

# Processus As-Built du City Rail Link: tunnels jumeaux à 40m de profondeur

Loris Tarot & Quentin Villamaux

Coordinateurs BIM sur le projet du CRL à Auckland, NZ  
Link Alliance

# Présentateurs



## Quentin Villamaux

- Coordinateur BIM chargé de la partie des tunnels traditionnels & TBM
- Diplômé de la promo 2020 de l'ESTP Paris en filière Bâtiment, Option BIM
- Originaire de la région niçoise (06), passionné d'escalade et de montagnes.



## Loris Tarot

- Coordinateur BIM chargé de la station d'Aotea
- Diplômé de la promo 2020 de l'ESITC Caen, option Batiment
- Originaire de la Mayenne (53), aime le foot.



# Le projet du City Rail Link d'Auckland

# Quelles entreprises forment la Link Alliance?

## City Rail Link Project Alliance

Alliance Partners:



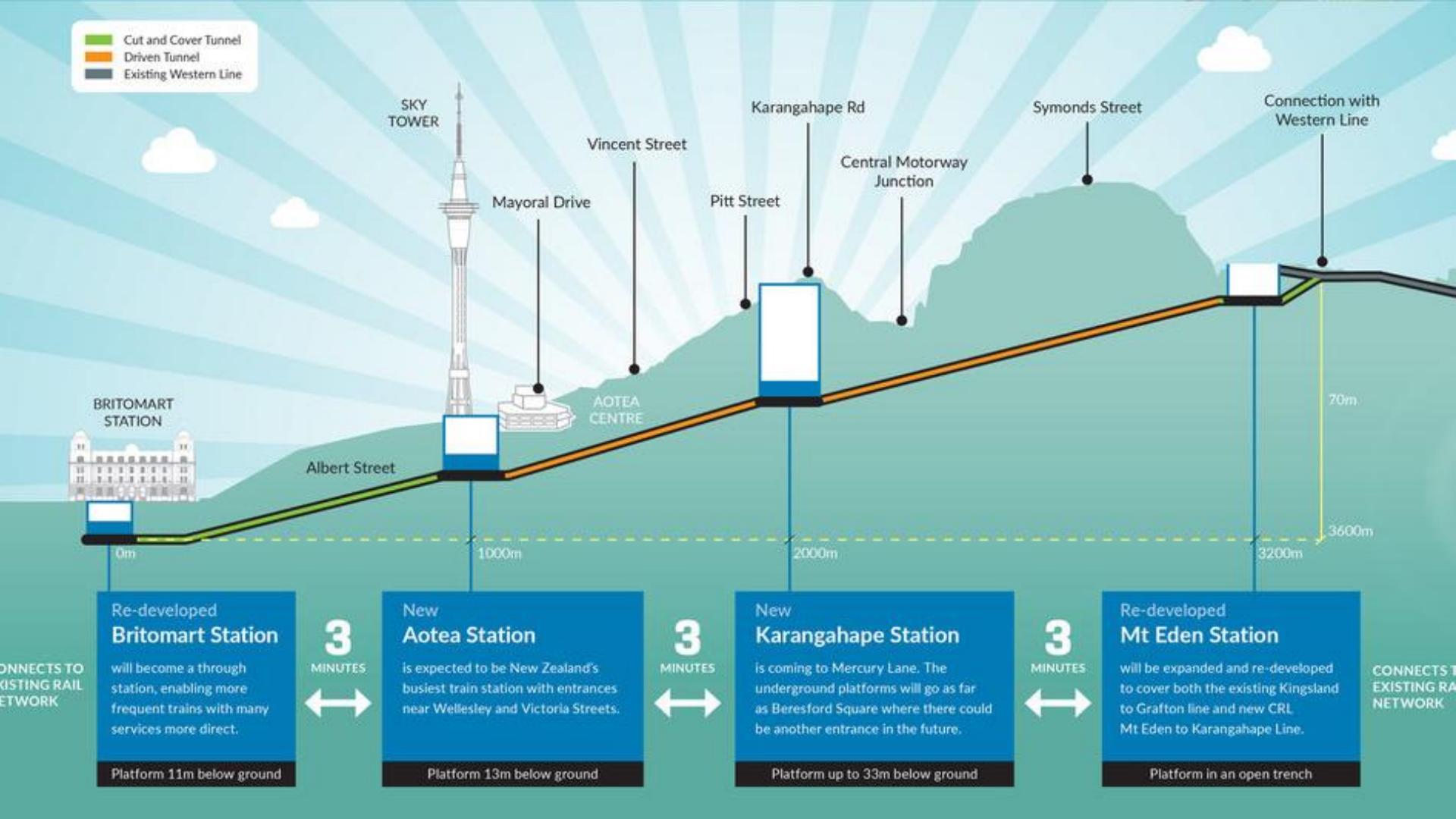
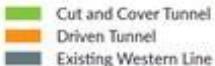
GRANDS PROJETS



Major Stakeholders:

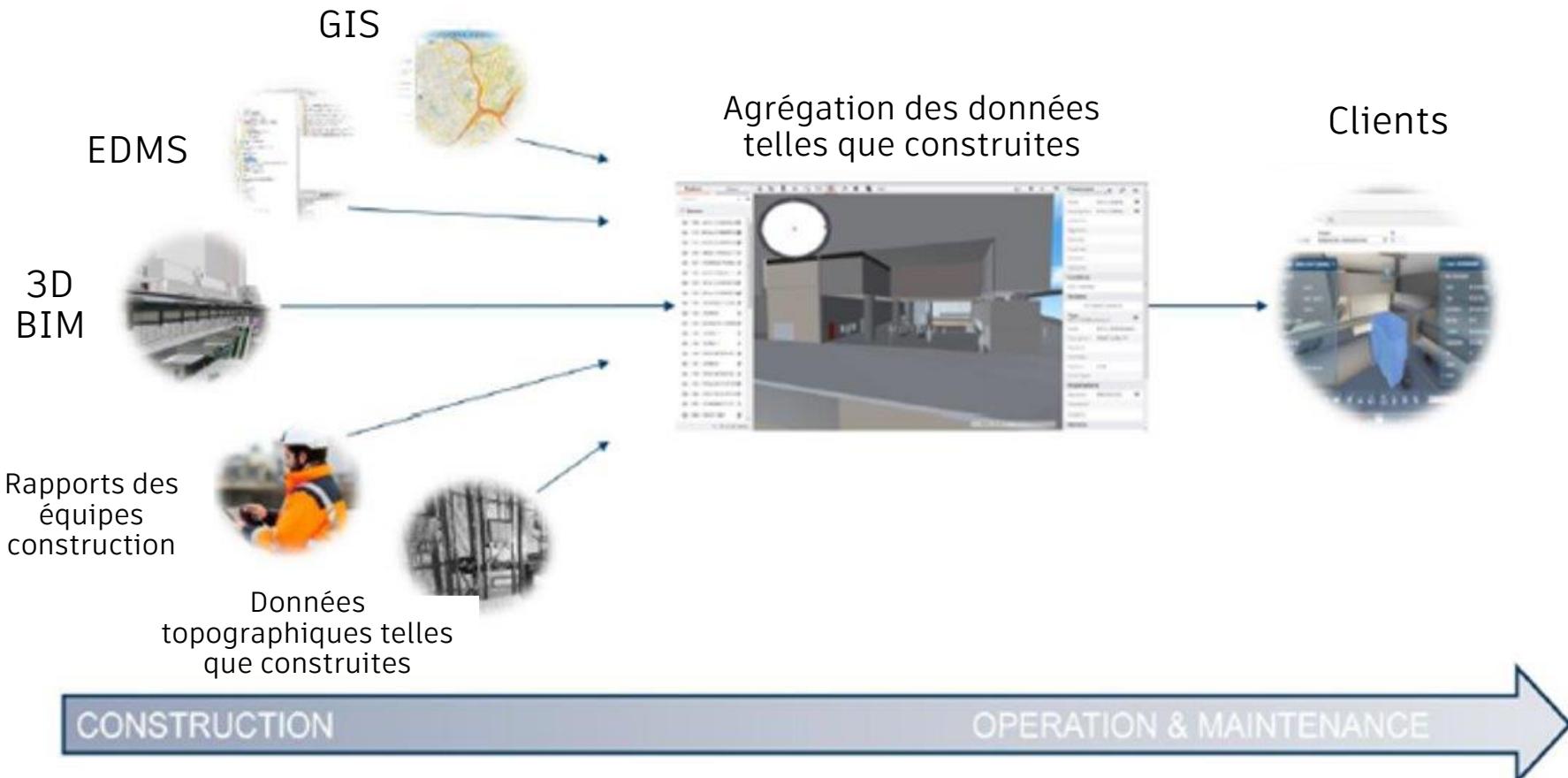






# **Processus de mise à jour As-Built**

# Processus de mise à jour As-Built



# Plans d'inspection et de test (ITP)

Liste des documents relatifs à la gestion de la qualité des ouvrages construits.

Link Alliance	
No:	Inspection / Test Point
X	Section Header
X.1	
X.1.1	What is being tested
<i>NB: Items listed in the ITP are to provide evidence of quality control measures taken during construction.</i>	
1	Material Compliance
1.1	Reinforcement
1.1.1	Material Compliance
1.2	Bolts and Nuts
1.2.1	Material Compliance
1.3	Concrete
1.3.1	Mix Design
1.4	Waterproofing
1.4.1	Material Compliance
1.5	Penetrations
1.5.1	Material Compliance

No:	Inspection / Test Point
X	Section Header
X.1	
2	Construction
2.1	Pre-construction check
2.1.1	IFC drawings
2.1.2	Set out of each pour
2.3	Reinforcement
2.3.1	Reinforcement installation
2.3.2	Reinforcement bar cover
2.3.3	Earthing and Bonding
2.3.4	Formwork installation
2.4	Concrete pour
2.4.1	Blinding Pour
2.4.2	Pre-pour inspection
2.4.3	Construction Joints
2.4.4	Concrete Placement

Rédigés par les conducteurs de travaux et validés par le client.

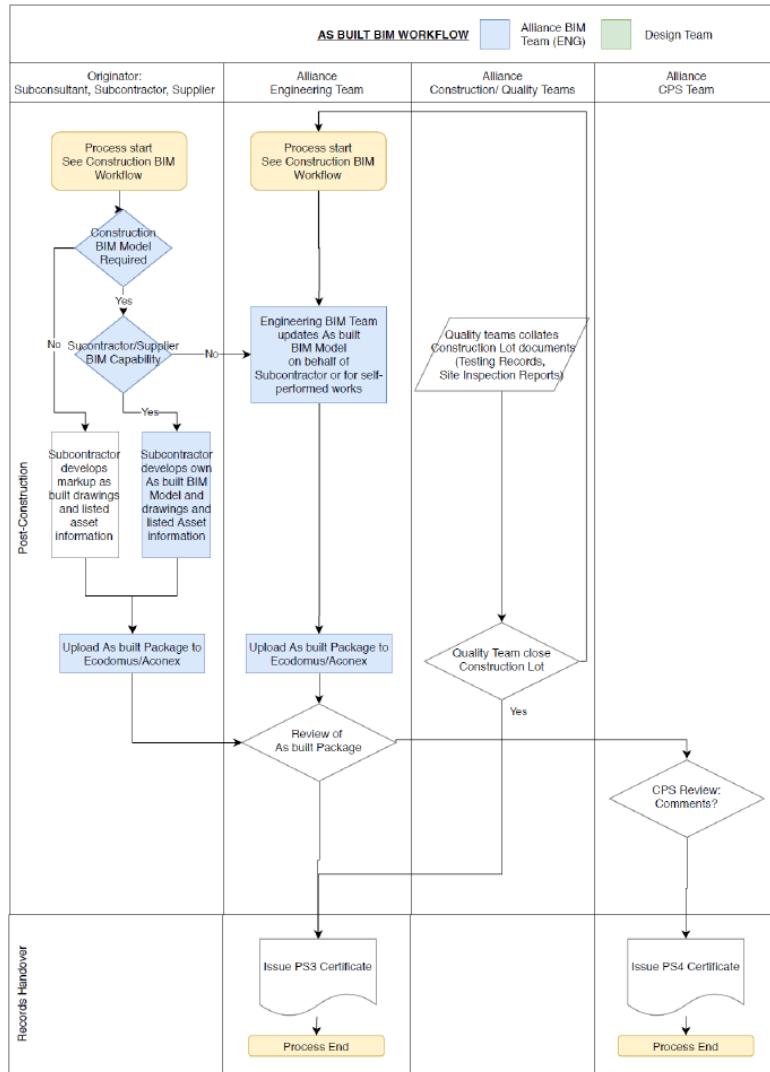
No:	Inspection / Test Point
X	Section Header
X.1	
2.4.3	Construction Joints
2.4.4	Concrete Placement
2.4.5	Temperature Monitoring
2.4.6	Pour
2.4.7	Concrete Curing and Finish
2.5	Waterproofing
2.5.1	Hydrophilic Waterstops - Volclay Waterstop RX101T/ Hydrotite CI-1020
2.5.3	Reinjectable system - Sikafuko Swell-1/ Fosroc Predimax/ GCP Injectokit
2.5.5	MapePlan TU membrane
2.5.6	Membrane protection screed
2.6	Penetration
2.6.1	Waterproofing - Volclay Waterstop RX102/ Hydrotite DSS0220/ SikaSwell P-profile
2.6.2	Pipe Install
3	Post Construction
3.1	As-Built
3.1.1	Survey As-Built

# Workflow As-built

## Modèles As built:

- Structure
- Architecture
- MEP
- VRD
- Systèmes ferroviaires
- Tunnels
- Géotechnique

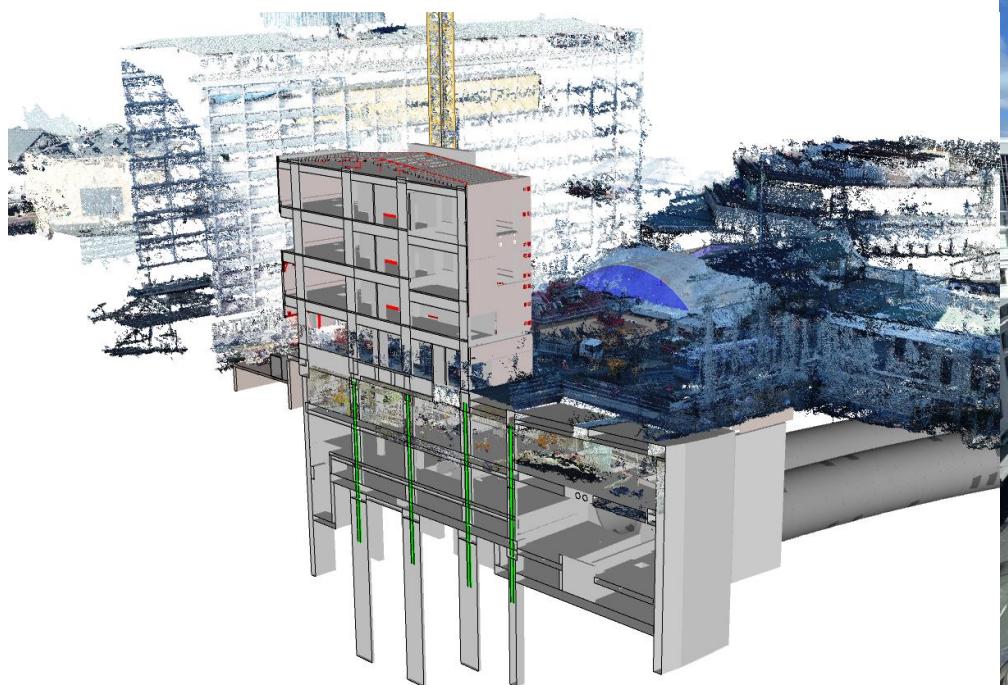
Mise à jour des modèles et plans as built par les sous-traitants s'ils en ont la capacité, sinon par l'équipe BIM de la Link Alliance.



# Études de cas

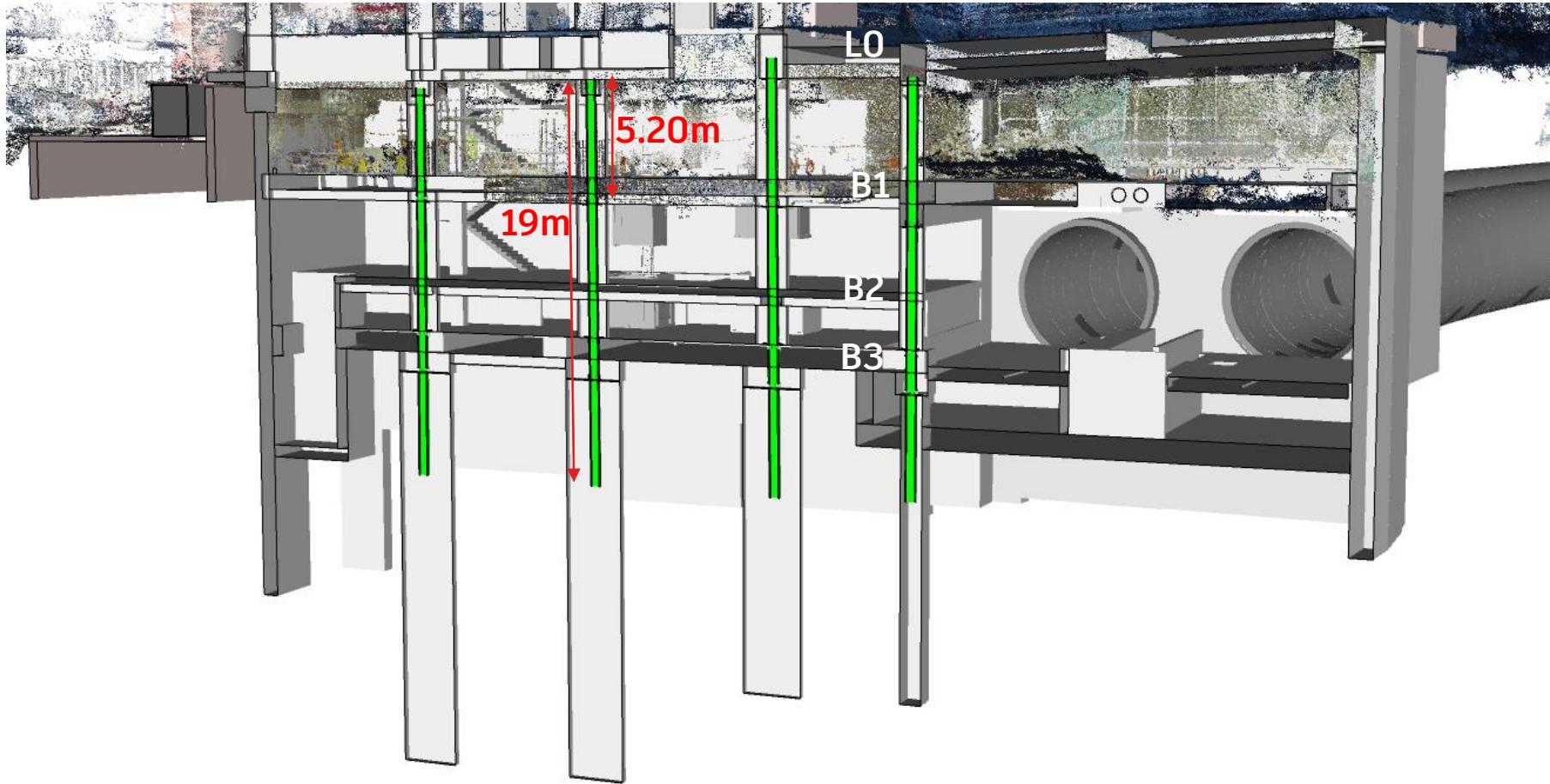
# As-built de la station d'Aotea

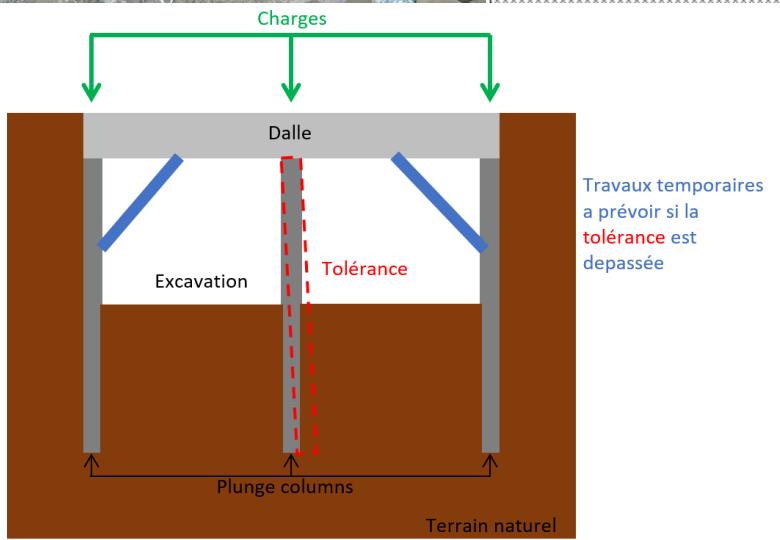
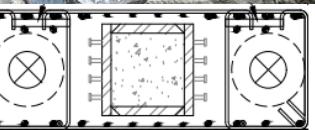
Études de cas des poteaux préfondés



# As-built de la station d'Aotea

Études de cas des poteaux préfondés



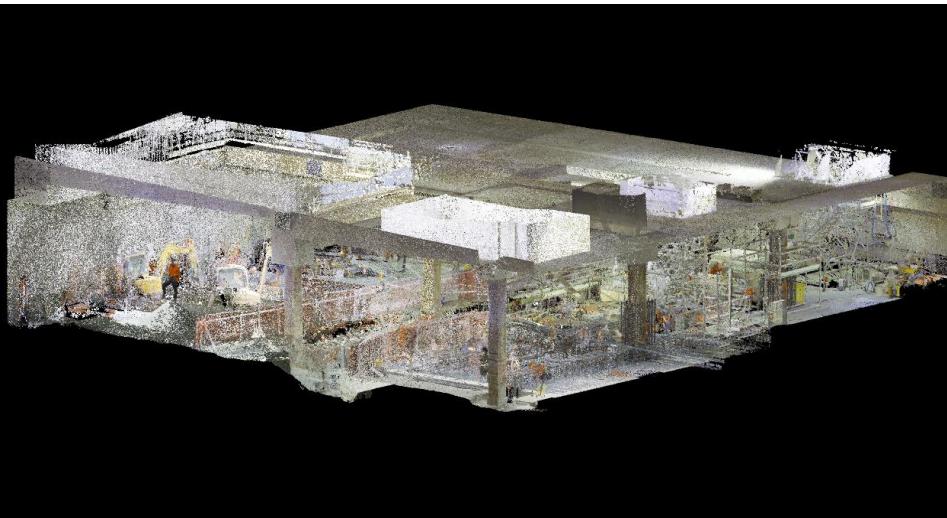


# Mise à jour as-built de la station d'Aotea

Études de cas des poteaux préfondés



Réception et nettoyage du nuage de point via ReCap

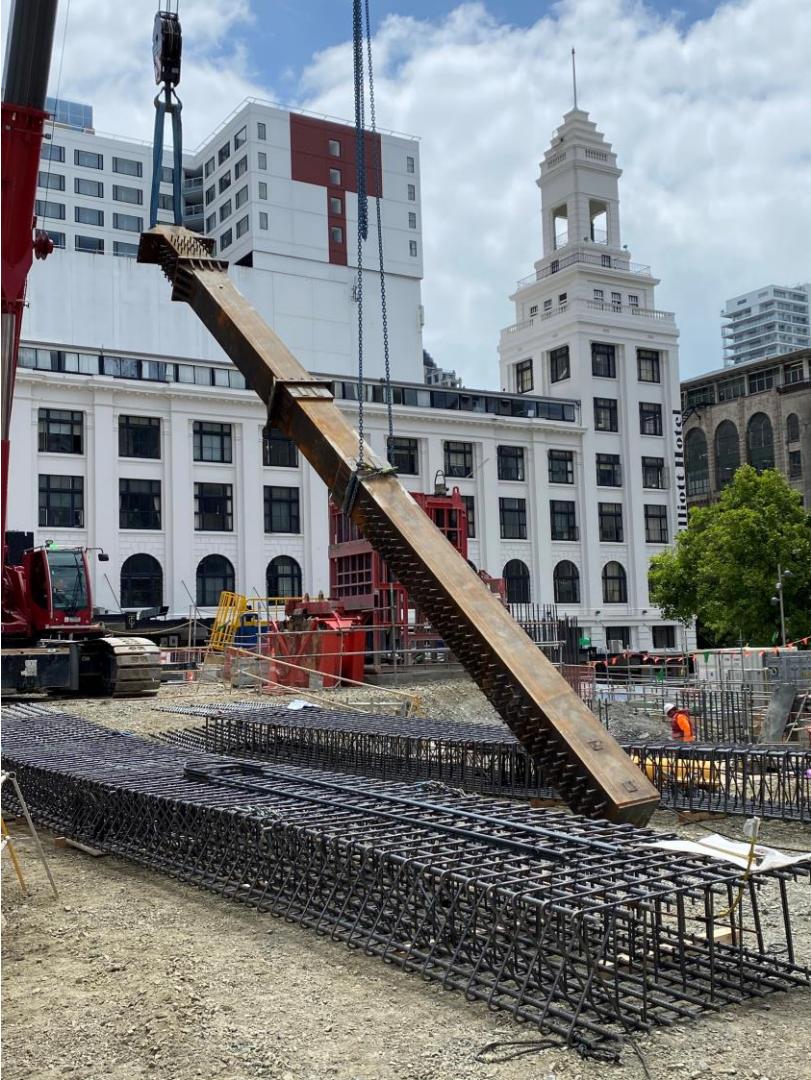


# As-built de la station d'Aotea

Études de cas des poteaux préfondés



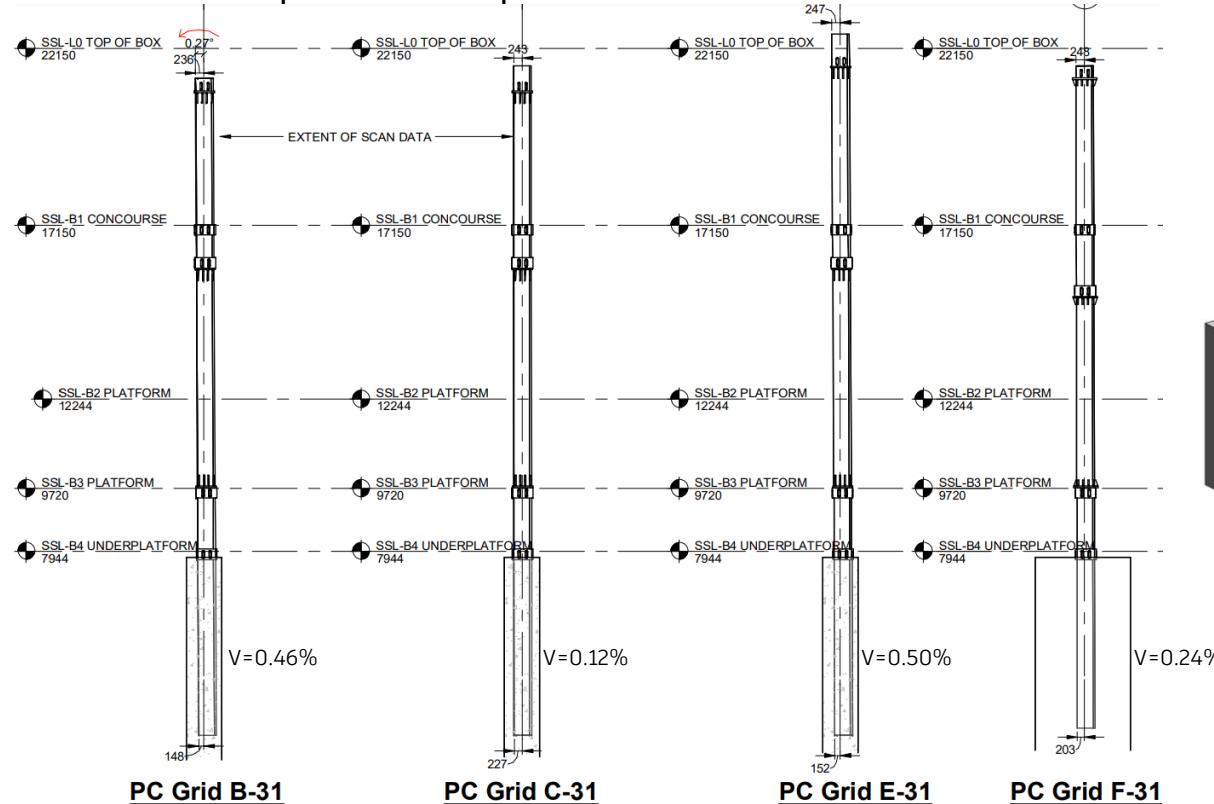
Mise à jour du modèle Revit



# As-built de la station d'Aotea

Études de cas des poteaux préfondés

Production de plans tels que construits



## PLUNGE COLUMNS

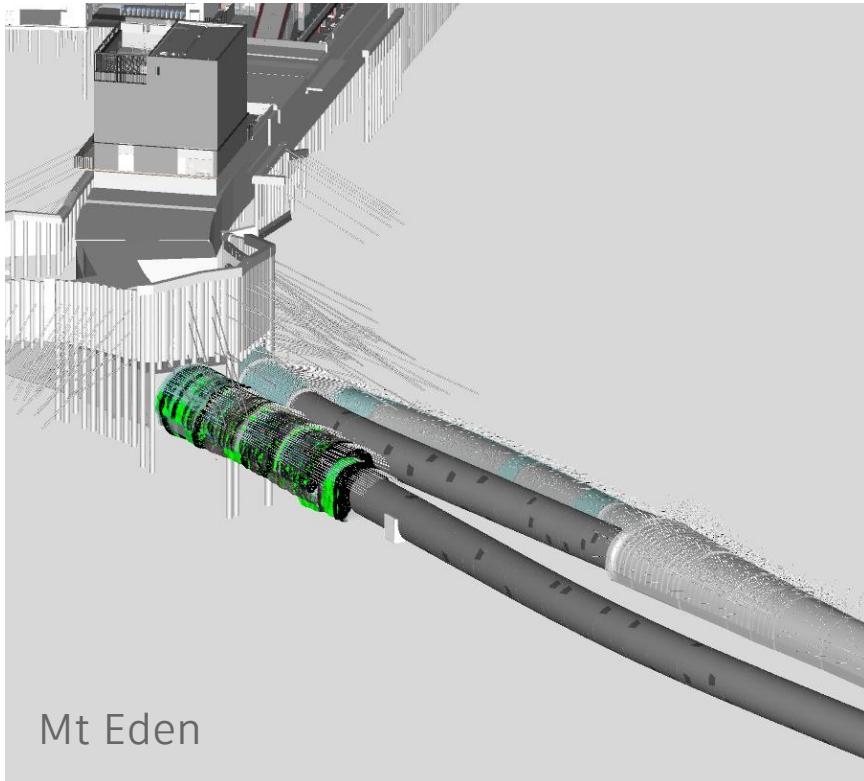
PC01

STEEL PLUNGE COLUMN TOLERANCE:  
VERT. POSITION AT GROUND LEVEL: +/- 25mm  
HORIZ. POSITION AT GROUND LEVEL: +/- 25mm  
VERTICALITY: 1:200  
TWIST (WHEN VIEWED IN PLAN):  $\pm 5.0$  DEGREES

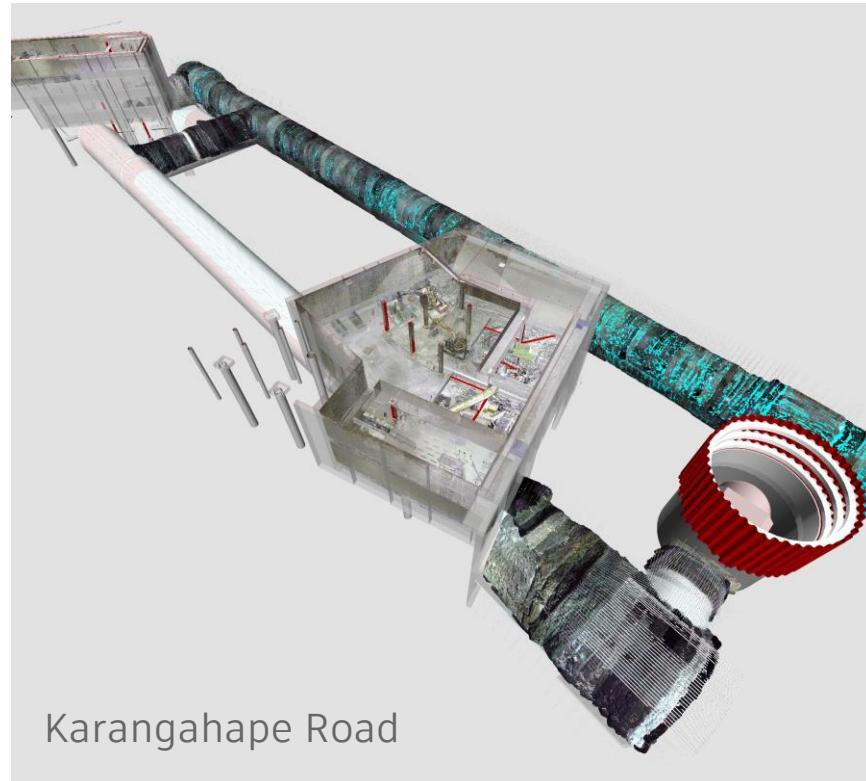


# Mise à jour as-built des Tunnels traditionnels

Études de cas des galeries servant au démarrage du Tunnelier



Mt Eden



Karangahape Road

Images extraites du modèle fédéré des tunnels depuis Navisworks manage

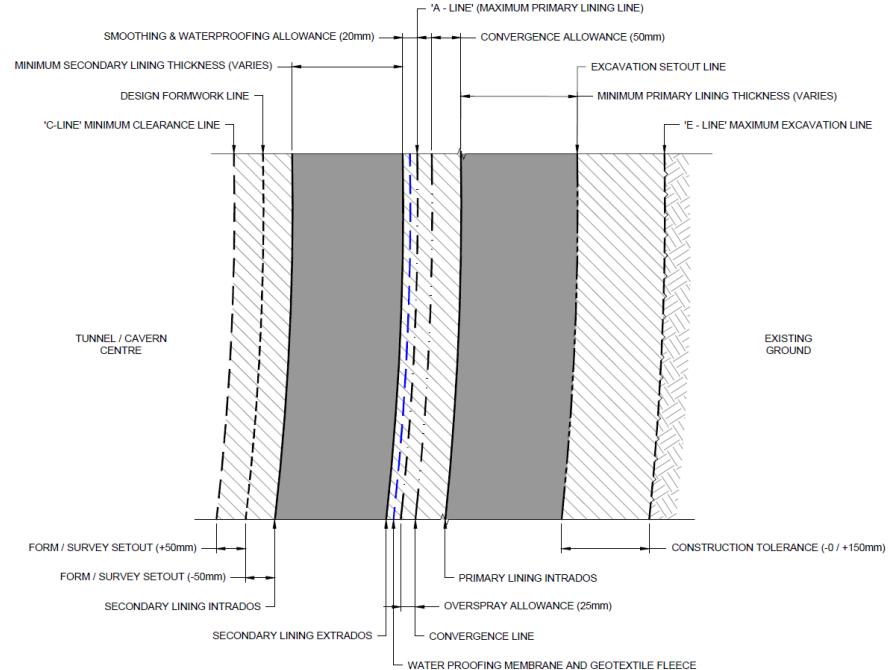
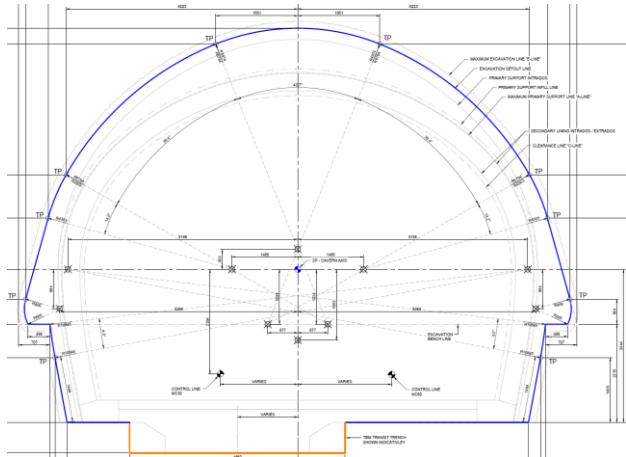
# As-built des Tunnels traditionnels

Quels types de structure?



## Structure en béton

- 1ère ligne: béton projeté pour former la voûte de la galerie
- 2ème ligne: béton coffré pour l'intérieur de la galerie



# **As-built des Tunnels traditionnels**

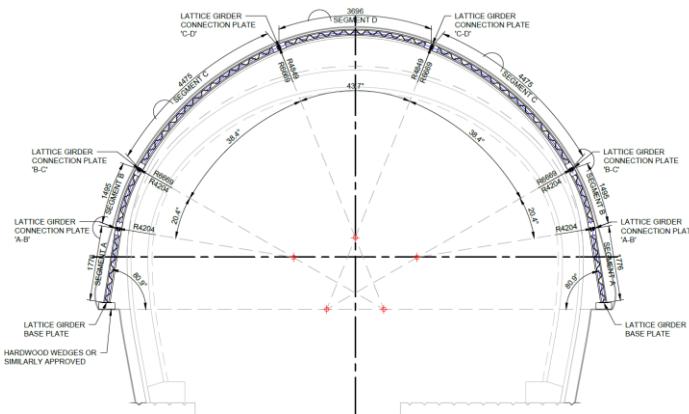
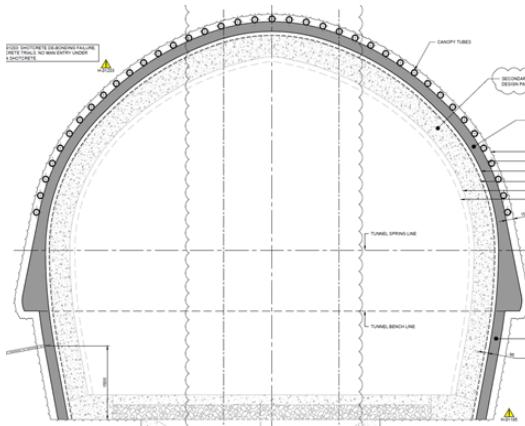
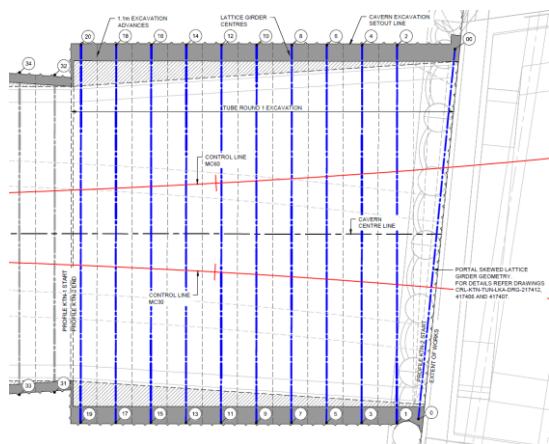


## Quels types de structure?

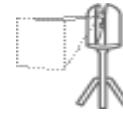
# Structure en acier

## Renforts des voûtes parapluies des galeries

- Tubes d'auvent
  - Ceintres



# As-built des Tunnels traditionnels



Quelles sont les données topographiques exploitables?

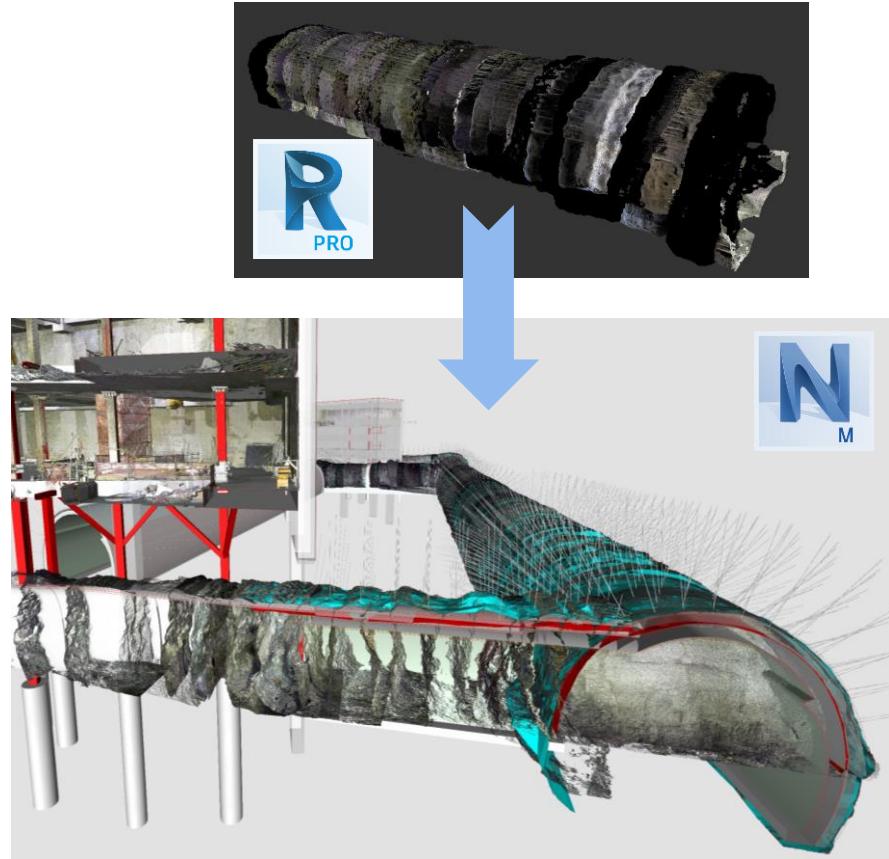
## Structure en béton

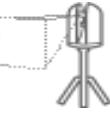
Scans 3D:

- Suivi de l'avancement sur Recap Pro
- Visualisation des interfaces
- Vérification de la conformité des ouvrages construits

Données topos:

- Rapport de points
- MESH pour chaque ligne





# As-built des Tunnels traditionnels

Quelles sont les données topographiques exploitablees?

## Structure en acier

Données topos:

- Rapport de points
- Coordonnées des points en format .CSV

Name
<a href="#">KTN 1-1 Lattice Girder As Built</a>
<a href="#">KTN 1-2 Lattice Girder As Built</a>
<a href="#">KTN 1-3 Lattice Girder As Built</a>
<a href="#">KTN 1-4 Lattice Girder As Built</a>
<a href="#">KTN 1-5 Lattice Girder As Built</a>
<a href="#">KTN 1-6 Lattice Girder As Built</a>
<a href="#">KTN 1-7 Lattice Girder As Built</a>
<a href="#">KTN 1-8 Lattice Girder As Built</a>

**KTN 1-1 Lattice Girder As-Built Report**

**Survey Information**

Survey Name: KTN 1-1  
Survey Date: 05/17/2019  
Surveyor: MCDONALD, SPENCER  
Profile View: SP10W - SP10E  
Lining vs off-shore: Off-shore  
Offset: 0.000  
Scale: 1:100

**Survey Settings**

Radius: 0.000 meters to PC line: 100.000m  
NOTE: To be used in conjunction with the horizontal position of the survey point.

**Cross-sections on alignment**

Horizontal: 0.000 m  
Easting: 200000.000 m  
Northing: 0.000 m  
Vertical offset: 0.000 m  
Tilted offset: 0.000 m

A	B	C	D
201114_1	399641.8	801462.5	60.579 LAT GIRD INTRADOS
201114_2	399642.8	801462.6	62.142 LAT GIRD INTRADOS
201114_3	399642.8	801462.7	63.612 LAT GIRD INTRADOS
201114_4	399641.8	801463.4	65.522 LAT GIRD INTRADOS
201114_5	399639.4	801464.1	66.622 LAT GIRD INTRADOS
201114_6	399637.7	801465	67.716 LAT GIRD INTRADOS
201114_7	399635.9	801465.7	66.726 LAT GIRD INTRADOS
201114_8	399634.4	801466.4	65.793 LAT GIRD INTRADOS
201114_9	399633.3	801466.9	64.189 LAT GIRD INTRADOS
201114_10	399632.4	801467.1	62.351 LAT GIRD INTRADOS
201114_11	399632.1	801467.1	60.793 LAT GIRD INTRADOS
201118_1	399643.5	801465	60.64 LAT GIRD INTRADOS
201118_2	399643.3	801464.9	62.317 LAT GIRD INTRADOS
201118_3	399642.8	801464.9	63.729 LAT GIRD INTRADOS
201118_4	399641.5	801465.2	65.493 LAT GIRD INTRADOS
201118_5	399639.7	801465.8	66.698 LAT GIRD INTRADOS
201118_6	399638	801466.4	67.083 LAT GIRD INTRADOS
201118_7	399636.4	801467	66.74 LAT GIRD INTRADOS
201118_8	399634.6	801467.5	65.572 LAT GIRD INTRADOS
201118_9	399633.3	801468	63.849 LAT GIRD INTRADOS
201118_10	399632.9	801468.2	62.449 LAT GIRD INTRADOS
201118_11	399632.9	801468.4	60.735 LAT GIRD INTRADOS
201119_1	399643.8	801465.4	60.704 LAT GIRD INTRADOS
201119_2	399643.6	801465.5	62.424 LAT GIRD INTRADOS
201119_3	399643.1	801465.7	63.821 LAT GIRD INTRADOS
201119_4	399641.6	801465.3	65.732 LAT GIRD INTRADOS
201119_5	399640	801466.8	66.712 LAT GIRD INTRADOS
201119_6	399638.4	801467.4	67.035 LAT GIRD INTRADOS
201119_7	399636.6	801467.9	66.66 LAT GIRD INTRADOS
201119_8	399634.7	801468.5	65.373 LAT GIRD INTRADOS
201119_9	399633.5	801468.8	63.786 LAT GIRD INTRADOS
201119_10	399633	801468.9	62.394 LAT GIRD INTRADOS
201119_11	399632.7	801469	60.684 LAT GIRD INTRADOS
201120_1	399644.3	801466.4	60.718 GIRDER BOTTOM
201120_2	399643.9	801466.5	62.44 GIRDER BOTTOM
201120_3	399643.4	801466.7	63.807 GIRDER BOTTOM

A	B	C	D
1	399646	801475.1	60.375
2	399645.8	801475.2	61.935
3	399645.4	801475.4	63.363
4	399644.8	801475.6	64.302
5	399643.6	801476	65.341
6	399641.5	801476.8	66.129
7	399639.4	801477.5	65.494
8	399638.1	801477.9	64.39
9	399637.5	801478	63.576
10	399637	801478.1	62.027
11	399636.7	801478.2	60.488
12			

KTN1-1

LATTICE GIRDER AS-BUILT-210210

KTN1-1

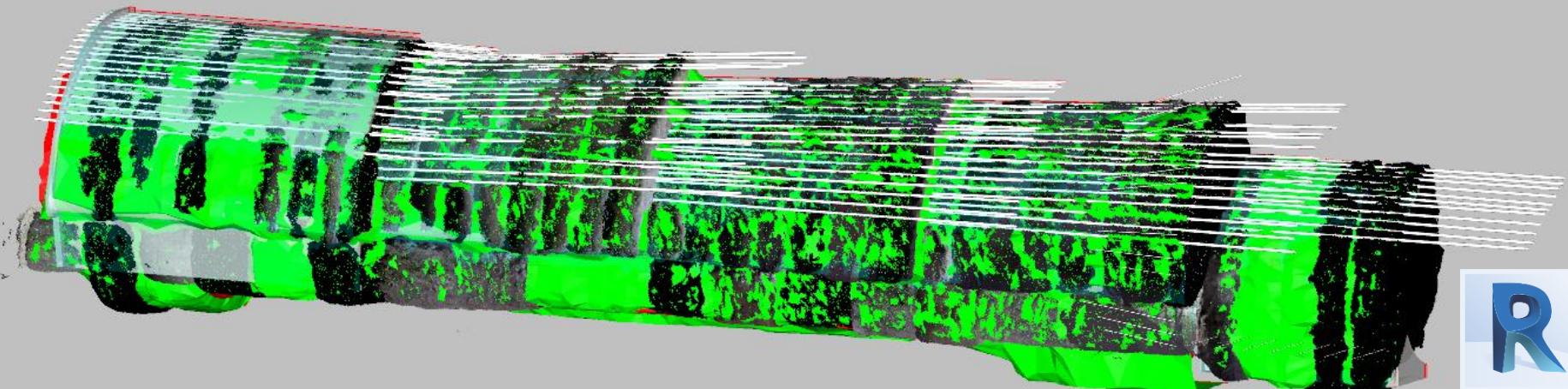
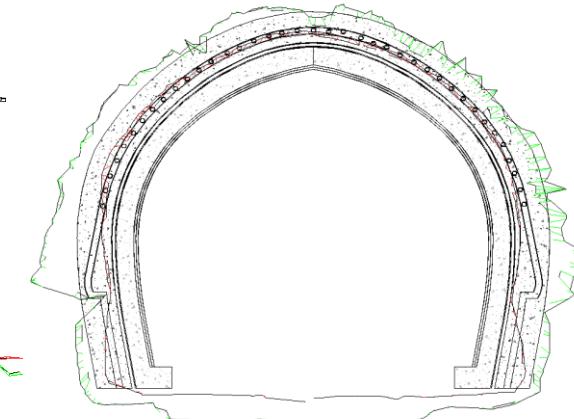
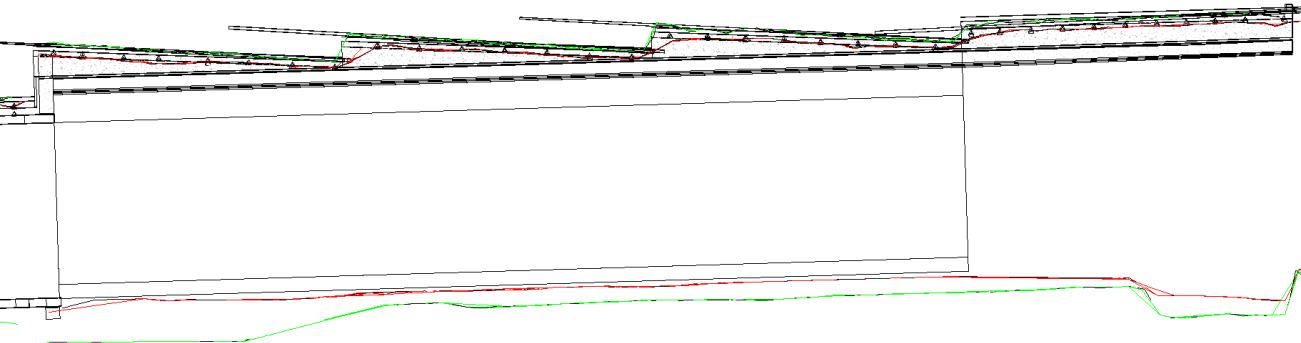
KTN1-2

KTN1-3

KTN1-4

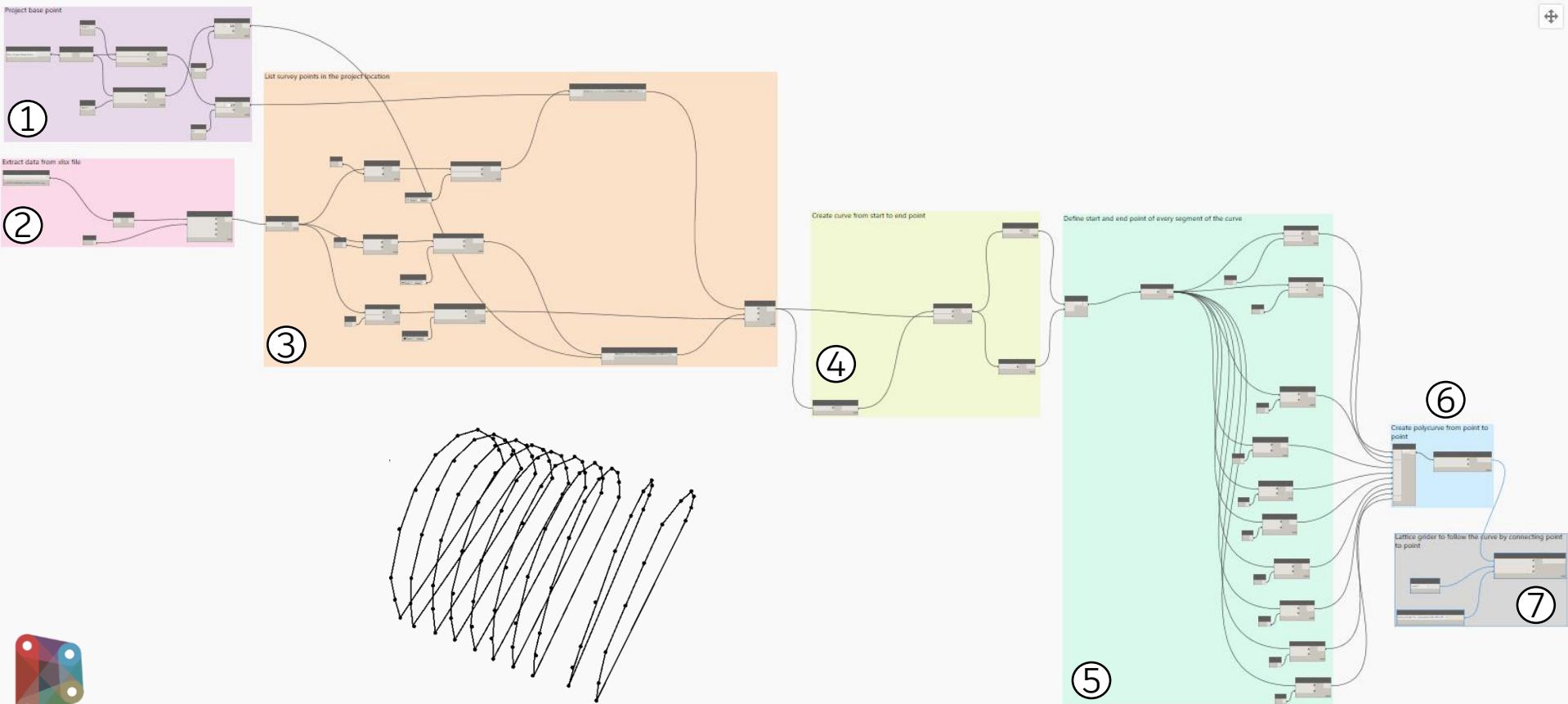
# As-built des Tunnels traditionnels

Mise à jour des E-line, A-line et C-line



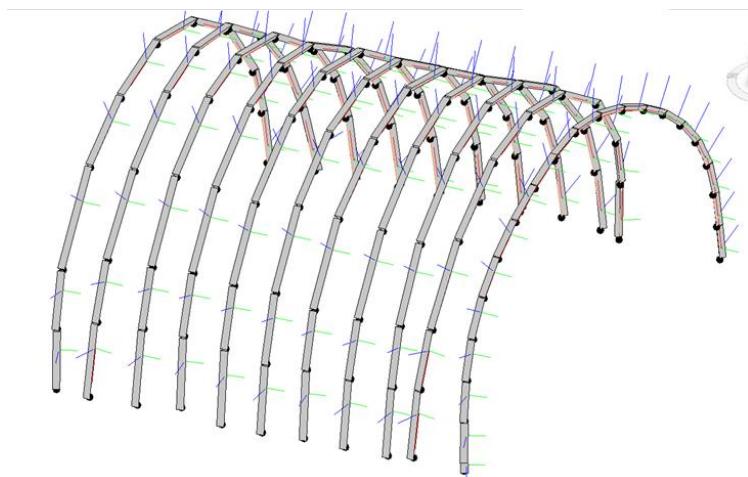
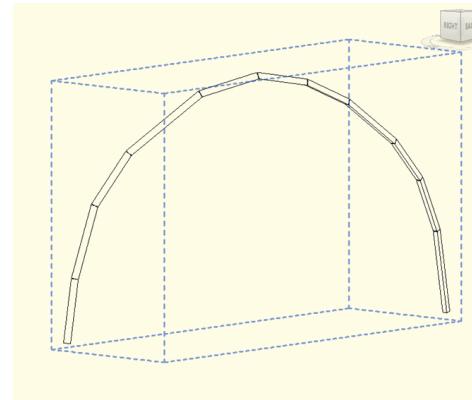
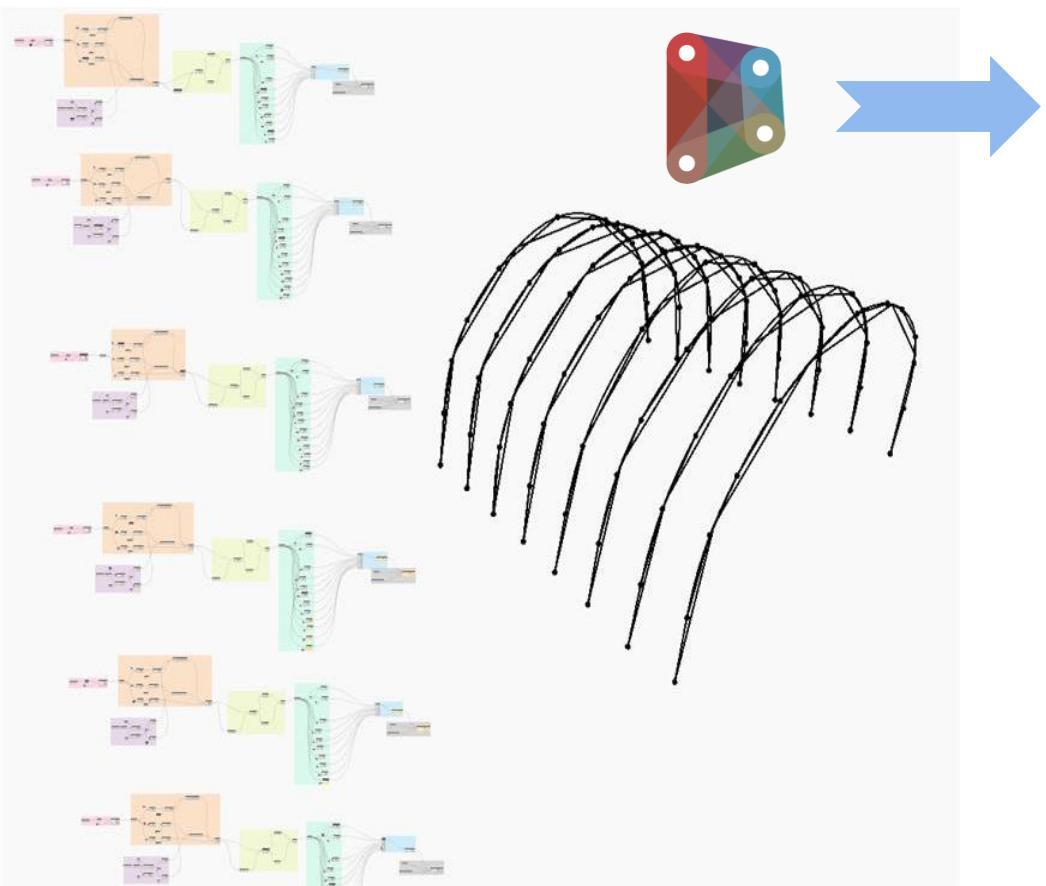
# As-built des Tunnels traditionnels

Automatisation du placement des ceintures en utilisant Dynamo



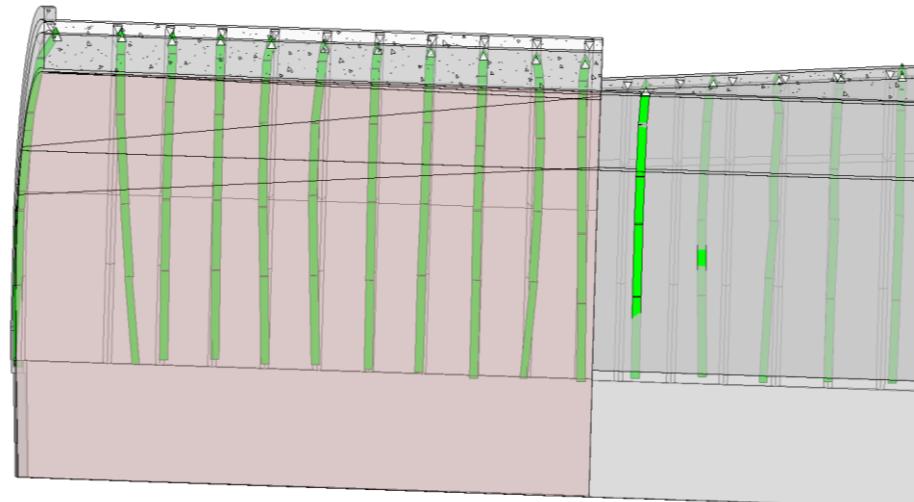
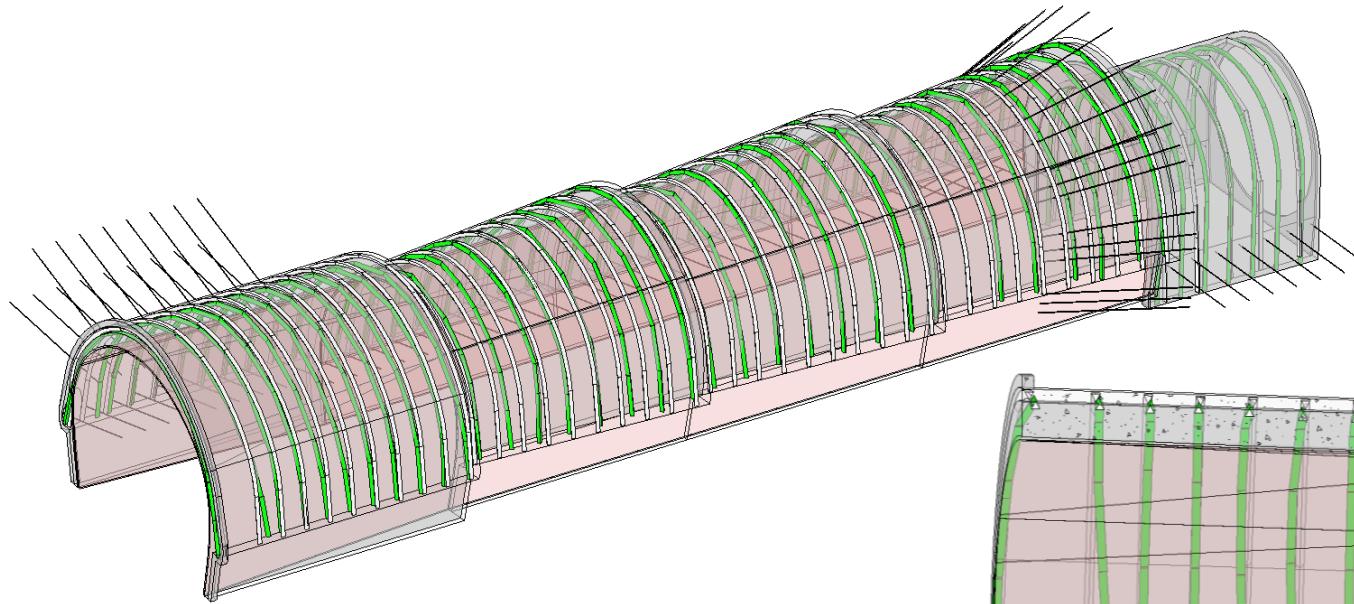
# As-built des Tunnels traditionnels

Automatisation du placement des ceintures en utilisant Dynamo



# As-built des Tunnels traditionnels

Automatisation du placement des ceintures en utilisant Dynamo



# Autres exemples de As-built

Systèmes ferroviaires, tunnels TBM, tranchées couvertes

**AAA-BBB-CCC-DDD-EEE-FGG**

Where:

**AAA** = Area (AOT, KTN etc.)

**BBB** = Location (MC30, XP etc.)

**CCC** = System (OHL, RCB)

**DDD** = Tag (FND, INS etc)

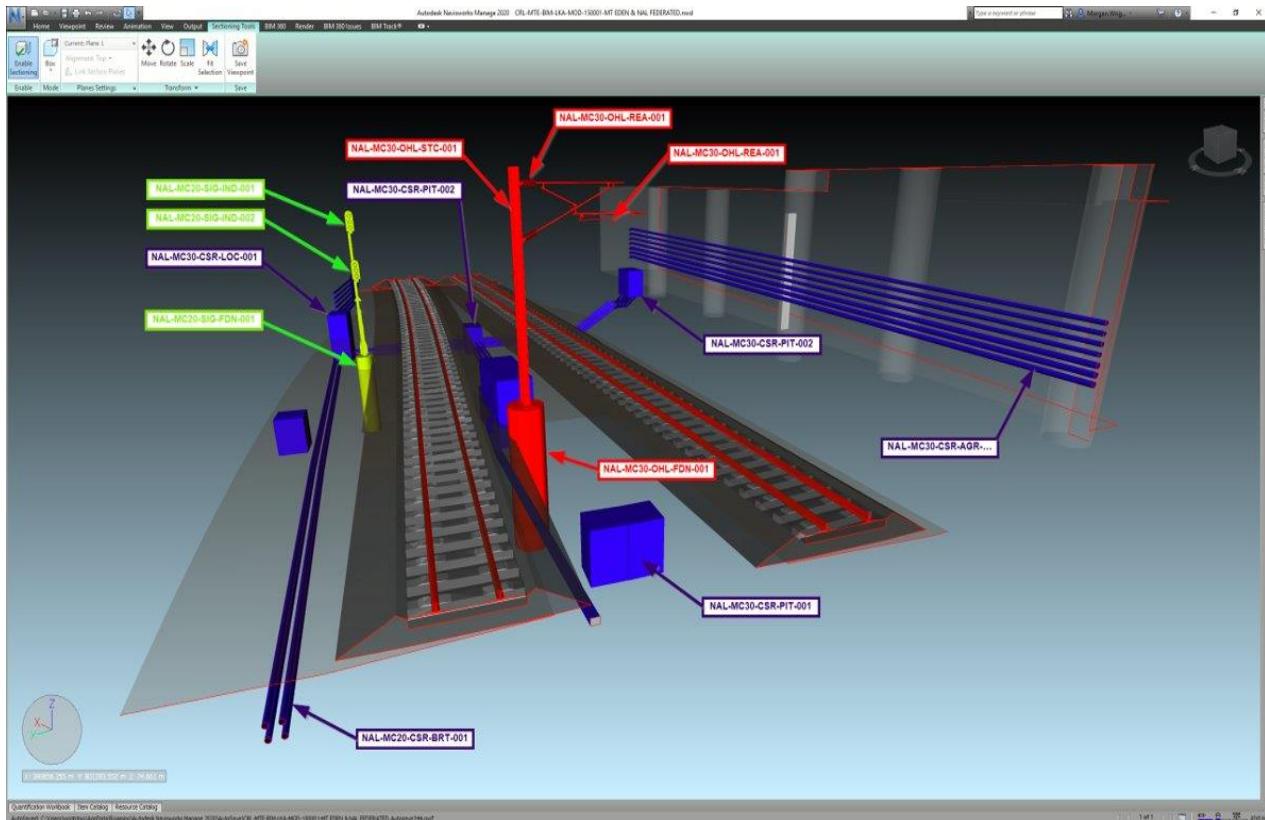
**EEE** = Sequential Number

**F** = Sub Tag

**GG** = Sequential Number

**NAL-MC20-OHL-INS-001**

OHL Insulator number 1 on track MC20





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