

BIM: PROGETTARE NELL'ERA DELLA CONNETTIVITÀ

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

Ing. Simone Eandi

Perché
siete qui
oggi?





ANOTHER BORING
BIM CONFERENCE?

Non parleremo di:



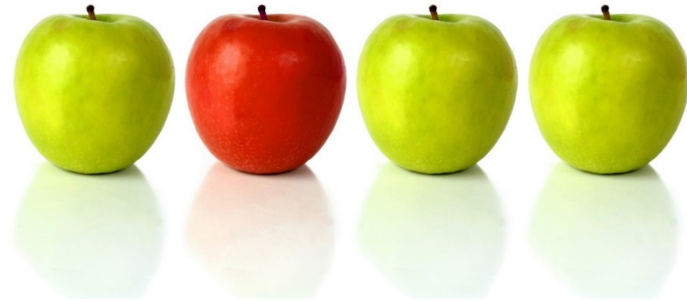
- Significato della parola BIM
- Quanto è bello e complesso raggiungere il 4-5-6....18D!
- Standard BIM
- Non ci chiederemo se il BIM è solo una moda passeggera
- Uguaglianza BIM-software

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

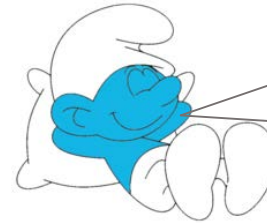
Il famigerato cambiamento...

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



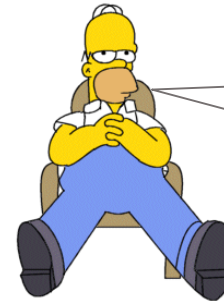
«Facciamolo in Revit anche se sembra un'impresa impossibile nei tempi richiesti, i problemi li risolveremo cammin facendo e di sicuro otterremo un risultato professionale....»

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.



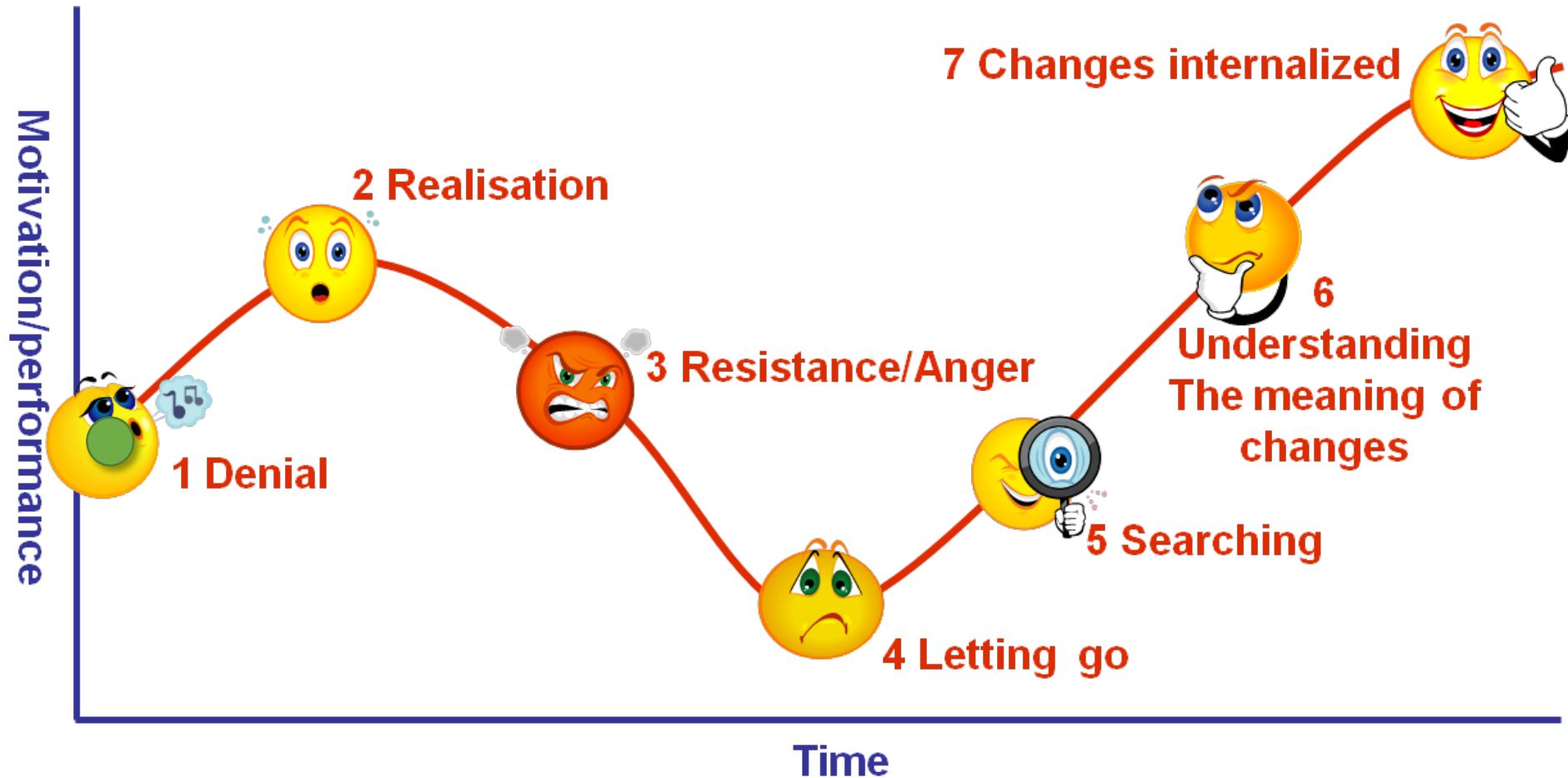
«Ma tanto tra un po' torneremo tutti ad usare Autocad e basta...e non dite che io non lo avevo detto»

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 lì 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...



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....



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

BIM INTRODUCTION PLAN

Geodata Group S.p.A.

BIM INTRODUCTION PLAN FOR INFRASTRUCTURE DESIGN



Geodata Group S.p.A.


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, quando il BIM sostituirà completamente il CAD, cosa accadrà ai BIM Managers? Ci sarà ancora bisogno di loro....?





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:

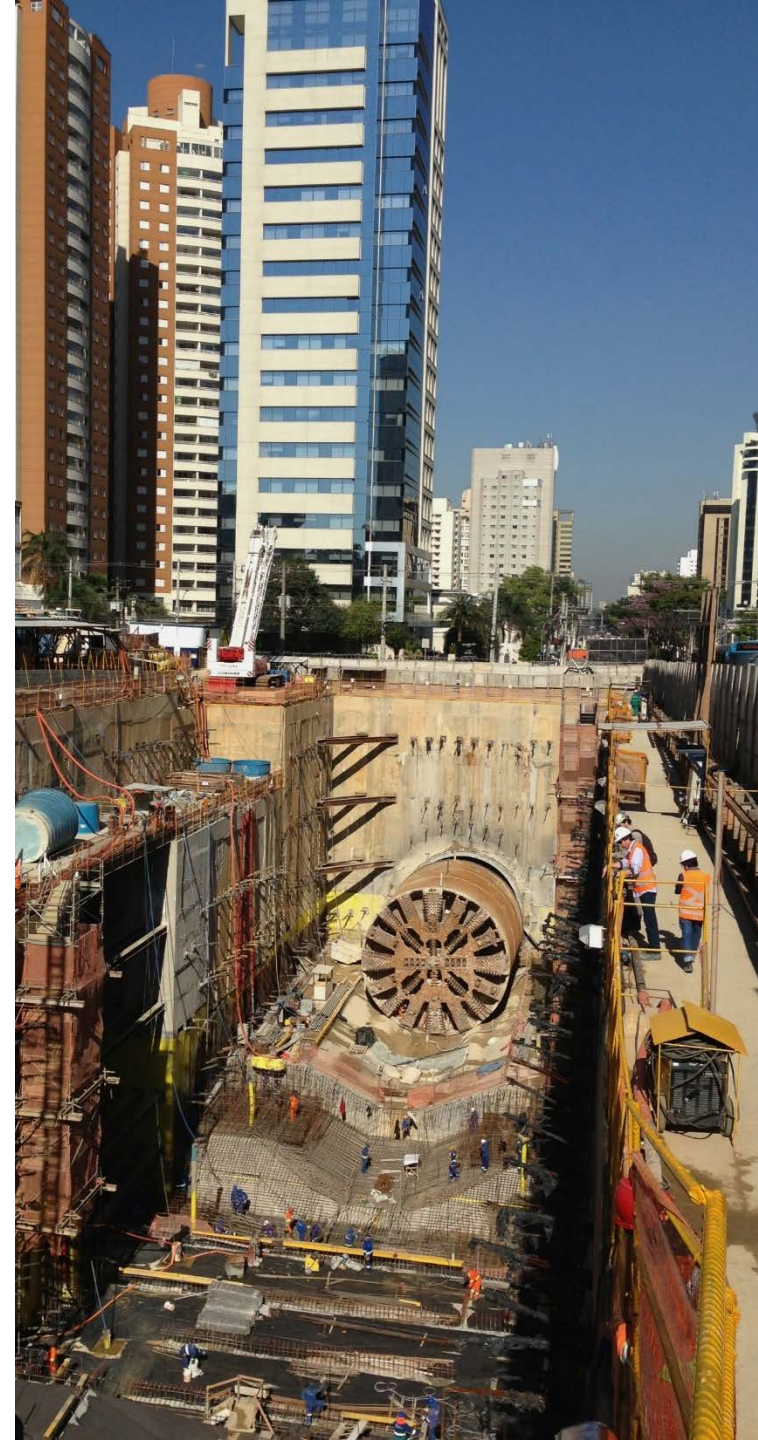
- Autocad 2012 per gli elaborati grafici in genere;
- Alice GL per i computi e le stime;
- Office 2007;

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.



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...

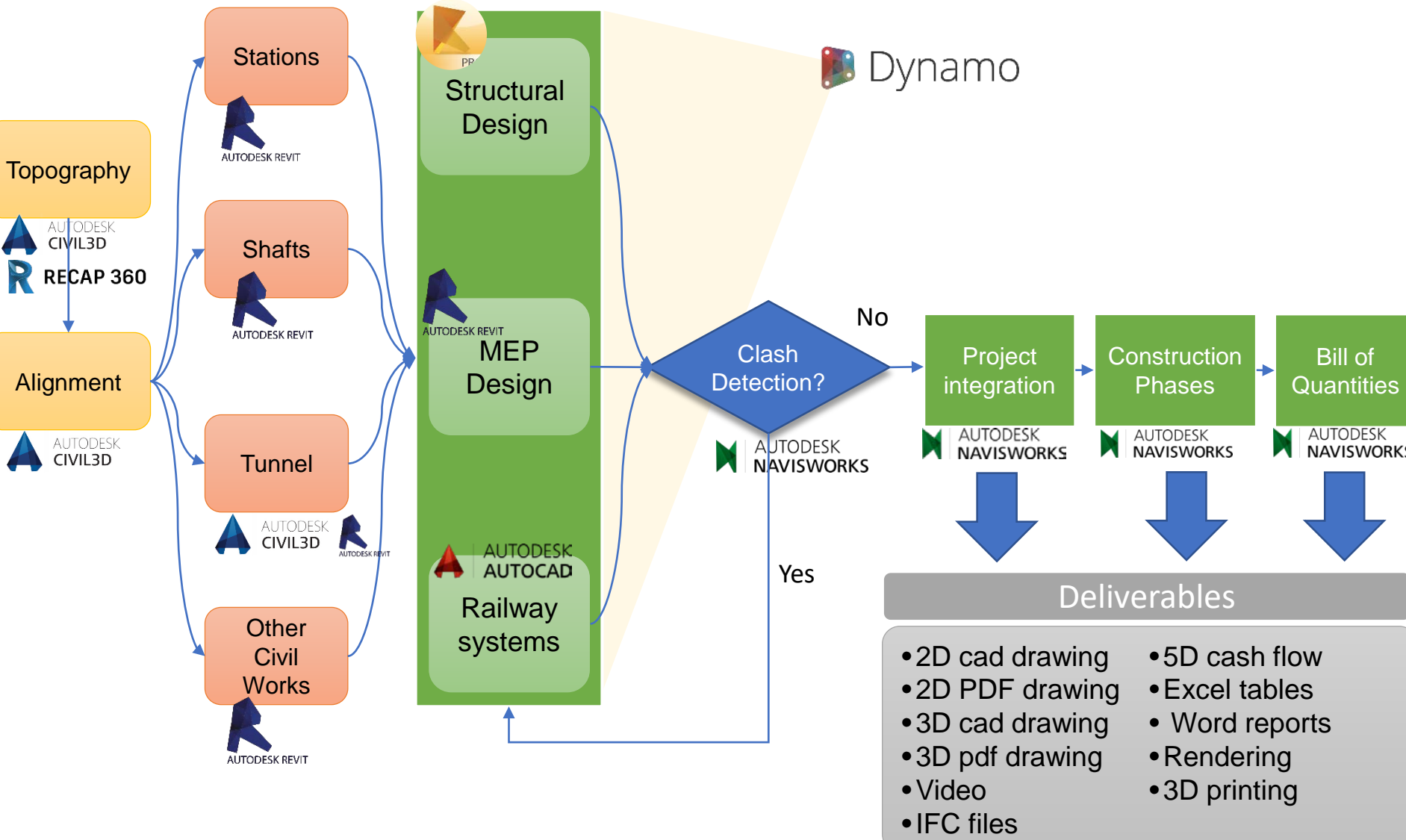


What we have done with BIM:

- 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

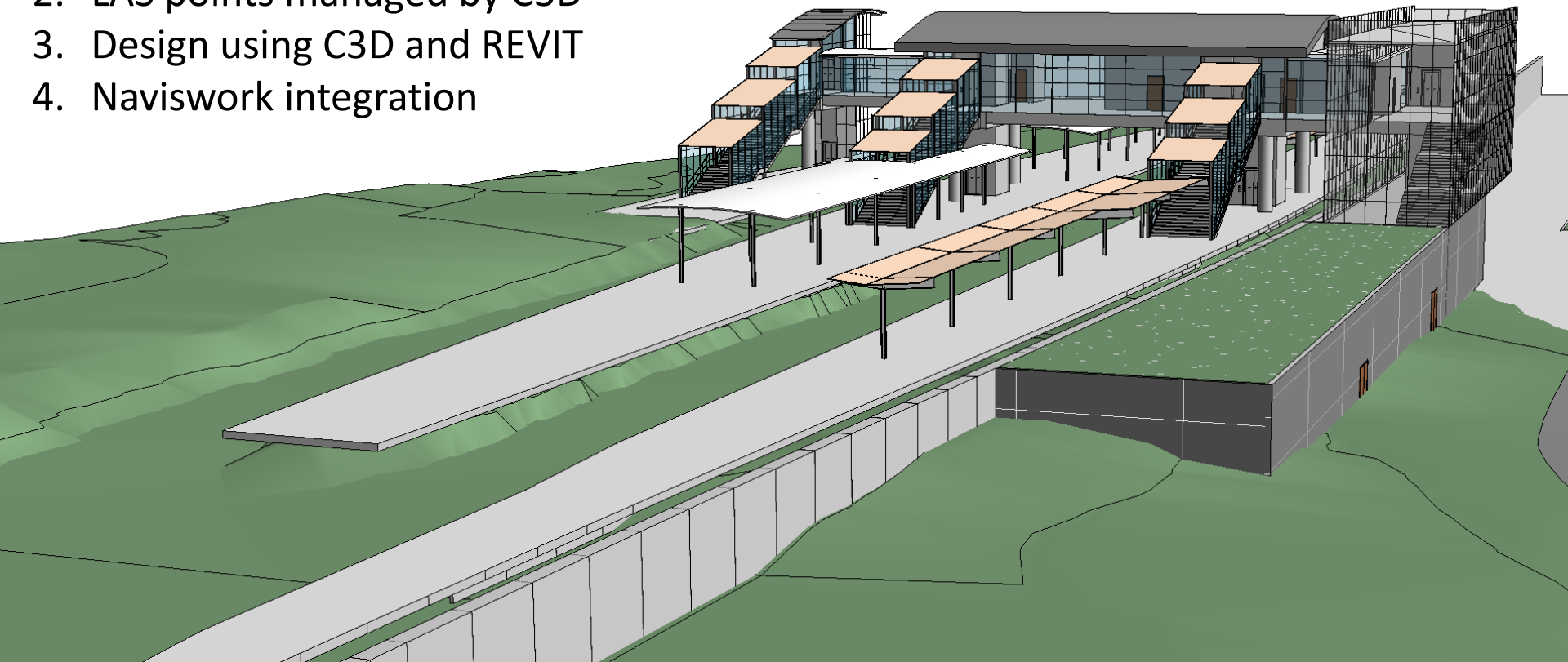


Northern Sydney Freight Corridor

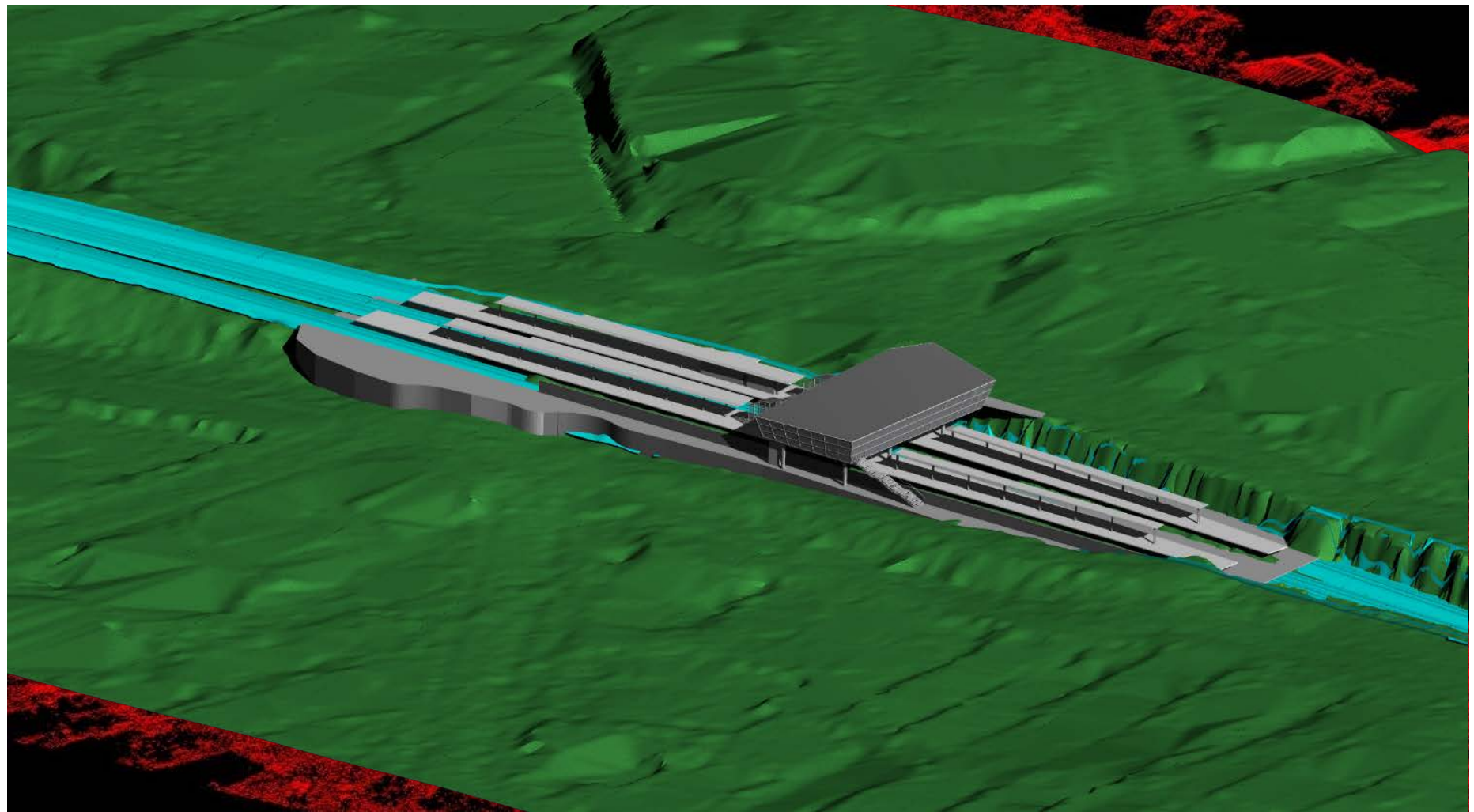
- Complex project
- Integration of different softwares: Infrastrucutre+Architecture

STEPS followed

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



Northern Sydney Freight Corridor



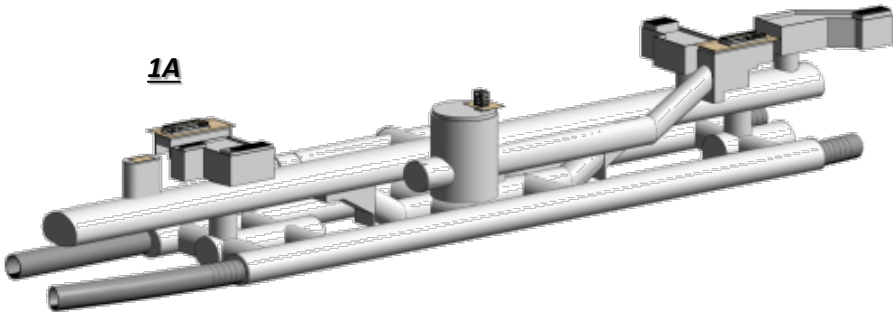
Metro Istanbul

DUDULLU - BOSTANCI : 13 Stazioni

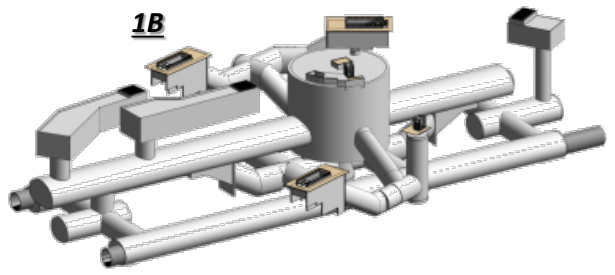
GÖZTEPE-ÜMRANIYE: 9 Stazioni

KIRAZLI - HALKALI : 9 Stazioni

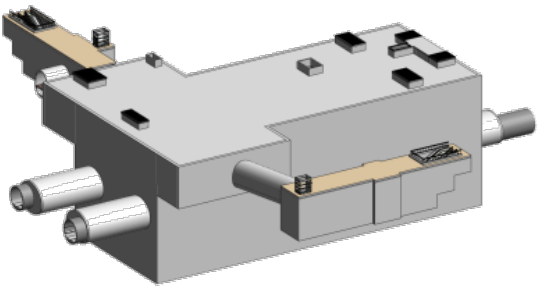
1A



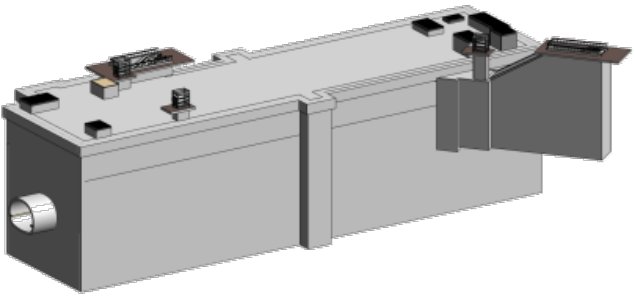
1B



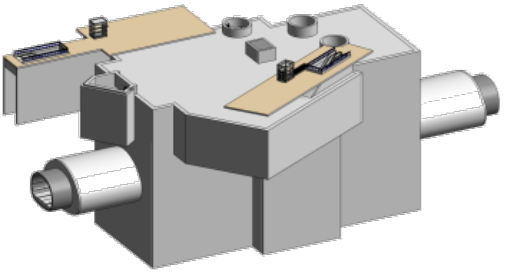
2A



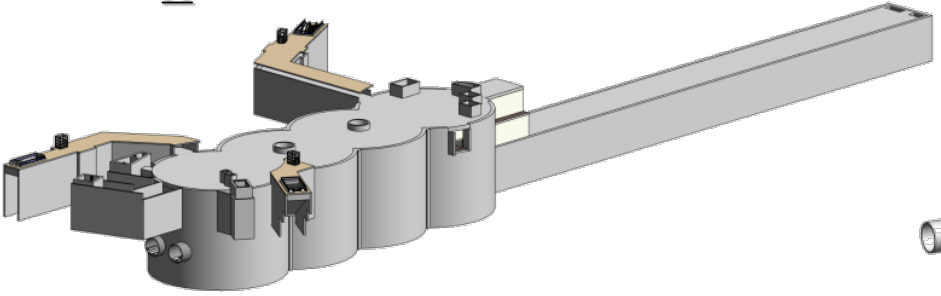
2B



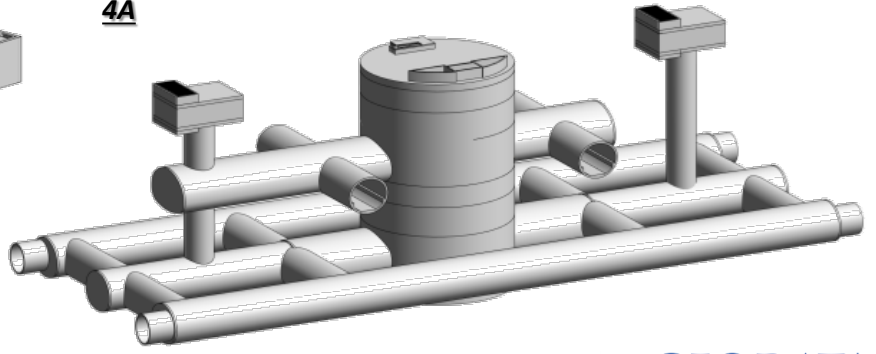
2C

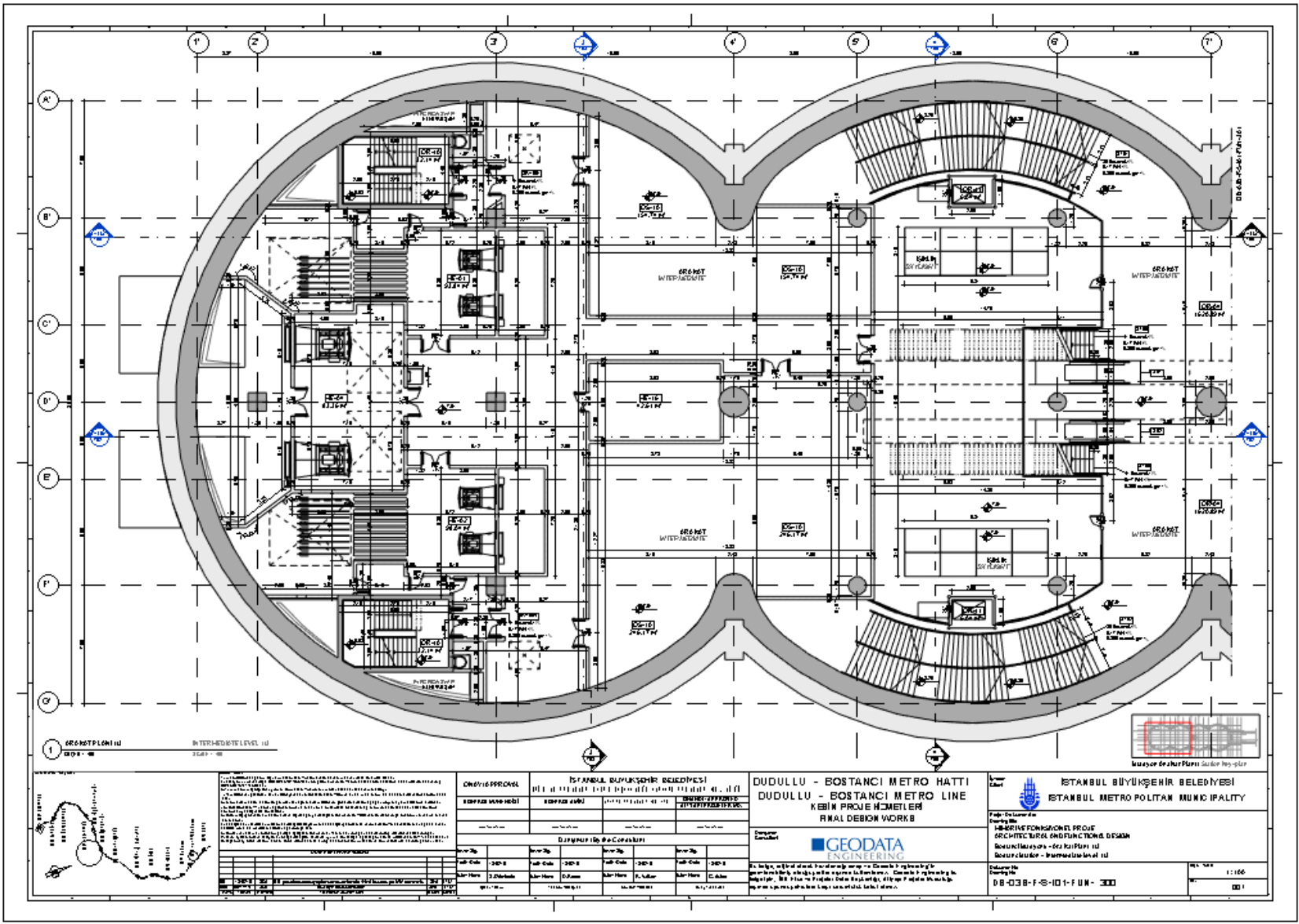


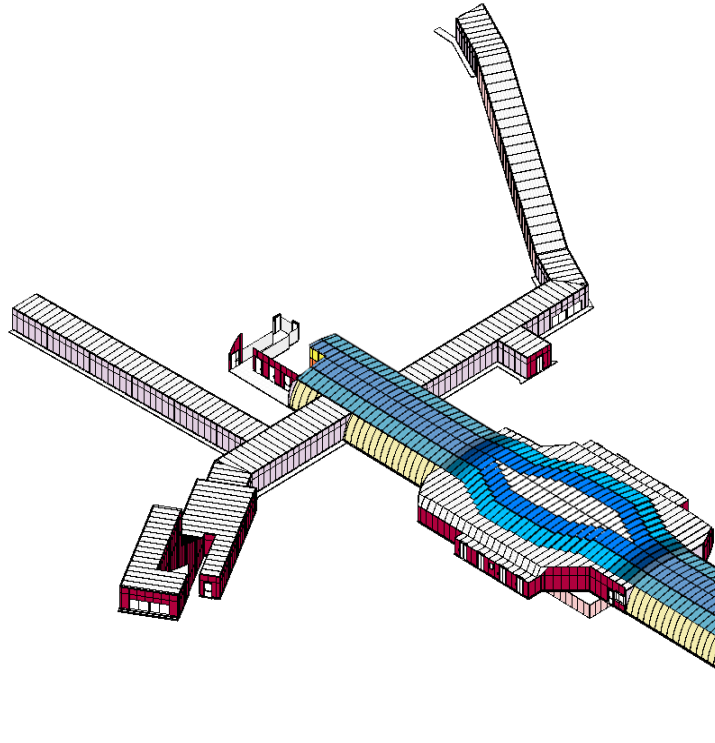
3C



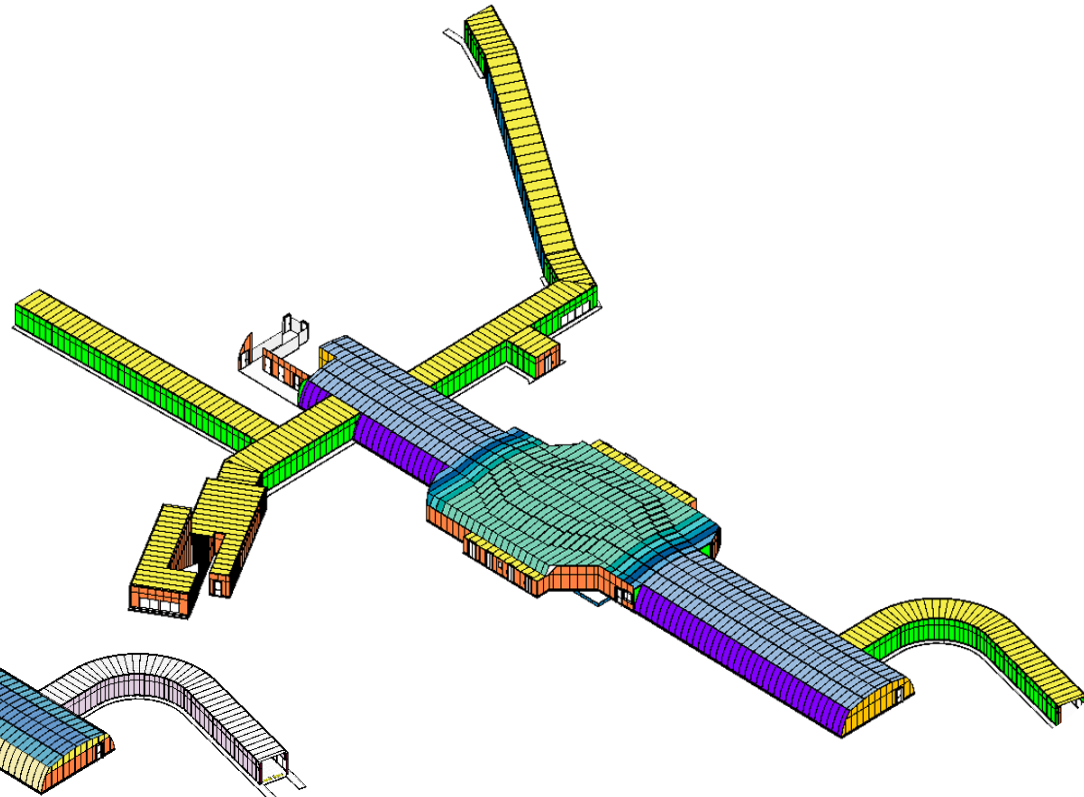
4A





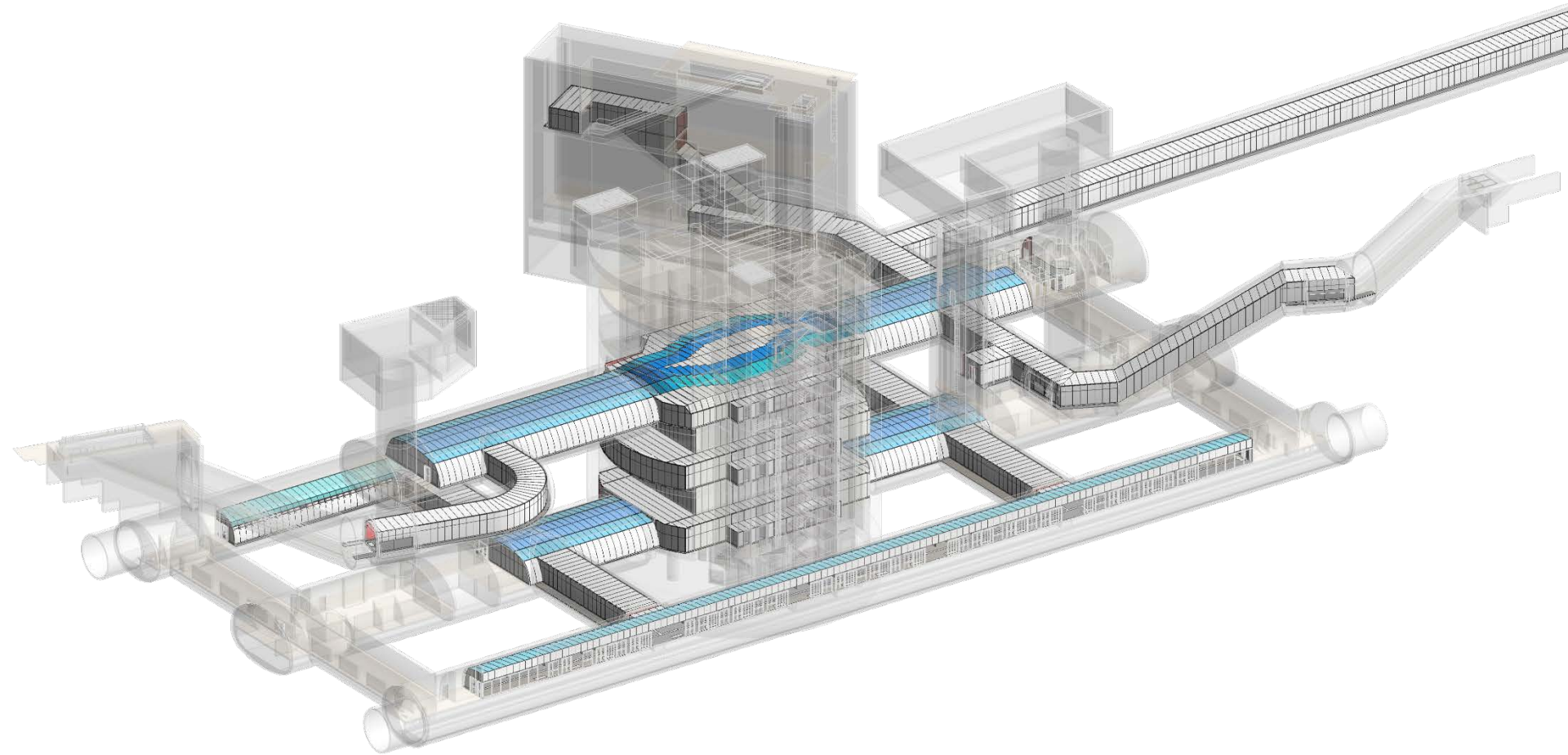


Elements by Name



Elements by Package

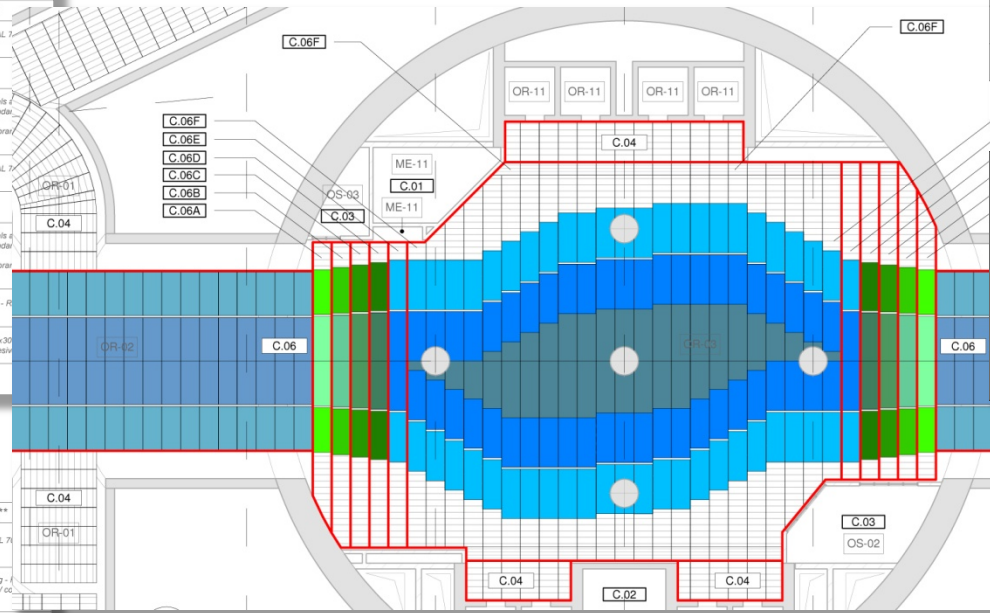
The Finishing Project linked to The Functional Project



MALZEME LEJANTI		MATERIALS PACKAGES LEGEND	
ZEMİN KAPLAMASI		PAVING*	
PA.01	60x60cm Gri Porcelain Karo (Granit seramik) RAL 7026 ile Seramik Yapıştırma Harcı	Gres Block Grey 60x60 - RAL 7026	cementitious adhesive
SCR.01	Şap	Screed	
P.01	NOT: Aşağıdaki malzemeler sadece yaptırım gereği olduğu durumlarda dahil edileceklerdir. BAR.01 - Bitüm esası su yalıtım membranı DD.01 - Drenaj Kanalı	NOTE: the following materials included ONLY in corresponde cleaning drain BAR.01 - Bituminous membr DD.01 - Drainage Canal	
PA.02	30x30cm Gri Porcelain Karo (Granit seramik) RAL 7026 ile Seramik Yapıştırma Harcı	Gres Block Grey 30x30 - RAL 7026	cementitious adhesive
SCR.01	Şap	Screed	
P.02	NOT: Aşağıdaki malzemeler sadece yaptırım gereği olduğu durumlarda dahil edileceklerdir. BAR.01 - Bitüm esası su yalıtım membranı DD.01 - Drenaj Kanalı	NOTE: the following materials included ONLY in corresponde cleaning drain BAR.01 - Bituminous membr DD.01 - Drainage Canal	
PA.03	30x30cm Açık Gri Porcelain Karo (Granit seramik) -kayzıyvan- RAL 7035 ile Seramik Yapıştırma Harcı	Gres light grey - stop 30x30 - RAL 7035	with cementitious adhesive
PA.04	30x30cm Açık Gri Porcelain Karo (Granit seramik) -kayzıylandırılmı- RAL 7035 ile Seramik Yapıştırma Harcı	Gres light grey-direction 30x30 - RAL 7035	with cementitious adhesive
SCR.01	Şap	Screed	

DUVAR KAPLAMASI		CLADDING**	
PA.02	30x30cm Gri Porcelain Karo (Granit seramik) RAL 7026 ile Seramik Yapıştırma Harcı	Gres Block Grey 30x30 - RAL 7026	cementitious adhesive
PAI.03	Sivali Tuğla Duvar/Betonarme Duvar/Döşeme Üzerine Suya Dayanıklı Beyaz Boya Yapılması RAL 9010	White water resistant painting - RAL 9010 on plastered brick wall / concrete wall/slab	
PAI.03	NOT: PA.02, H=180cm yüksekliğine kadar uygulanacaktır. PAI.03 ise 180cm'in üstündeki yüksekliklerde uygulanacaktır.	NOTE: PA.02 to be installed up to H=180cm; PAI.03 to be applied above H=180cm	
PAI.01	Sivali Tuğla Duvar/Betonarme Duvar/Döşeme Üzerine Suya Dayanıklı Beyaz Boya Yapılması RAL 9010	White water resistant painting - RAL 9010 on plastered brick wall / concrete wall/slab	
PAI.01	Betonarme Yüzeylerin İşlenmesi	Reinforced concrete surface treatment	
PAI.02	Betonarme yüzeylere koruma esası boya sürülmesi	Reinforced concrete surface anti graffiti system	
ALM.03	Ön boyalı I formunda profil ayacı RAL7026	Prepainted / shaped profile footer RAL7026	

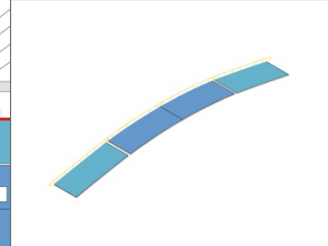
TAVAN KAPLAMASI***		CEILING***	
PAI.01	Betonarme Yüzeylerin İşlenmesi	Reinforced concrete surface treatment	
PAI.03	Sivali Tuğla Duvar/Betonarme Duvar/Döşeme Üzerine Suya Dayanıklı Beyaz Boya Yapılması RAL 9010	White water resistant painting - RAL 9010 on plastered brick wall / concrete wall/slab	
GYP.02	Taşıyıcı sistemli Alçı Paneller	Plasterboard ceiling with support structure	
FC.01	Taşıyıcı Sistemli Arkadan Aydınlatmalı Polikarbon Paneller - saydam kırmızı RAL 3002, Kalınlık=16mm, U=33 cm	Polycarbonate Multilayer Type Panel - translucent red RAL 3002, Thick =16 mm, L=33 cm - with support structure	
PAI.03	Sivali Tuğla Duvar/Betonarme Duvar/Döşeme Üzerine Suya Dayanıklı Beyaz Boya Yapılması RAL 9010	White water resistant painting - RAL 9010 on plastered brick wall / concrete wall/slab	



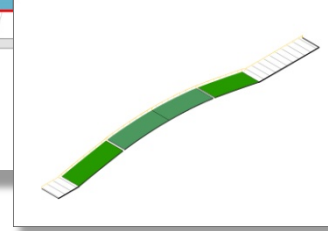
Malzeme Paketi Materials Package	
C.06	
Code / Kod	
CE.02	
CE.03	
FC.02	

Malzeme Paketi Materials Package	
C.06A	
Code / Kod	
CE.04	
CE.05	
FC.01	
FC.02	

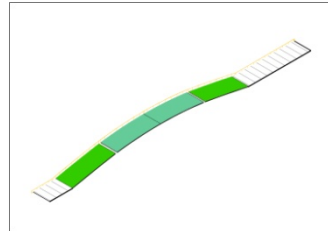
Malzeme Paketi Materials Package	
C.06B	
Code / Kod	
CE.06	
CE.07	
FC.01	
FC.02	



Malzeme Paketi Materials Package	
C.06	
Code / Kod	
CE.02	
CE.03	
FC.02	



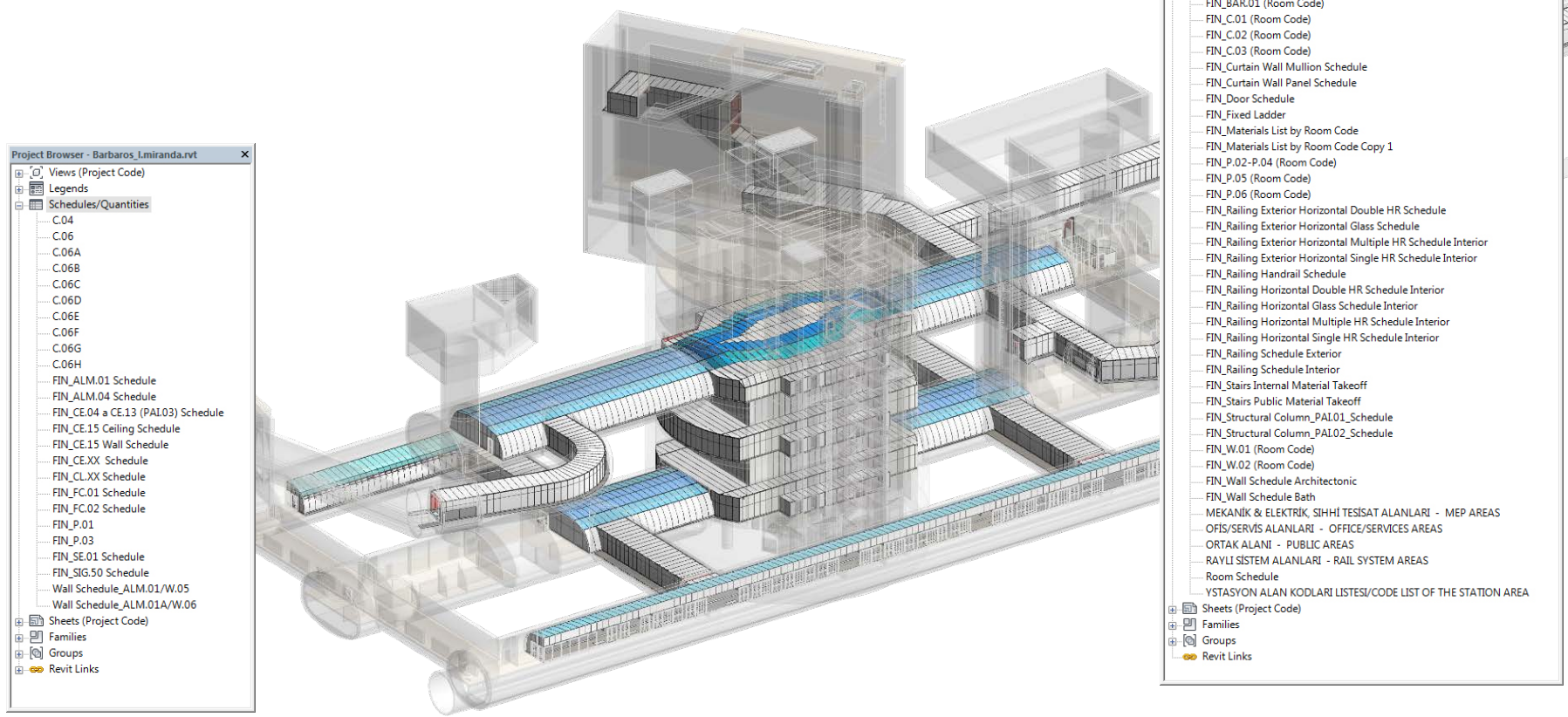
Malzeme Paketi Materials Package	
C.06C	
Code / Kod	
CE.08	
CE.09	
FC.01	
FC.02	

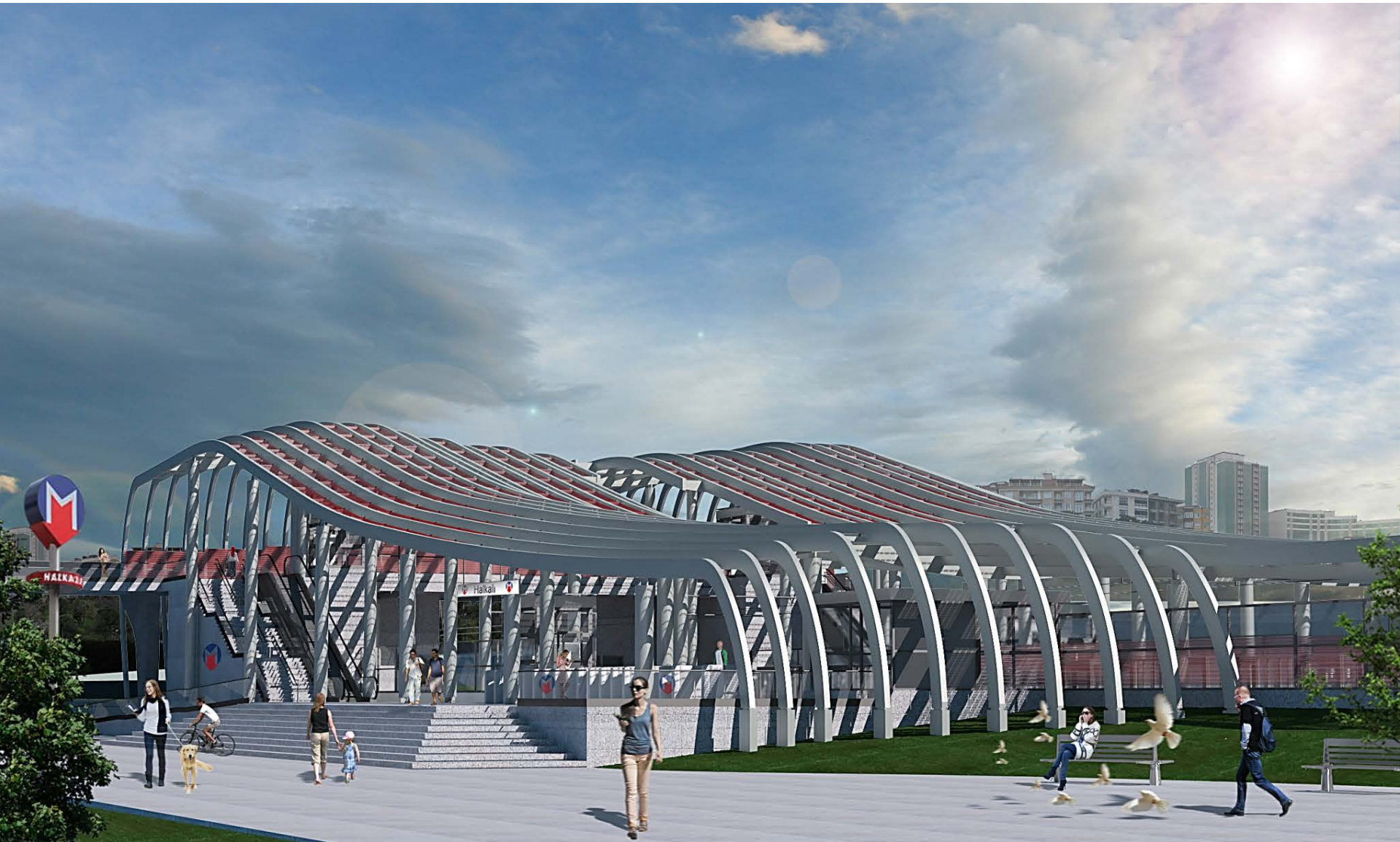


Malzeme Paketi Materials Package	
C.06B	
Code / Kod	
CE.06	
CE.07	
FC.01	
FC.02	

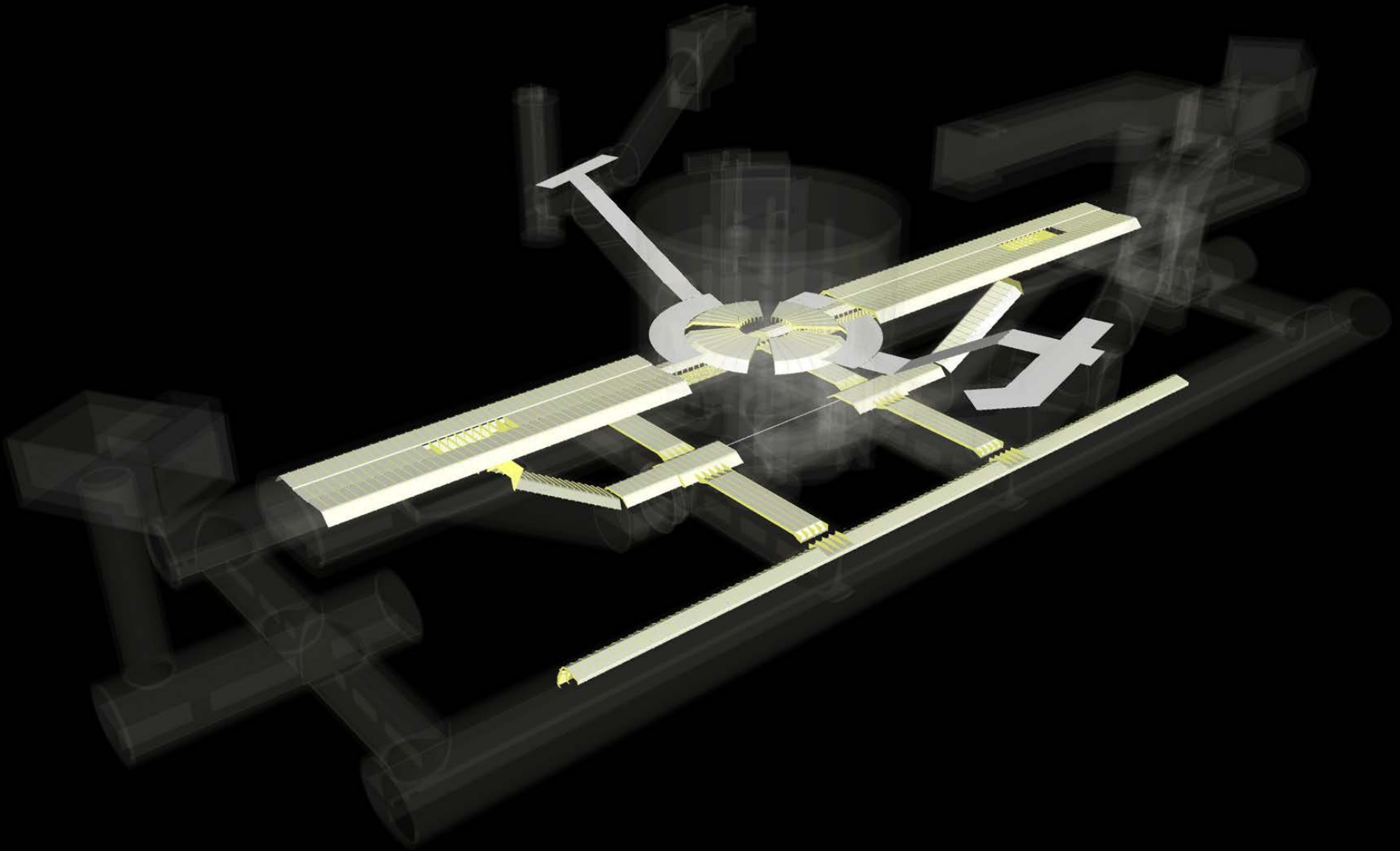
Ground Requirement

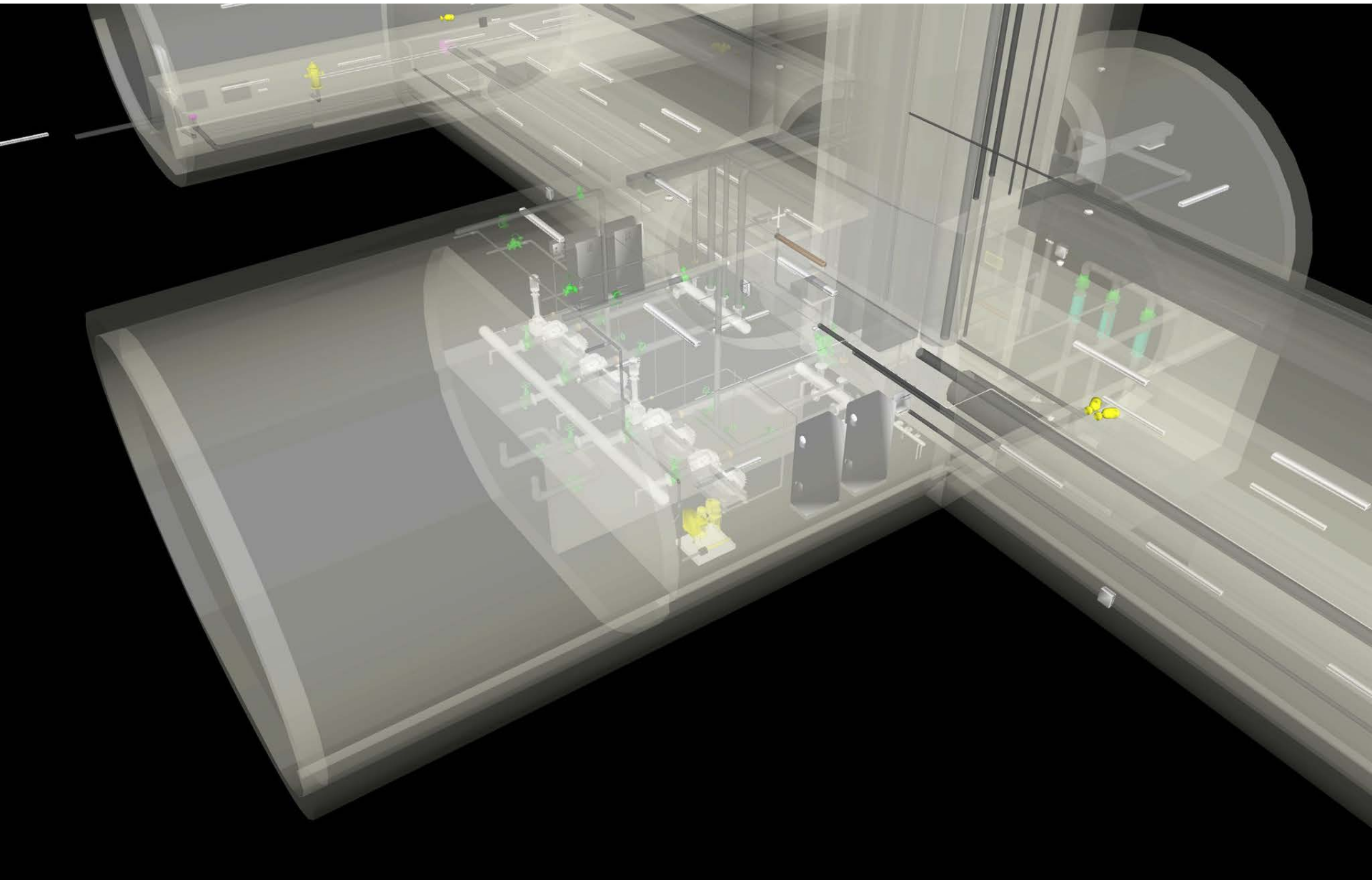
- ❖ Price-list oriented tagged elements;
- ❖ Consistent use of filters through tagging;
- ❖ The proper parameters.

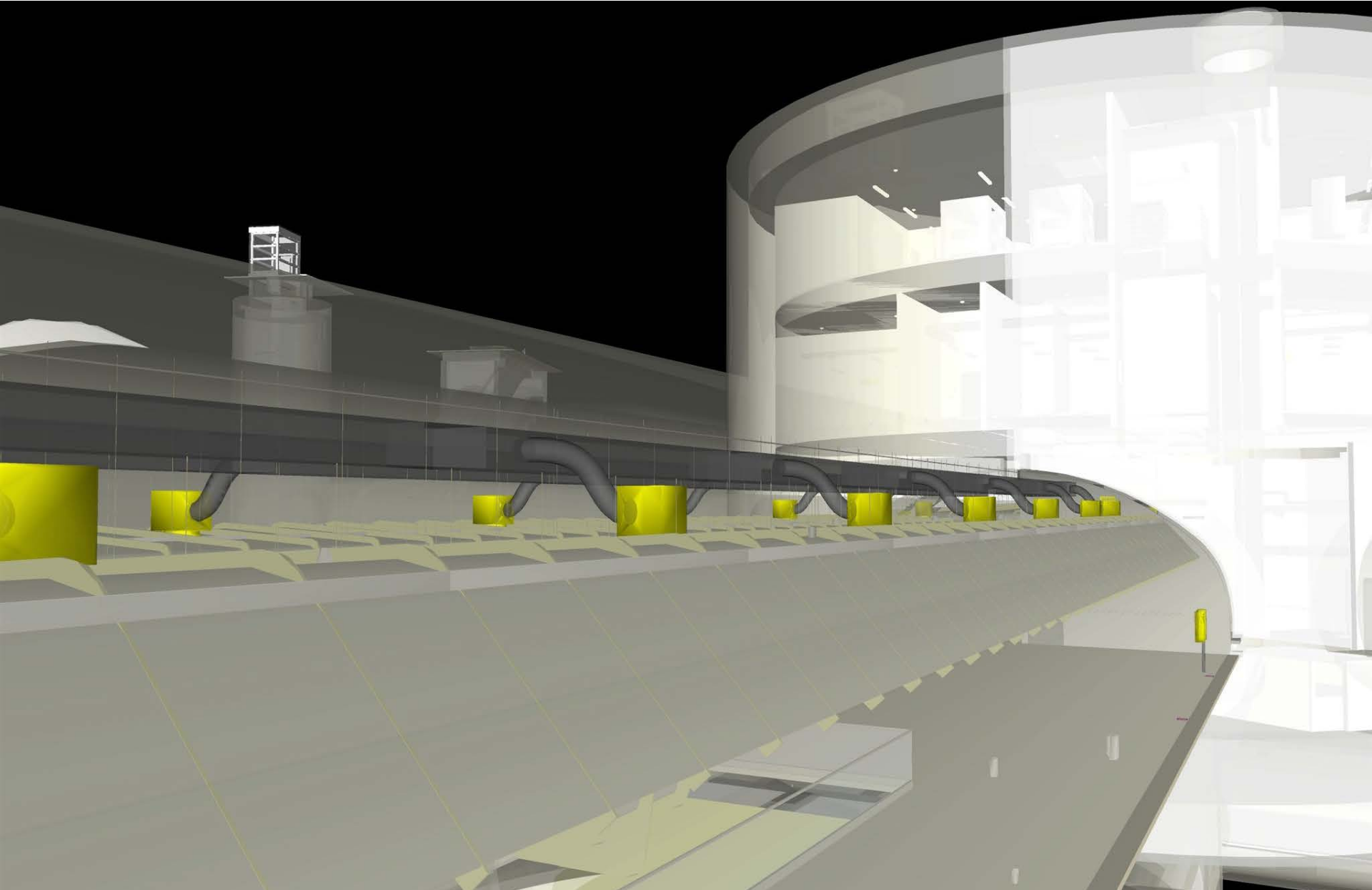


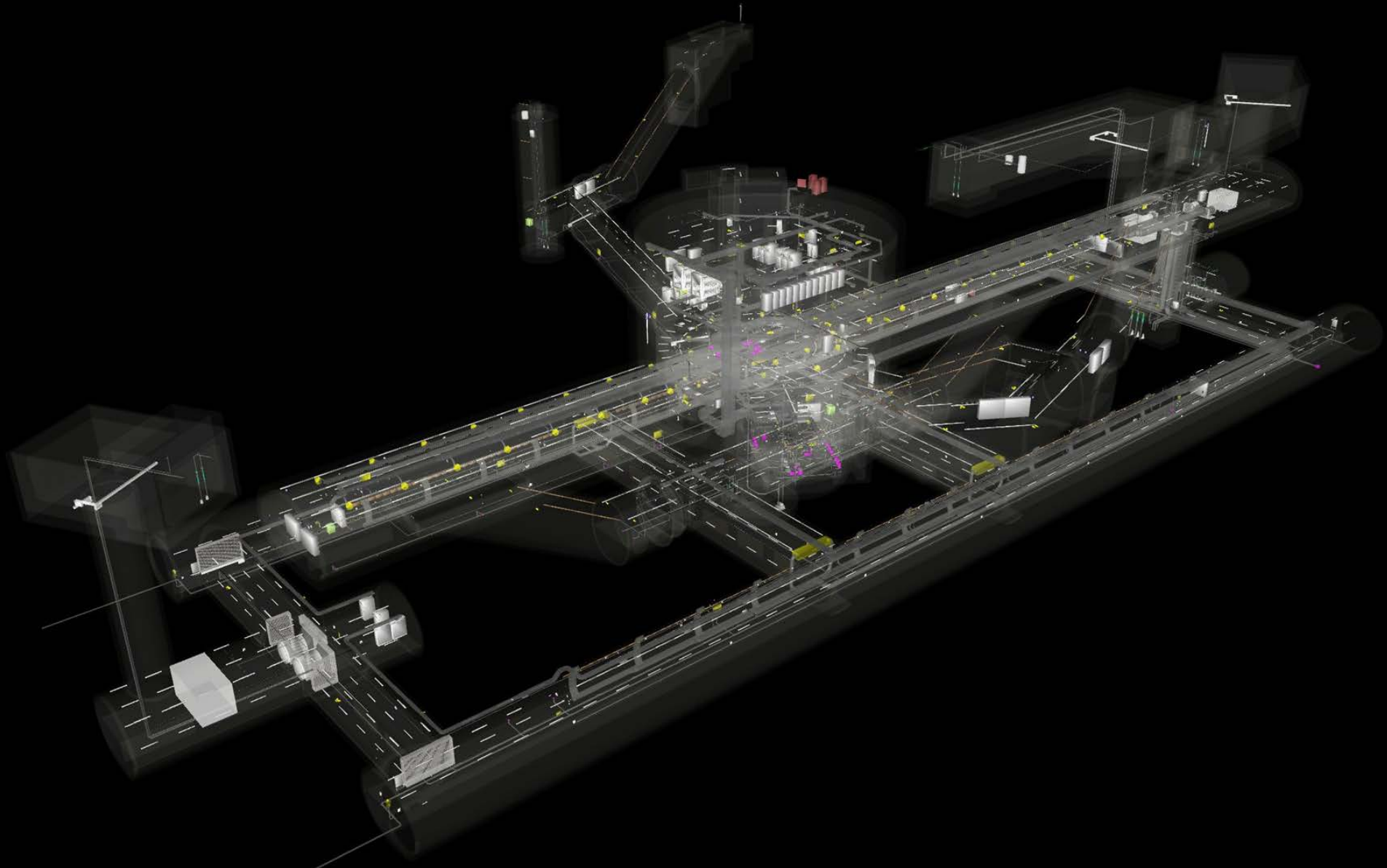






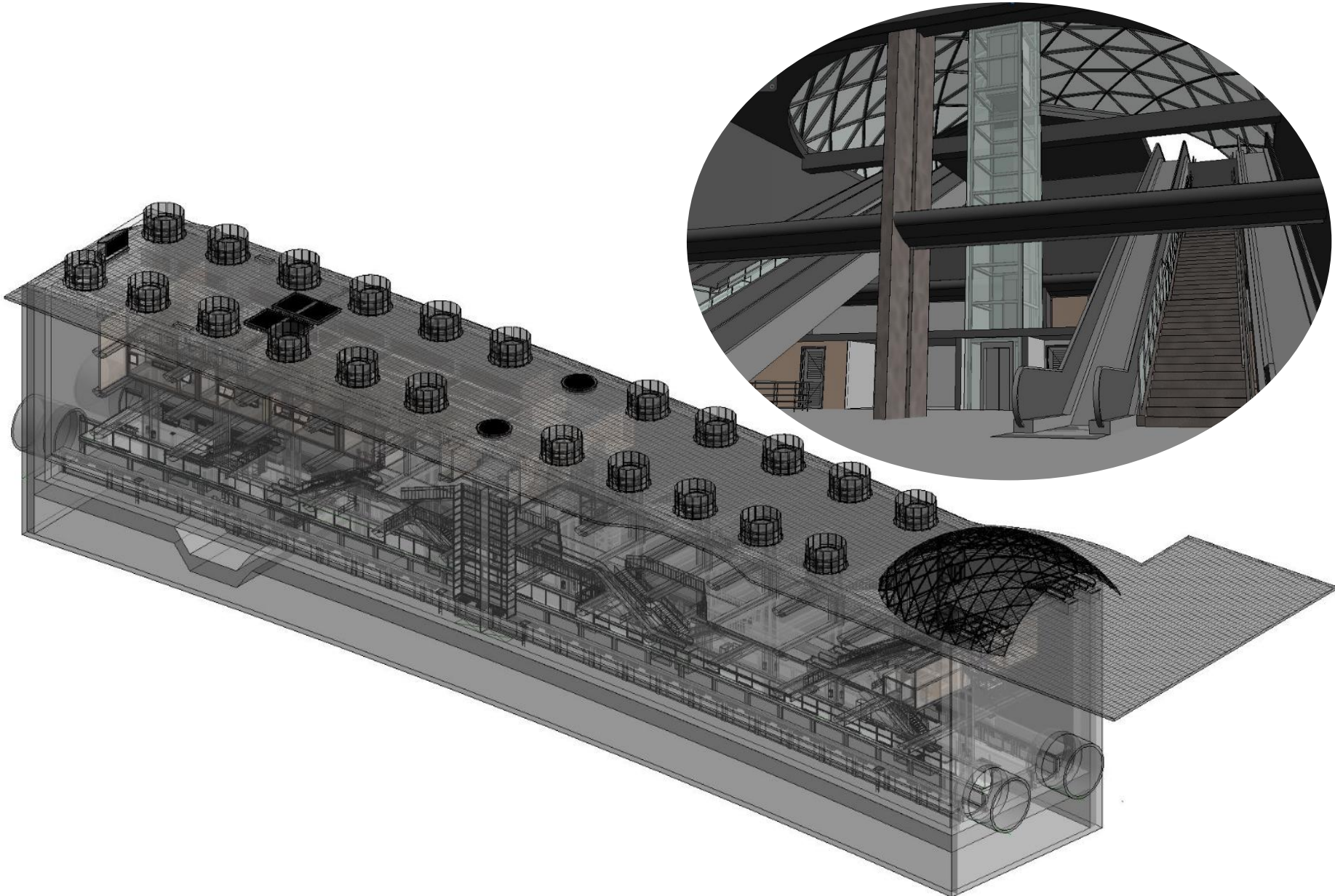


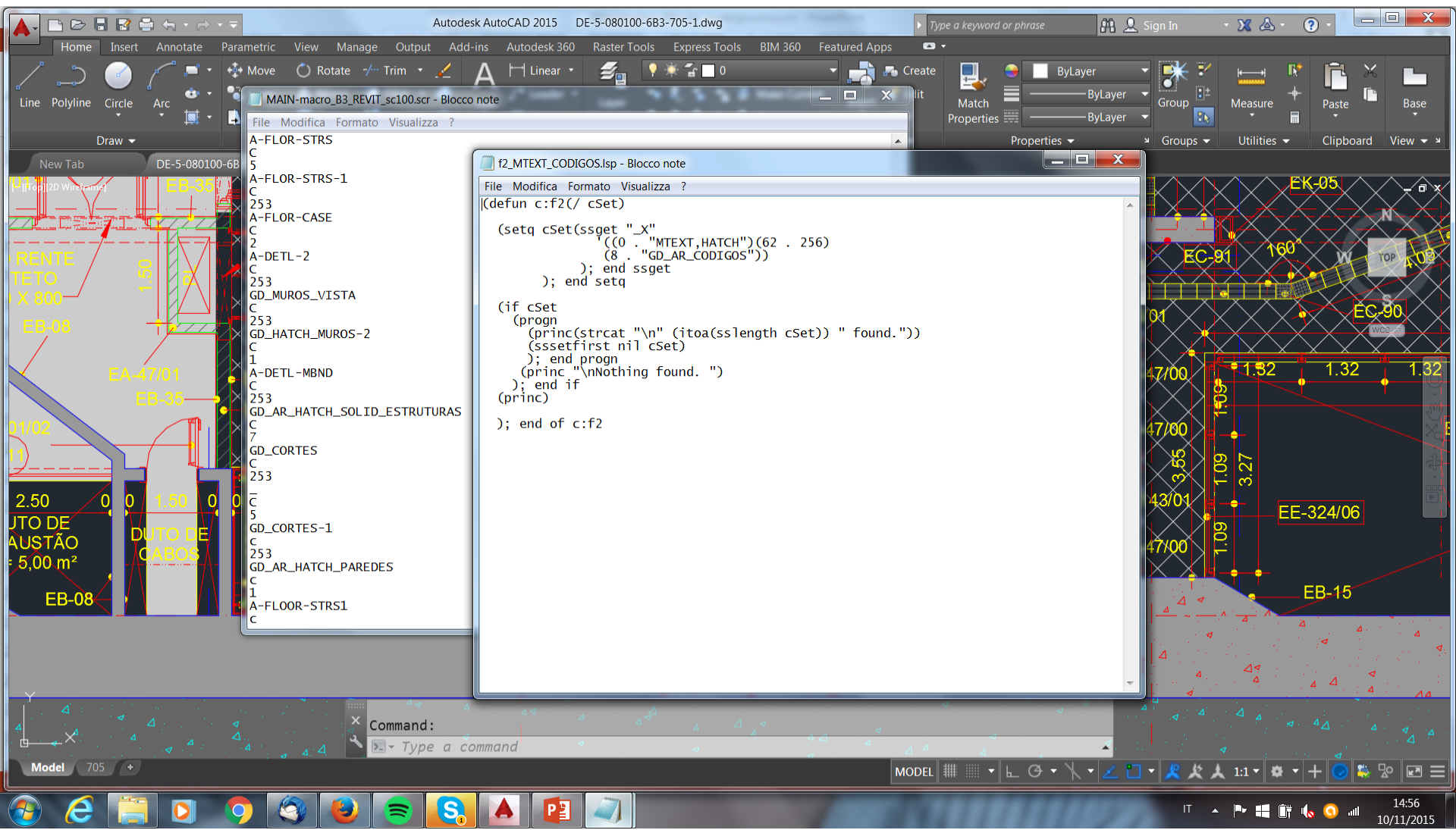




Metro Sao Paulo- Brazil

Using REVIT with rigid design standard



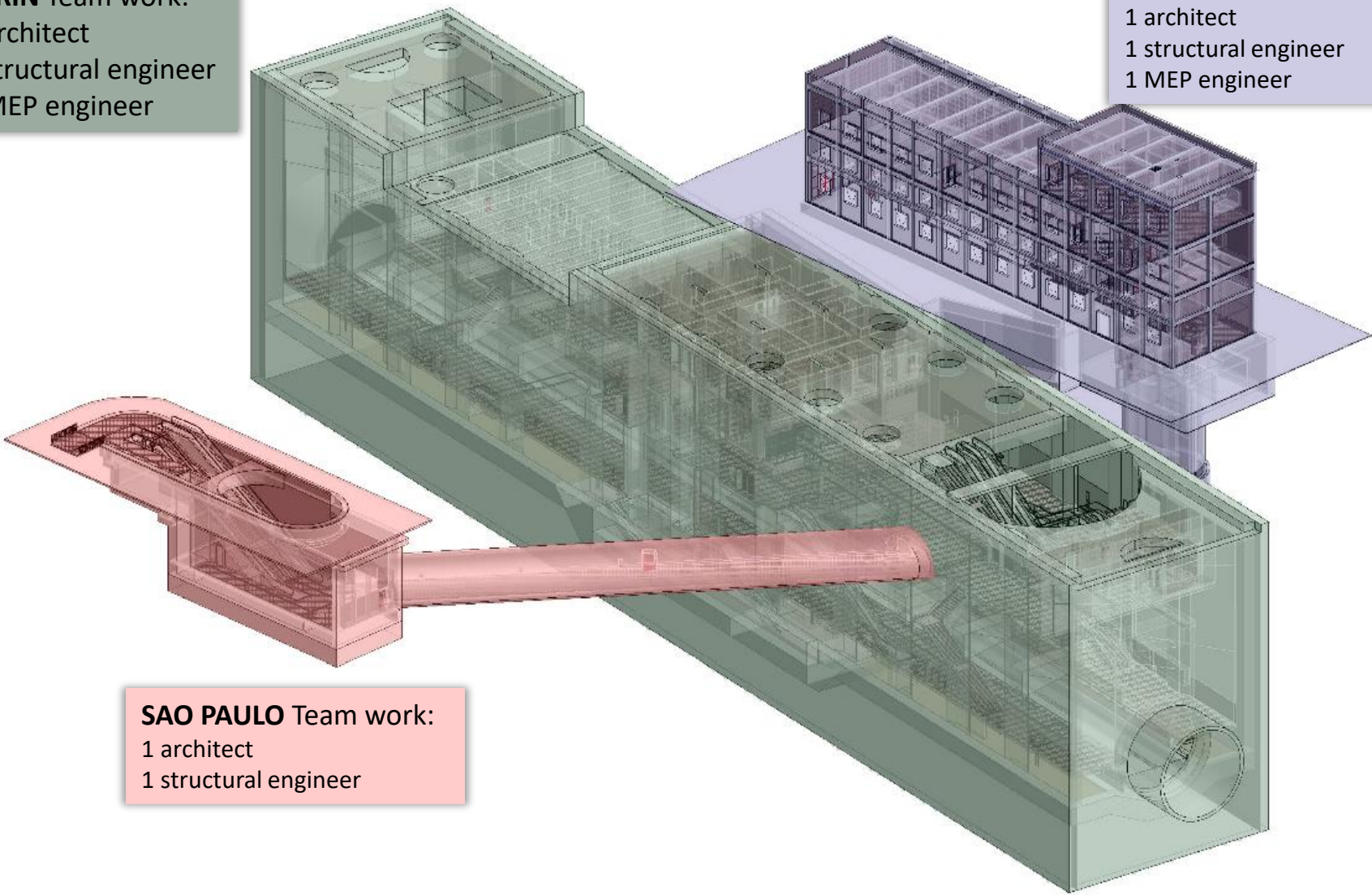


Metro Sao Paulo- Brazil

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

Santiago Batico Railway line (Chile)

Revit and construction phases

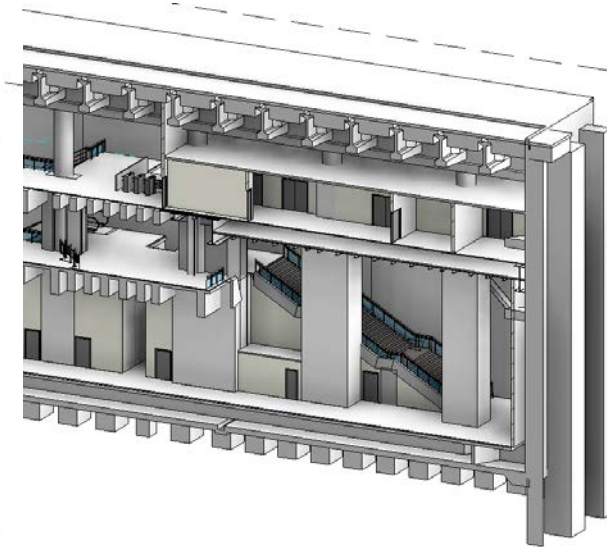
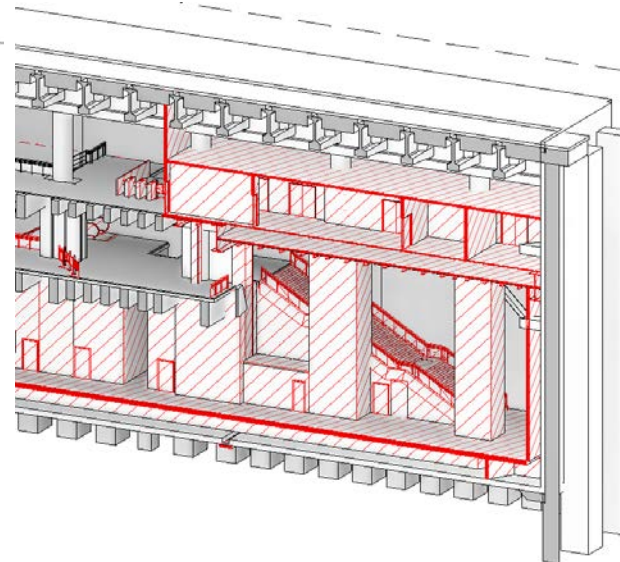
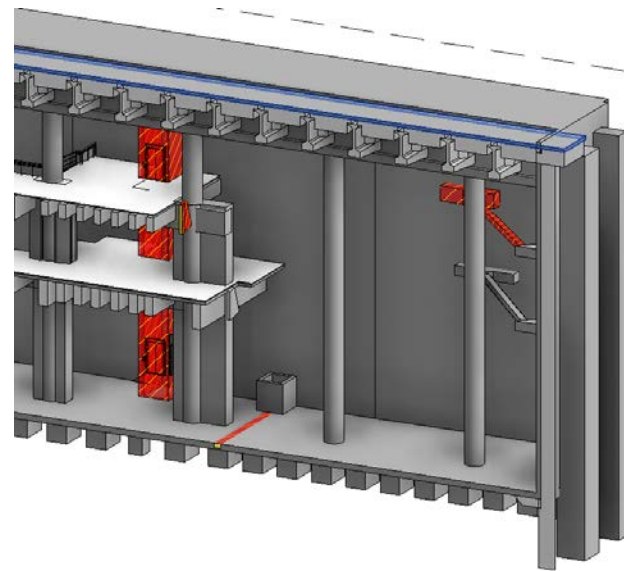
The Quinta Normal station in Santiago of Chile is an existing station, built with a big space foreseen to host a future station.

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

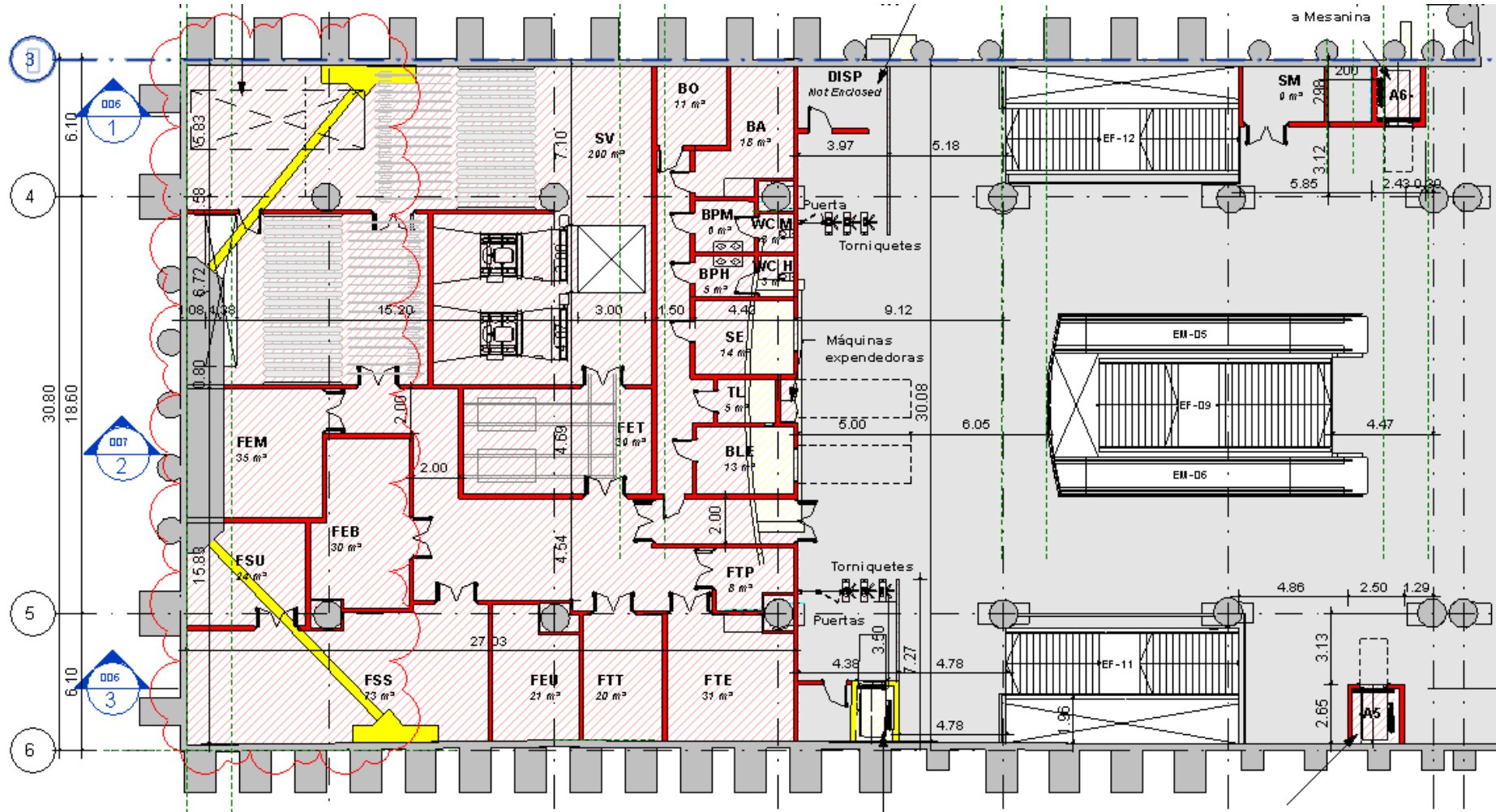


Santiago Batico Railway line (Chile)

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



Metro Sao Paulo- Brazil

REVIT- ROBOT interoperability

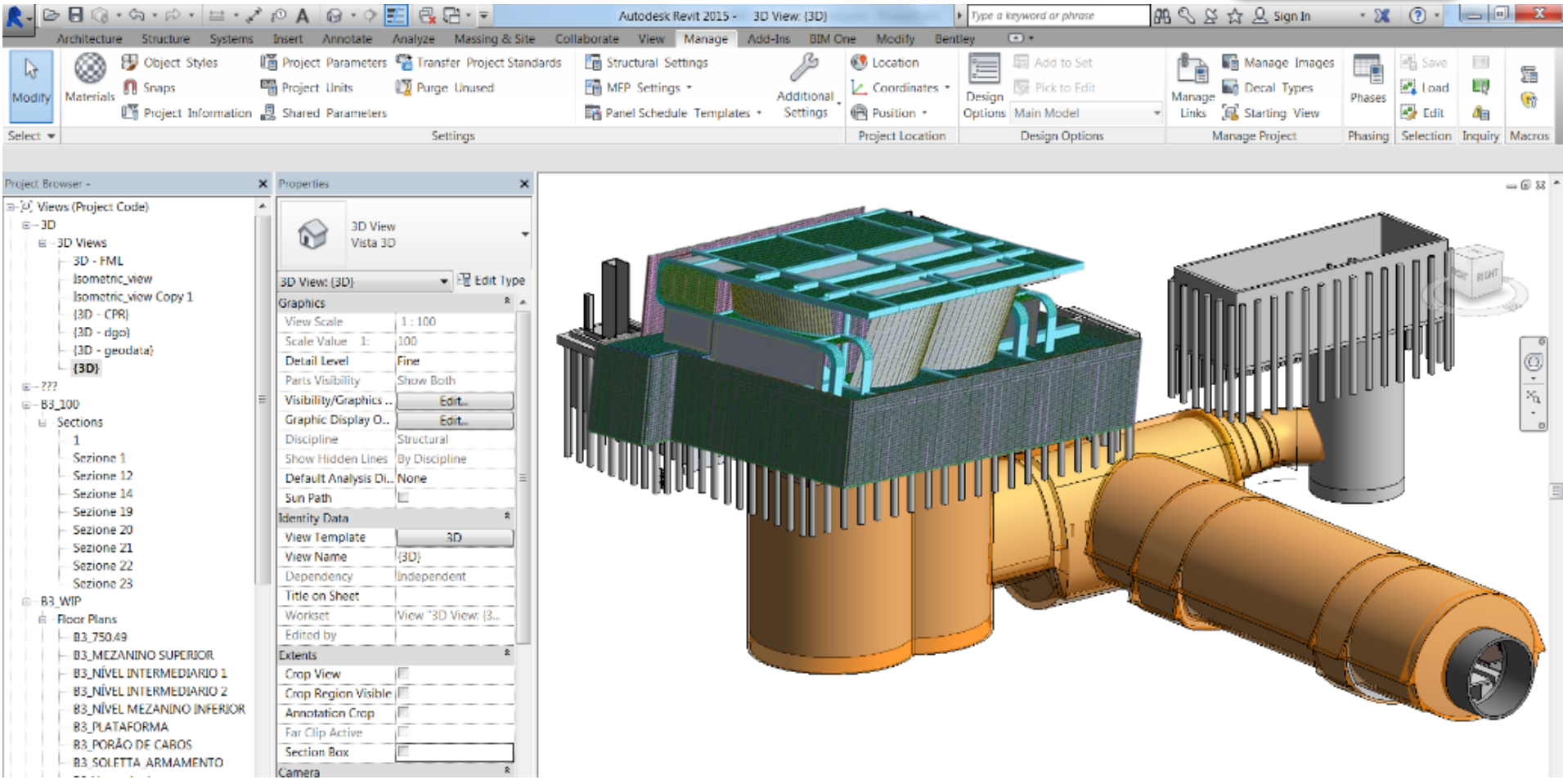
From REVIT into ROBOT



Structure calculation in ROBOT

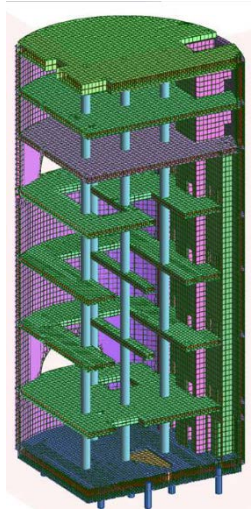
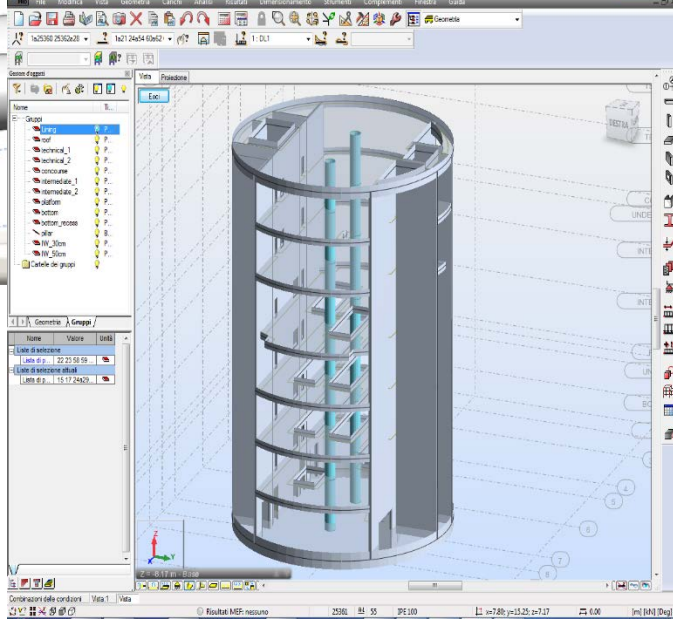
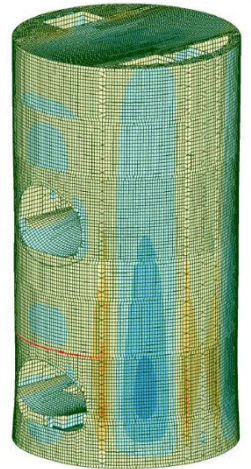
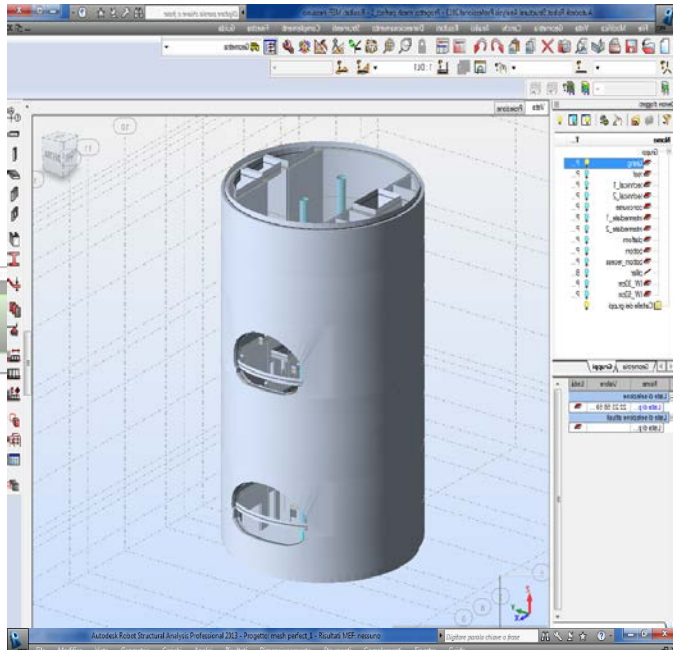
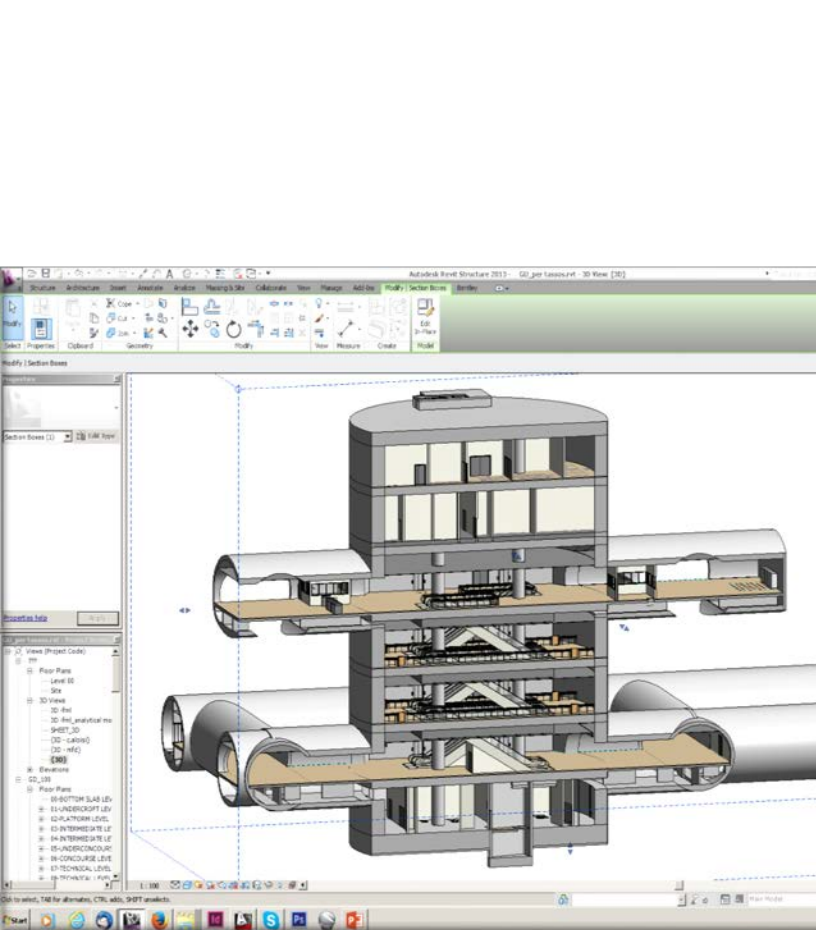


Back to REVIT



Metro Istanbul

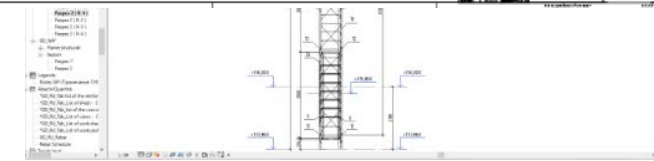
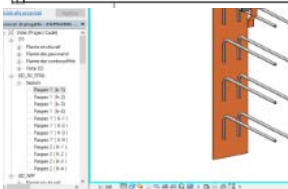
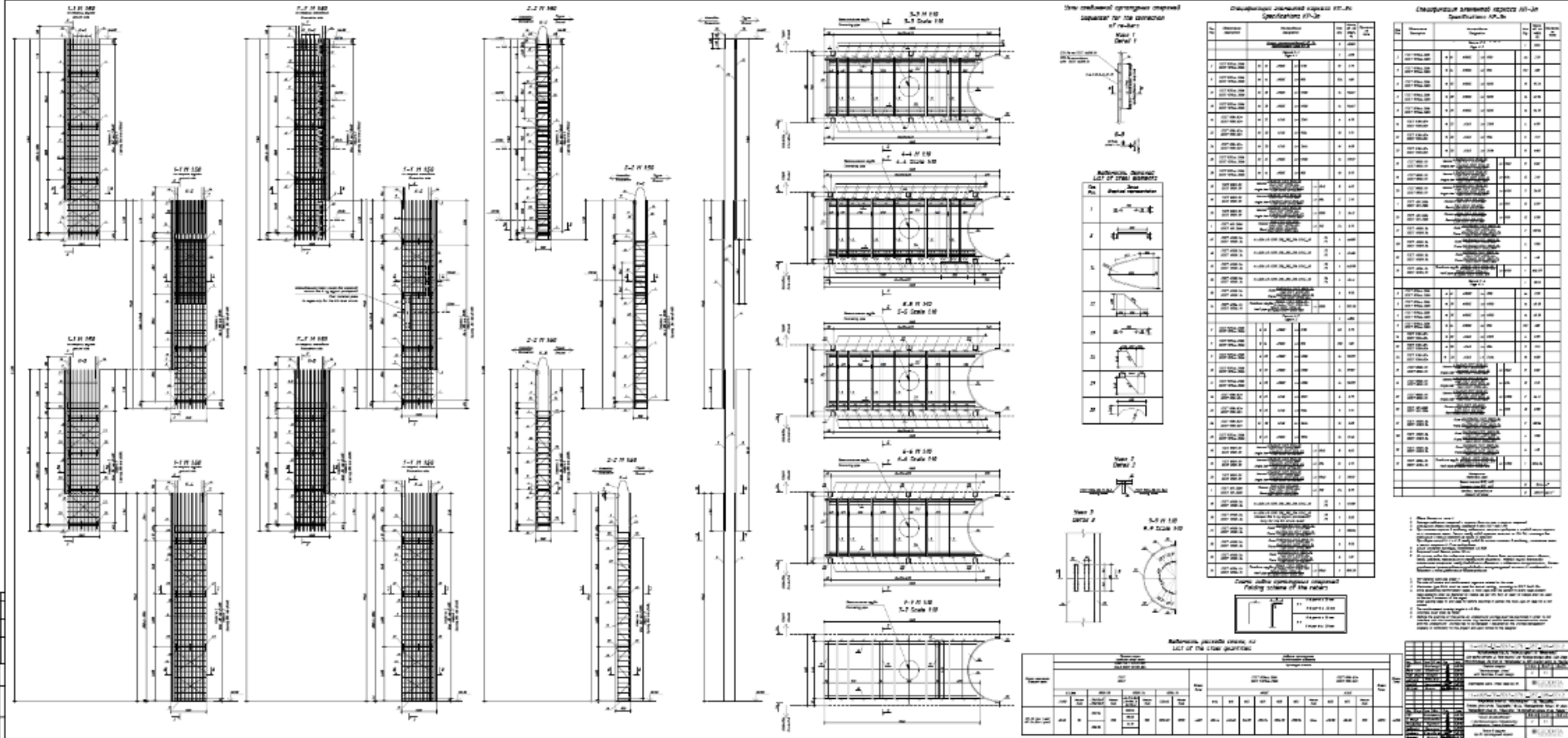
REVIT- ROBOT interoperability



Bottom slab rebar

The screenshot displays the Autodesk Robot Structural Analysis Professional 2013 interface. The main window shows a 3D model of a circular bottom slab with a grid of rebar reinforcement. The rebar is arranged in a circular pattern with radial and circumferential bars. A blue line highlights a specific bar in the model. The interface includes a menu bar at the top, a toolbar with various icons, and a left-hand tree view showing the project hierarchy. The bottom-right corner features a table with rebar properties.

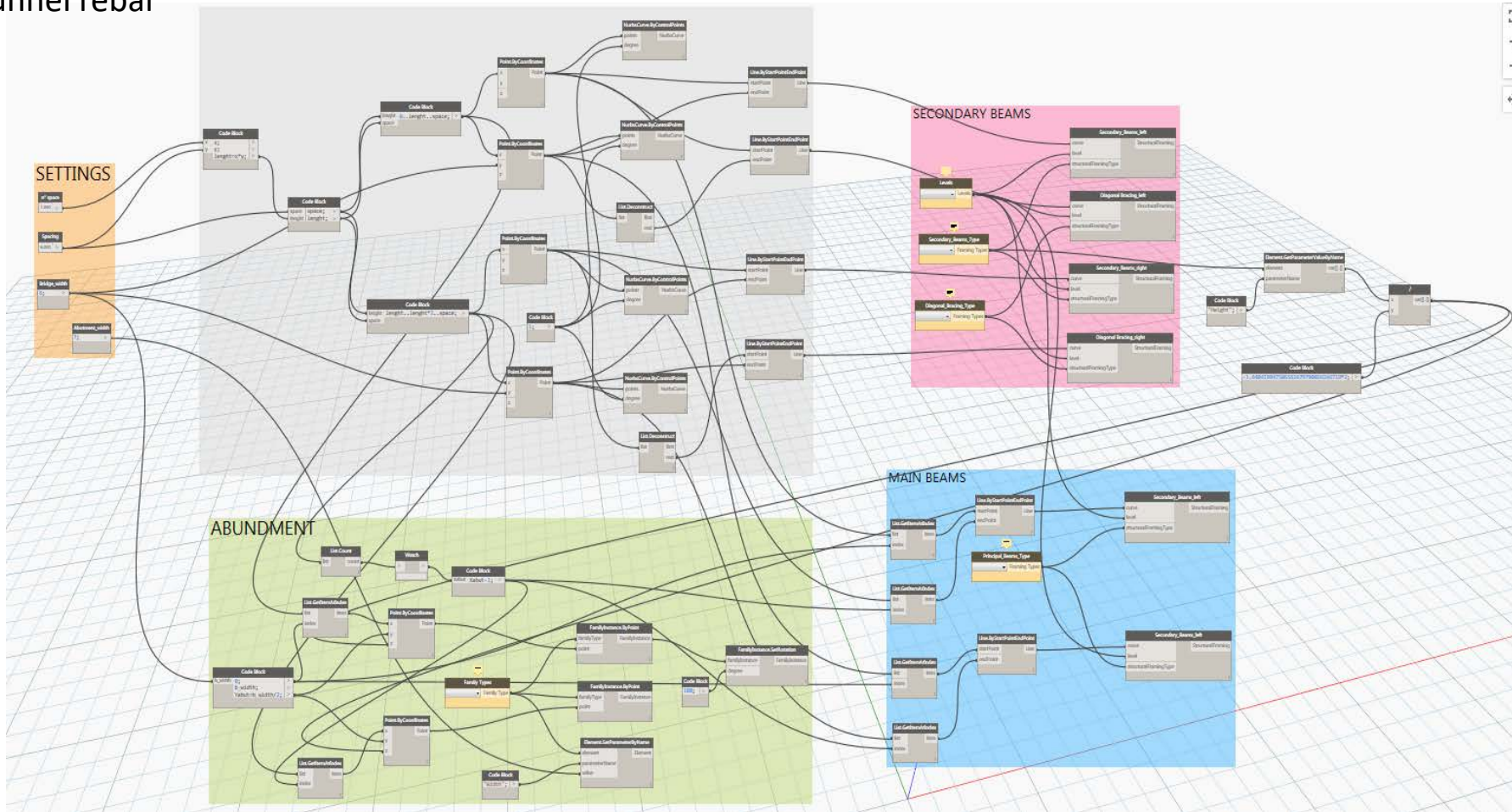
	Nr	Tipo di armatura	Classe dell'acciai	Diametro (mm)	Codice della forma	Numero	(m)	(m)	(m)
	1	1 superiore in direzione X		32.0	00	1	A = 1.60		
	2	2 superiore in direzione X		32.0	00	1	A = 1.66		
	3	3 superiore in direzione X		32.0	00	1	A = 1.94		
	4	4 superiore in direzione X		32.0	00	1	A = 2.02		
	5	5 superiore in direzione X		32.0	00	1	A = 2.19		
	6	6 superiore in direzione X		32.0	00	1	A = 2.37		
	7	7 superiore in direzione X		32.0	00	1	A = 2.43		
	8	8 superiore in direzione X		32.0	00	1	A = 2.67		
	9	9 superiore in direzione X		32.0	00	1	A = 2.71		
	10	10 superiore in direzione X		32.0	00	1	A = 2.91		
	11	11 superiore in direzione X		32.0	00	1	A = 3.06		
	12	12 superiore in direzione X		32.0	00	1	A = 3.12		
	13	13 <valore diverso>		32.0	00	4	A = 3.26		



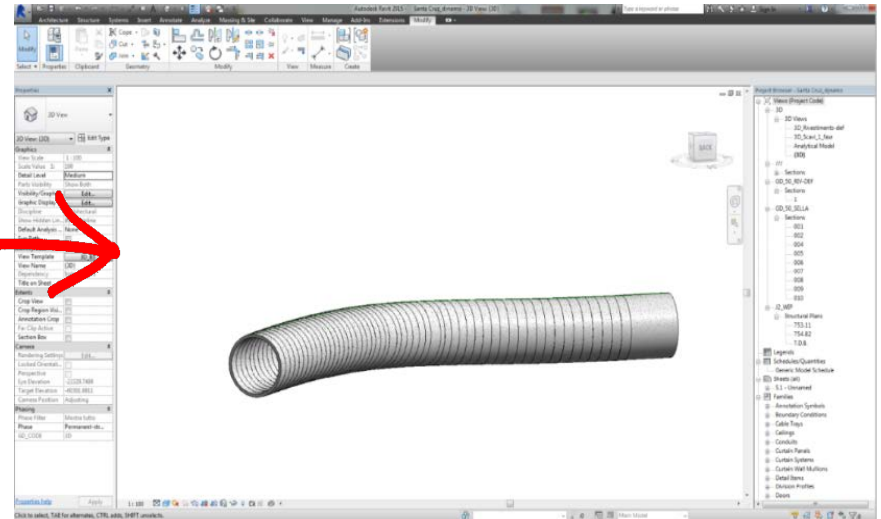
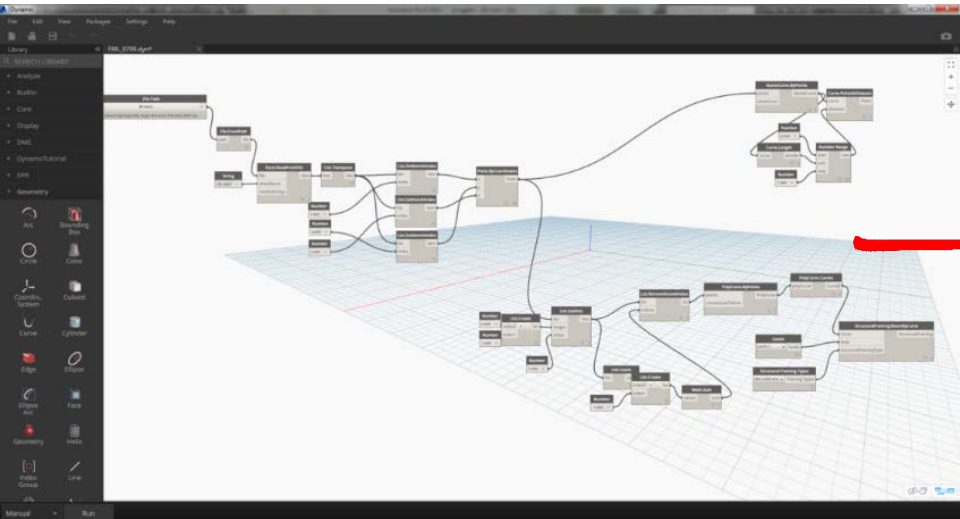
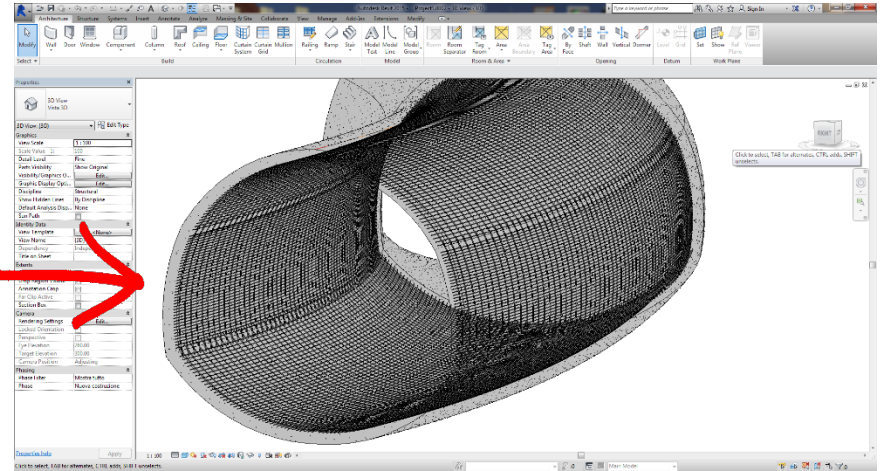
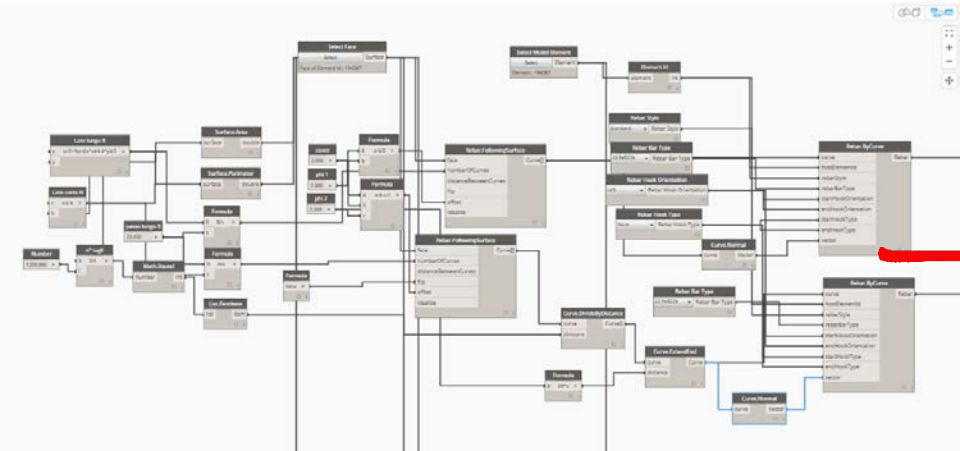
Using DYNAMO to realize dynamic automatic workflows...

We use it to:

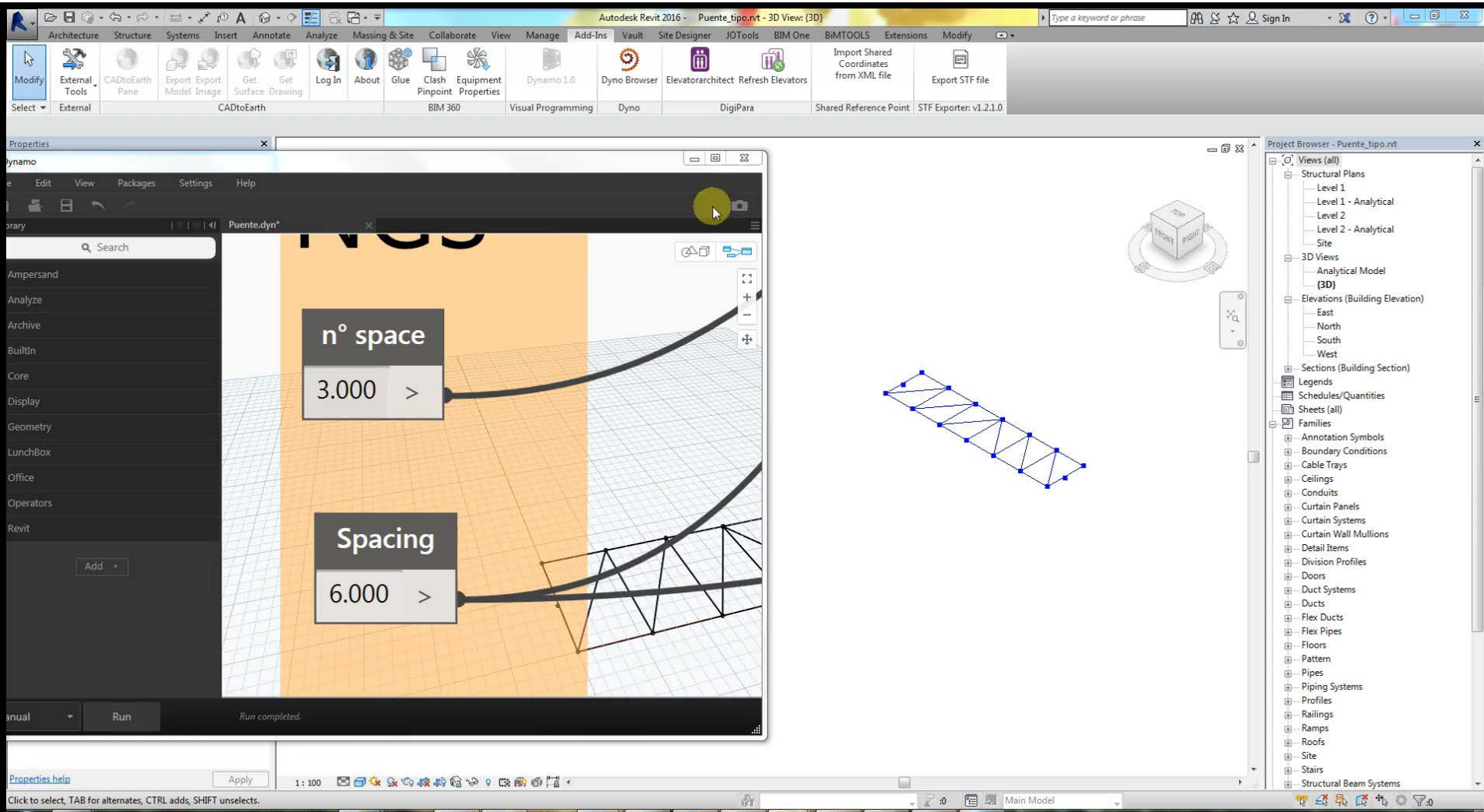
- Rename automatically a specific parameter of elements (like beams, doors, etc...)
- Path simulations for evacuation evaluation
- Calculate volume of a specific selection (this is not possible with schedule)
- Tunnel rebar



Using DYNAMO to realize dynamic automatic workflows...



BIM using dynamo to realize dynamic bridge models...

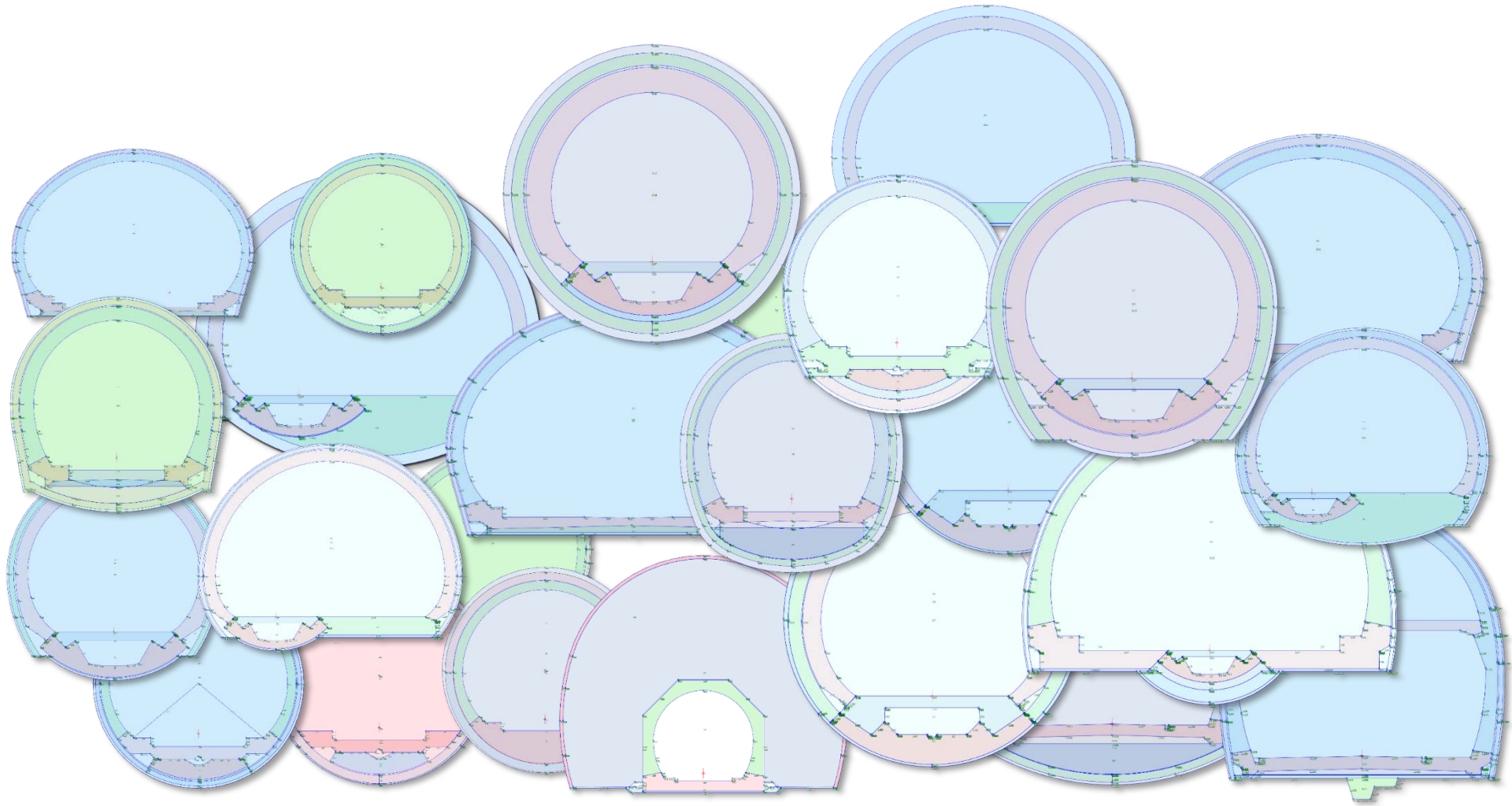


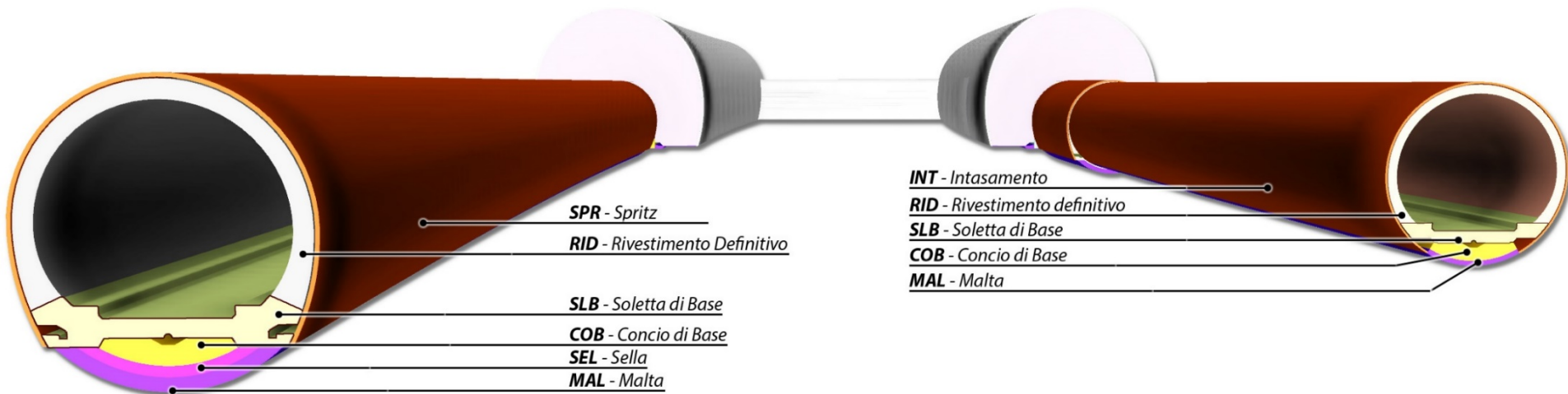
The importance of BoQ

The screenshot illustrates the parametric design of a tunnel in AutoCAD Civil 3D. The interface is divided into several panels:

- Toolbox:** Contains various toolsets for creating and editing tunnel geometry, including Geometric, Advanced Geometry, Accessory, Workflow, and Miscellaneous.
- Assembly:** Shows a hierarchical list of tunnel components, such as:
 - 1. BOCCONFERTE
 - 2. CALOTTA
 - 3. SPINTI
 - 4. SPOLLICINI
 - 5. CONVI
 - 6. PIA
 - 7. RINFORZO
 - 8. SCALFO
 - 9. SCALFO
- Main View:** Displays a detailed cross-section of the tunnel, showing concentric layers and a central rectangular structure. The layers are color-coded (blue, green, light blue, pink).
- BoQ (Bill of Materials):** A table at the bottom right lists the parameters used in the design:

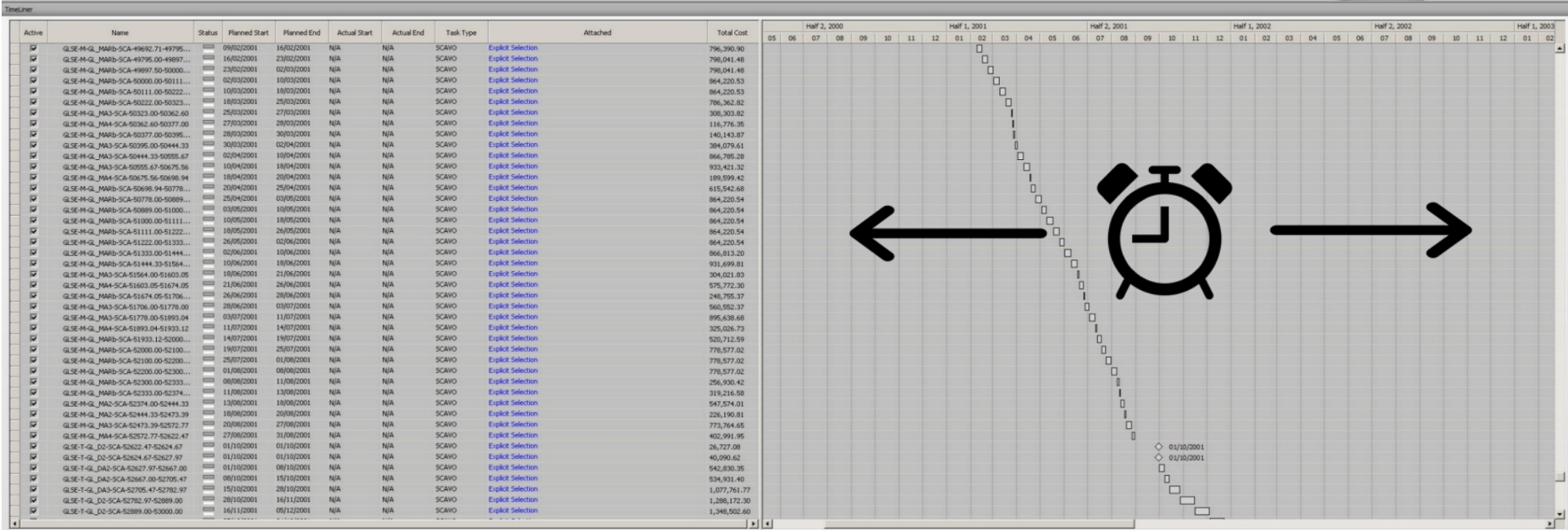
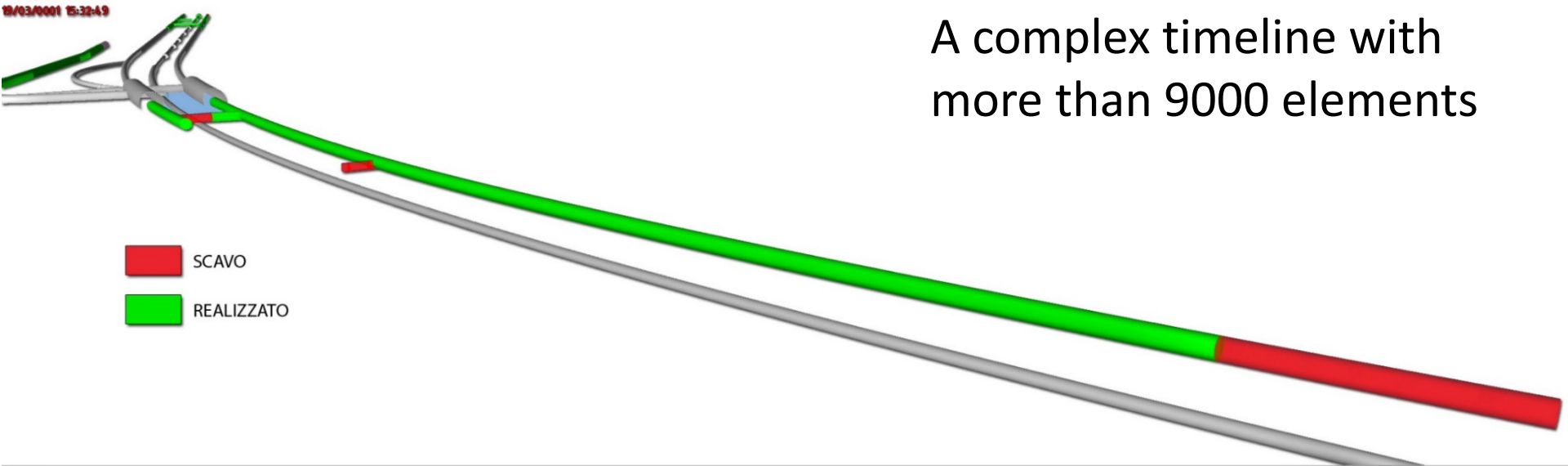
Name	Type	Direction	Default value	Comments	Description
SIA	Side	Input	1/4		
ARC_R	Integer	Input	24		
CC_Circle	String	Input	C20		
SIA	String	Input	C20		

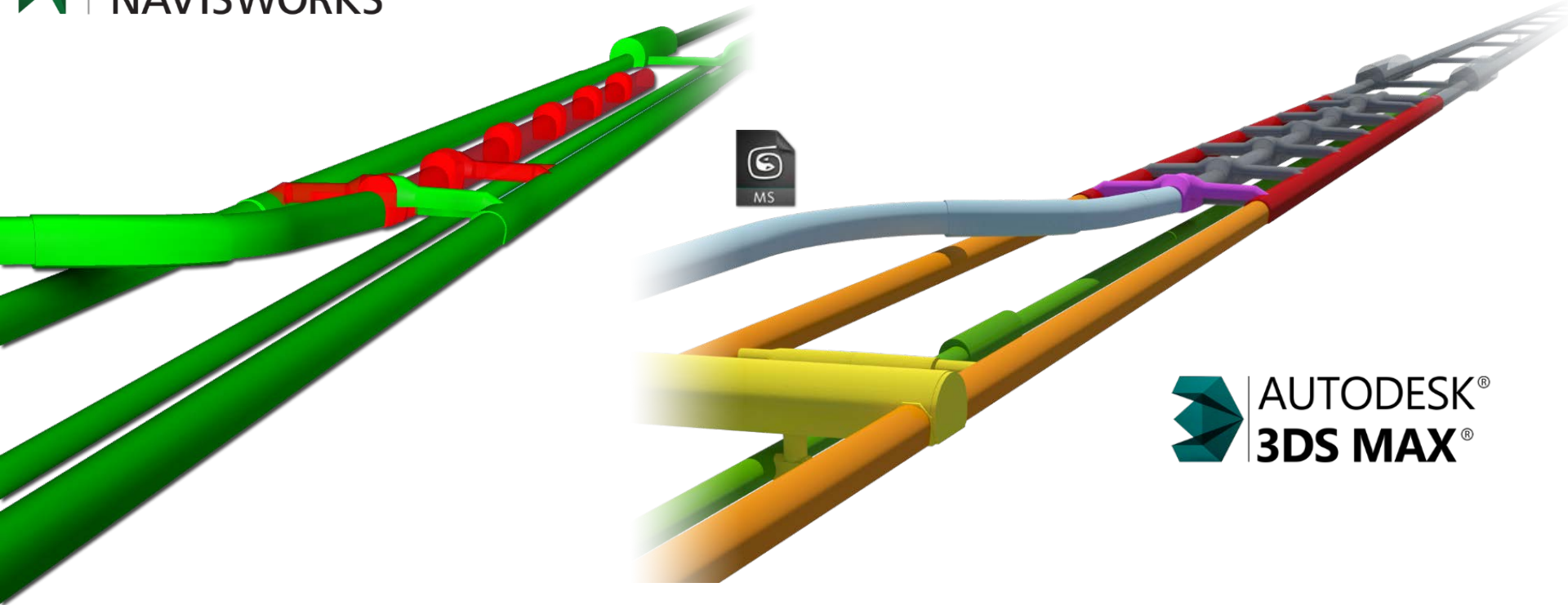




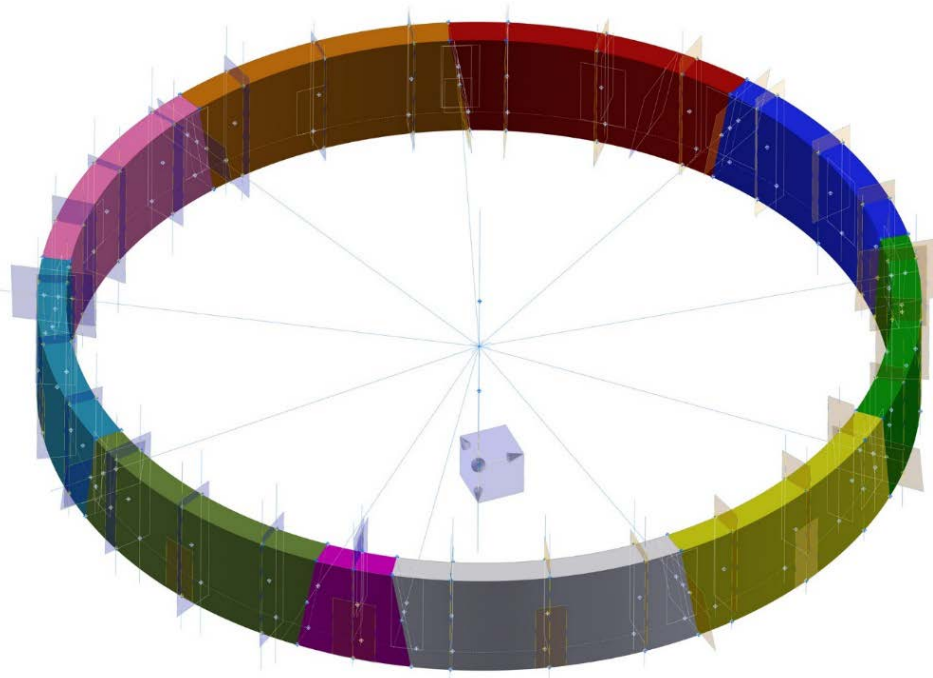
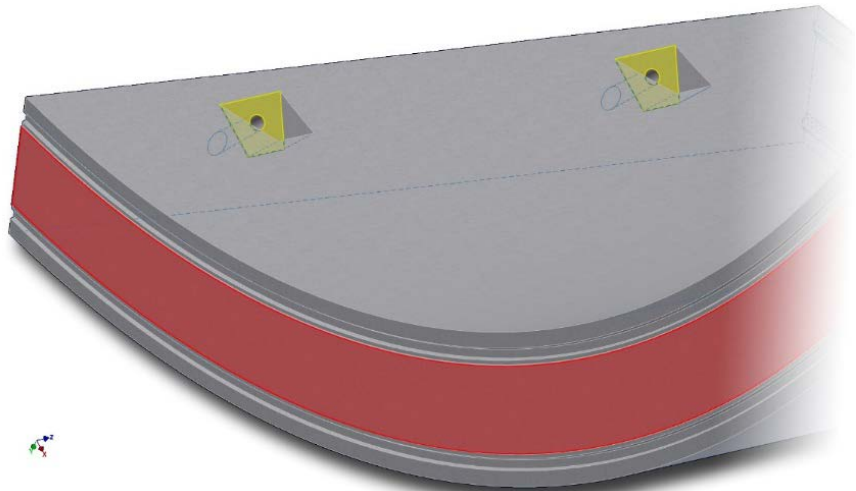
Ogni elemento è indipendente e può essere computato in funzione del tempo in cui viene eseguito

A complex timeline with more than 9000 elements



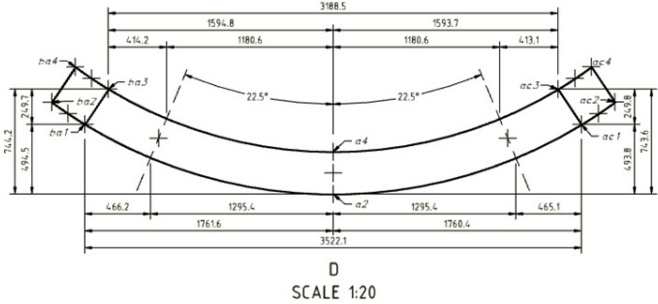


Inventor: Tunnel Segment Design



Inventor: Tunnel Segment Design

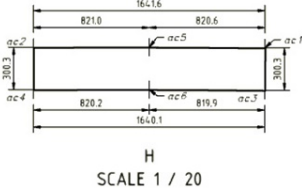
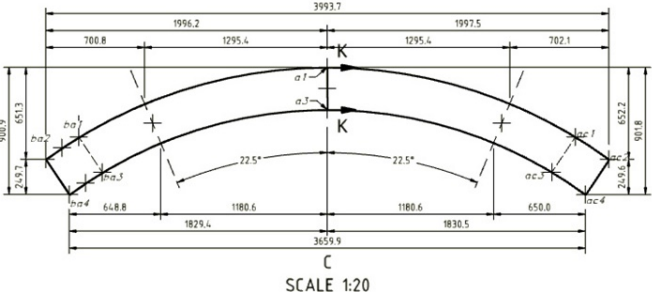
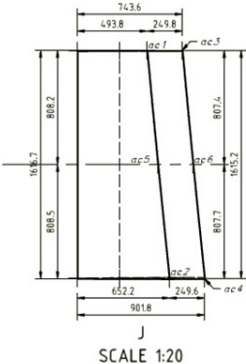
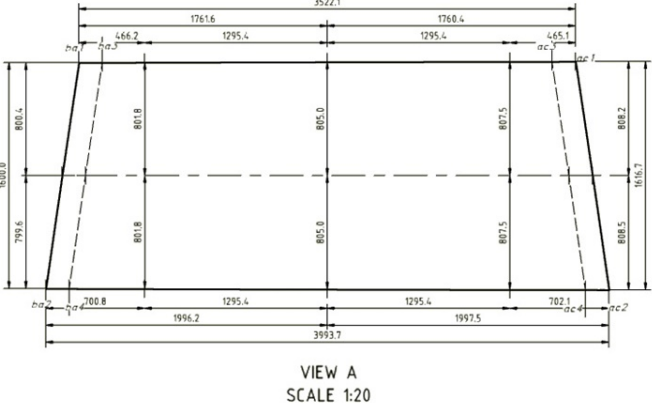
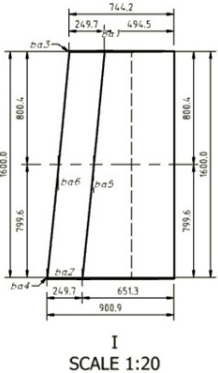
- 2D drawing from Inventor to PDF or Autocad
- All data are coherent



GEOMETRY OF SEGMENT a
VOLUME=1.8397mc

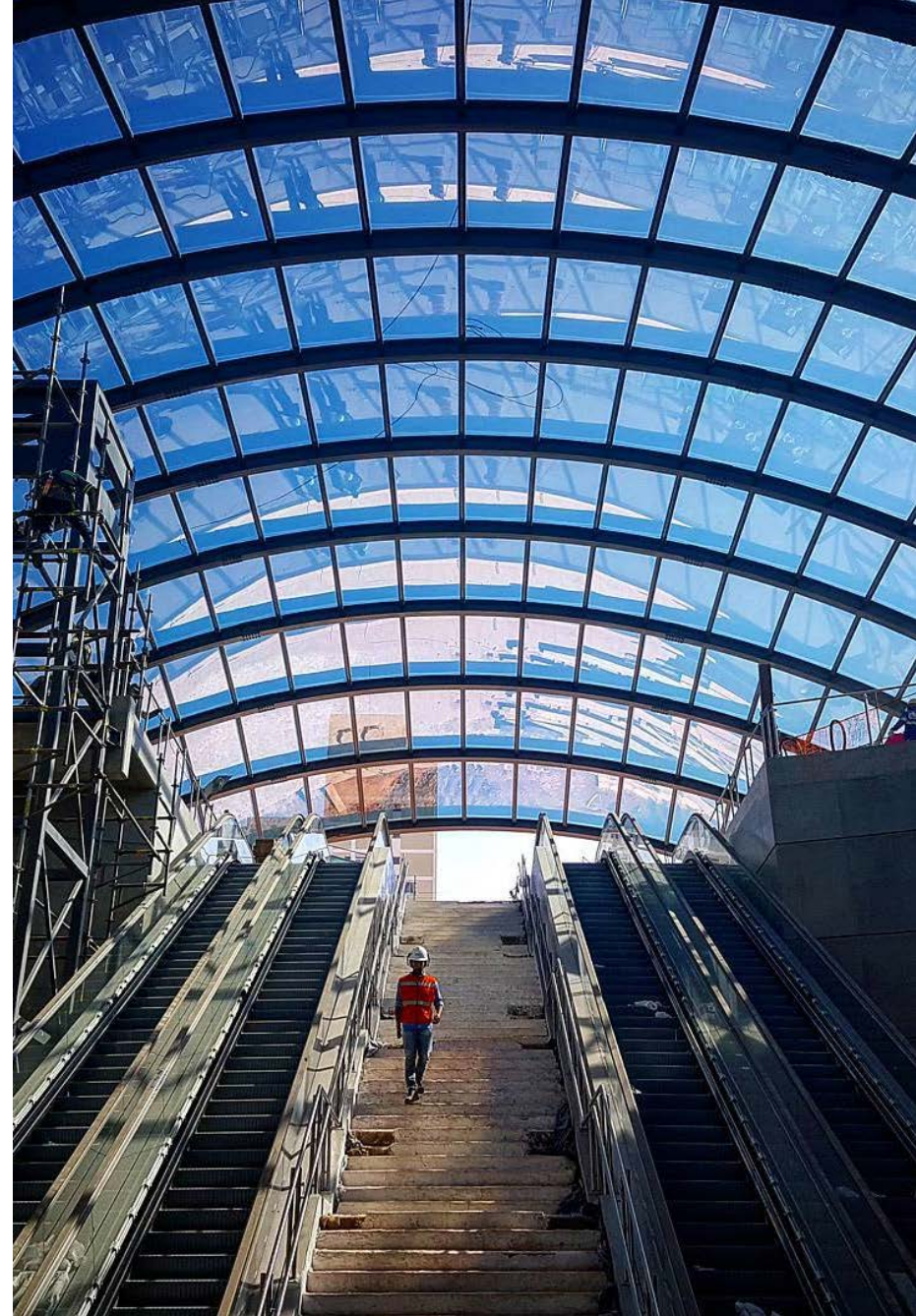
CHARACTERISTIC:

- AVERAGE WIDTH 1600.000mm
- INTERNAL DIAMETER 6170.000mm
- EXTERNAL DIAMETER 6770.000mm
- THICKNESS 300.000mm
- MINIMUM PLANIMETRIC RADIUS 30000.000mm



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....

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

