Humble introduction

- **Name: Sr T. N. WONG**
- **FRICS, FHKIS, FCInstCES, RISM, MNZIS**
- **Chairman, NZIS (HK Branch) 2016**
- **Chairman, HKIS Land Surveying Division 1992-1994**
- **President, HKIS 1997/98**
- **FIG, Vice President (2003-2006)**

3D REALITY MODELING AND BIM APPLICATION FOR CIVIL ENGINEERING AND BUILDING CONSTRUCTION

Contents

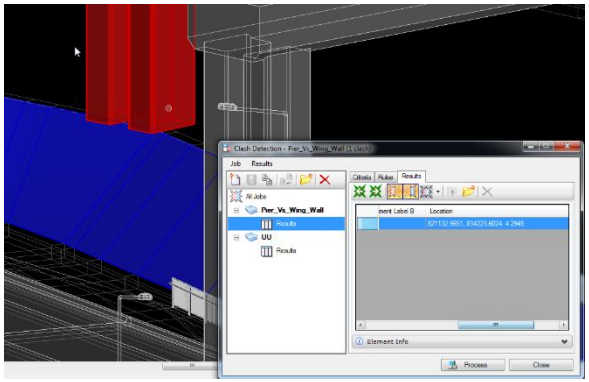
- 1. Role of Professional Land Surveyor
- 2. Present scenario working from 2D Working Drawing and what are the shortfalls
- 3. BIM Levels
- 4. Actual case to share
- 5. Benefits of change

Role and Duty of Professional Land Surveyor

1. Responsible to Principal Resident Engineer (PRE)
2. Lead, manage and supervise a team of professional land surveyor and Resident RSSOE/RSOE (Engineering) in all aspects of : -
   a. Land
   b. Engineering surveying;
   c. GNSS;
   d. ADMS;
   e. Laser Scanning;
   f. Hydrographic Surveying;
   g. Geodetic Surveying;
   h. Topographical Surveying; and
   i. Photogrammetry.
3. Data capturing and data creation, quality data management and documentation.
4. Liaise with Contractors' survey managers
5. Communication, Coordination and co-operation with engineers and inspectors on all work fronts
6. Ensure quality of data and hence quality of the works
7. Delivery quality of services
8. Safety
9. Training of young graduates to be RSOE and professional qualification

BIM for construction

3D Information Model



Clashes

Bridge Name: East
Bridge Unit: Unit1 :: CIP Concrete Box Bridge

Materials Quantity Report

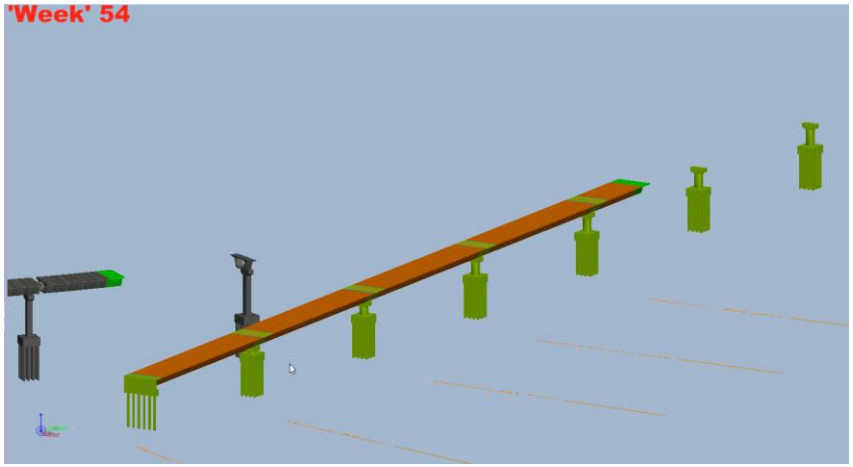
Superstructure Quantities

Component Name	Component Type	Material Name	Material Type	Pay Unit	Unit Price	Quantity	Cost
Deck3	Deck	None	Undefined	Cubic Meter	1.00	3616.93	3616.93
Deck2	Deck	None	Undefined	Cubic Meter	1.00	2993.68	2993.68
Deck1	Deck	None	Undefined	Cubic Meter	1.00	249.48	249.48
Deck4	Deck	None	Undefined	Cubic Meter	1.00	249.48	249.48
Deck5	Deck	None	Undefined	Cubic Meter	1.00	249.48	249.48
Deck6	Deck	None	Undefined	Cubic Meter	1.00	2494.25	2494.25
						Total	8853.29

Substructure Quantities

Component Name	Component Type	Material Name	Material Type	Pay Unit	Unit Price	Quantity	Cost
Abutment1	Stem Wall	None	Undefined	Cubic Meter	1.00	172.05	172.05
	Back Wall	None	Undefined	Cubic Meter	1.00	2.30	2.30
	Footing	None	Undefined	Cubic Meter	1.00	17.11	17.11
Pier21	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier22	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier23	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier24	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier25	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier26	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25
	Piles	None	Undefined	Meters	1.00	18.00	18.00
Pier27	Cap	None	Undefined	Cubic Meter	1.00	17.25	17.25

Quantity



4D? 5D?

Present Situation
From Design Stage to Construction Stage

Generating and managing

from

2D working drawings

to

3D setting out and construction data

Present Process

Before Concreting/construction:

- **1. Setting out by the Contractor**
- **2. Setting out check by Resident Site Staff (Surveying)**

After Concreting:

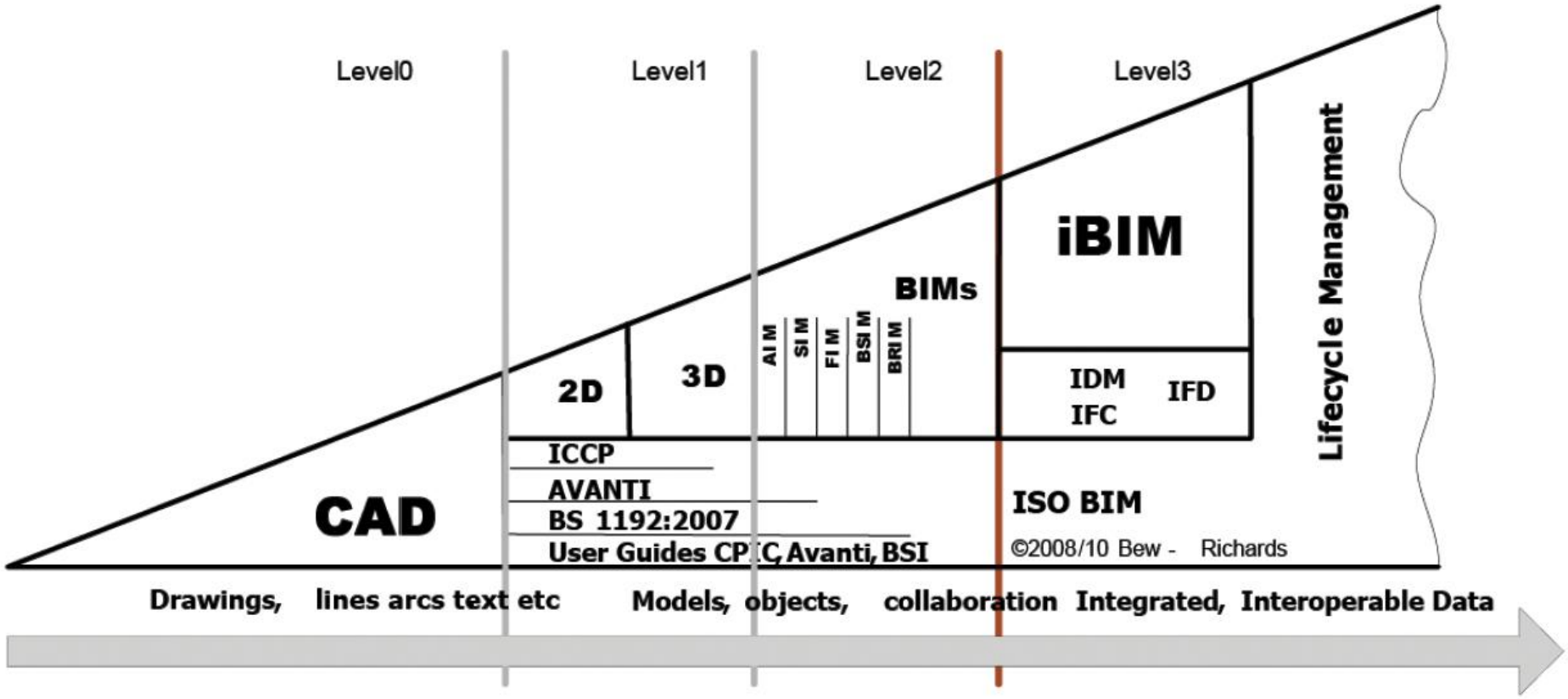
- **3. Join as-built record survey**
- **4. Compared these as-built record survey data with design data to determine the quality of the work.**
- **5. Report on the quality of workmanship and monitor mitigation works to meeting the standard.**
- **6. Final as-built record survey in 3D**
- **7. Final quantities and final account.**

Shortfalls

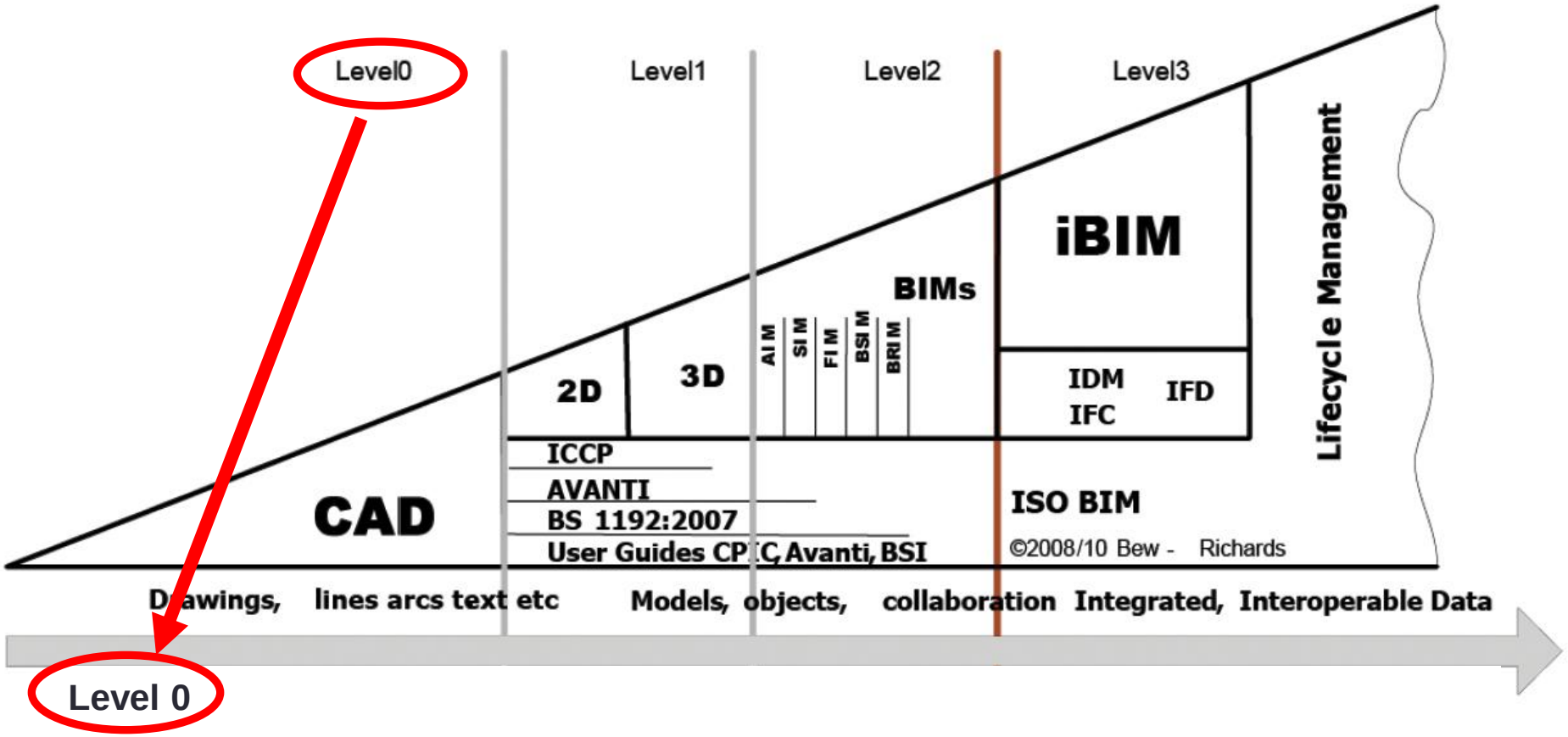
- 1. Difficult to check design faults due to lack of existing ground information
- 2. Hard to detect clashes
- 3. Not easy to visualise
- 4. Rework or abortive work if not detected before actual work being carried out

- So, We use “BIM” process to improve this.

Different Levels of Development in BIM



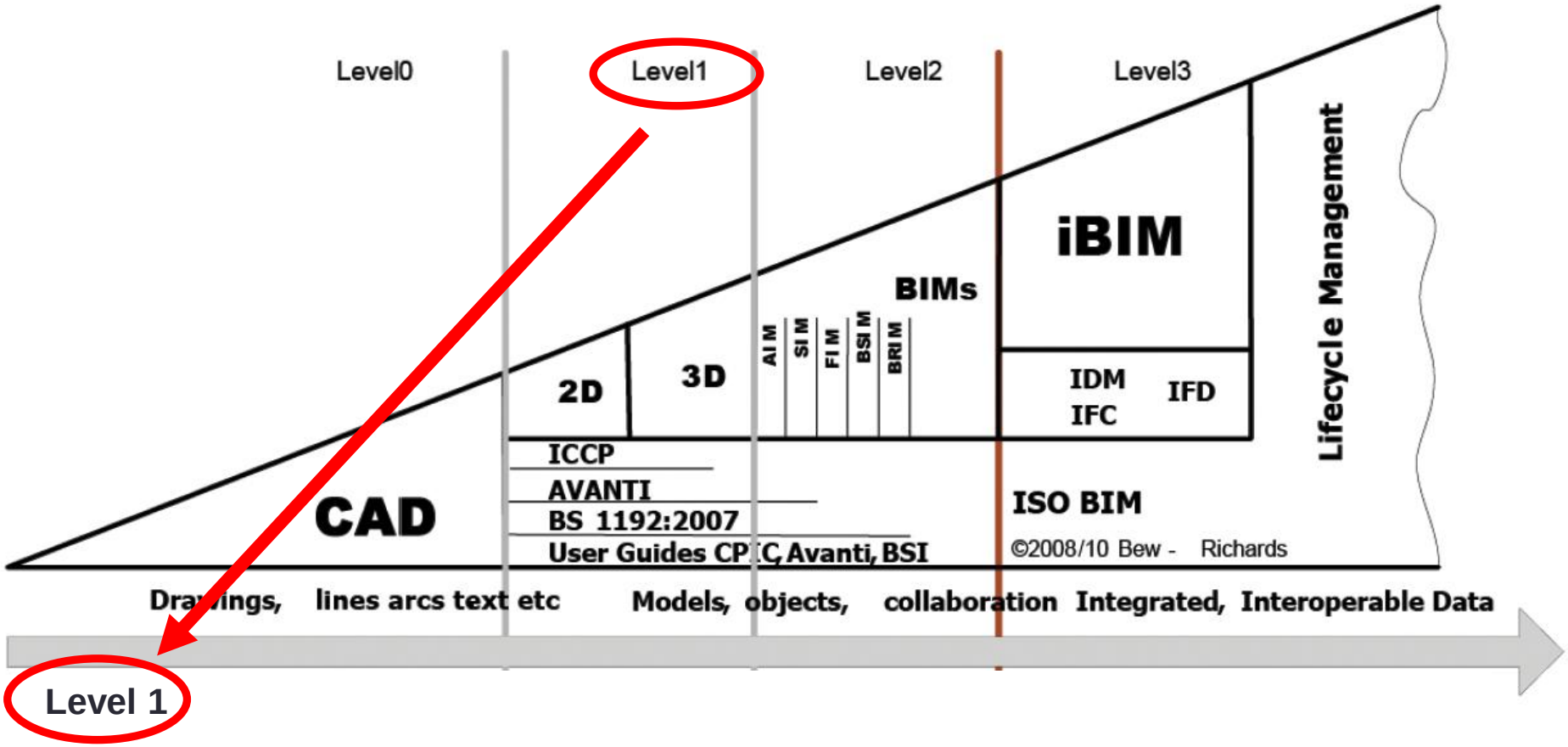
Different Levels of Development in BIM



Separate sources of information covering the basic assets information in paper documents

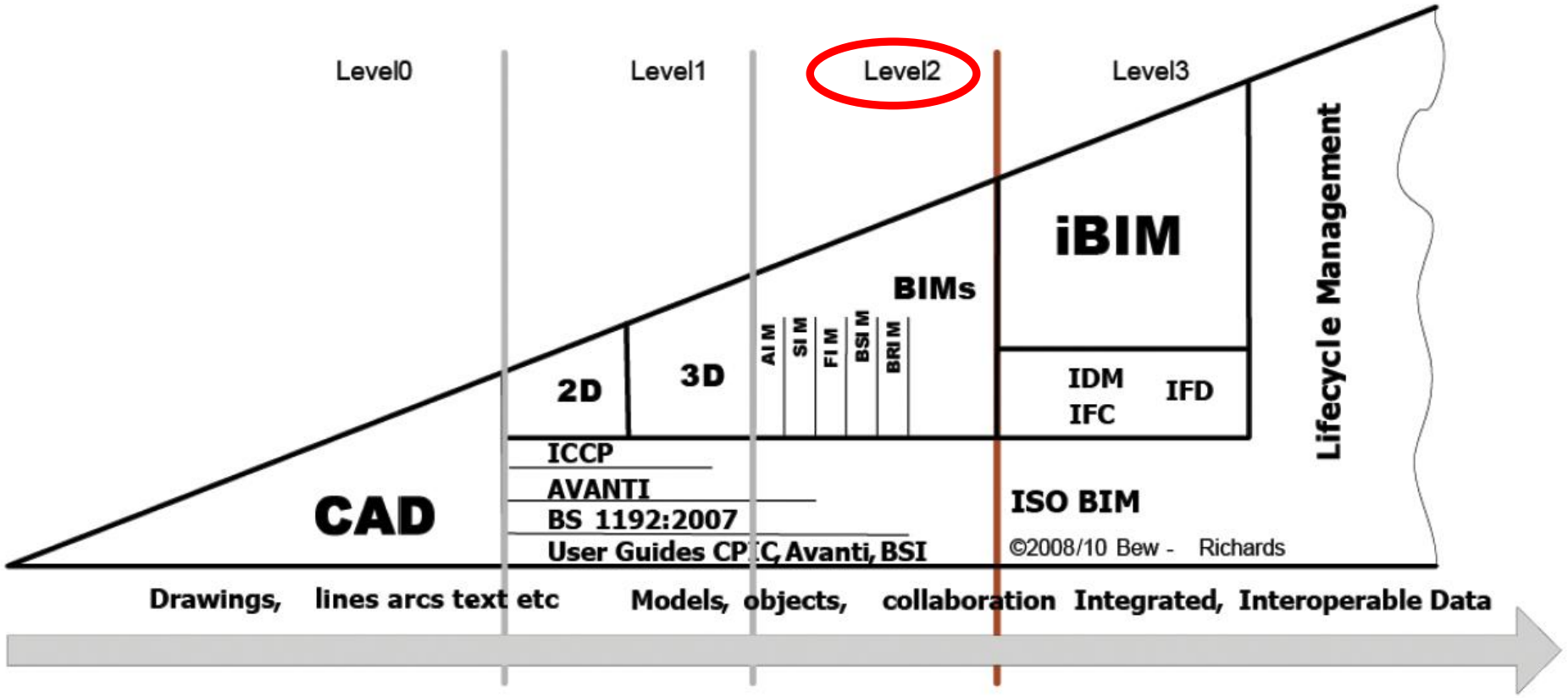
They are in CAD format as drawings, lines, arcs, text etc.

Different Levels of Development in BIM

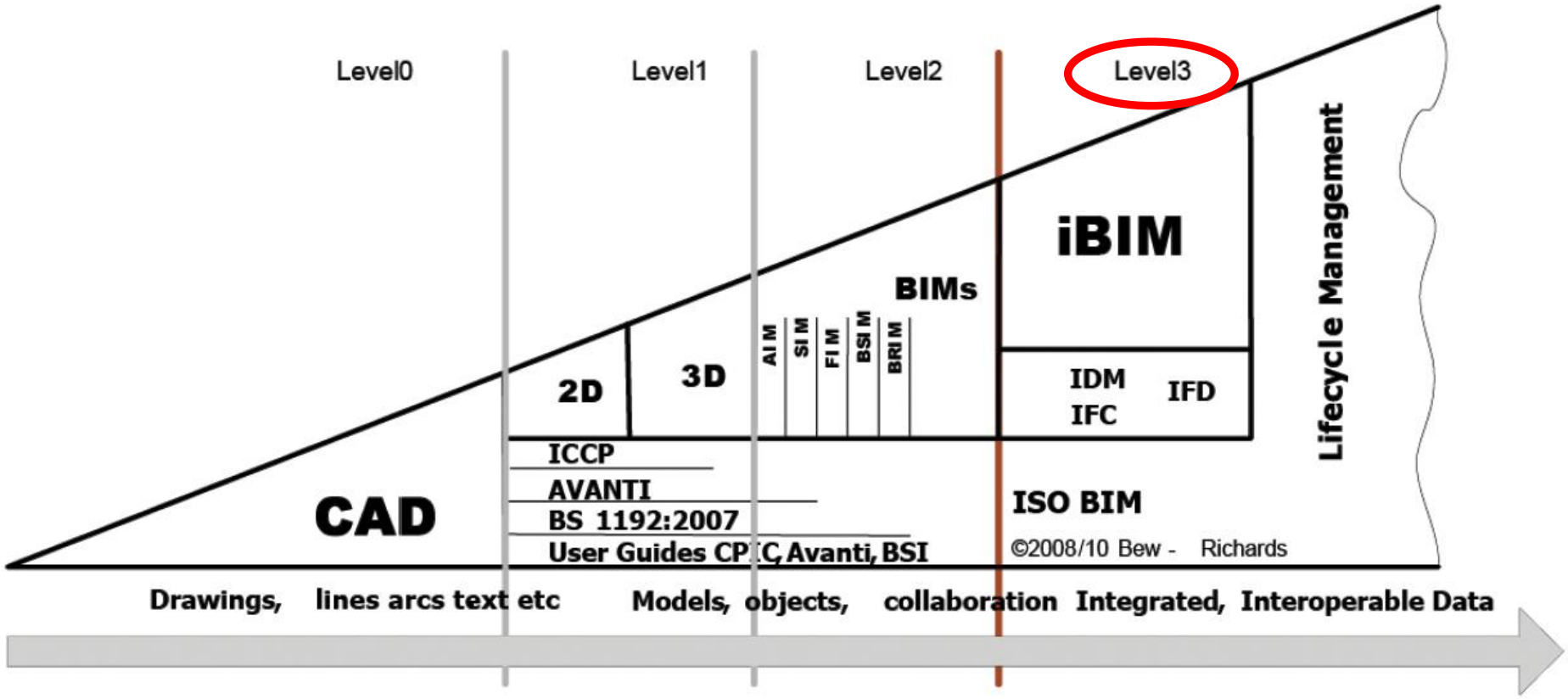


Separate sources of information covering the range of assets information in semi-structured electronic documents in 2D or 3D

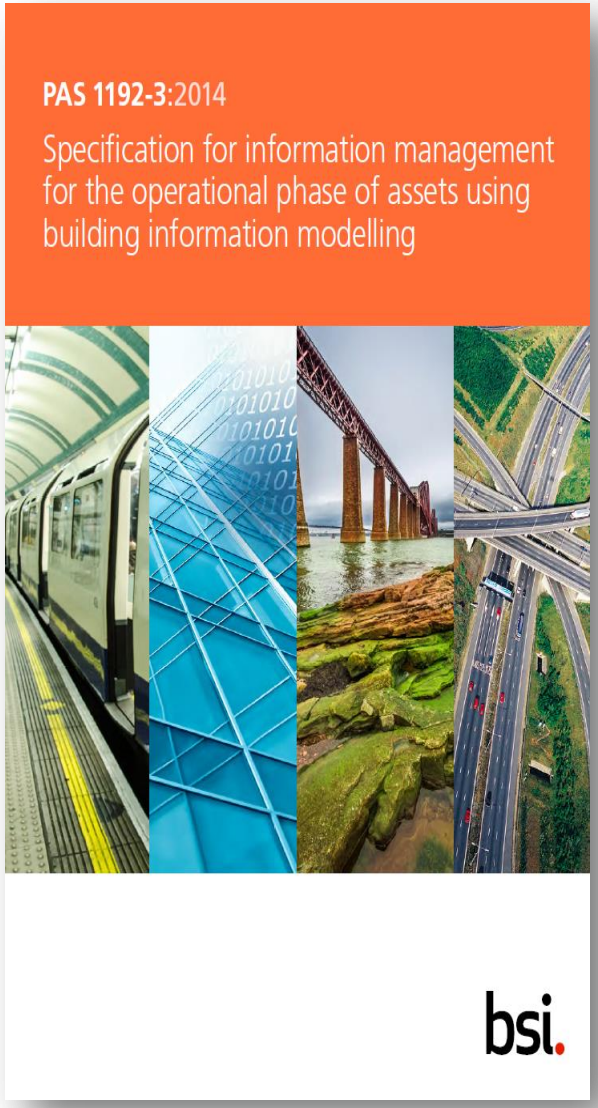
Different Levels of Development in BIM



Different Levels of Development in BIM



"BIM-enabled" *Operations and Maintenance*



Relationship with other publications

This PAS builds on the existing code of practice for the collaborative production of architectural, engineering and construction information, defined within BS 1192:2007.

"LEVEL 1"
DESIGN

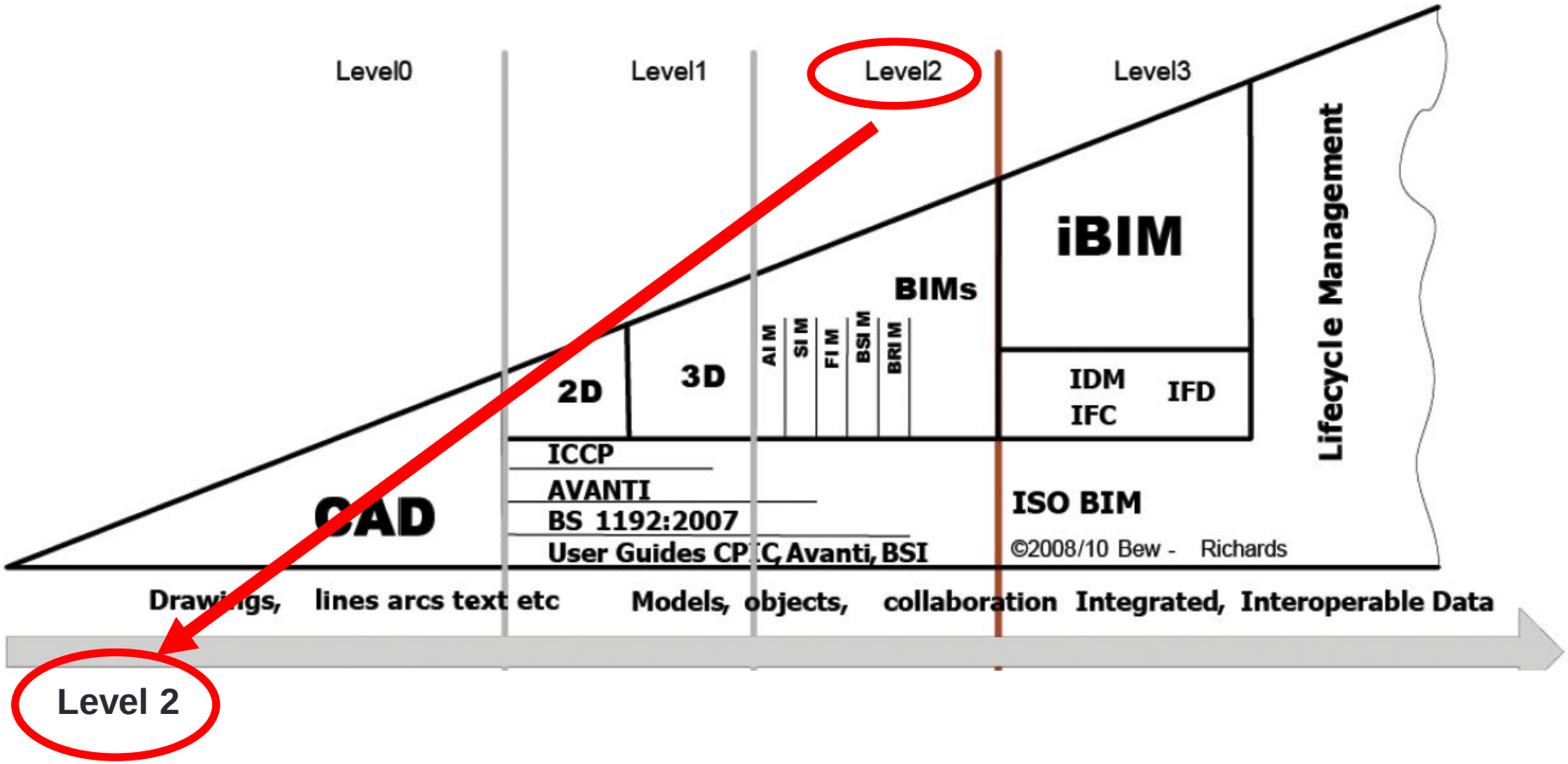
It is a companion document of, and refers heavily to PAS 1192-2:2013, *Specification for information management for the capital/delivery phase of construction projects using building information modelling.*

"LEVEL 2"
CONSTRUCTION

It also refers heavily to the BS ISO 55000 series, *Asset management*, PAS 55:2008, *Asset management*, and to existing facilities management standards BS 8210:2012 and BS 8587:2012. BS 8536:2010 and BS 8572:2011 have also been useful source documents in relation to facilities management.

"LEVEL 3"
OPERATIONS

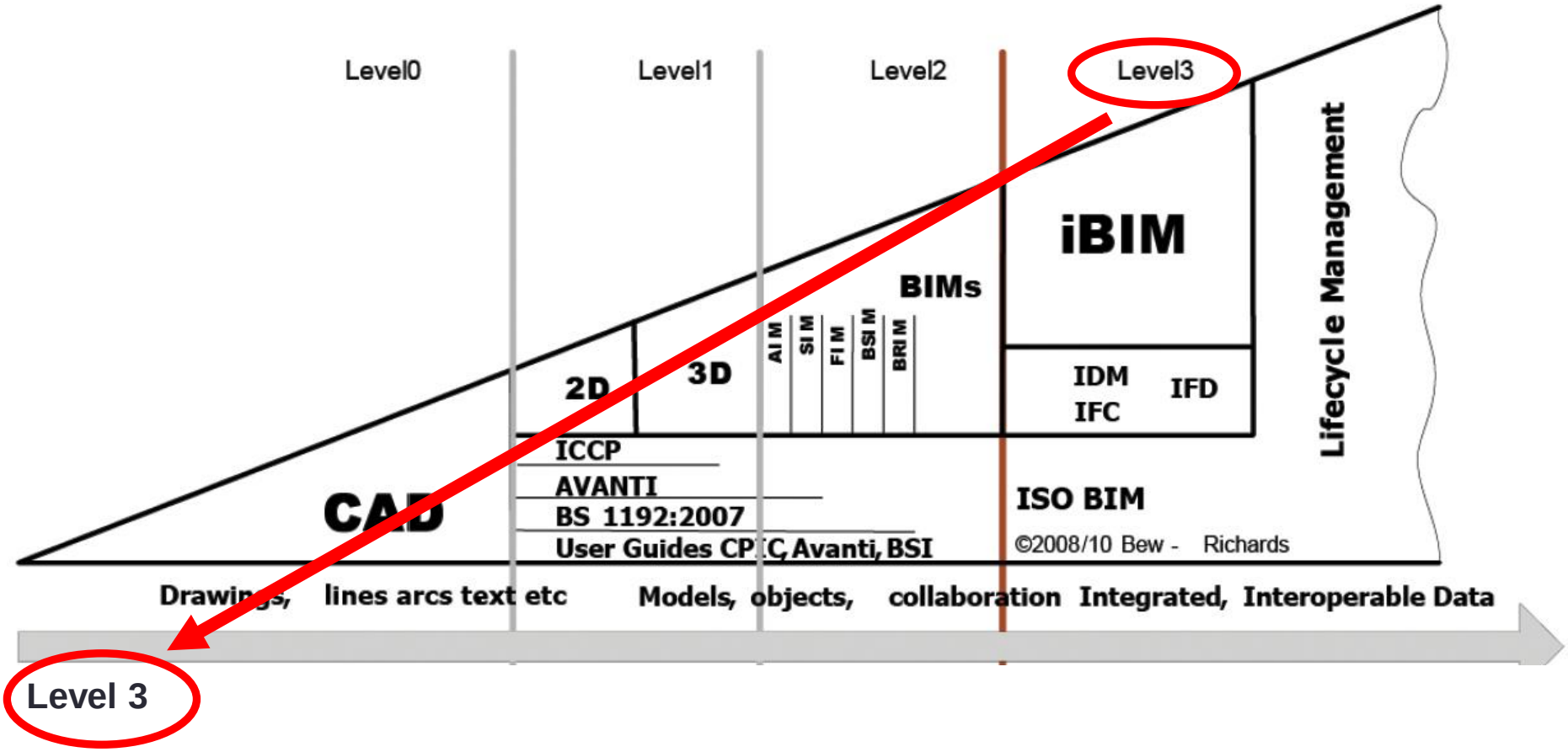
Different Levels of Development in BIM



Federated file-based electronic information with some automated connectivity (BIM).

This information include: Architectural, Structural, Fire, Building Services, Bridges and …etc.

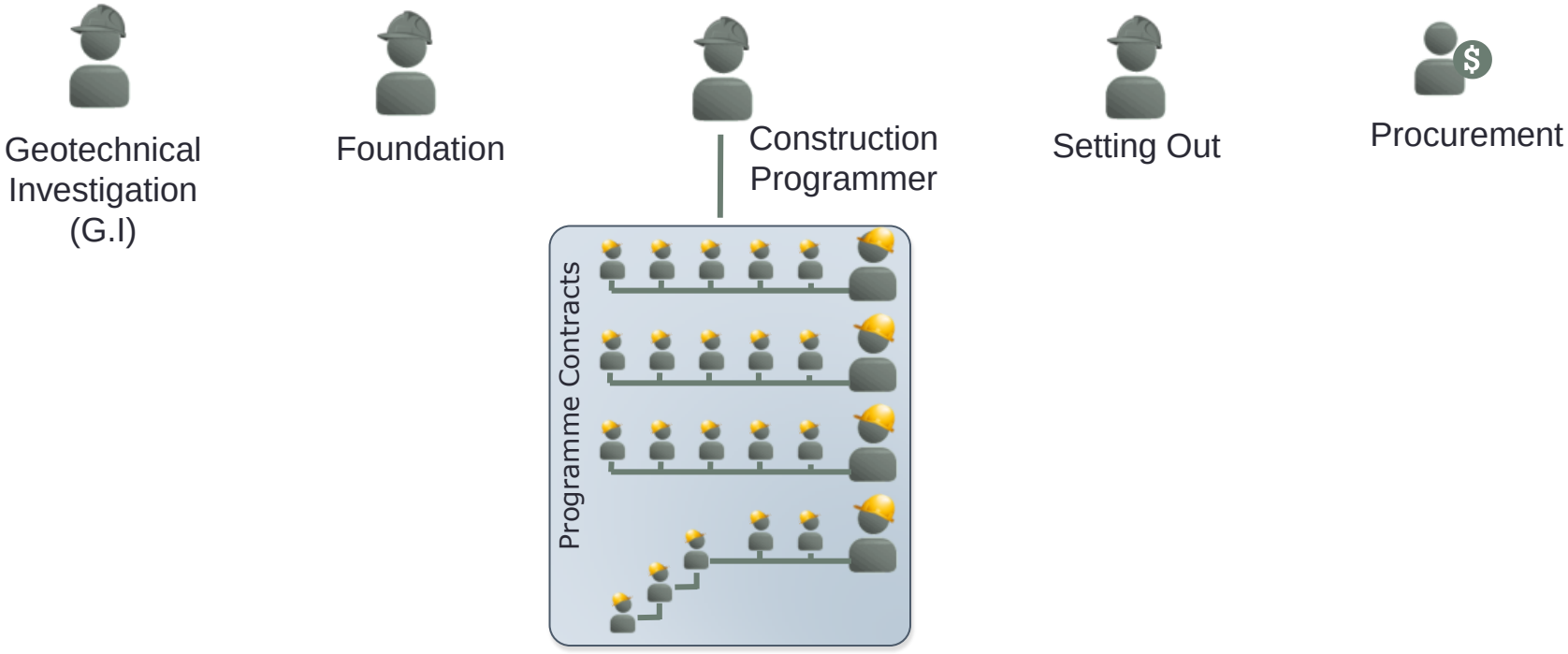
Different Levels of Development in BIM



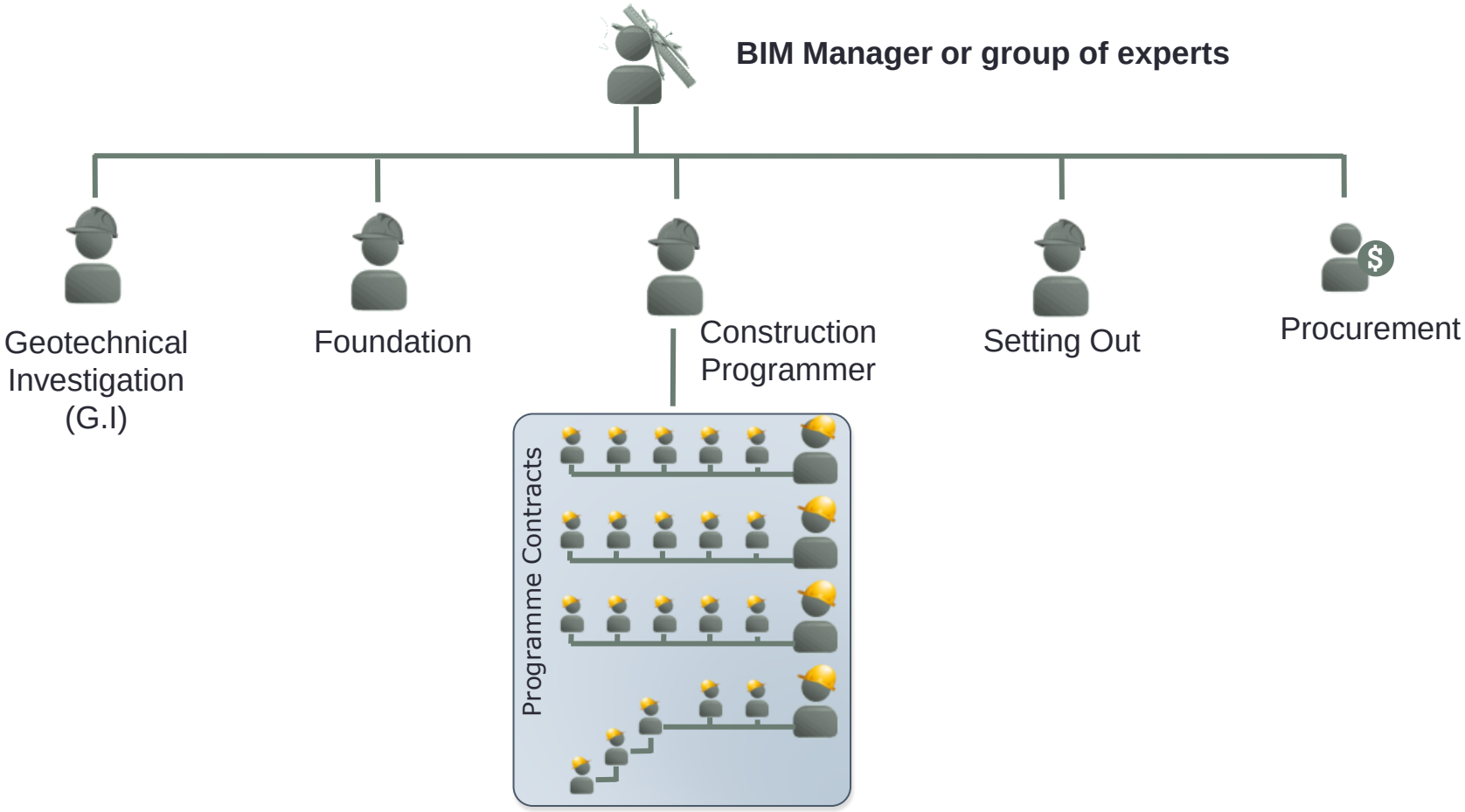
Integrated electronic Information with full automated connectivity and wed-based (iBIM)

Leading to Lifecycle Asset Management.
<u>They are models, objects, collaboration integrate, interoperable data</u>

Parties Involved in Construction



Parties Involved in Construction



This can be a group/team of experts to plan and to coordinate/ implement the sequence/schedules of each stage of the construction

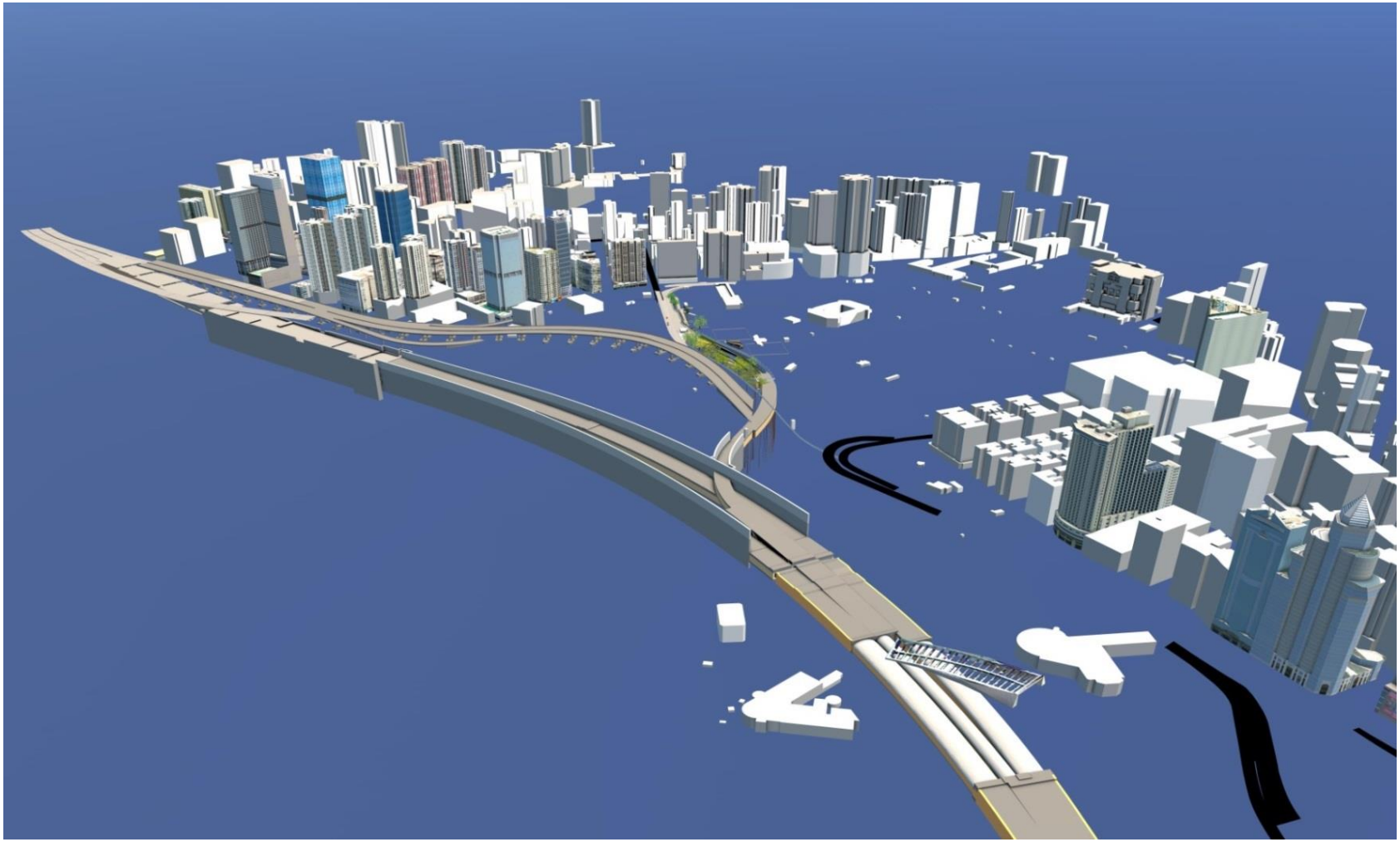
Functions of BIM Manager

- Information Coordination
- 3D Information Model
- Resolution of Technical Query (TQ)
- Constructable (3D)
- Construction Schedule (4D)
- Costing (5D)
- As-built (6D)
- Asset Lifecycle (7D)

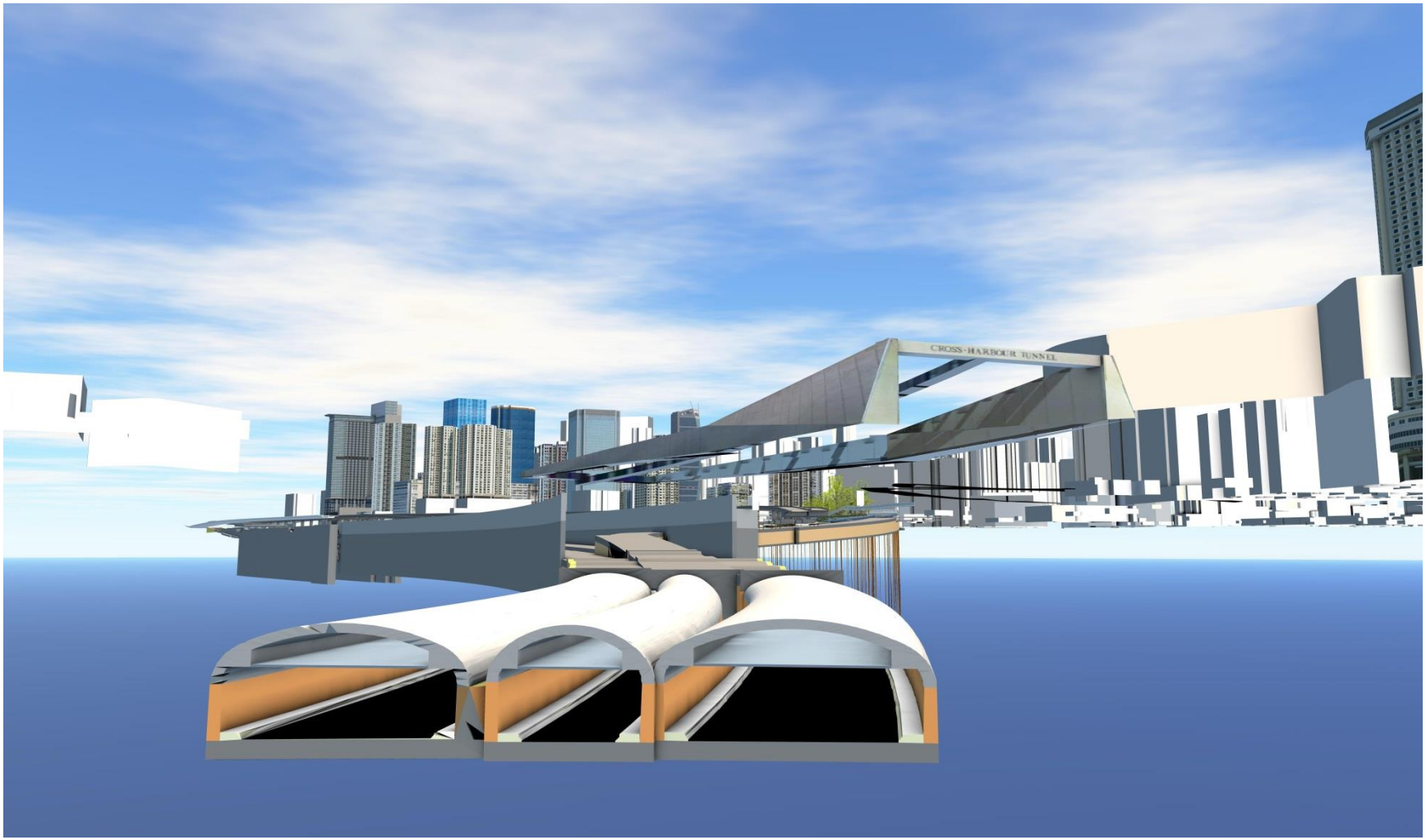
Functions of BIM Manager

- Information Coordination
- 3D Information Model

Overview of 3D Information Model in CWB Project



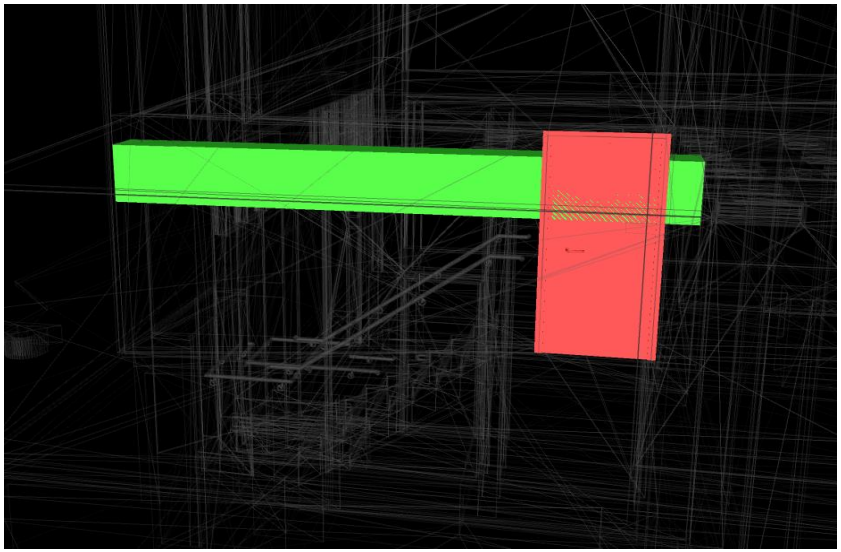
3D Information Model of Mined Tunnel Underneath the Existing Cross Harbour Tunnel



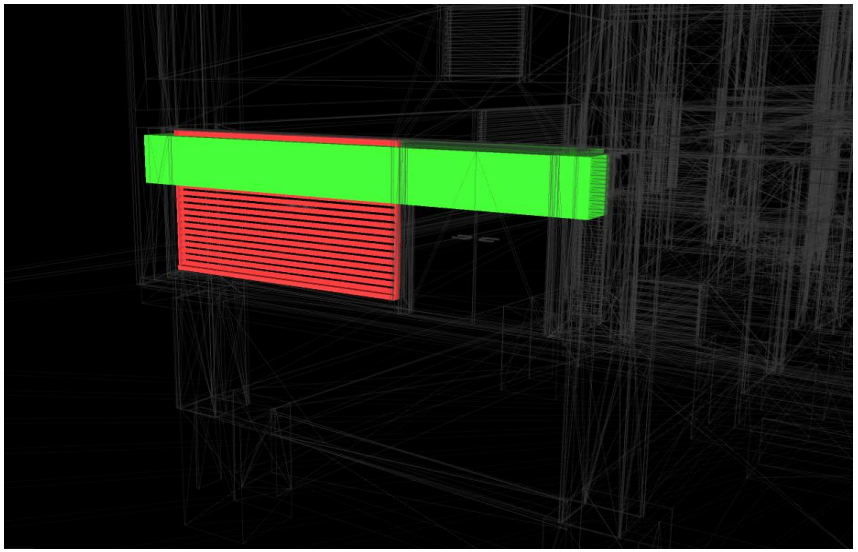
Functions of BIM Manager

- Information Coordination
- 3D Information Model
- Resolution of Technical Query (TQ)

Technical Query (TQ) (Clash Finding)

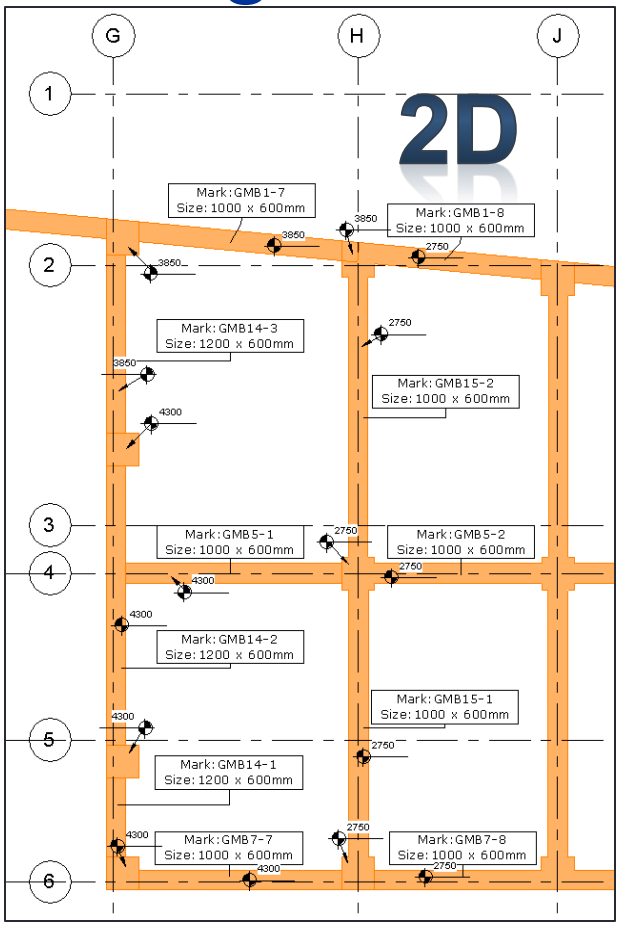


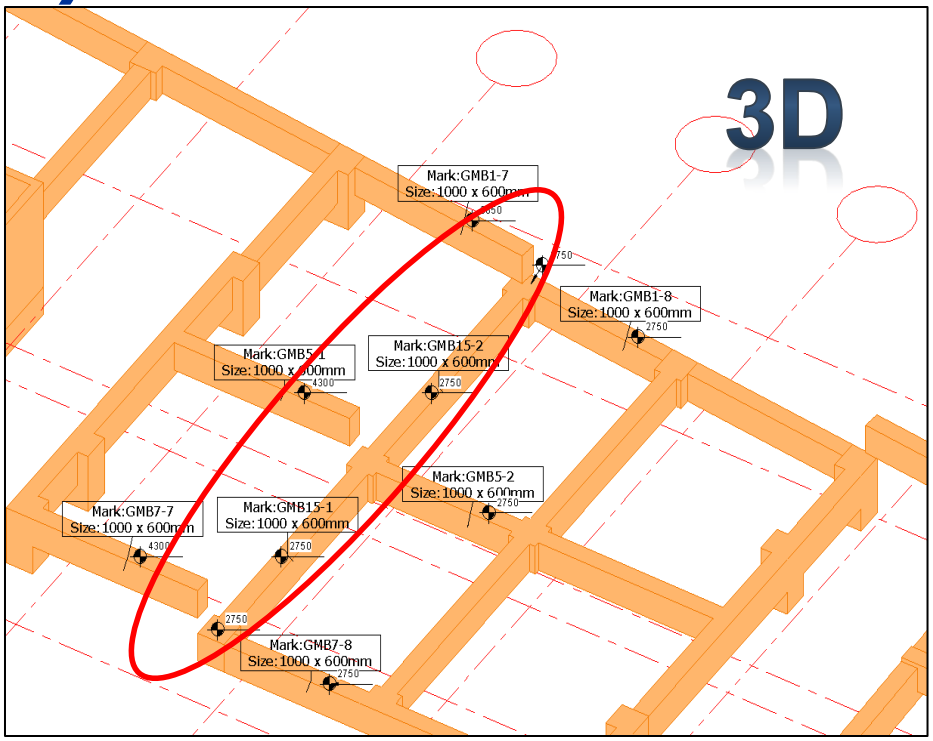
Door clashes with Beam



Louver clashes with Beam

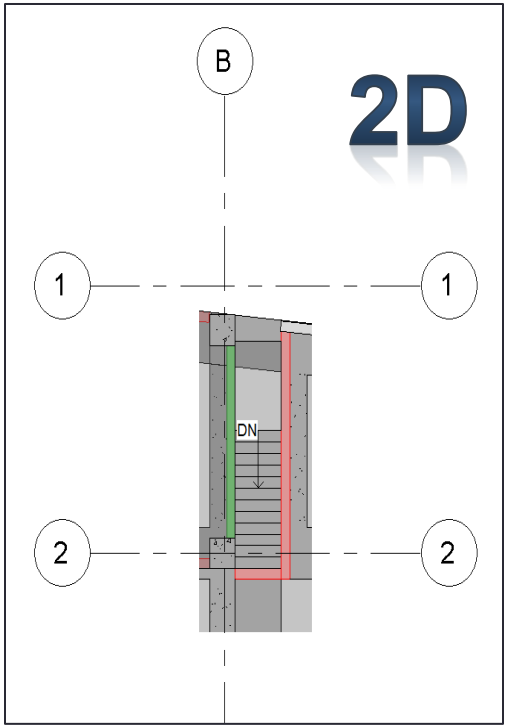
Technical Query (TQ)
(Missing Information)

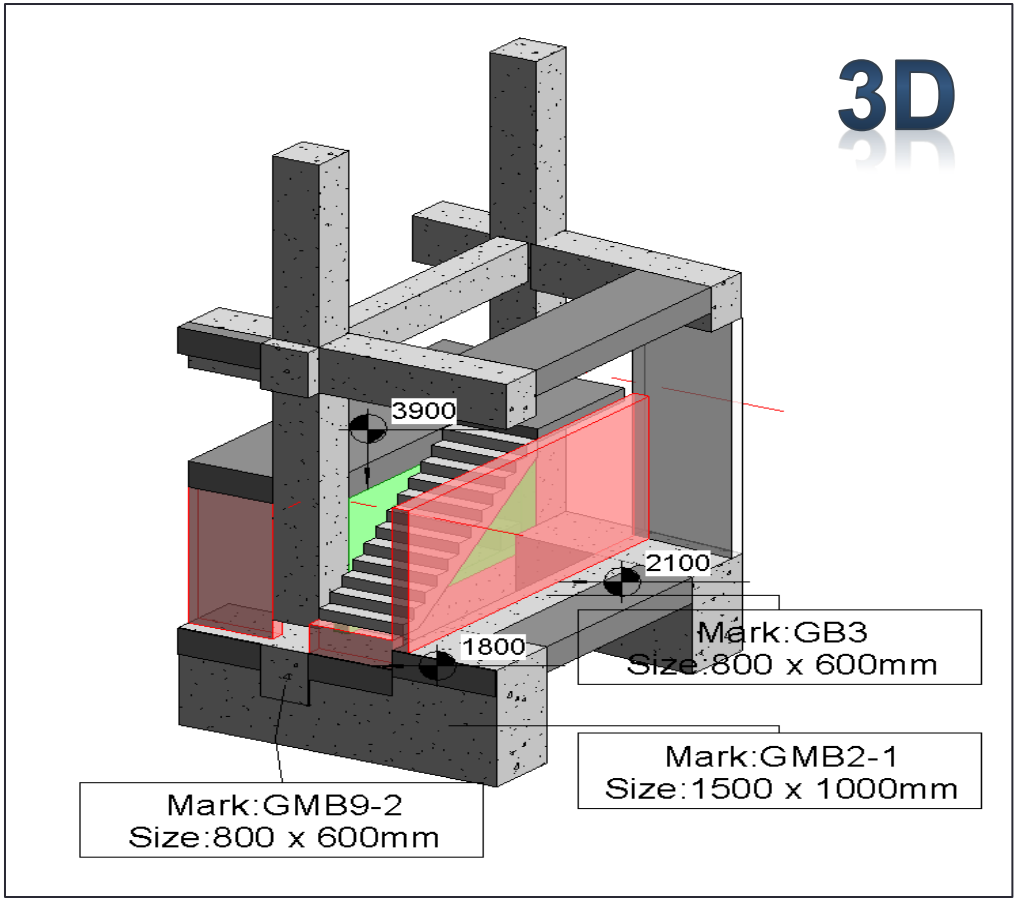




Missing Information detected
Beams found not connected from 3D

Technical Query (TQ)
(Missing Information)



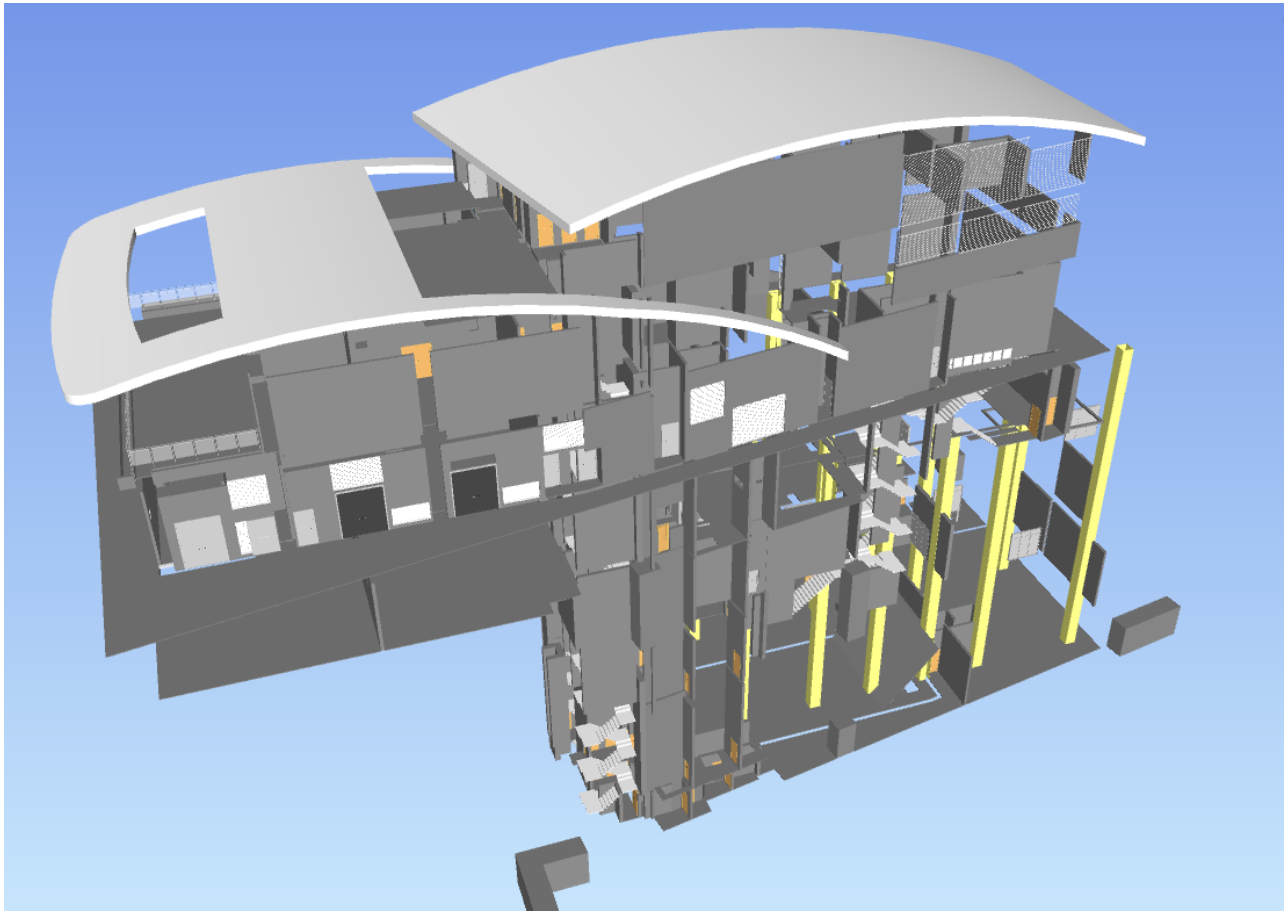


Wall is found missing, no support to slab
Advise to add the wall

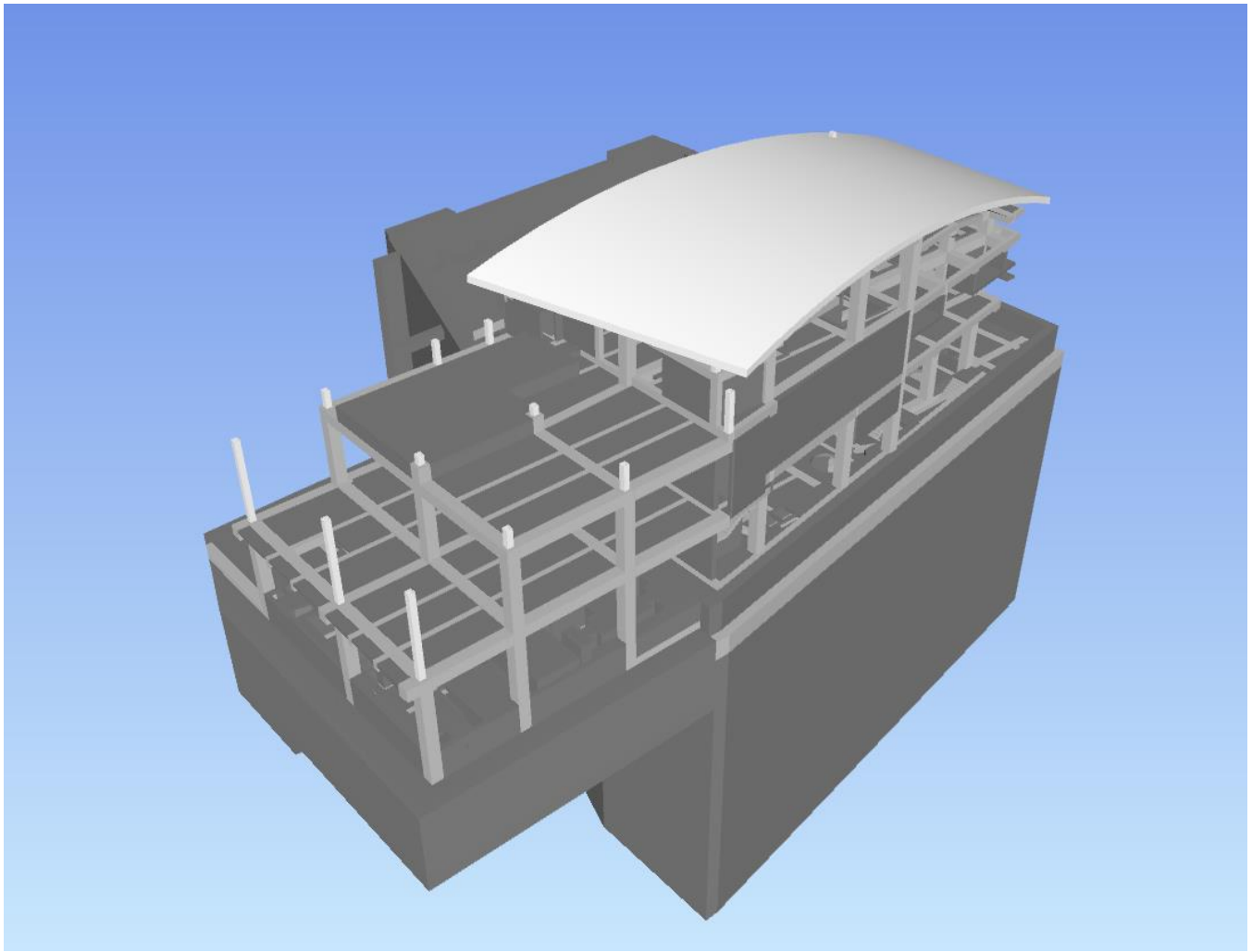
Functions of BIM Manager

- Information Coordination
- 3D Information Model
- Resolution of Technical Query (TQ)
- Constructable (3D)

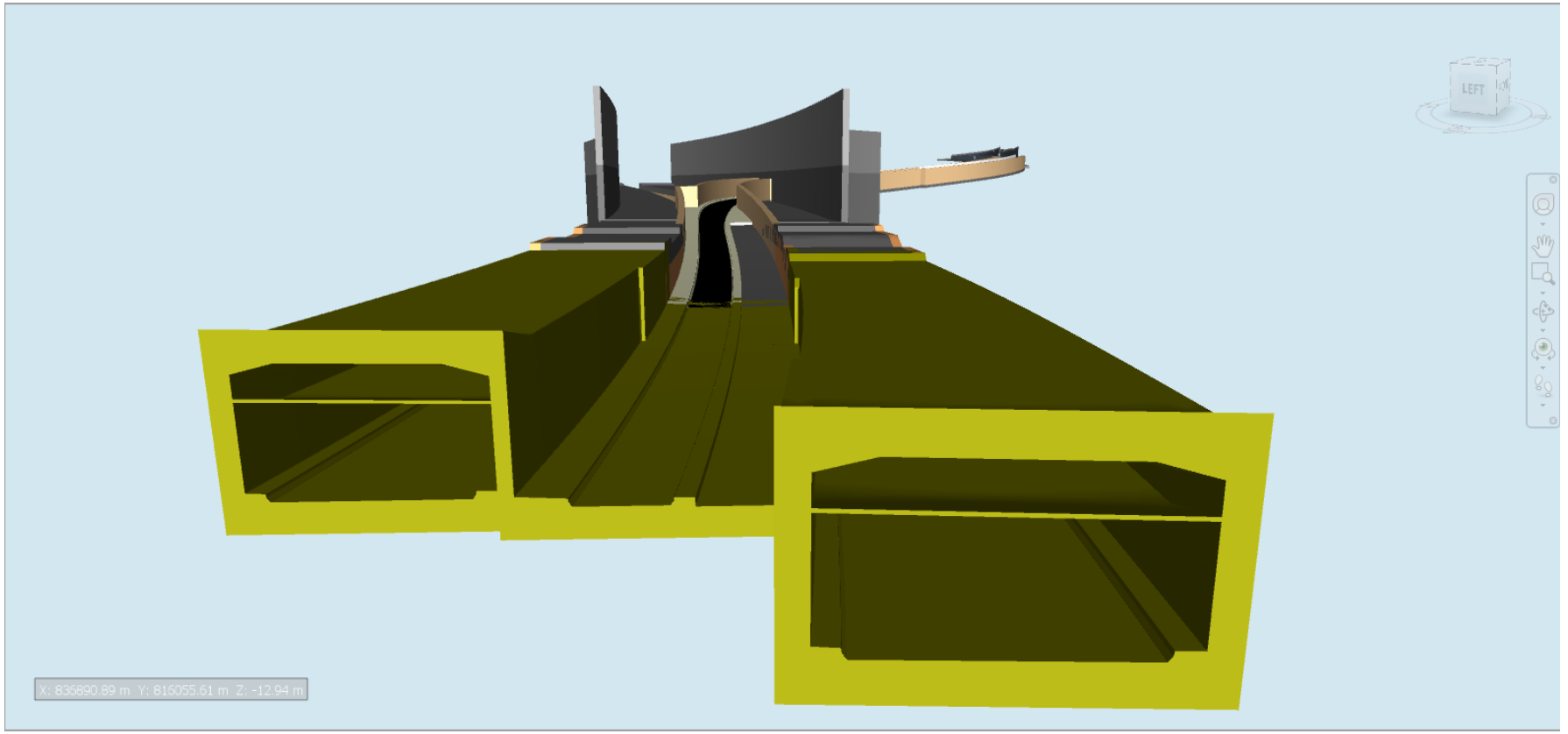
Constructable Model (Ventilation Building)



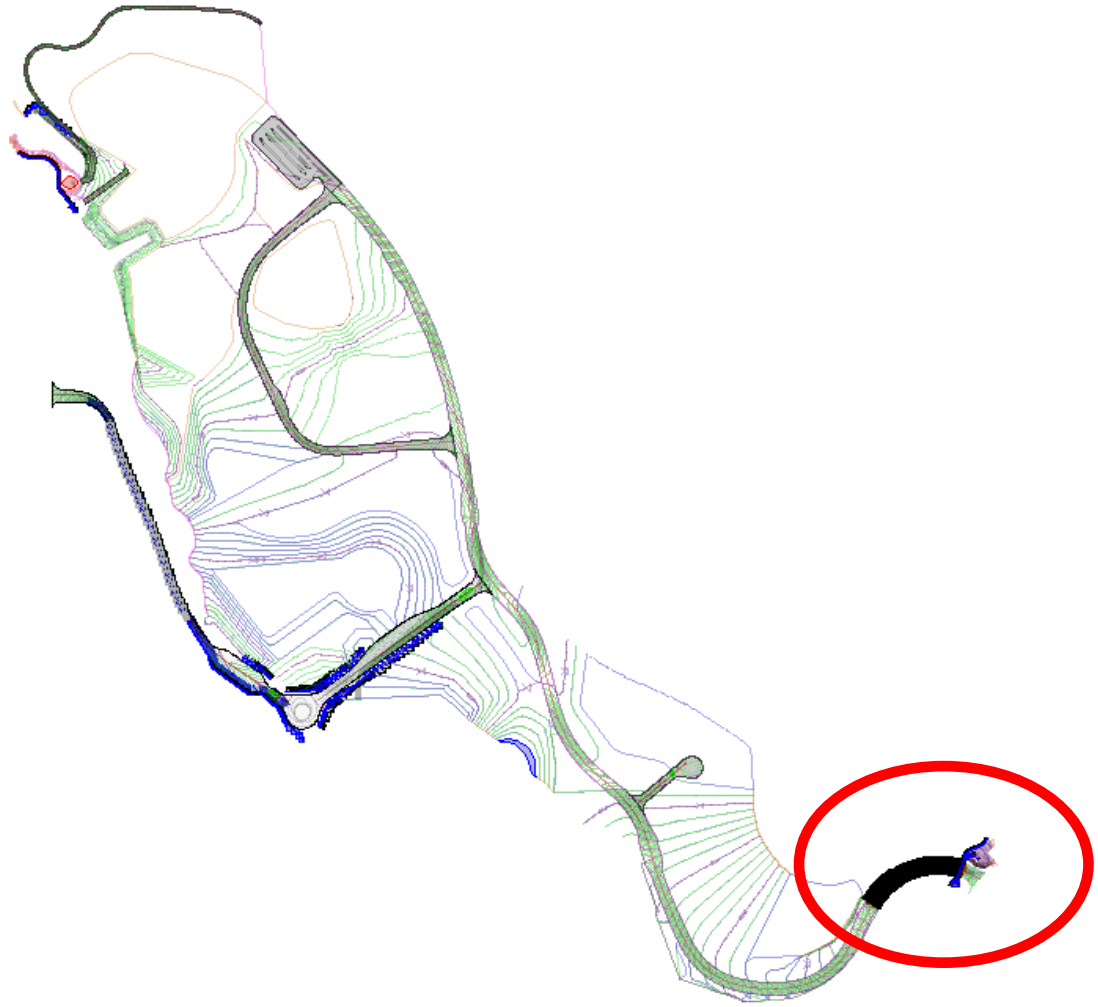
Constructable Model(Ventilation Building)



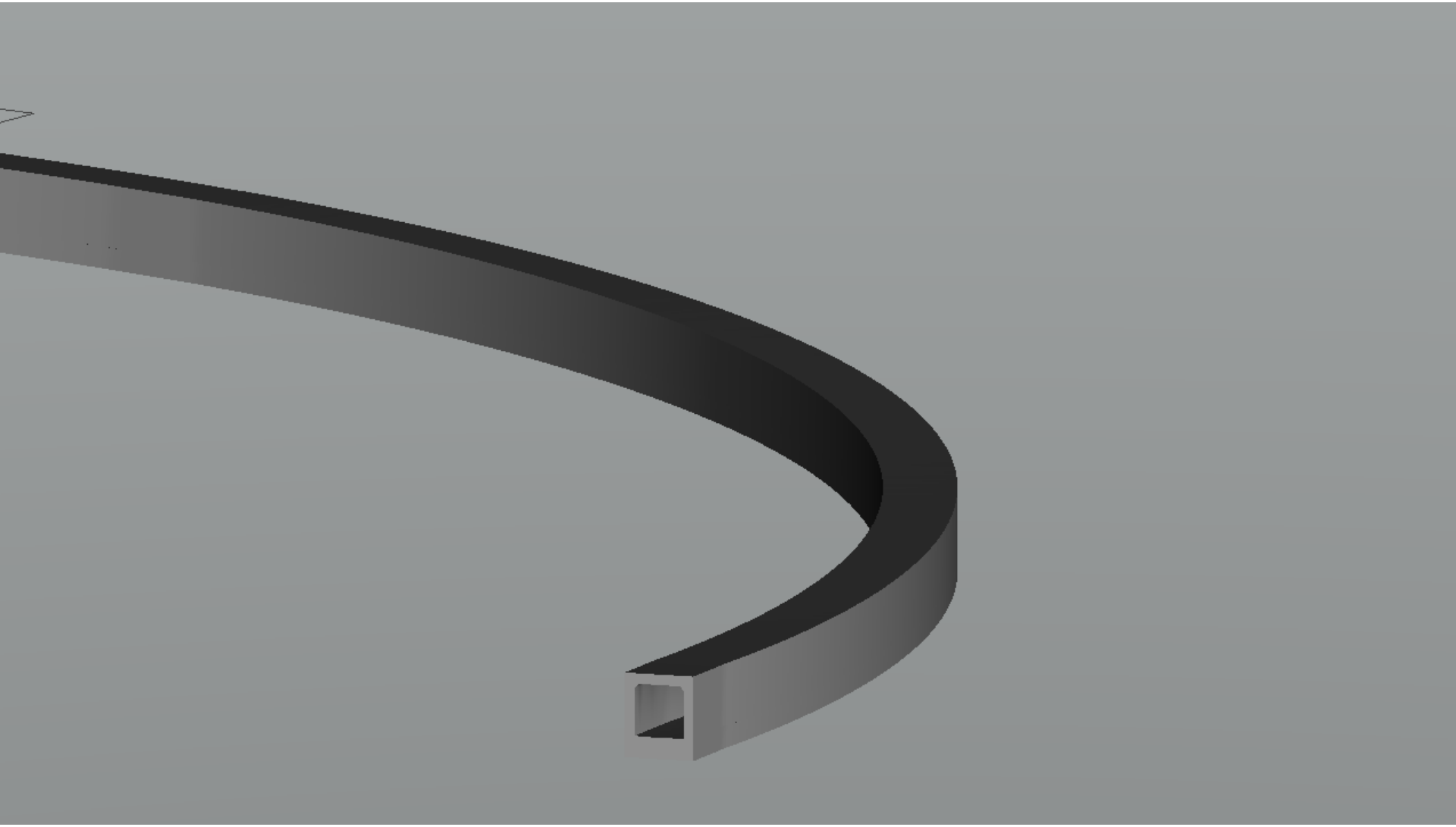
Constructable Model (Tunneling)



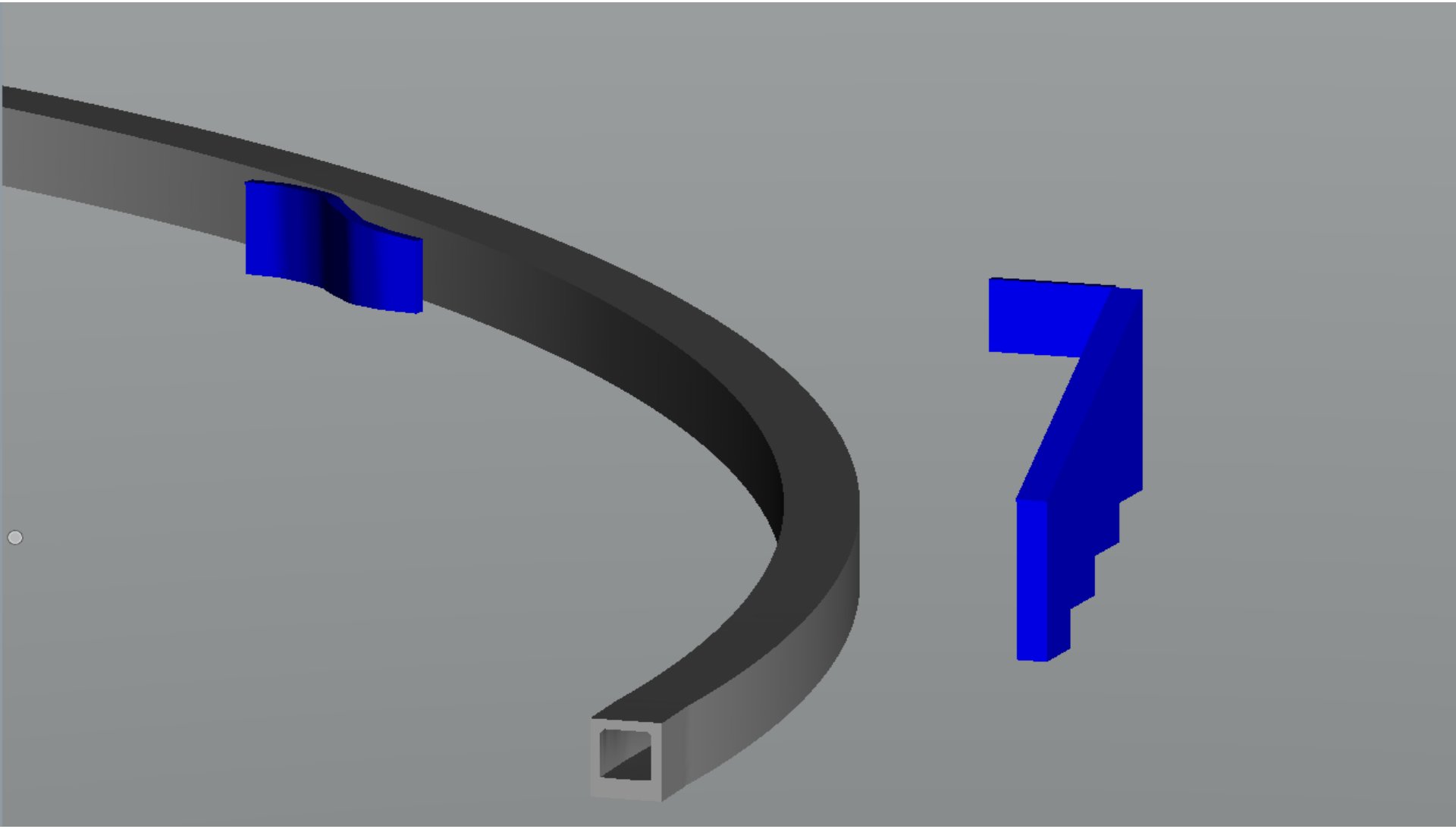
Constructable Model (Composite Structures)



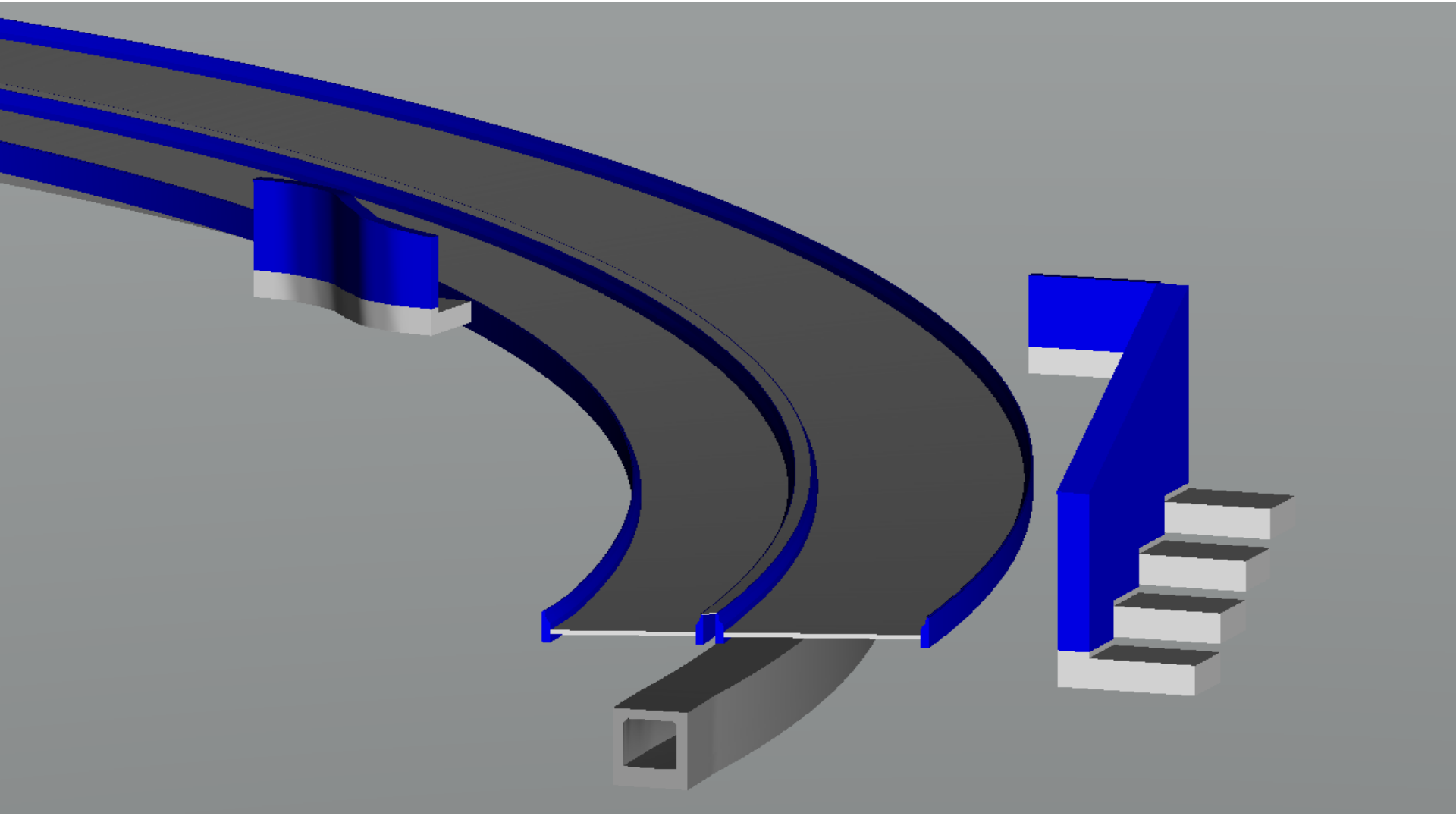
Box Culvert



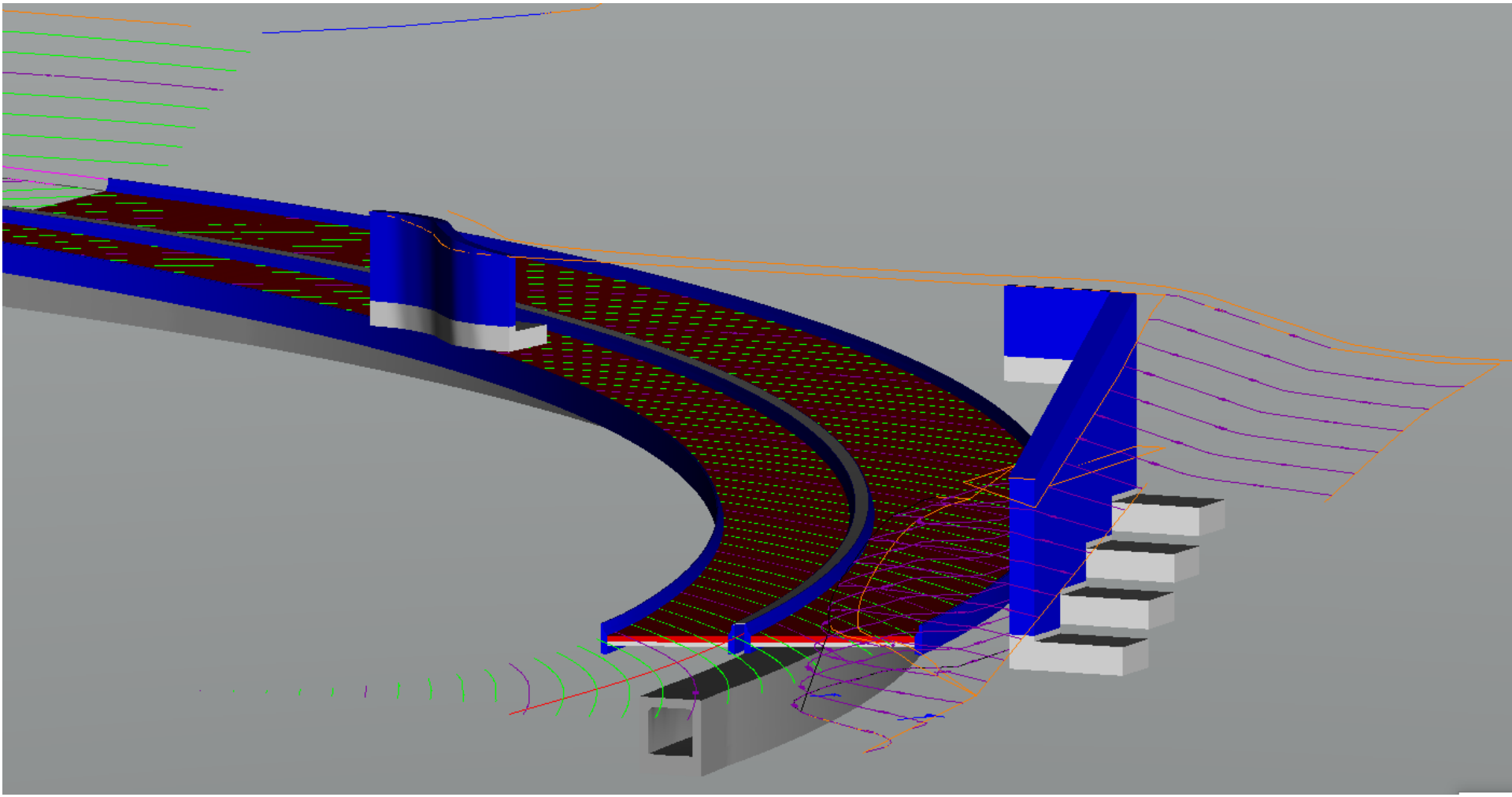
Retaining Wall



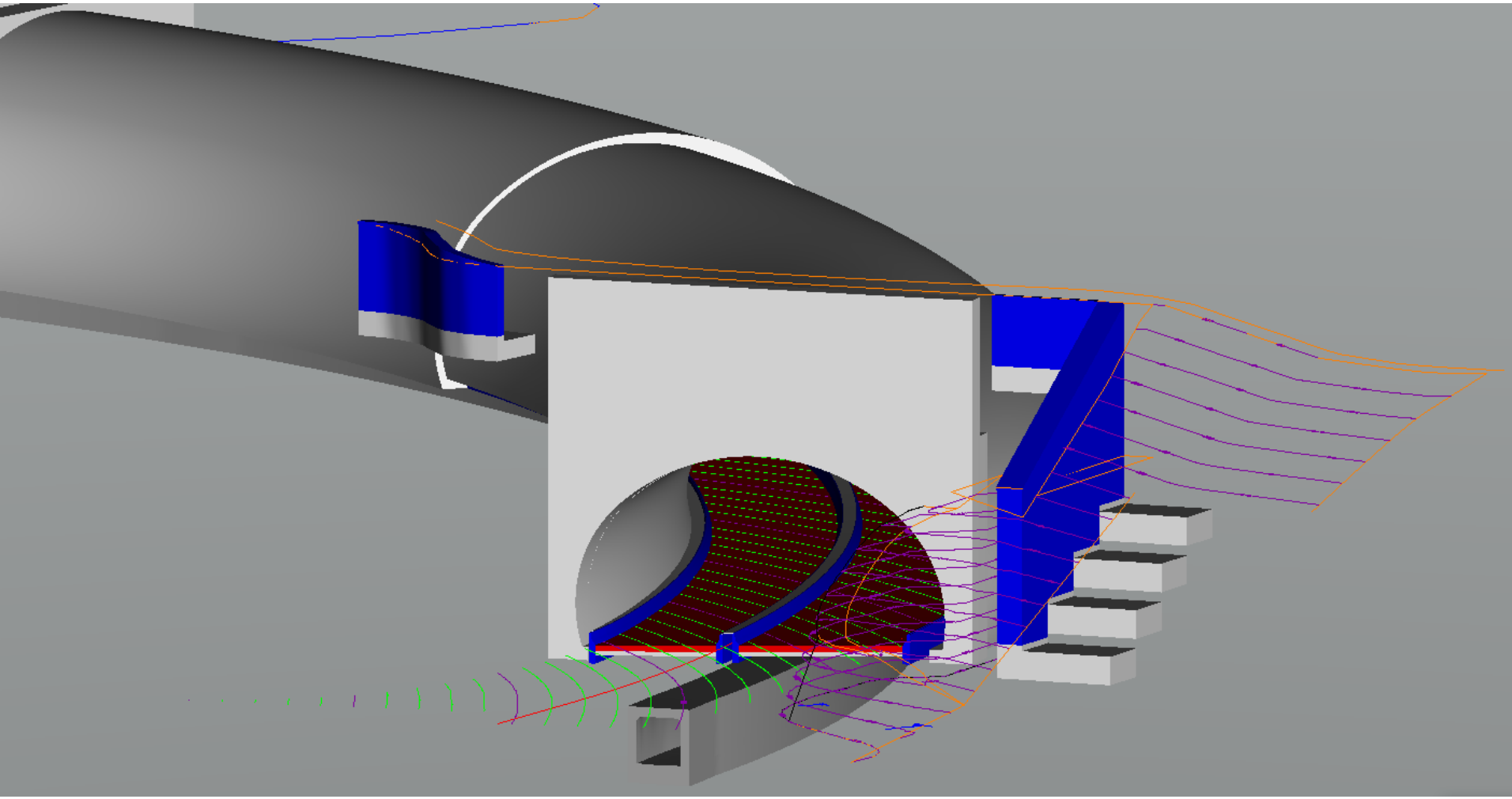
Base Slab



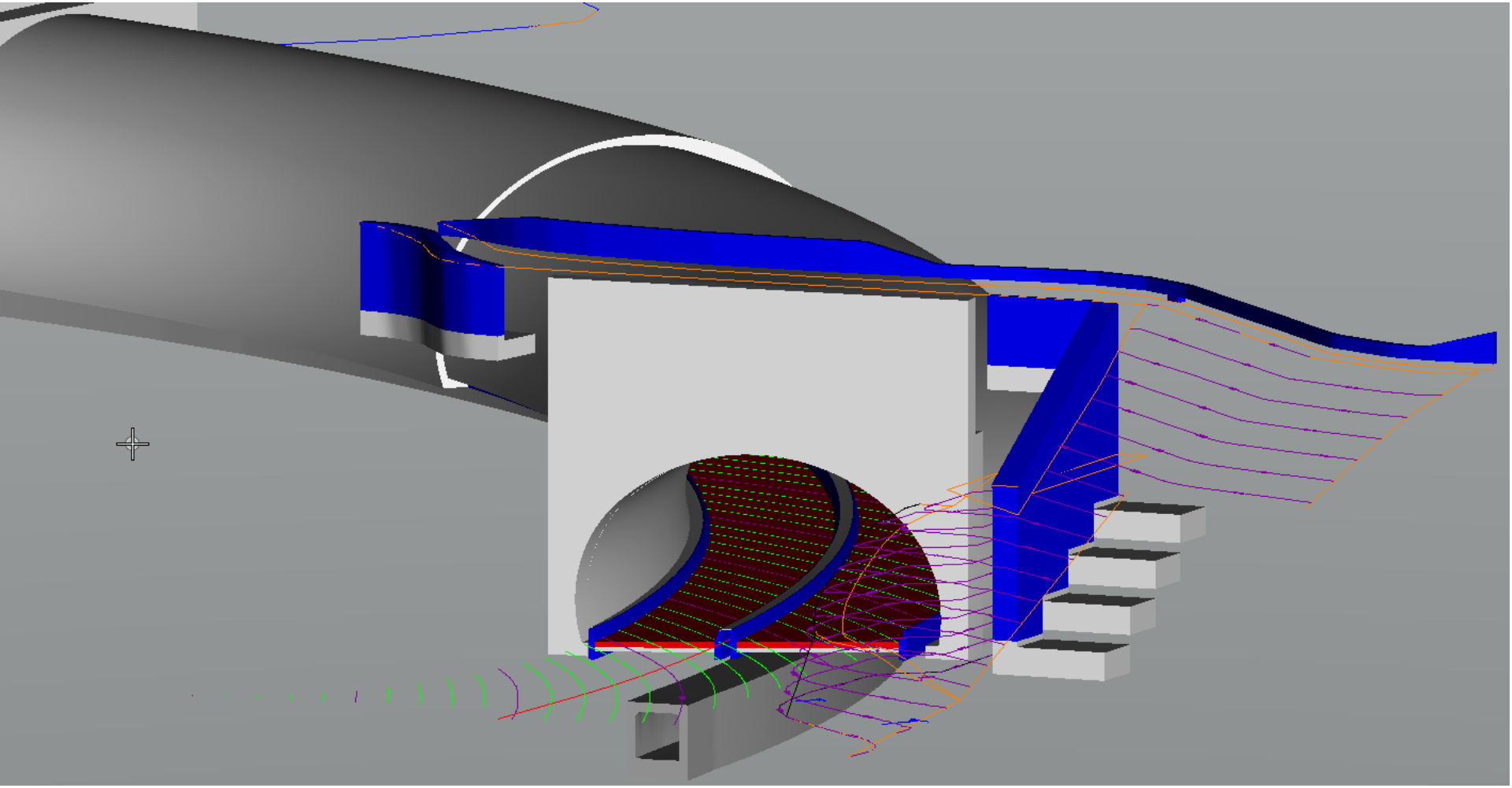
Tunnel Base



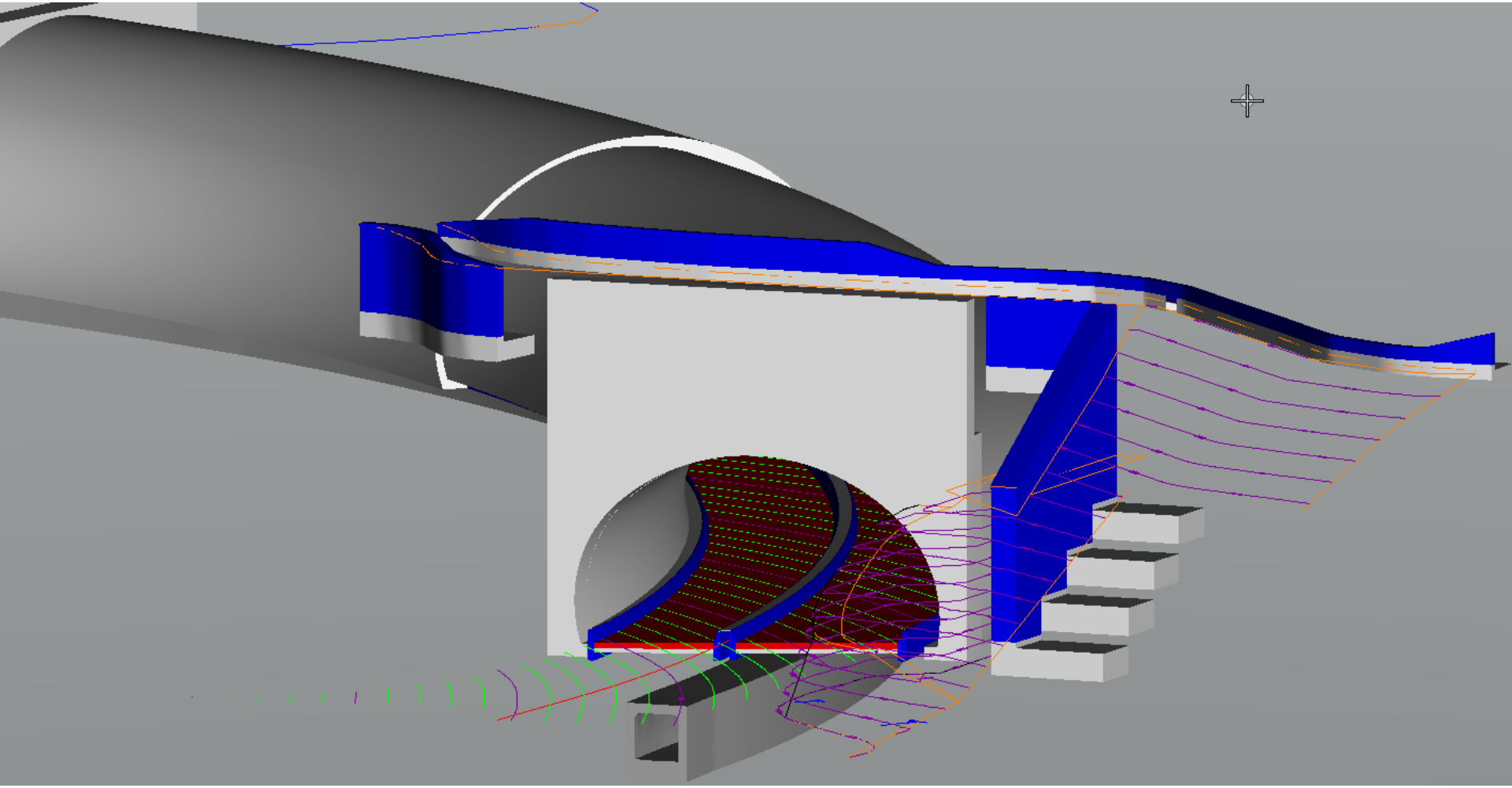
Tunnel Wall



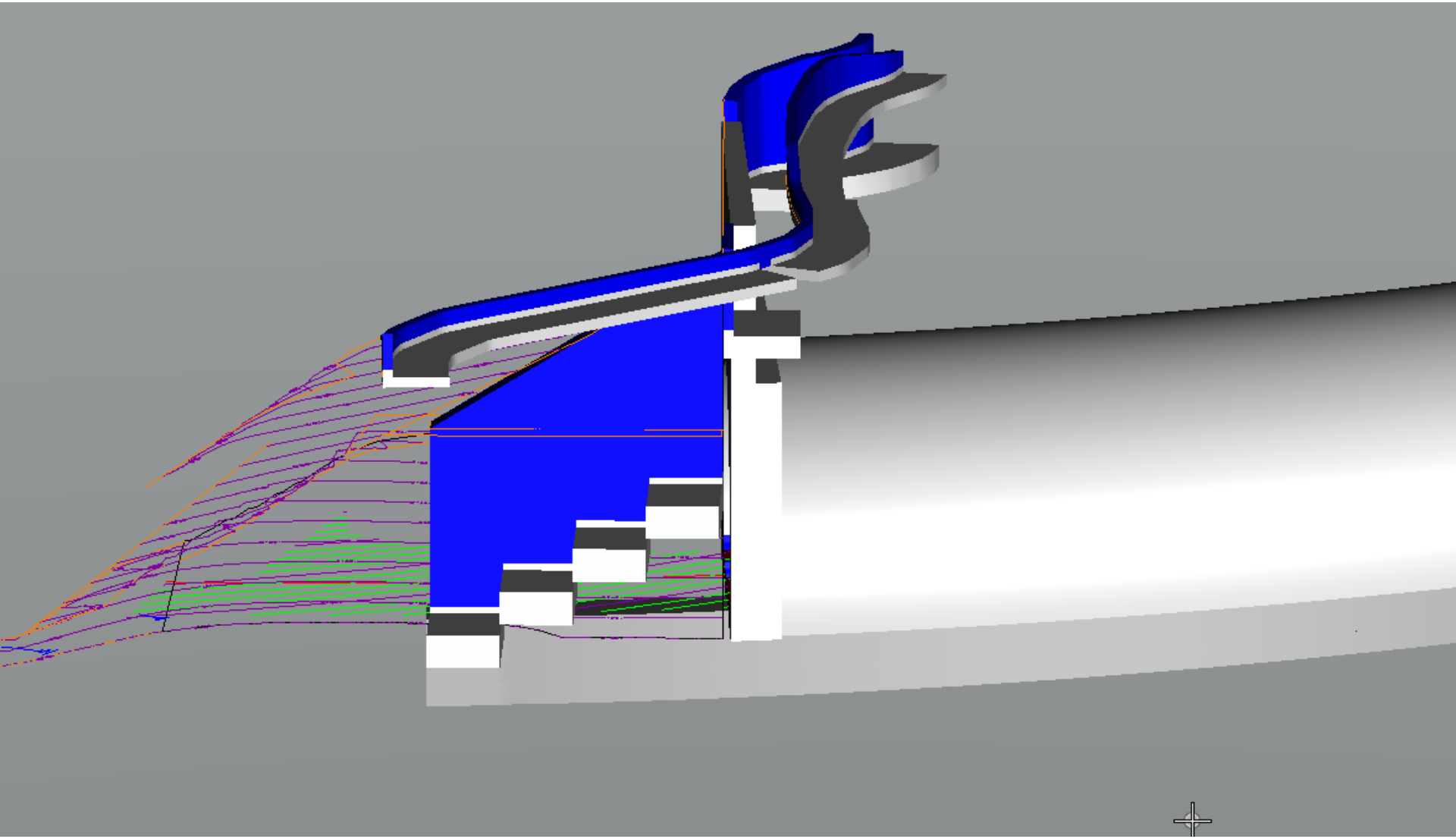
Retaining Wall (Top of the Tunnel)



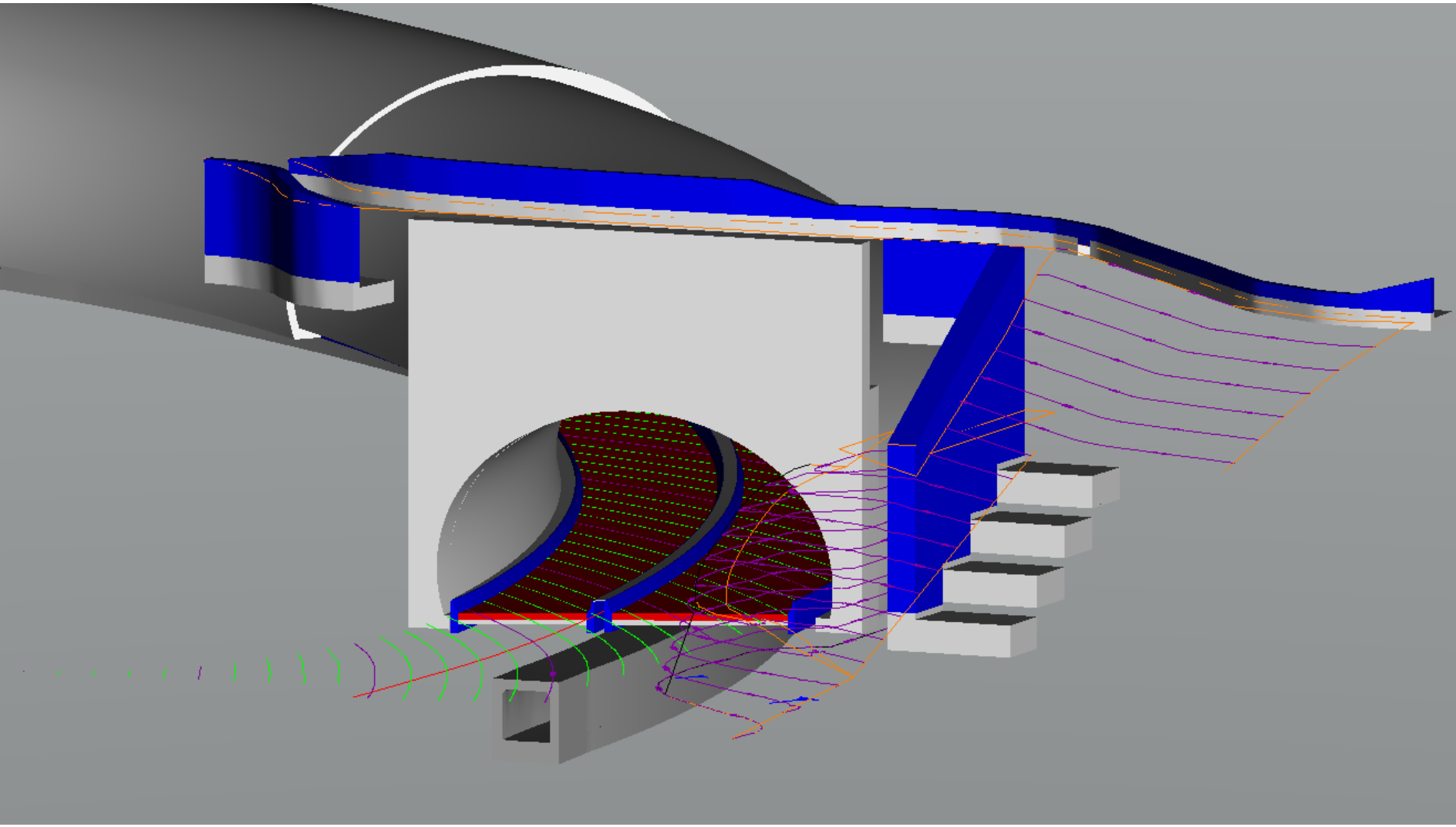
Road (On Top of the Tunnel)



Road (On Top of the Tunnel – Side View)



Constructable Model (Composite Structures)



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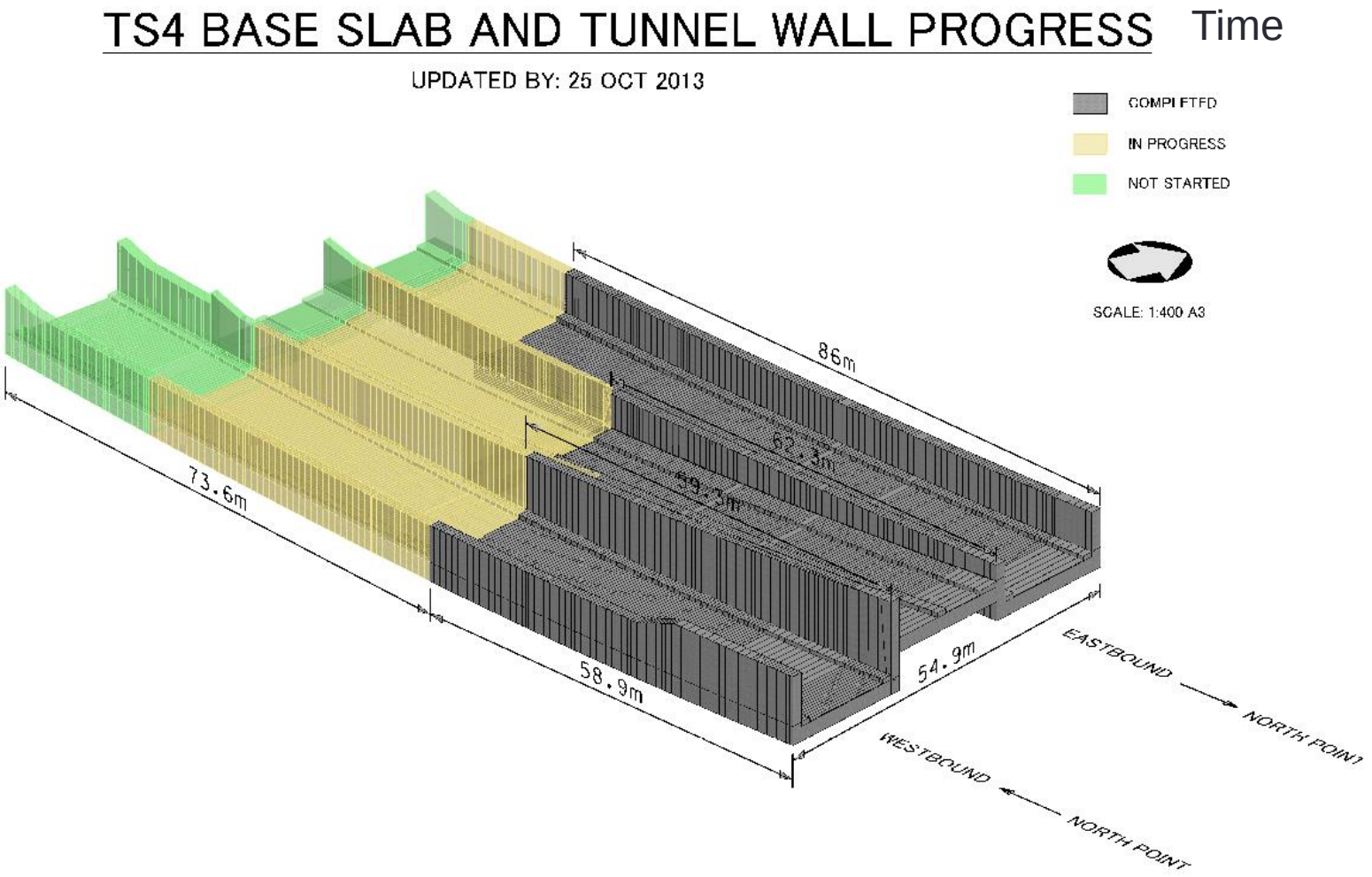
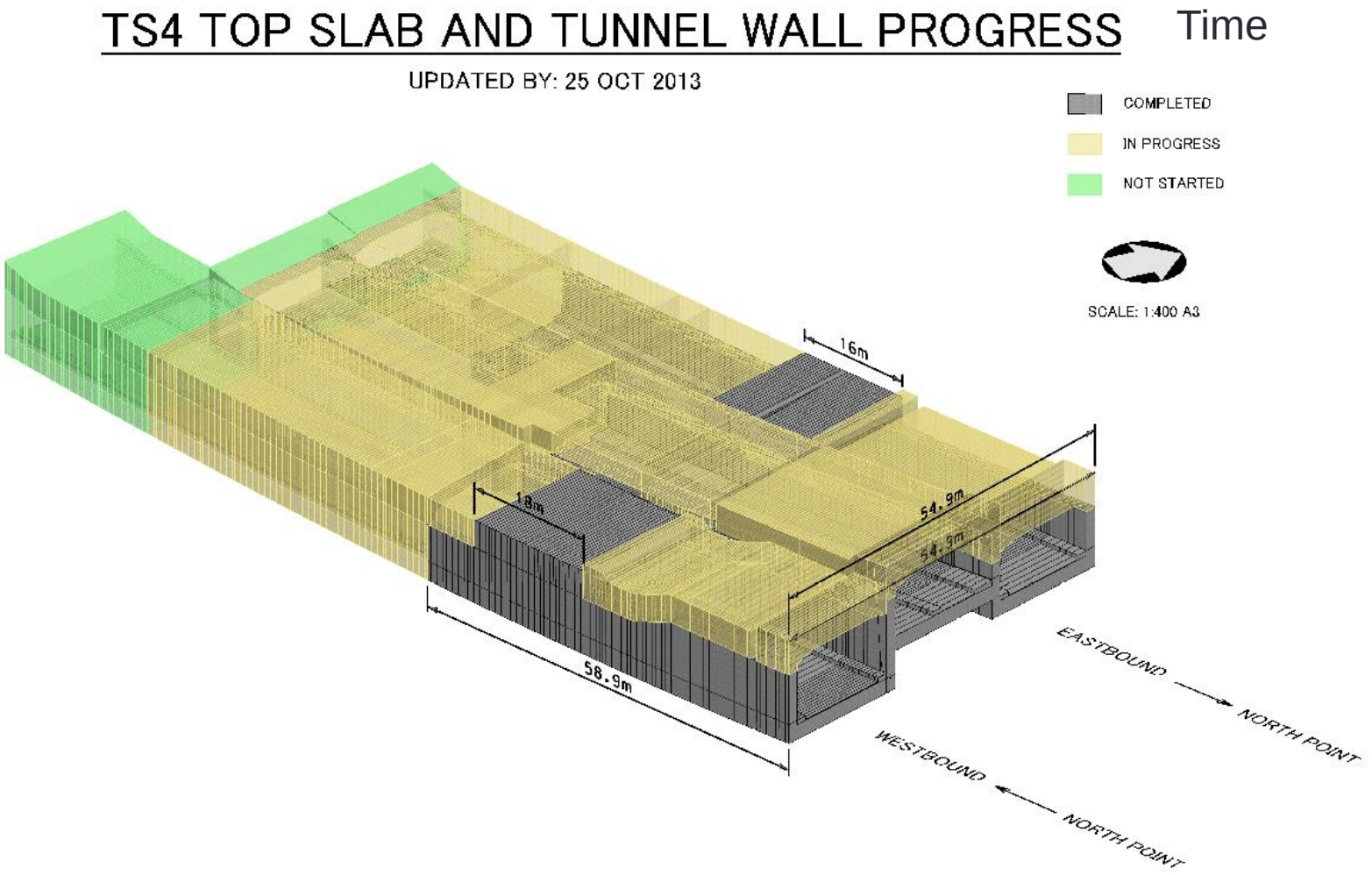
- Construction Schedule (4D)

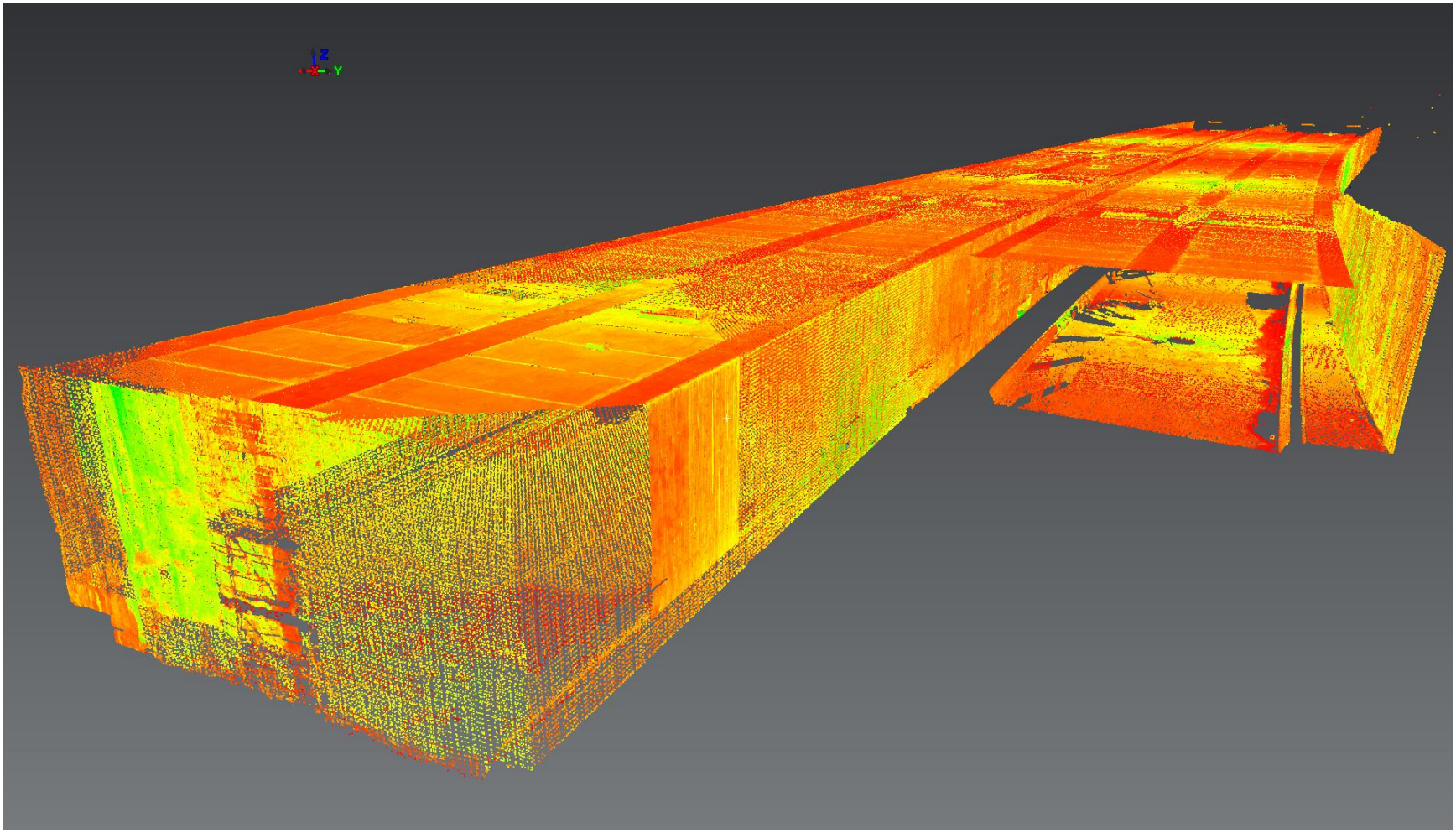
Progress Presentation



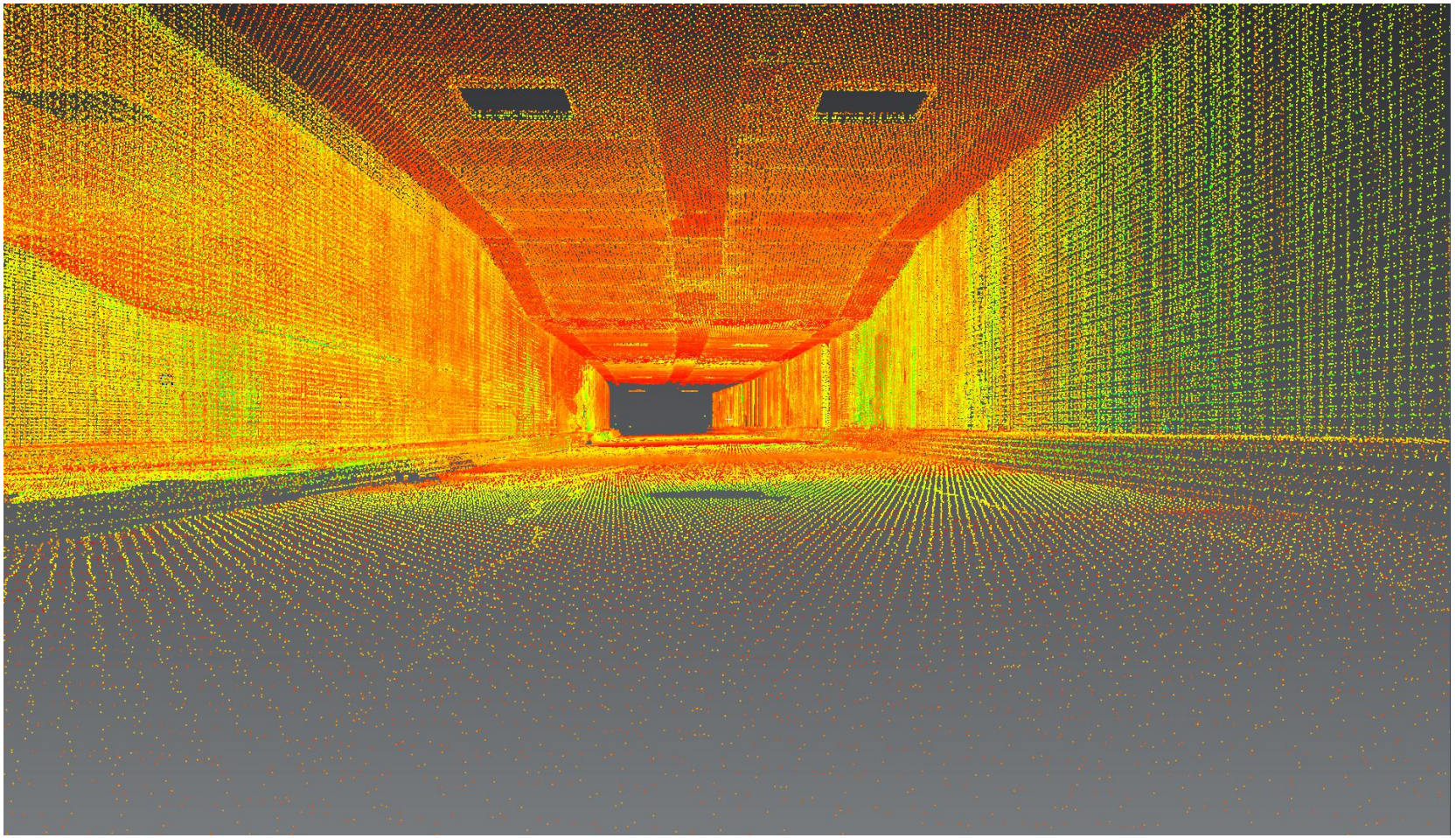
Progress Presentation



As-Built Record Survey in 3D By Laser Scanning



As-Built Record Survey in 3D By Laser Scanning



Functions of BIM Manager

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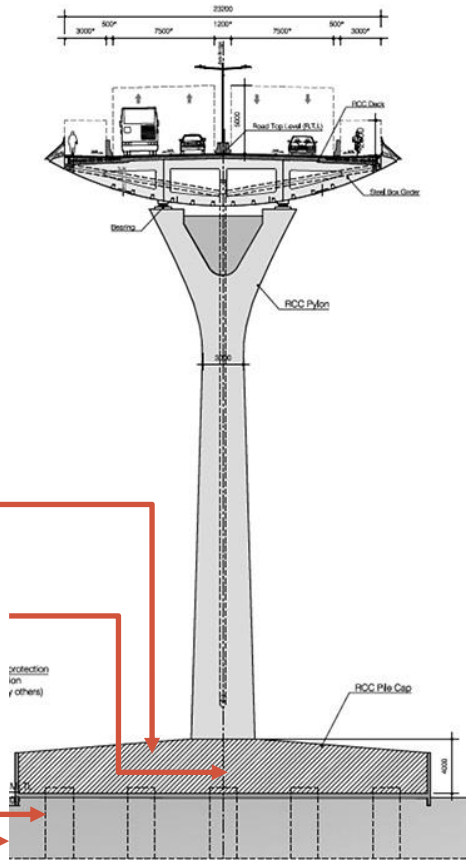
- As-built (6D)
- Asset Lifecycle (7D)

Example: Bridge Construction (Pier Segment)



Pile Cap

Central of gravity of starter bars of column at cut-of-level

Piling

G.I. (Predrill for founding level)

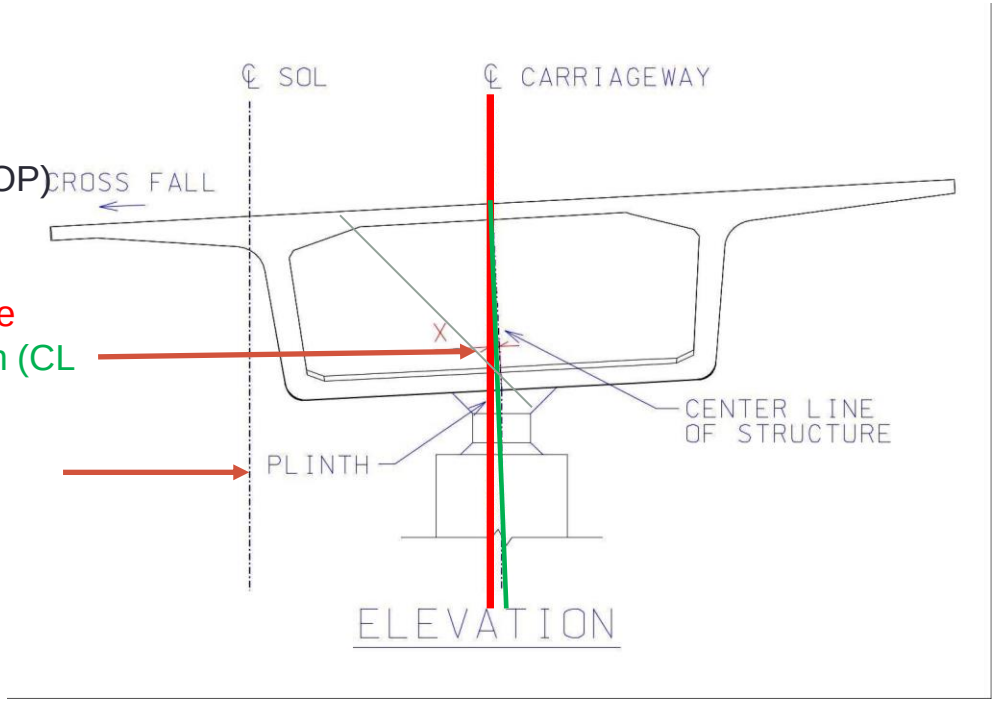
© Ney & Partners

Example: Bridge Construction (Pier Segment)

Calculate Setting Out Point (SOP)

Crossfall at particular Chainage (CL of Carriageway) at Column (CL of Structure) Position

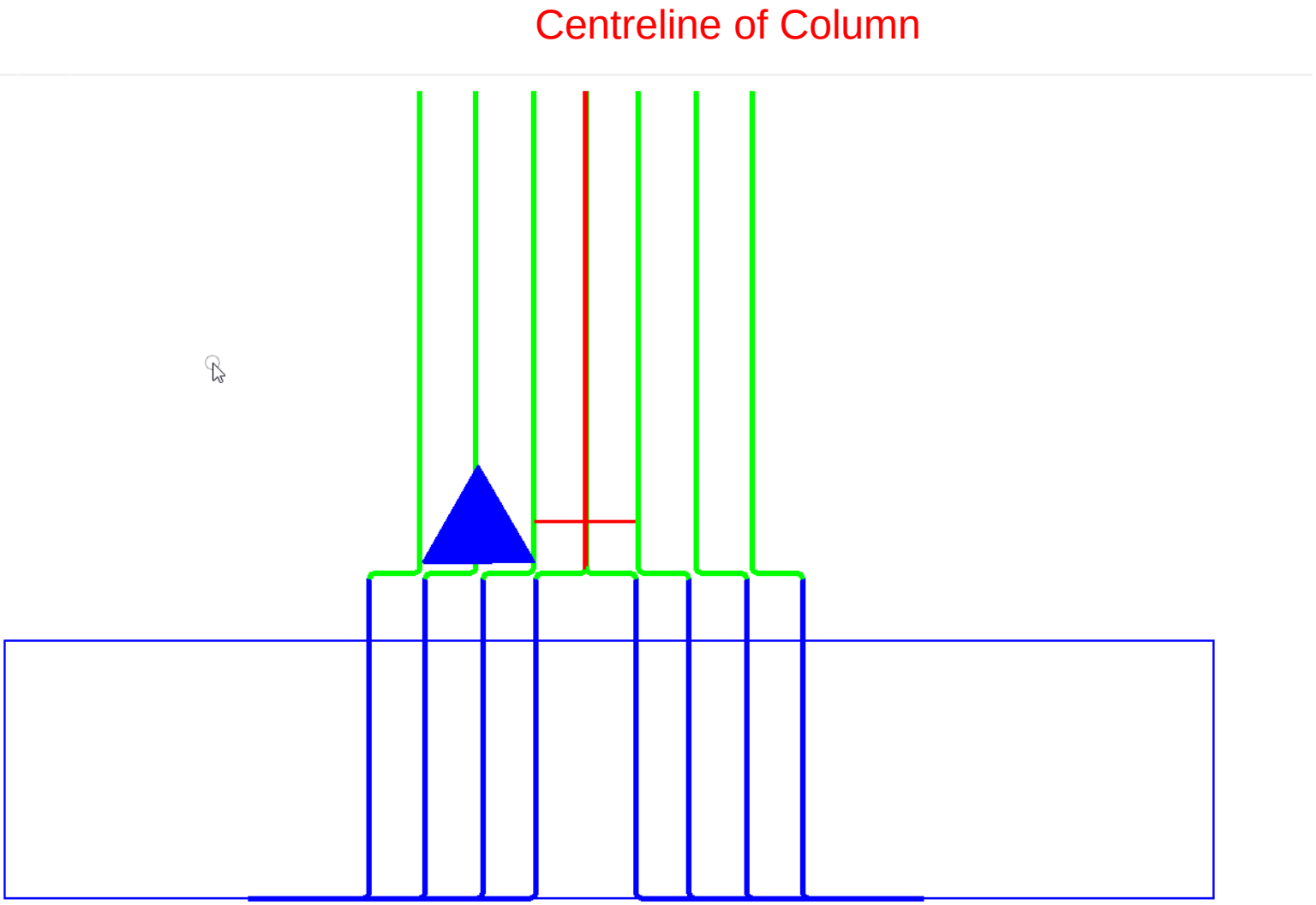
Check Setting Out Line (SOL)



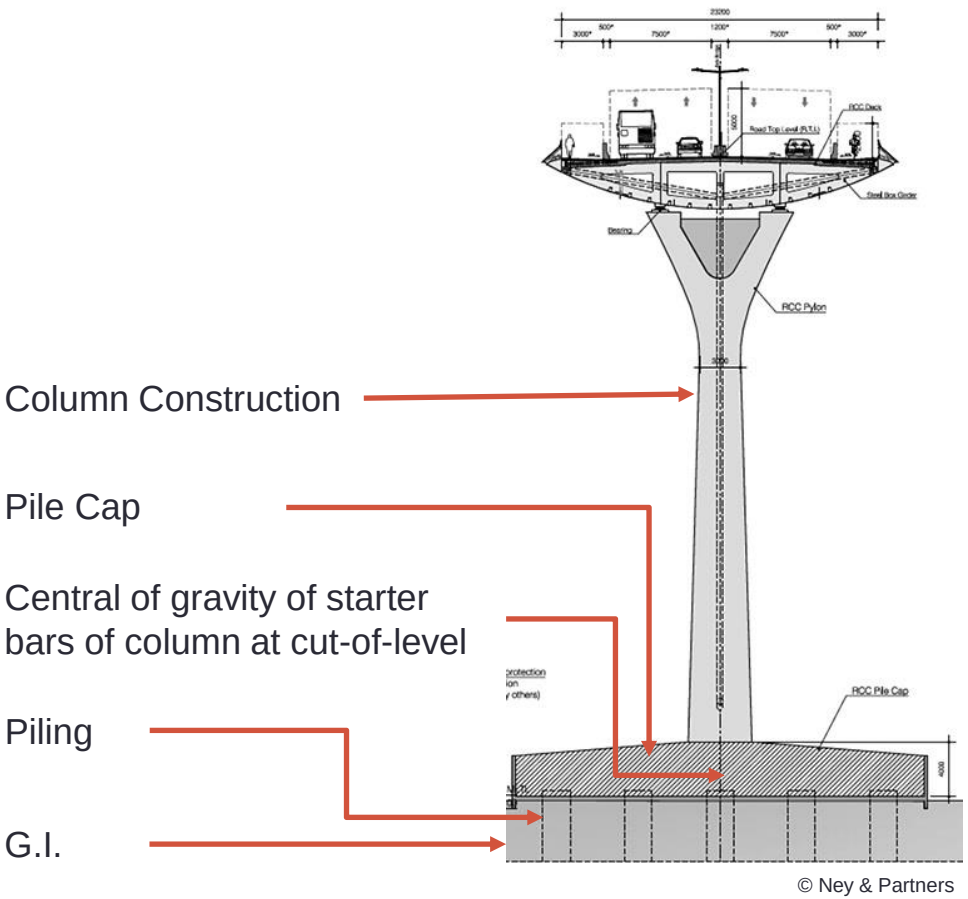
Example: Bridge Construction (Pier)

© http://www.rbdck.com/

Pile Cap and Column Construction



Example: Bridge Construction (Pier)



© Ney & Partners

Example: Bridge Construction (Pier Segment)

Crossheads

Cast-in-situ Beam

Construction of crosshead for new Island Eastern Corridor bridge

Example: Bridge Construction (Pier Segment)

100mm Tarmac (Black Top)

Segmental Construction

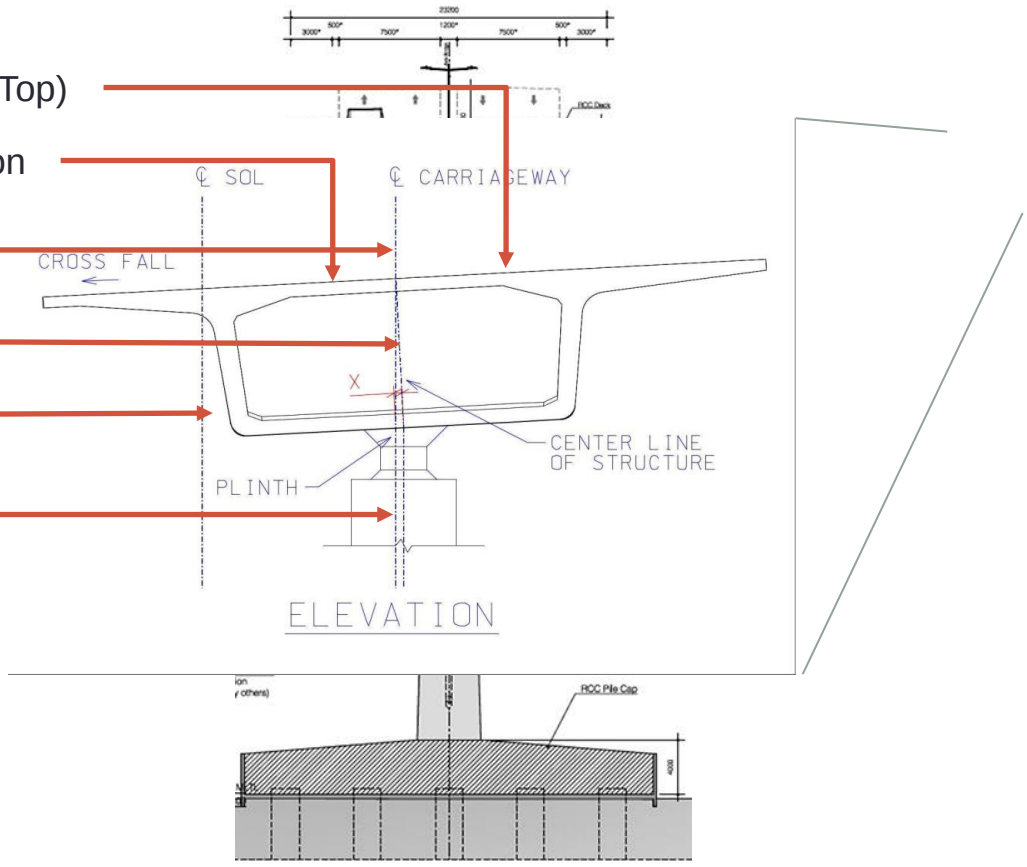
℄ of Carriageway

℄ of Structure

Pier Segment

℄ of Bearing

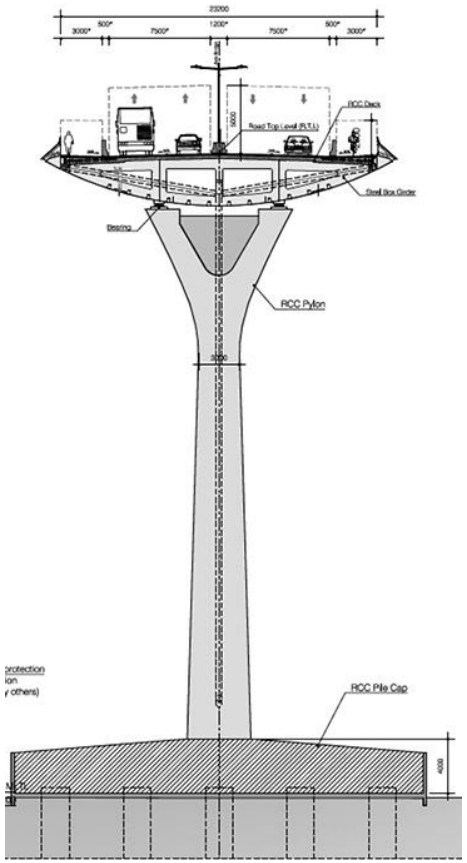
Top of Column/Pier



© Ney & Partners

Example: Bridge Construction (Pier Segment)

- Type(s) of Materials



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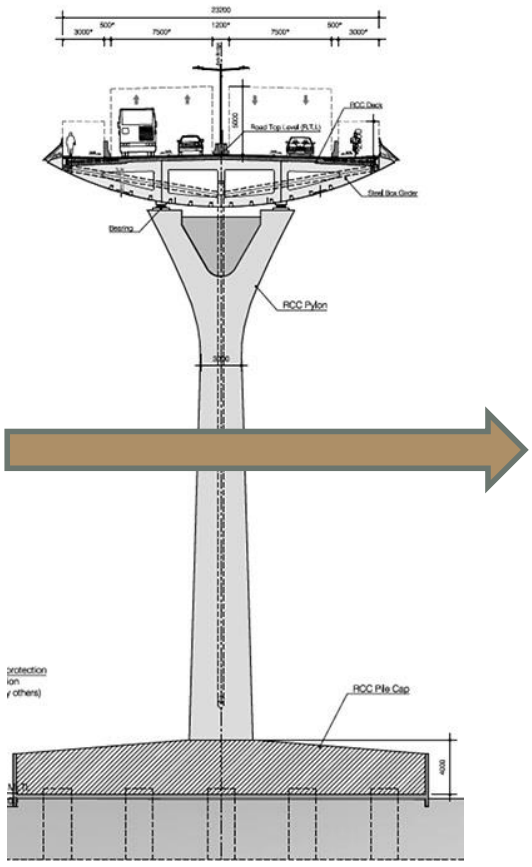
Example: Bridge Construction (Pier Segment)

- Type(s) of Materials
  - Name & Size of Rebar
  - Class of Concrete
  - Class & Type of Rock at Founding Level
  - Class & Type of Grouting
- Quantity of Material(s)
- Logistics:
  - Availability of Material(s)
    - Sourcing
      - Supplier(s)
      - Location of supplier(s)
    - Purchase Order (PO)
  - Timing of Material(s)
    - Shipping
    - Storage
    - Delay
- Timing of Construction



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4D + 5D

Way forward:
Natural Reality Model to BIM Modeling

What is NEW and what we have been trying to do??

BIM Process by "Resident Land Surveyors"

A. Data Acquisition (Capture Reality for Conceptual Design) in 3D

- 1980 Datum
- Google Map
- Ground & Existing information(Nature & Man-made)
- Environmental

B. Detailed Design Stage (Virtual Model)

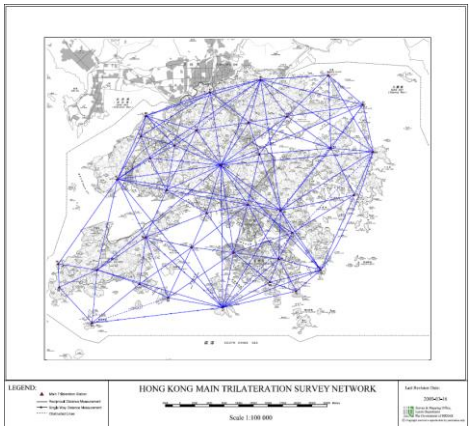
1. 2D Drawings
2. 3D Models

C. BIM Model (Reality Model)

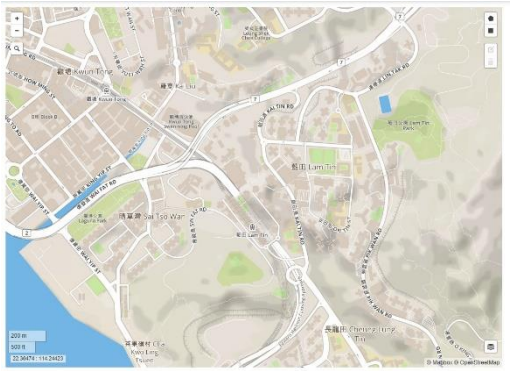
- (A) + (B)
- Constructable Model

From 1980 Datum, Existing Environment to BIM Model (From the WHOLE to the PARTS)

1. HK1980 Datum

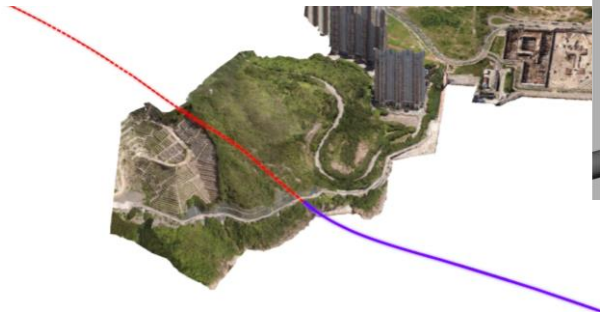


2. Google Map

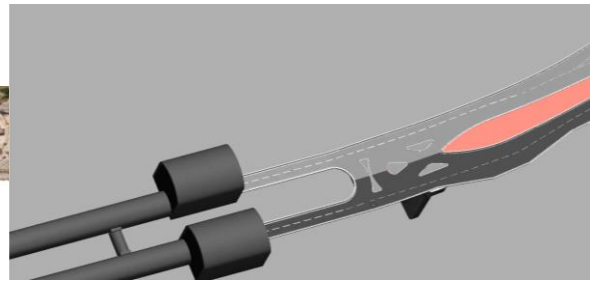


3. Natural Reality Model

4. Conceptual Design

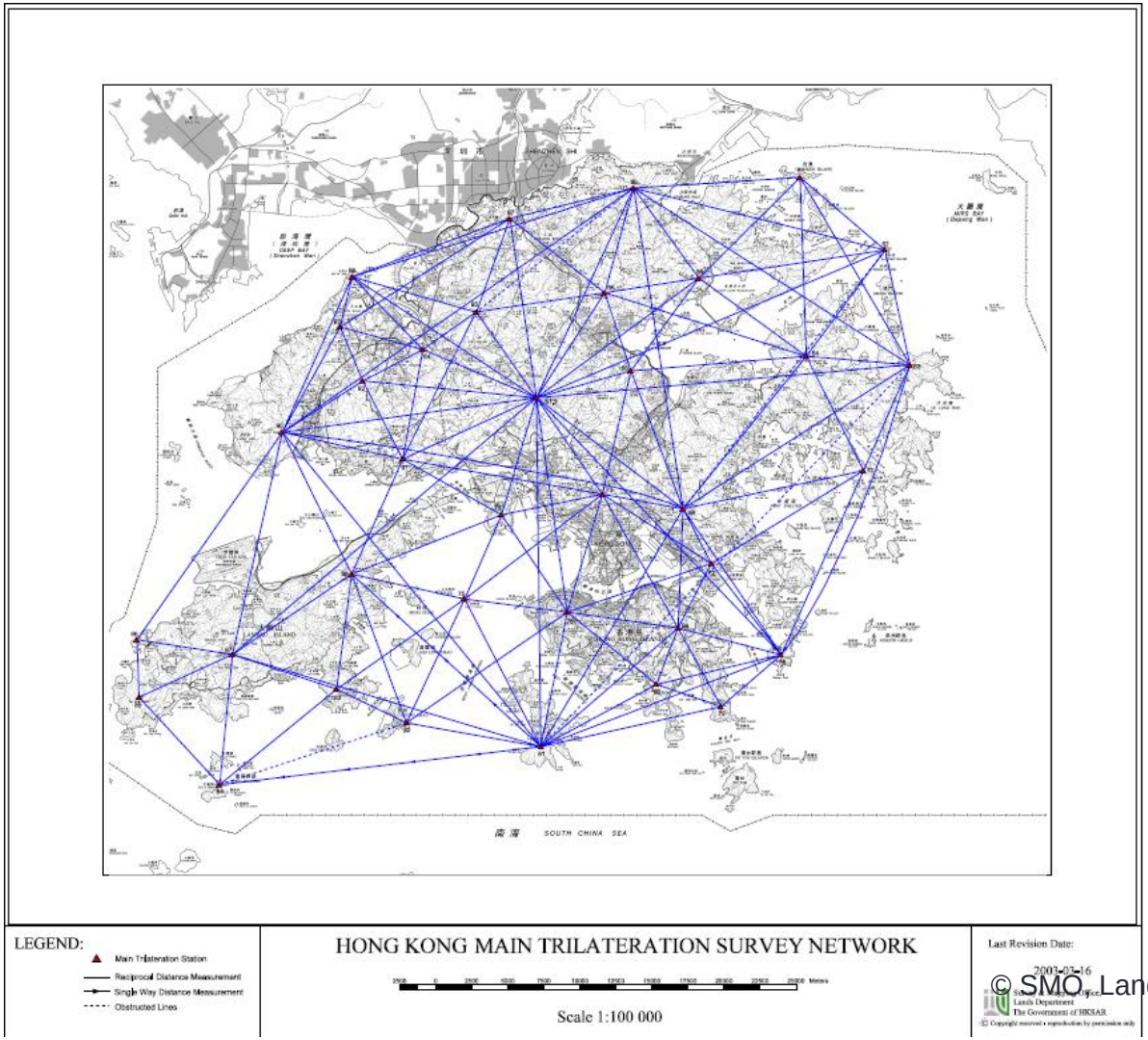


5. Detail Design



6. BIM Model (Reality Model)

1. HK1980 Datum – Trig Points



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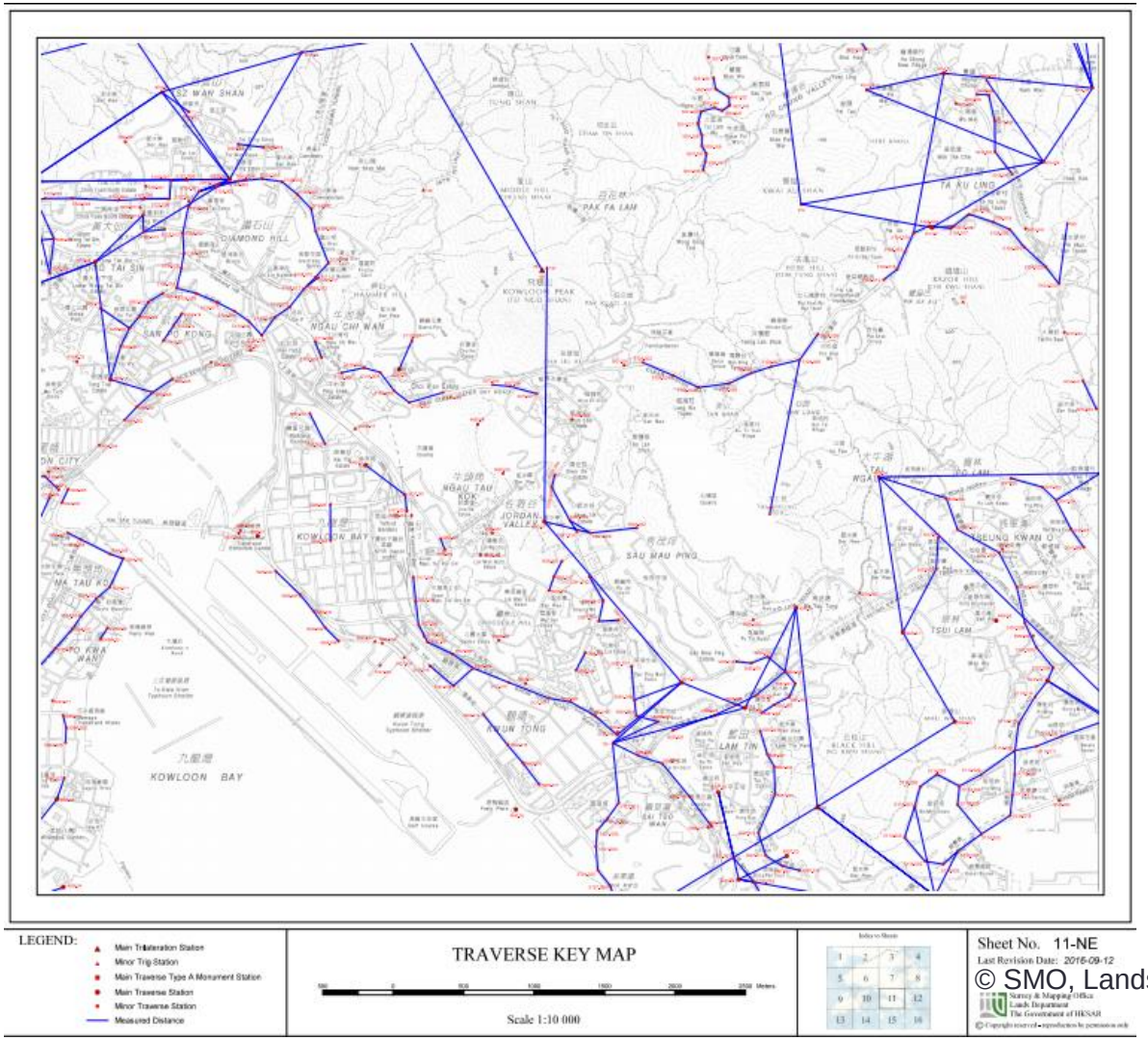
HK1980 Datum – Traverse Points



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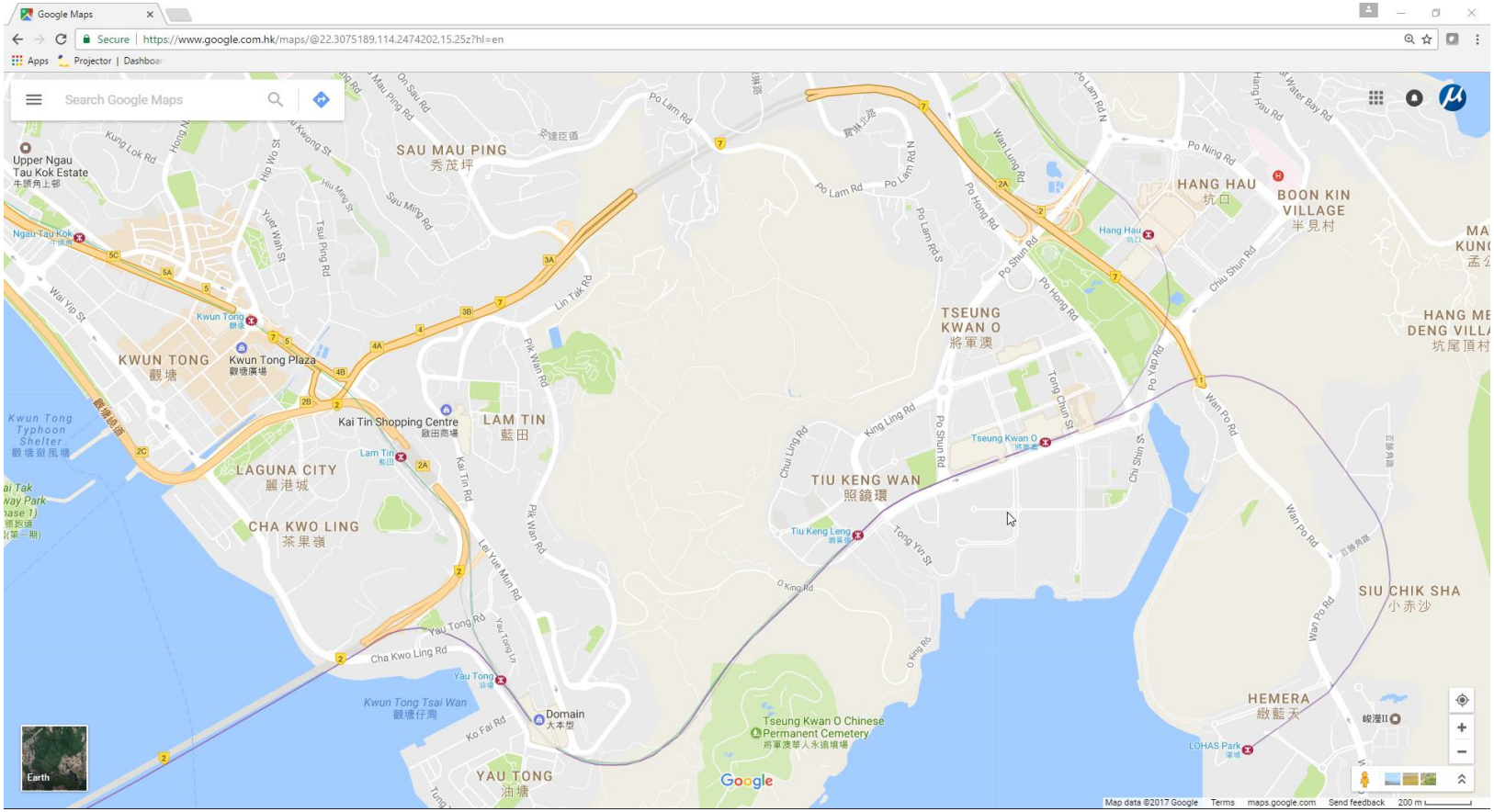
2. Google Map


Google Maps
Secure | https://www.google.com.hk/maps/@22.3075189,114.2474202,15.25z?hl=en
Search Google Maps
SAU MAU PING
秀茂坪
Upper Ngau Tau Kok Estate
牛頭角上邨
KWUN TONG
觀塘
Kwun Tong Plaza
觀塘廣場
Kwun Tong Typhoon Shelter
觀塘避風塘
Kai Tin Shopping Centre
啟田商場
LAM TIN
藍田
LAGUNA CITY
麗港城
CHA KWO LING
茶果嶺
Kwun Tong Tsai Wan
觀塘仔灣
Domain
大本型
YAU TONG
油塘
Tseung Kwan O Chinese Permanent Cemetery
將軍澳華人永遠墳場
TSEUNG KWAN O
將軍澳
HANG HAU
坑口
BOON KIN VILLAGE
半見村
TIU KENG WAN
照鏡環
SIU CHIK SHA
小赤沙
HEMERA
緻藍天
LOHAS Park
Earth
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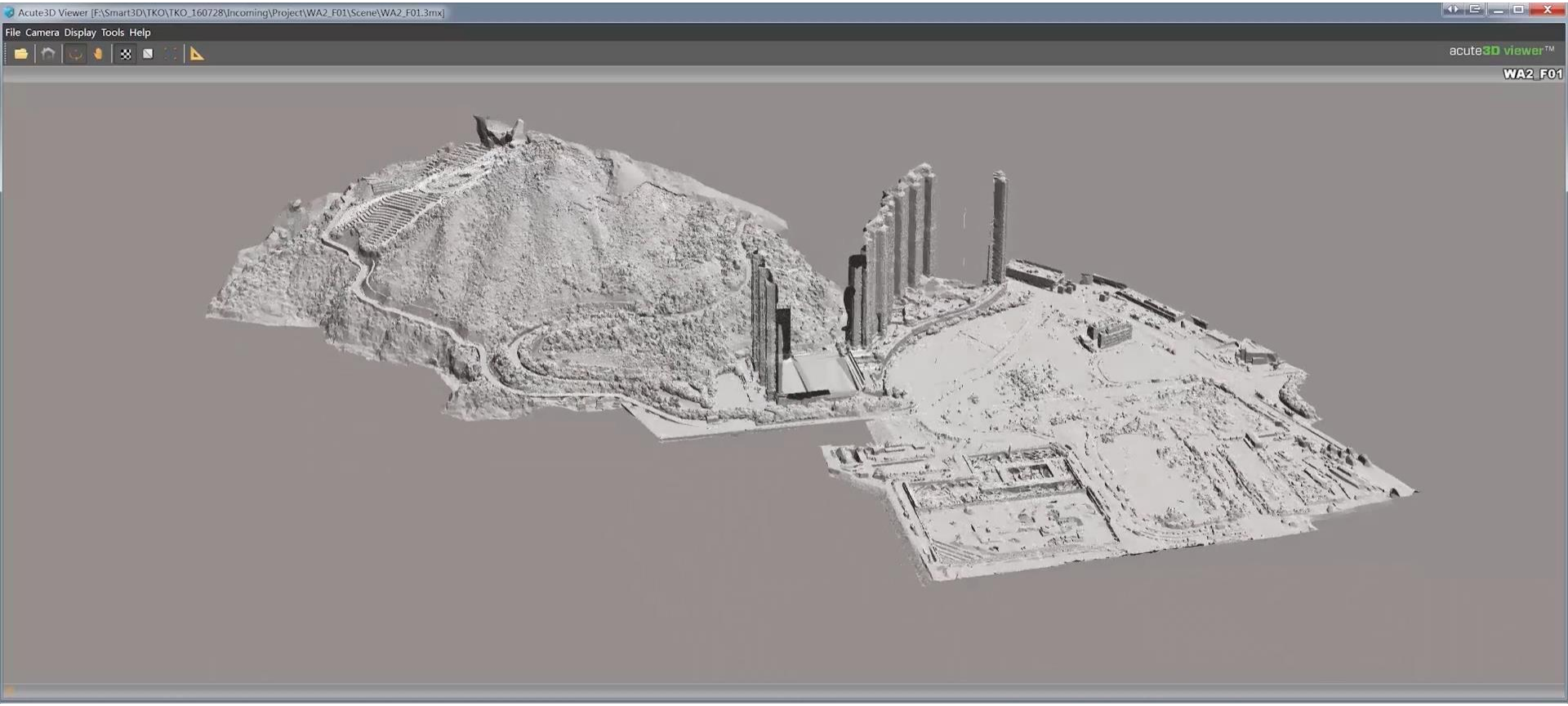
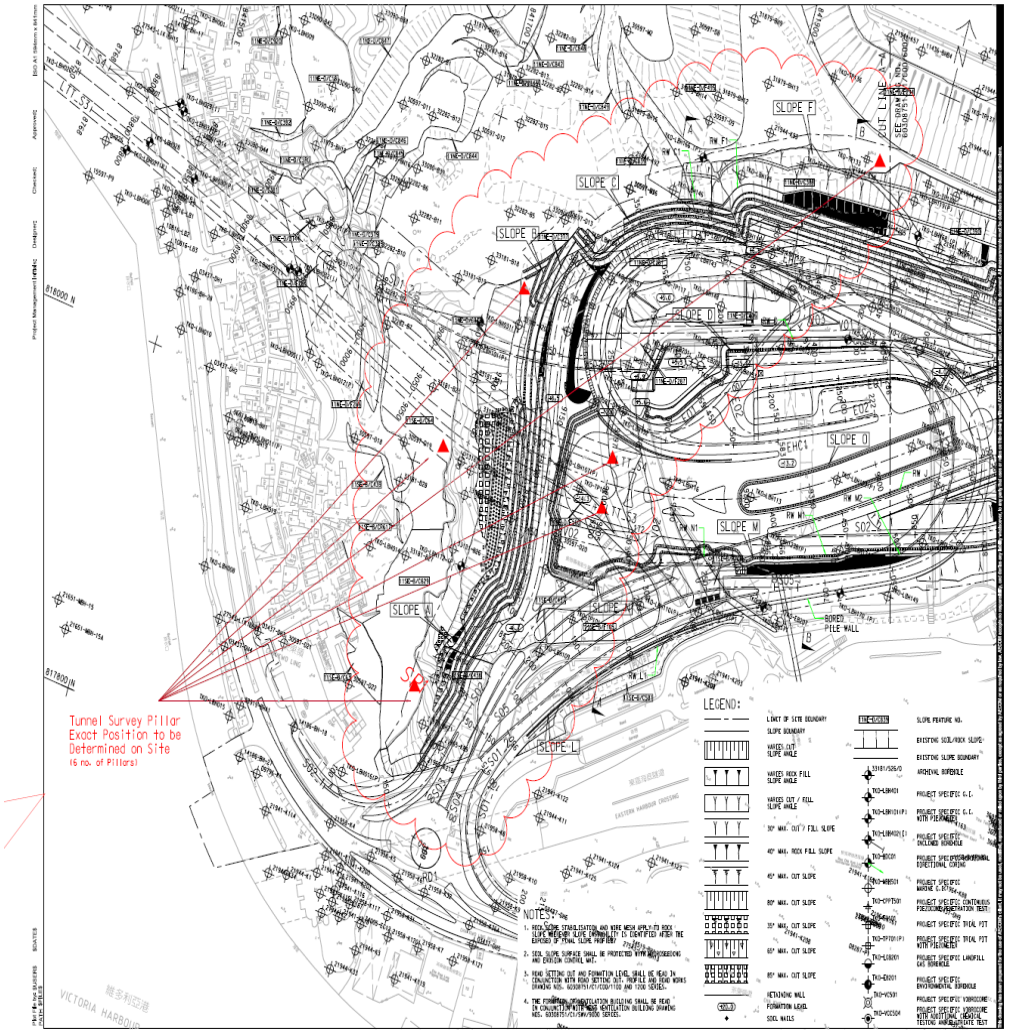
3. Natural Reality Model

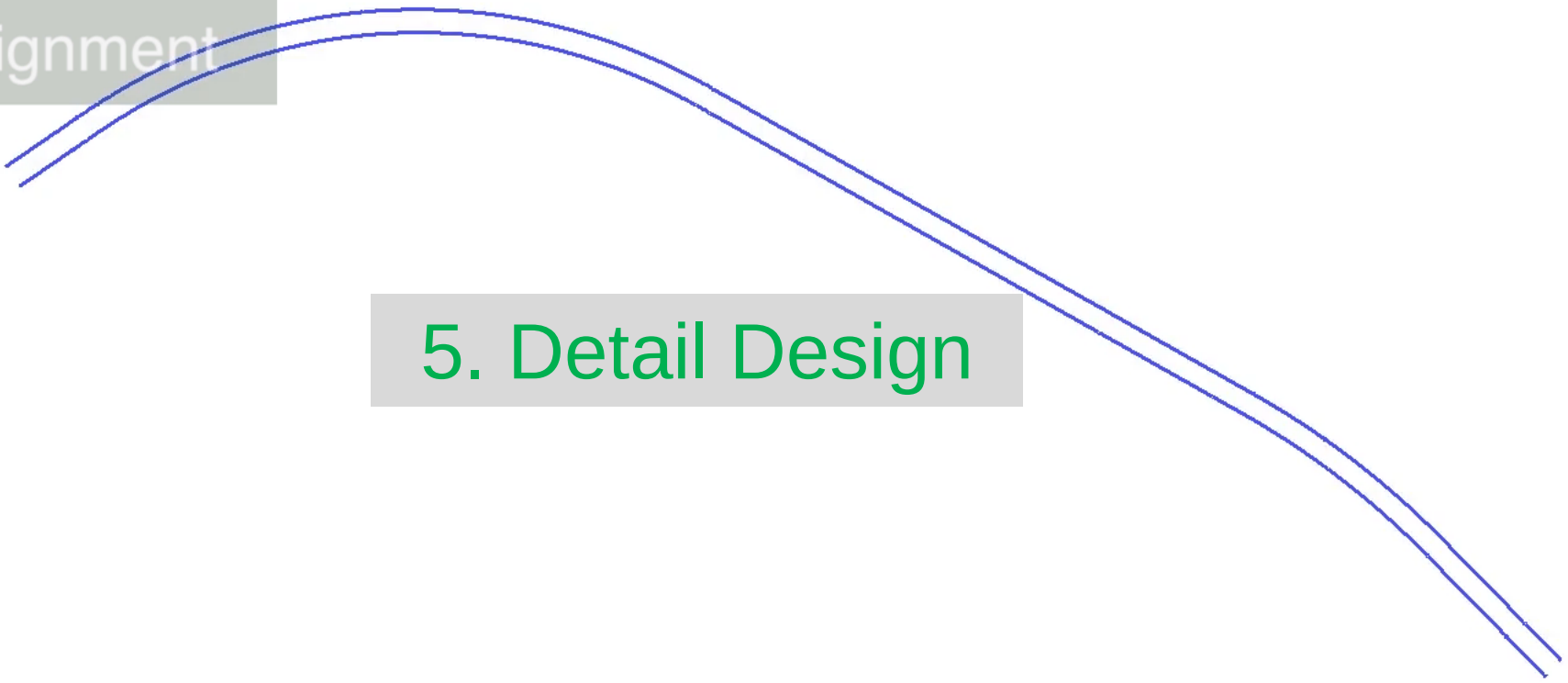


From Working Drawing to Conceptual Design



4. Conceptual Design

5. Detail Design



6. BIM Model (Reality Model)

Lam Tin
Infrastructure Interchange Model

The benefits of BIM is not only limited to Design and Construction; but also **Operation and Maintenance**

Asset-Relationship Model : Bridge

Environmental Qualification

- Environmental Monitoring Method
- Impact Assessment

Design Requirement

Alignment Design
Design Properties

- Design Code (TPDM)
- Speed
- Sight Distance (HZ &Vz)
- Numbers of Lanes
- Geology

Preliminary Design

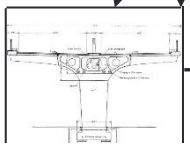
Structures Maintenance

- Budgets
- Frequency
- Records
- Alert, Action Limits
- Lifespan

Contractor Properties

- Project Value
- Contract Period
- Numbers of Labor
- Experience

Location:
Easting/Northing
Chainage
East/Westbound
District



Bridge Section

Supplier Lists

Section 1

Section 2

Spare:

C-No. 6791

Test Results

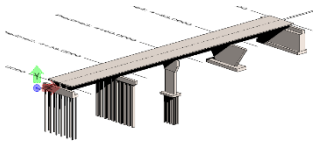
- Tons
- Dimension

C-No. 6792

C-No. 6793

Construction Properties

- Method
- Duration
- Safety



Logistics Properties

- Locations
- Shipping
- Storage
- PO

BIM

Asset-Relationship Model : Pump

Environmental Qualification

- Qualification Method
- EQ Zone Rating

License Application Requirement

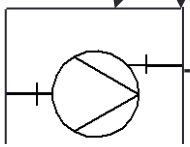
CCS Pump Sizing Calculation
Design Pump Properties
- Design Disch Press
- Design Flowrate
- Design NPSH

Flow Diagram

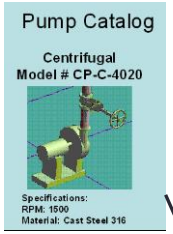
Inservice Test Program
- Test Frequency
- Test Method
- Test Parameters
- Alert, Action Limits

Room Properties
- Normal Temp, Humid
- Accident Temp, Humid
- Rad Levels

Location:
Aux Building
Bldg 12
Level 5
Room 12561



CCS Pump
VS2-CCS-MP-01A



Gould
Model CP-C-4020

Division 1

Serial 6791

Test Results
- Discharge Press
- Flowrate

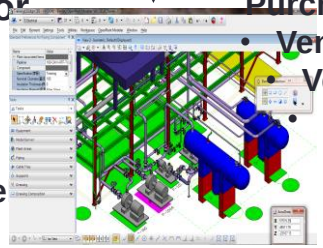
Division 2

Serial 6792

Spare:

Serial 6793

Wall, Ceiling, Floor Properties
- Fire Barrier
- Shield Wall
- Missile Shie



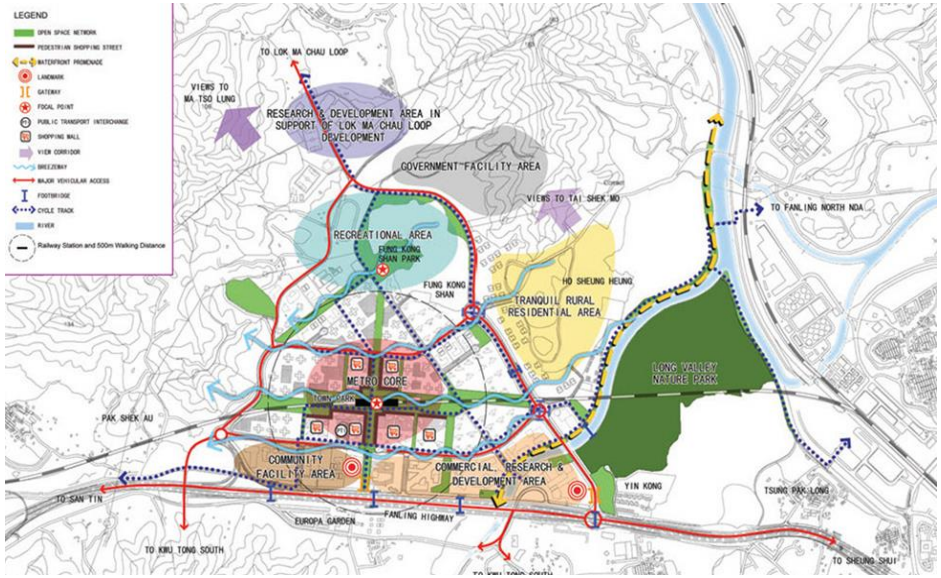
BIM

Purchased Pump Properties
- Vendor Model Disch Press
- Vendor Model Flowrate
- Vendor Model NPSH

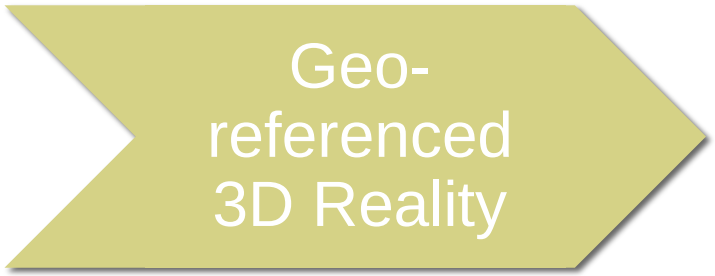
(Level 3 BIM) Asset Management

BIM Lifecycle (Ideal)

Blue Print (Development Plan)



BIM Lifecycle (Ideal)



Blue Print

BIM Lifecycle (Ideal)

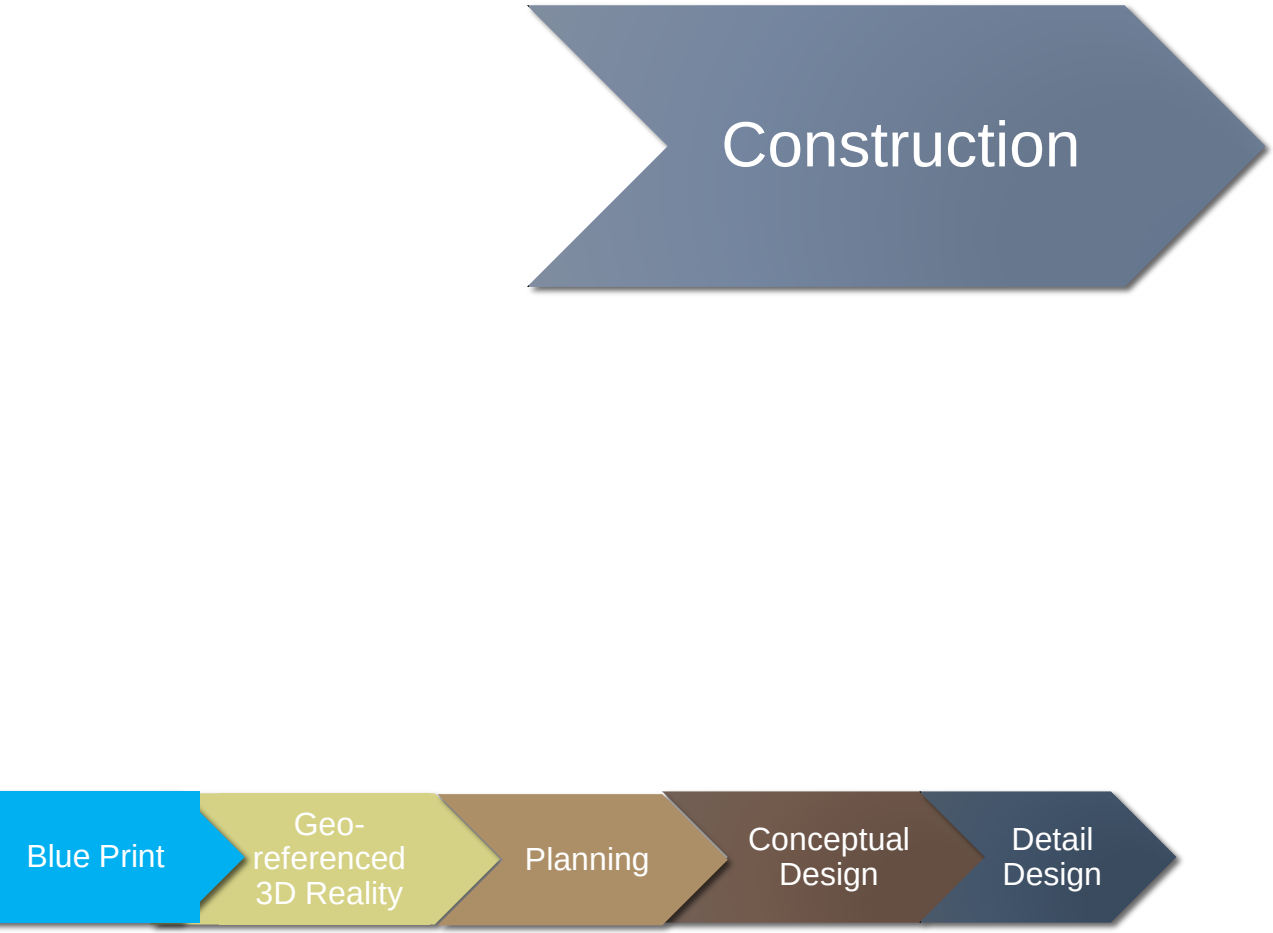
Blue Print

Geo-referenced 3D Reality

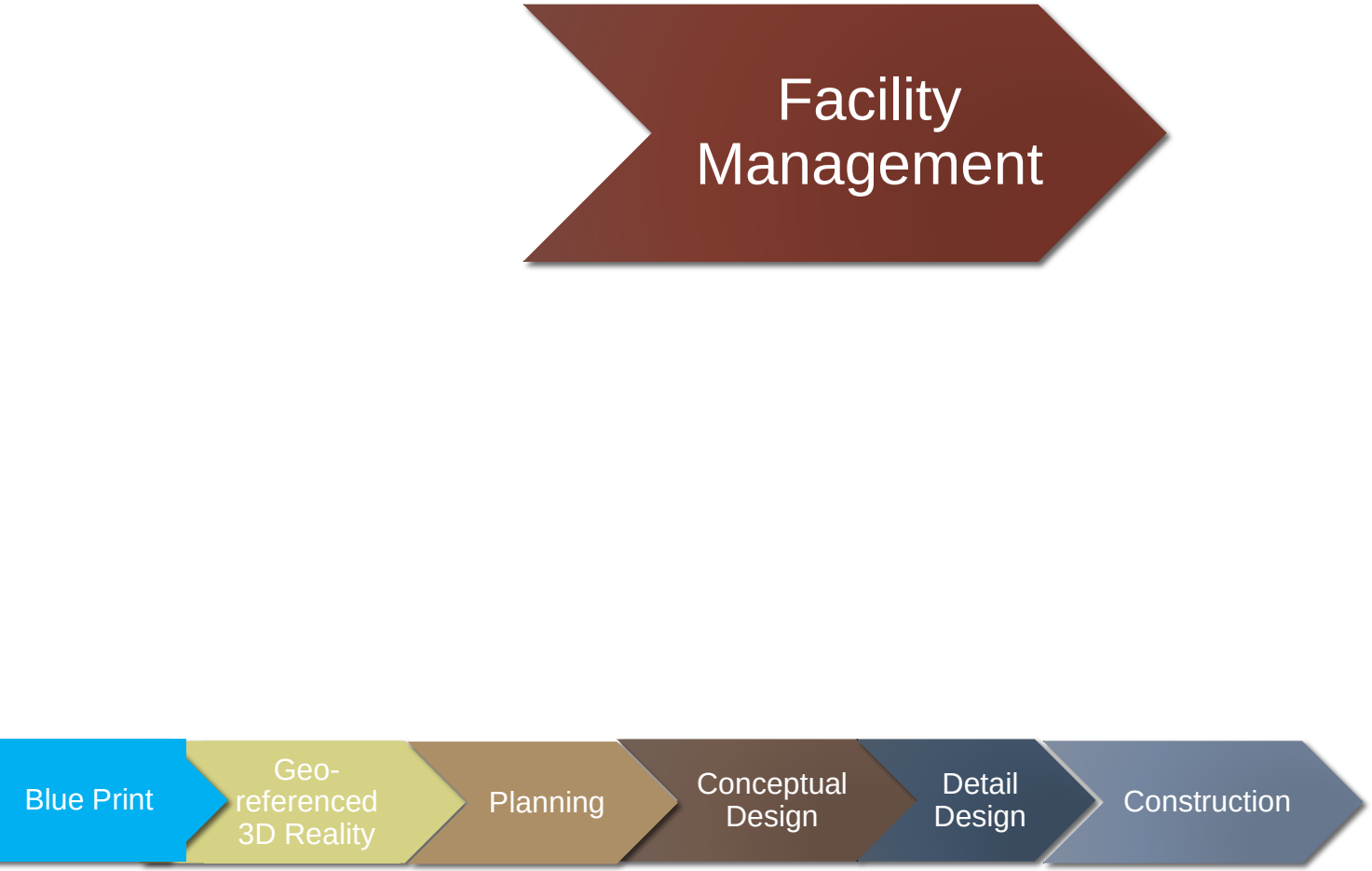
BIM Lifecycle (Ideal)

BIM Lifecycle (Ideal)

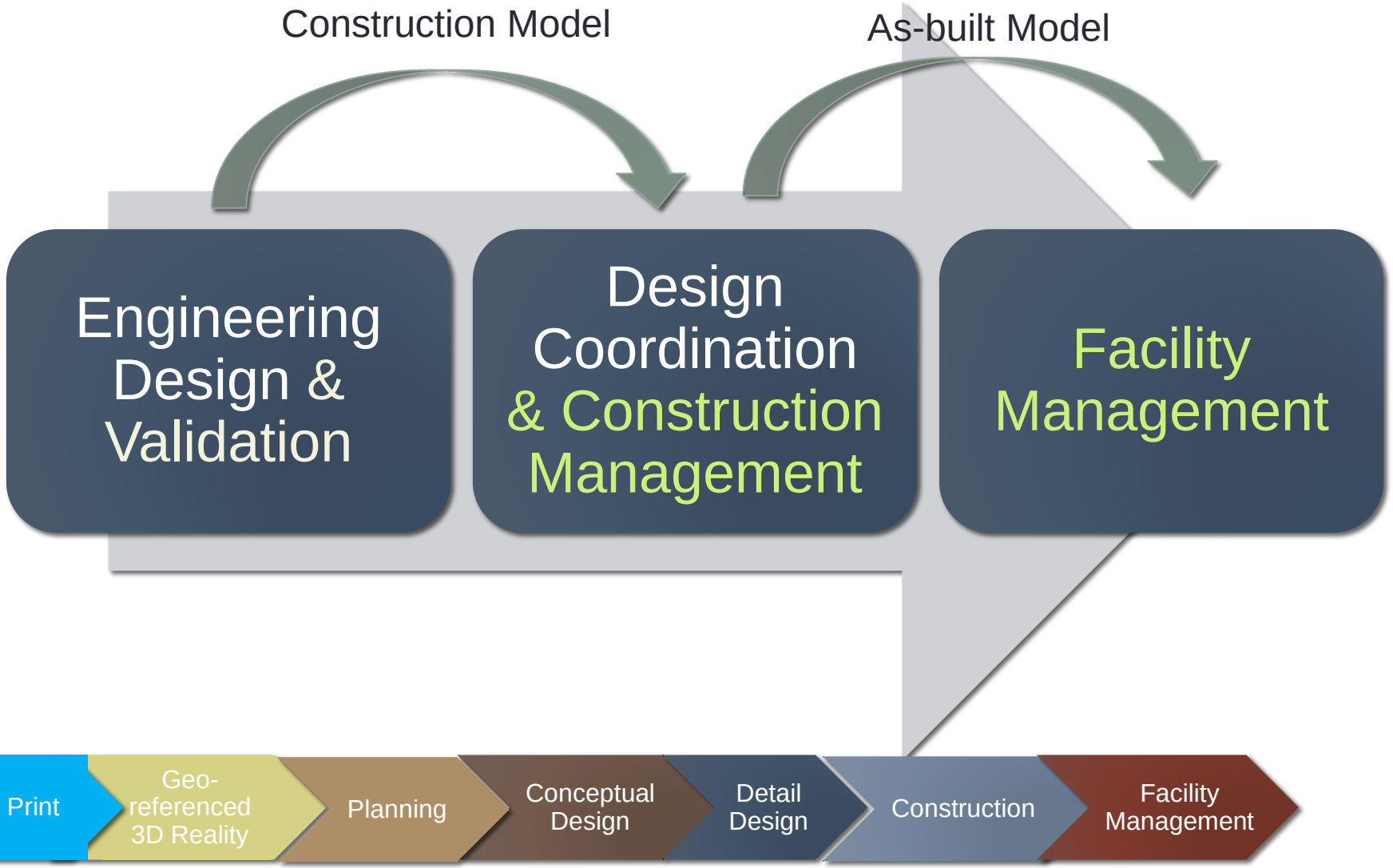
BIM Lifecycle (Ideal)



BIM Lifecycle (Ideal)



BIM Lifecycle (Ideal)



THANK YOU