

# Efficiency Underground: Málaga Metro's BIM and IFC 4x3 Integration

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**Rosa Ureña Bolaños**

MSc Civil Engineer and BIM Manager.  
Responsible for the BIM implementation at TPF.  
Project Manager in the Department of Transport  
Infrastructures.



**José Ignacio León García**

MSc Civil Engineer and BIM specialist.  
Experience in port terminals, structures  
and linear infrastructure projects.

# About TPF



tpf  
INGENIERÍA

## WHO WE ARE

TPF GROUP  
PRESENCE IN  
33 COUNTRIES



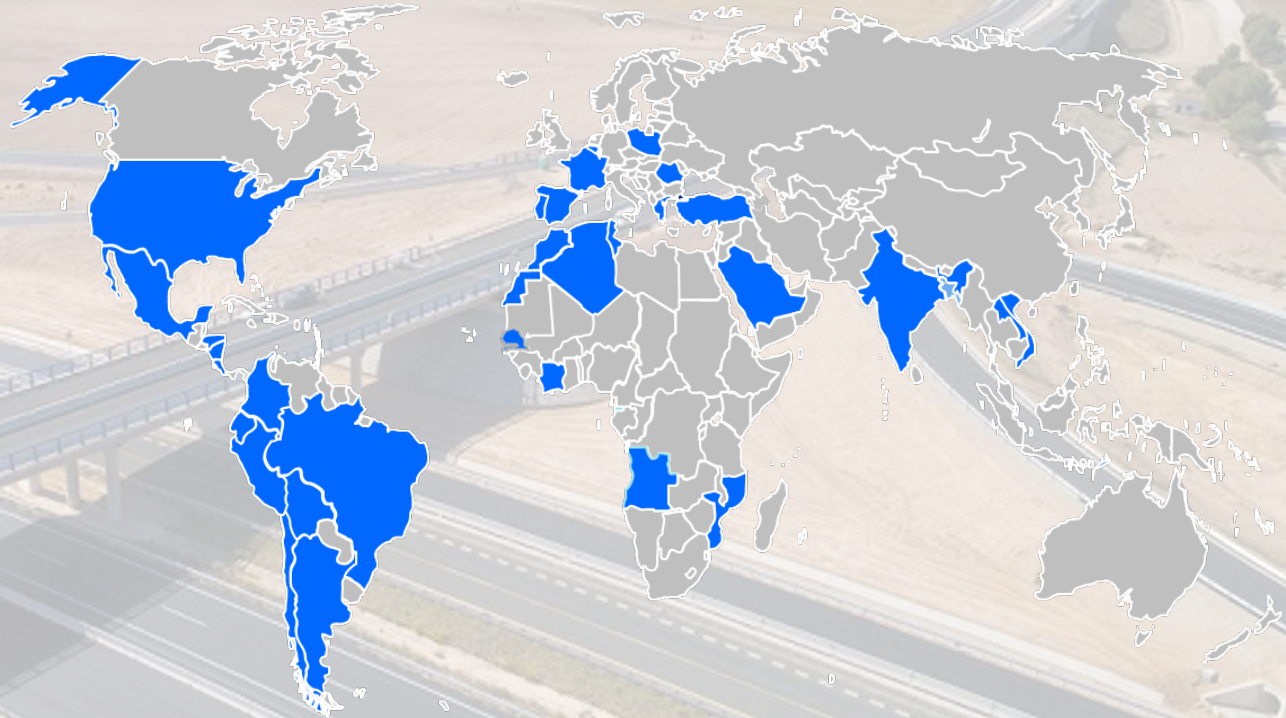
EXPERIENCE IN  
65 COUNTRIES



TPF GROUP  
4,900  
EMPLOYEES



TPF GROUP  
€280 MILLION





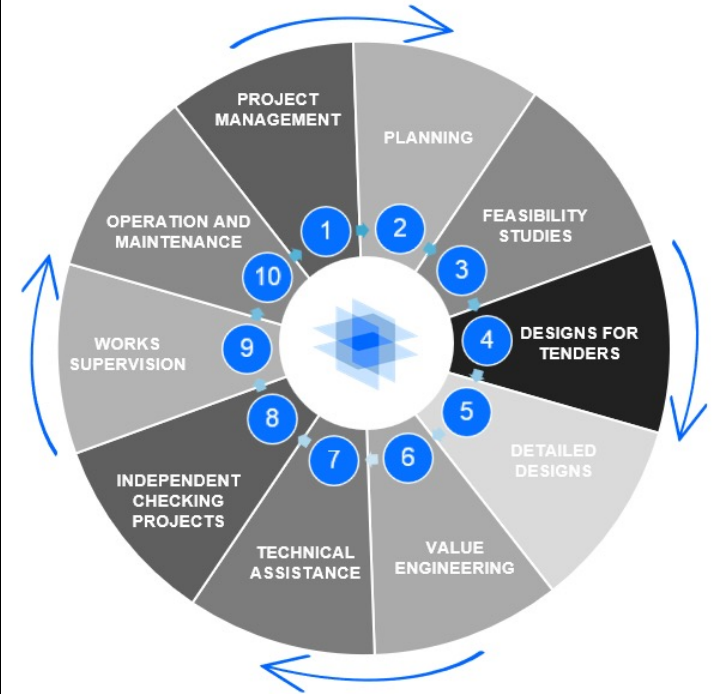
# About TPF



## SECTORS OF ACTIVITY



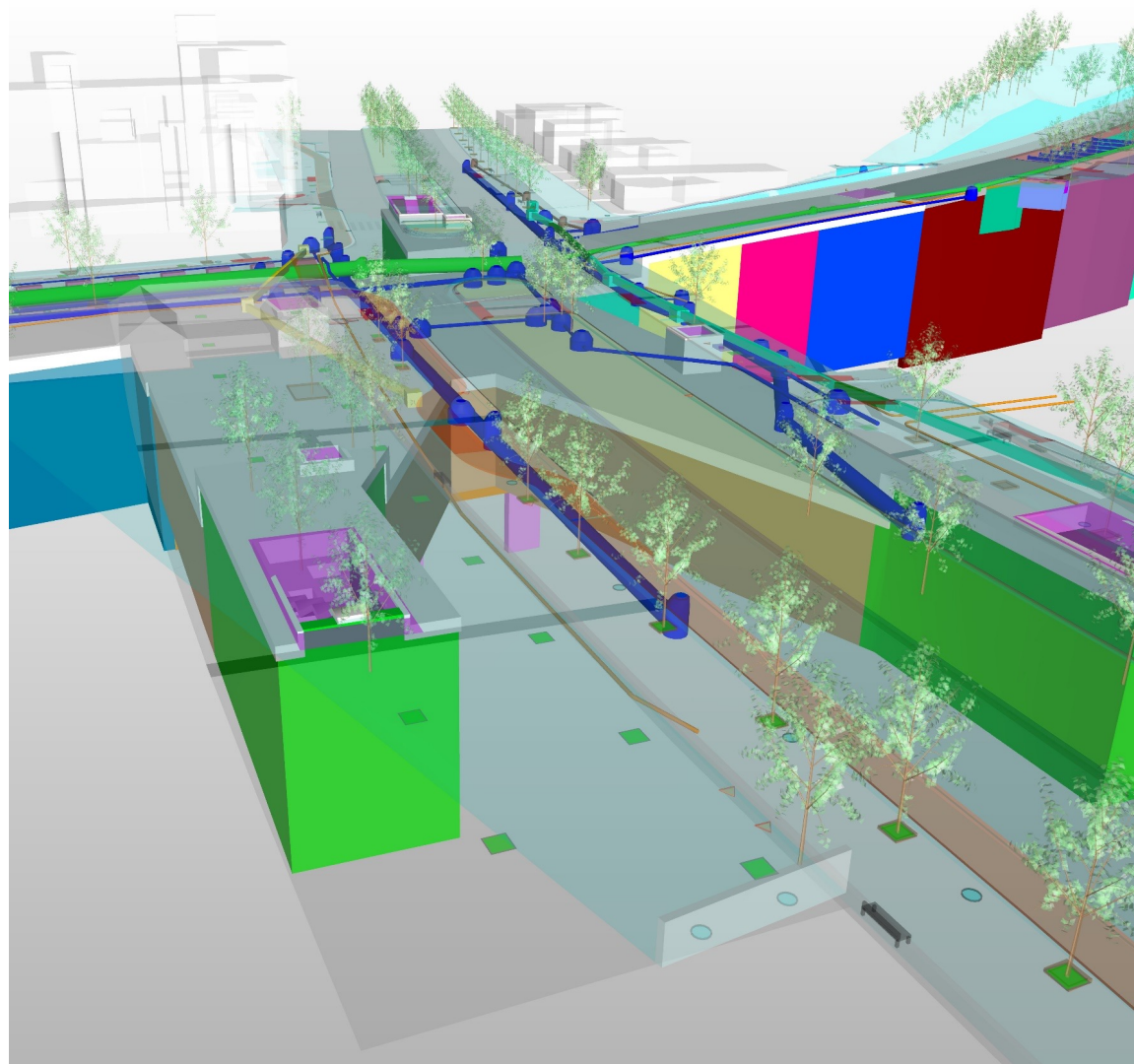
## PROJECT CYCLE



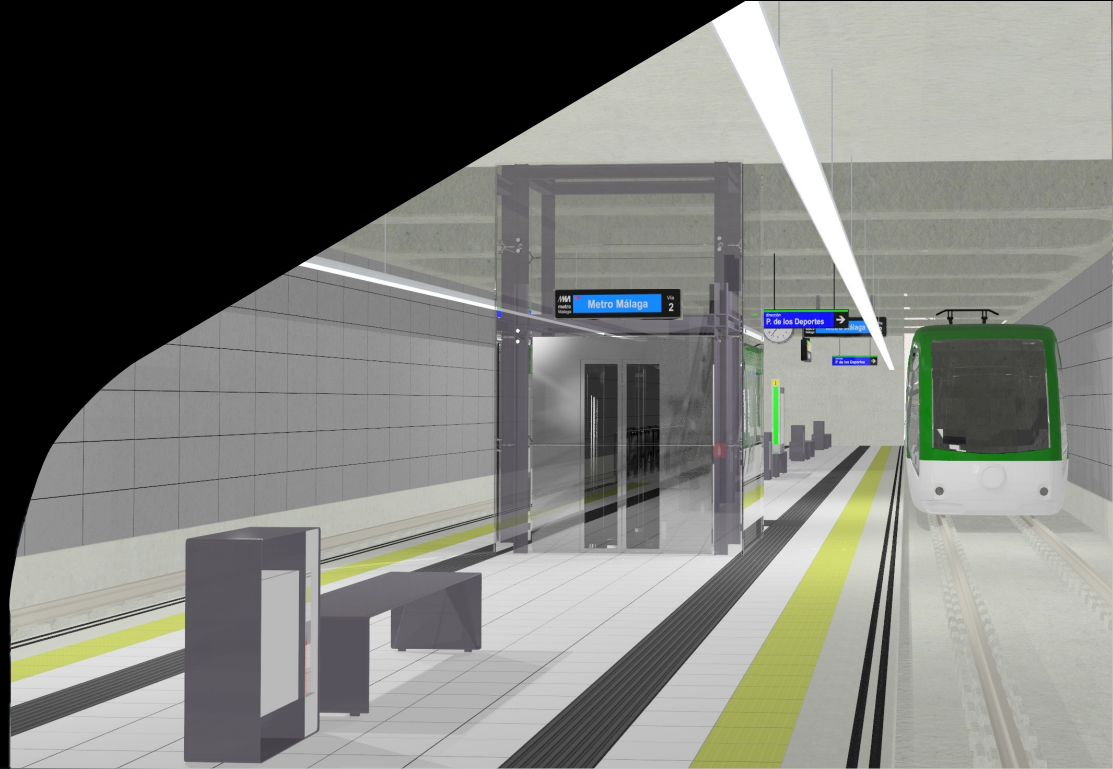


# Agenda

- 1 Context
- 2 Challenges & Design Solutions
- 3 IFC 4.3 Export & Data Schema
- 4 Closing remarks



# Context



# Metro project in a consolidated urban area

## MALAGA CITY

- 570.000 INHABITANTS
- MONUMENTAL HISTORIC AND TOURISTIC AREA



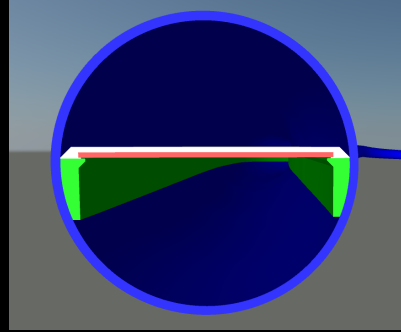
AGENCIA DE OBRA PÚBLICA  
DE LA JUNTA DE ANDALUCÍA  
Consejería de Fomento,  
Articulación del Territorio y Vivienda



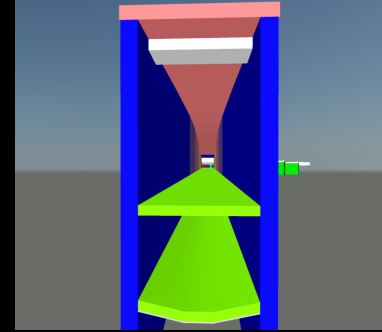


# Preliminary Design and Detailed Design

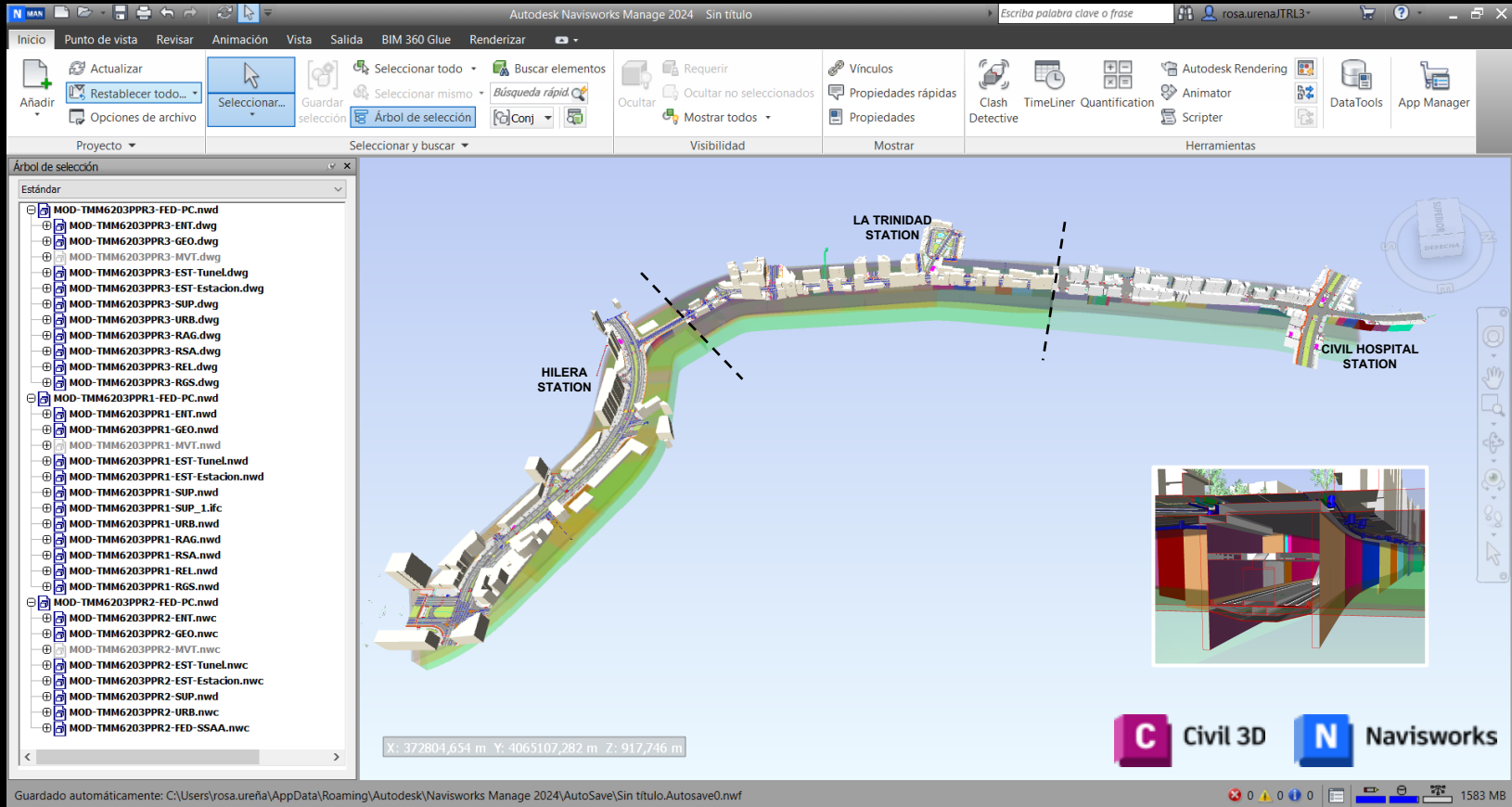
Alternatives for TBM  
(tunnel boring machine)



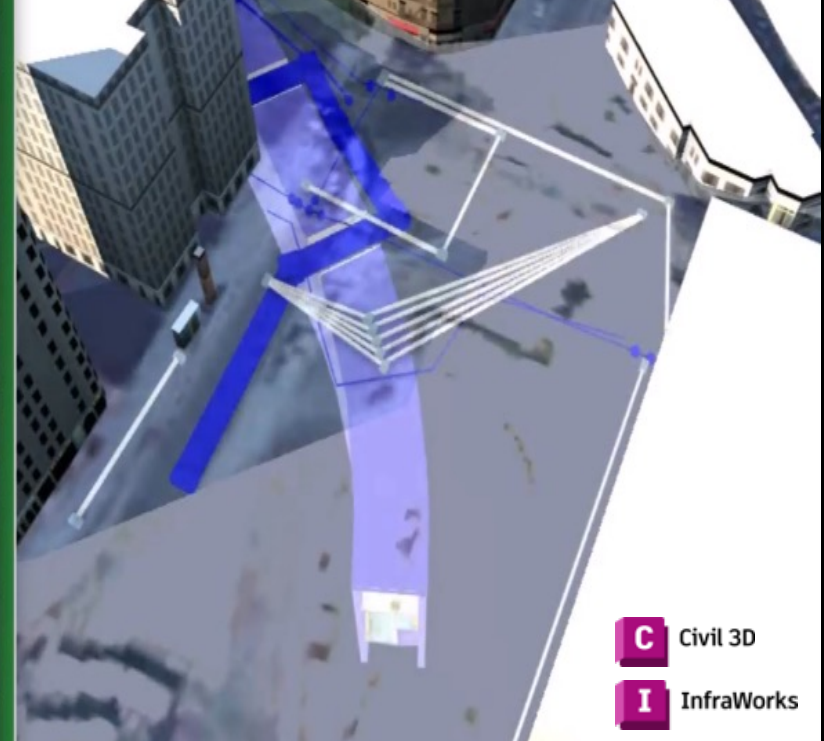
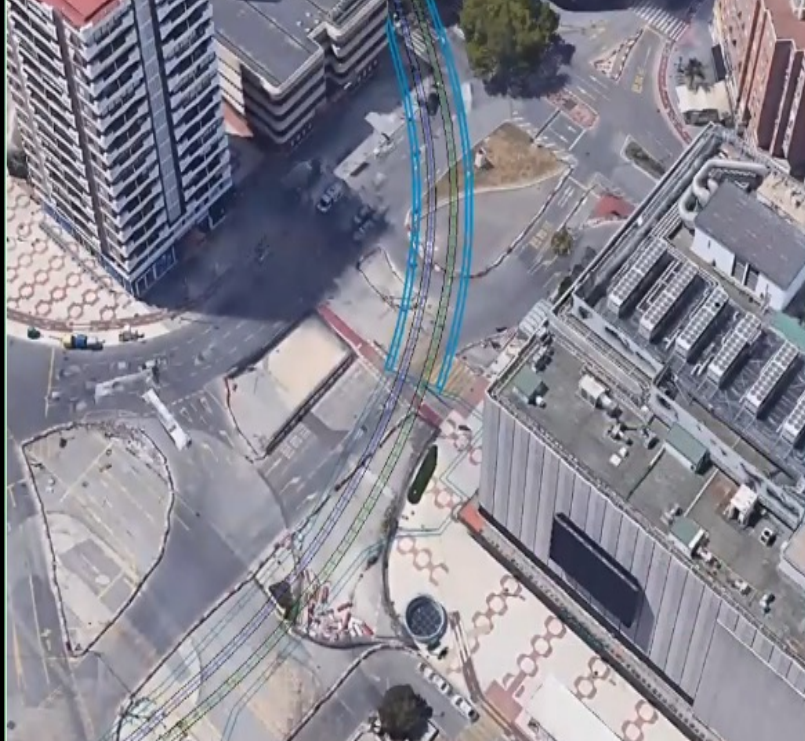
Alternatives for cut and cover  
tunnel with diaphragm walls



# Selected Alternative and BIM Model

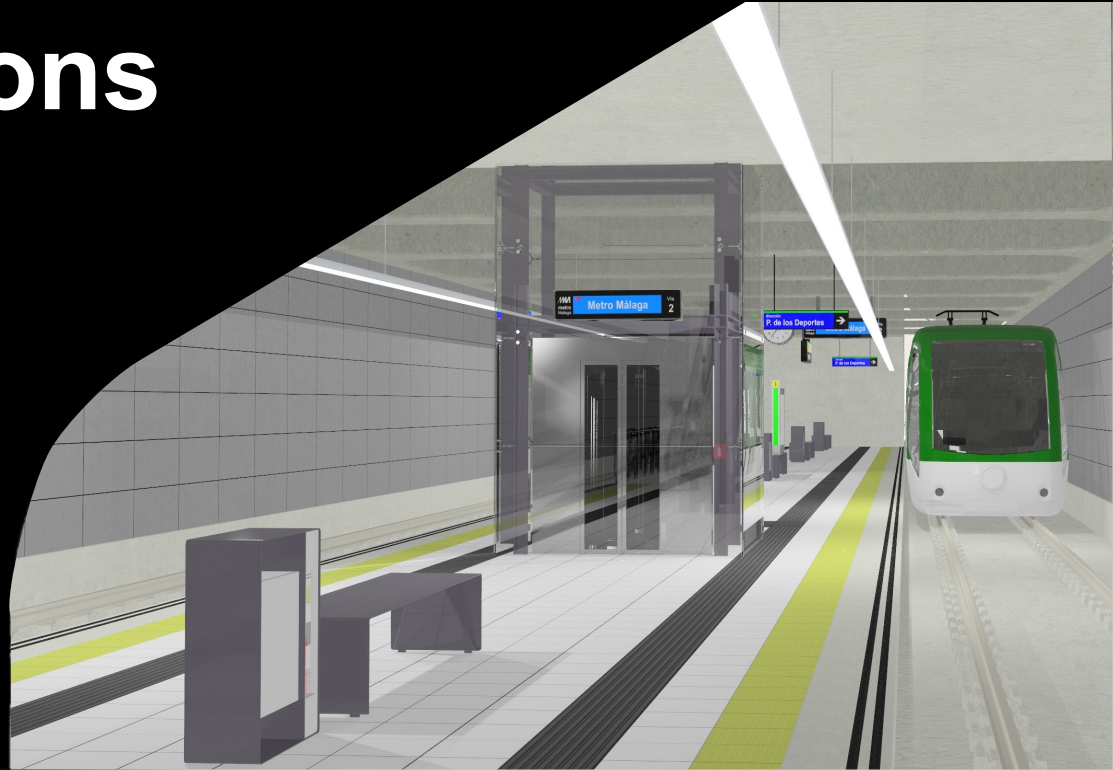


# Selected alternative and BIM Model



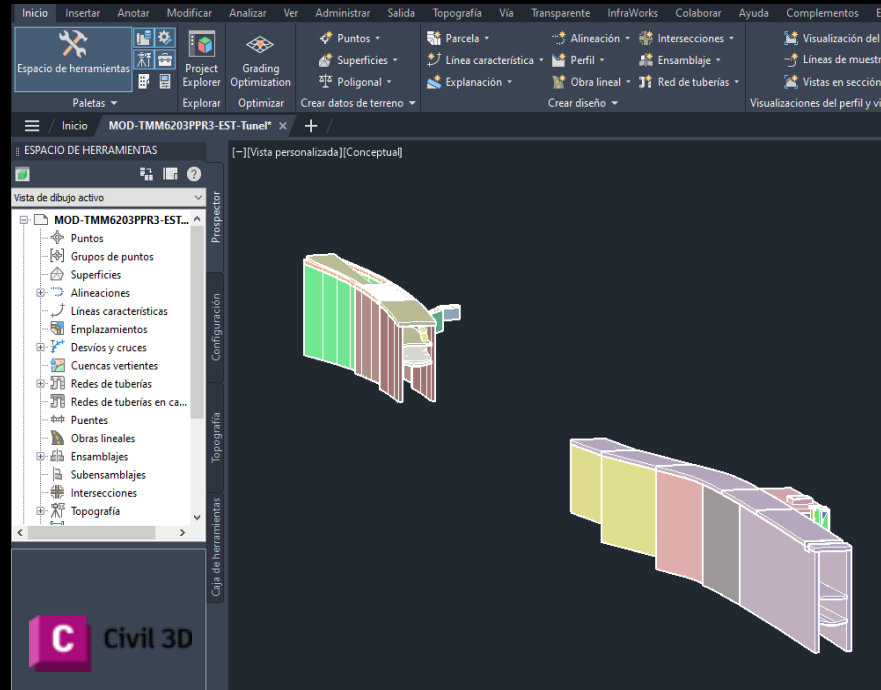


# Challenges & Design Solutions

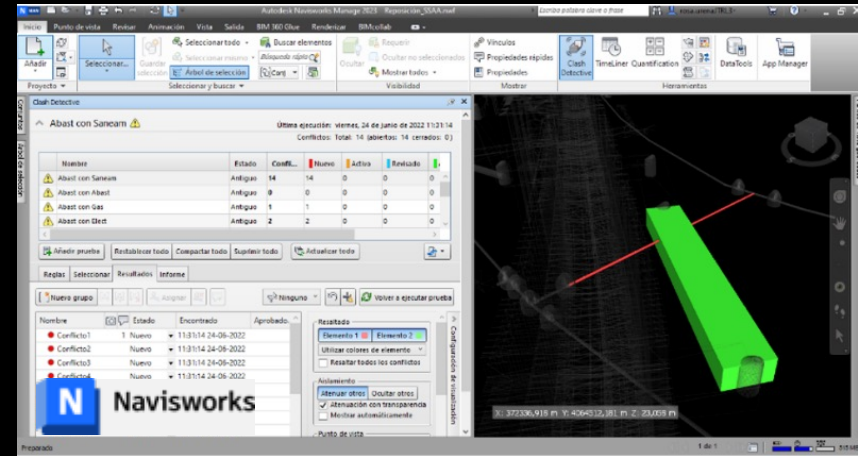


## Challenges in design

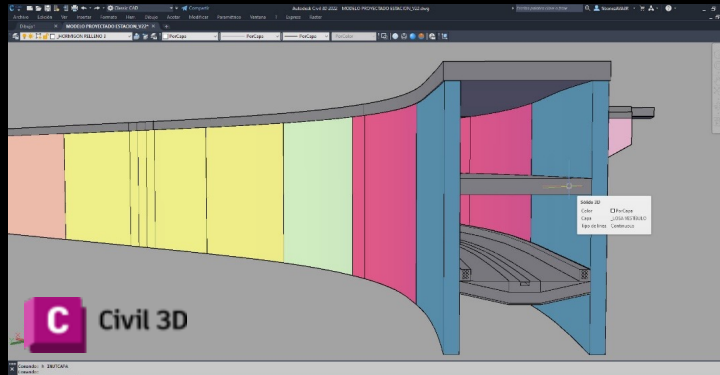
- Designing complex variable sections



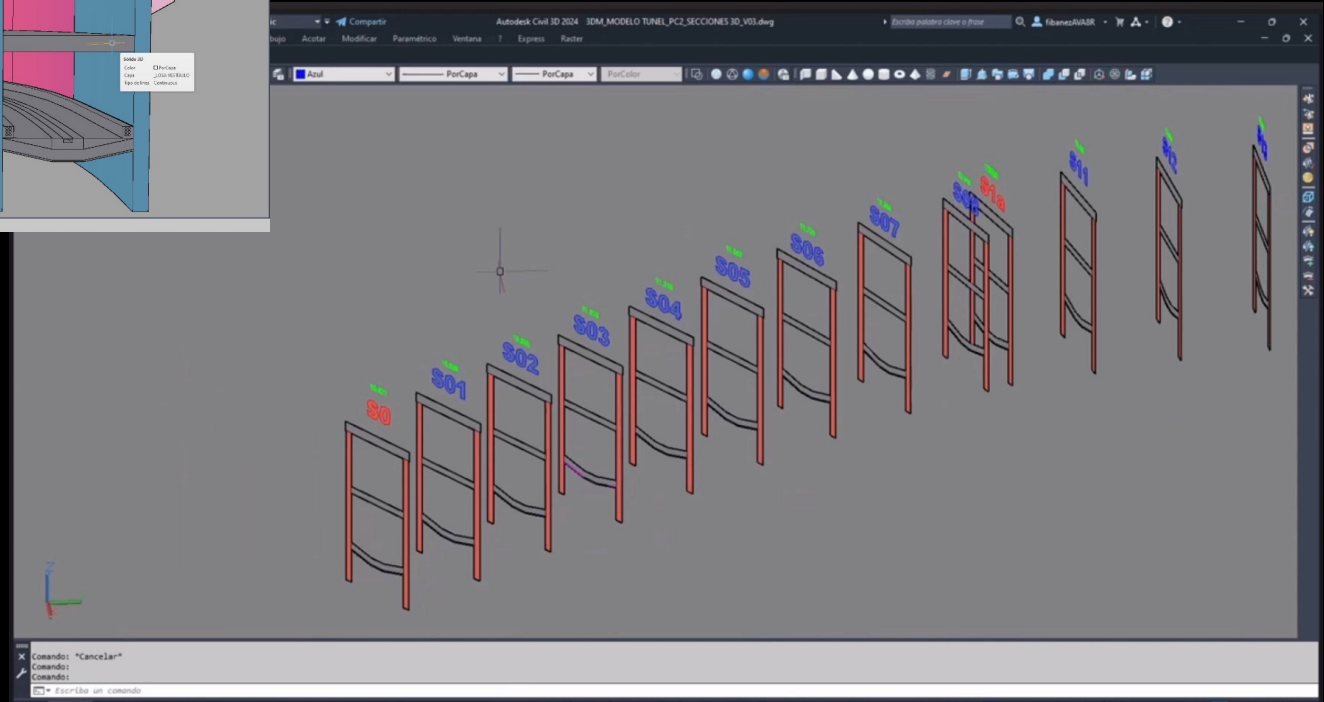
- Parametric design of utilities



# Designing complex variable sections

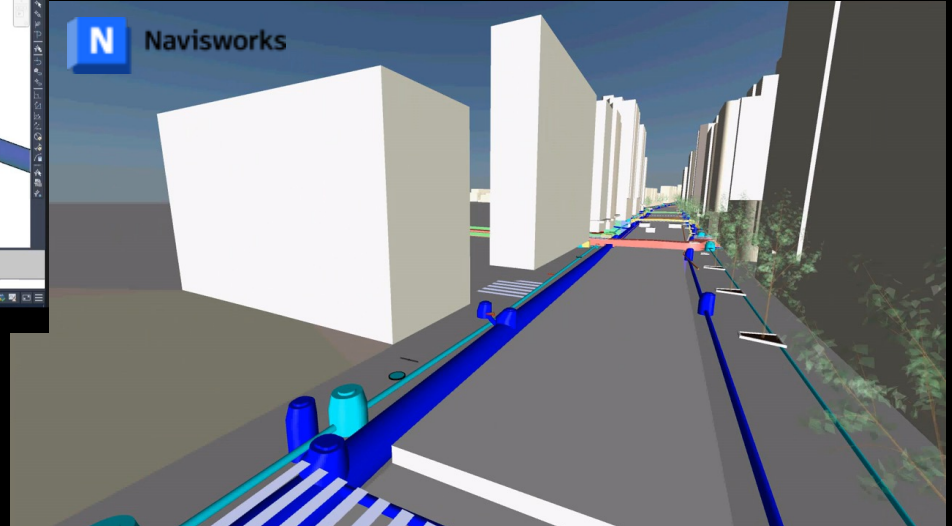
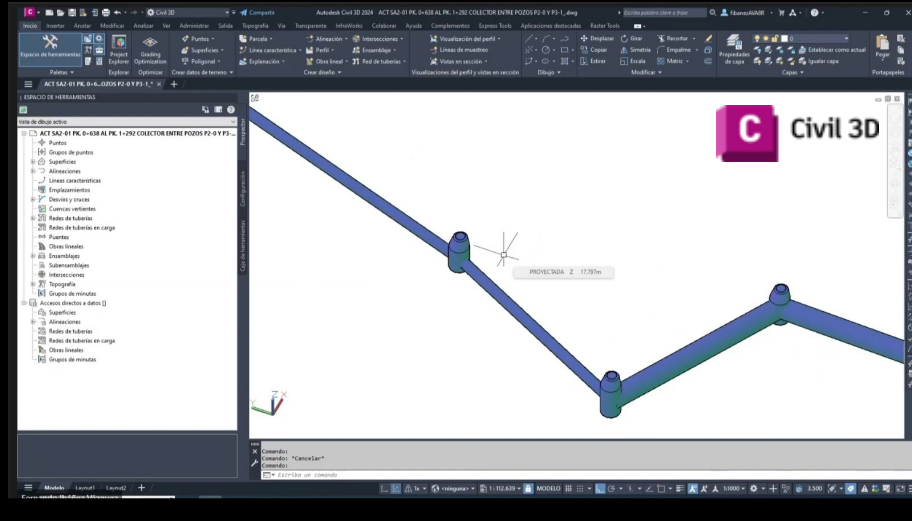


LOFT command



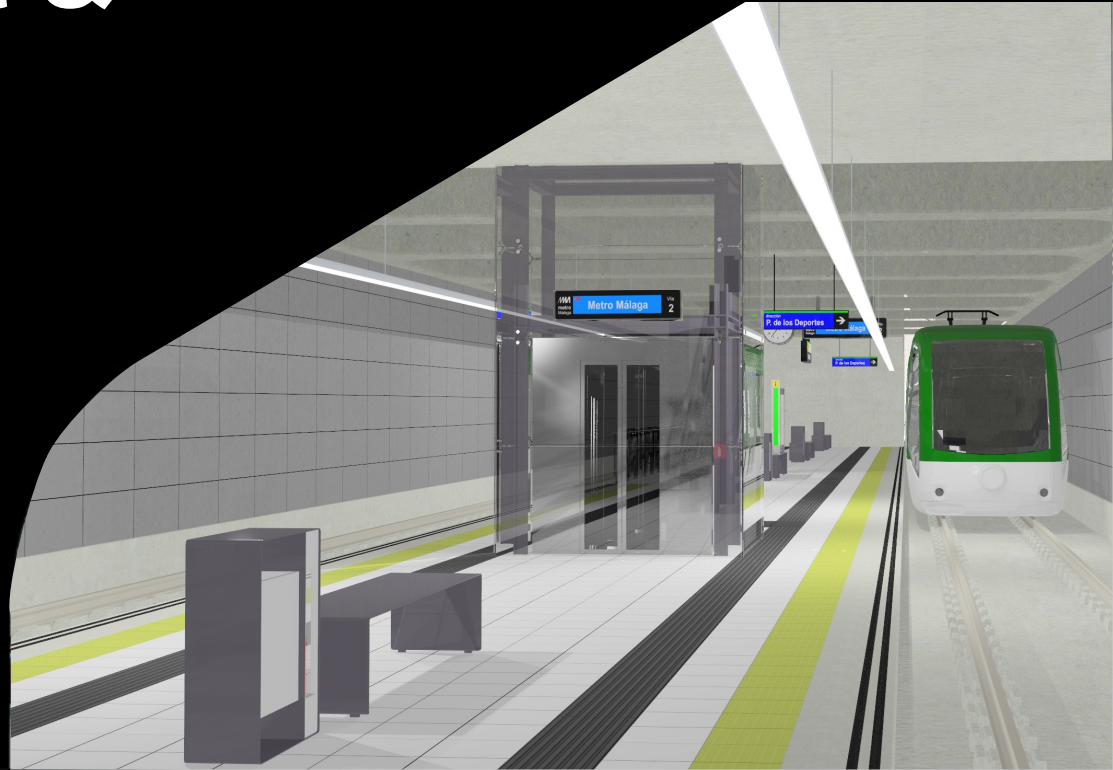


# Parametric design of utilities



PARAMETRIC PIPING MODULE

# IFC 4.3 Export & Data Schema



# Challenges in the IFC



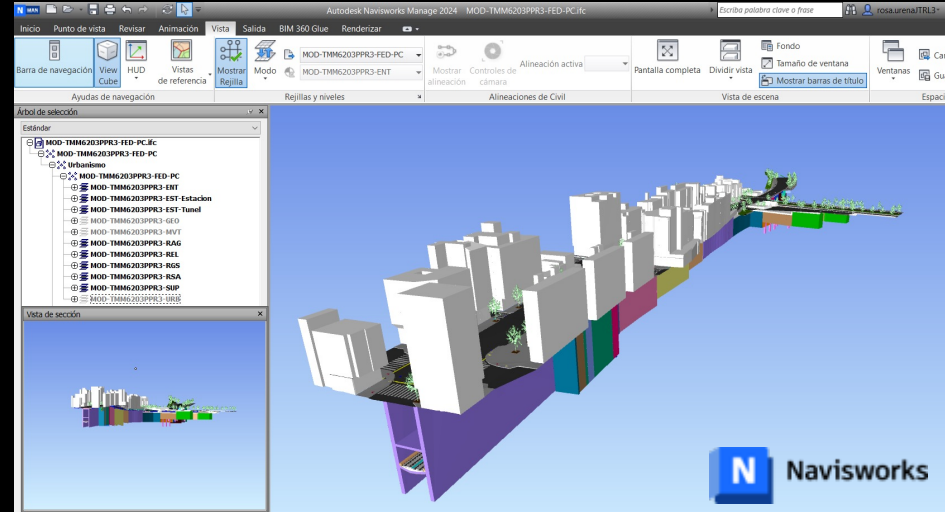
Achieving precise geometry



Creating a well-structured federated model

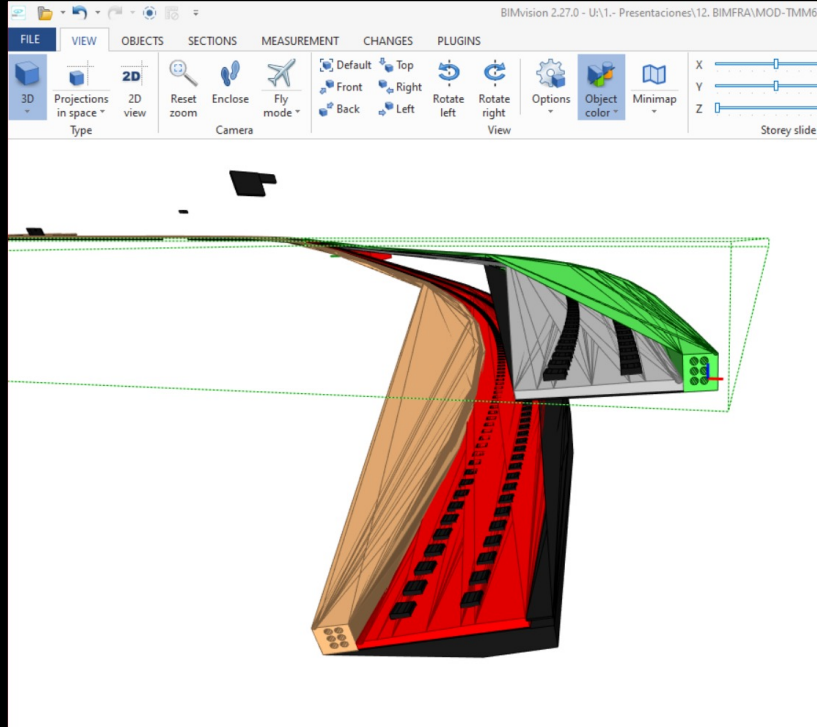


Obtaining a valid classified model in IFC 4.3 format

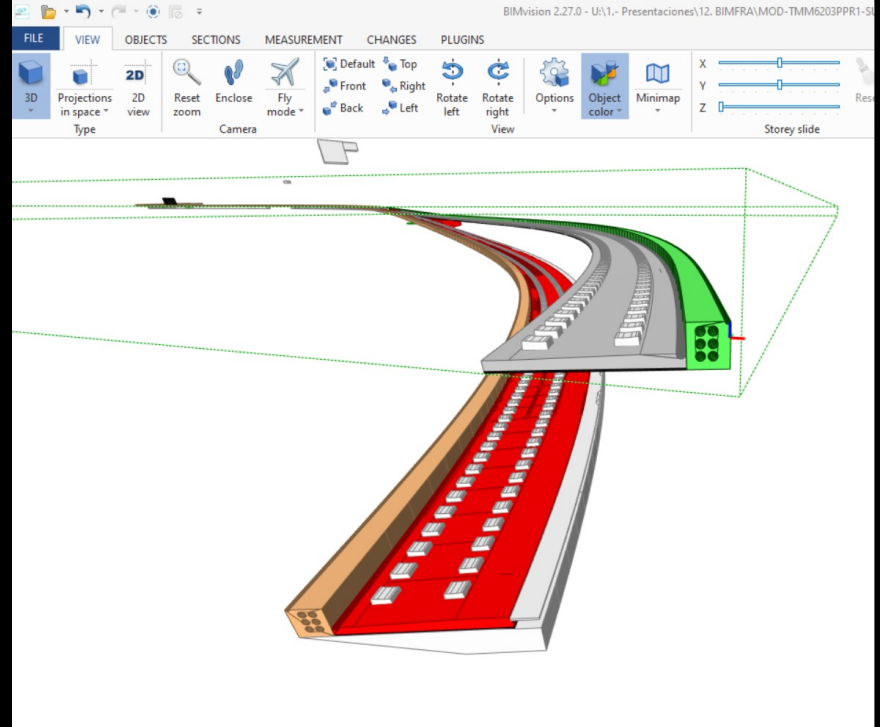




# Achieving precise geometry



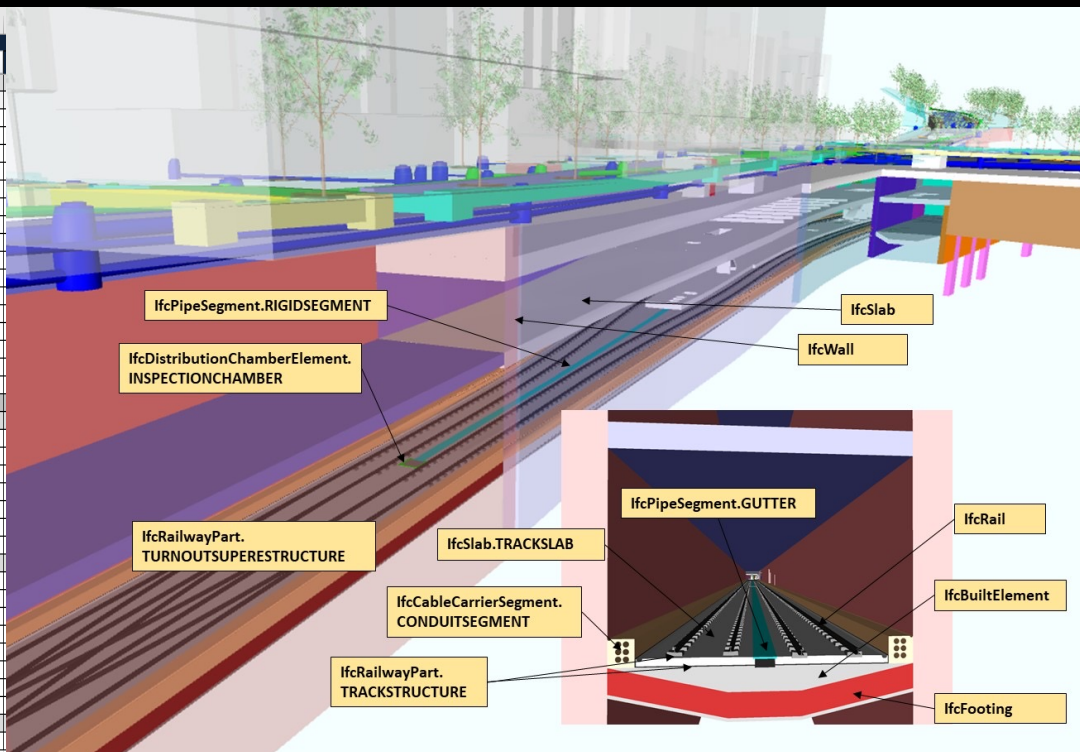
IFC 4.1



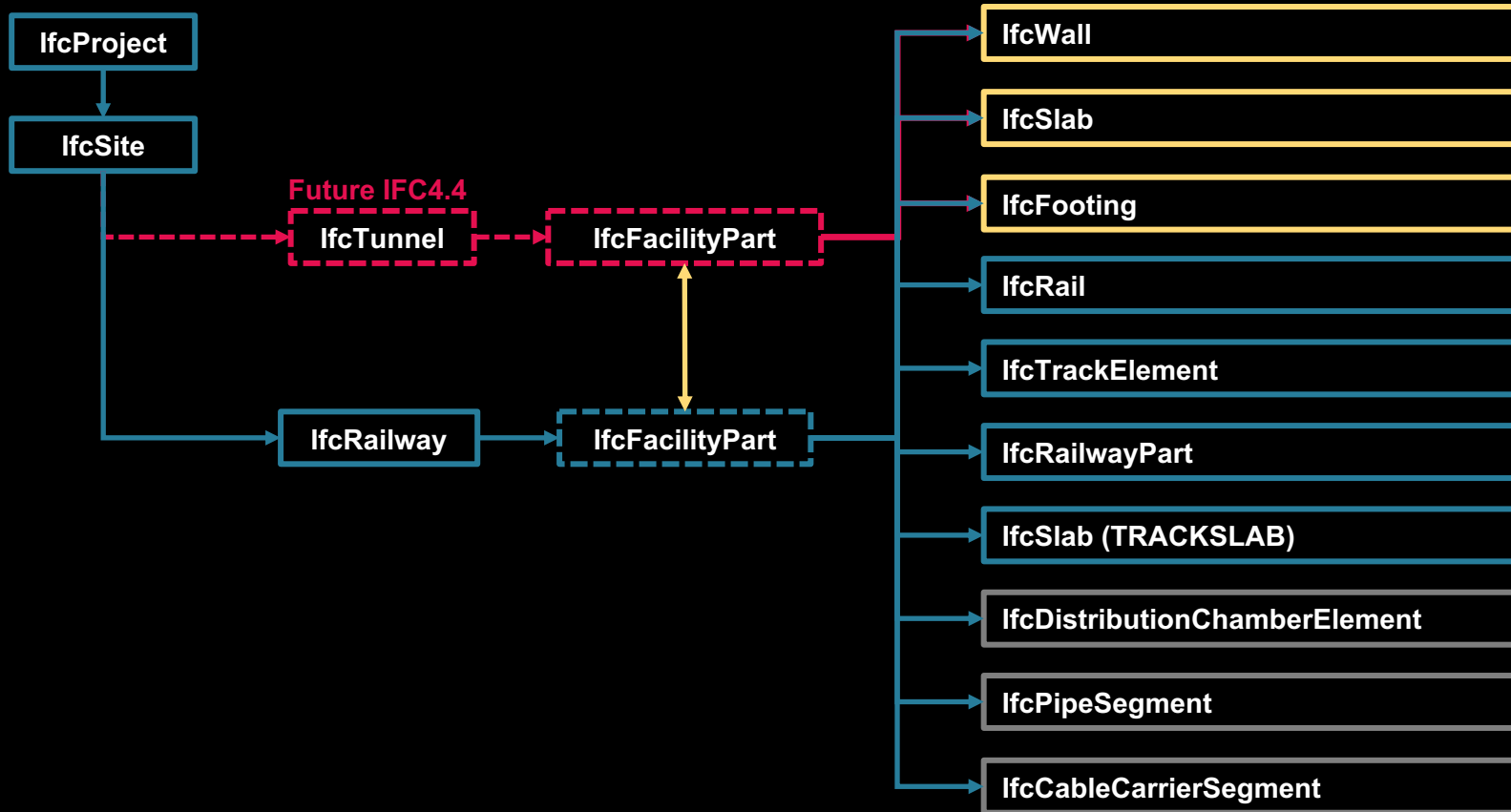
IFC 4.3

# Obtaining a valid classified model in IFC 4.3

Elements	IfcEntity	IfcType	Clasificación Ferroviaria RHM
53 Estructuras de Túnel de Línea/Pozos			
54 TÚNEL DE LÍNEA (PK 1+290 AL PK 1+553,520)			
55 Pantalla tipo 01 (e=100cm) P.K. 1+290 - 1+370	IfcWall		FUNEST.020.010.030
56 Pantalla tipo 02 (e=100cm) P.K. 1+370 - 1+410	IfcWall		FUNEST.020.010.030
57 Pantalla tipo 03 (e=100cm) P.K. 1+410 - 1+460	IfcWall		FUNEST.020.010.030
58 Pantalla tipo 04 (e=100cm) P.K. 1+460 - 1+520	IfcWall		FUNEST.020.010.030
59 Pantalla tipo 05 (e=60cm) P.K. 1+520 - 1+553,52	IfcWall		FUNEST.020.010.030
60 LOSA DE CUBIERTA - P.K. 1+290 - 1+295,57	IfcSlab		FUNEST.020.020.070
61 LOSA DE CUBIERTA - P.K. 1+295,57-P.K. 1+352,21	IfcSlab		FUNEST.020.020.070
62 LOSA DE CUBIERTA - P.K. 1+352,21-P.K. 1+388,67 - pozo	IfcSlab		FUNEST.020.020.070
63 LOSA DE CUBIERTA - P.K. 1+388,67-P.K. 1+460	IfcSlab		FUNEST.020.020.070
64 LOSA DE CUBIERTA - P.K. 1+460 - 1+520	IfcSlab		FUNEST.020.020.070
65 LOSA DE CUBIERTA - P.K. 1+520-1+553,52	IfcSlab		FUNEST.020.020.070
66 LOSA INTERMEDIA	IfcSlab		FUNEST.020.020.070
67 PASO DE SERVICIOS -P.K. 1+295,57-P.K. 1+295,57	IfcSlab		FUNEST.020.020.070
68 CONTRABÓVEDA P.K. 1+290 - 1+520	IfcFooting		FUN.TUN.040.030
69 CONTRABÓVEDA P.K. 1+520 - 1+533,52	IfcFooting		FUN.TUN.040.030
70 HVI-15	IfcBuiltElement		FUNEST.020.020.080
151 Vía, drenaje y comunicación ferroviaria			
152 Superestructura			
153 Camil Vía derecha (camil UIC-54)	IfcRail	RAIL	FUN.VIA.070.010.050
154 Camil Vía izquierda (camil UIC-54)	IfcRail	RAIL	FUN.VIA.070.010.050
155 Aparato Vía/ Etrélele	IfcTrackElement	USERDEFINED	FUN.VIA.070.020.050
156 Hormigón en masa HM-20	IfcRailwayPart	TRACKSTRUCTURE	FUN.VIA.060.010.010
157 Hormigón HA-25F (placa de vía)	IfcSlab	TRACKSLAB	FUN.VIA.060.010.020
158 Mantel elastomérico bajo placa de vía, e=30mm	IfcRailwayPart	TRACKSTRUCTURE	FUN.VIA.060.060
159 Suministro de par de bloques tipo EDILON EBS	IfcRailwayPart	TRACKSTRUCTURE	FUN.VIA.060.040.010
160 Drenaje			
161 Arqueta de registro 0.40x0.40	IfcDistributionChamberElement	INSPECTIONCHAMBER	FUNDRE.050.010
162 Arqueta de registro 0.80x0.80	IfcDistributionChamberElement	INSPECTIONCHAMBER	FUNDRE.050.010
163 Arqueta de registro 1.00x1.00	IfcDistributionChamberElement	INSPECTIONCHAMBER	FUNDRE.050.010
164 Colector PVC 160	IfcPipeSegment	RIGIDSEGMENT	FUNDRE.040.010
165 Colector PVC 200	IfcPipeSegment	RIGIDSEGMENT	FUNDRE.040.020
166 Pañilla Tramec en canalita central del túnel	IfcPipeSegment	GUTTER	FUNDRE.030.010
167 Arqueta de impulsión	IfcDistributionChamberElement	INSPECTIONCHAMBER	FUNDRE.050.020
168 Tapa de arqueta	IfcDistributionChamberElement	INSPECTIONCHAMBER	FUNDRE.050.060
169 Comunicación ferroviaria			
170 Canalita comunicaciones lateral 6 tubos 160mm	IfcCableCarrierSegment	CONDUITSEGMENT	FUN.COM.120.030.030



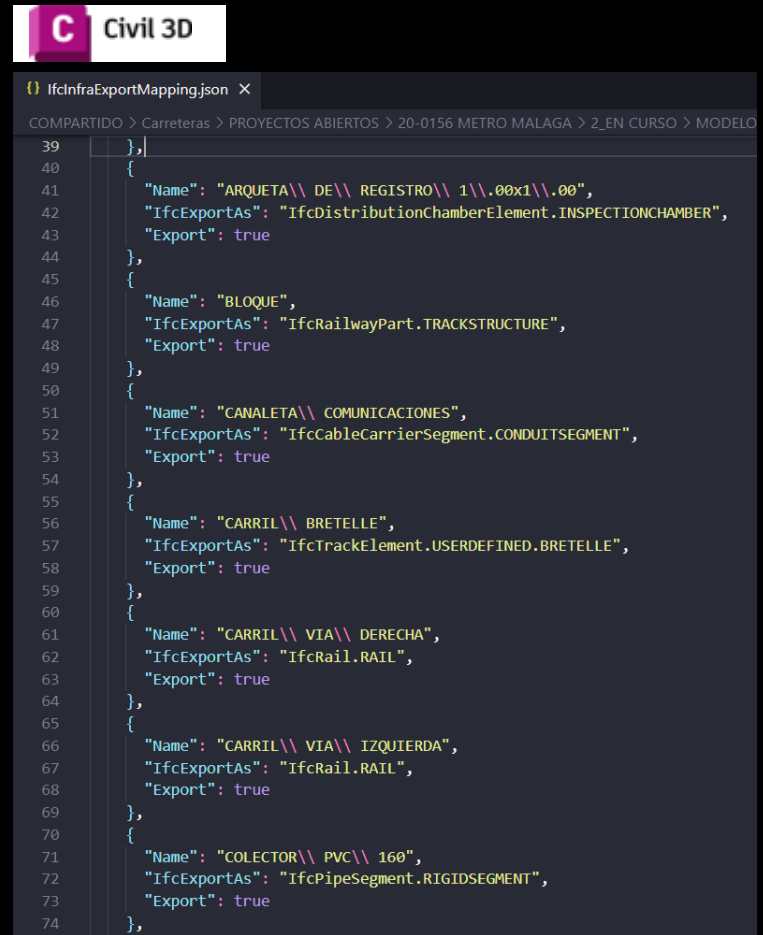
# Obtaining a valid classified model in IFC 4.3





# Obtaining a valid classified model in IFC 4.3

- Create **IfcInfraConfiguration.json** and **IfcInfraExportMapping.json** files
- **Set up the attributes** at **IfcInfraConfiguration.json** file
- **Map Civil 3D Elements to IFC Entities** at **IfcInfraExportMapping.json** file
- **Export to IFC 4.3**



```
{
  "Name": "ARQUETA\\ DE\\ REGISTRO\\ 1\\.00x1\\.00",
  "IfcExportAs": "IfcDistributionChamberElement.INSPECTIONCHAMBER",
  "Export": true
},
{
  "Name": "BLOQUE",
  "IfcExportAs": "IfcRailwayPart.TRACKSTRUCTURE",
  "Export": true
},
{
  "Name": "CANALETA\\ COMUNICACIONES",
  "IfcExportAs": "IfcCableCarrierSegment.CONDUITSEGMENT",
  "Export": true
},
{
  "Name": "CARRIL\\ BRETELLE",
  "IfcExportAs": "IfcTrackElement.USERDEFINED.BRETELLE",
  "Export": true
},
{
  "Name": "CARRIL\\ VIA\\ DERECHA",
  "IfcExportAs": "IfcRail.RAIL",
  "Export": true
},
{
  "Name": "CARRIL\\ VIA\\ IZQUIERDA",
  "IfcExportAs": "IfcRail.RAIL",
  "Export": true
},
{
  "Name": "COLECTOR\\ PVC\\ 160",
  "IfcExportAs": "IfcPipeSegment.RIGIDSEGMENT",
  "Export": true
},
}
```

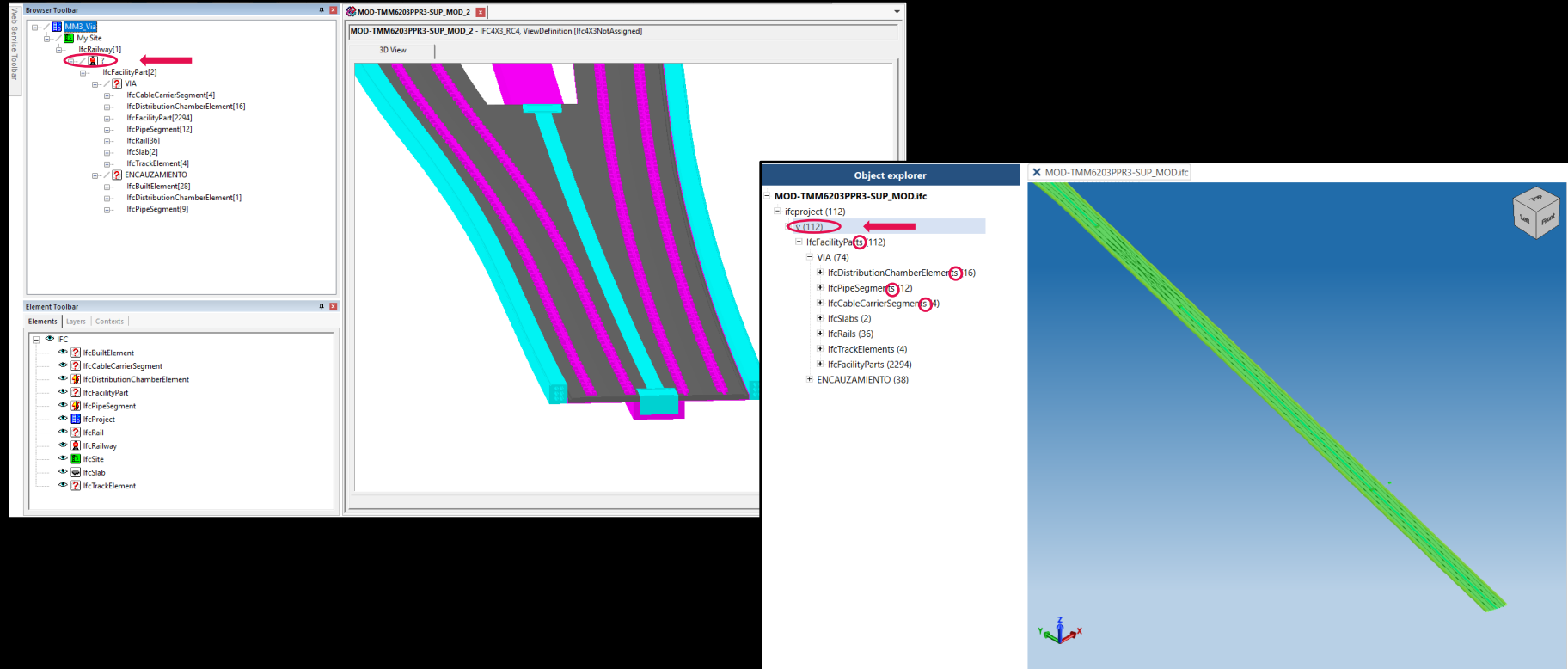
**Herramientas**

<b>GENERAL</b>	<b>VISTA</b>	<b>PORTAPAPELES</b>	<b>PROPIEDAD</b>	<b>#TagBIM</b>	<b>CLASIFICACIONES</b>	<b>HERRAMIENTAS</b>	<b>GESTIÓN MODELOS IFC</b>
<b>Seleccionar</b> Medidor Estilo Vista Aspecto Visibilidad	Copiar Seleccionar Seleccionar Seleccionar Analizar Expandir todo Reducir todo	Esplodi elemento Orizzontale Verticale	Editar IFC Añadir modelo Exportar a IFC				

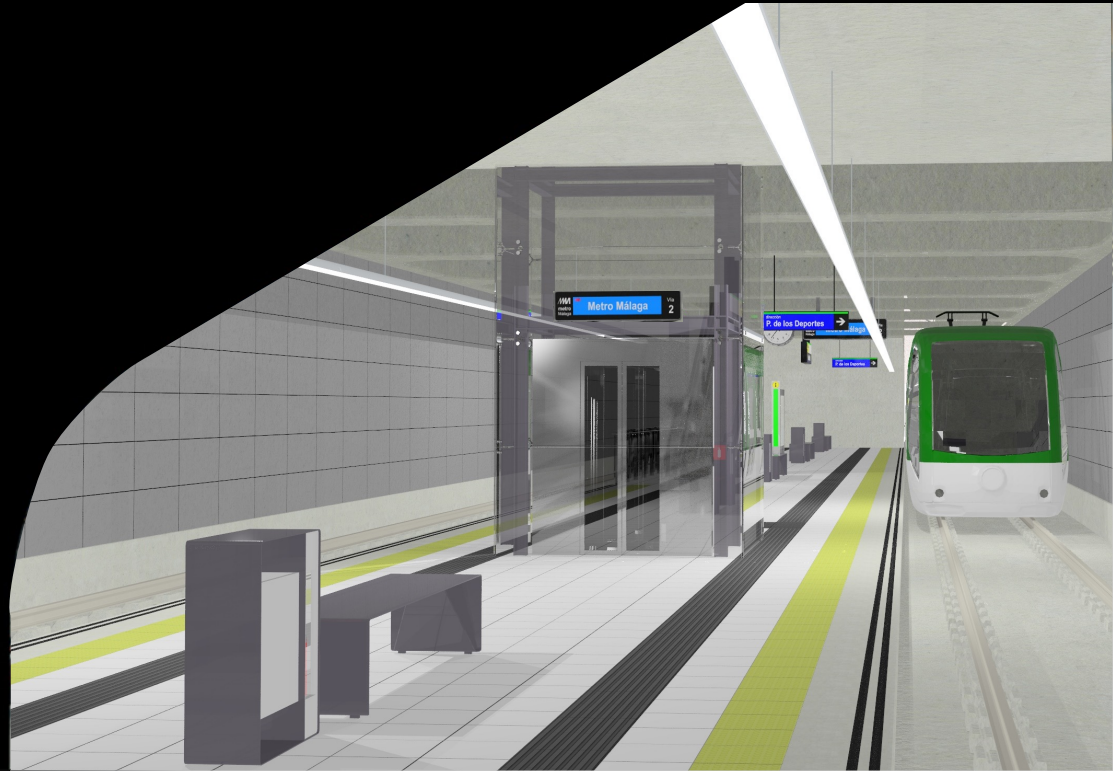
**Entidad**

- MOD-TMM6203PPR3-SUP\_MOD\_2.ifc
  - MM3\_Via
    - IfcSite (1)
      - My Site
        - IfcRailway (1)
          - IfcRailway
            - IfcFacilityPart (2)
              - ENCAUZAMIENTO
                - IfcDistributionChamberElement (1)
                - IfcPipeSegment (9)
                - VIA
                  - IfcFacilityPart (2294)
                  - IfcCableCarrierSegment (4)
                  - IfcDistributionChamberElement (16)
                  - IfcPipeSegment (12)
                  - IfcRail (36)
                  - IfcSlab (2)
                  - IfcTrackElement (4)

# Obtaining a valid classified model in IFC 4.3



# Closing remarks







# Closing remarks

- Successfully tackled project challenges by employing **unprecedented design tools**, yielding **positive outcomes** for our team.
- **Enhanced the efficiency** of our design workflow by integrating these new design tools into our processes
- Better understanding of the **IFC data schema structure** and the **existing entities** in which objects from the model can be classified.
- Leveraged the BIM model as a structured **data repository**, facilitating organized data management.
- Employed meticulously **classified data**, enabling seamless information transmission and its use in **future project stages**.

“

"In the world of railways, progress is the outcome of teamwork, innovation, and a shared vision. In this railway event, we have demonstrated that when we join forces and embrace technology, we can build a safer, more efficient, and sustainable future on tracks. The journey is just beginning, and together, we continue to lay down a path to success!"

CHATGPT 😊

”



# New Autodesk online Rail Community

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Let's keep the conversations going!