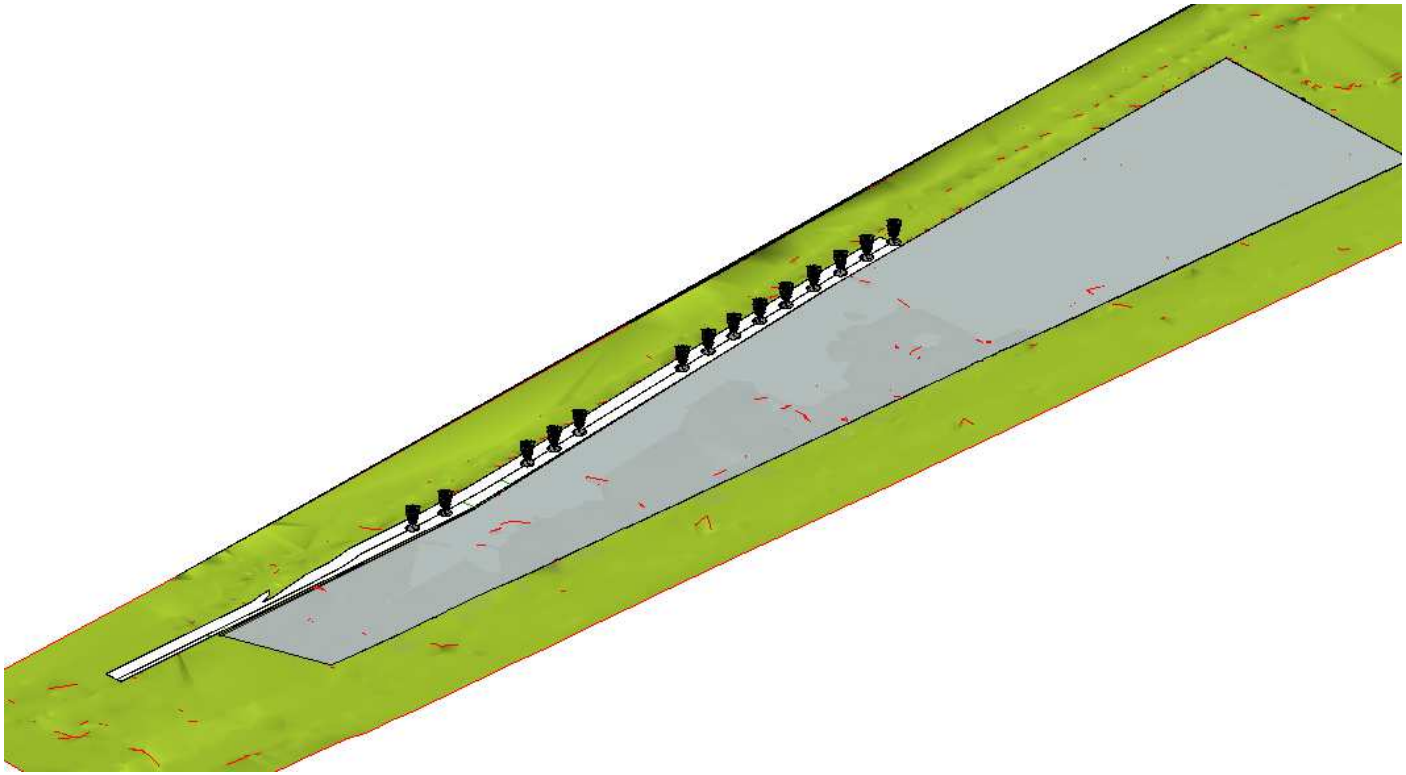
Civil 3D Objects in Revit

- Civil 3D platform objects are imported in a Revit family



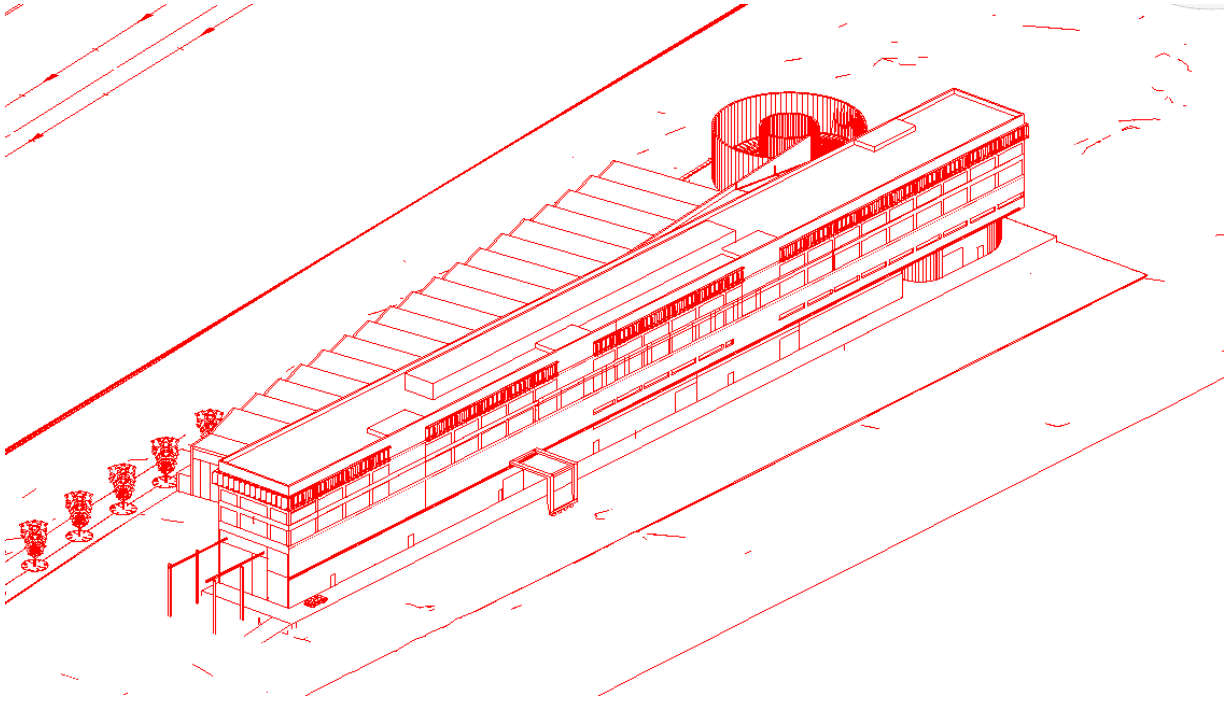
Topography in Revit

- Using Civil 3D Revit Addon



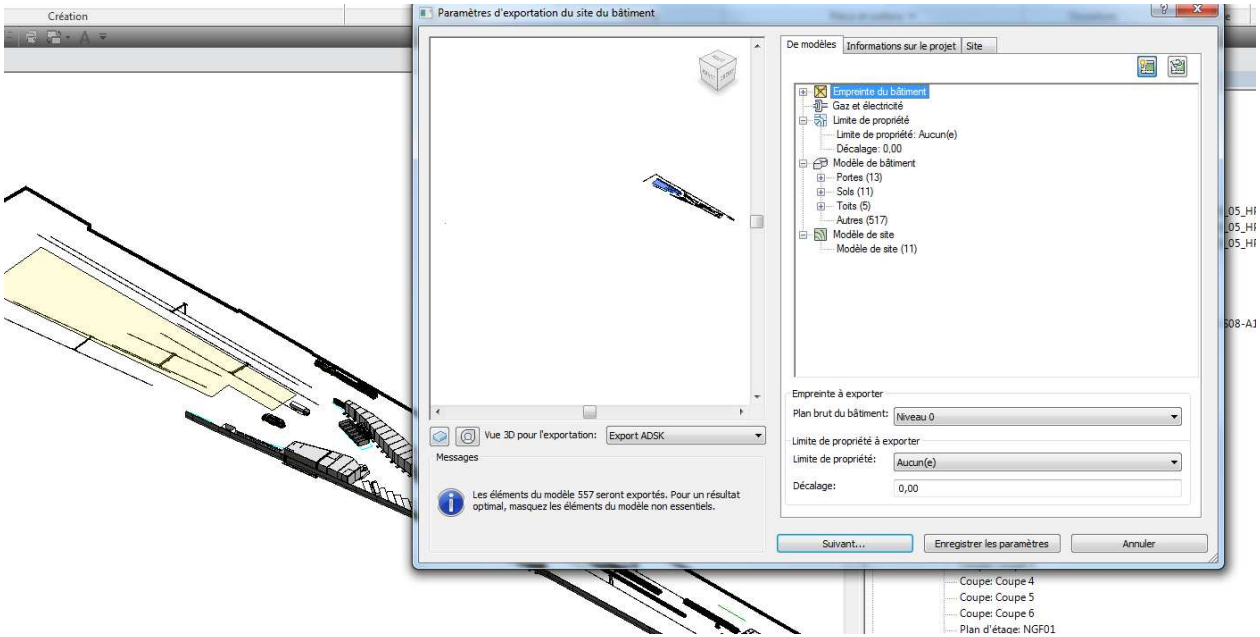
Design Authoring

- Architect Marc Barani model using Sketchup Imported in an rfa



Revit To Civil 3D

- Exporting Revit model as « Building Site » (adsk file)

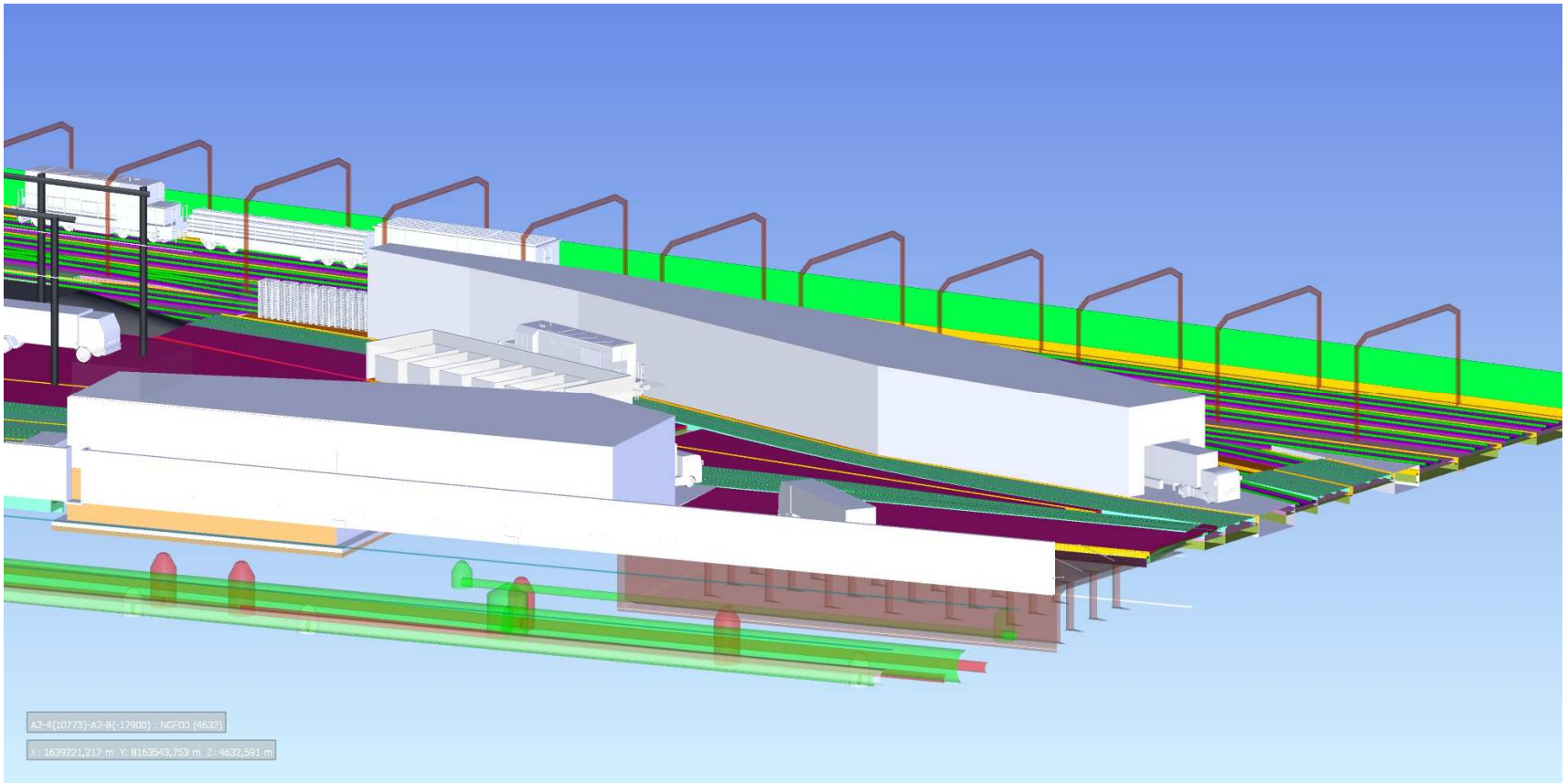


Lessons Learnt

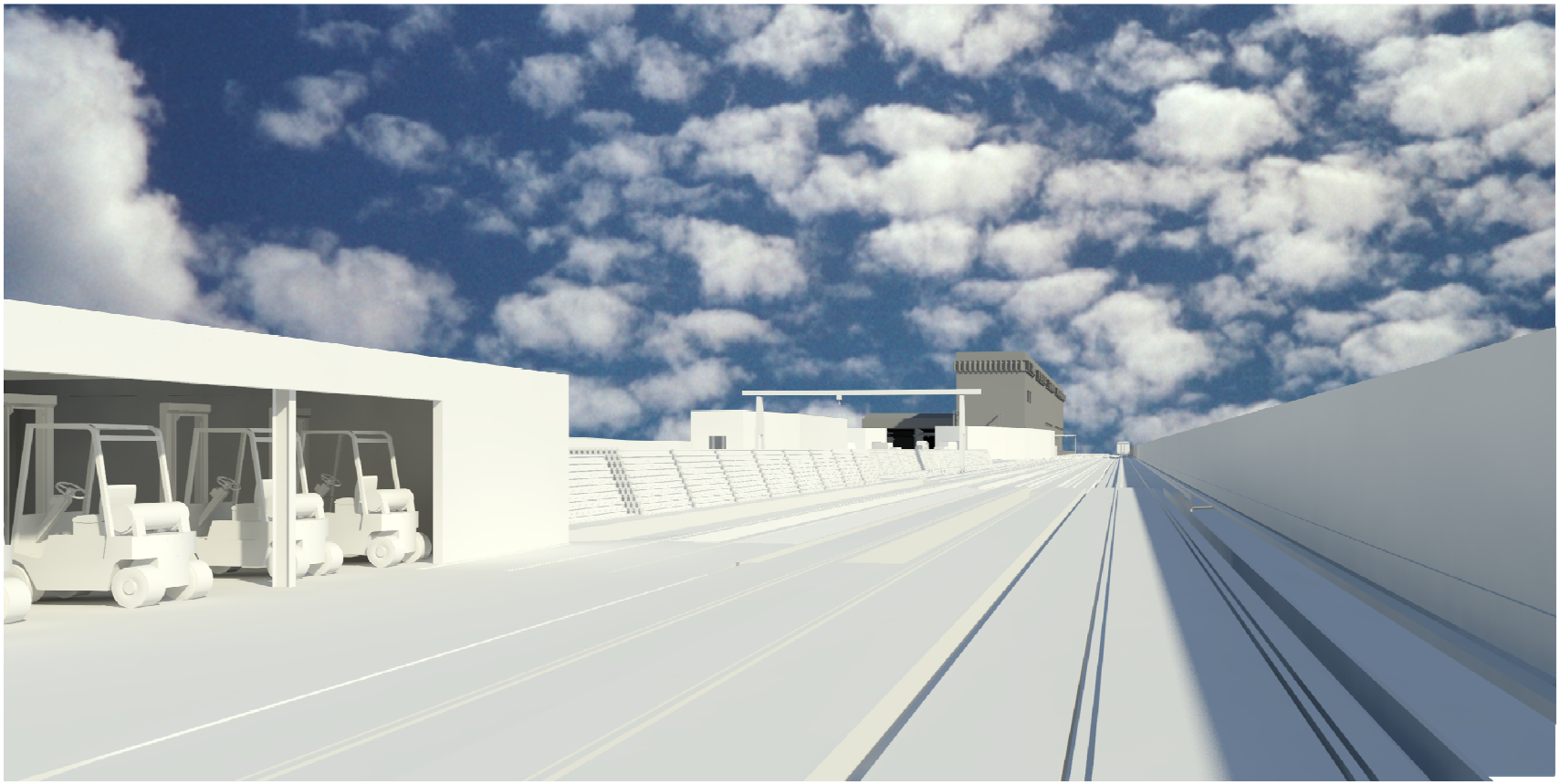
- Set BIM as a requirement in the contract
- Use of Revit and Civil 3D addon for interoperability

Coordination Model & Design Reviews

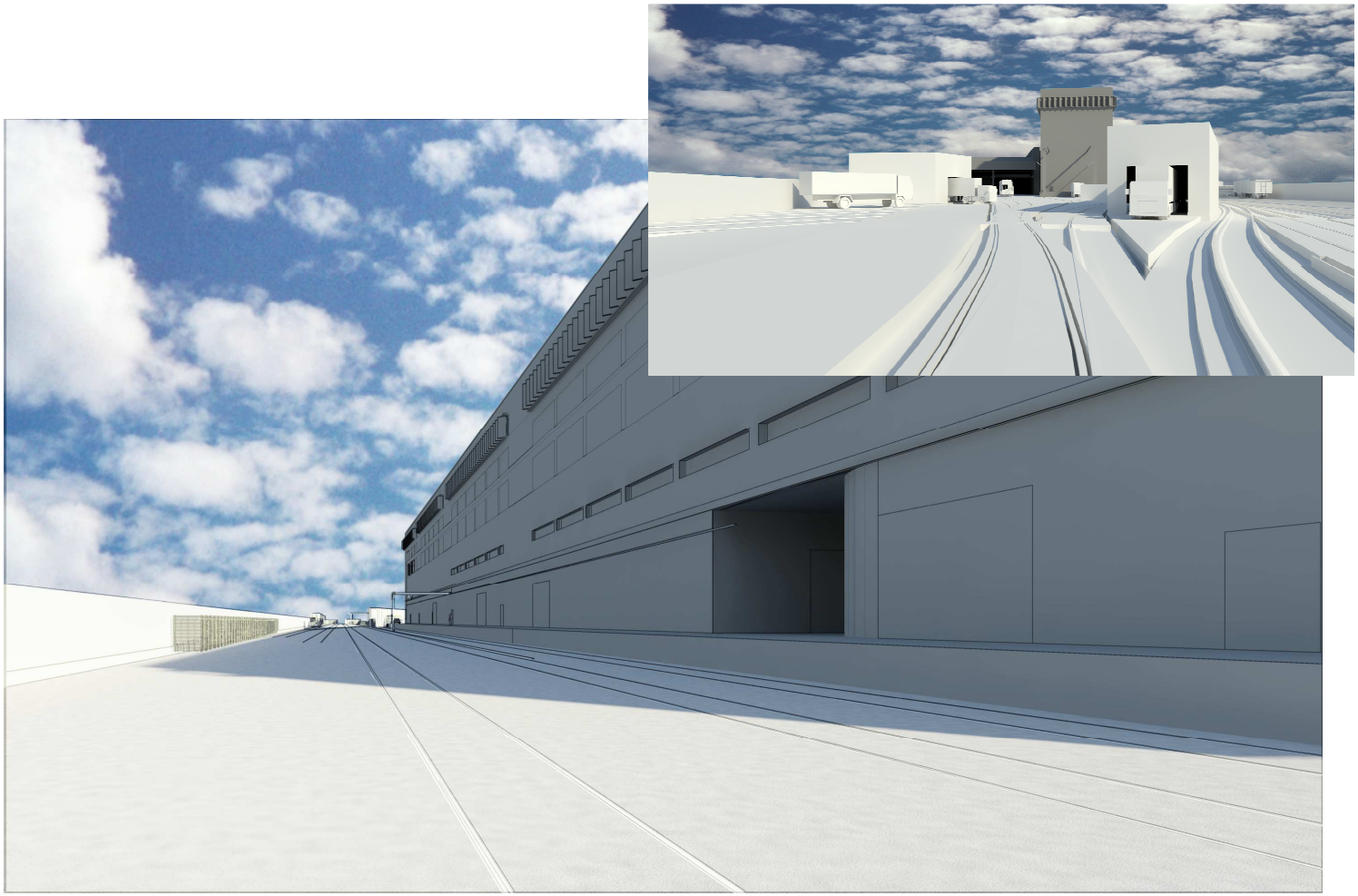
Visualisation tools



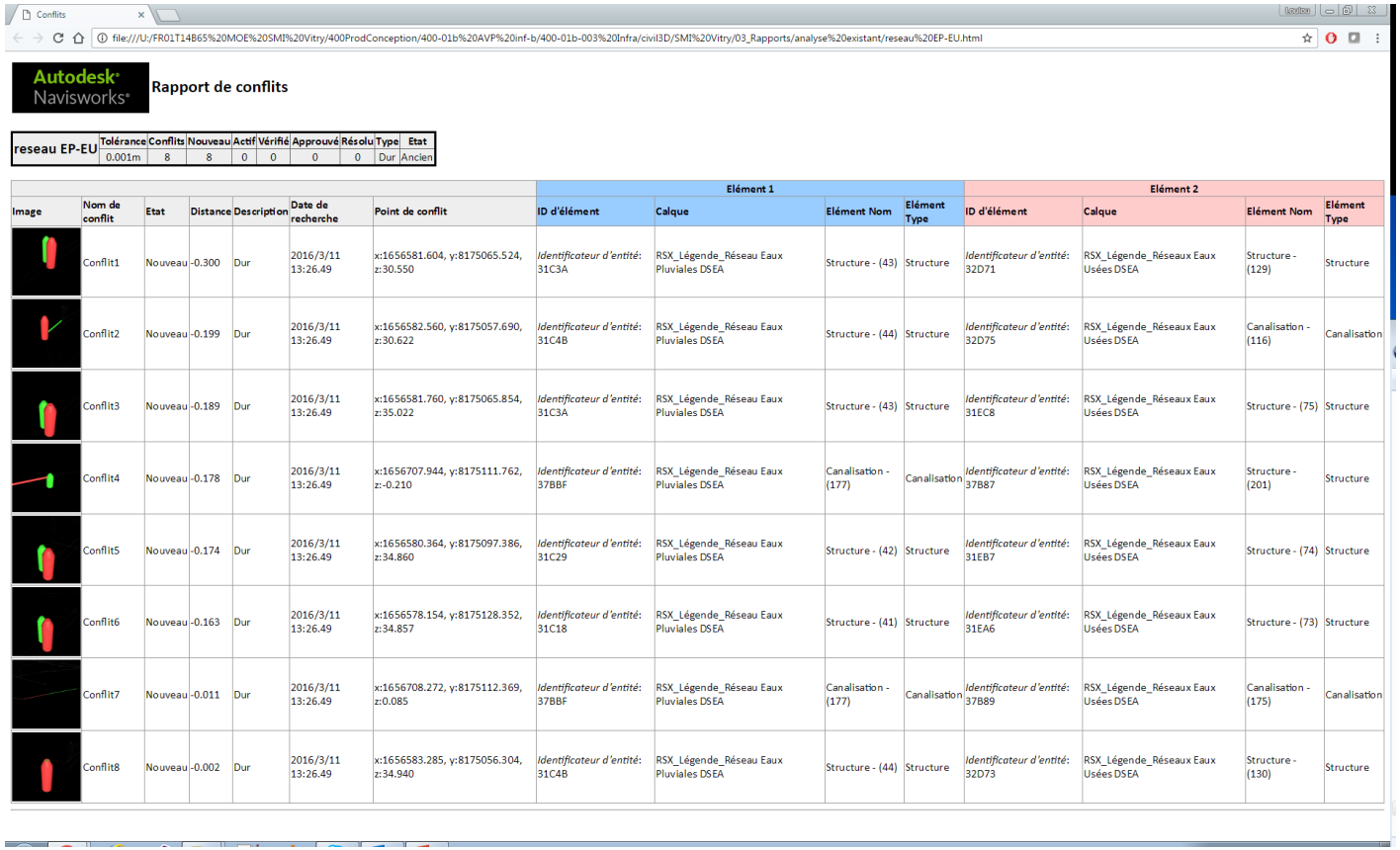
Images



Images



Automated Clash detection



Conflits

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Autodesk Navisworks

Rapport de conflits

reseau EP-EU	Tolérance	Conflits	Nouveau	Actif	Vérifié	Approuvé	Résolu	Type	Etat
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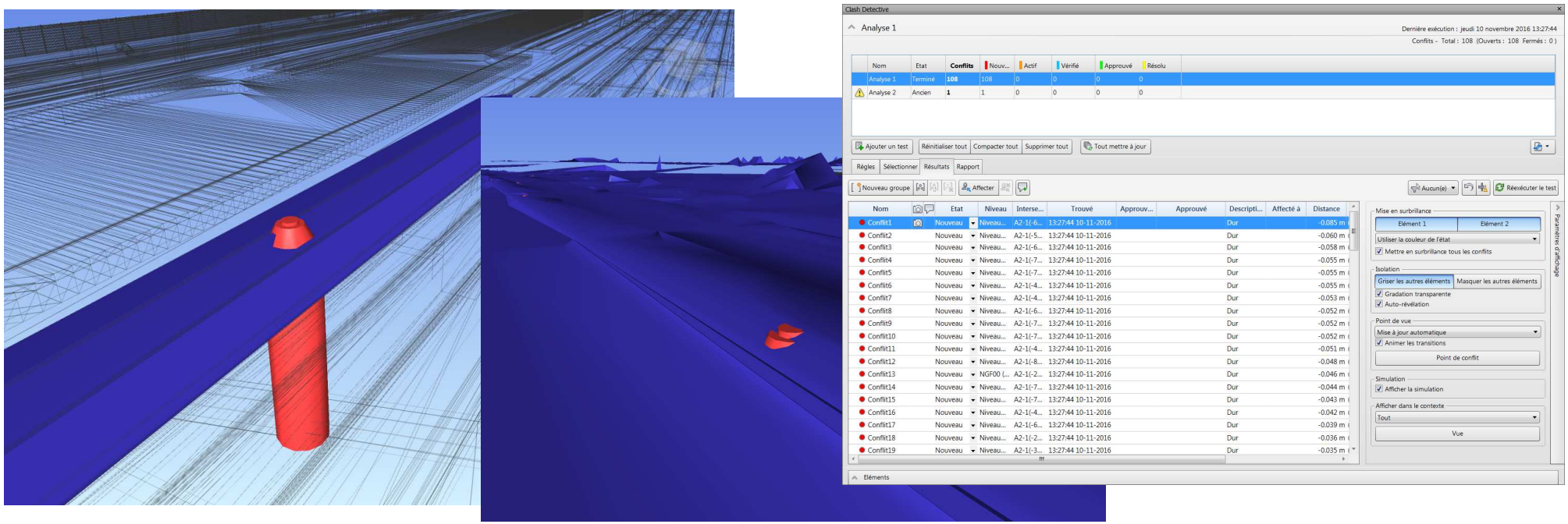
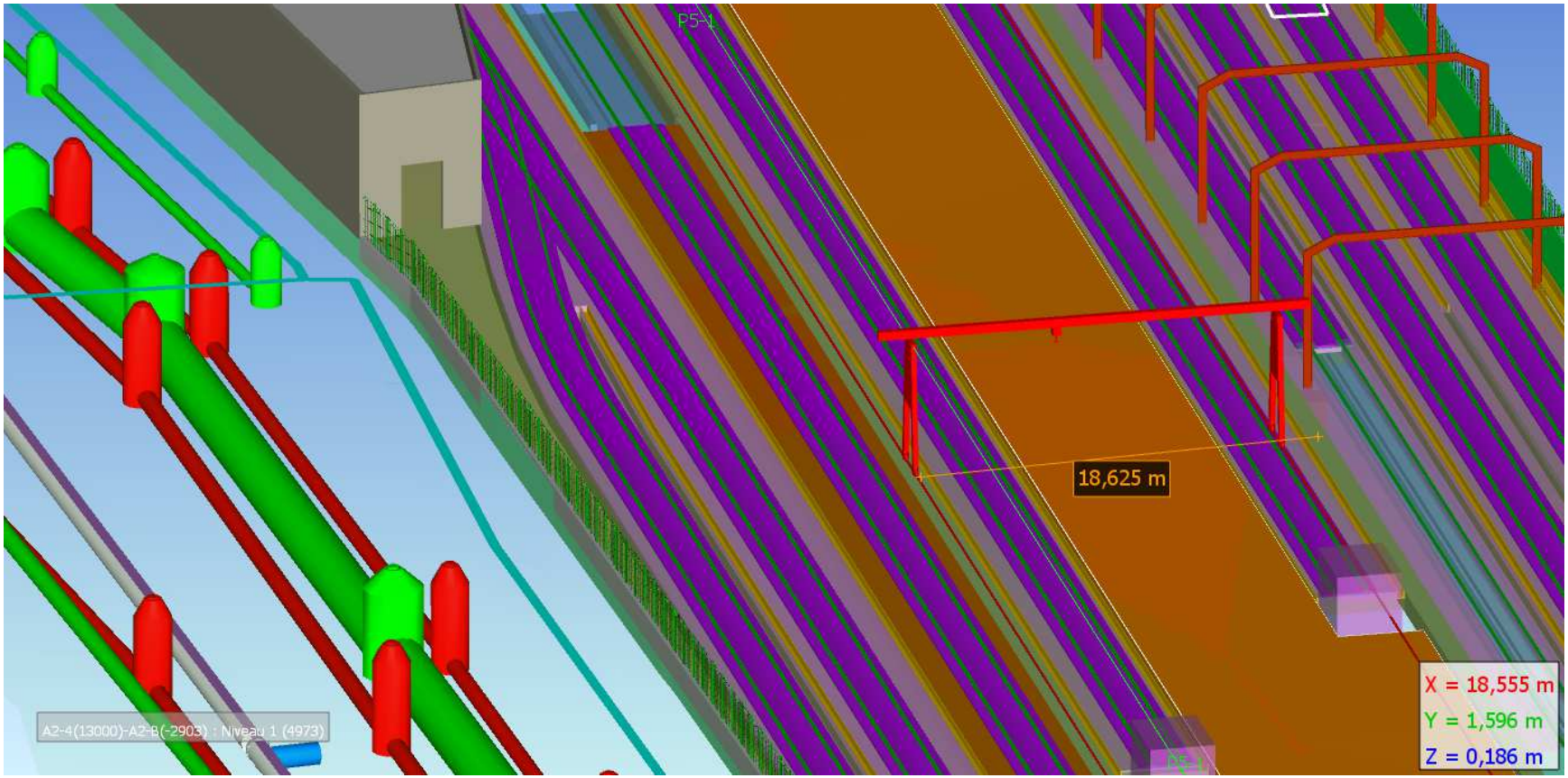
							Elément 1				Elément 2			
Image	Nom de conflit	Etat	Distance	Description	Date de recherche	Point de conflit	ID d'élément	Calque	Elément Nom	Elément Type	ID d'élément	Calque	Elément Nom	Elément Type
	Conflit1	Nouveau	-0.300	Dur	2016/3/11 13:26.49	x:1656581.604, y:8175065.524, z:30.550	*Identificateur d'entité:* 31C3A	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (43)	Structure	*Identificateur d'entité:* 32D71	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (129)	Structure
	Conflit2	Nouveau	-0.199	Dur	2016/3/11 13:26.49	x:1656582.560, y:8175057.690, z:30.622	*Identificateur d'entité:* 31C4B	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (44)	Structure	*Identificateur d'entité:* 32D75	RSX_Légende_Réseaux Eaux Usées DSEA	Canalisation - (116)	Canalisation
	Conflit3	Nouveau	-0.189	Dur	2016/3/11 13:26.49	x:1656581.760, y:8175065.854, z:35.022	*Identificateur d'entité:* 31C3A	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (43)	Structure	*Identificateur d'entité:* 31EC8	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (75)	Structure
	Conflit4	Nouveau	-0.178	Dur	2016/3/11 13:26.49	x:1656707.944, y:8175111.762, z:-0.210	*Identificateur d'entité:* 37BBF	RSX_Légende_Réseau Eaux Pluviales DSEA	Canalisation - (177)	Canalisation	*Identificateur d'entité:* 37B87	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (201)	Structure
	Conflit5	Nouveau	-0.174	Dur	2016/3/11 13:26.49	x:1656580.364, y:8175097.386, z:34.860	*Identificateur d'entité:* 31C29	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (42)	Structure	*Identificateur d'entité:* 31EB7	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (74)	Structure
	Conflit6	Nouveau	-0.163	Dur	2016/3/11 13:26.49	x:1656578.154, y:8175128.352, z:34.857	*Identificateur d'entité:* 31C18	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (41)	Structure	*Identificateur d'entité:* 31EA6	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (73)	Structure
	Conflit7	Nouveau	-0.011	Dur	2016/3/11 13:26.49	x:1656708.272, y:8175112.369, z:0.085	*Identificateur d'entité:* 37BBF	RSX_Légende_Réseau Eaux Pluviales DSEA	Canalisation - (177)	Canalisation	*Identificateur d'entité:* 37B89	RSX_Légende_Réseaux Eaux Usées DSEA	Canalisation - (175)	Canalisation
	Conflit8	Nouveau	-0.002	Dur	2016/3/11 13:26.49	x:1656583.285, y:8175056.304, z:34.940	*Identificateur d'entité:* 31C4B	RSX_Légende_Réseau Eaux Pluviales DSEA	Structure - (44)	Structure	*Identificateur d'entité:* 32D73	RSX_Légende_Réseaux Eaux Usées DSEA	Structure - (130)	Structure

Clash Detection
Navisworks & AutoCAD Civil 3D

- Defined from C3D layers



Manual Design Reviews



Lesson Learnt

- Data management
  - Specification of the model
  - Layer convention & folder structure
  - Data shortcut
- Possibility to model objects using different tools
- Additional non-BIM modelling
- Use of Navisworks for QTO & 3D Coordination
- Set BIM as a requirement in the contract
- Use of Revit and Civil 3D addon for interoperability
- Reduce number of automated clash detected, do not run clash detection on the entire project

How did I do?

- Your class feedback is critical. Fill out a **class survey** now.
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- AU speakers will get feedback in real-time.
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- Meet Autodesk developers, testers, & support engineers ready to help with your most challenging technical questions.