Reality Modelling

BIM Model based on a Point Cloud

RAMBØLL

Bright ideas.
Sustainable change.

About me

- Jón Gunnar Hilmarsson
- BIM manager at Rambøll – Bridge department
- Worked in Transport for 9 years

- Specialist in Bentleys BIM software
- Heavy focus on BIM in transport

- Experience from NO, SE, UK, GE and DK

Point cloud scanning – What is it

- A point cloud is a set of data points in space. The points may represent a 3D shape or object. Each point position has its set of Cartesian coordinates

- Point clouds are generally produced by 3D scanners or by photogrammetry software, which measure many points on the external surfaces of objects around them

- Data can be retrieved by Drone, by fixed station or by mobile unit

- Is often referred to as Reality Capturing

Reality Capture at **Rambøll**

Point cloud scanning – What is it

- PCC or LIDAR – format that seems to be in developments
- Other techniques such as Photogrammetry and sonar capture can produce a Point Cloud
- Density and accuracy differs

- Challenge with long lineal objects
- Challenge with Noise
- Accuracy varies.
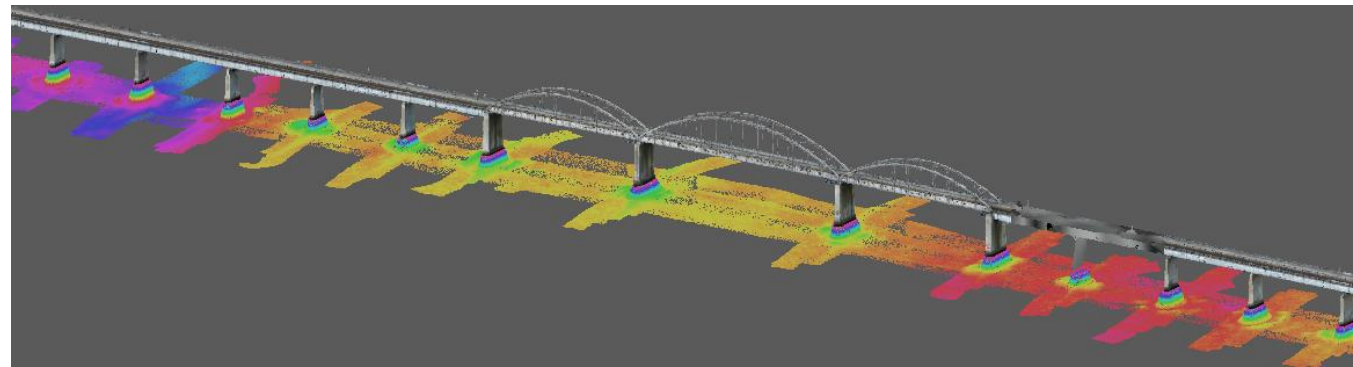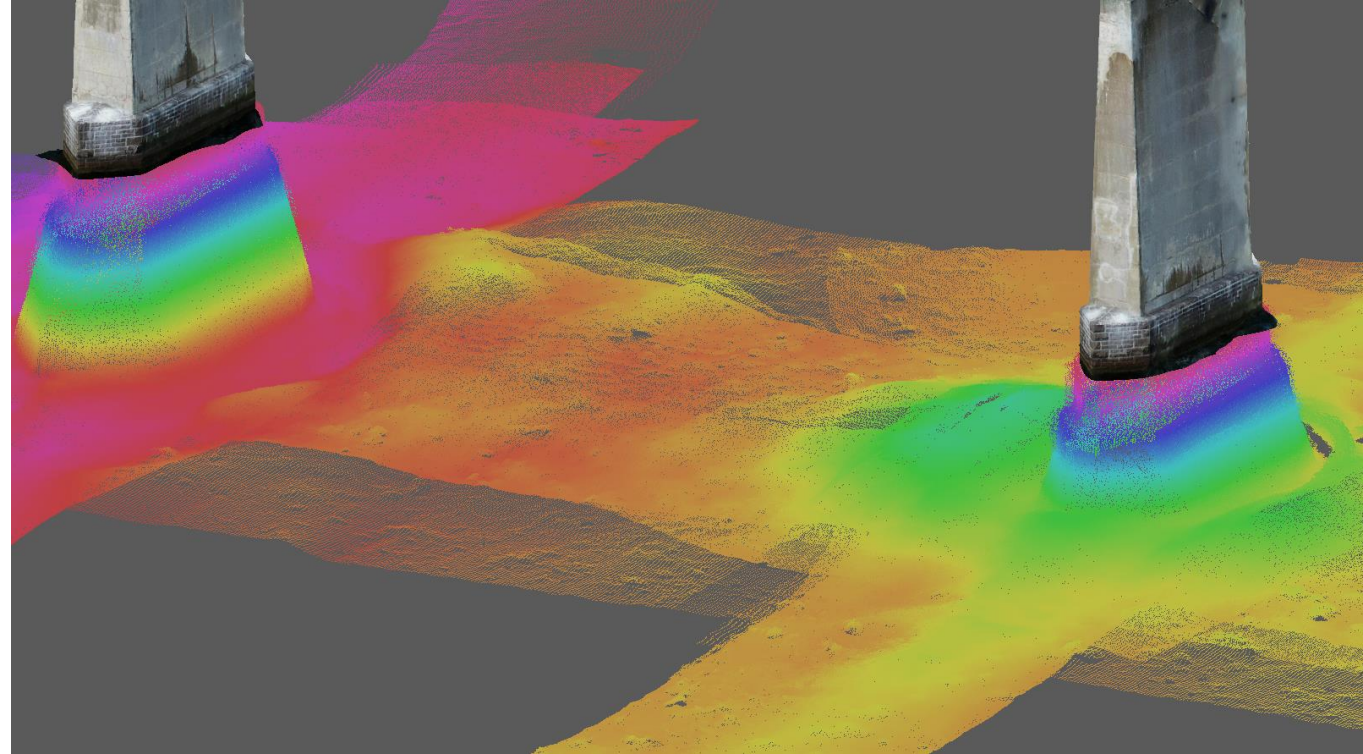
BIM models and Point clouds

- Point cloud is "unintelligent" data
- Creating a BIM model is an attempt to combine the as-build situation with intelligent BIM models

- BIM models are the chosen digital solution for design models
- Point Cloud are perhaps the best survey technology today

- There is a natural common ground because of the programs

- Main purpose to combine these items is the end product

BIM
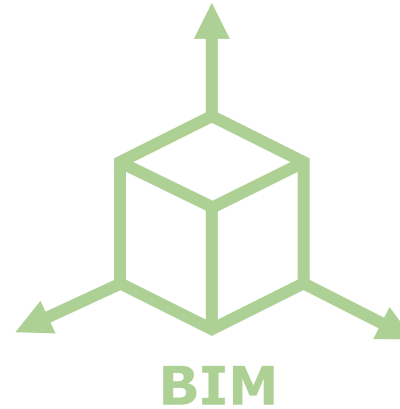
The accuracy questions

- The scan technology can have incredible accuracy
- Worked with scans with as much as 0.7 mm accuracy.
- There is a large different between scans and also internal difference
- Technology, execution and translation all has impact

- Scans are see only to surface, ground and edges can be hidden in dirt or grass

- There seems to be difficult to determent a specific number for accuracy

The accuracy questions

- Accuracy becomes even more complicated when the cloud is translated into a BIM model
- The process introduces potential for human mistakes
- There is a mismatch in how objects are in reality and how BIM models can represent them

- On Dybbelsbro Project, the accuracy was essential. The model accuracy was unknown and therefor we could not use the BIM models as planned

- Resent DB project have a accuracy tolerance of +/- 10 cm
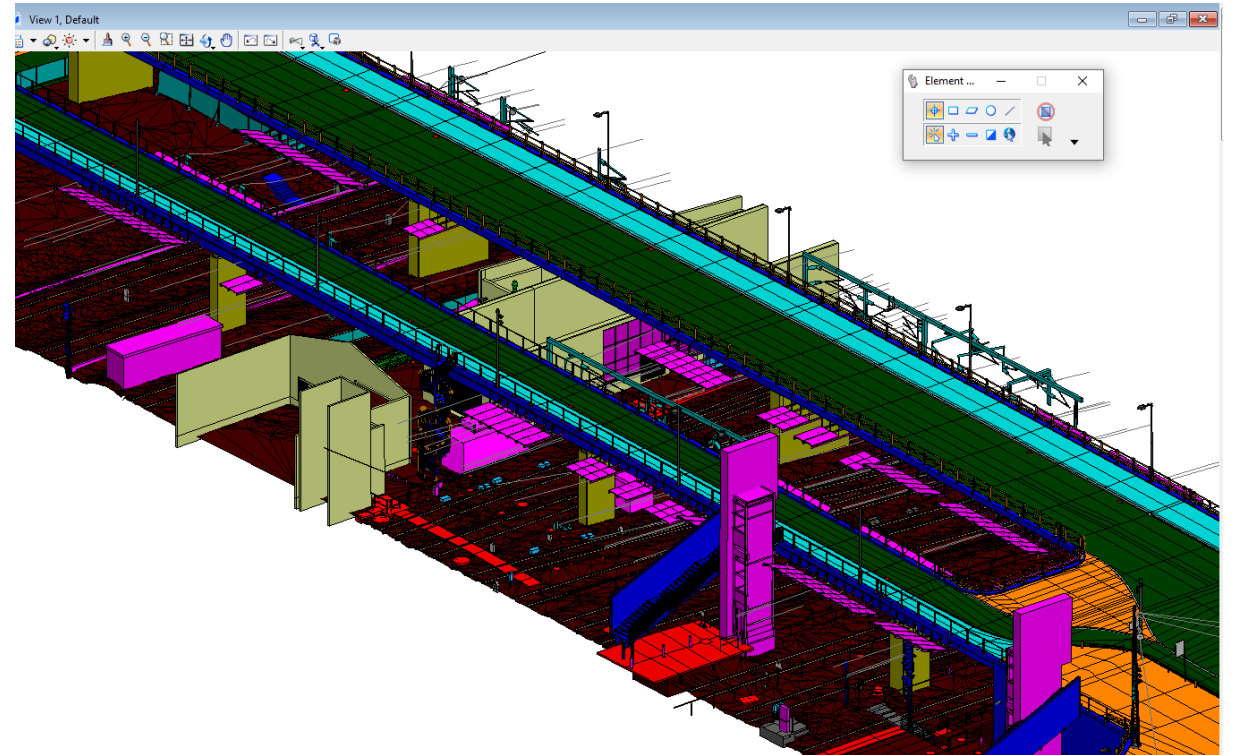
Market landscape

- Domestically:
- Modelling of existing structure has been a demand for years
- Survey method varies, but we can see a very hight value in utilizing the point cloud method
- Experience from projects where we model a structure because of interphases and to create a digital twin of an existing structure
- Very interesting test with scans from train and car
- The value of Point clouds and BIM models has been apparent for some time, often it is used as separated solutions
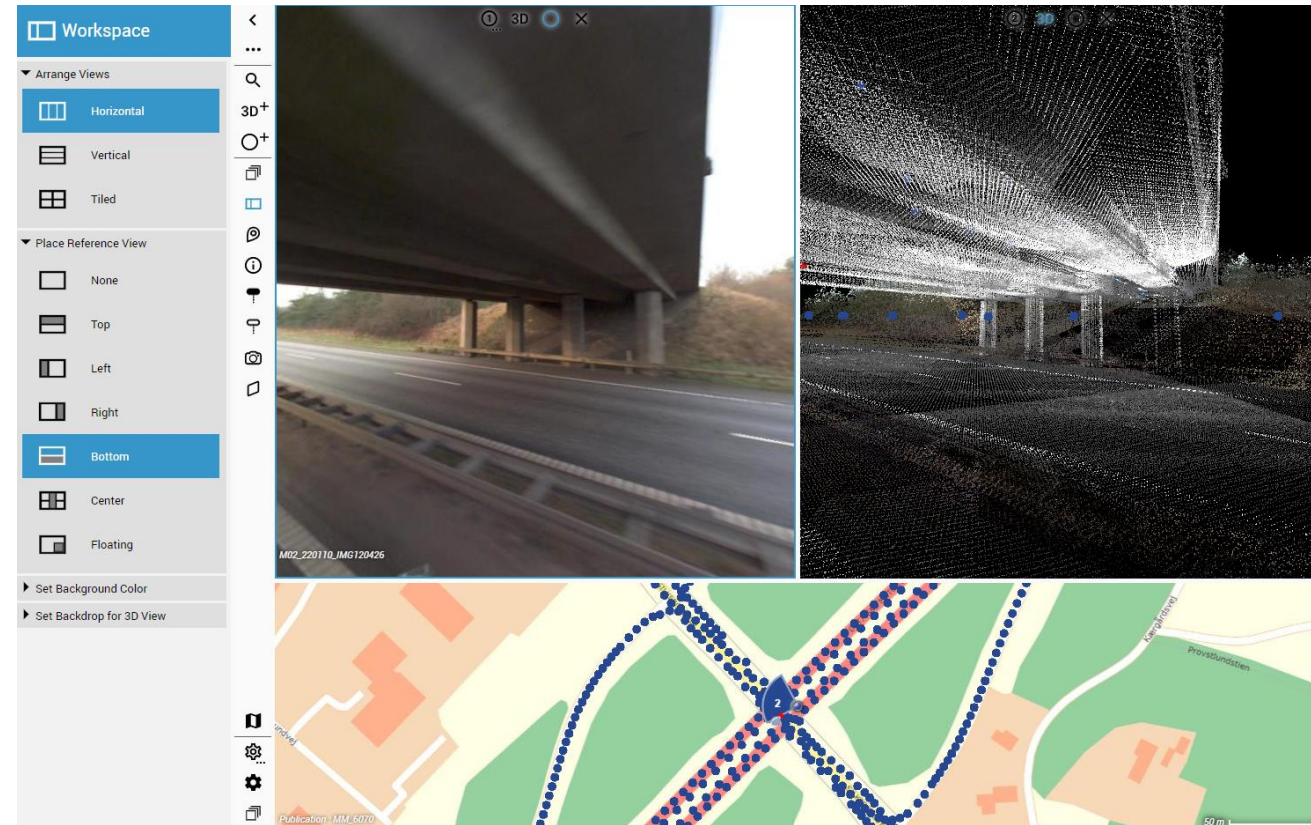
Market landscape

- Internationally:
- Often see a Point Cloud used, not necessary a BIM models created
- Project in SE where the design teams chose to create a very accurate model form the point cloud to use in coordination and drawings production
- GE, and particularly DB, demands a BIM models of exiting structures in most new contracts that I have seen
- The demands in GE are that there will be a scanning and that the BIM model has certain accuracy from that scanning.
- Creating BIM models talks directly in the very hight ambitions of DB's BIM development

Challenges

- Generating surfaces is often not possible due to noise and density of the Point Cloud
- High vegetation and road side dirt interferers with the scanned result
- Quality of the scan relies on the method
- Unintelligent data can be very time consuming to work with
- Large models are very heavy
- Few users that can adopt the technique without help
- Shadows are tricky to take into consideration

- My PC is now suffering a bit from creating this presentation

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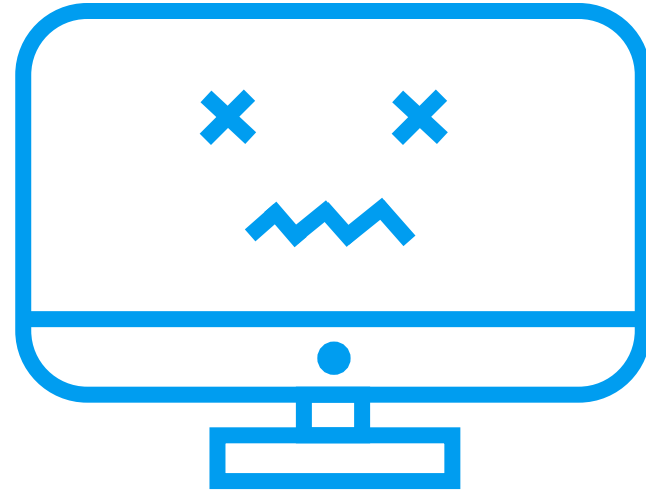
Value for the project

- Combining surveyed geometry to the BIM models has obvious benefits
- Is the magical LOD 500
- Coordination is the current low hanging fruit.

- Collect the design in one place
- Create multiple usage possibilities
- Is very benefitable for the execution of the project
- Will be important when we manage to tame the data properly
- Is the natural step toward Digital Twin
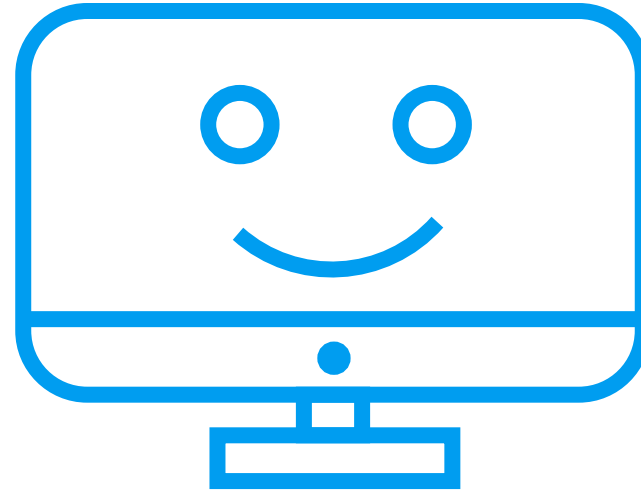
How I work with Reality Models

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Clip the Cloud

- Orient model
- Start with a clip
- Add Masks

- Reduced model
  can be exported

Ramboll
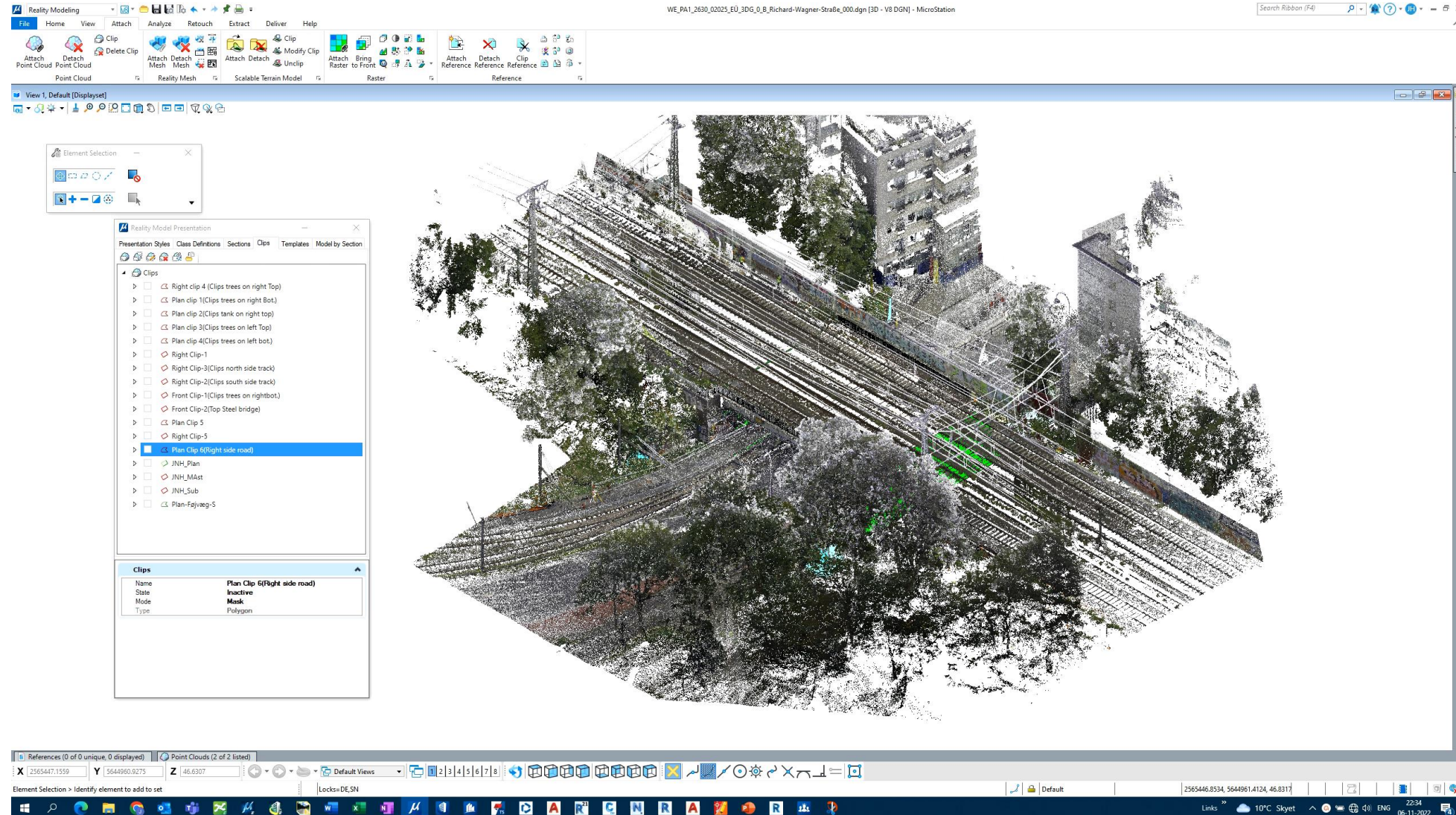
Classify

- The classes are created and set up as wished

- Clips and view orientation are you friend here

- The program will classify with fences, meaning that everything within a certain line of sight will be included

- Classes can be turned on and off, witch also helps with capturing objects in the cloud

- The model with classes can be exported as a new POD model
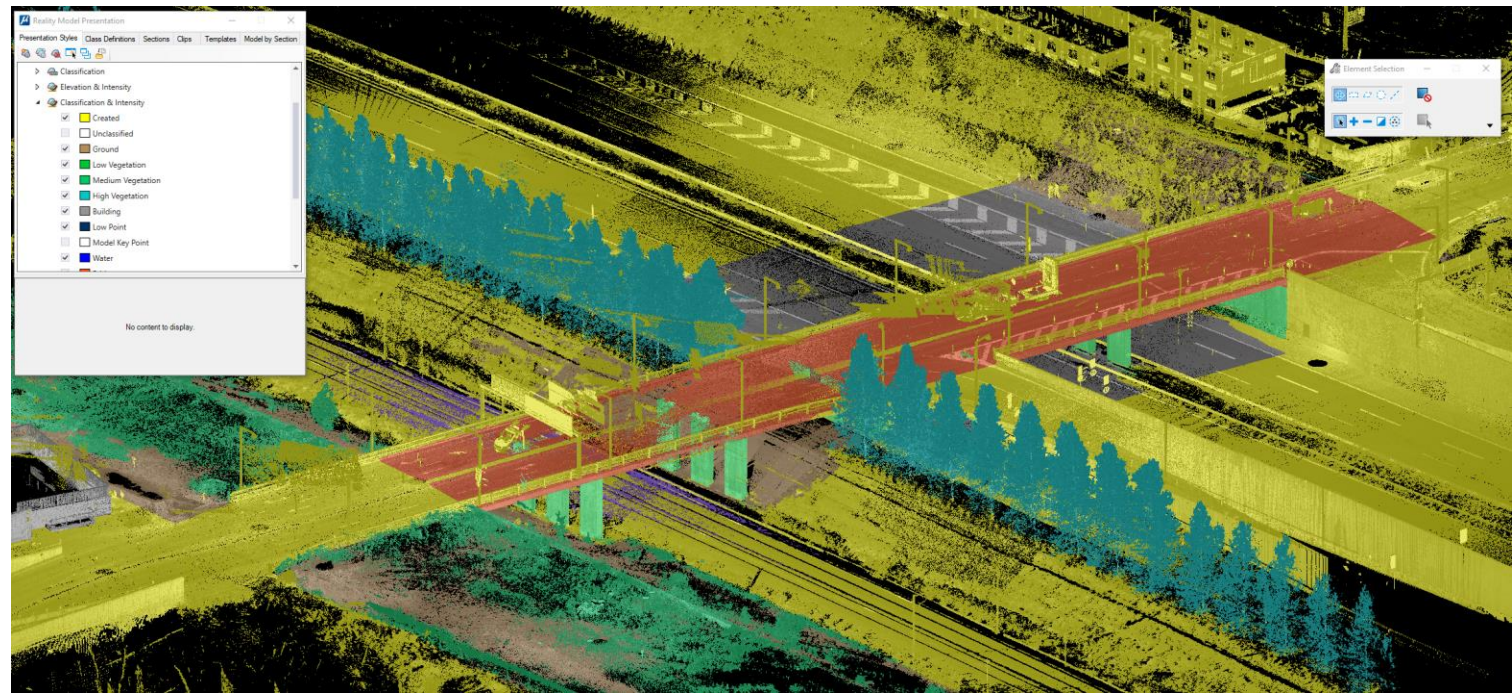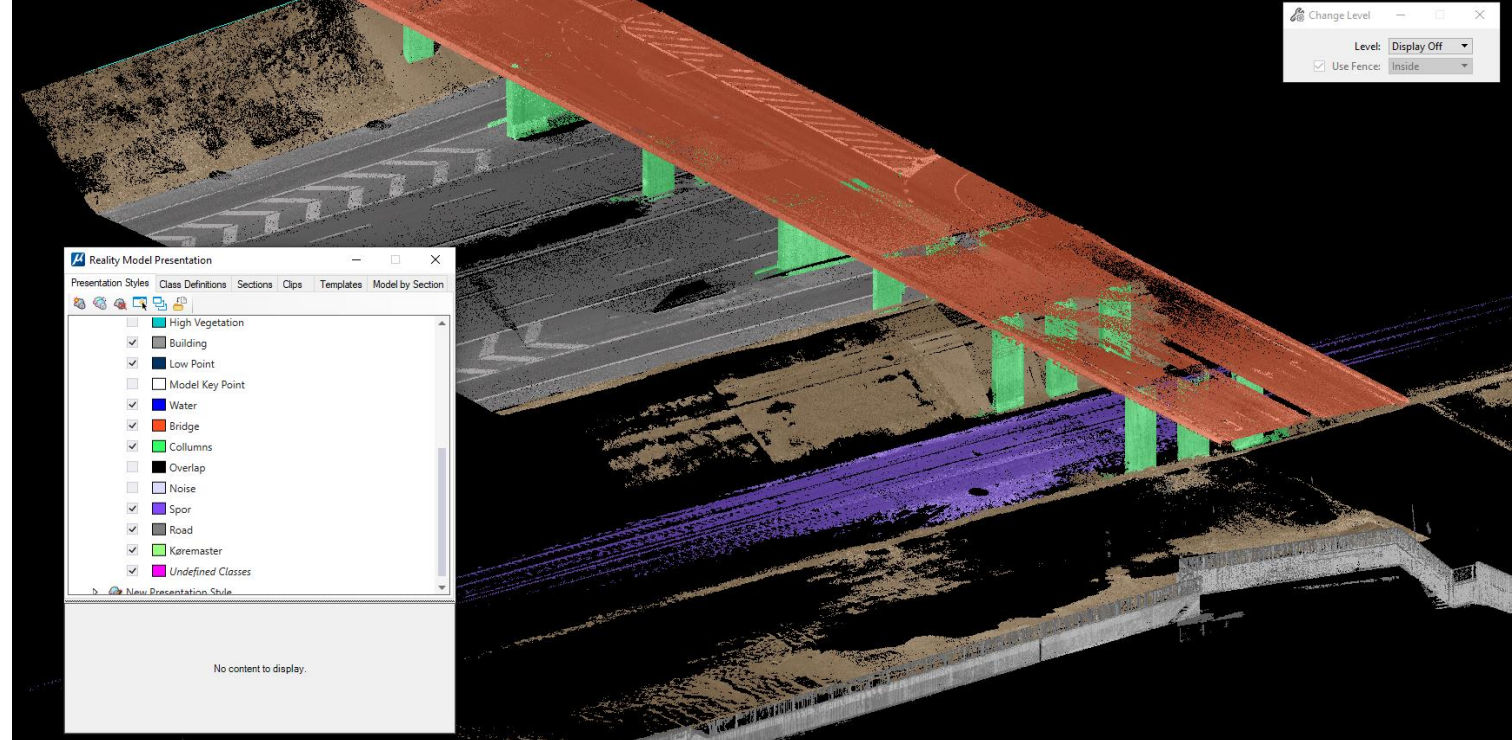
Model by section

- A section is created
- A profile (Template) is created
- A Model by Section is set up
- In the section, the Template is adjusted to the scan
- Right click brigs the section 5 m forword
- The next Template is placed and adjusted
- The final step is to generate a solid from the lofted surface

Ramboll
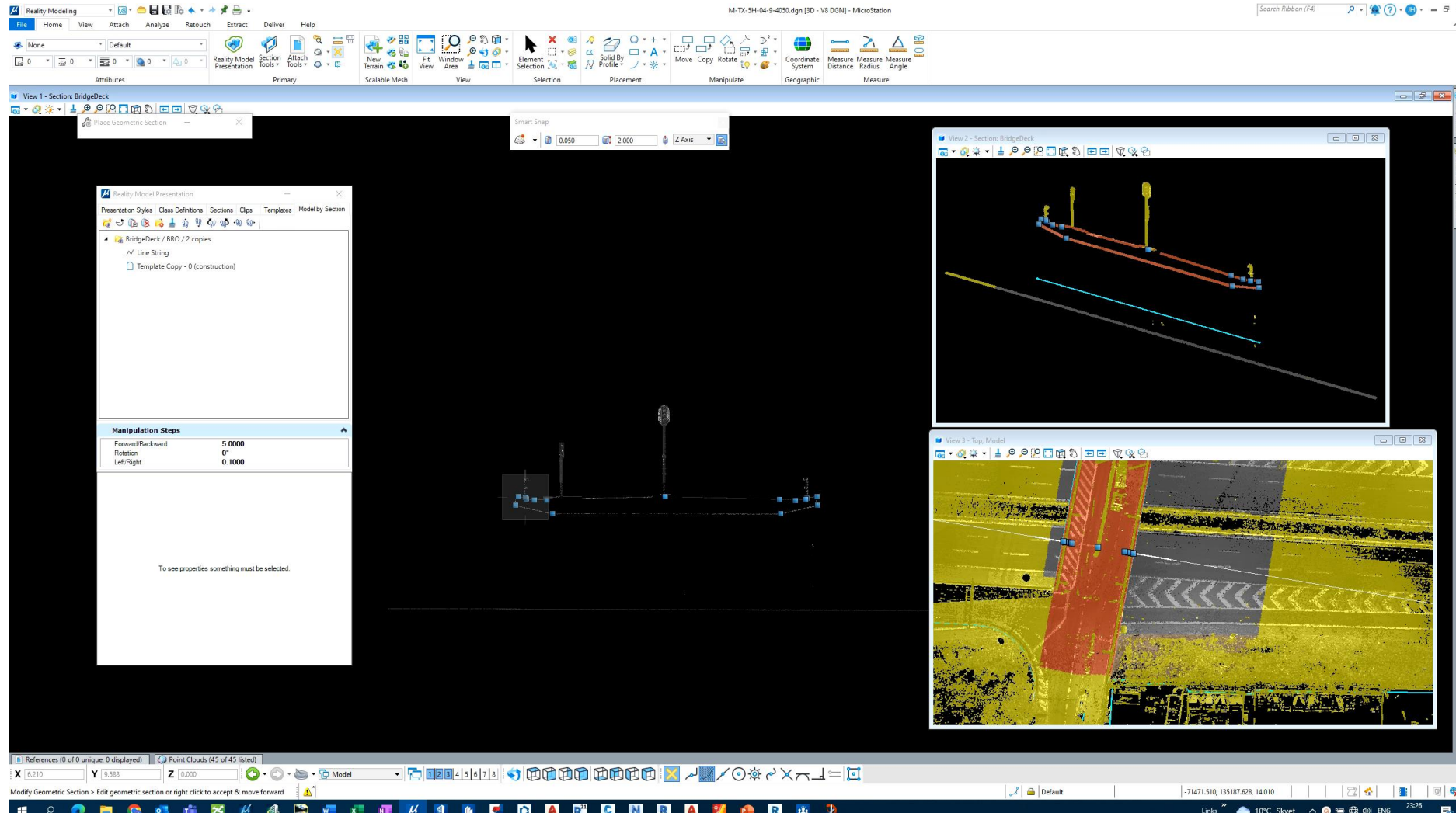
Snap function

- Snap function activated
- Parameters are set
- Line function chosen
- Line traced along the wall

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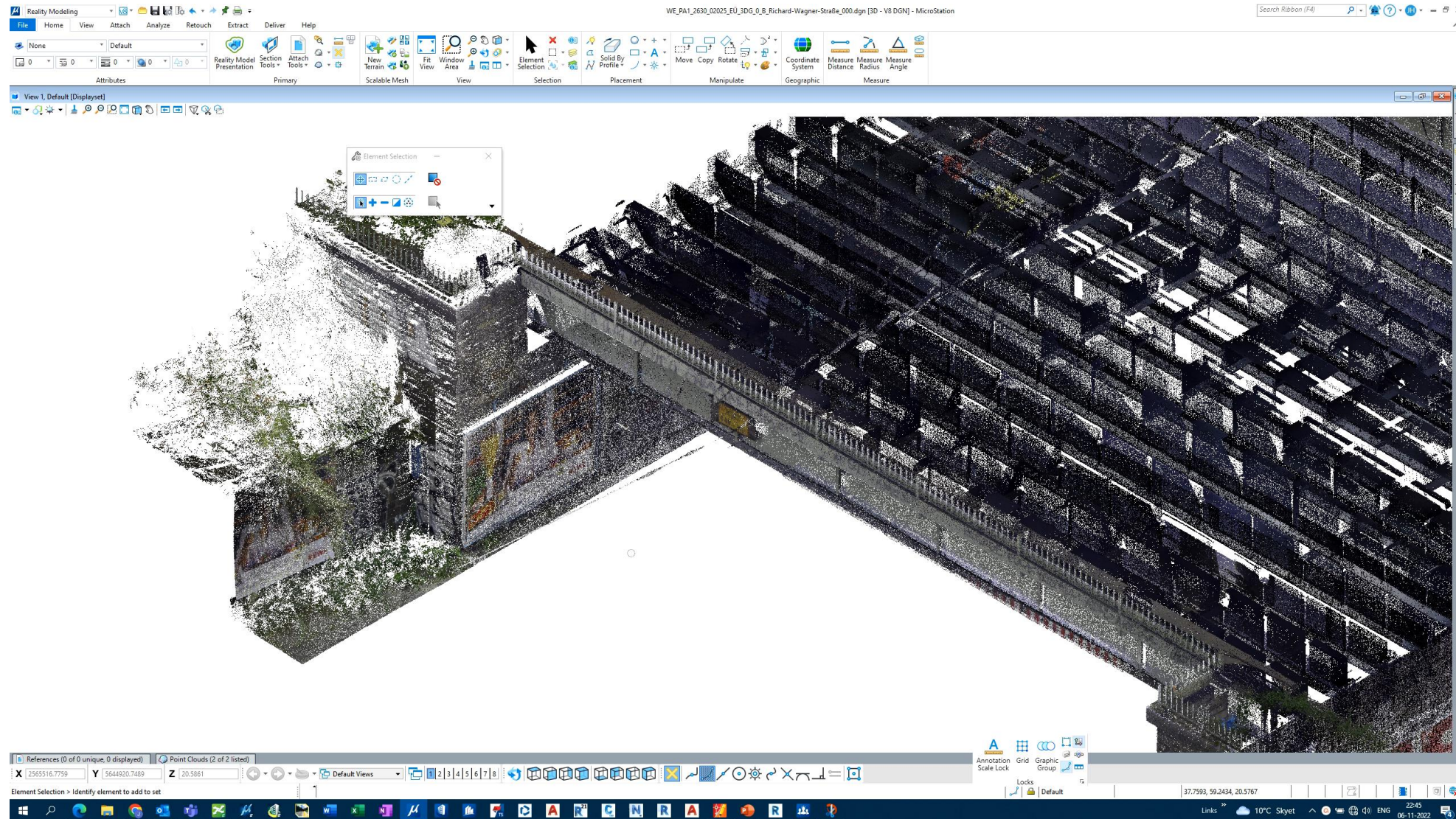
Case studyes

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Stibro over Øresund

- Dense Point Cloud with a lot of noise
- First step was to classify the points
- Give a full control over the content of the Point Cloud
- Turning off the irrelevant content make it accessible to work with
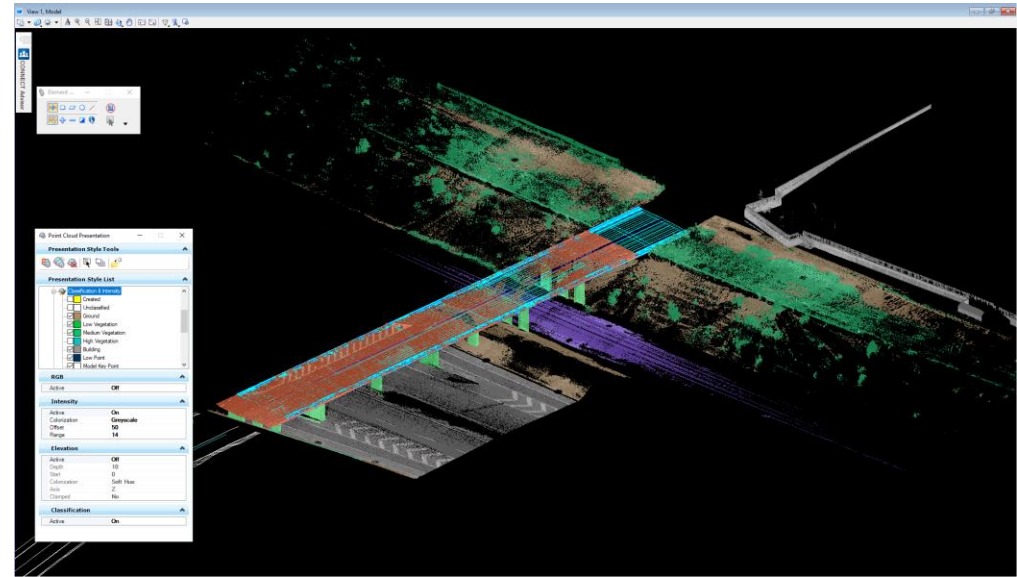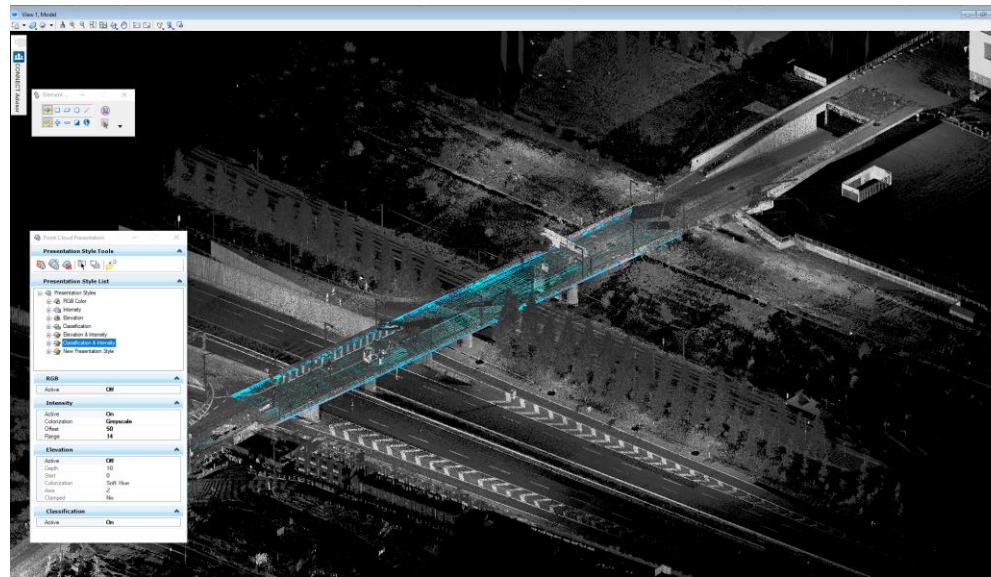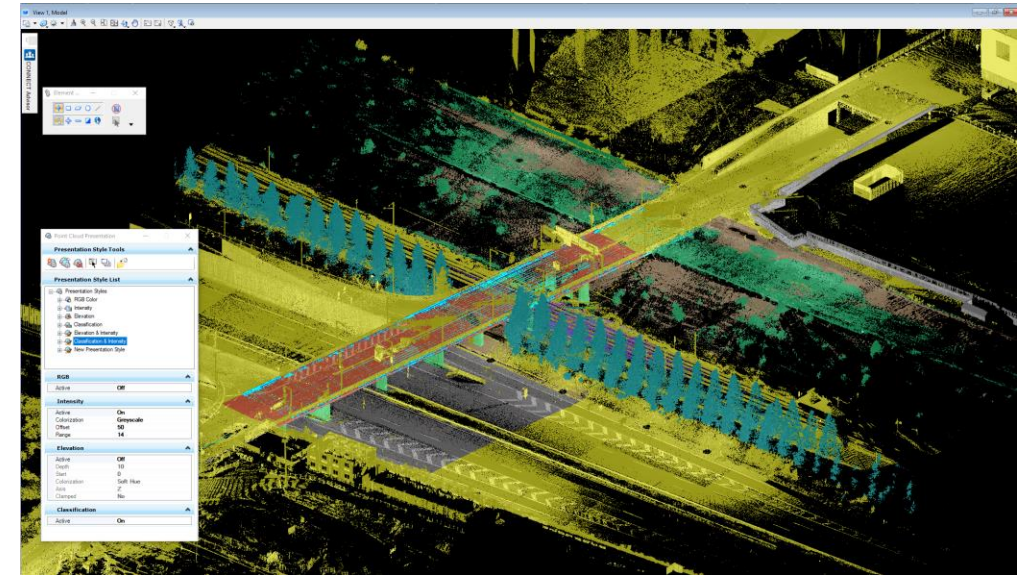
Stibro over Øresund

- Bridge deck created with the Model by Section method
- Gives the objects:
  - Section profiles
  - Traced lines at profile corner
  - Surfaces
  - Solid
- Vertical objects are traced with the snap function
- The top and bottom edges of a column or a wall can be placed very accurately
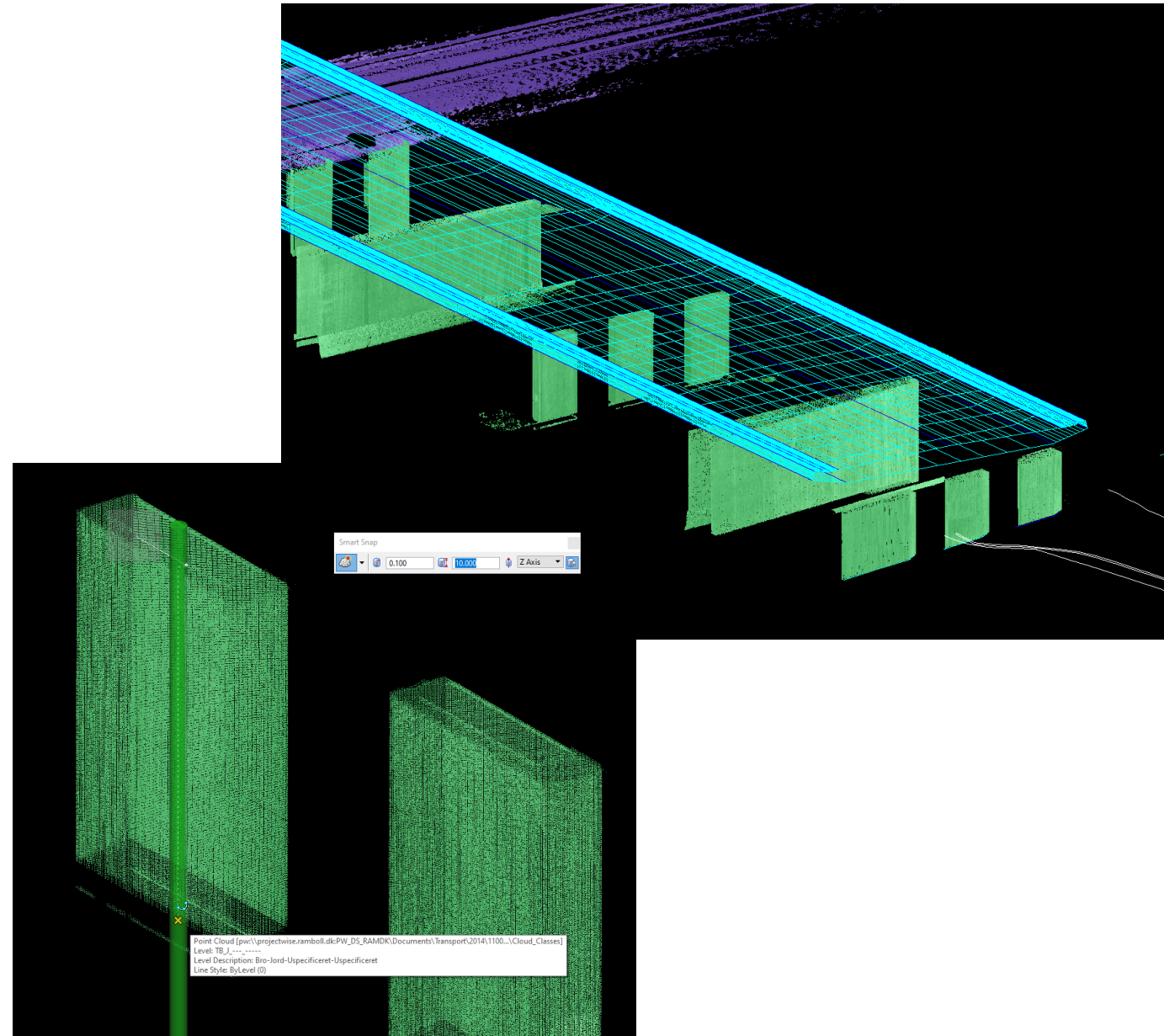
Storbælt

- The task was to create a LOD350 BIM model of the Vest bridge
- Lack of drawings and absence of a coordinate system made the Point Cloud a valuable asset
- The scan only included the top of the bridge
- The share length of the project made it very difficult to work with
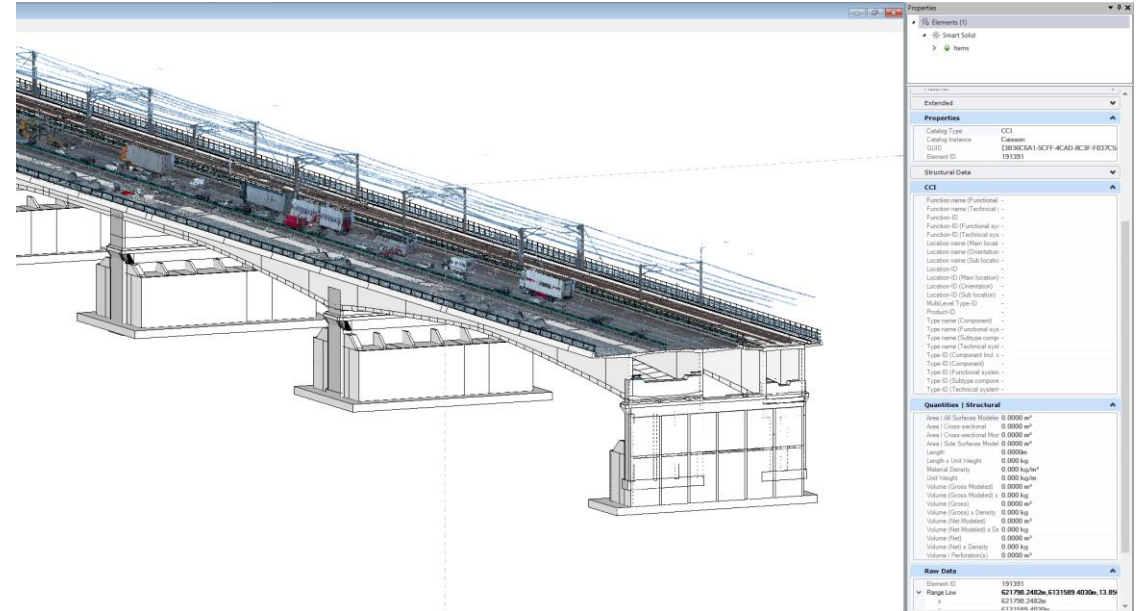
Storbælt

- The East bridge included the same challenges
- There are more objects included in the scan
- There was an additional scan from the inside of the anchor blocks witch were mainly used for calibration and check

- Substantial value of the BIM model is from the coordination to the scanned geometry
- BIM items introduced in OBD, the delivery was IFC
- The intention is that the model can be further developed
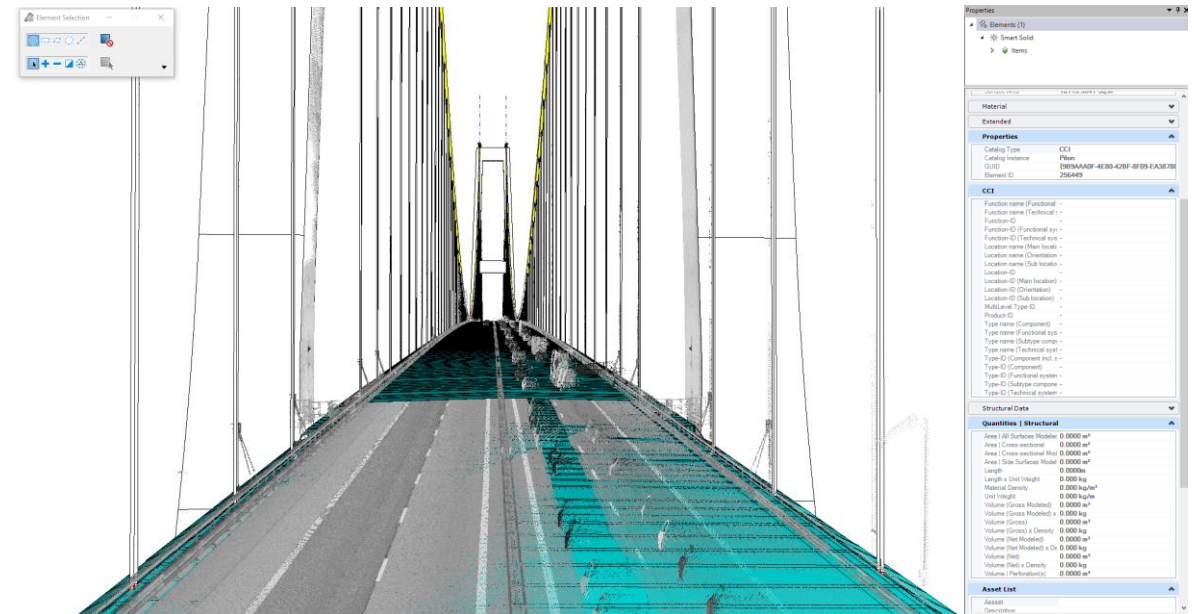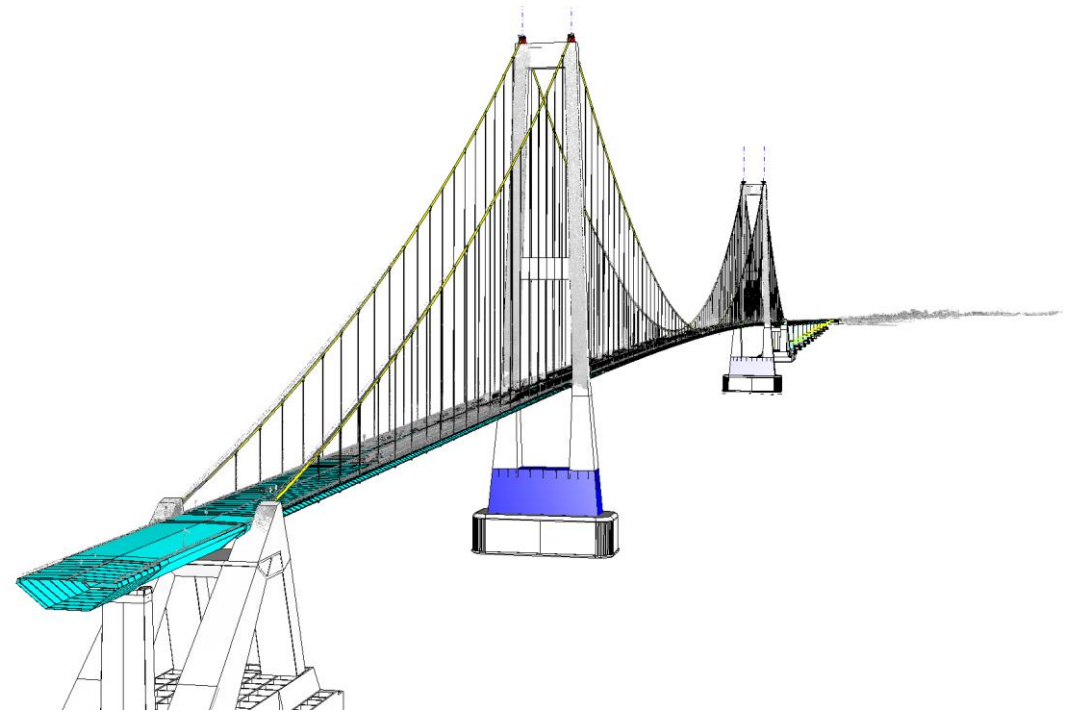
Storbælt

- Used model by section to extract the top surface of the bridge deck
- Guide lines and surface
- The guideline was used to trace the horizontal alignment
- The surface gave us the vertical alignment as it was the terrain.
- The alignment was created by surveyed data

- The alignment as an object became very valuable for the client
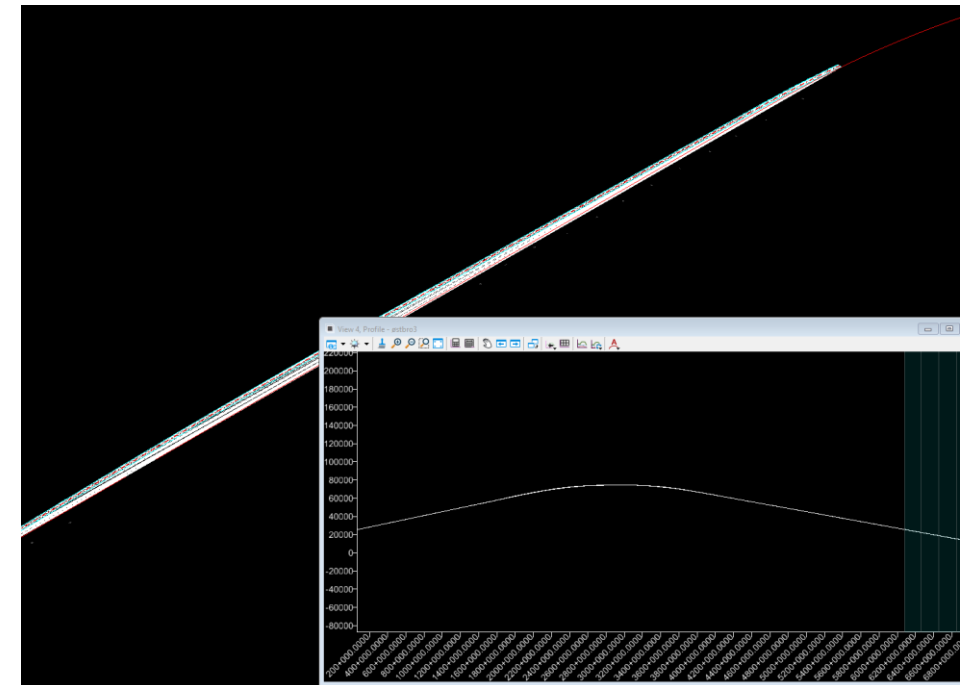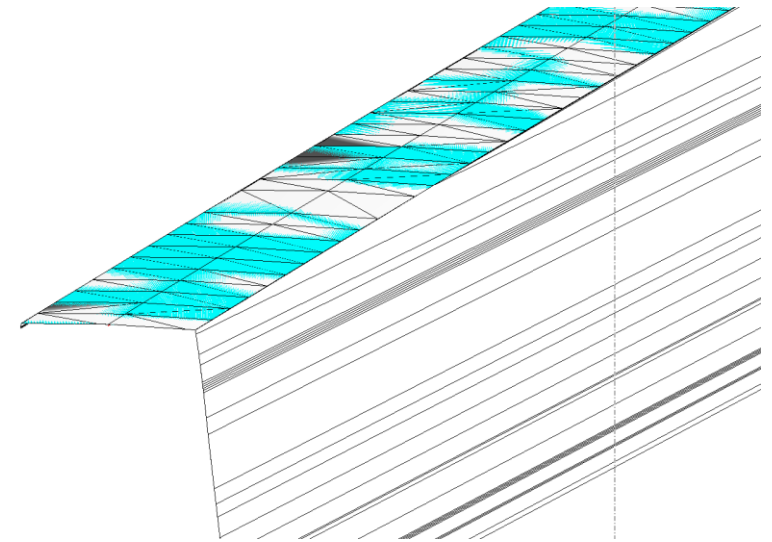
Köln - Westpange

- Input from Point Cloud and drawings
- Detailed geometry and most parts of structures visible – very few assumptions
- Scan reviled details not present on the drawings
- The construction type dictated a different approach than the previous examples
- Data was added in OBD

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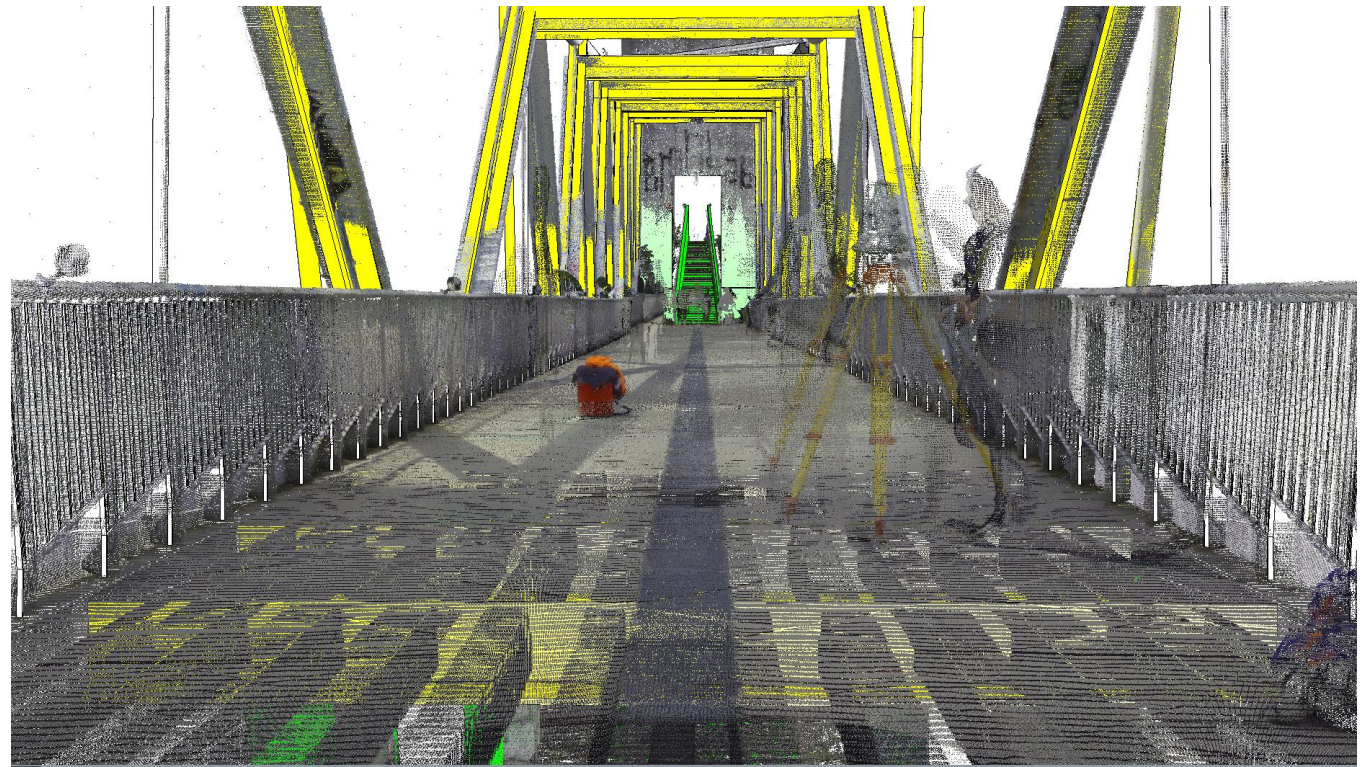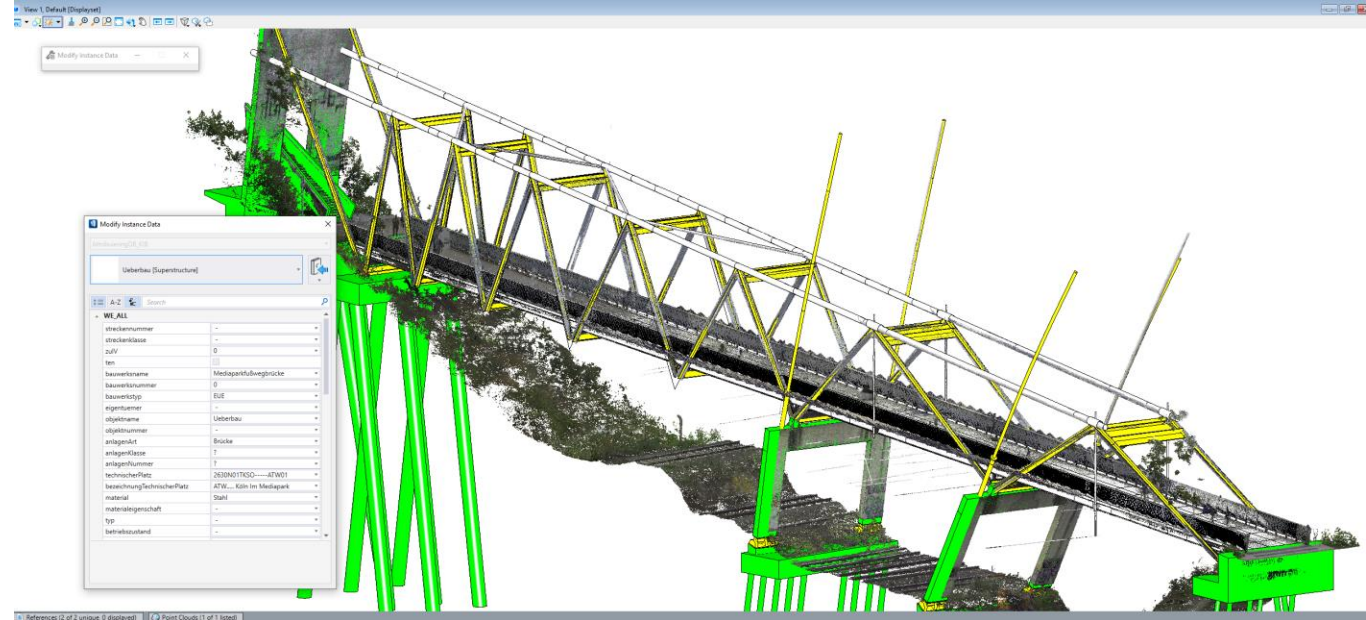
Köln - Westpange

- Input from Point Cloud and drawings
- Detailed geometry where structures were visible
- Large portion of the geometry hidden
- Assumptions communicated through data
- Modelling techniques made the accuracy much higher than delivery demands
- Intention to use as design input
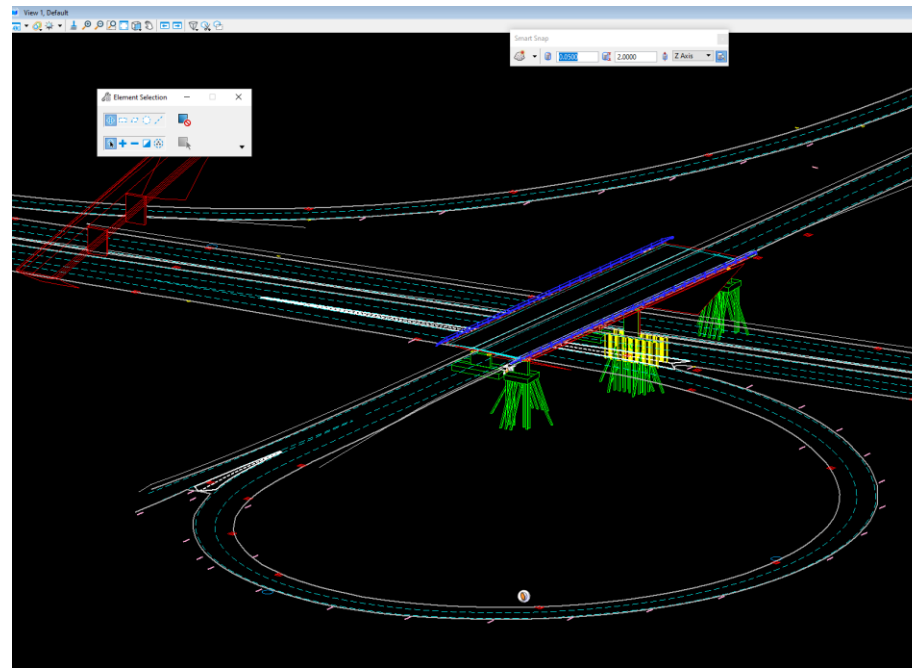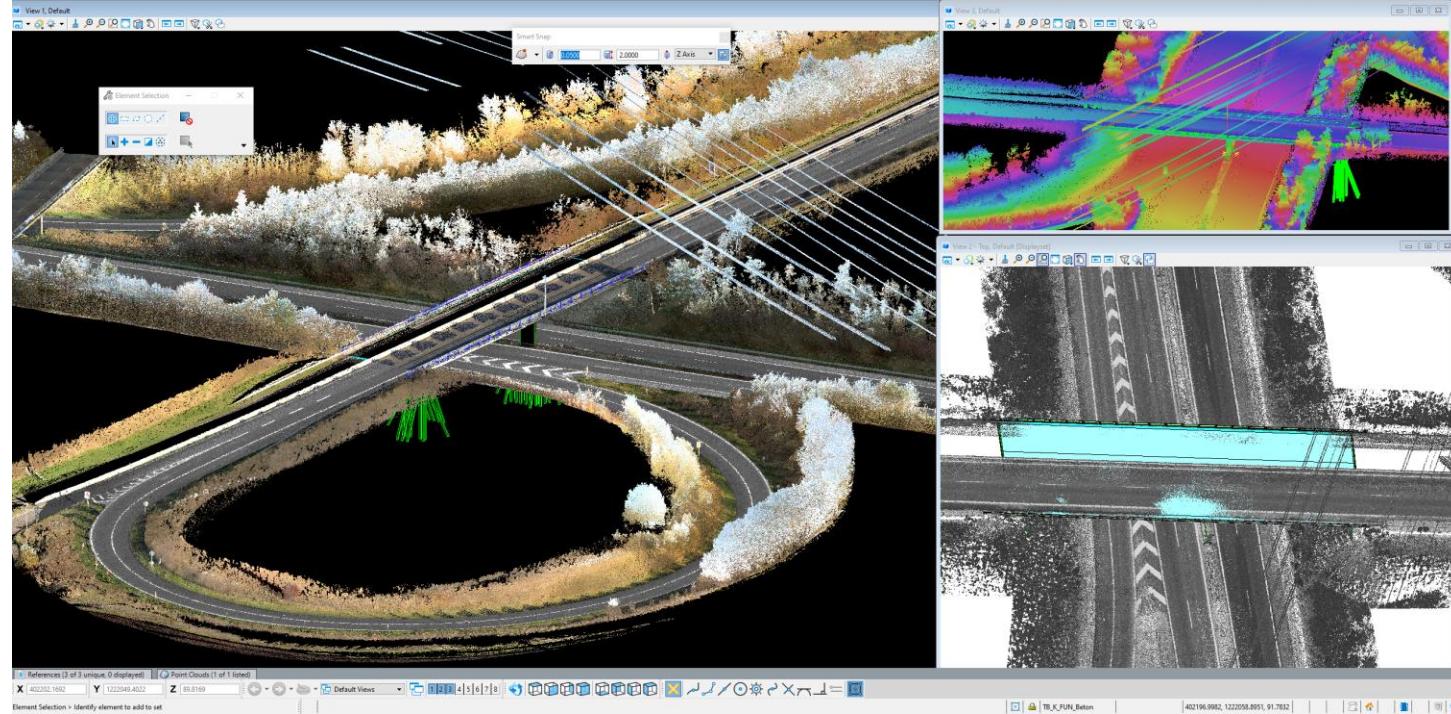- Data was added in OBD
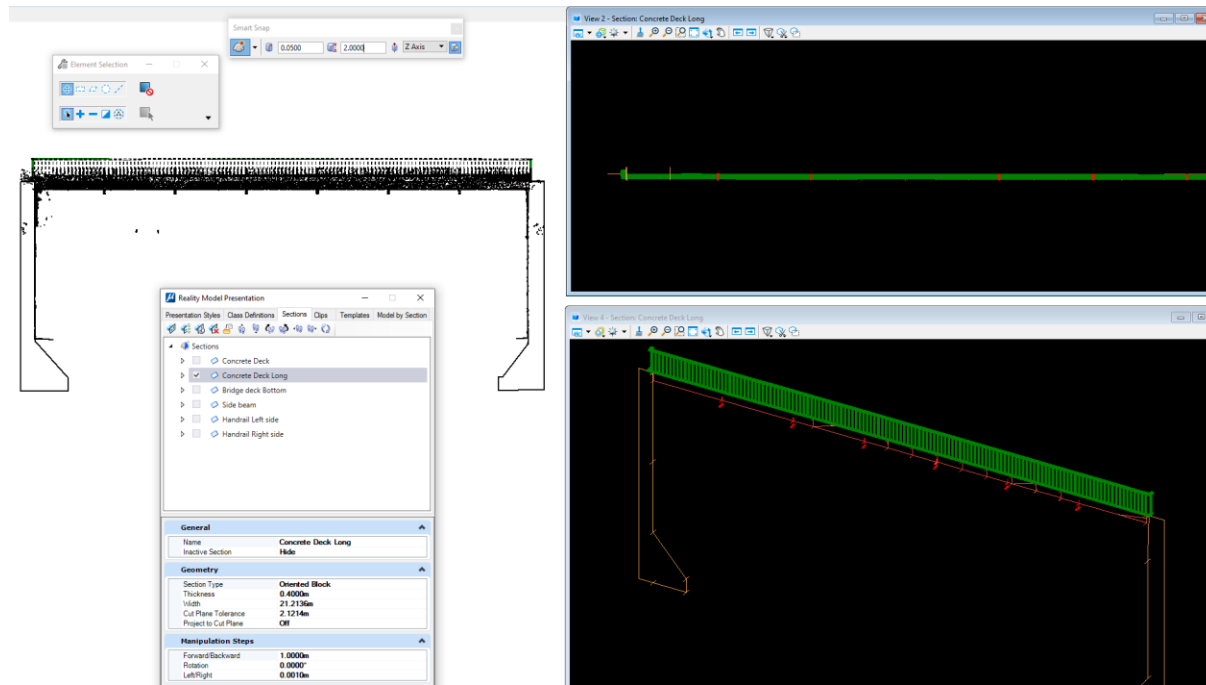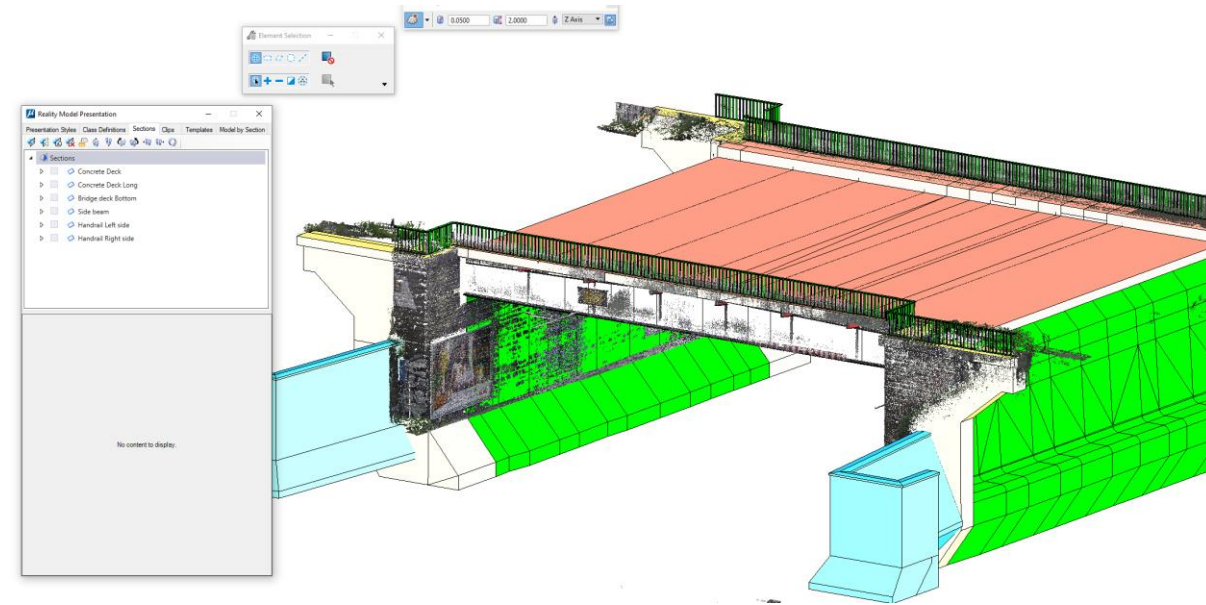
E45, 6070 & 6090

- The E45 has the task of creating a model of existing structures
- The input is survey lines and drawings
- Point Cloud provided as additional survey
- The scan is performed from a vehicle

- The Point Cloud is available to us as .pod model and as a web based view solution
- Details and images gives the solution extra value

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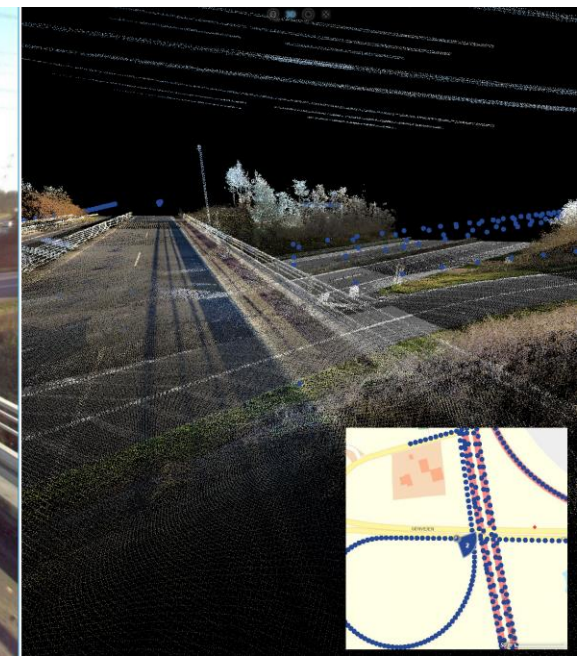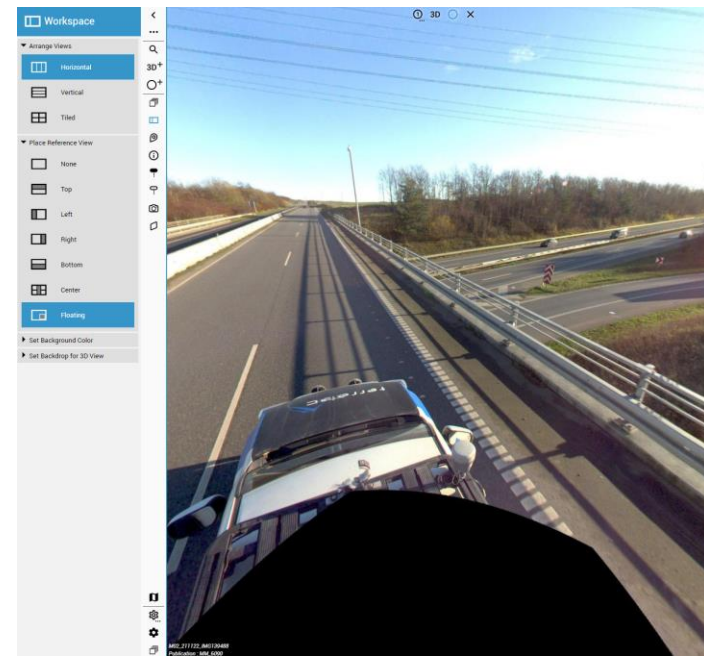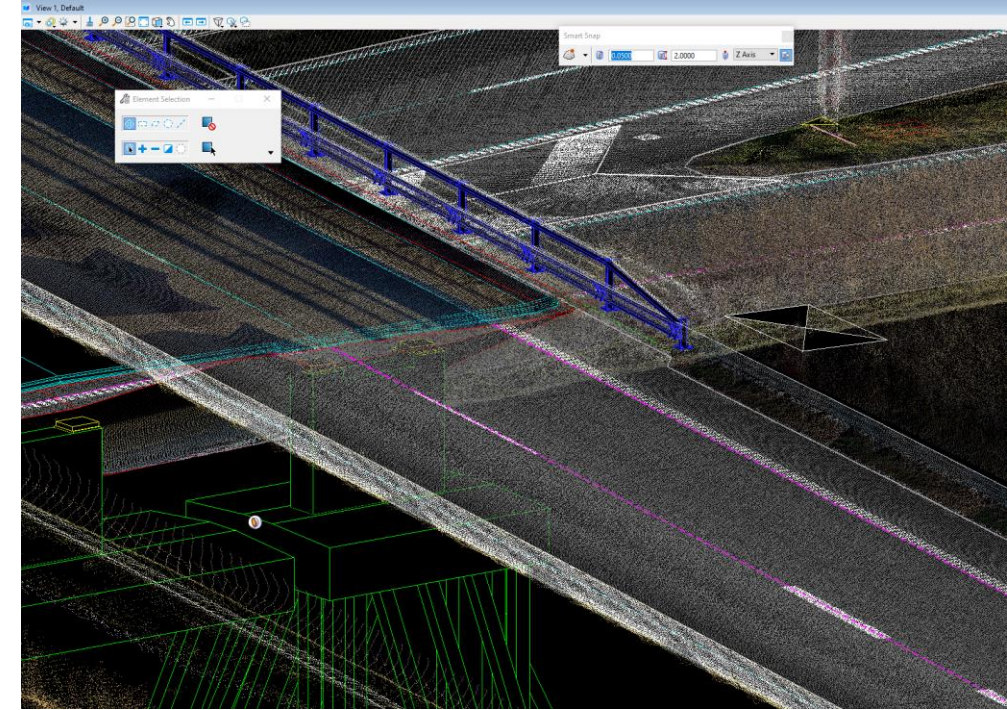
E45, 6070 & 6090

- The Point Cloud is processed, cleaned from noise
- The survey lines provided are processed from the scan

- The Point cloud includes many details that the survey did not include
- We can choose to use items that are not necessary available from the survey
- Due to the good integration in our authoring software, and the level of detail, we did use the cloud as primary input

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