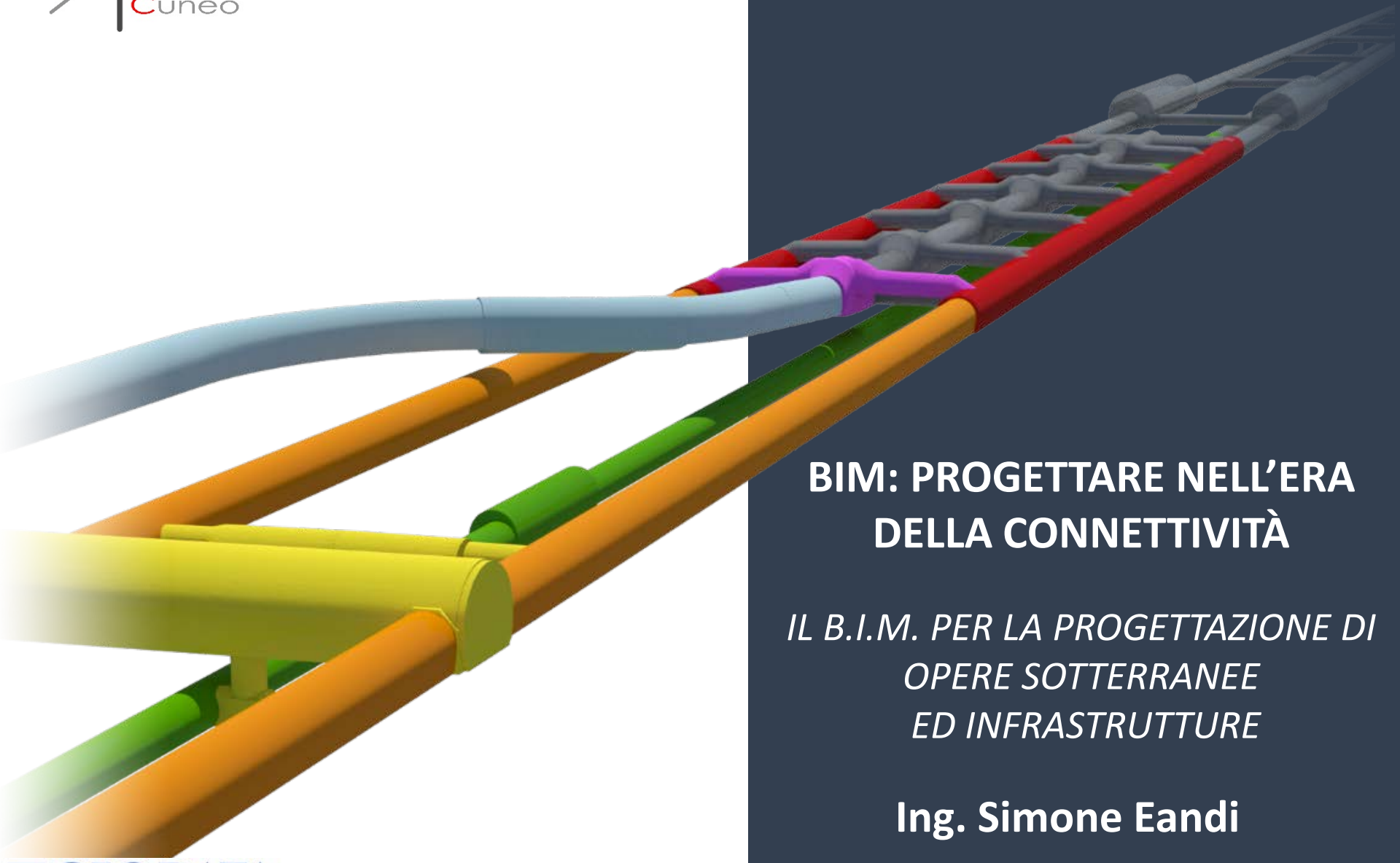
Giovani Ingegneri Cuneo

INARSIND



BIM: PROGETTARE NELL'ERA DELLA CONNETTIVITÀ

IL B.I.M. PER LA PROGETTAZIONE DI OPERE SOTTERRANEE ED INFRASTRUTTURE

Ing. Simone Eandi

GEODATA
UNDERGROUND SOLUTIONS

Perché siete qui oggi?


ANOTHER BORING
BIM CONFERENCE?

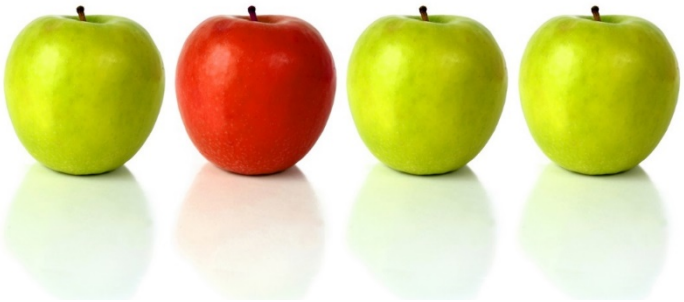
Non parleremo di:

- Significato della parola BIM
- Quanto è bello e complesso raggiungere il 4-5-6….18D!
- Standard BIM
- Non ci chiederemo se il BIM è solo una moda passeggera
- Uguaglianza BIM-software

Dal 2011 abbiamo deciso di lavorare seriamente con il BIM!

- Cosa ci serve?
- Chi ci serve?
- Quanto ci vuole?
- Cosa vogliamo ottenere?
- Cosa possiamo integrare?

…CAMBIARE



Cosa abbiamo cercato di fare?

OBIETTIVO: come minimo **progettare tutte le metropolitane con il BIM**

STRATEGIA:

- Scelta del software: **Autodesk Building Suite + Autodesk Infrastructure Suite**
- Scelta di un partner tecnico: **One Team**
- Programma di formazione complesso: **140 ore** di **formazione, 122 persone coinvolte**
- Tentativo di integrare le **licenze con un uso internazionale** per tutte le sedi

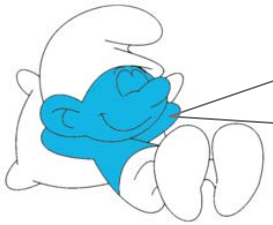
GEODATA
UNDERGROUND SOLUTIONS

Il famigerato cambiamento…

Il giovane impaziente: a volte l'entusiasmo va anche un po' contenuto e gestito

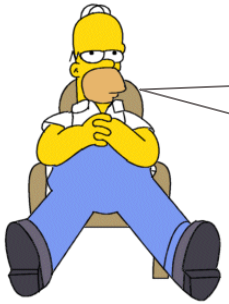
«Facciamolo in Revit anche se sembra un'impresa impossibile nei tempi richiesti, i problemi li risolveremo cammin facendo e di sicuro otterremo un risultato professionale….»

Il giovane stanco: una delle categorie peggiori…la mancanza di voglia di innovazione già nei primi anni di lavoro è un brutto segnale…



«Se volete lo faccio in BIM, ma non sono capace e sono sicuramente lento. Inoltre è passato diverso tempo dal corso e mi sono dimenticato tutto…»

Il senior privo di stimoli: un vero e proprio muro contro il quale è difficile averla vinta. Tanto lui sa già tutto ed ha già visto tutto.

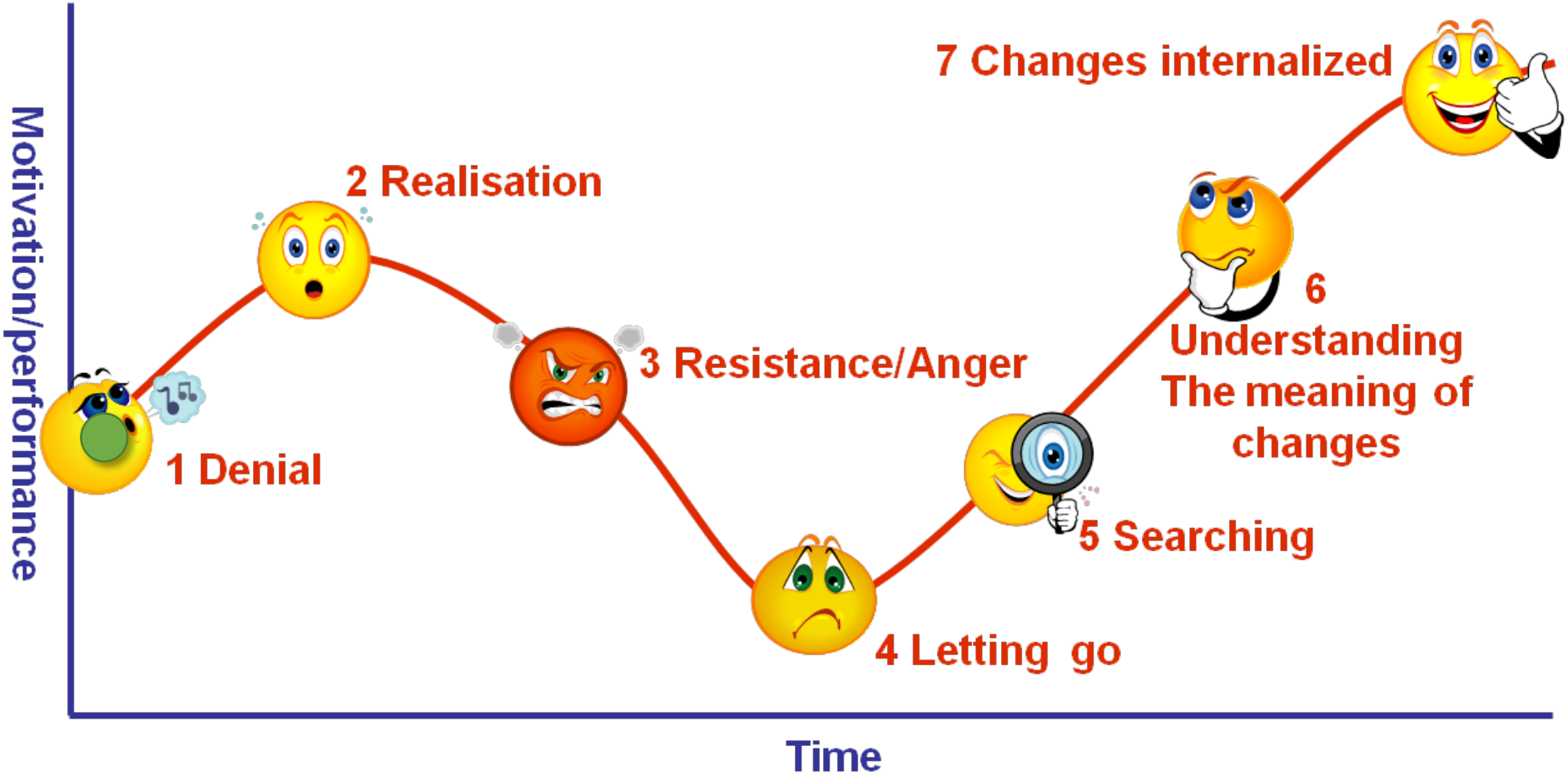


«Ma tanto tra un po' torneremo tutti ad usare Autocad e basta…e non dite che io non lo avevo detto»

Il senior proattivo: una vera e propria risorsa da valorizzare. E' di stimolo non solo per gli altri senior ma anche per i giovani.

«Mi metto li e tra la sera e sabato e domenica studio il problema e cerchiamo di capire come possiamo farlo. E comunque non lo faccio per il lavoro lo faccio soprattutto per me!»

I passi del cambiamento…



GEODATA
UNDERGROUND SOLUTIONS

Mano male che la scuola ci aiuta….

Se escludiamo, le facoltà di architettura in cui vi è un'idea del BIM e in maggior modo di cosa sia REVIT, presso le facoltà di ingegneria italiane il BIM sembra ancora un oggetto misterioso.

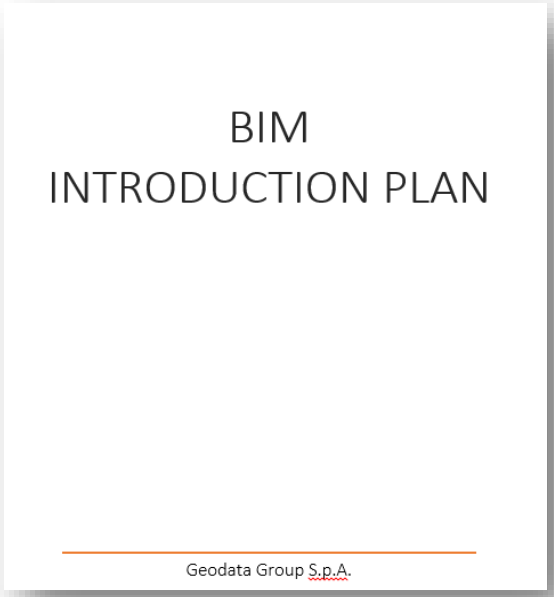
Nel 2015 su oltre 40 colloqui a diverso titolo svolti a neo laureati di ingegneria italiani il 75% degli intervistati alla domanda:
«Come si pone lei rispetto al BIM?» ci ha fatto questa faccia….

GEODATA
UNDERGROUND SOLUTIONS

Riorganizzazione gerarchica e organizzativa

Passare al BIM vuol dire anche:

- Ridisegnare la gerarchia organizzativa della struttura
- Ridisegnare i processi
- Generare e creare nuove regole prima sconosciute
- Identificare figure prima sconosciute come il BIM Manager
- Lavorare su manuali e procedure



GEODATA
UNDERGROUND SOLUTIONS

Il BIM MANAGER…questo sconosciuto

I am the
BIM MANAGER!
I'm here to save your BUSINESS!

- Chi è un BIM Manager?
- Qual è il suo ruolo?
- Si tratta solo di un utente evoluto che usa il BIM meglio degli altri?
- Deve essere più un tecnico o più un manager?
- Quale ampiezza di competenze deve avere?
- In 3-5 anni, quano il BIM sostituirà completamente il CAD, cosa accadrà ai BIM Managers? Ci sarà ancora bisogno di loro….?

GEODATA
UNDERGROUND SOLUTIONS

Difficoltà nel BIM per le infrastrutture e per il sotterraneo

- Non c’è un unico elemento puntuale
- La relazione con il territorio
- La necessità dell’uso di diversi software
- La necessità di forzare i software esistenti a fare cose «contro natura»
- La richiesta del dato nella forma convenzionale 2D
- La mancanza di vere e proprie procedure
- La mancanza di qualcuno realmente «esperto»
- La convenzione dell’ « abbiamo sempre fatto così»

E i Committenti?

16 BUILDING INFORMATION MODELLING

The Contractor must use BIM (Building Information Modelling) to achieve the following objectives:

(i) To create a detailed Project Information Model that contains accurate and up-to-date multi-disciplinary graphical and non-graphical design information and that is progressively developed from concept through to Final Design and as-constructed. The intended use of the Project Information Model during the design phase of the D&C Activities is to enable and achieve:

(A) effective design visualisation and collaboration between engineering disciplines and between the Contractor, the PTA and other stakeholders;

(B) efficient design collaboration, removal of duplicate design effort and reduction in errors and rework within the Contractor's design team; and

(C) identification and resolution of technical criteria and design quality issues such as clash detection and maintenance access.

(ii) To provide the PTA and other stakeholders with the opportunity to monitor the Current

L'Aggiudicatario potrà sviluppare il progetto con i software che riterrà più opportuni, ma sarà suo onere predisporre l'editing finale nei formati compatibili con il software del Committente.

A tal fine si precisa che il Committente dispone di:

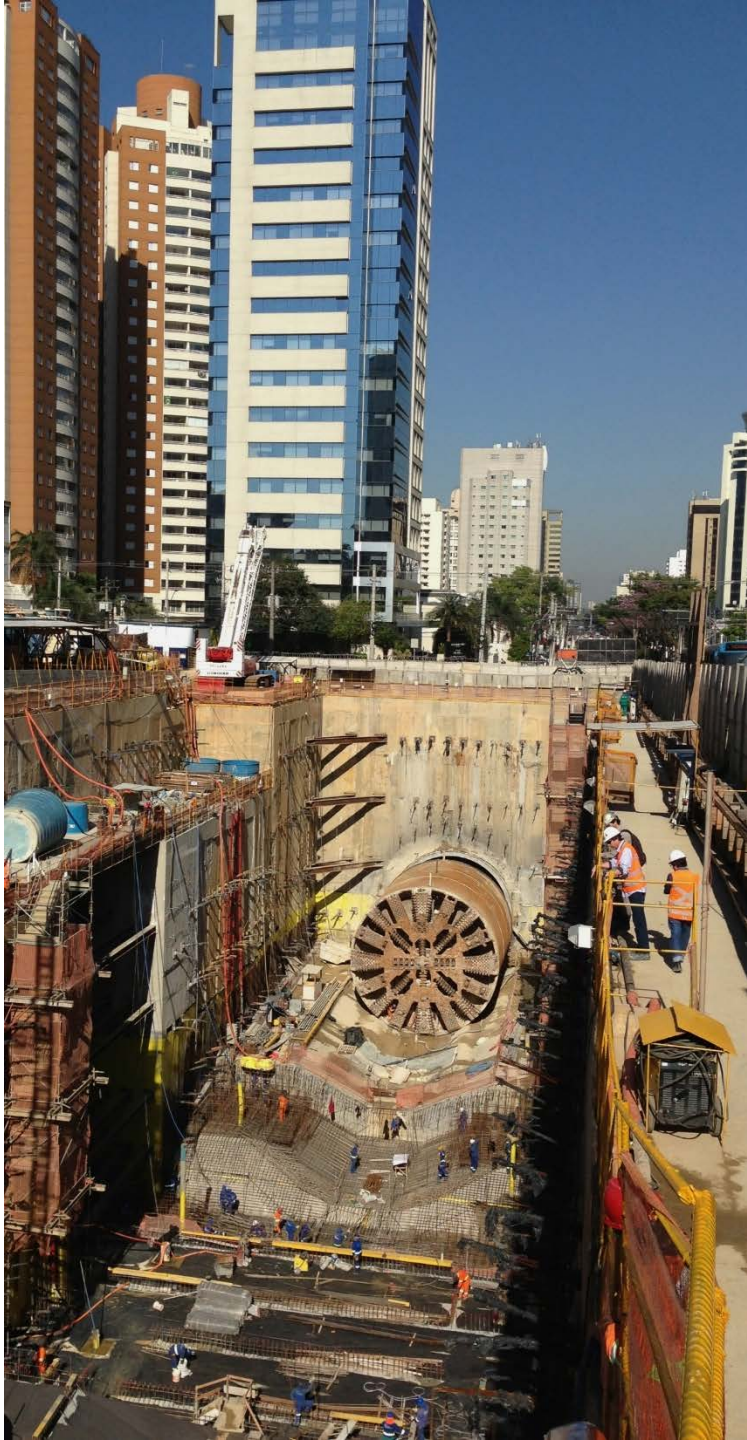
- Autocad 2012 per gli elaborati grafici in genere;
- Alice GL per i computi e le stime;
- Office 2007;

Asset Information Model (AIM) at any time during (including at the end of) the Maintenance Phase for the Assets that the Contractor is responsible for maintaining.

GEODATA
UNDERGROUND SOLUTIONS

Cosa abbiamo imparato

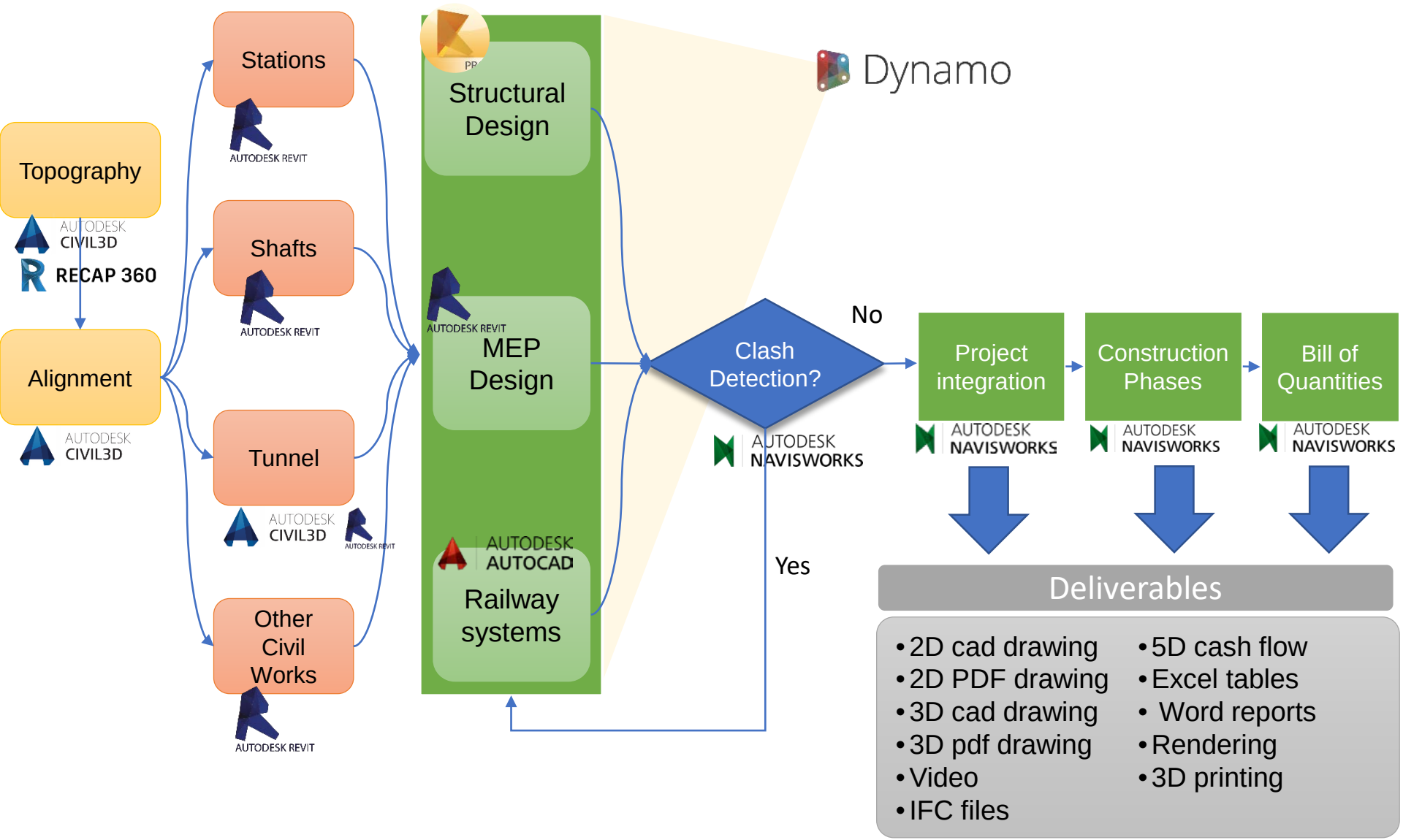
- La tavola da disegno rende le **gerarchie più chiare**, con il BIM si devono ridefinire le regole su chi comanda.
- **Grandi poteri generano grandi responsabilità**: professionalità più complete e preparate.
- Che le persone vanno educate sul fatto che il **BIM non è come la borsa di Mary Poppins**.
- Che il **BIM è un po' come il bungee jumping**: da un lato attrae morbosamente un po' tutti poi, quando si tratta di metterlo in pratica, spaventa.
- L' «**abbiamo sempre fatto così**» è ancora troppo forte da sconfiggere e prima poi si palesa…



What we have done with BIM:

- Stations for **Metro di Doha** RED Line
- 35 stations of **Lima Metro line** 2
- 22 stations of **Metro Curitiba**
- Some station for **Metro Quito**
- Some station for **Sao Paulo Metro** and integration with ROBOT
- Detailed design of **3PS cavern in Monaco**
- Integrated design infrastructure+Architecture of **NFSC project in Sydney** (6km and 3 stations)
- Metro Moscow 2 integrated stations
- Complete design **Dudullu Bostanci Line- Istanbul**
- Complete design of **Goztepe- Umranye Line- Istanbul**
- Complete design of **Halkali-Kirazli Line - Istanbul**
- Integrated system for tunnel segment definition: INVENTOR
- **Santiago – Batuco** Railway Project
- **Forrestfield Airport Link – Perth** Australia
- **Brenner Base tunnel** : Tender Design
- **Kariba Dam - Zaire**
- **El Bala Dam - Bolivia**
- **Metro Melbourne**: tunnel and segments

Metodologia per la realizzazione di metropolitane in ambiente BIM



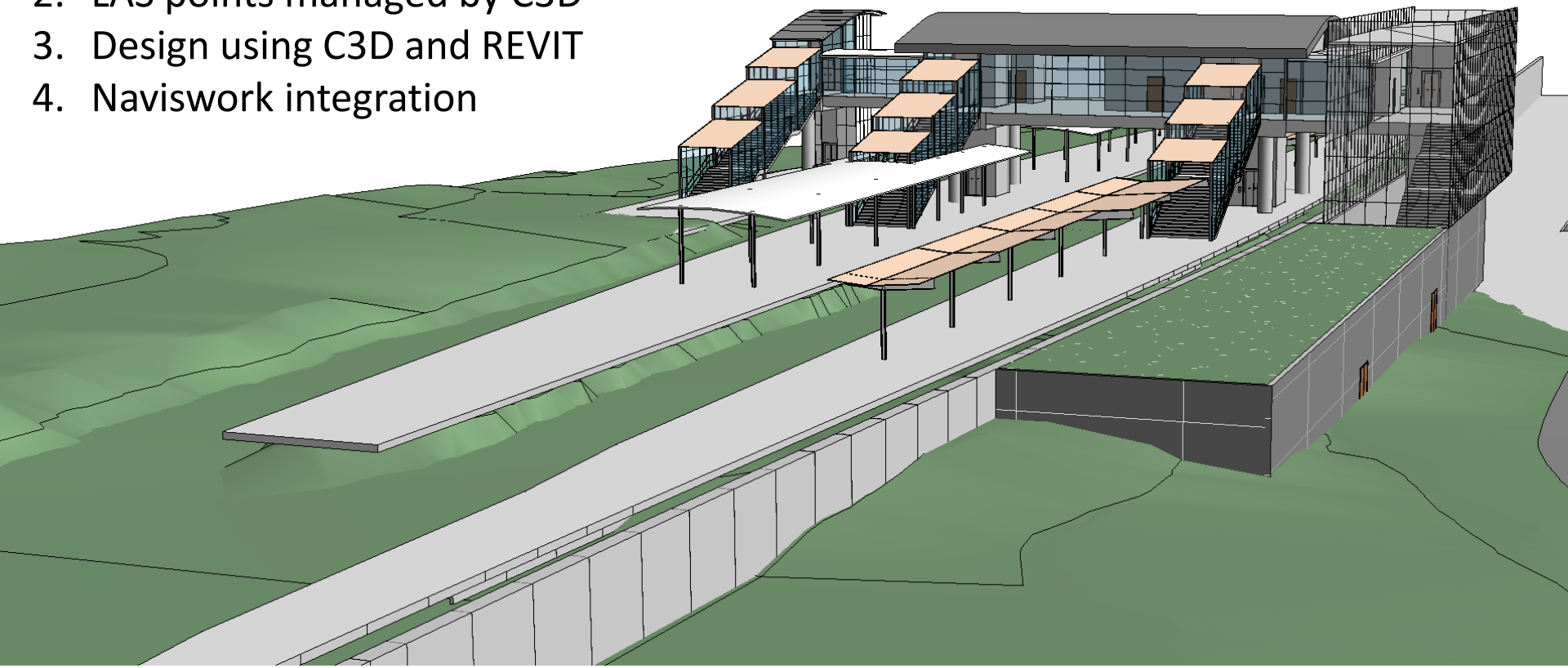
GEODATA
UNDERGROUND SOLUTIONS

Northern Sydney Freight Corridor

- Complex project
- Integration of different softwares: Infrastrucutre+Architecture

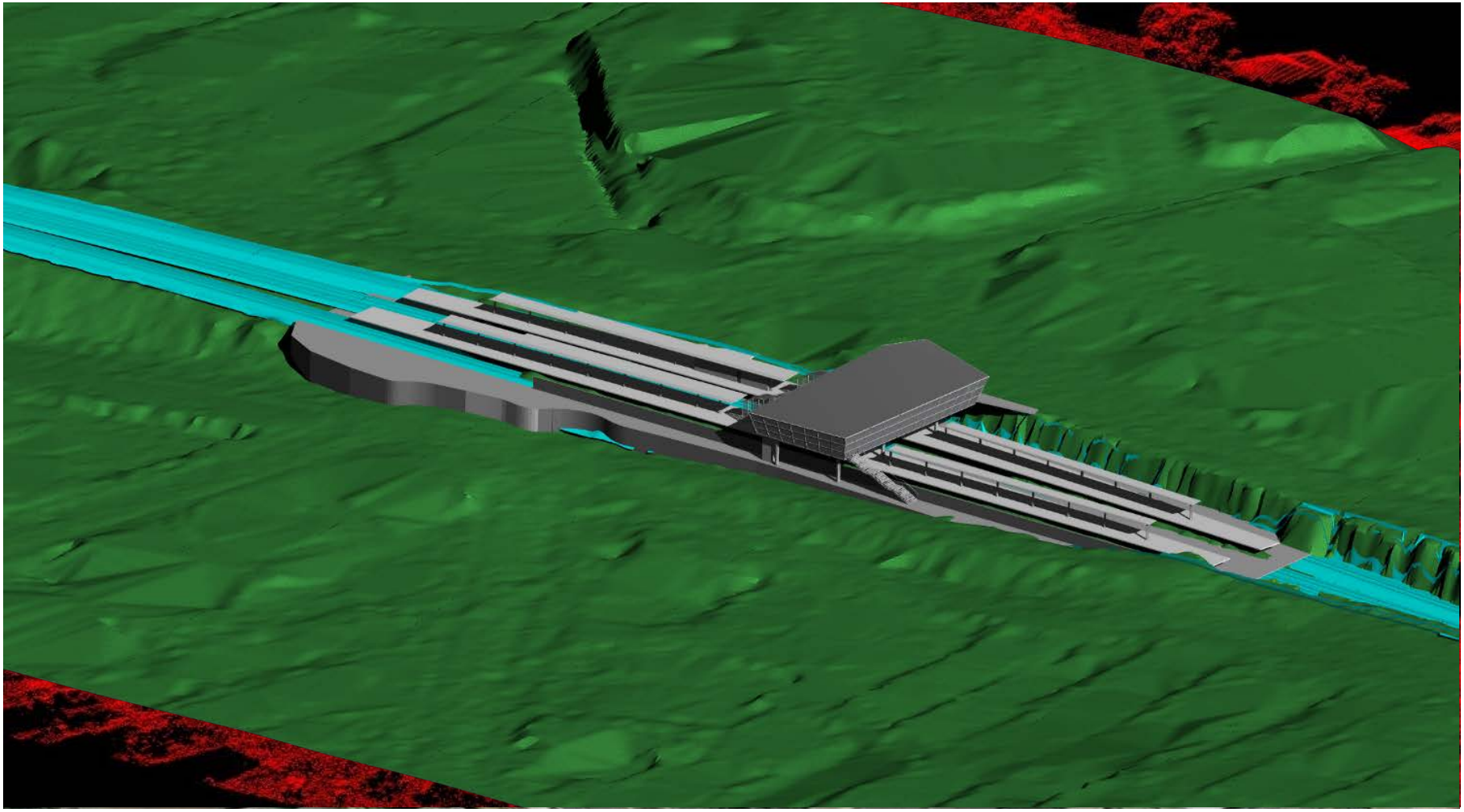
STEPS followed

1. Aerial Lidar Survey
2. LAS points managed by C3D
3. Design using C3D and REVIT
4. Naviswork integration



GEODATA
UNDERGROUND SOLUTIONS

Northern Sydney Freight Corridor



GEODATA
UNDERGROUND SOLUTIONS

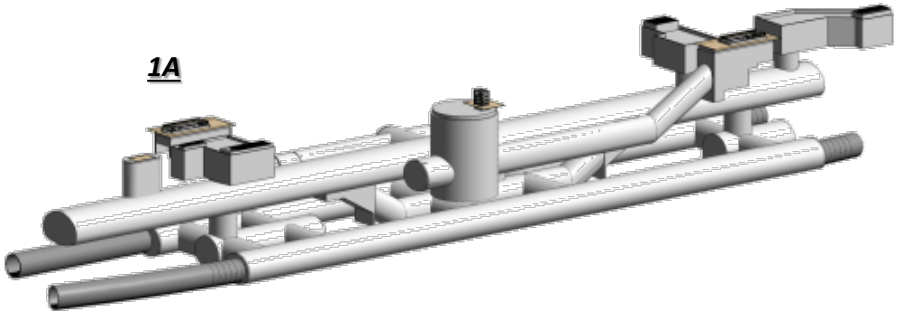
Metro Istanbul

DUDULLU - BOSTANCI : 13 Stazioni

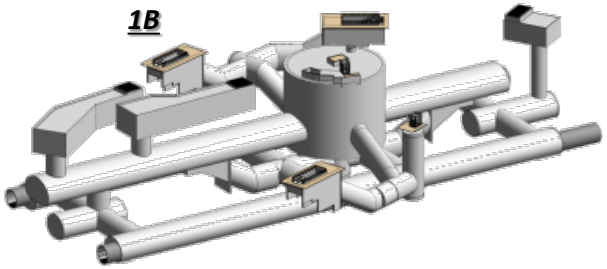
GÖZTEPE-ÜMRANİYE: 9 Stazioni

KIRAZLI - HALKALI : 9 Stazioni

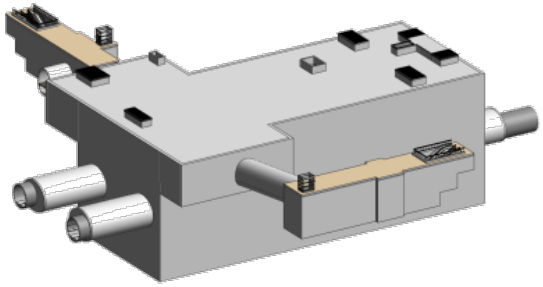
1A



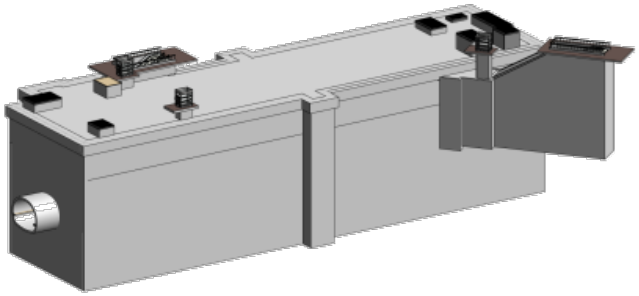
1B



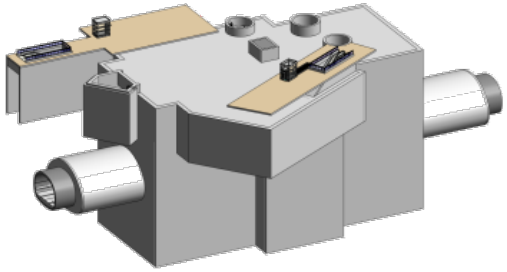
2A



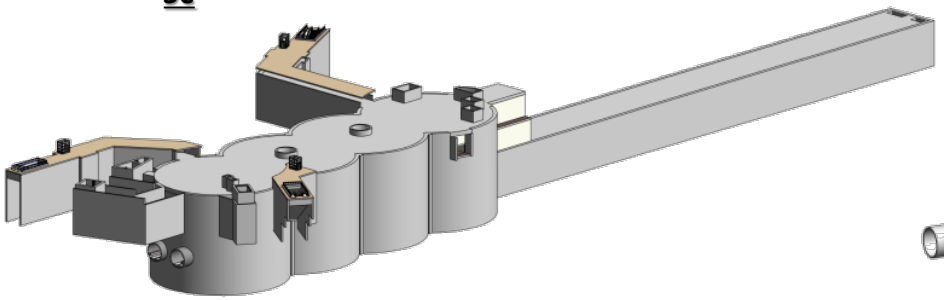
2B



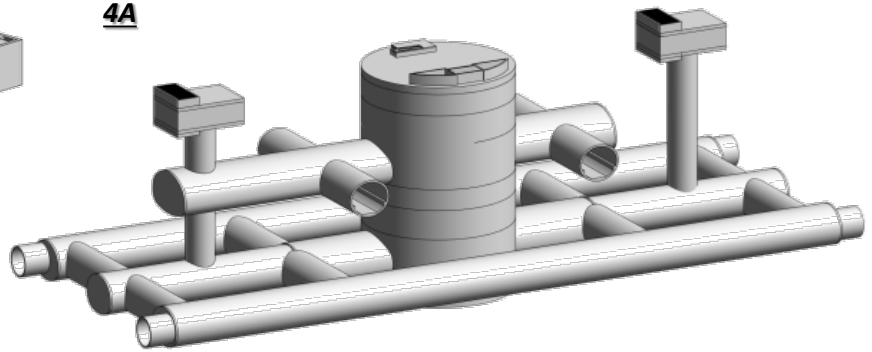
2C



3C



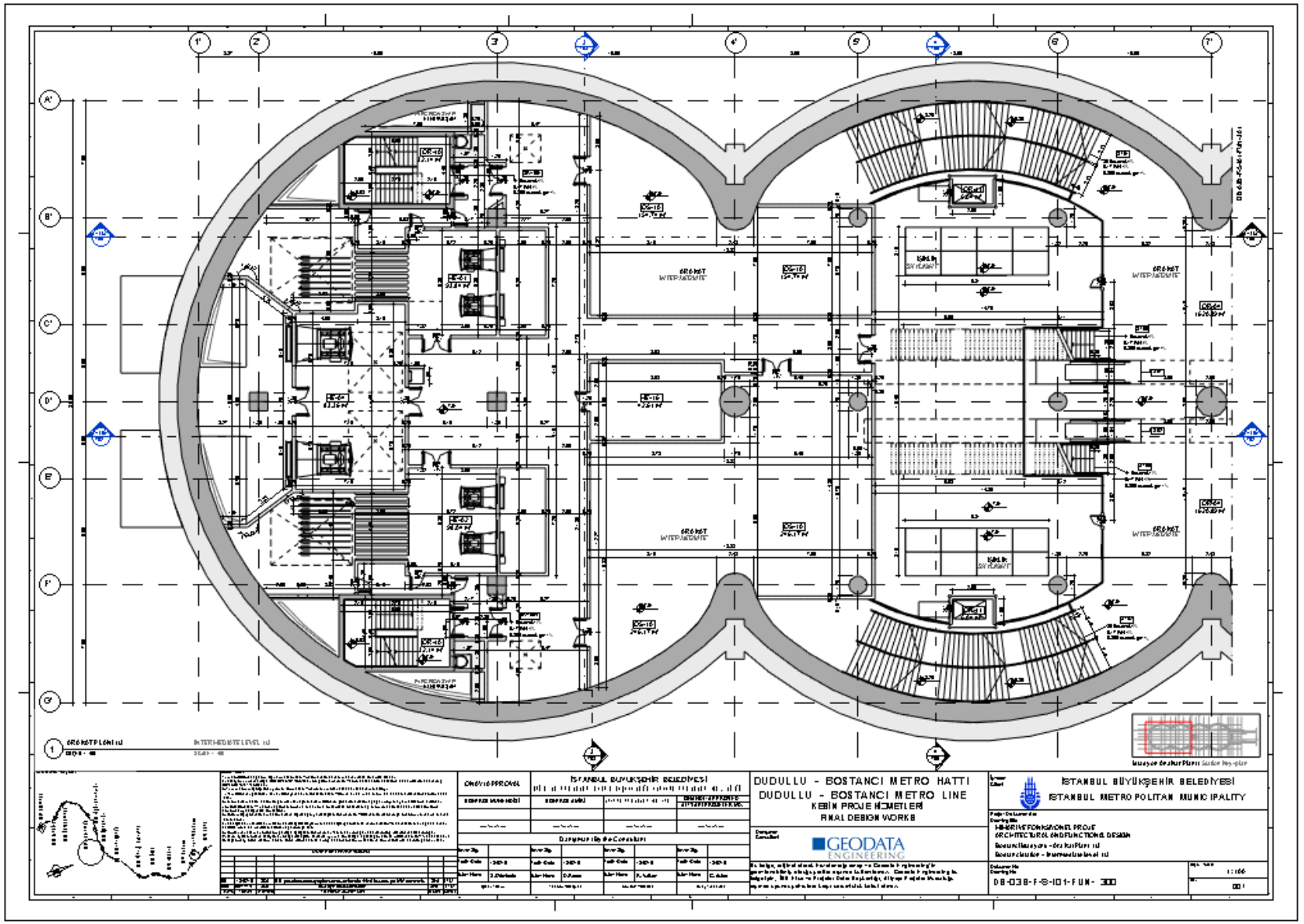
4A



GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

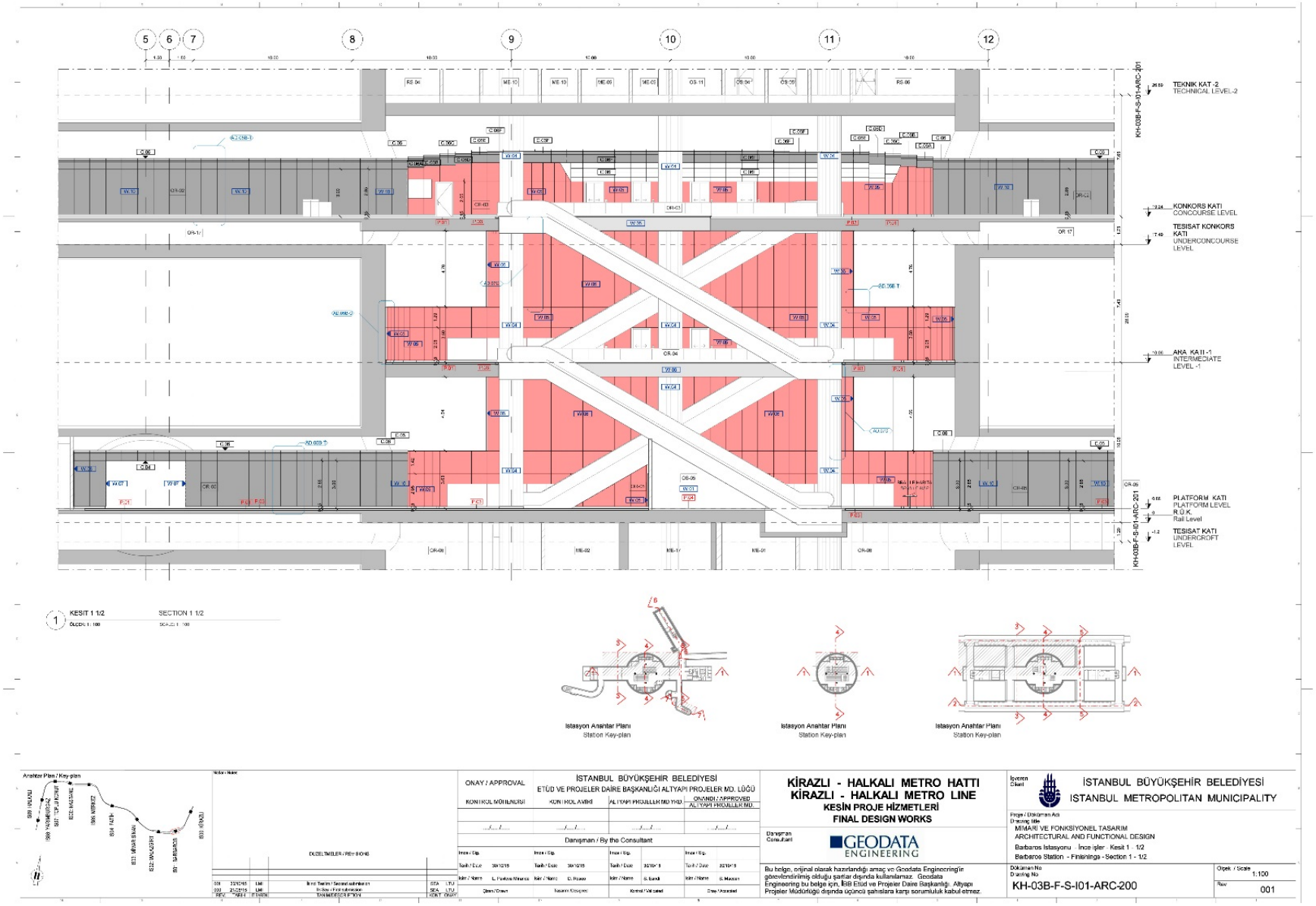
Development in REVIT



GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

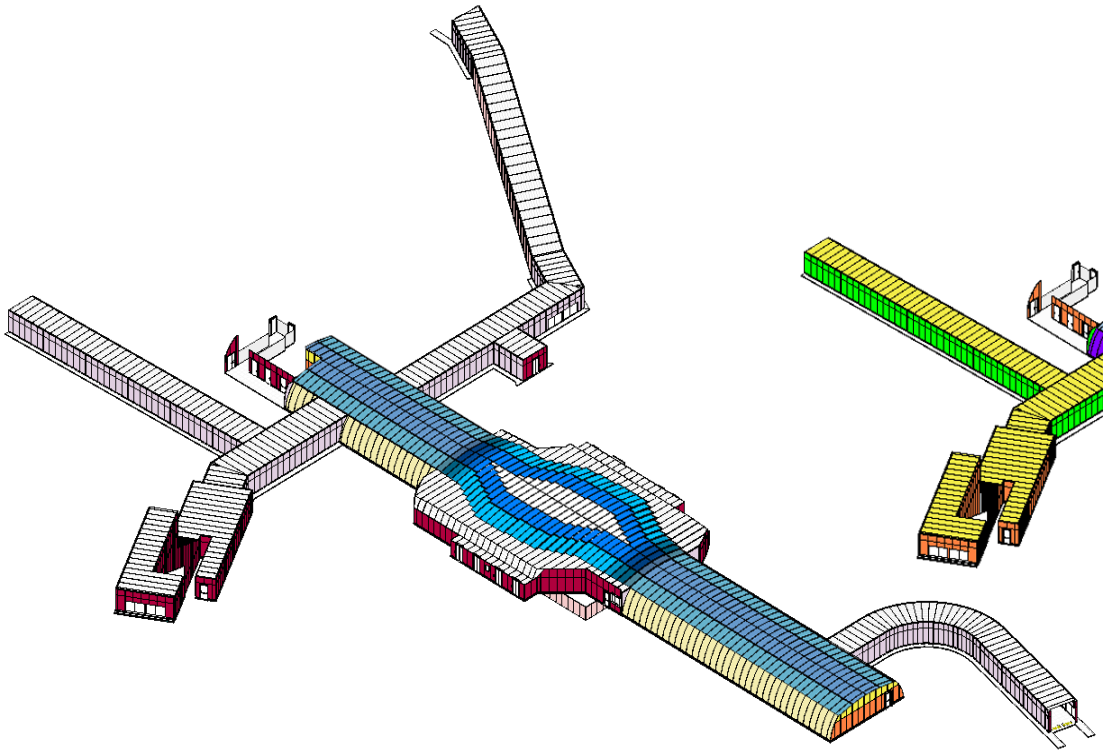
Development in REVIT



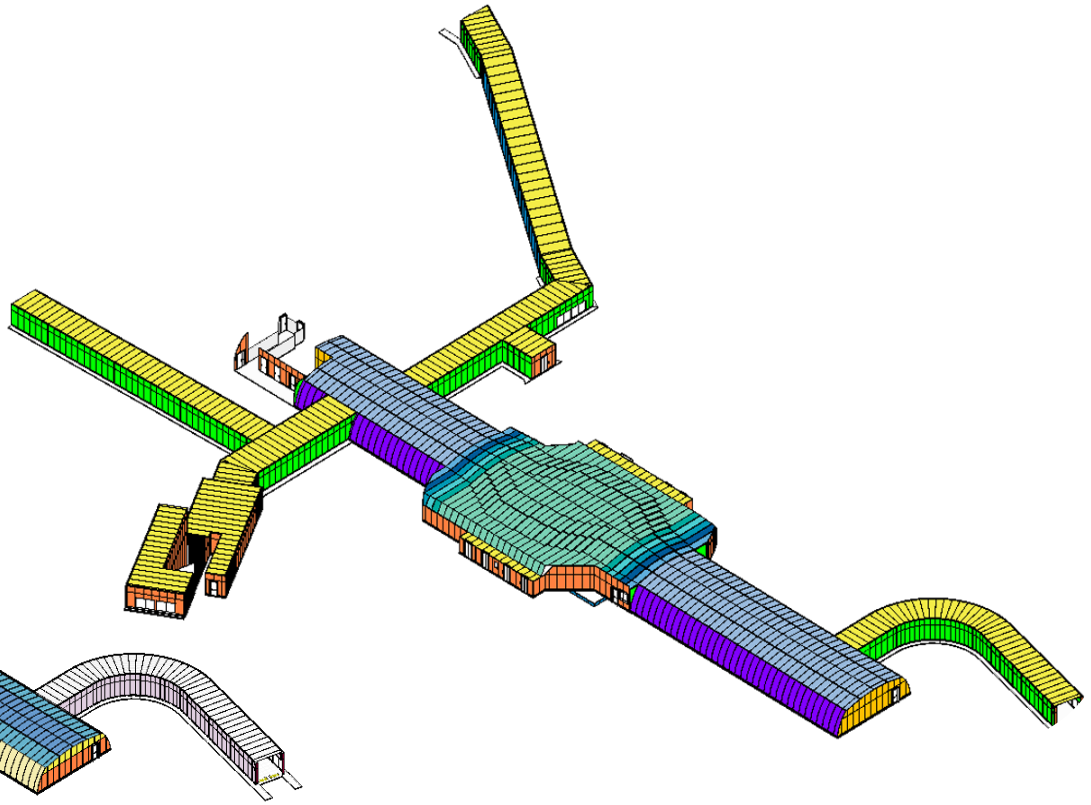
GEODATA UNDERGROUND SOLUTIONS

Metro Istanbul

Working out the model: Packages



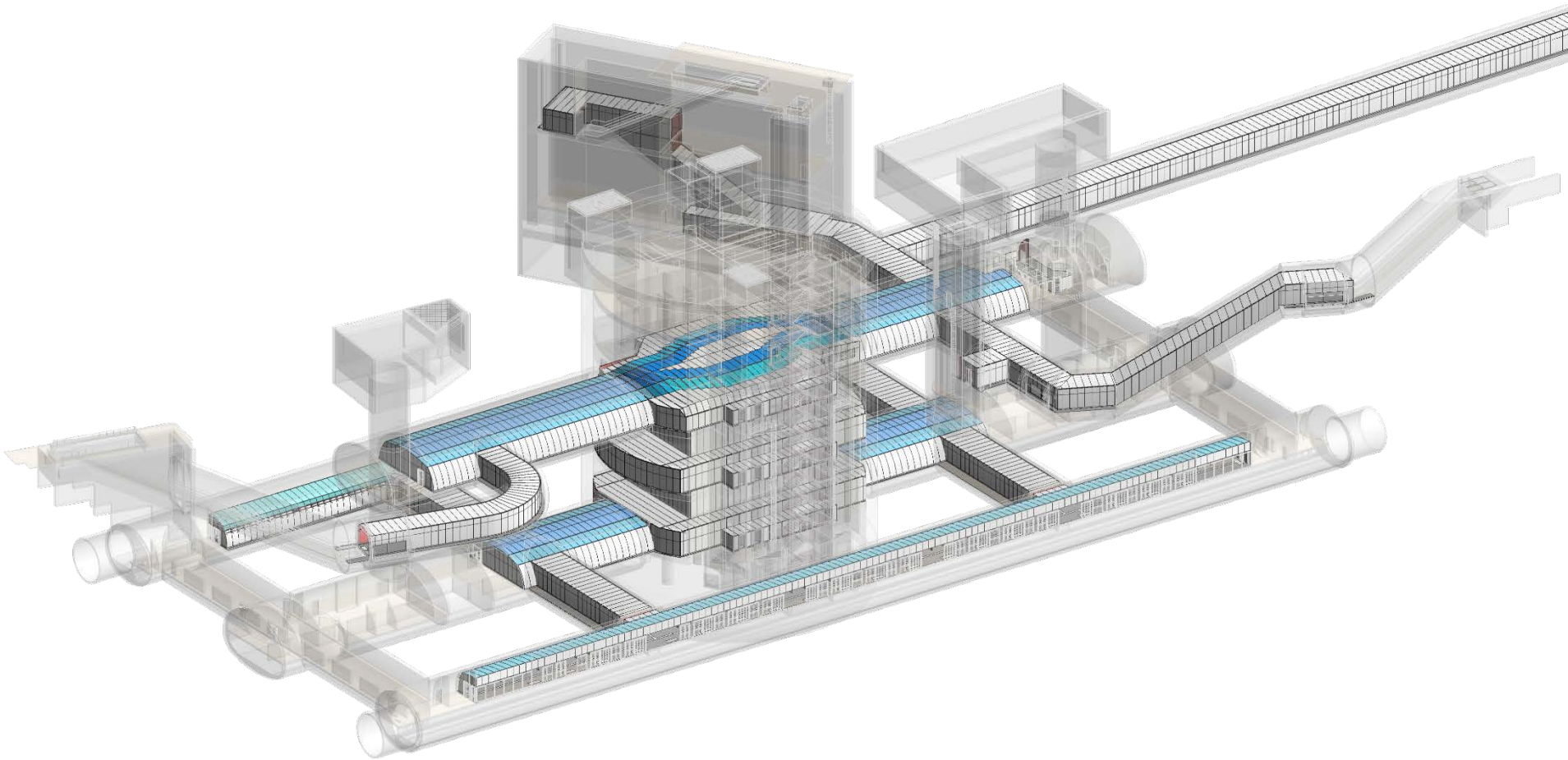
Elements by Name



Elements by Package

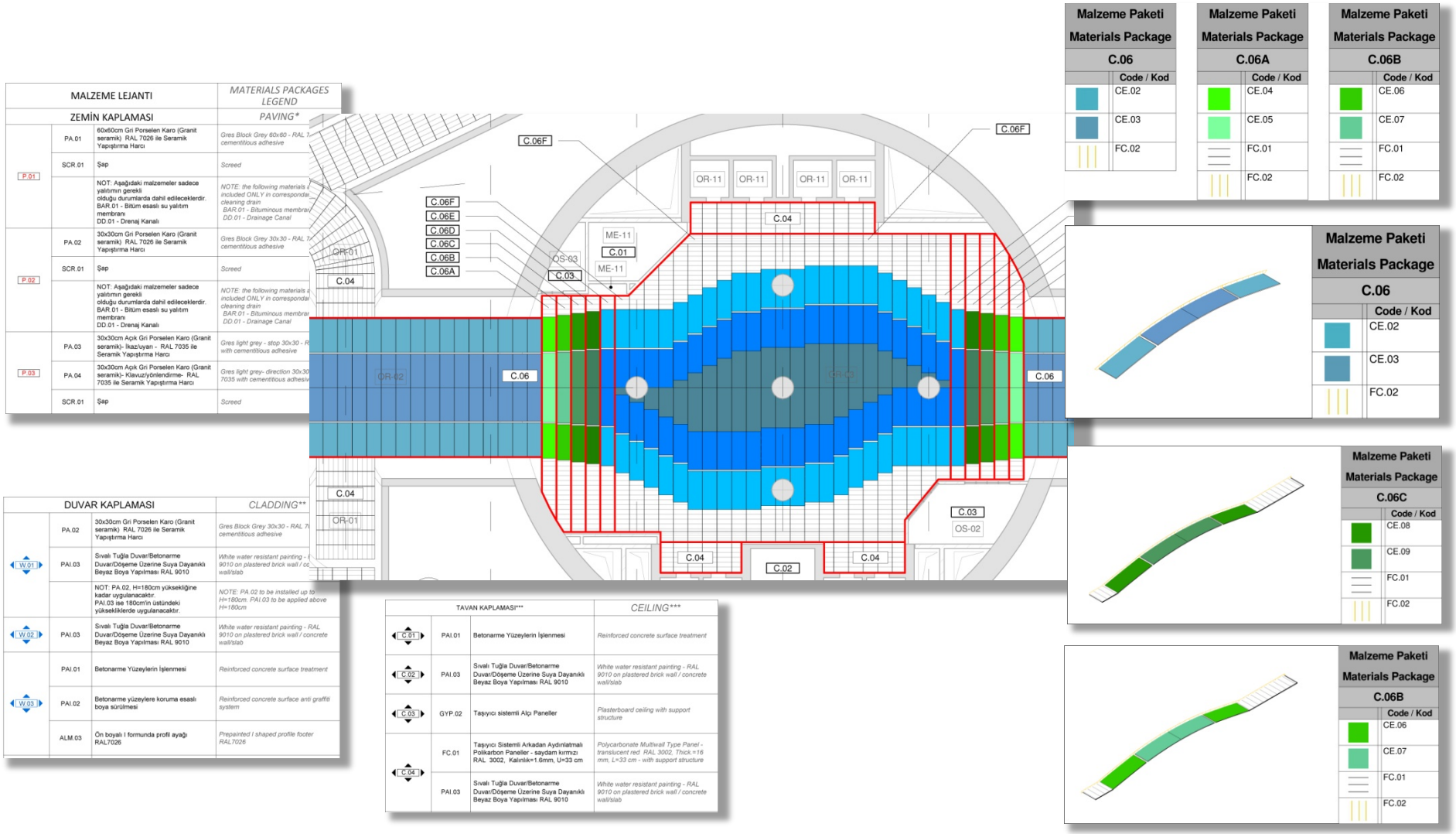
GEODATA
UNDERGROUND SOLUTIONS

The Finishing Project linked to The Functional Project



Metro Istanbul

Development in REVIT



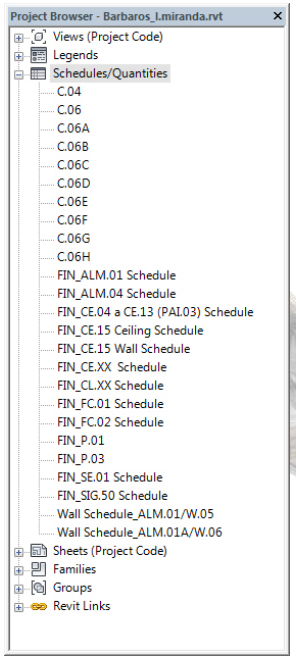
GEODATA
UNDERGROUND SOLUTIONS

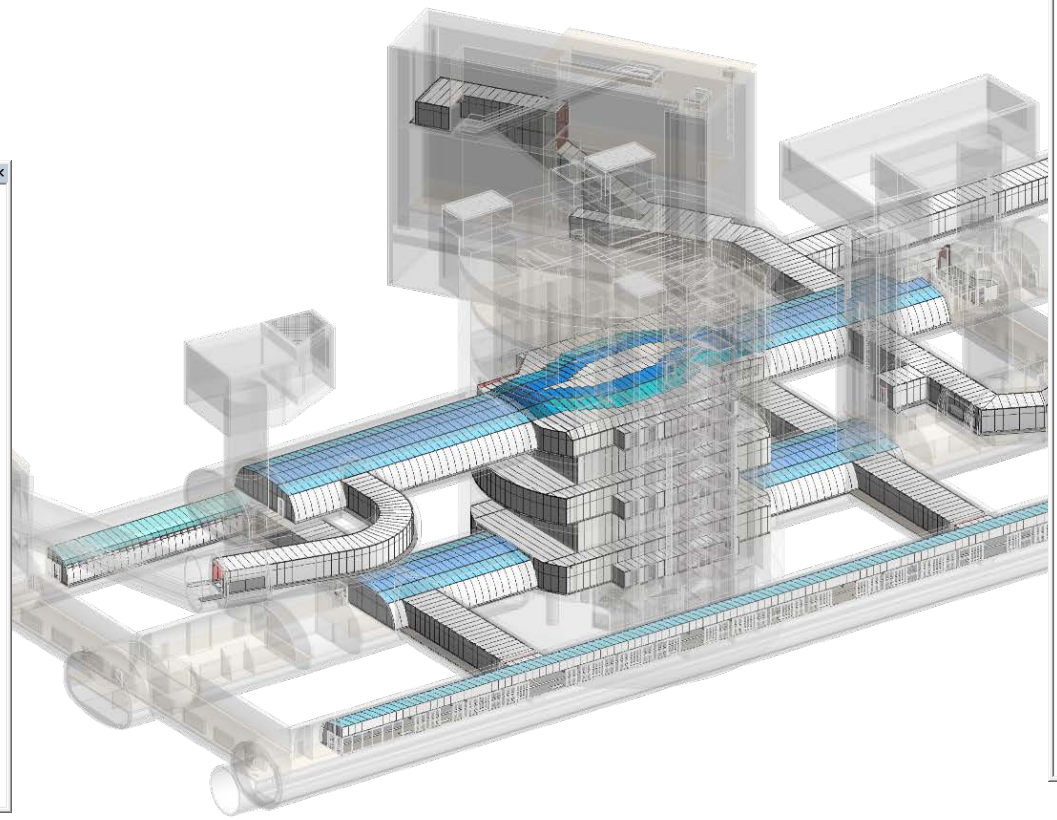
Metro Istanbul

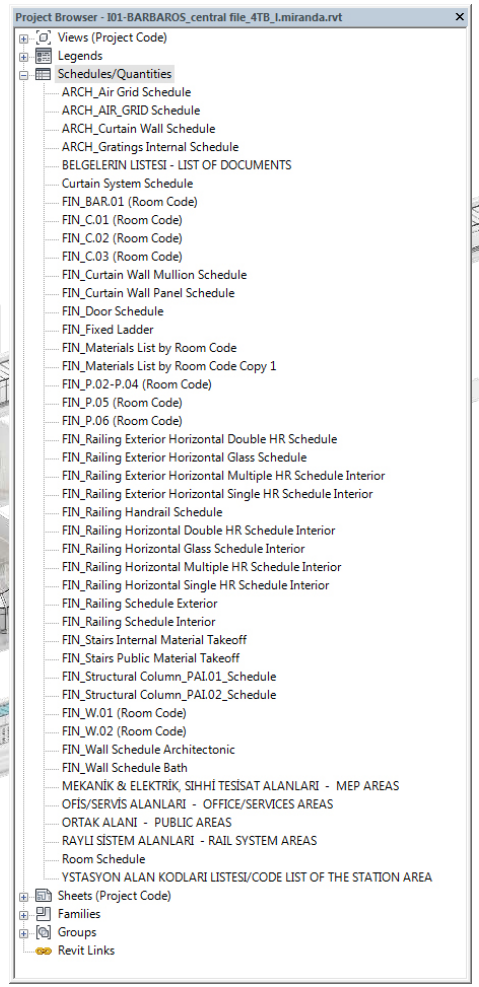
Bill of Quantities

Ground Requirement

- **Price-list oriented tagged elements;**
- **Consistent use of filters through tagging;**
- **The proper parameters.**



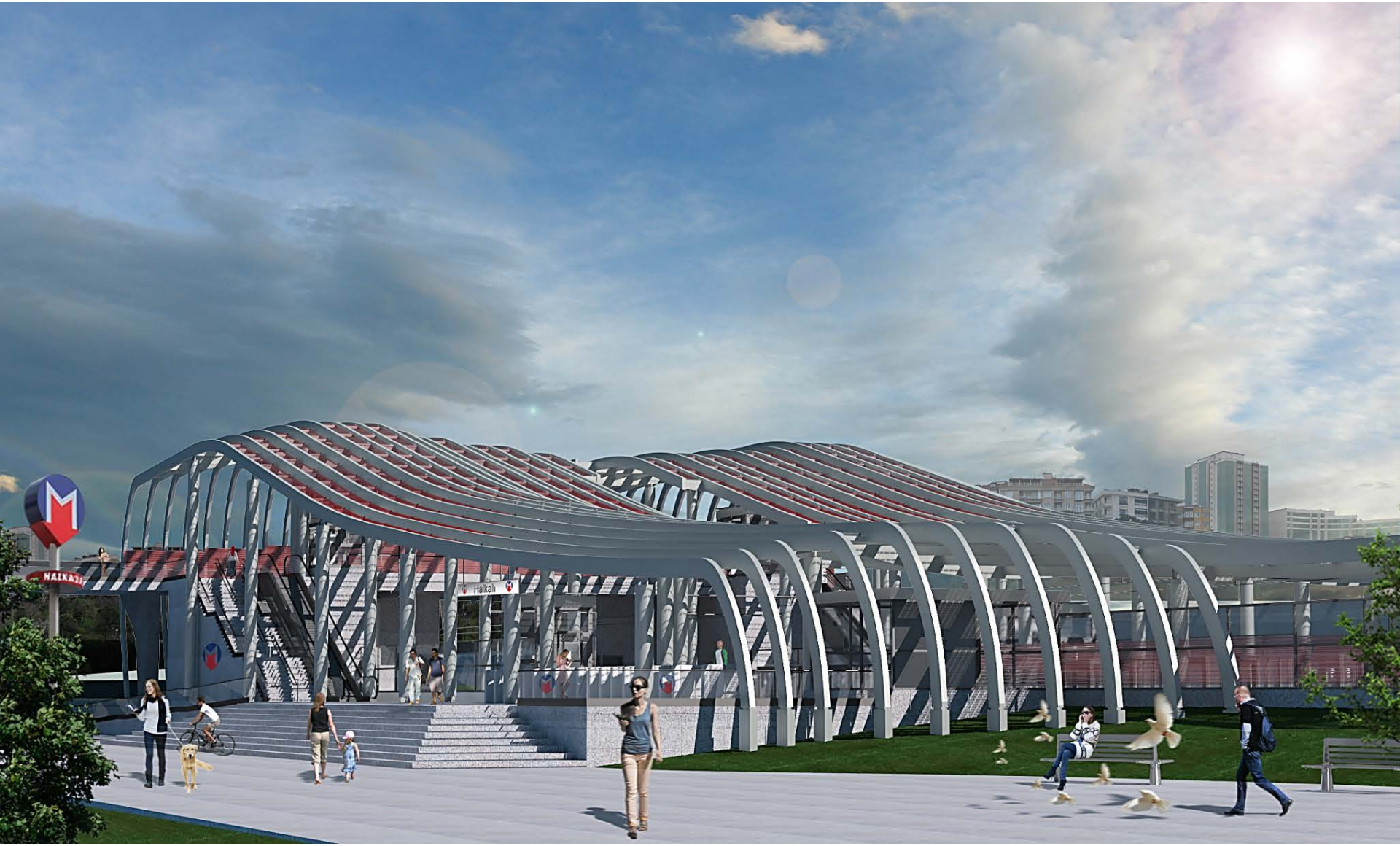




GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

From REVIT to 3D Max



GEODATA
UNDERGROUND SOLUTIONS

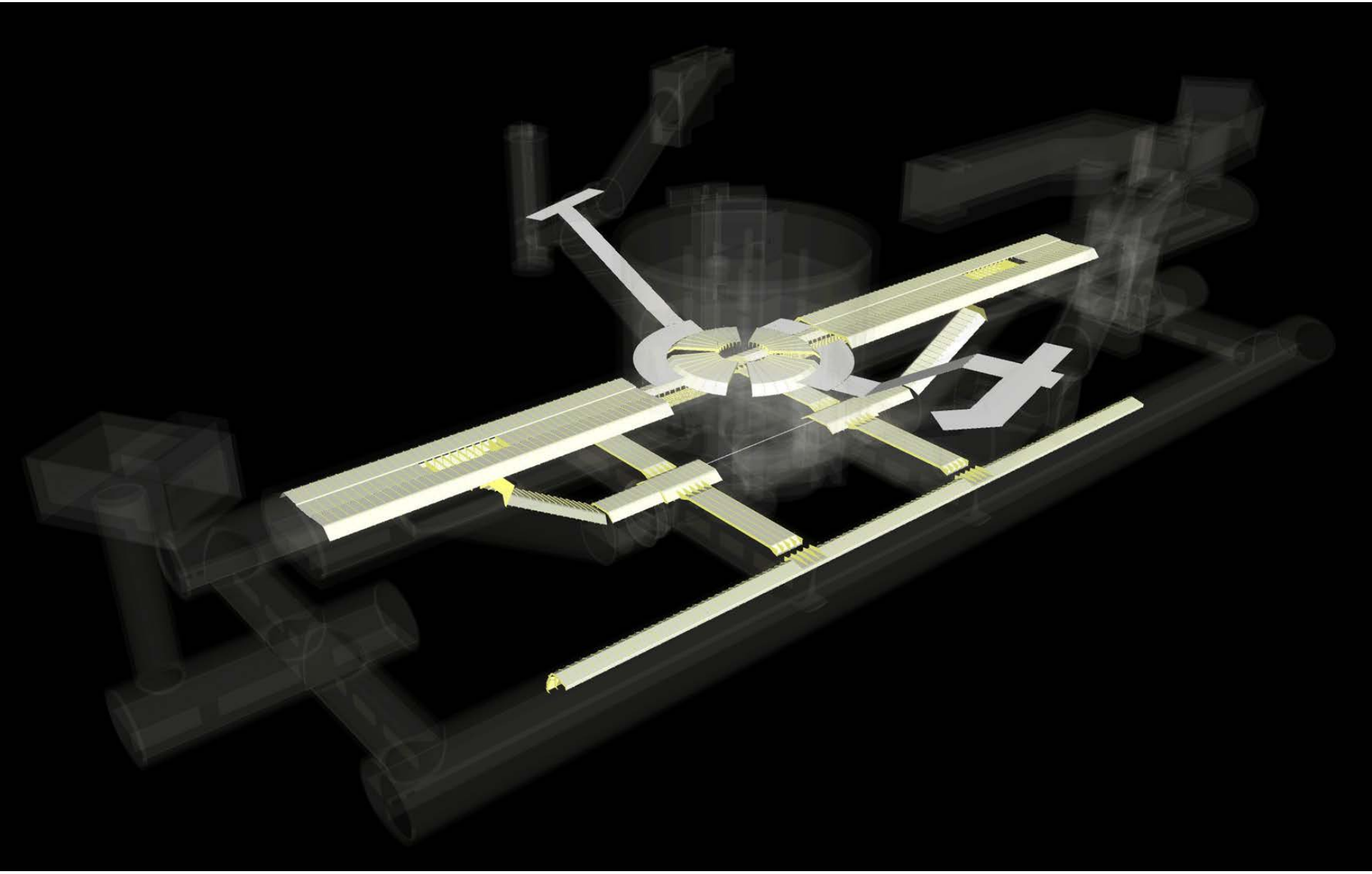
Metro Istanbul

From REVIT to 3D Max

GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

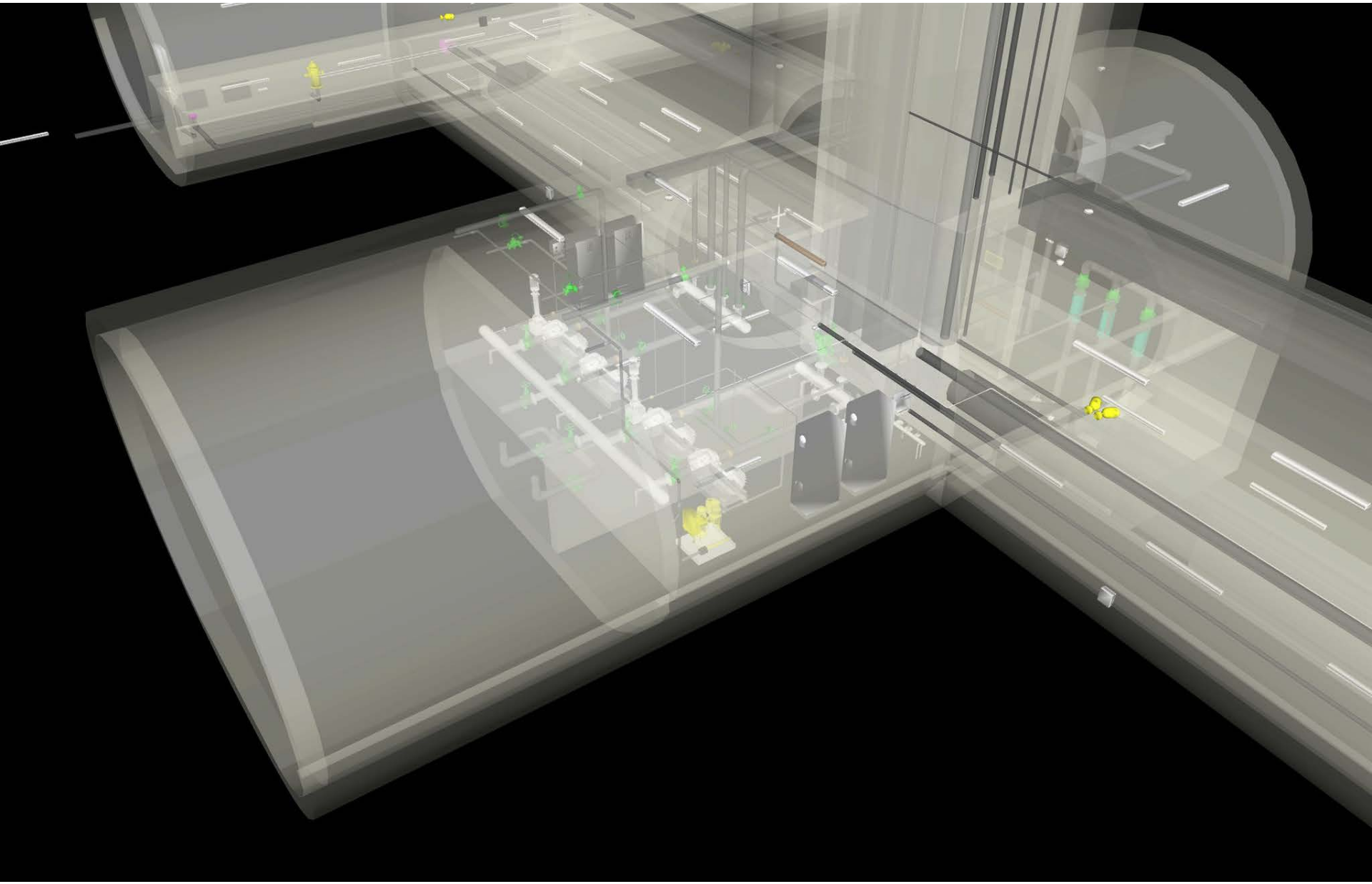
Everything together in Naviswork



GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

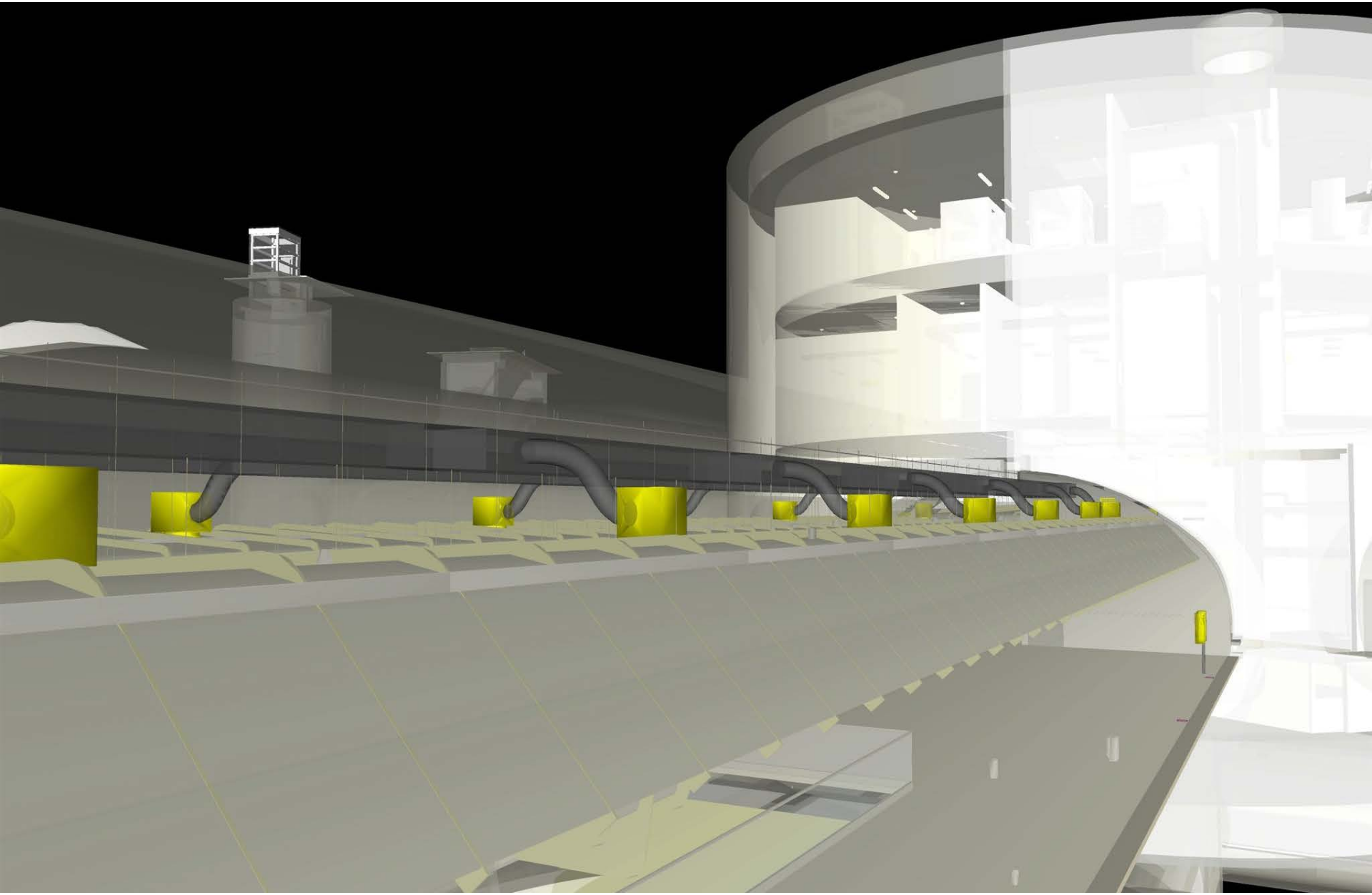
Everything together in Naviswork



GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

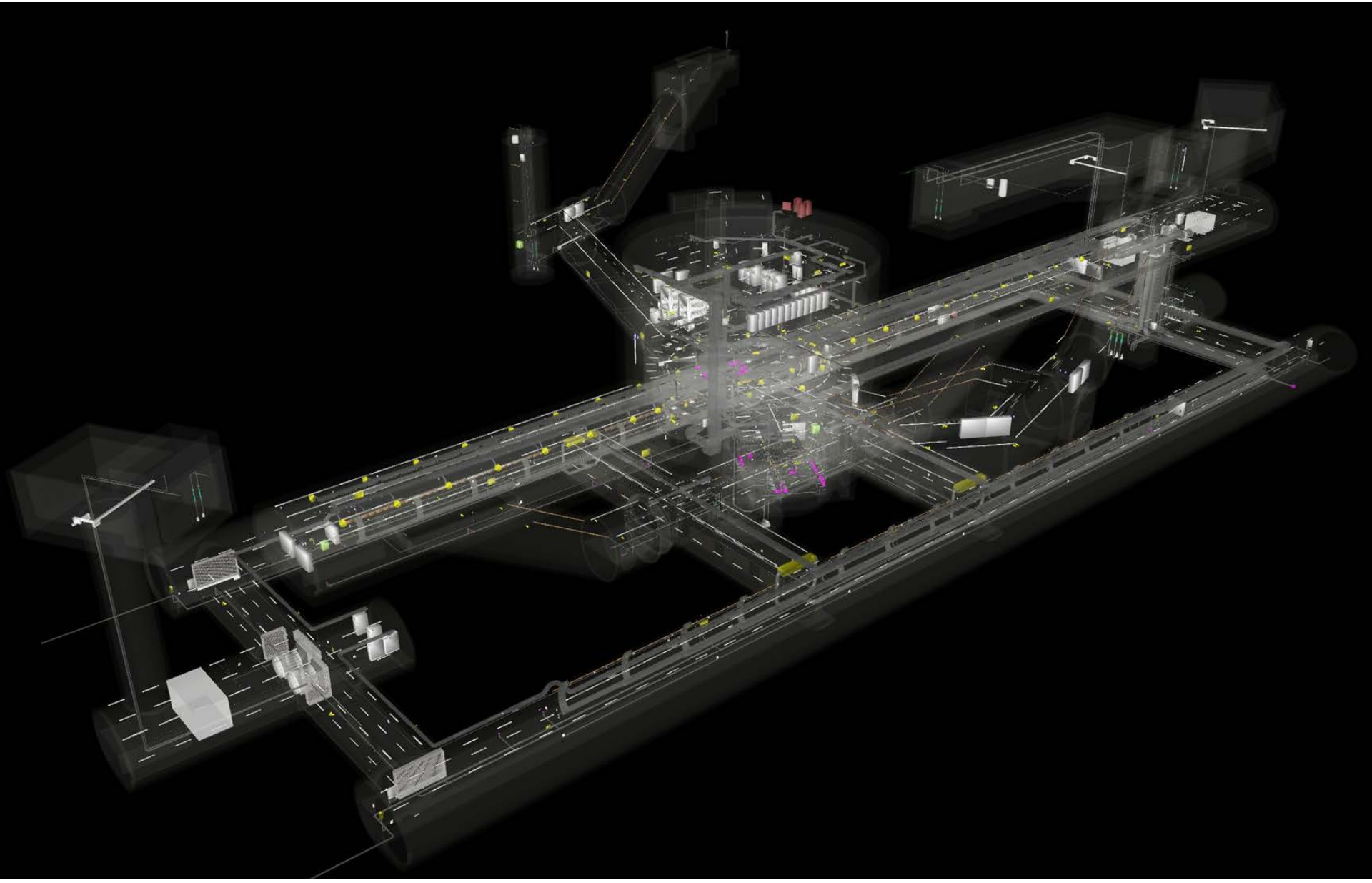
Everything together in Naviswork



GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

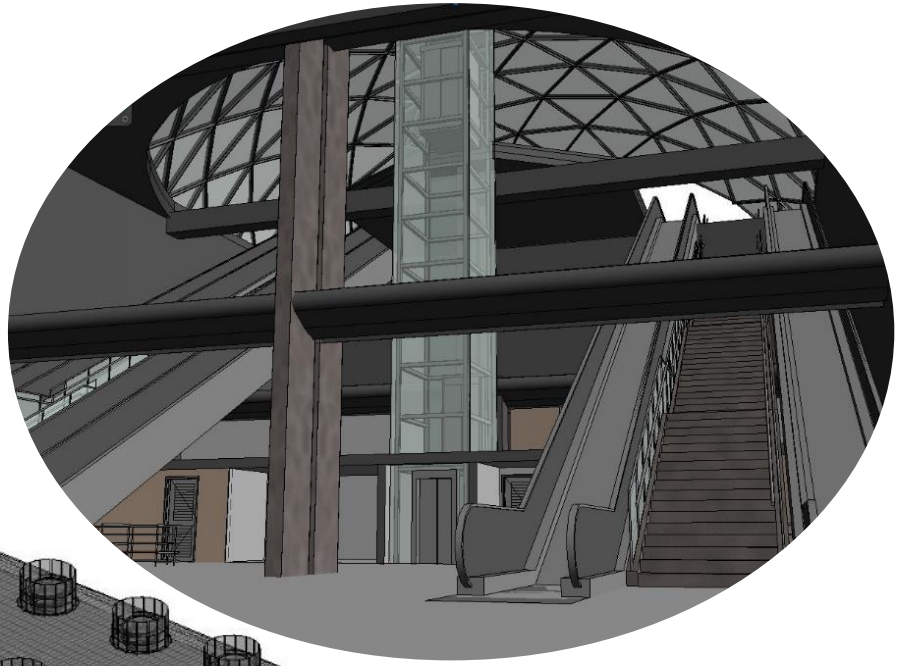
Everything together in Naviswork

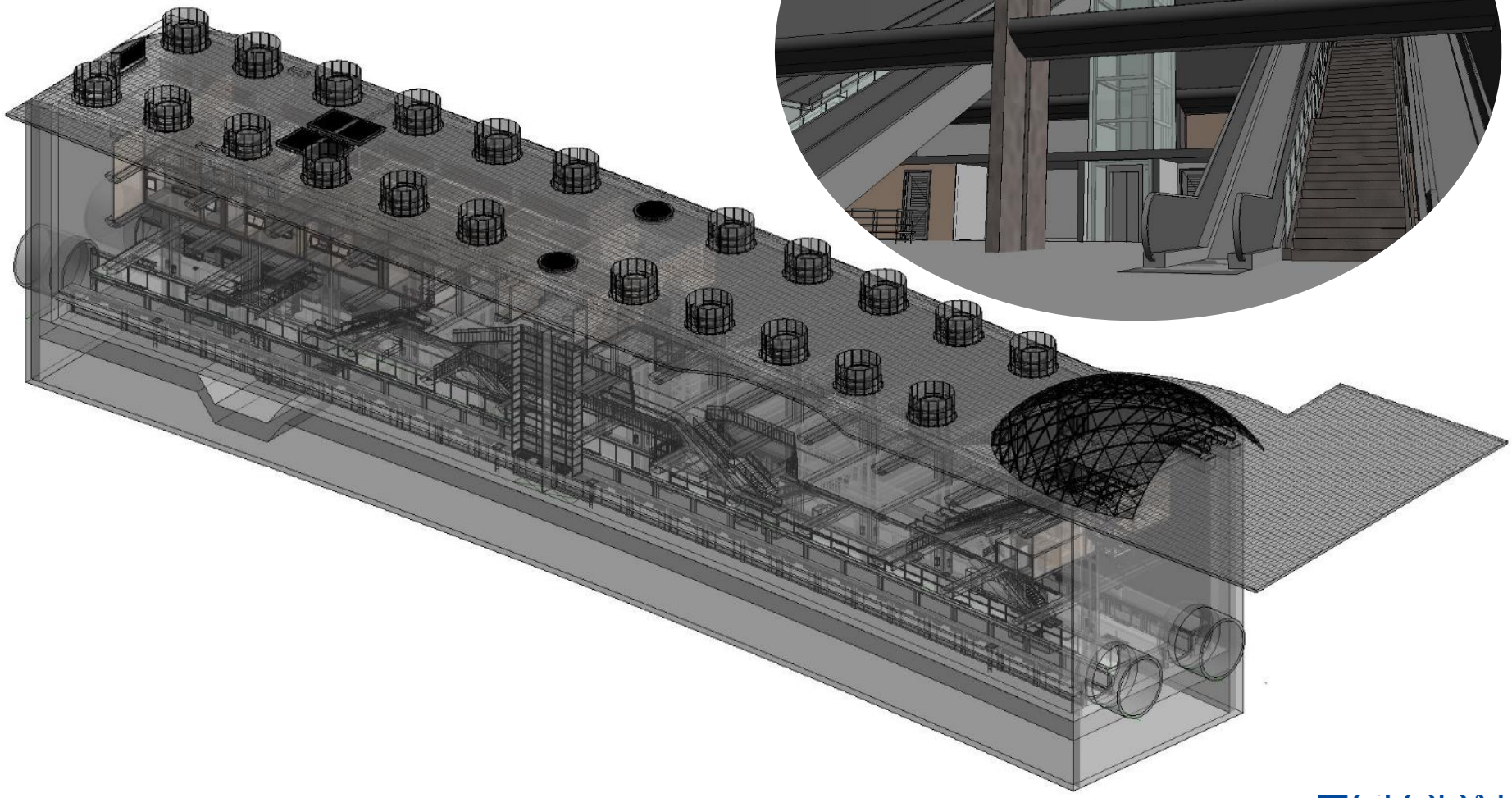


GEODATA
UNDERGROUND SOLUTIONS

Metro Sao Paulo- Brazil

Using REVIT with rigid design standard

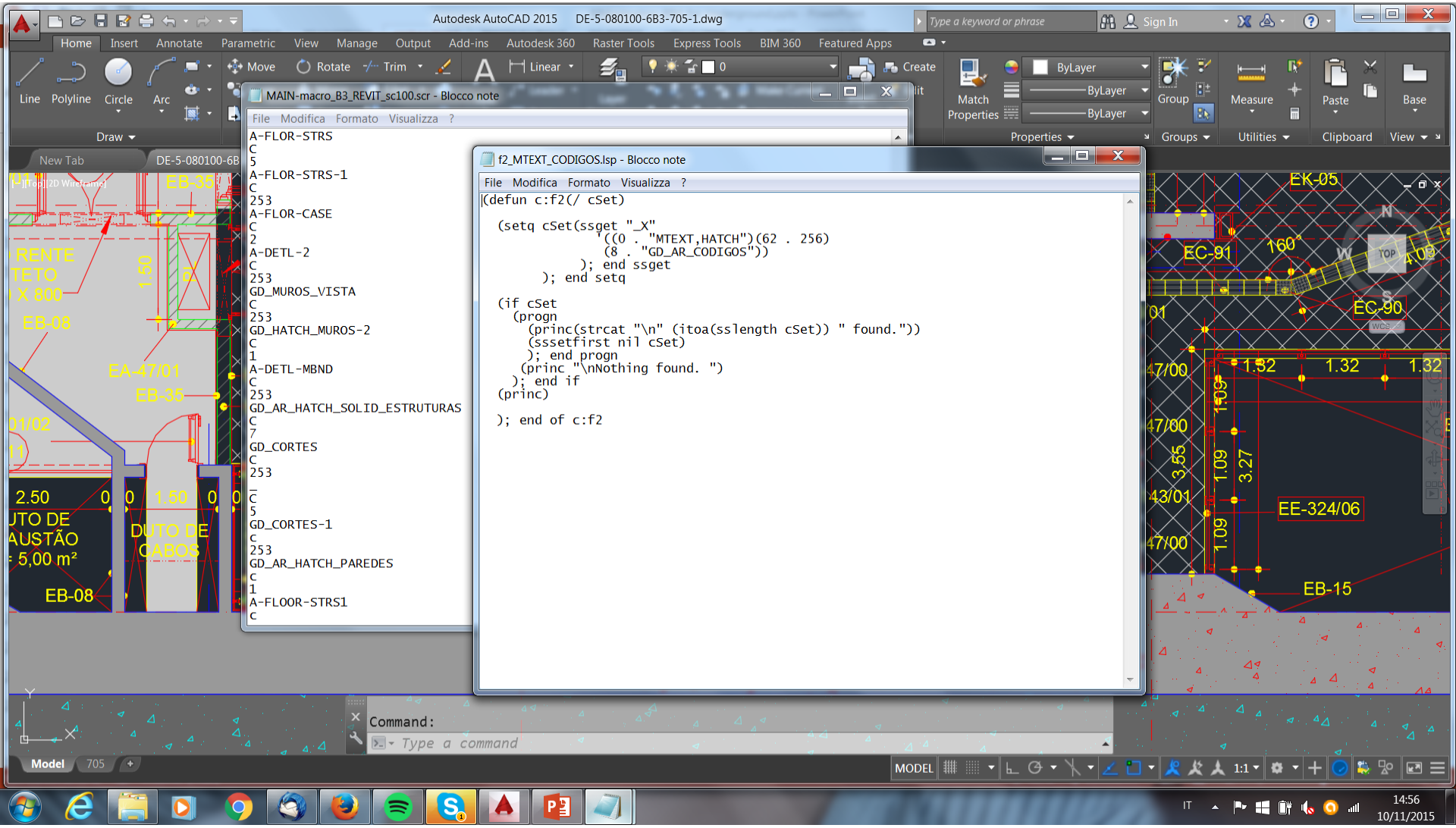




GEODATA
UNDERGROUND SOLUTIONS

Metro Sao Paulo- Brazil

Using REVIT with rigid design standard



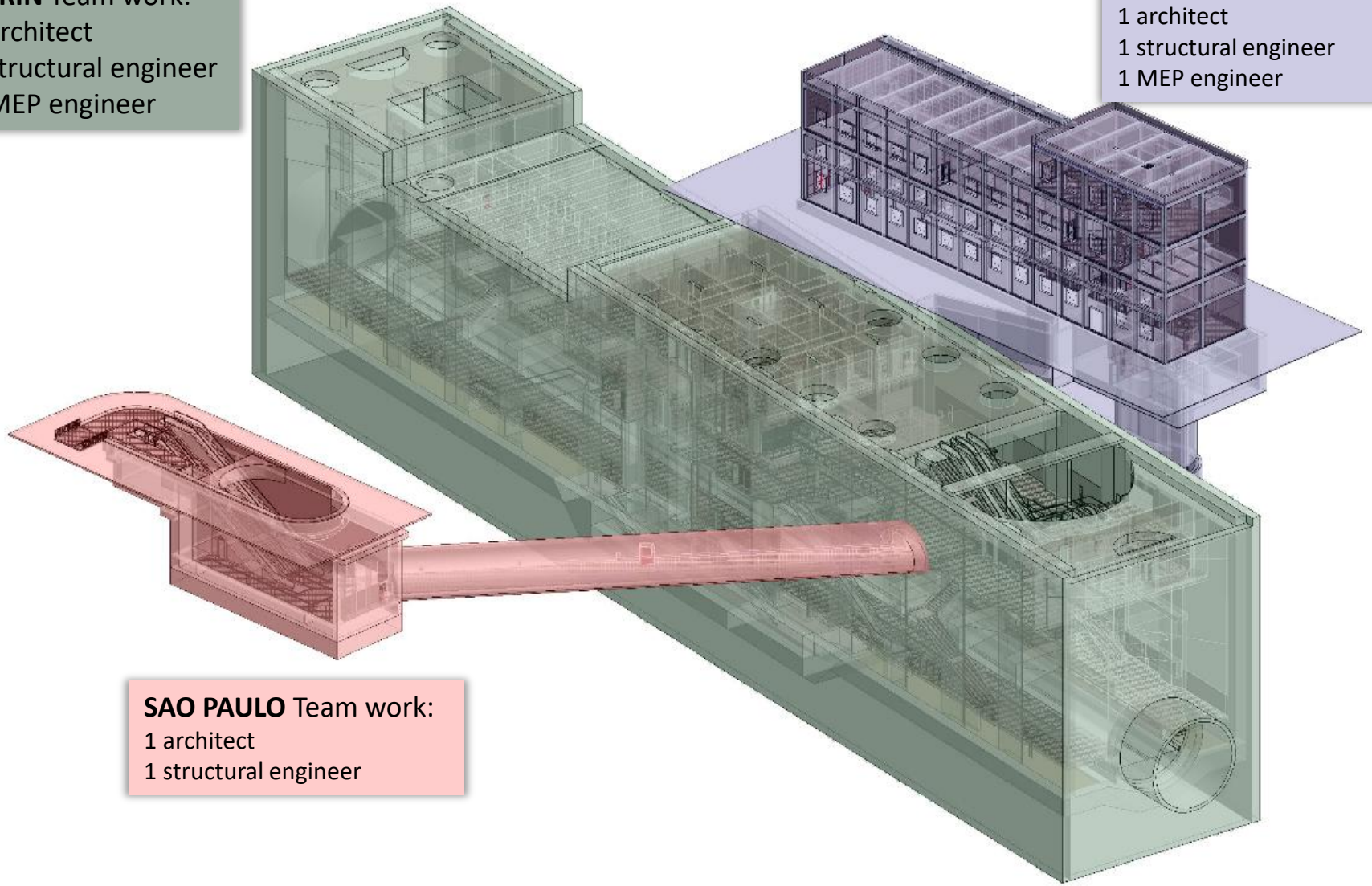
GEODATA
UNDERGROUND SOLUTIONS

Metro Sao Paulo- Brazil

Working with workset

TURIN Team work:
1 architect
2 structural engineer
1 MEP engineer

CHILE Team work:
1 architect
1 structural engineer
1 MEP engineer



SAO PAULO Team work:
1 architect
1 structural engineer

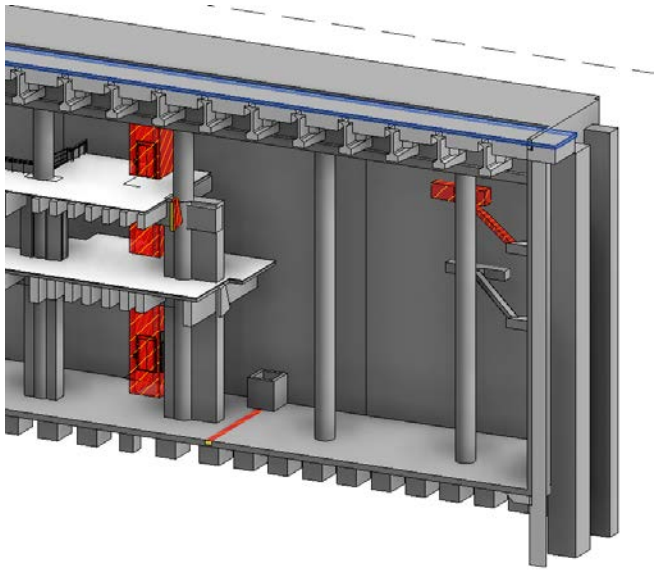
GEODATA
UNDERGROUND SOLUTIONS

Santiago Batuco Railway line (Chile)

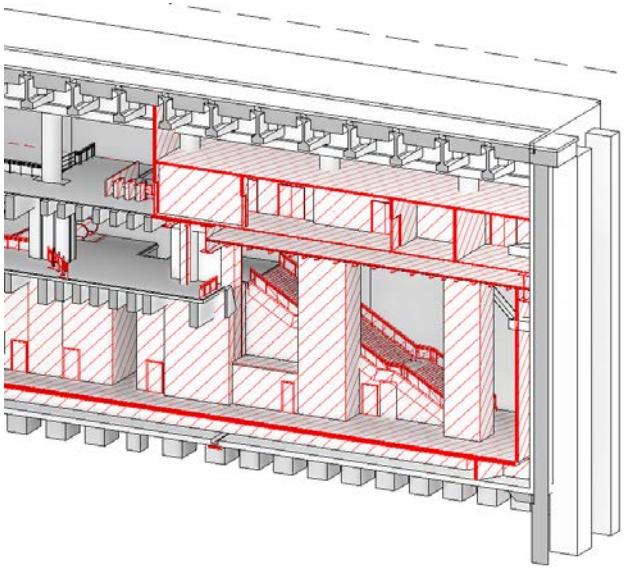
Revit and construction phases

The Quinta Normal station in Santiago of Chile is an existing station, built with a big space foreseen to host a future station.
During our project, we decided to change many things they though years ago, demolishing some parts and realizing new ones.

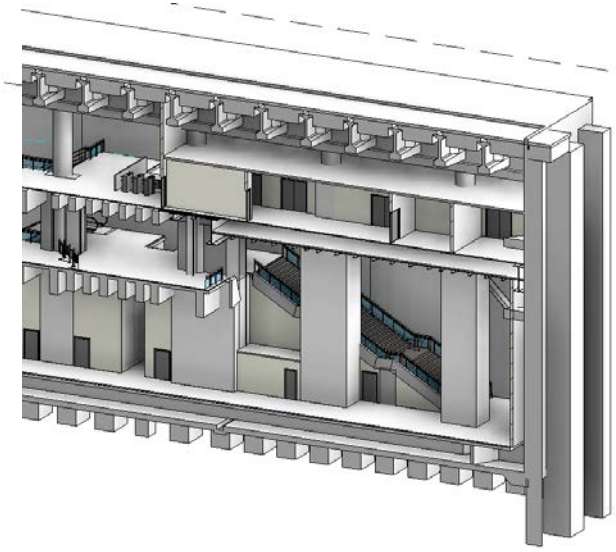
Existing phase with demolished elements highlighted in red colour



New elements highlighted in red colour



Final solution designed during project phase



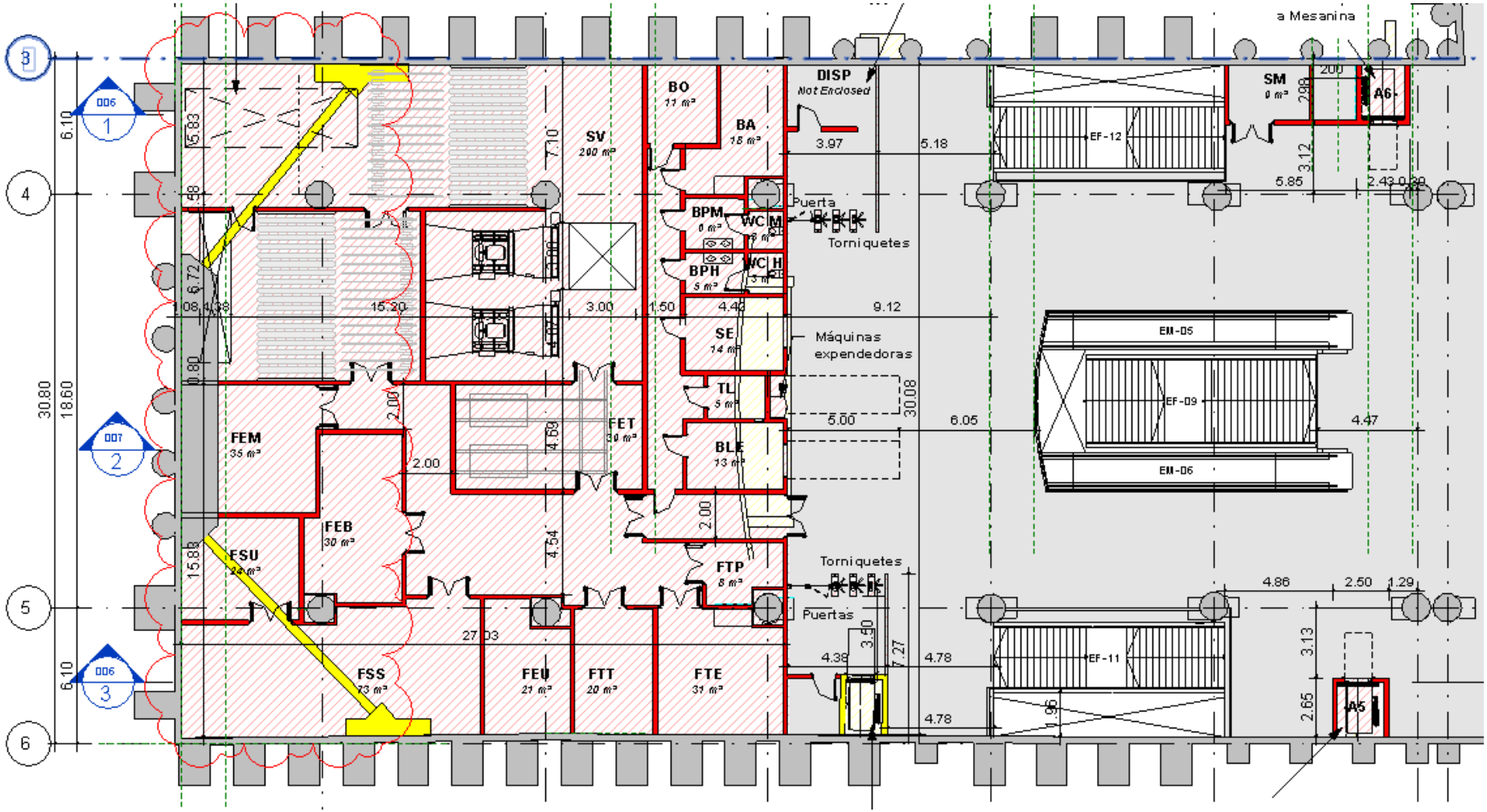
GEODATA
UNDERGROUND SOLUTIONS

Santiago Batuco Railway line (Chile)

Revit and construction phases

You can obtain the same behaviour even in plan view

- In yellow colour the demolished elements
- In red colour the new elements

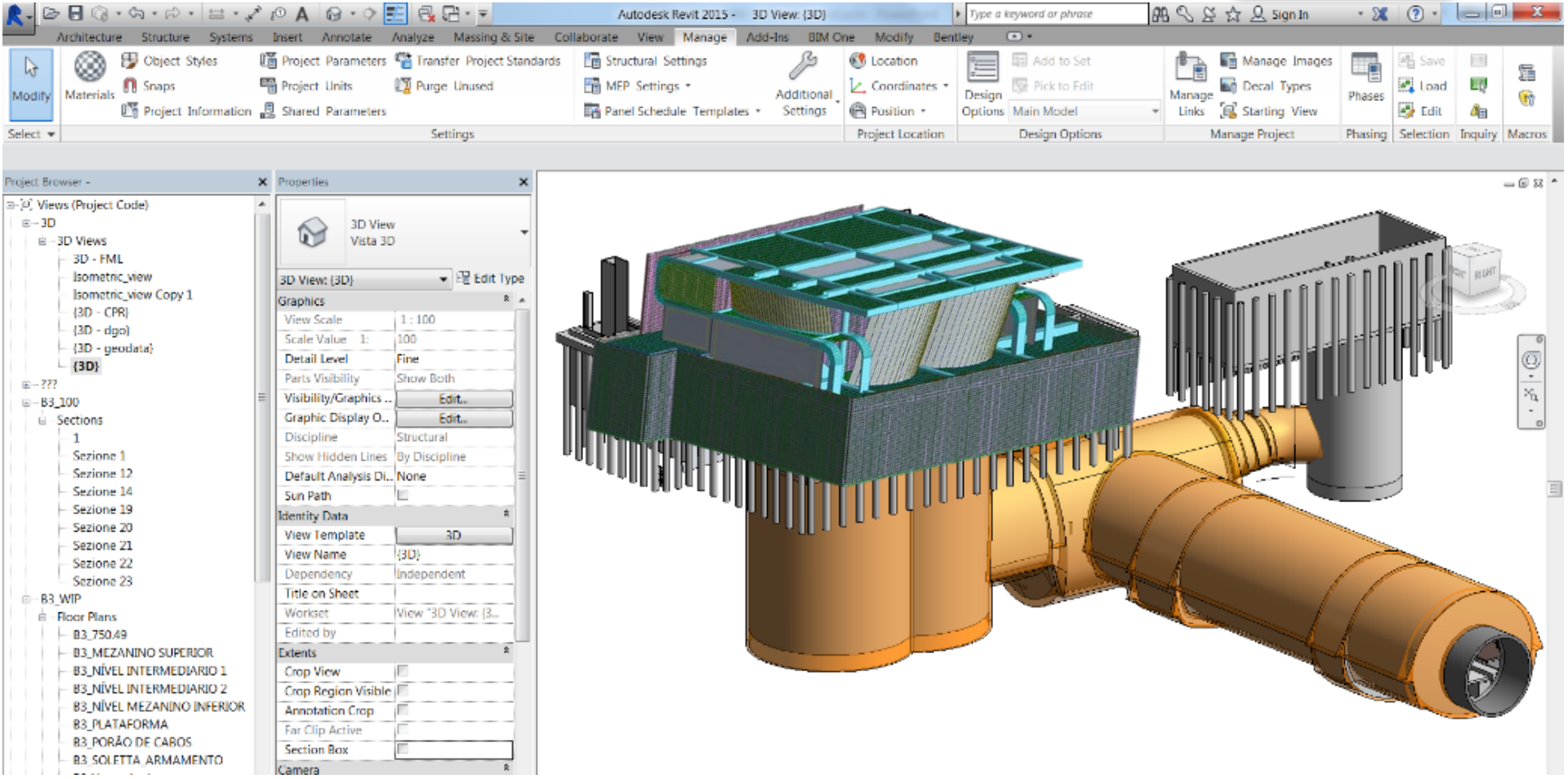


GEODATA
UNDERGROUND SOLUTIONS

Metro Sao Paulo- Brazil

REVIT- ROBOT interoperability

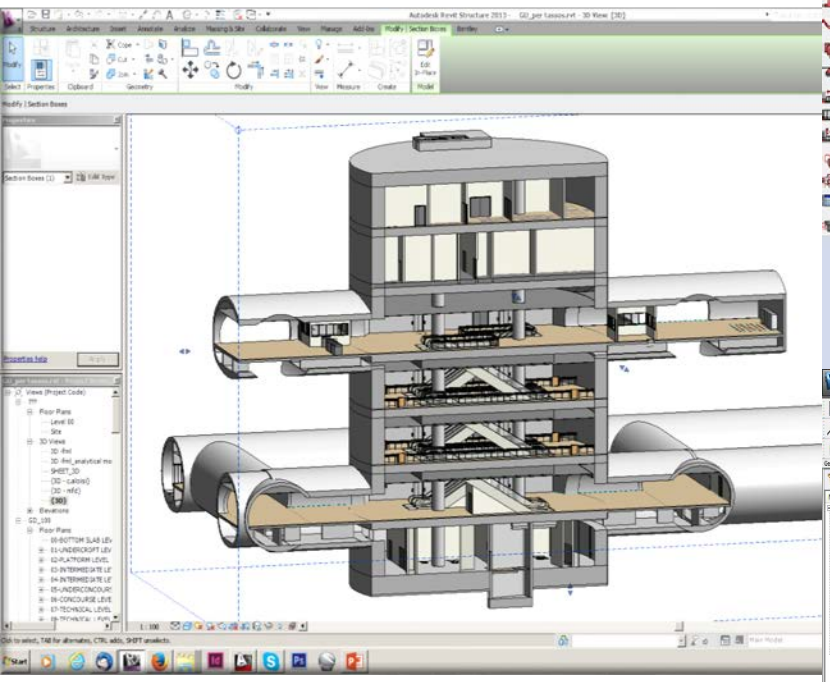
From REVIT into ROBOT → Structure calculation in ROBOT → Back to REVIT

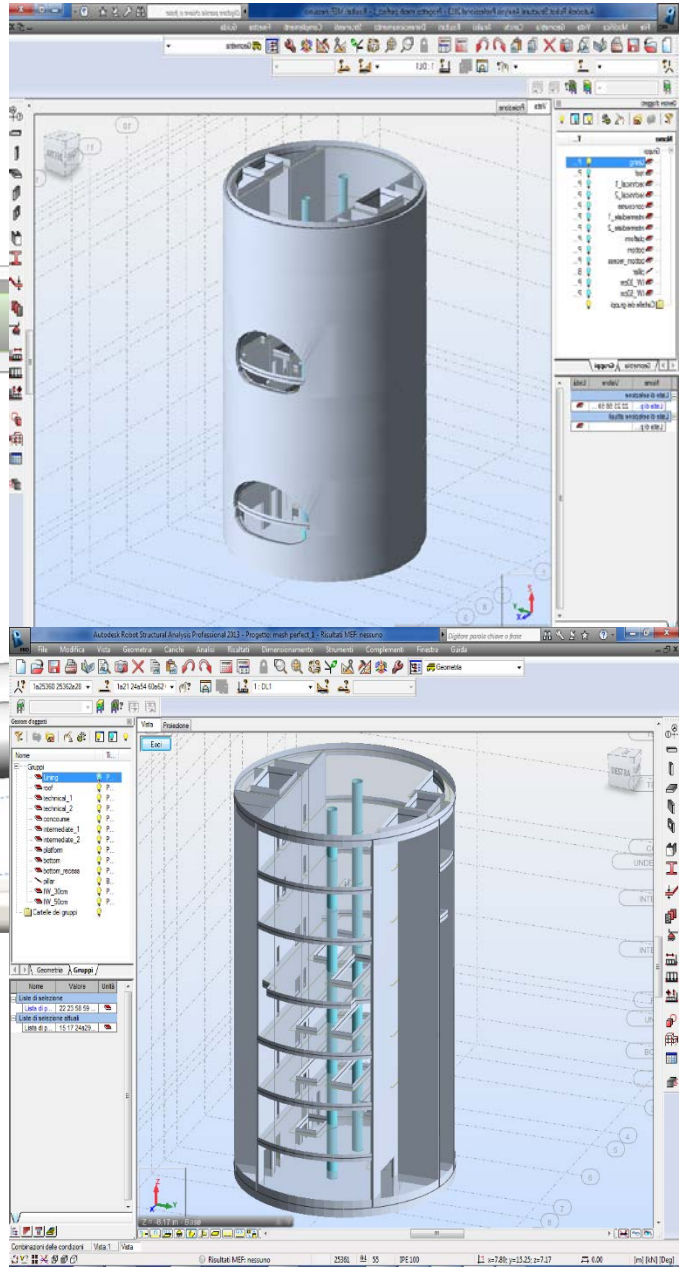


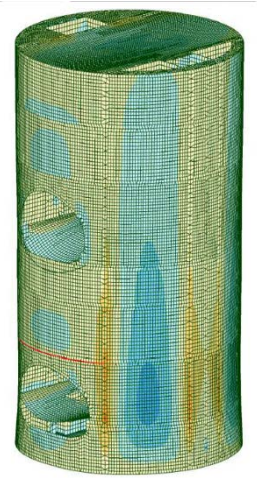
GEODATA
UNDERGROUND SOLUTIONS

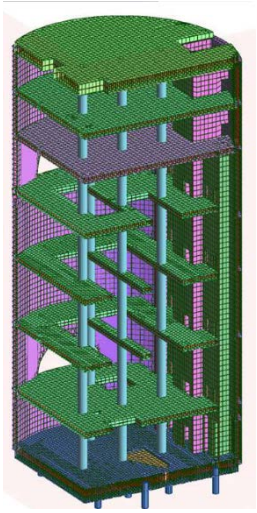
Metro Istanbul

REVIT- ROBOT interoperability







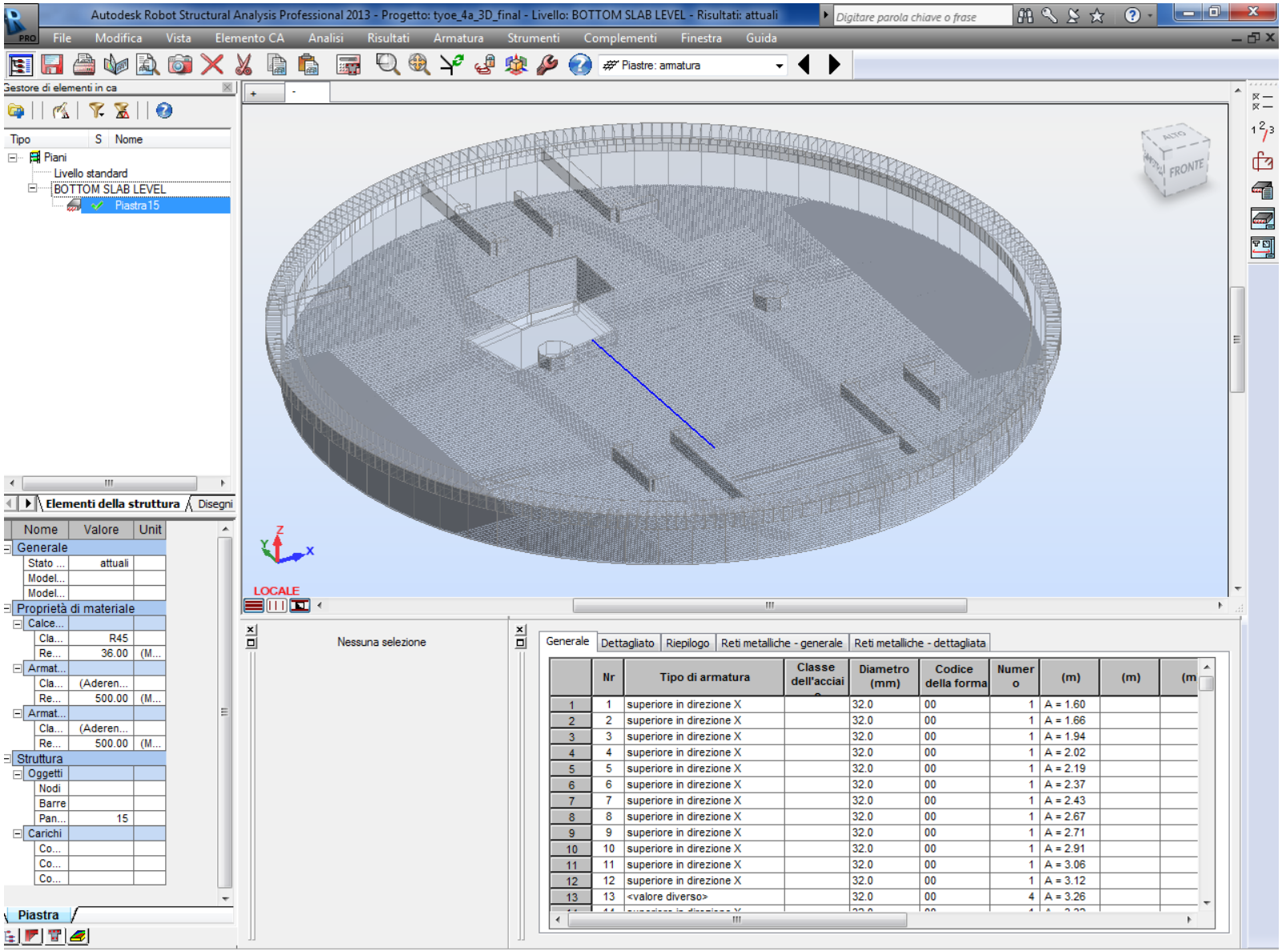


GEODATA
UNDERGROUND SOLUTIONS

Metro Istanbul

REVIT- ROBOT interoperability

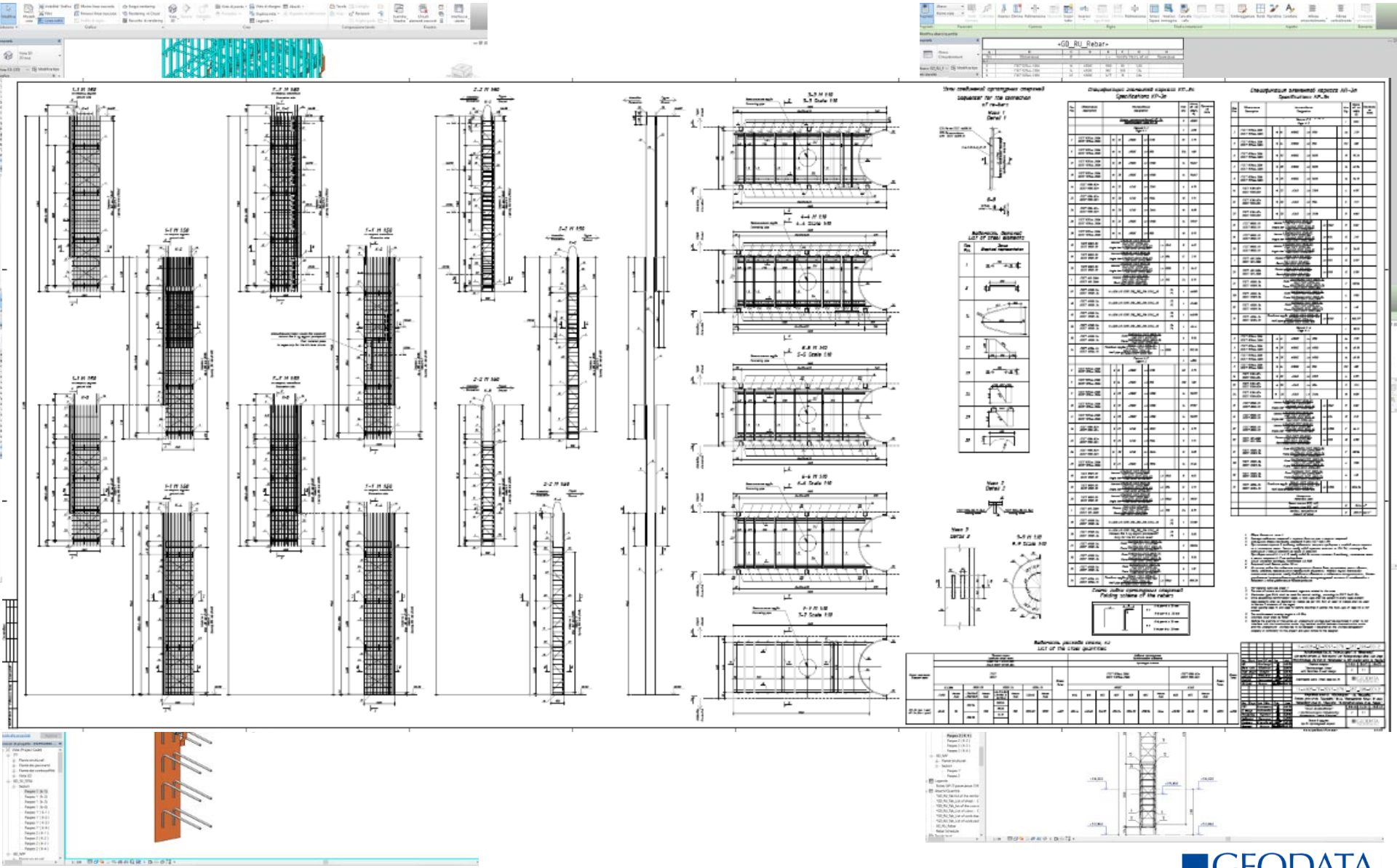
Bottom slab rebar



GEODATA UNDERGROUND SOLUTIONS

Metro Moscow

REVIT used for rebar a diaphragm wall

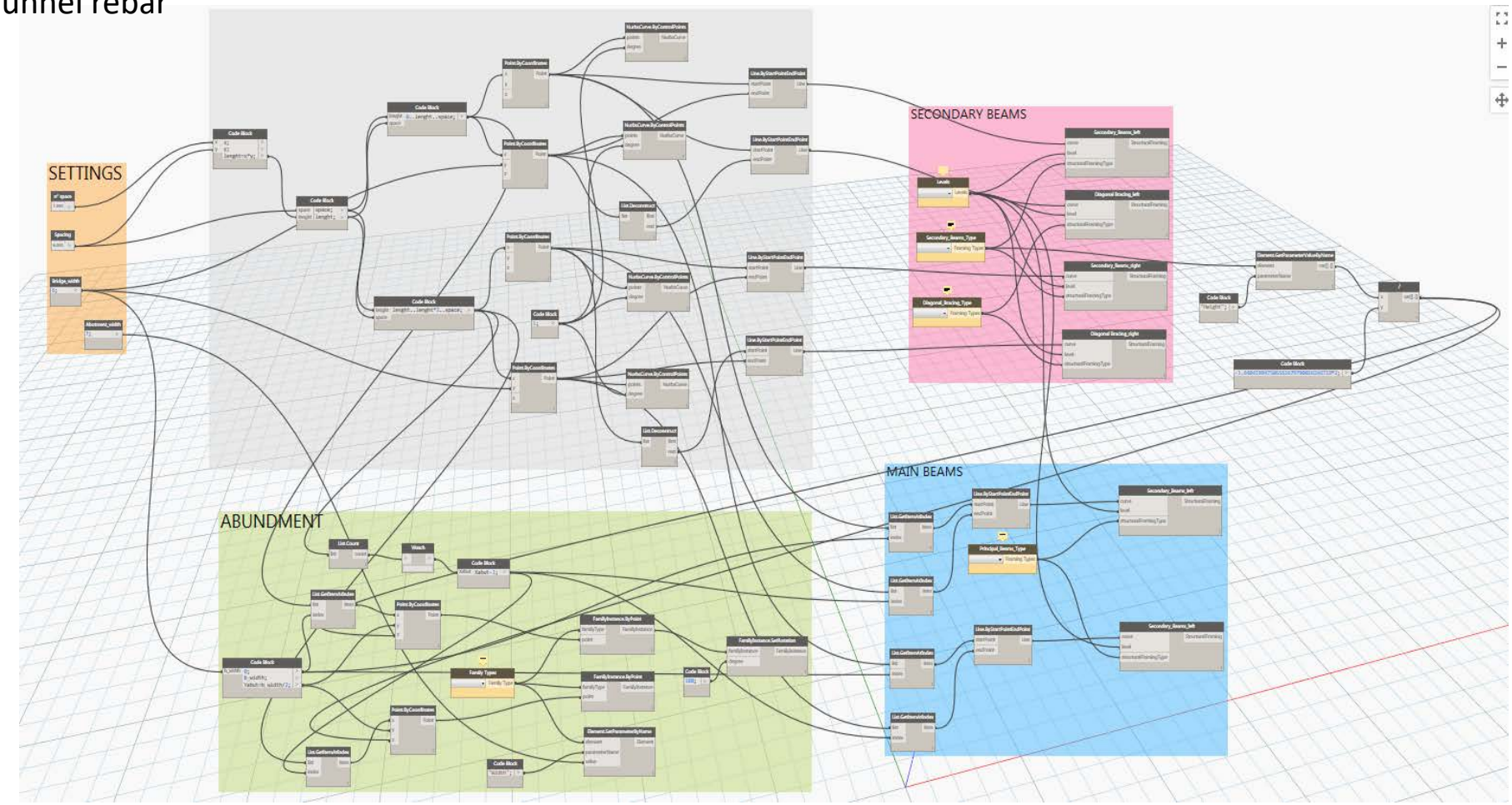


GEODATA
UNDERGROUND SOLUTIONS

Using DYNAMO to realize dynamic automatic workflows…

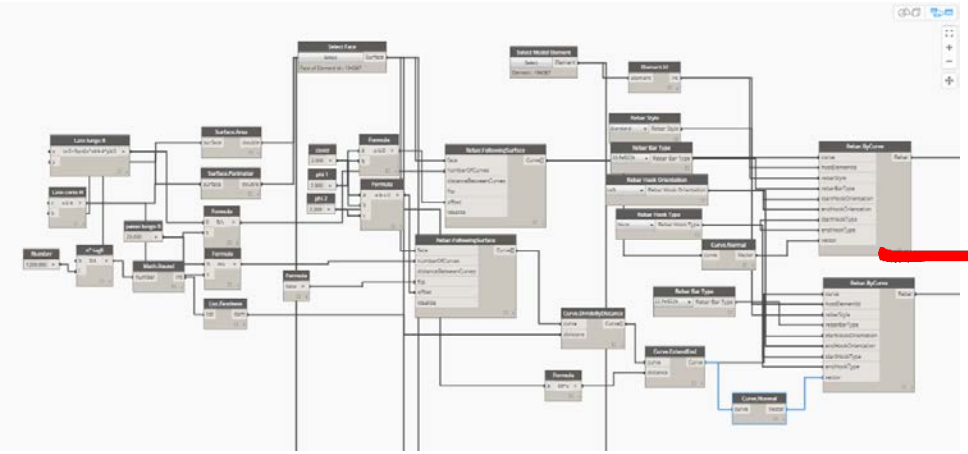
We use it to:

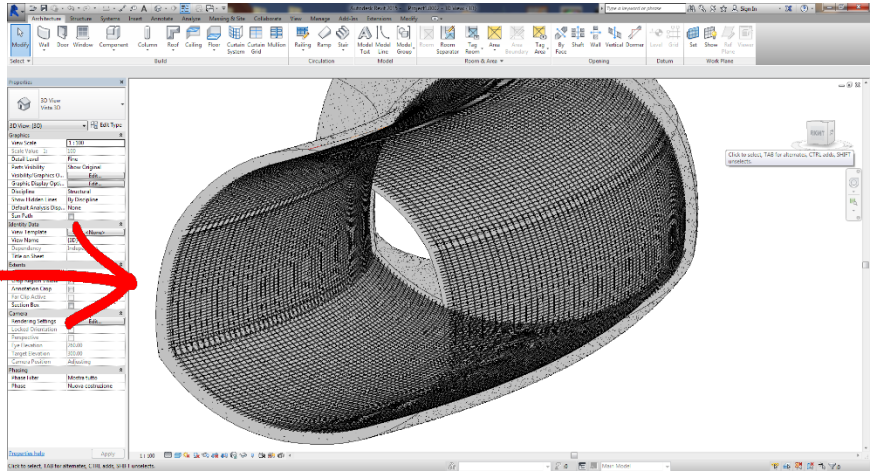
- Rename automatically a specific parameter of elements (like beams, doors, etc…)
- Path simulations for evacuation evaluation
- Calculate volume of a specific selection (this is not possible with schedule)
- Tunnel rebar

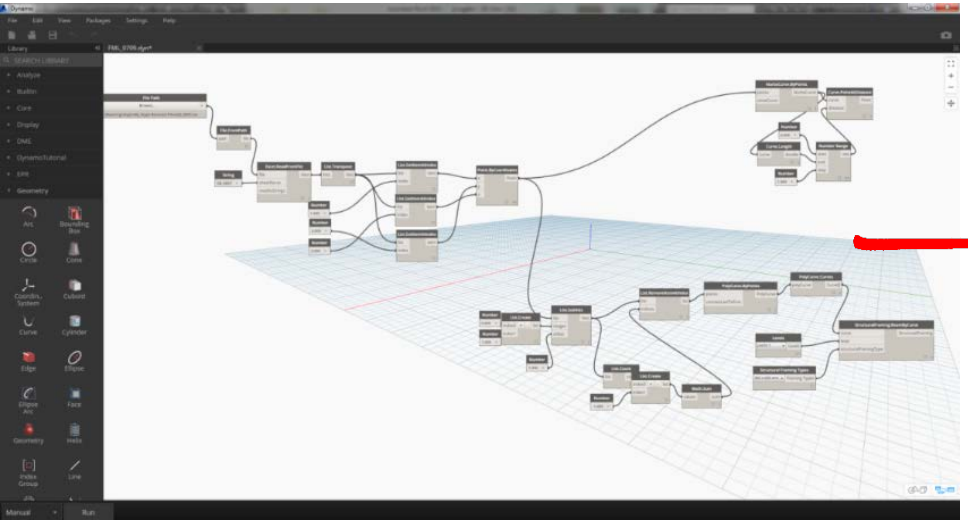


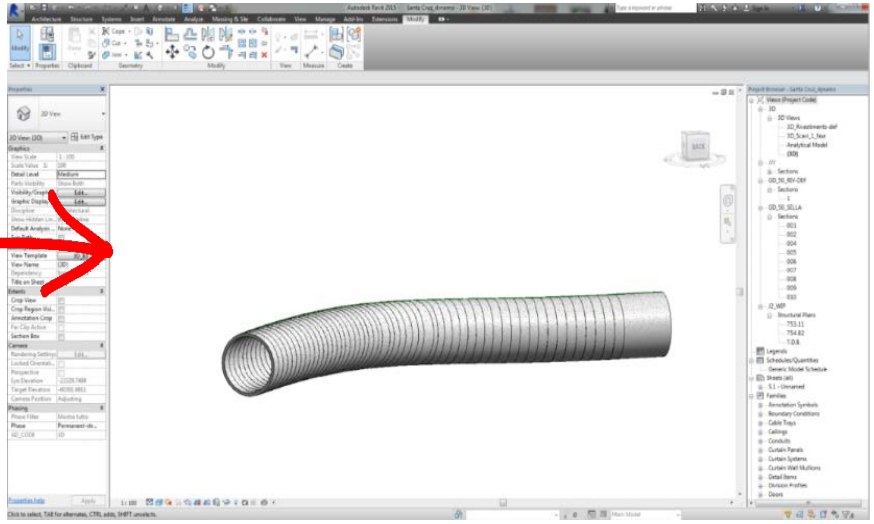
GEODATA
UNDERGROUND SOLUTIONS

Using DYNAMO to realize dynamic automatic workflows…



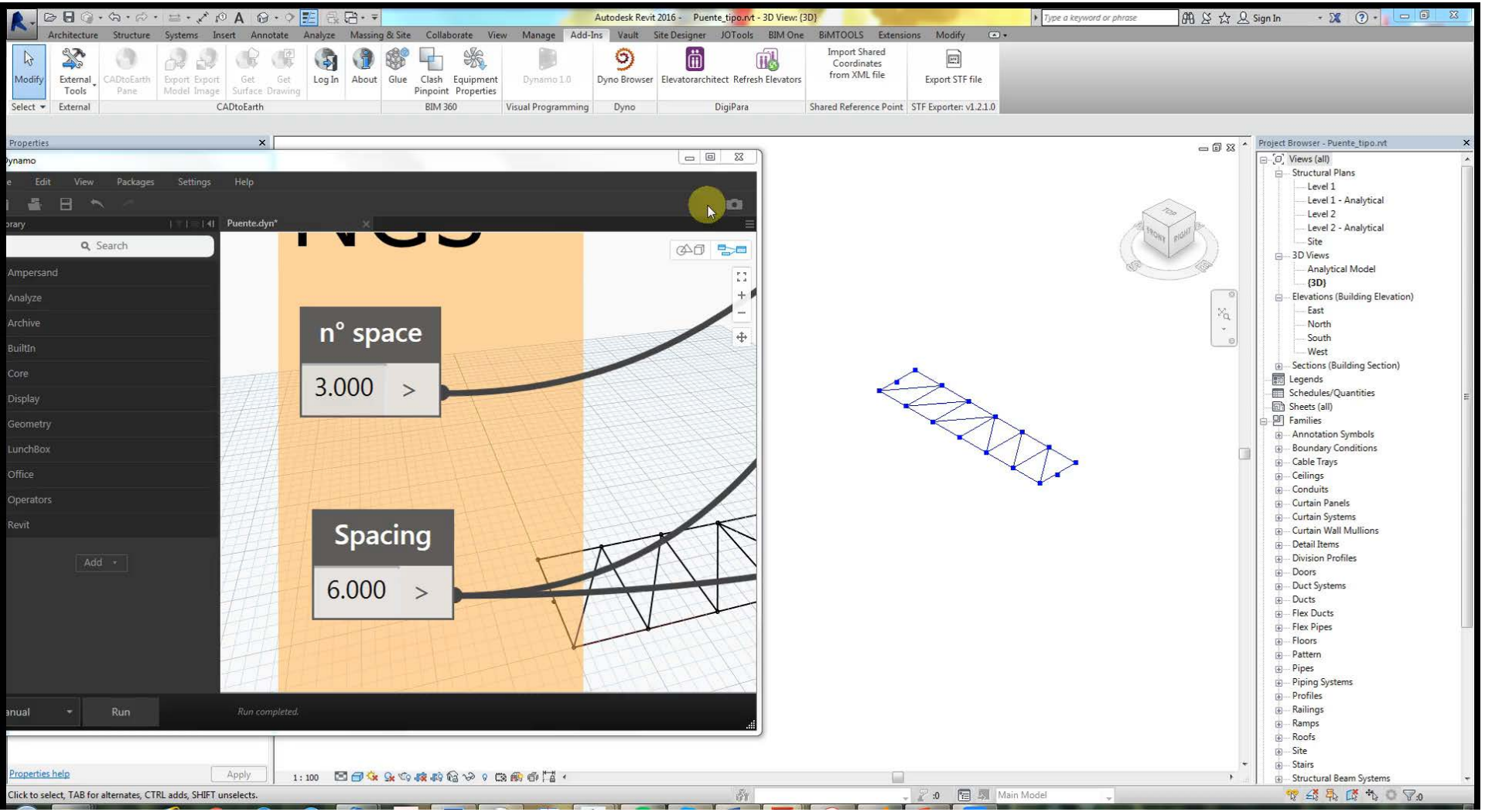






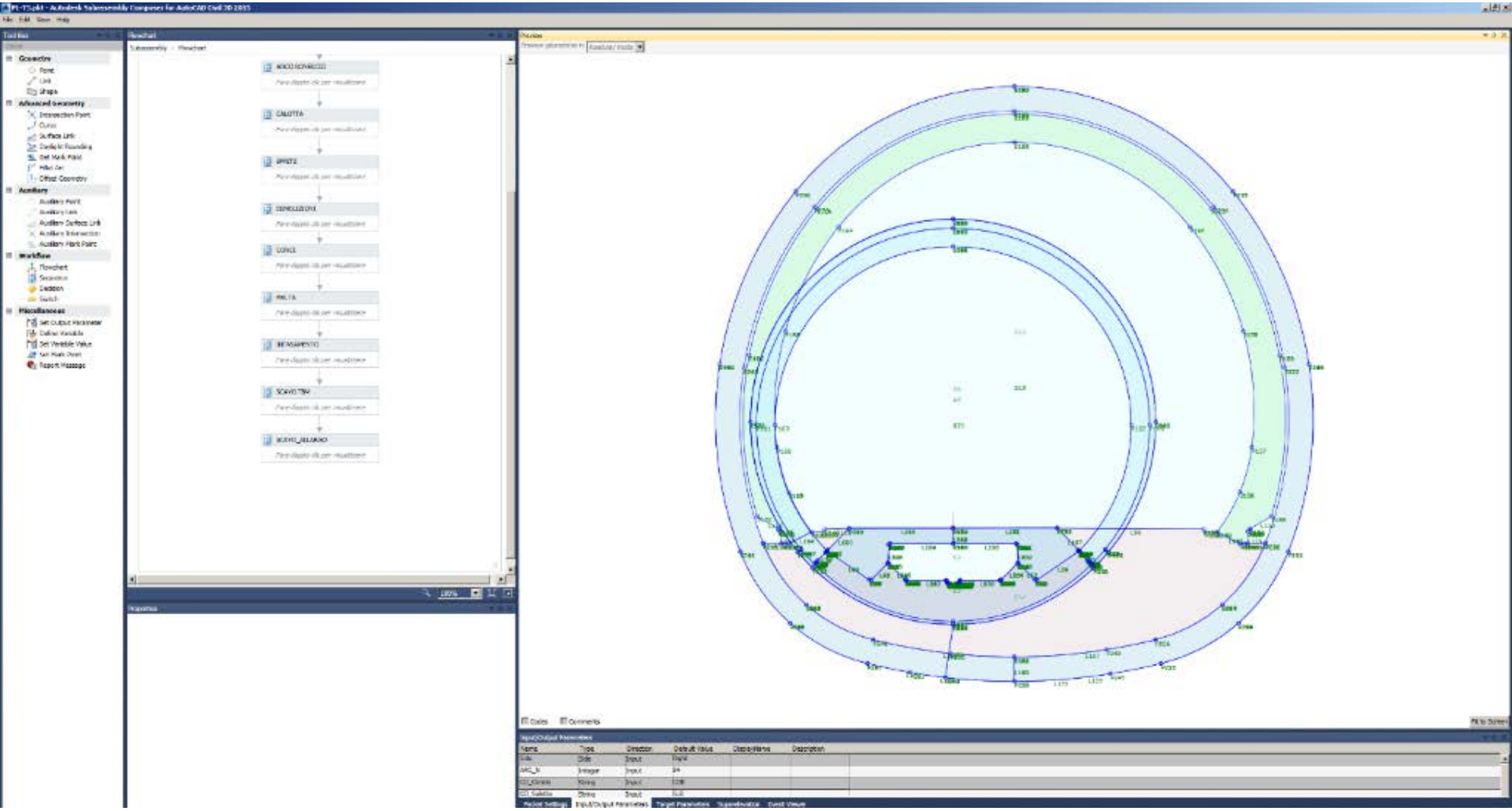
GEODATA
UNDERGROUND SOLUTIONS

BIM using dynamo to realize dynamic bridge models…

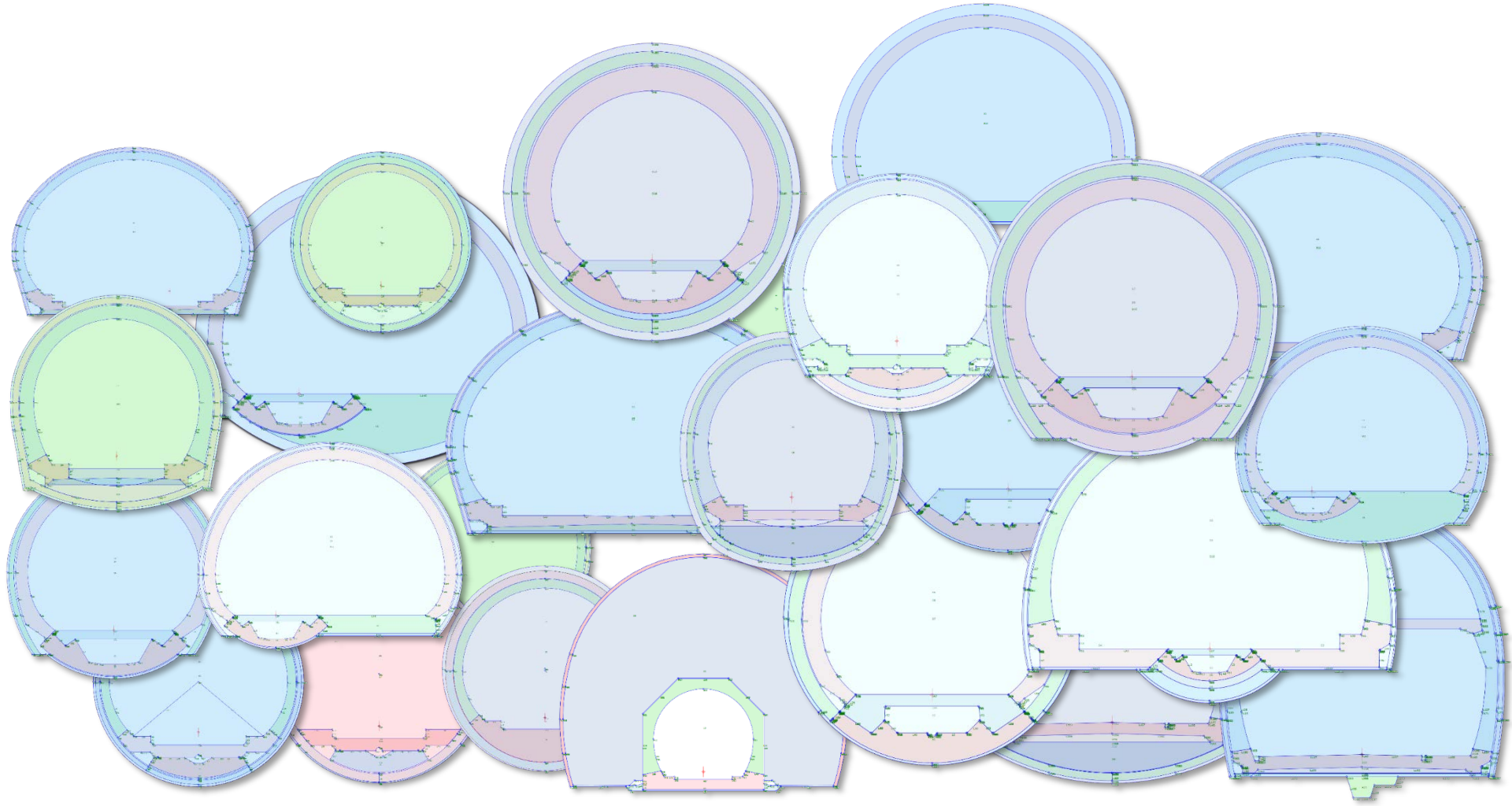


GEODATA
UNDERGROUND SOLUTIONS

The importance of BoQ!



CIVIL 3D: Parametric tunnel design



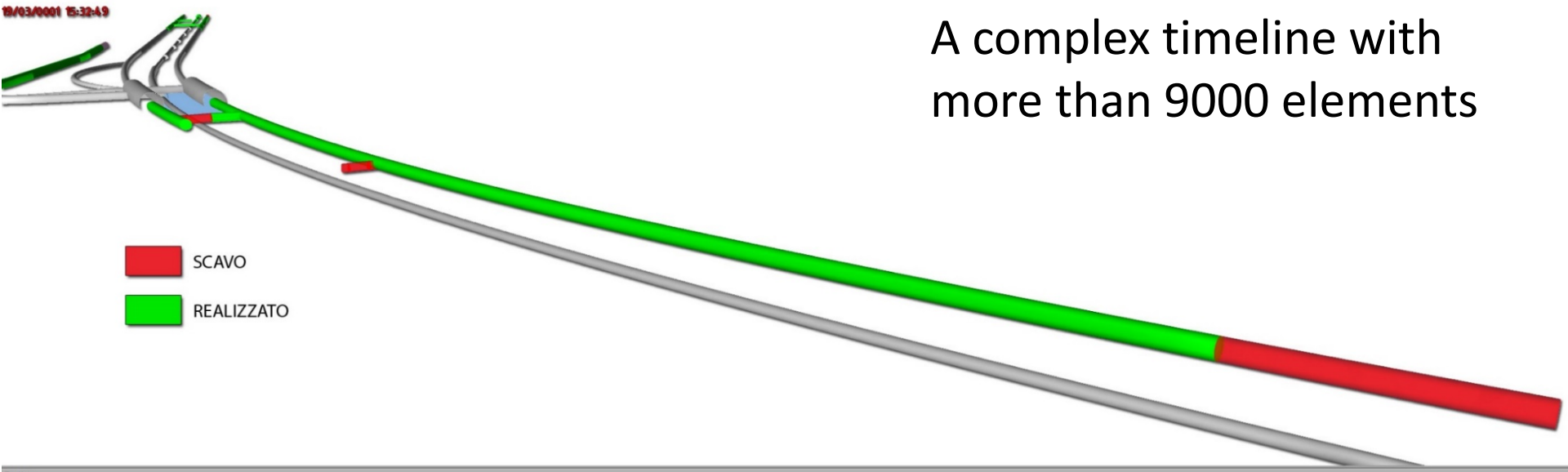
GEODATA
UNDERGROUND SOLUTIONS

Naviswork approach

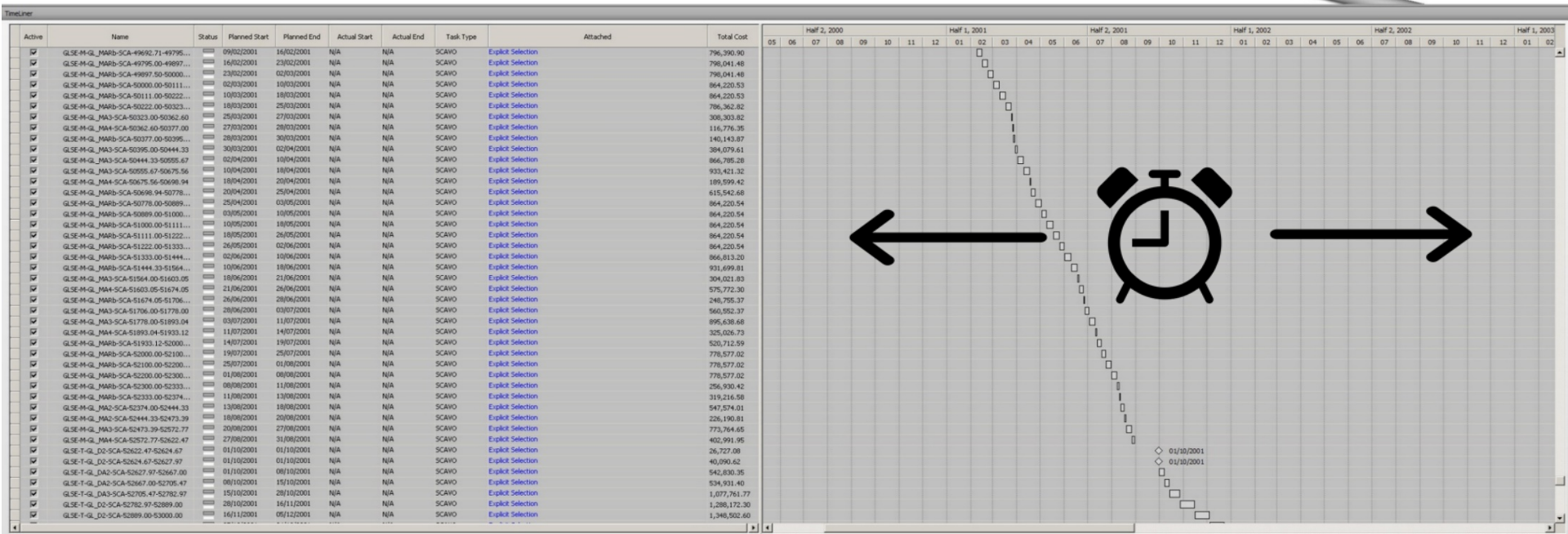
Ogni elemento è indipendente è può essere computato in funzione del tempo in cui viene eseguito

Civil 3D

Naviswork approach

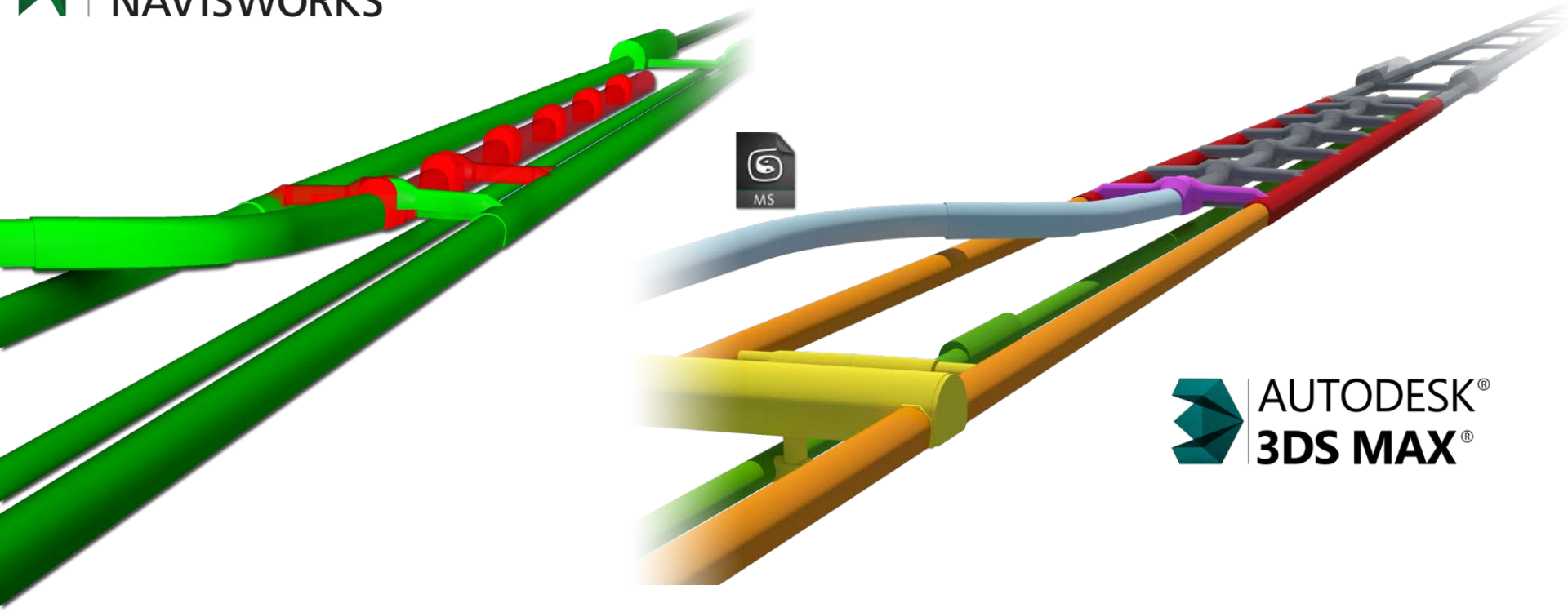


A complex timeline with more than 9000 elements



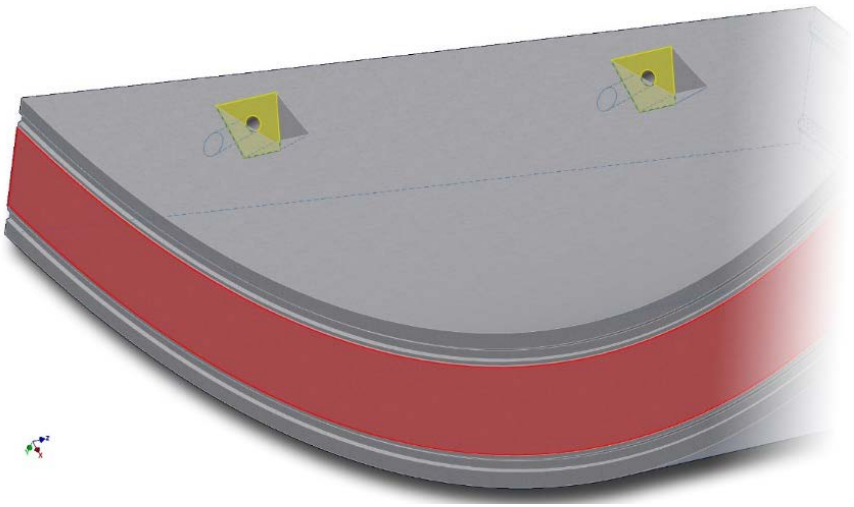
Civil 3D+NAVISWORK

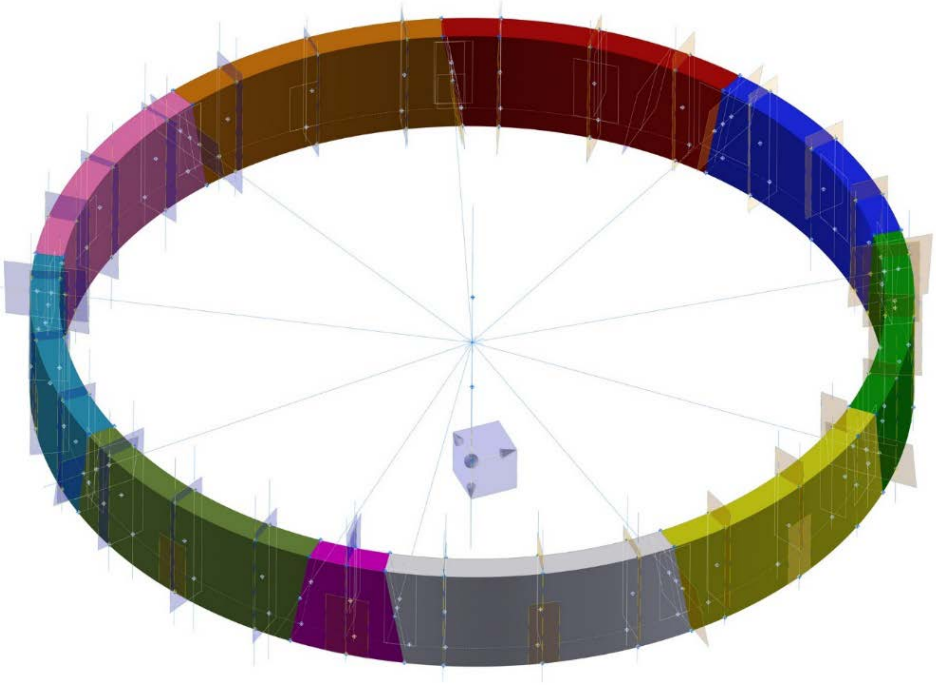
Naviswork + 3DS Max increasing realism



GEODATA
UNDERGROUND SOLUTIONS

Inventor: Tunnel Segnment Design

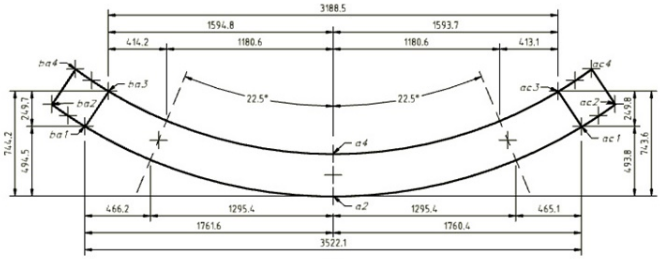




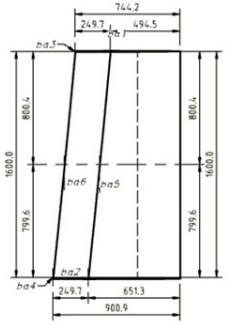
GEODATA
UNDERGROUND SOLUTIONS

Inventor: Tunnel Segnment Design

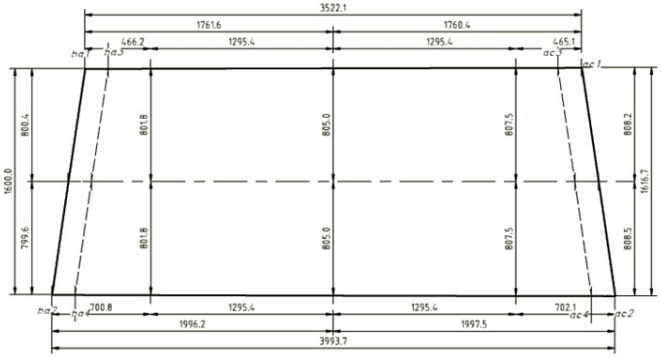
- 2D drawing from Inventor to PDF or Autocad
- All data are coherent



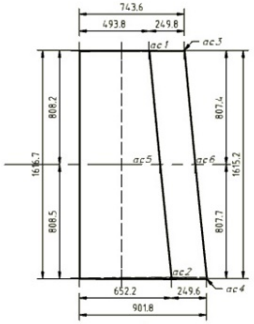
D
SCALE 1:20



I
SCALE 1:20



VIEW A
SCALE 1:20

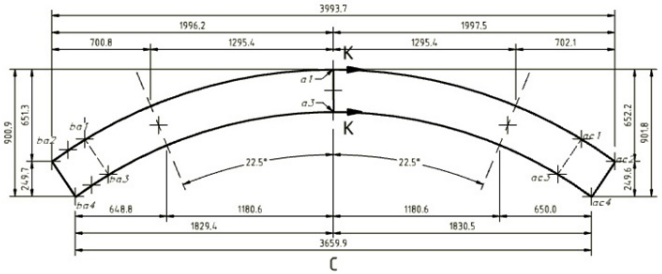


J
SCALE 1:20

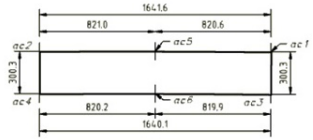
GEOMETRY OF SEGMENT a
VOLUME=1.8397mc

CHARACTERISTIC:

-
- AVERAGE WIDTH 1600.000mm
- INTERNAL DIAMETER 6170.000mm
- EXTERNAL DIAMETER 6770.000mm
- THICKNESS 300.000mm
- MINIMUM PLANIMETRIC RADIUS 300000.000mm



C
SCALE 1:20

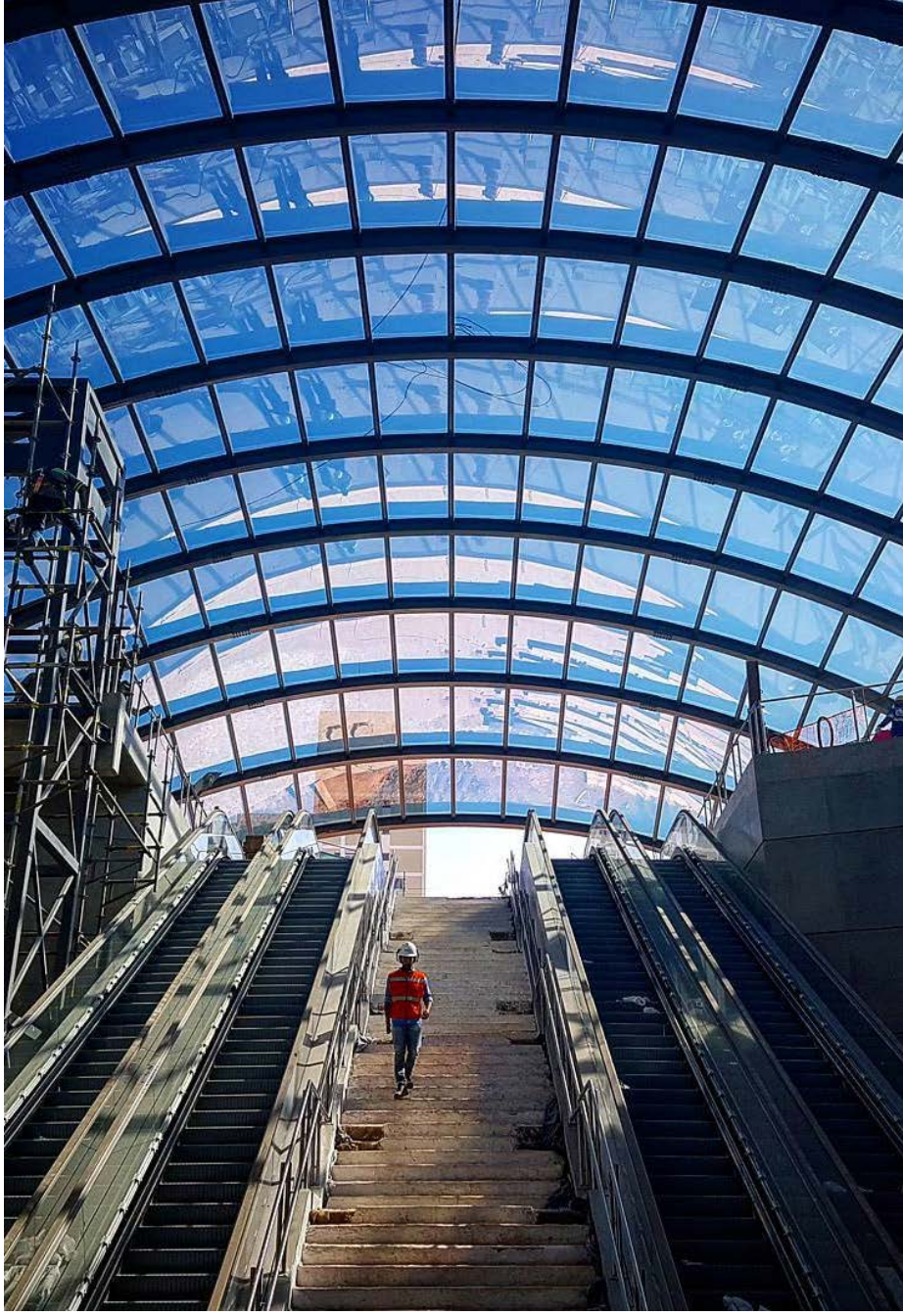


H
SCALE 1 / 20

GEODATA
UNDERGROUND SOLUTIONS

Qualche consiglio….

- Studiate! Non abbiate paura di reimparare da zero, non pensate di essere troppo vecchi o troppo piccoli…
- Il progettista BIM è prima di tutto un ingegnere o architetto che sa fare le cose che già sapeva fare in modo molto più integrato.
- Il BIM può essere disturbante perché rompe le gerarchie: fregatevene!
- Fate domande stupide: sono quelle che servono di più per imparare.
- Non tenetevi le cose per voi: insegnate, popolate i forum, siate portatori di futuro.



And for the future….

GEODATA
UNDERGROUND SOLUTIONS

If you want to build a ship, don't drum up the men to gather wood, divide the work, and give orders. Instead, teach them to yearn for the vast and endless sea.

Antoine-Marie-Roger de Saint-Exupéry