

Positive experience and *savings* in connection with implementing model based construction

Mari Karttunen, NCC Housing
Property Development Manager, Architecture

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5. Summary

NCC's geographical markets

- Sweden
- Norway
- Finland
- Denmark
- Germany
- Baltic Countries
- St. Petersburg



One NCC – three businesses

Industrial



NCC Roads

Construction and
civil engineering



NCC Construction units

Development

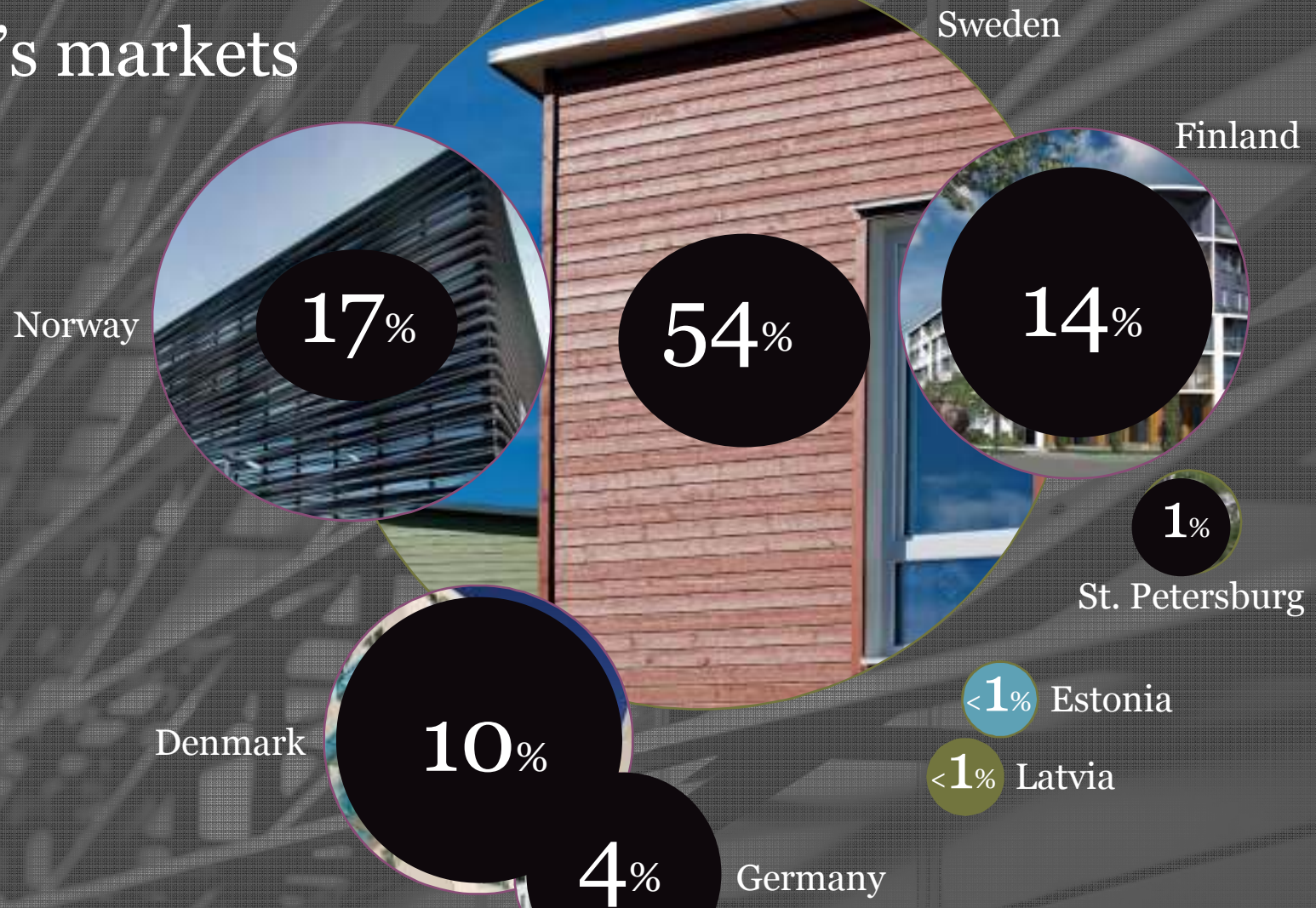


NCC Housing and
NCC Property Development

A large, semi-transparent green-tinted photograph of construction workers in a tunnel. The workers are wearing hard hats and safety gear, and are gathered around a large piece of machinery or equipment. The background shows the structural elements of the tunnel.

Sales **SEK 58 billion**
Employees **18,400**

NCC's markets



Share of net sales

NCC in Estonia

Tallinn
2 ongoing dwellings

2013
Together with Riga
137 started flats
Turnover 13M€



Our vision

To *renew* our industry and provide
superior sustainable solutions

Our values

Honesty

Respect

Trust

*Pioneering
spirit*

Pioneering spirit

We take initiative,
work proactively
and with energy

We have
the courage to try
new ideas and
working methods

We drive
development
together with our
stakeholders

Value chain

Development

Concept
and analysis

Land
acquisition

Concept
development

Design and
architecture

Leasing

Project
execution

Sales





NCC and VDC



Building information modelling development

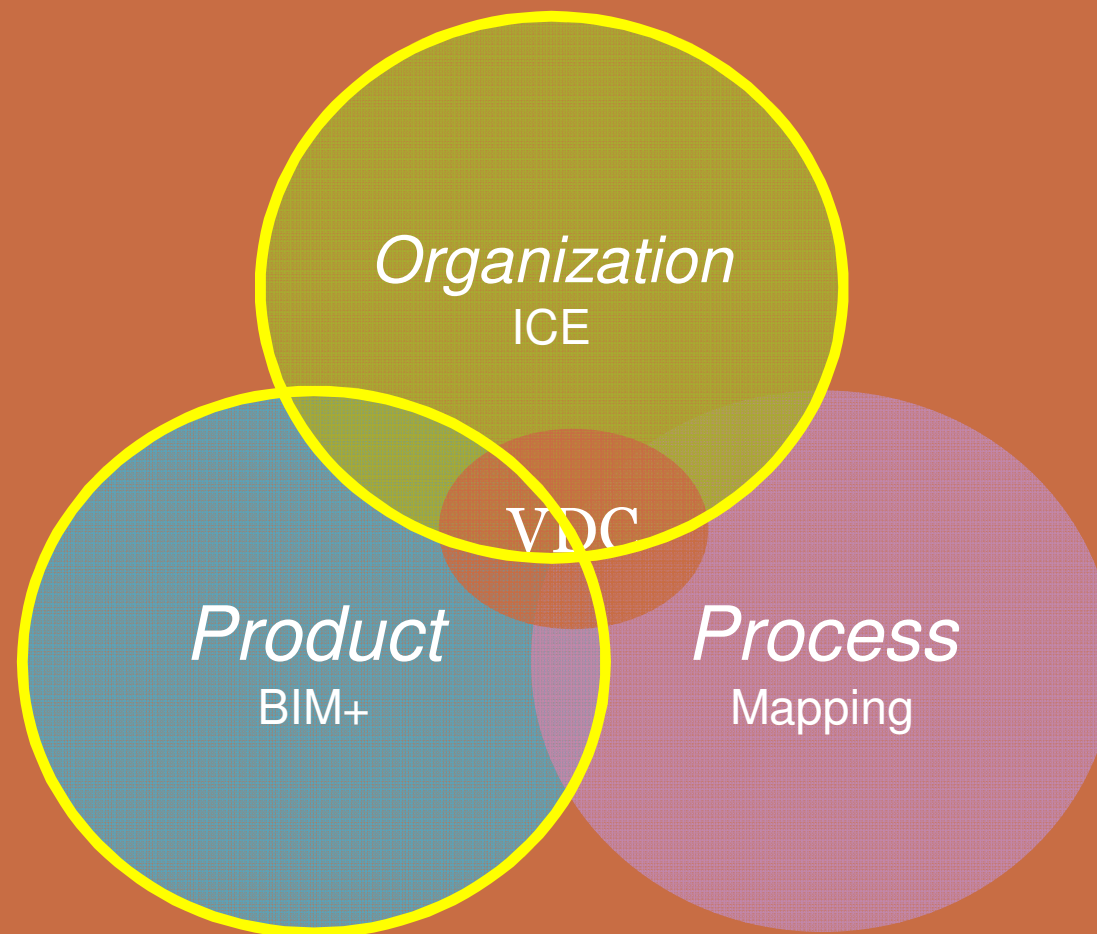
- VDC-competence centers in NCC



VDC Certificate course 2014



VDC – Virtual Design & Construction



VDC in projects

Concepts, visualizations



Project Development



Meetings on the site, 4D



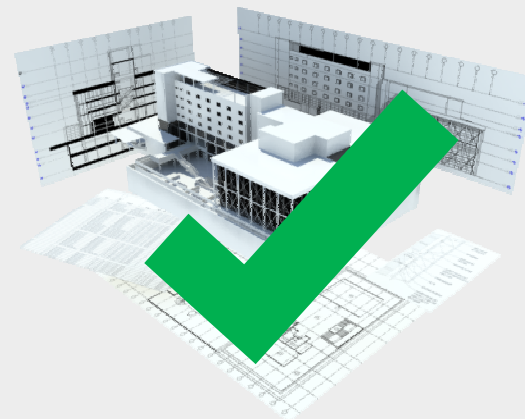
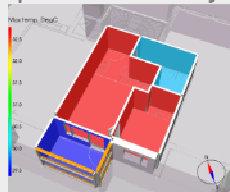
Surveyor



Energy analyses



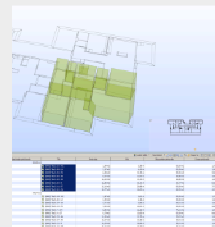
Temperature analyses



Building site plans



Quantities and key figures



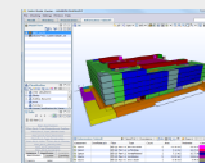
Detailed models



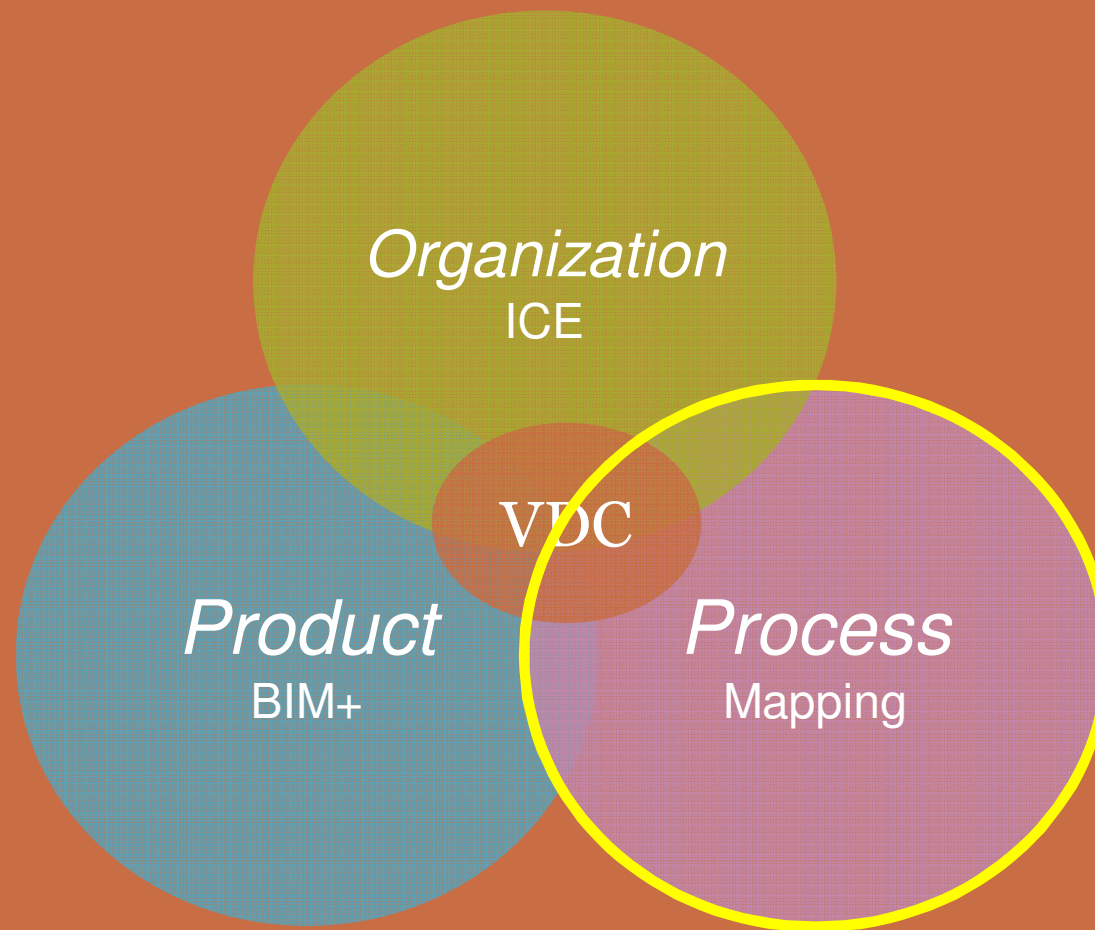
Clash checking



Procurement



VDC – Virtual Design & Construction



NCC Project Studio

The way of working

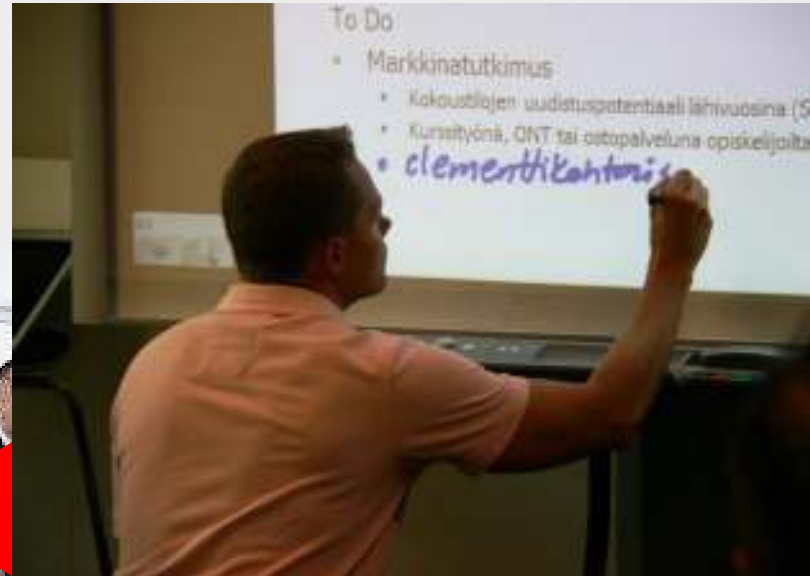
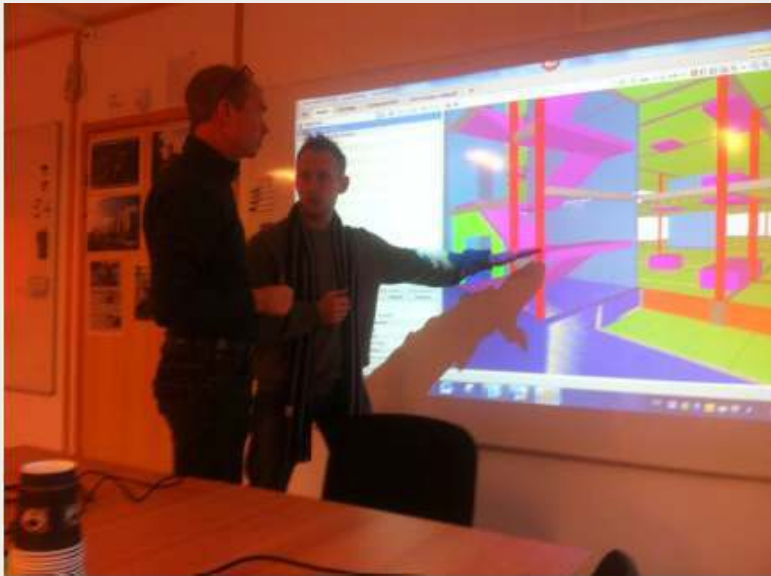




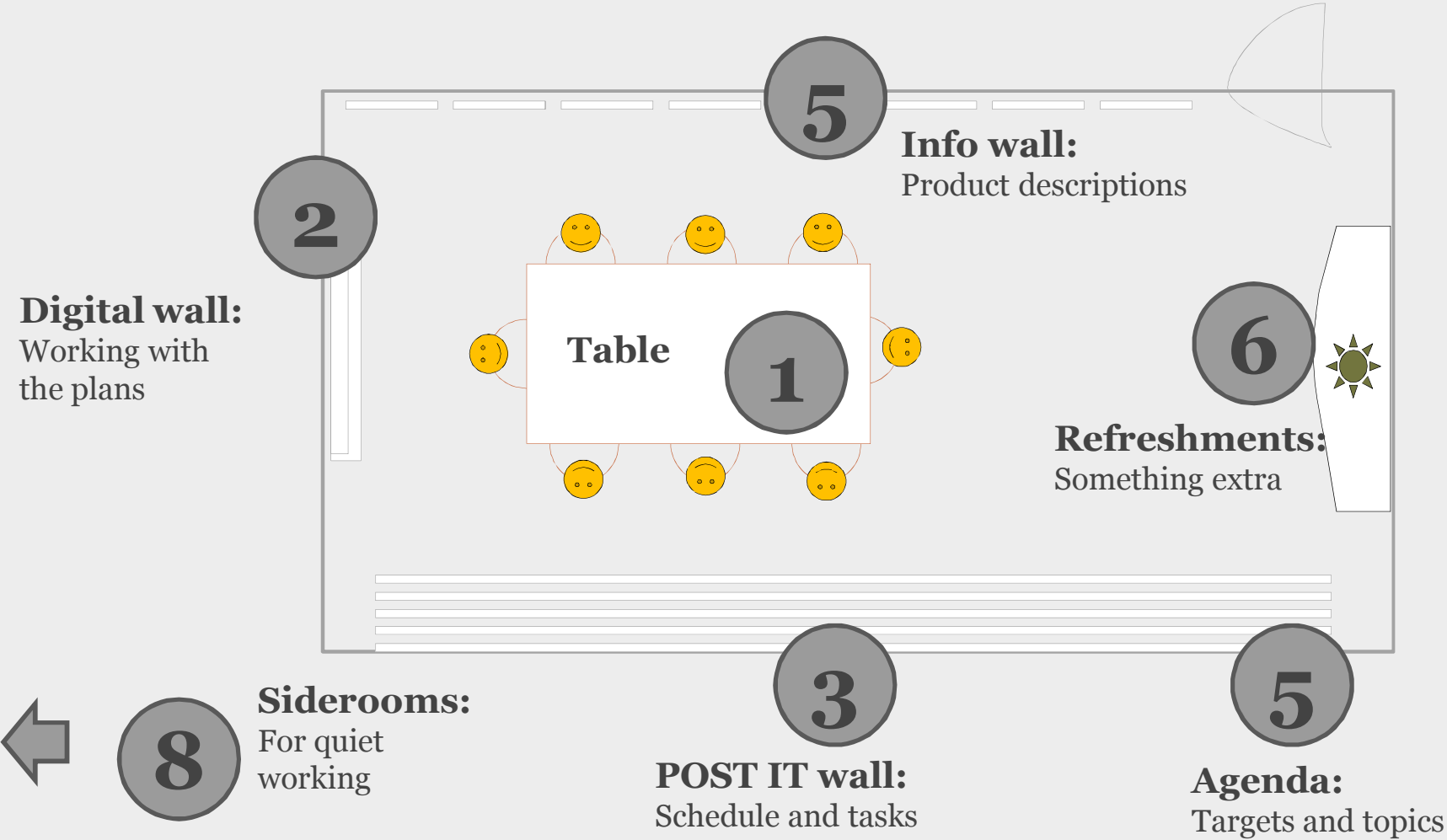
Right people in
the right place
from the start

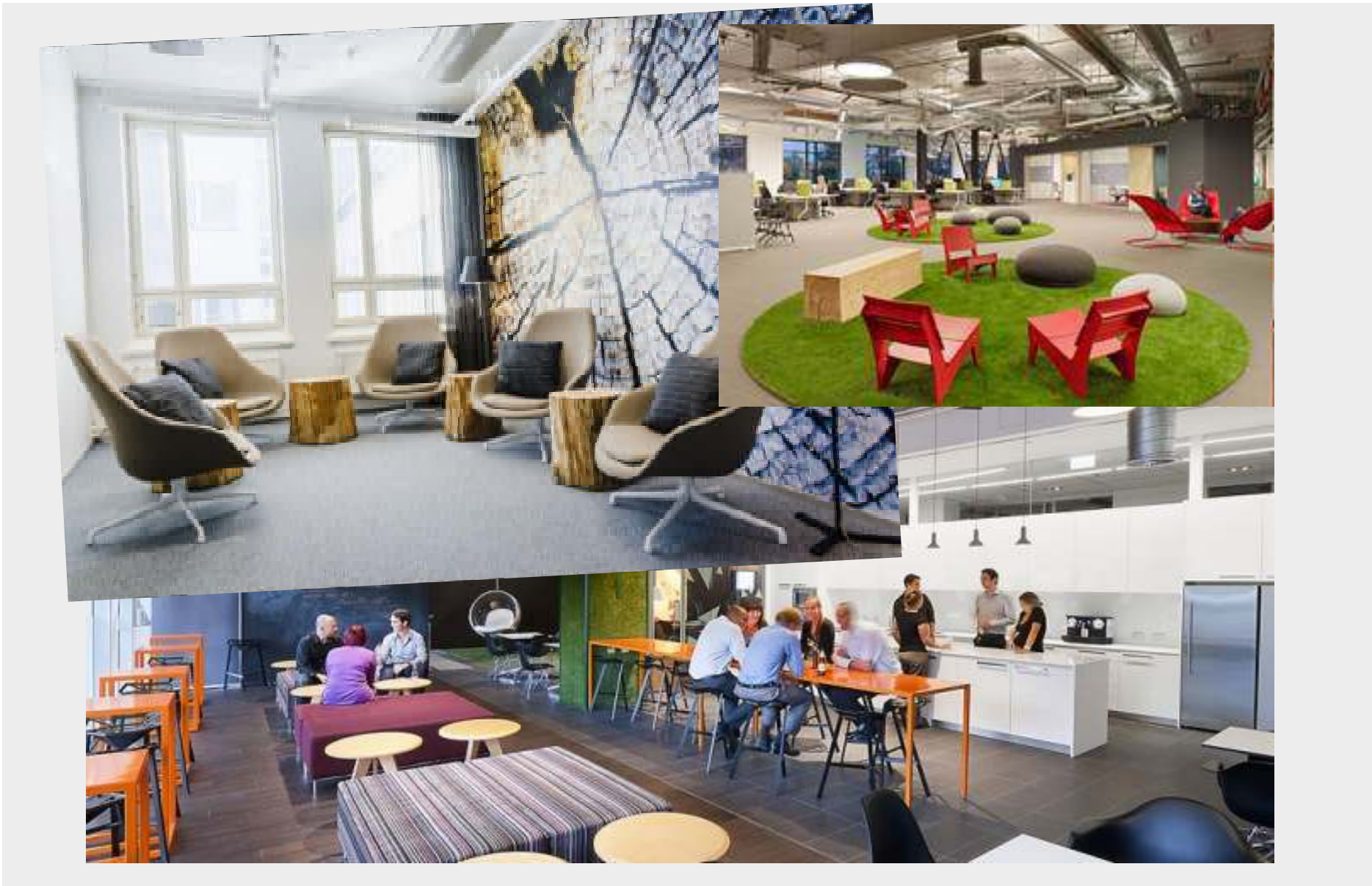
*A shared
place
of work*





Project Studio facilities





Savings

- 1. Case / Renovation of High School Maininki, Espoo*
- 2. Case / Apartment buildings Marco Polo & Tynimeri, Helsinki*

Locate Expenses 14.3.2014:

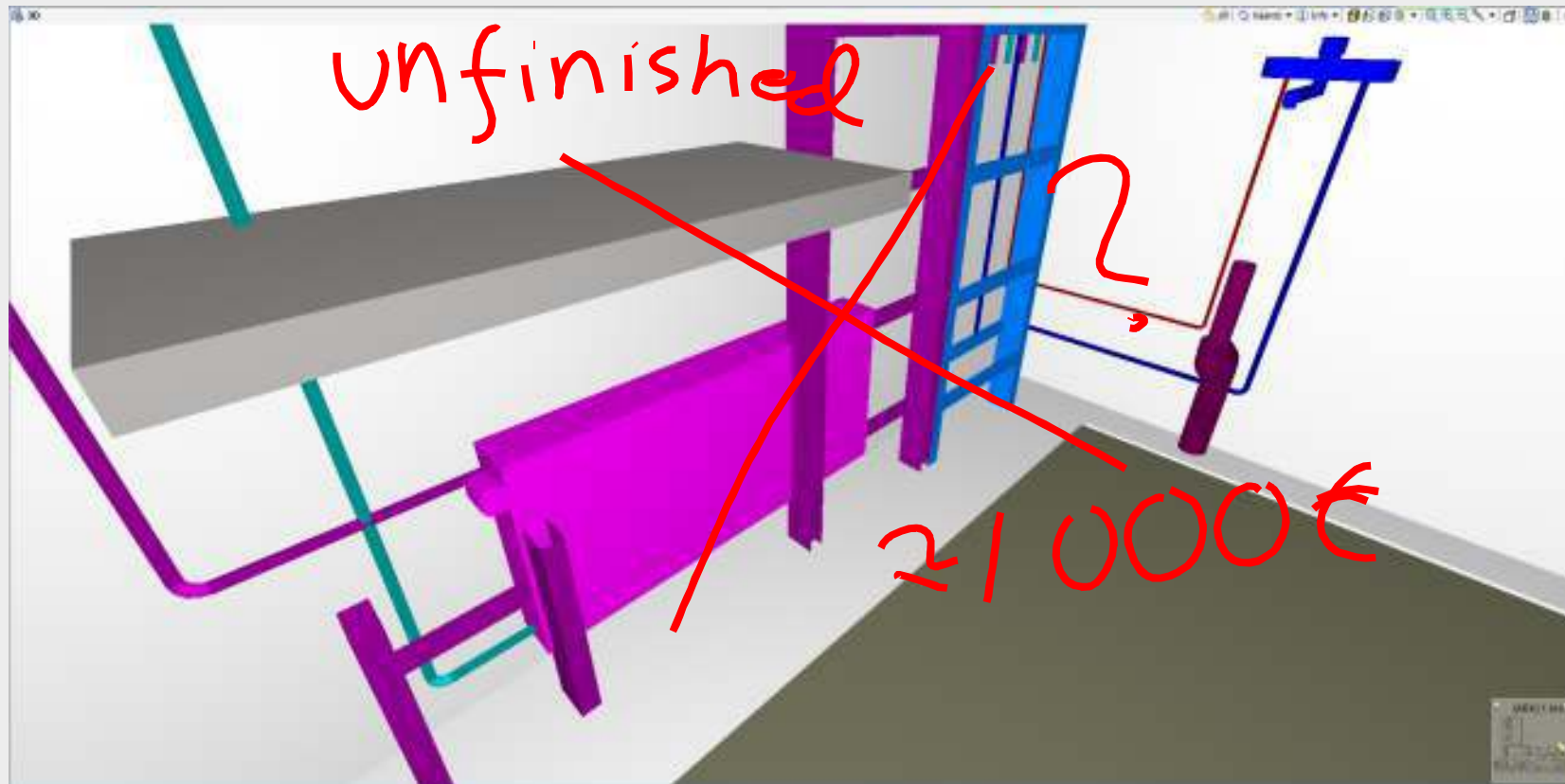
Case / Renovation of High School Maininki, Espoo

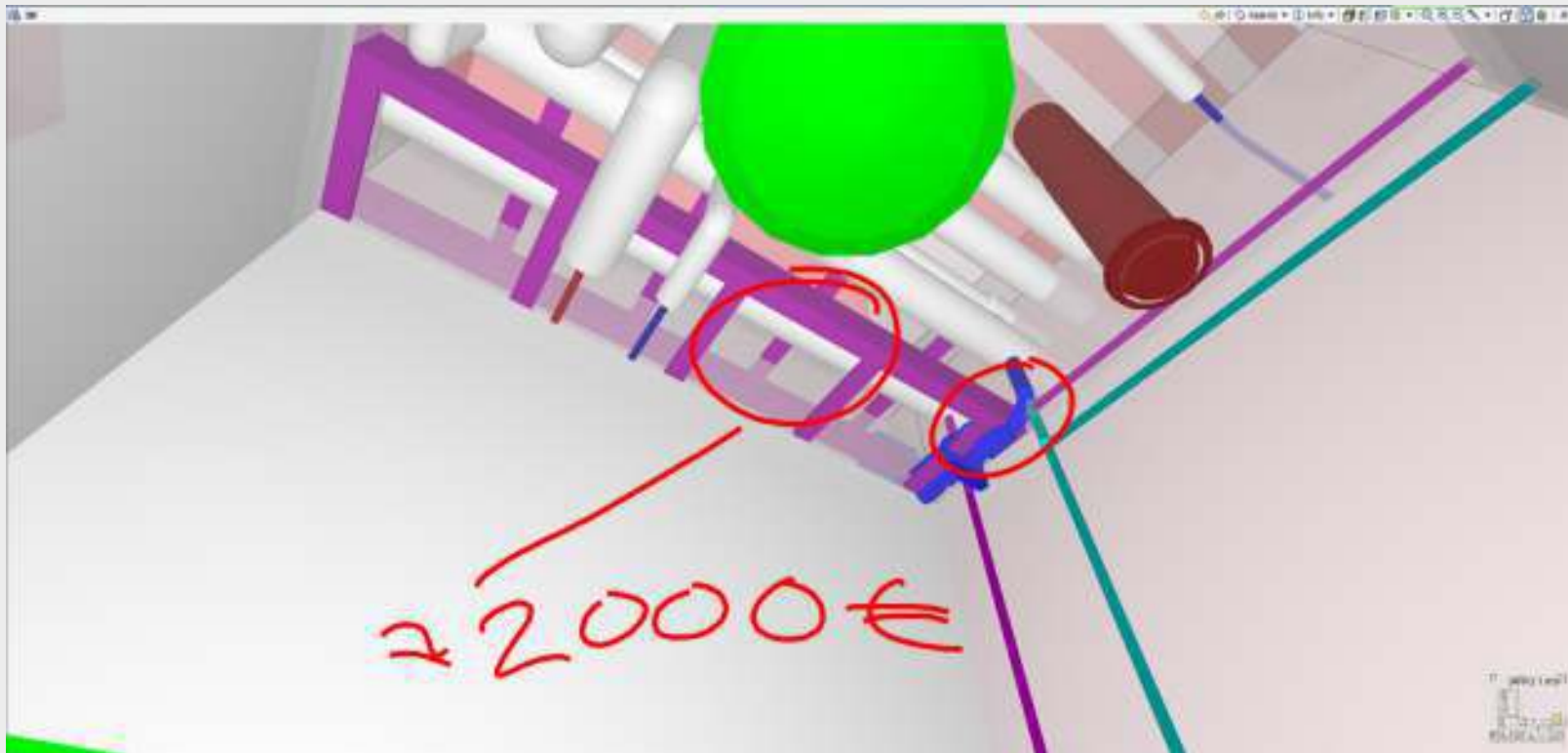


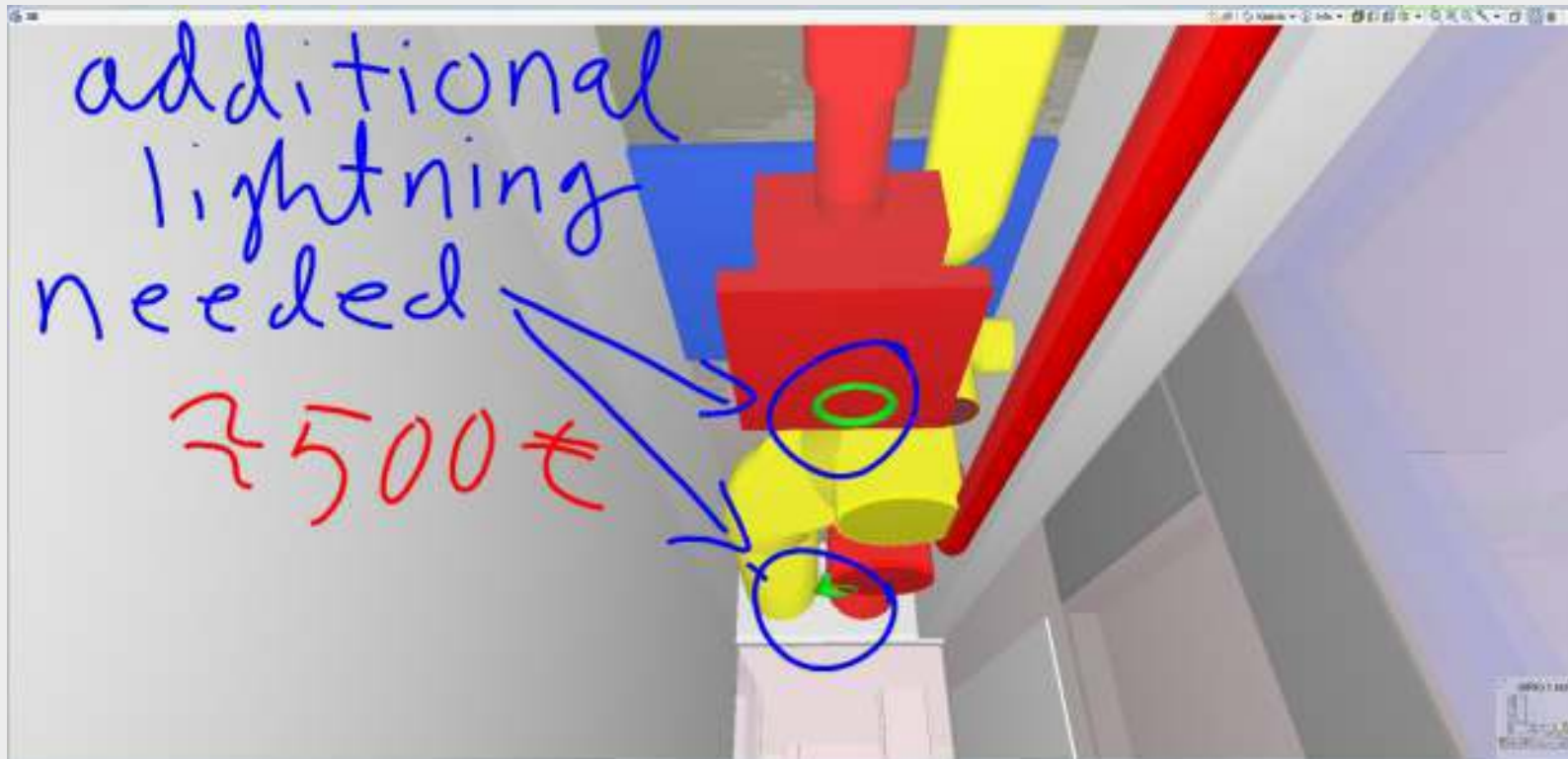
Heikki Karjalainen
HVAC-specialist, NCC

Tero Lilja
VDC-specialist, NCC





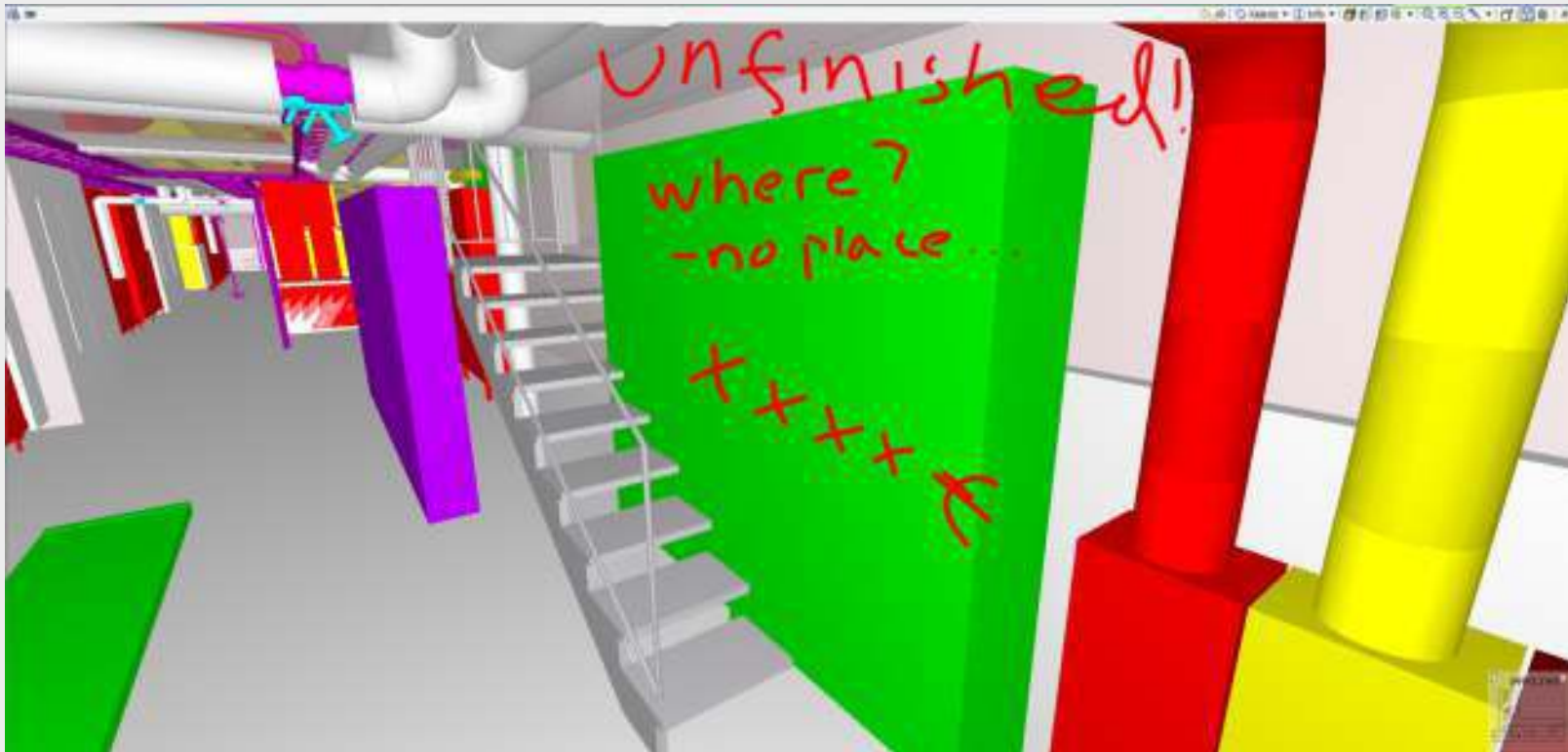


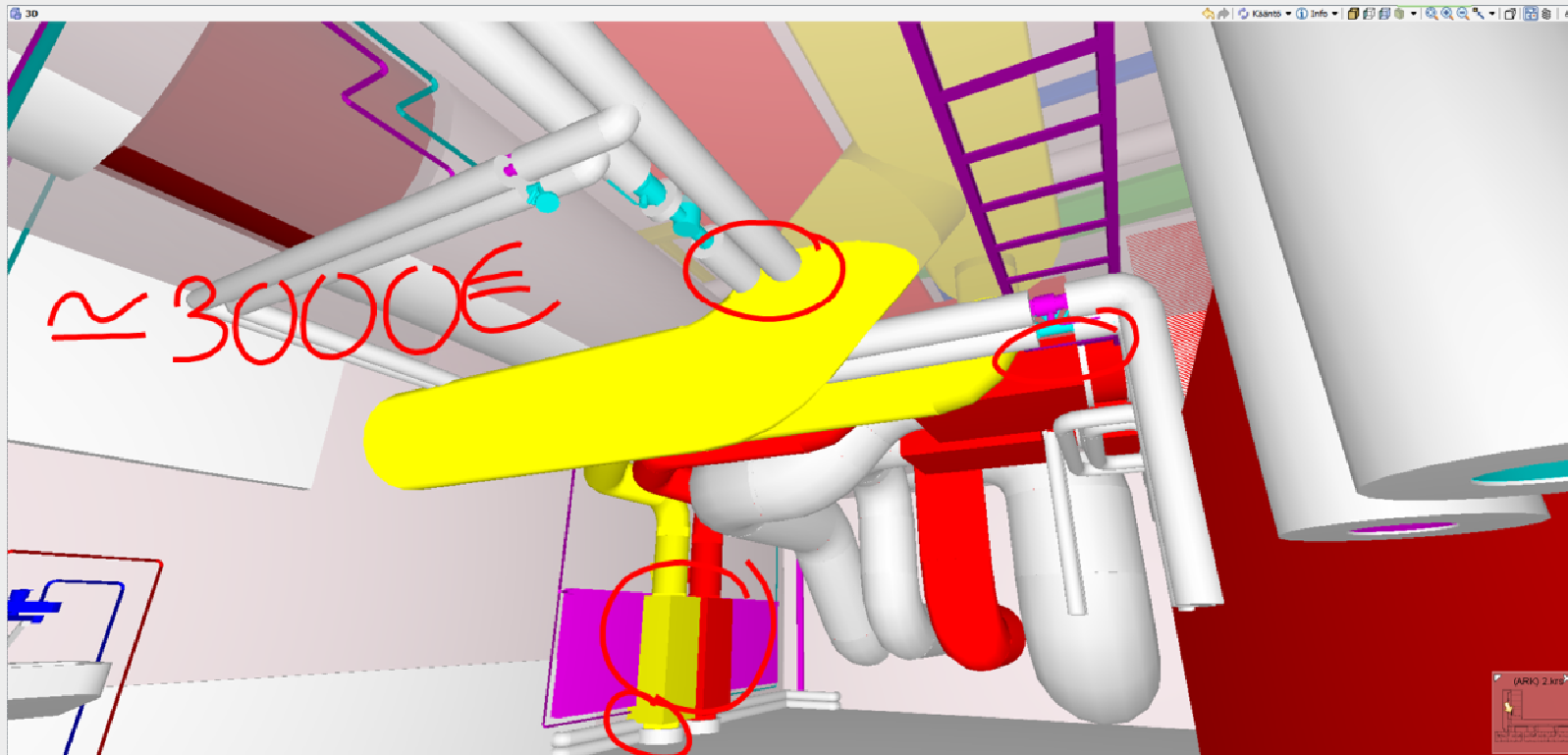


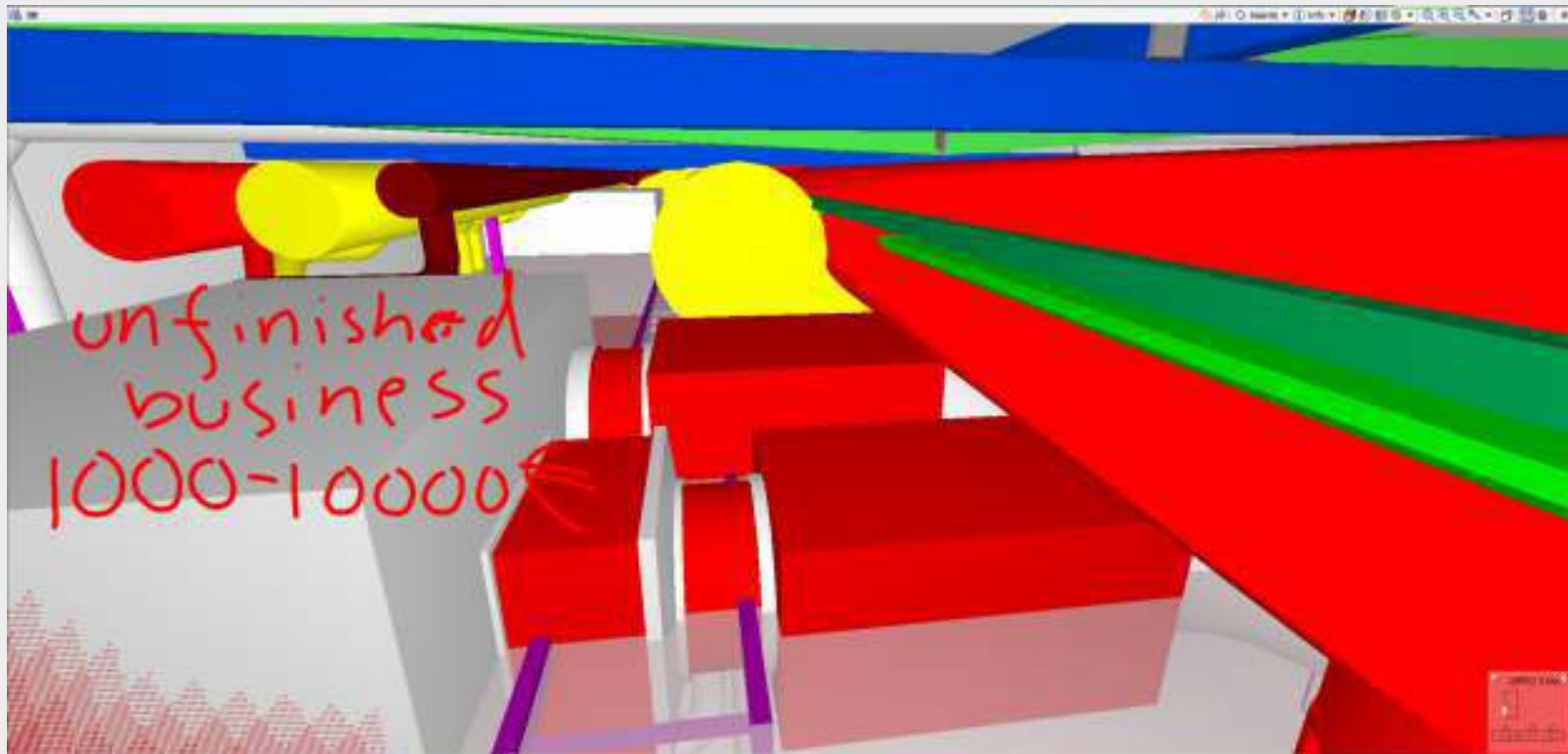


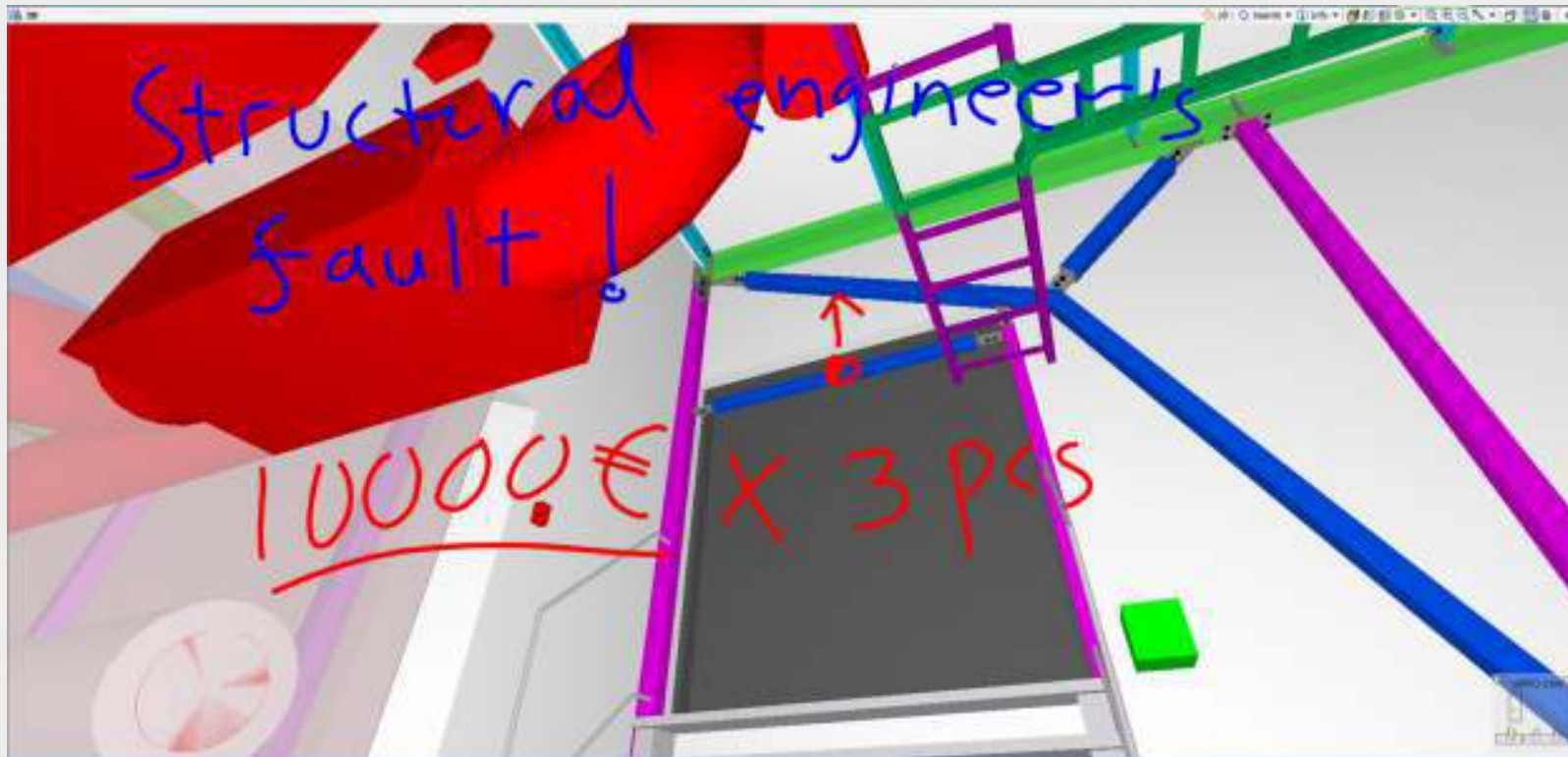












Locate Expenses 14.3.2014:

Case / Renovation of High School Maininki, Espoo

CONCLUSIONS:

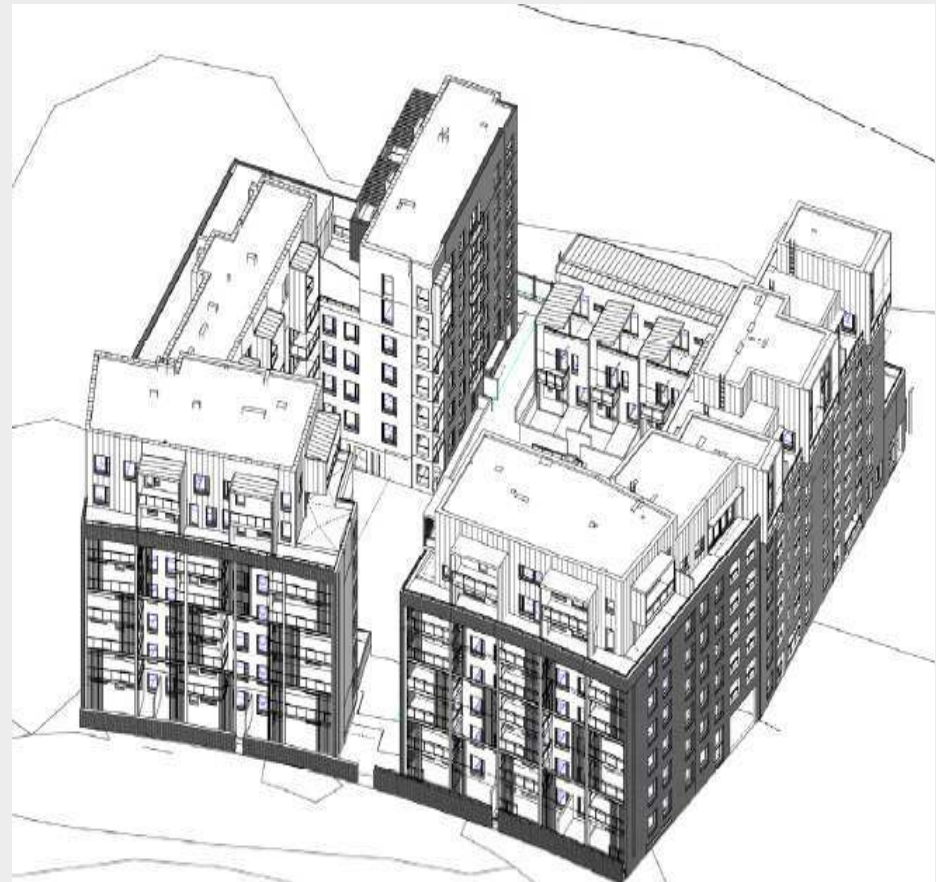
- You can easily spot problems
 - Price giving is not accurate
 - Would these problems have been spotted without a model?
- > *This is a good way of motivating people to use BIM!*

Residential Buildings Marco Polo & Tyynimeri *Postmodelling*



Marco Polo & Tyynimeri - Background

- Fairly large apartment project in scale of Helsinki area
- The project includes 123 apartments and total of 10 129 sqm
- Both construction sites (MarcoPolo and Tyynimeri) will be built at the same time
- Turnover is about 30 m€ and it is about 15 % of NCC Finland Housing Construction yearly turnover
- The construction started in April 2013 and will be ready in October 2014.



Marco Polo & Tyynimeri - Background



- Developer had already checked all the drawings for collision
- The project was fairly large and the drawings were complex. Due to that NCC suggested the post-modeling for the structure, HVAC and electrical drawings.
- Although the client was responsible for the main planning, the client agreed to pay half of the post-modeling. (Modeler Optiplan Oy)
- All these drawings were post-modeled before the construction started.
- More than 100 problems were discovered from the post-model before the construction started on April 2013.

Advantages of post-modeling

- Identifying the problems ja fixing the problems before the construction
- To create cooperation between the developer, designers and contractor in the early stage of the project.
- To become familiar with project through the 3D model
- To notice how many problems finished 2D drawings can include
- Discovering how much the problems and errors would have cost if they would have been found on the construction site.

Savings

- Postmodelling cost about 100000€
- The direct savings made were about as much
- The undirect savings were not reported, such as
 - other collisions due to change of plan
 - time needed for construction
 - time needed for procurement

Positive experience

1. *NOVO, Denmark*
2. *KVÆSTHUSBROEN, Denmark*

NOVO Måløv – VDC in tender



Facts:

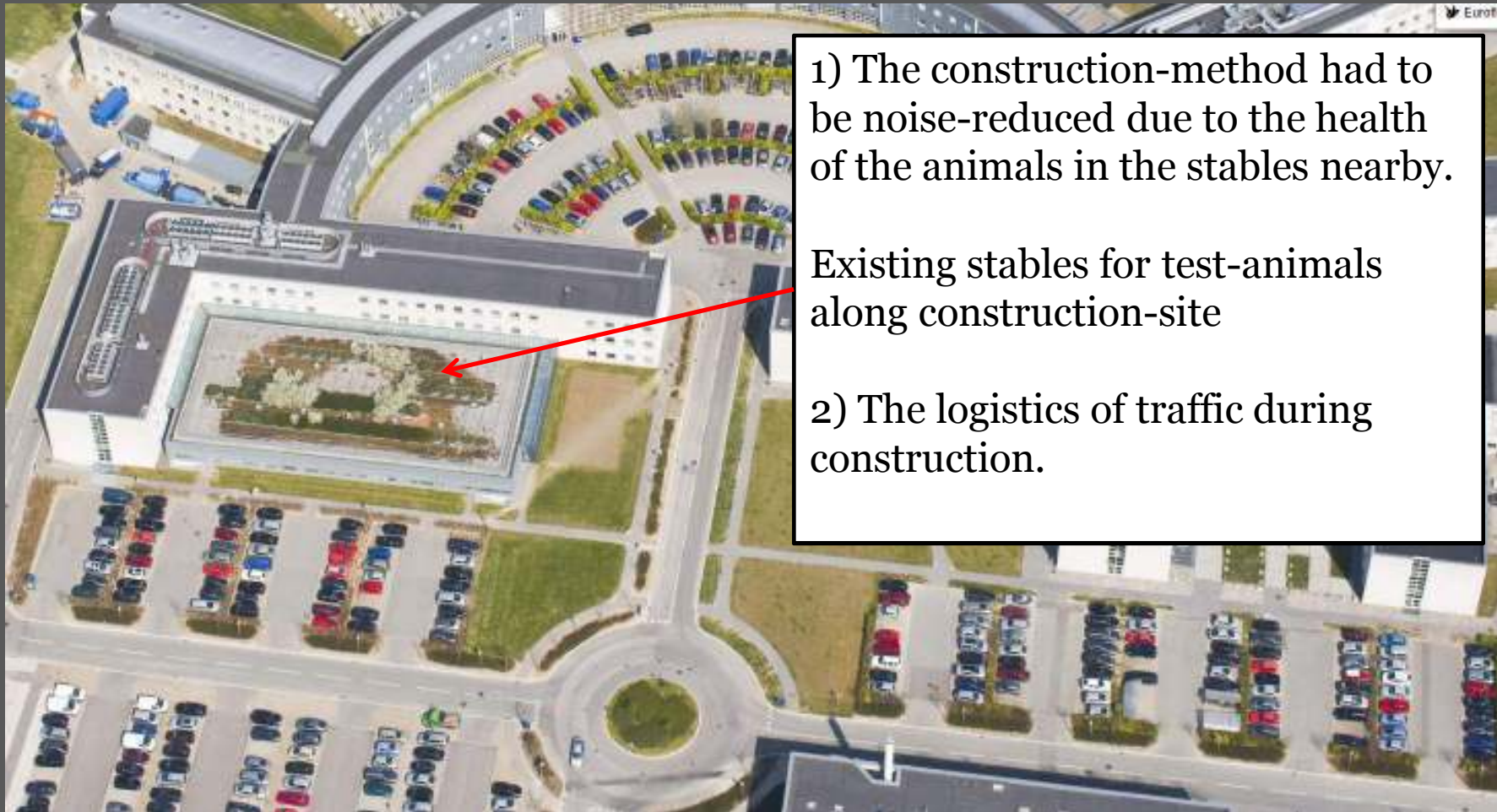
Laboratories
Offices
Stables for test-animals

8000 m²

Architect: RH Arkitekter
Structural: Rambøll



Client demands in tender:



1) The construction-method had to be noise-reduced due to the health of the animals in the stables nearby.

Existing stables for test-animals along construction-site

2) The logistics of traffic during construction.

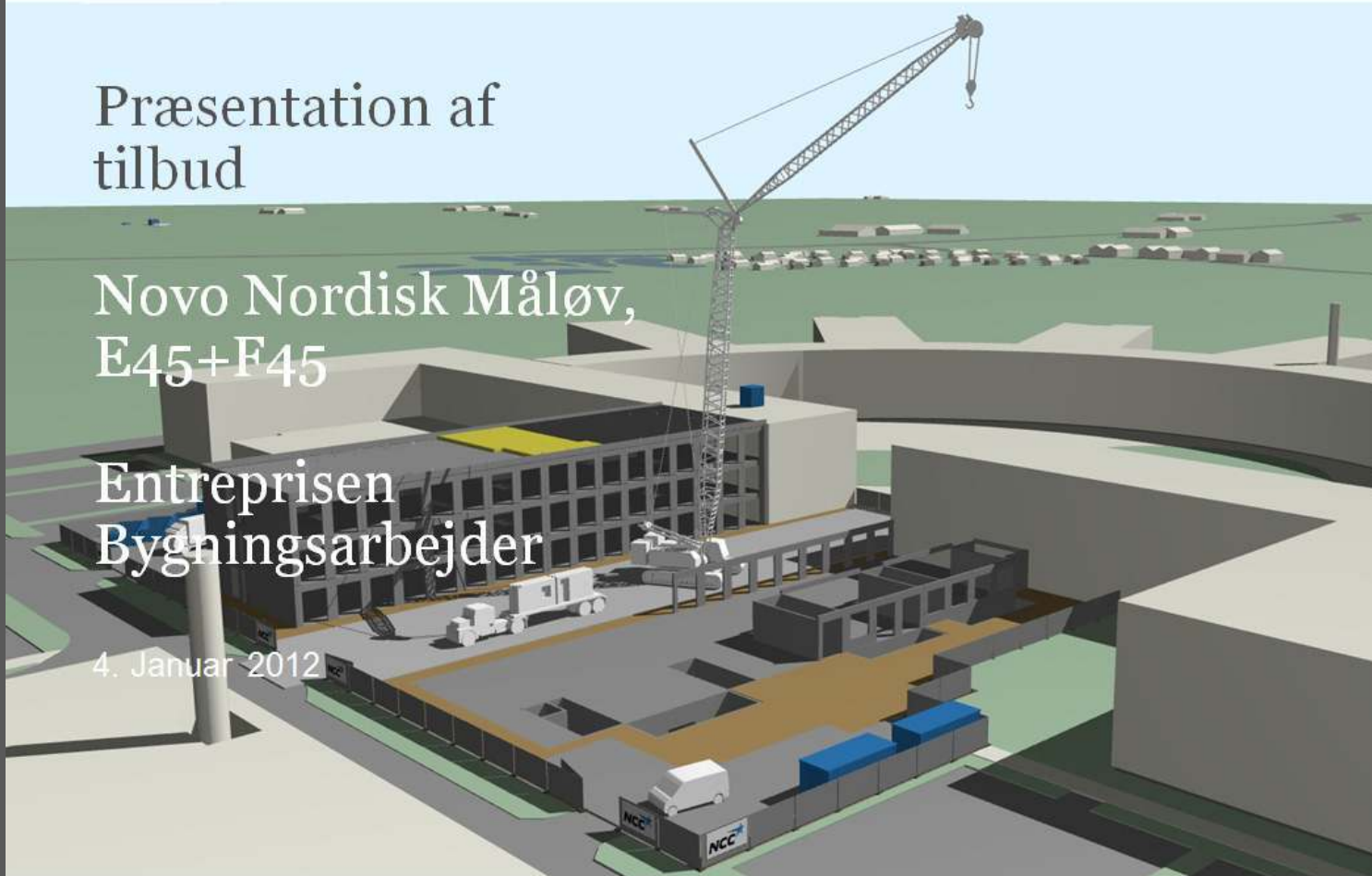


Præsentation af tilbud

Novo Nordisk Måløv,
E45+E45

Entreprisen
Bygningsarbejder

4. Januar 2012



4D – Presentation of construction



2012

2013

mar.	apr.	maj	jun.	jul.	aug.	sep.	okt.	nov.	dec.	jan.	feb.
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- Situationen inden opstart.



4D – Presentation of construction



2012

2013



- Rundkørsel forlagt.
- Ledninger omlagt.
- Situationen inden mobilisering af byggeplads.



4D – Presentation of construction



2012

2013



- Etablering af byggeplads.
- Stigevojn kørt på plads.
- Gangveje uden om byggeplads.
- Tæt hegn, med 3 låger.



4D – Presentation of construction



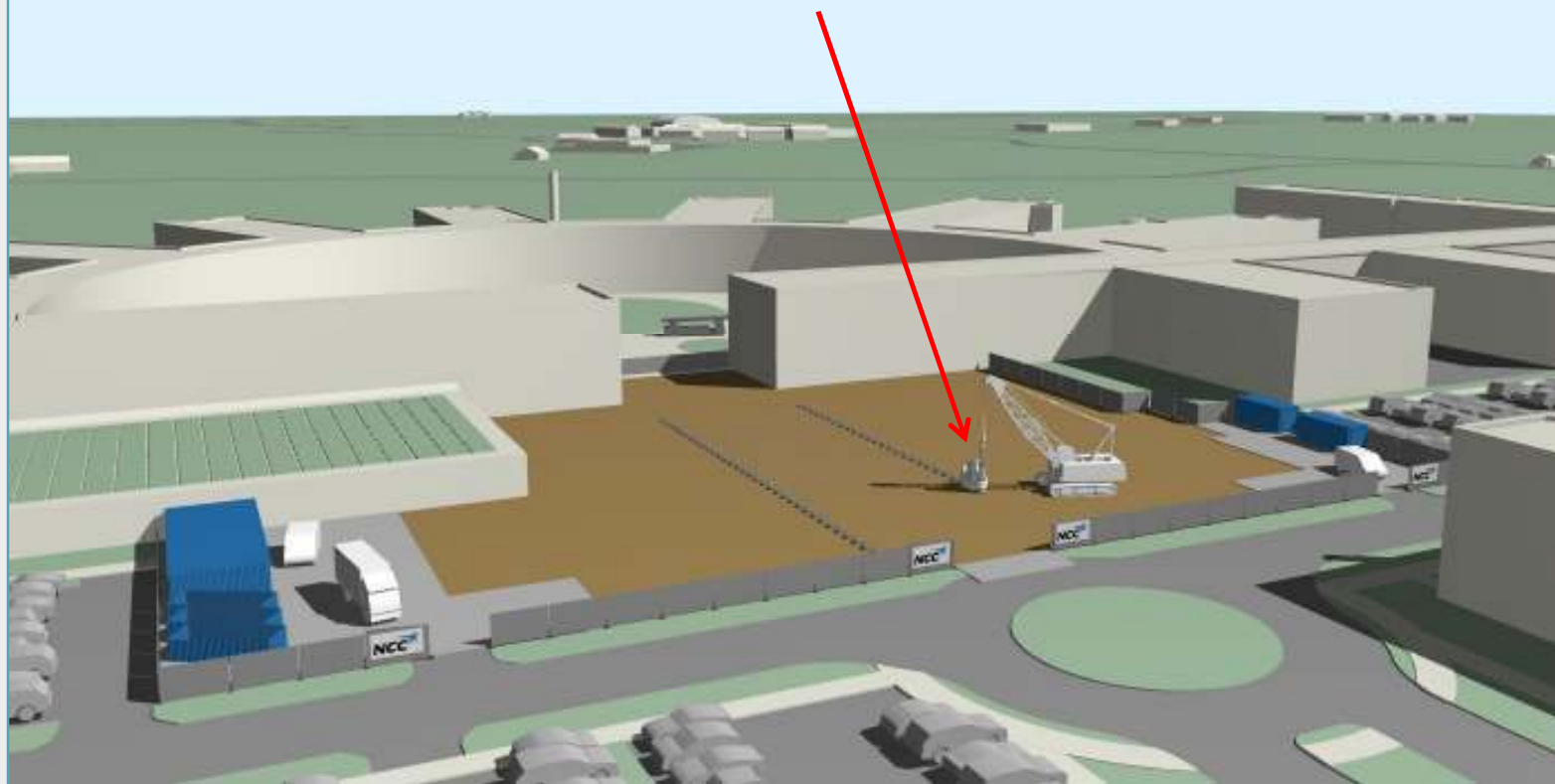
2012

2013



- Spuns placeres med Silent Piler.

SILENT PILER



4D – Presentation of construction



2012

2013



- Udgravning fra nord mod syd.
- Opstart af fundamenter og kanaler.



4D – Presentation of construction

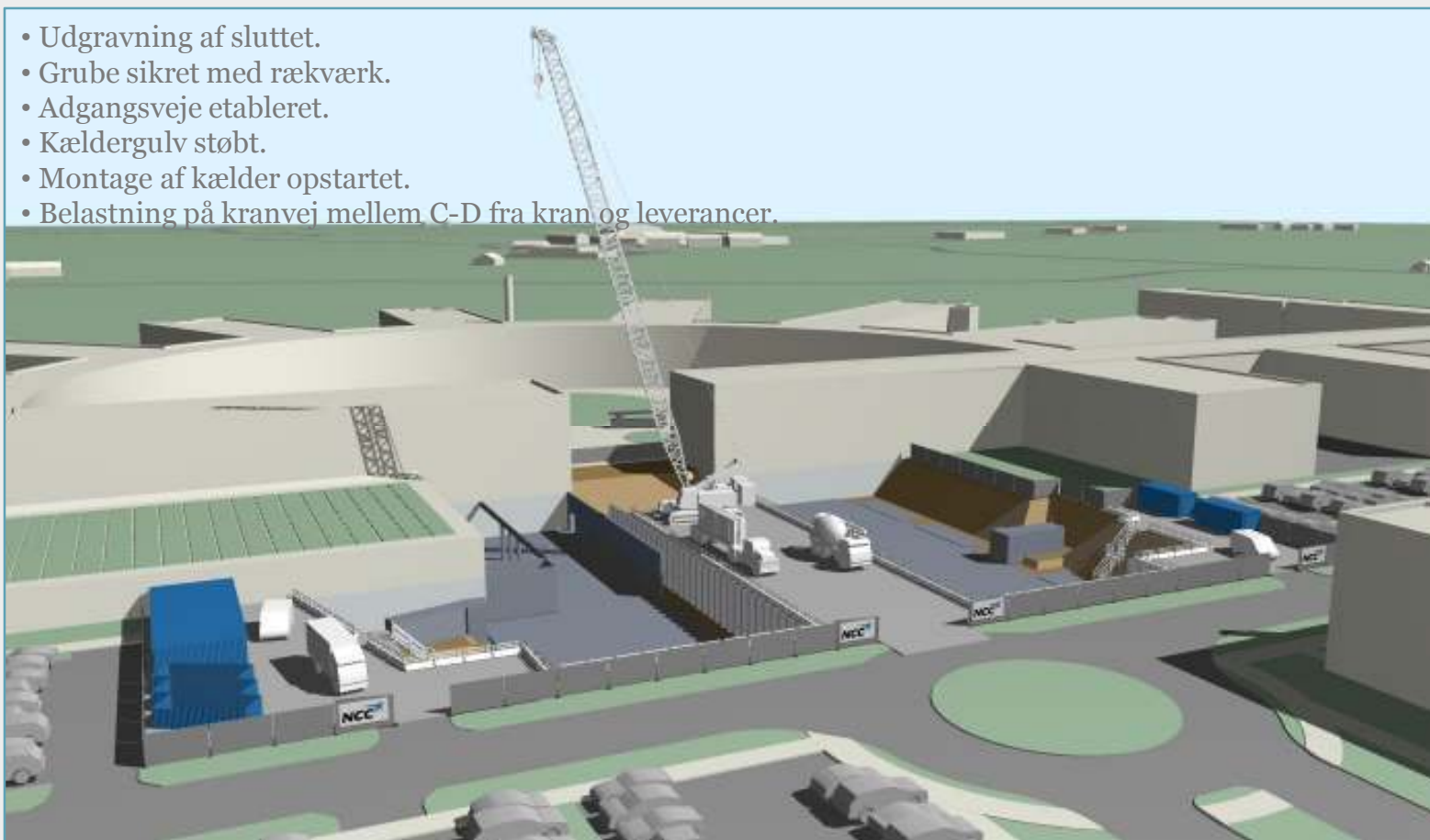


2012

2013



- Udgravning af sluttet.
- Grube sikret med rækværk.
- Adgangsveje etableret.
- Kældergulv støbt.
- Montage af kælder opstartet.
- Belastning på kranvej mellem C-D fra kran og leverancer.



4D – Presentation of construction



2012

2013

mar.	apr.	maj	juni	jul.	aug.	sep.	okt.	nov.	dec.	jan.	feb.
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- Opstart af dæk over klæder.



4D – Presentation of construction



2012

2013



- Dæk over klæder afsluttet.
- Tilfyldning afsluttet.

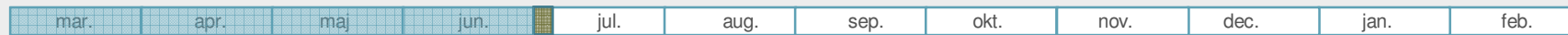


4D – Presentation of construction



2012

2013



- Montage af F45 over terræn opstartet.
- Afskærmer.
- Klargøring til facadearbejde over eksisterende bygning mod vest.

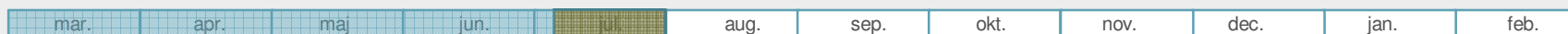


4D – Presentation of construction



2012

2013



- F45 rejst.
- Montage af E45 over terræn opstartet.
- Adgangsvej til tag.
- Tagarbejde pågår.
- Forberedelse til inst.aggr på tag.
- Fødder til taghusskærm placeret.
- Beredskab til brandslukning.



4D – Presentation of construction



2012

2013



- Montage af E45 fortsætter.
- Tekniske aggregater monteret på F45.
- Vinduer monteret i facader.
- Lukket råhus/tæt tag.
- Op start af udtørring med permanente anlæg.
- Skalmur opstartet, gavlen først.
- Udvendig hejs på sydgavl.
- Interimsdøre i sydgavl.

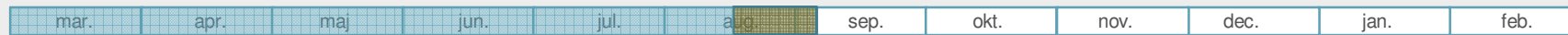


4D – Presentation of construction



2012

2013



- E45 rejst.
- Skalmur på F45 fortsætter.
- Indvendig aptering og installationer pågår.

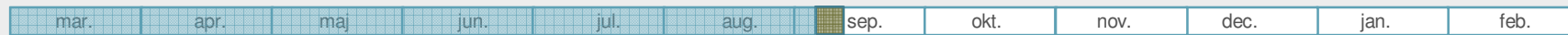


4D – Presentation of construction



2012

2013



• Tagarbejde på E45

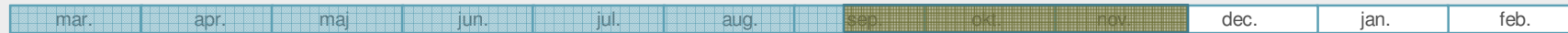


4D – Presentation of construction



2012

2013



- Tagskærme monteret.
- Udvendig arbejde på begge bygninger færdiggøres.
- Indvendig aptering og installationer pågår.

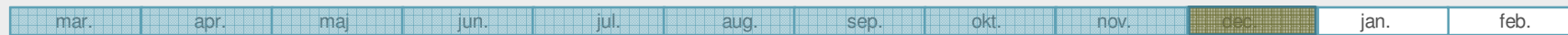


4D – Presentation of construction

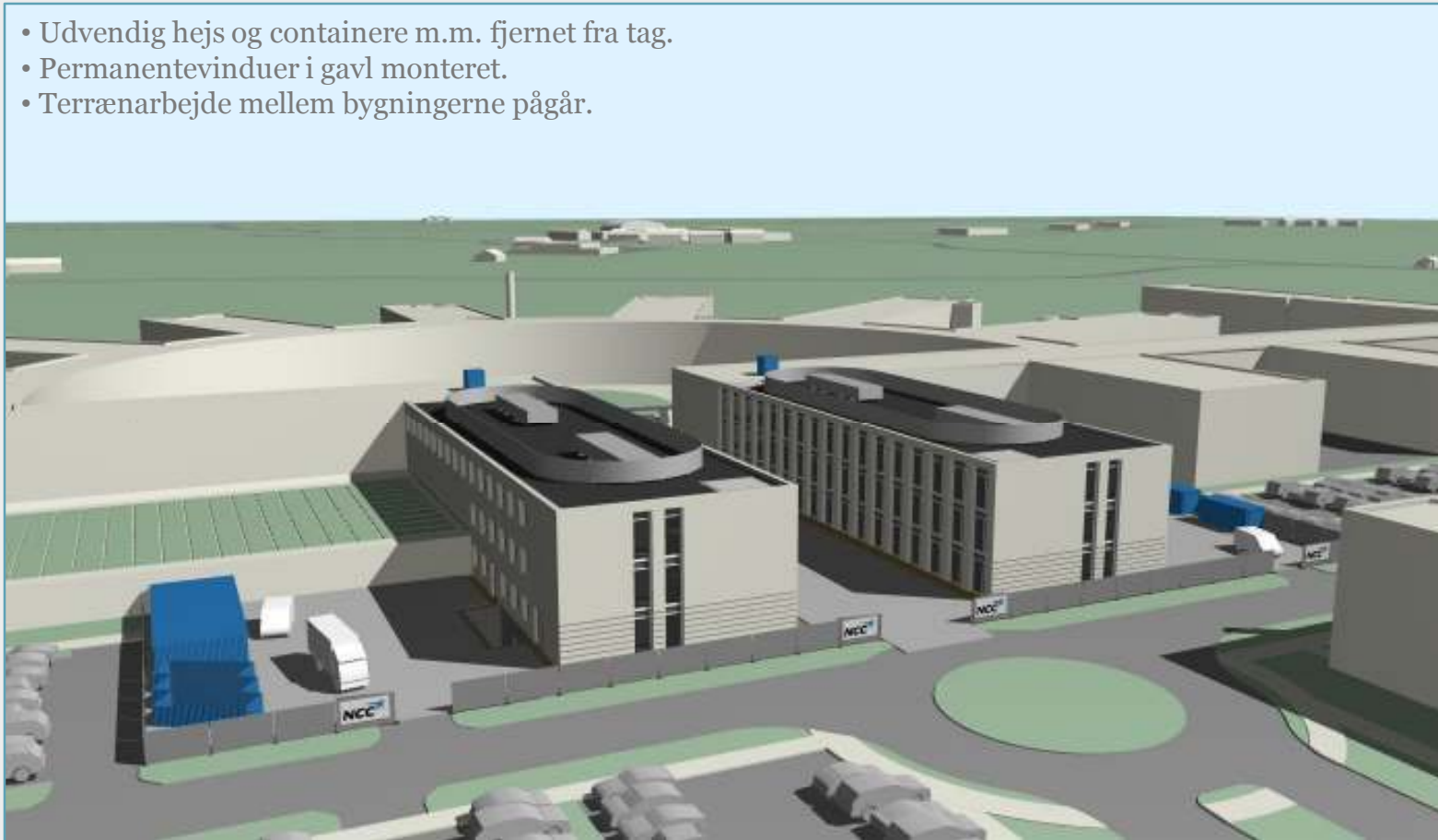


2012

2013



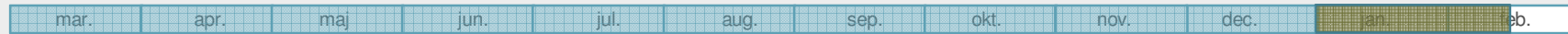
- Udvendig hejs og containere m.m. fjernet fra tag.
- Permanentevinduer i gavl monteret.
- Terrænarbejde mellem bygningerne pågår.



4D – Presentation of construction

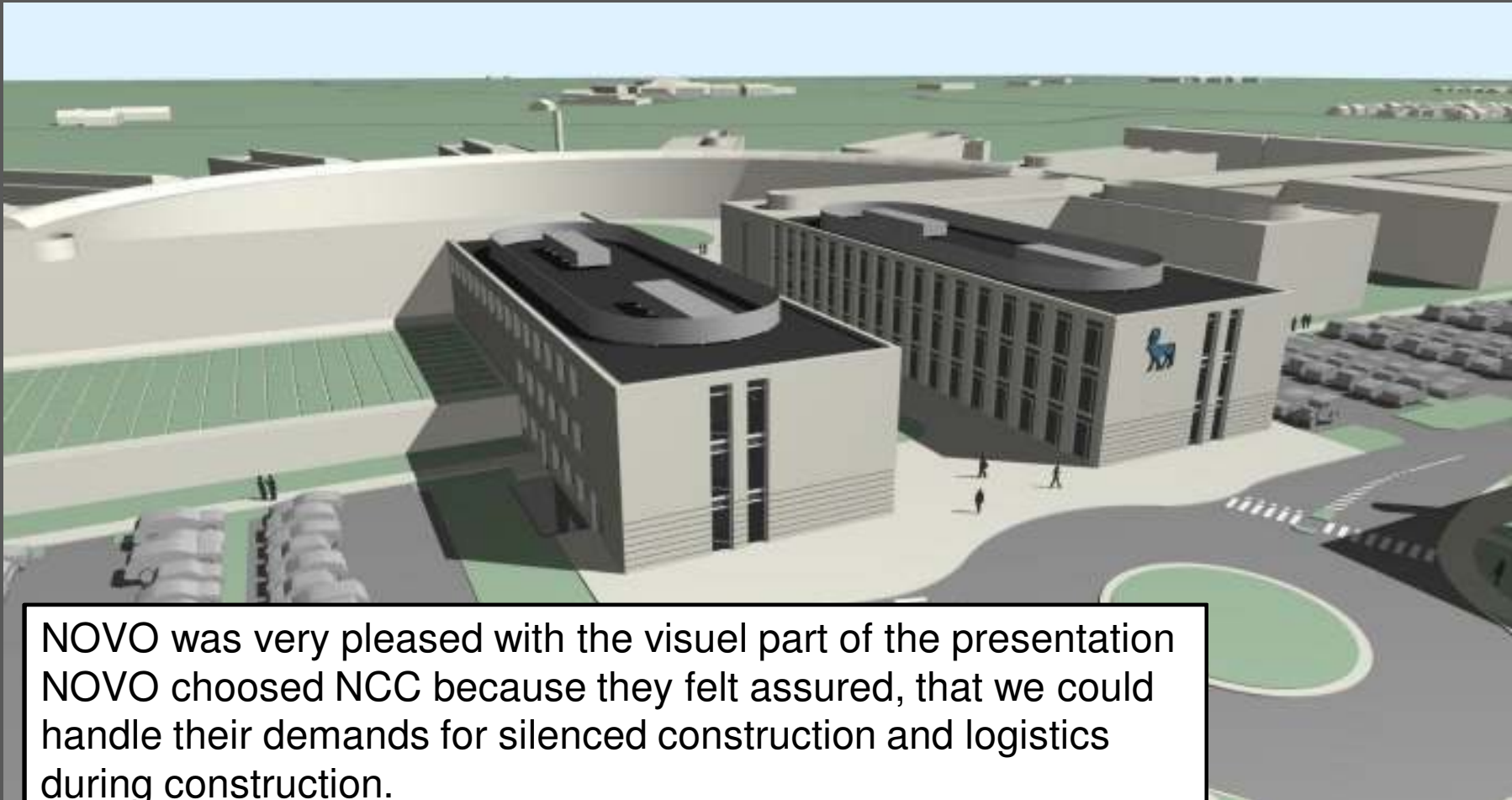
2012

2013



- Byggeplads afrigget.
- Terræn retableret.
- Mangeludbedring afsluttet.
- Aflevering.



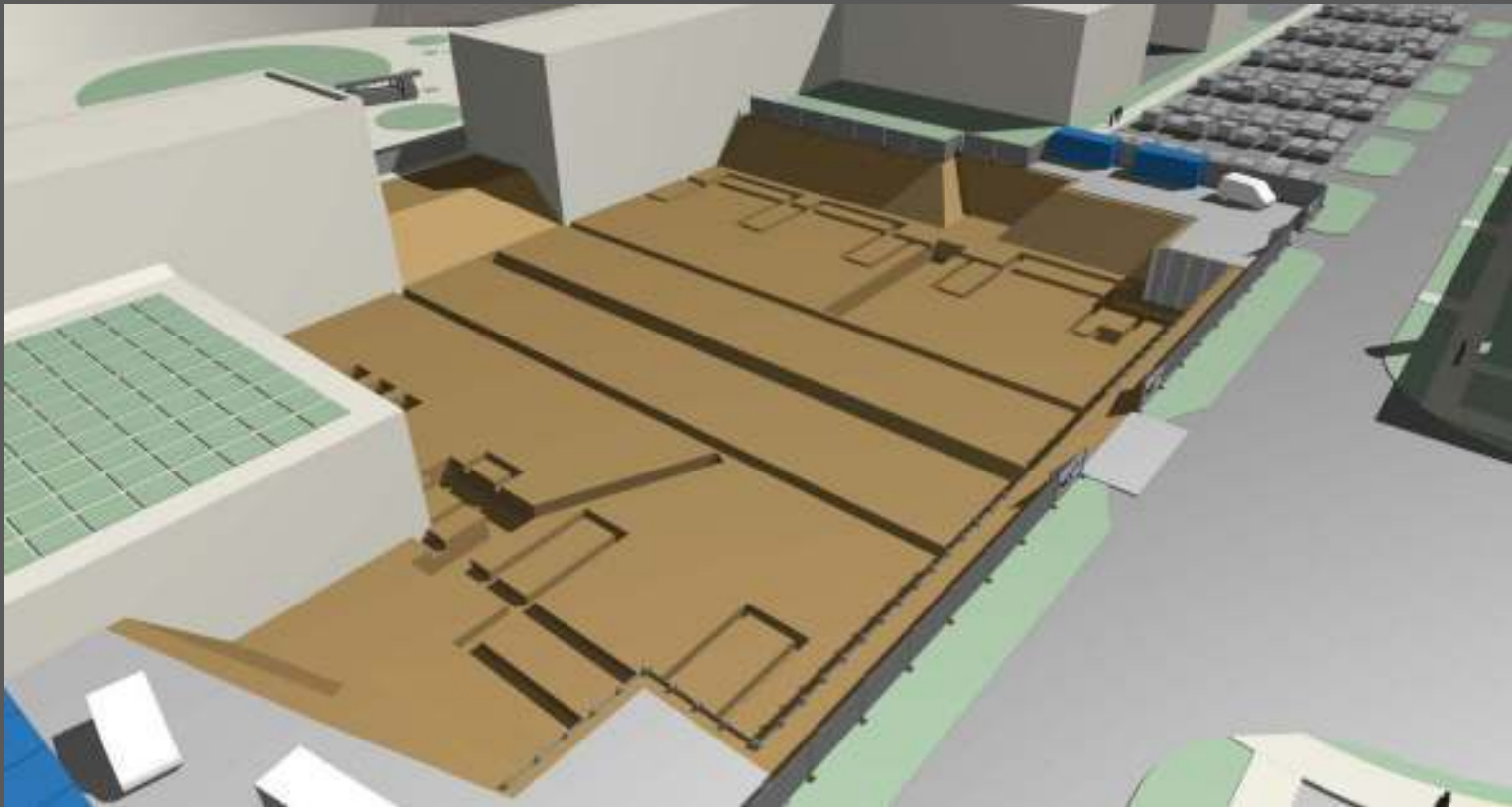


NOVO was very pleased with the visual part of the presentation NOVO chose NCC because they felt assured, that we could handle their demands for silenced construction and logistics during construction.

NOVO used the presentation internally to inform the employees about the construction and the logistics.

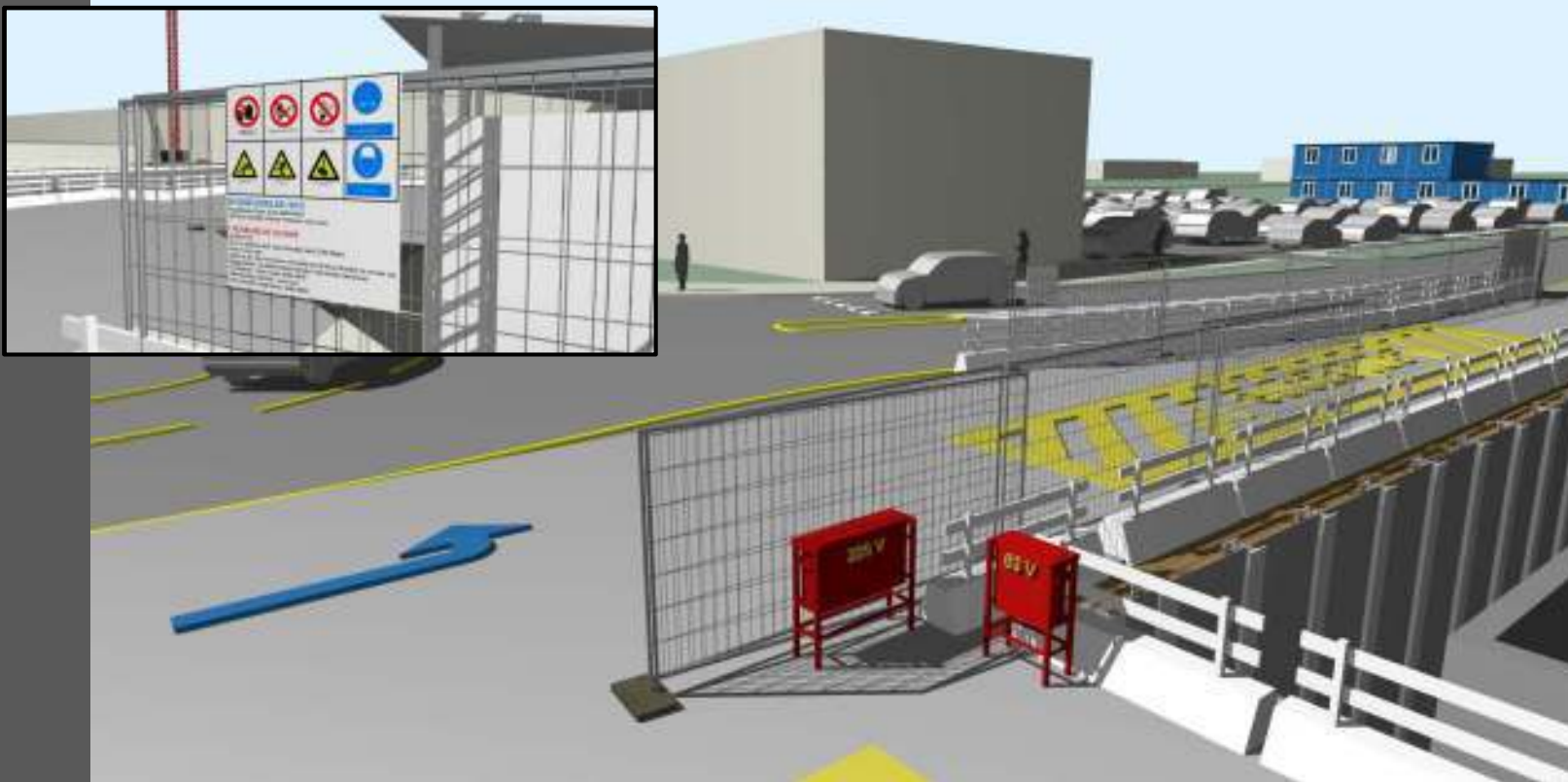
VDC for NCC

The terrain and groundwork was modelled and quantities for the groundwork was extracted for accurate digging and construction.



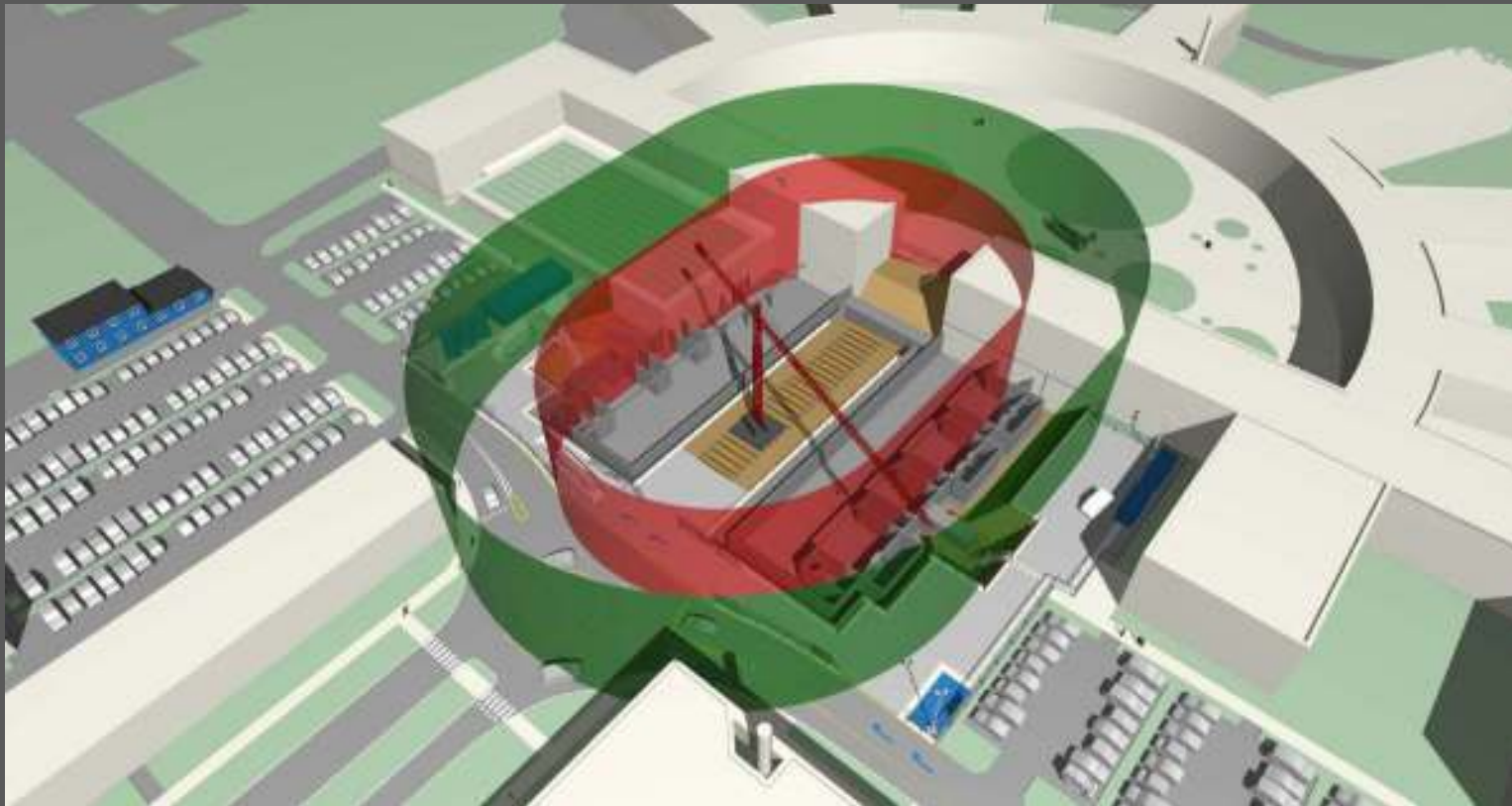
VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



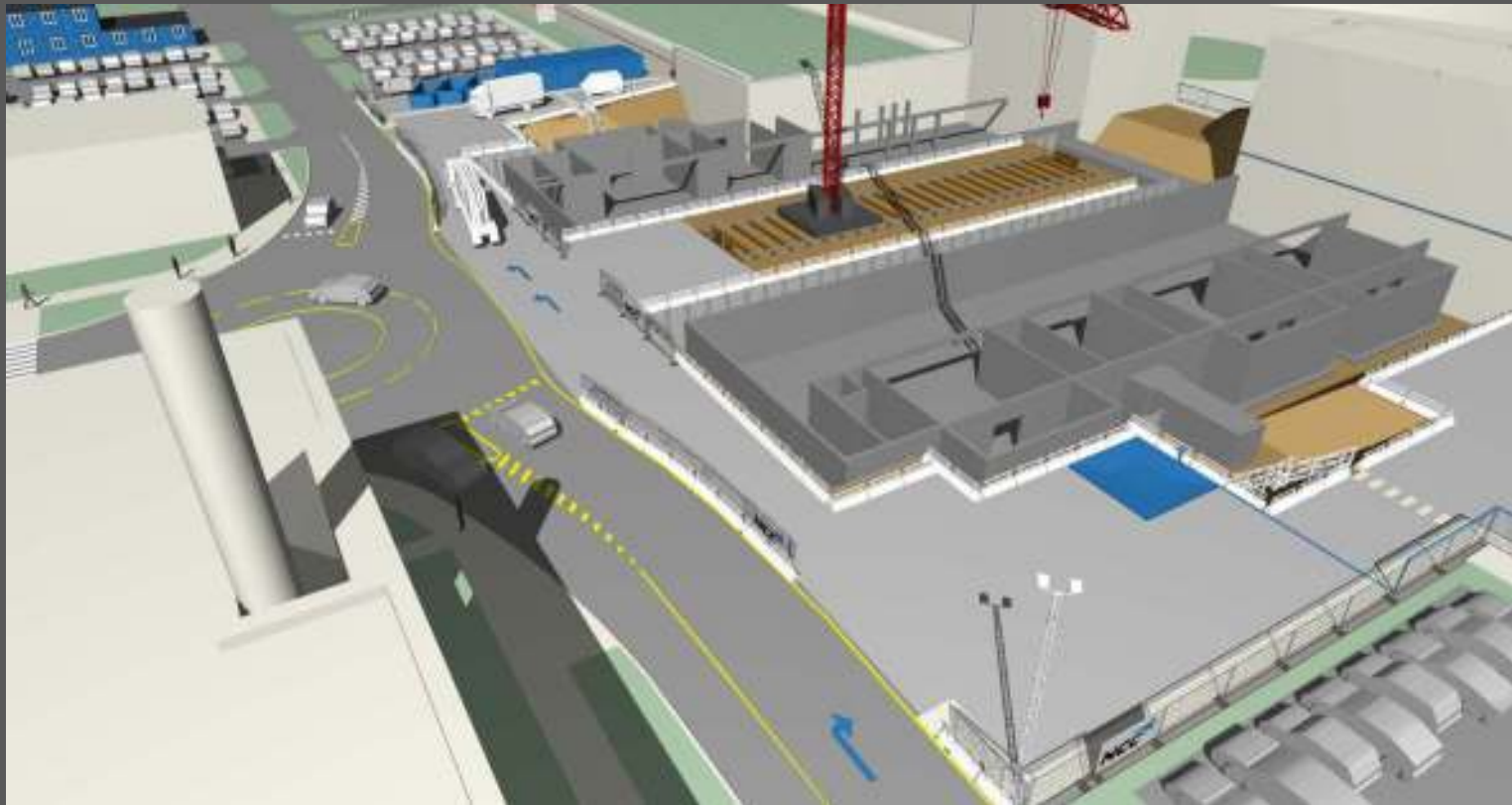
VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



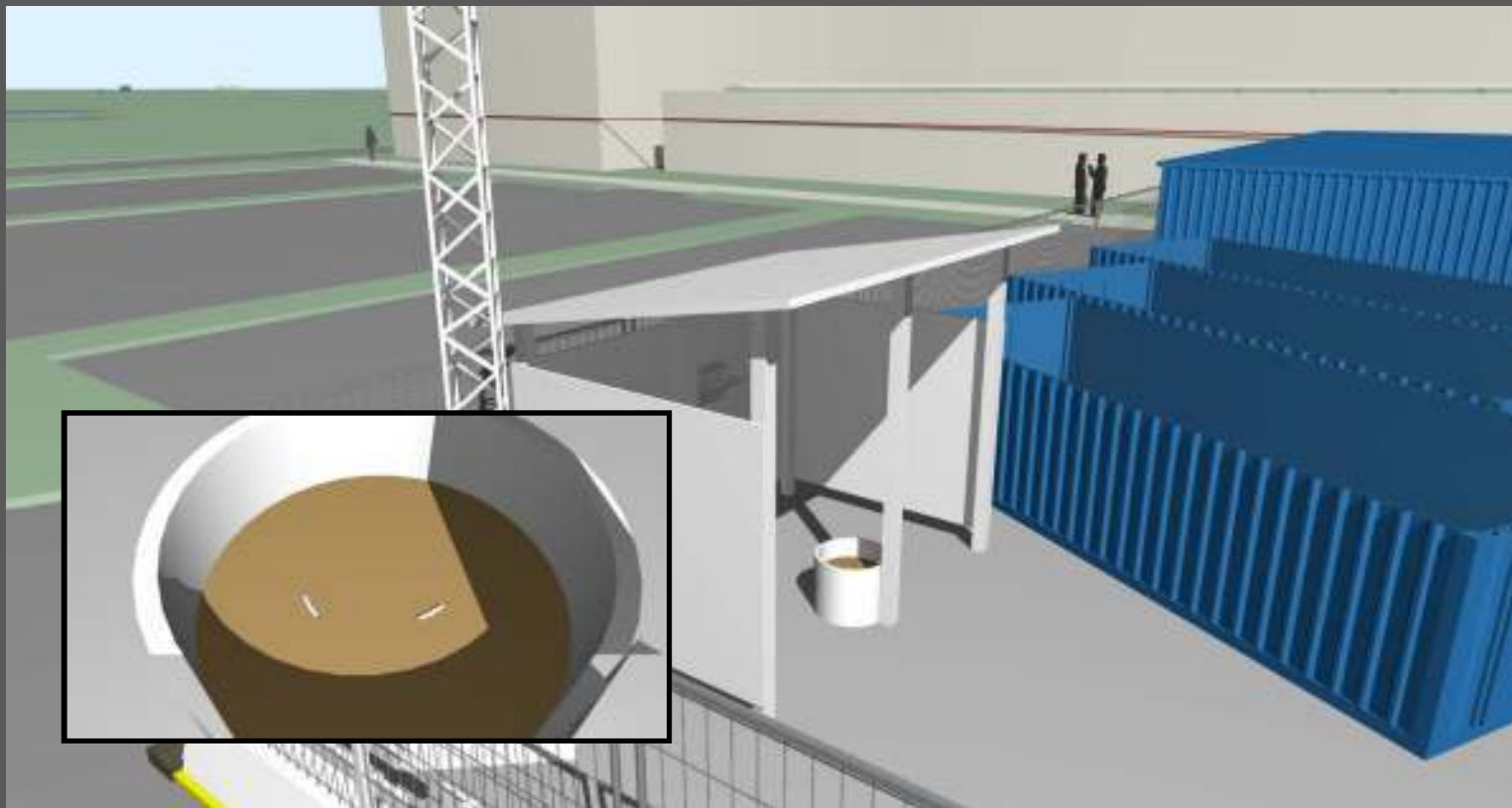
VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



VDC for NCC

The model was used for planning the construction-proces and the construction-site both in design and production



Summary

VDC helped to win a tender by visualizing the construction-methods and in that way fulfill the clients demands.

VDC could afterwards use the model to plan and coordinate construction, logistics and the construction-site.



KVÆSTHUSBROEN

- 4D-simulation



VDC- Model og Design
NCC Construction Danmark – Oct. 2012
Michael Edwards Pedersen & Kristian Mouridsen

KVÆSTHUSBROEN



KVÆSTHUSBROEN



KVÆSTHUSBROEN





”KVÆSTHUS” means hos ”house of the injured” and is an old name the fleet called their hospital for their injured marines.

These were established in 1684-86 when Denmark was at war with Sweden.

- 2005: Copenhagen Opera completed - 2008: The Playhouse completed
- Lack of parking was evident
- The 'Kvæsthusproject is one of Realdanias prestige projects, and is a gift to Copenhagen. It is realised in partnering setup with Realdania and 'The Royal Theater/Ministry of Culture' through the subsidiary company Kvæsthusselskabet A/S.

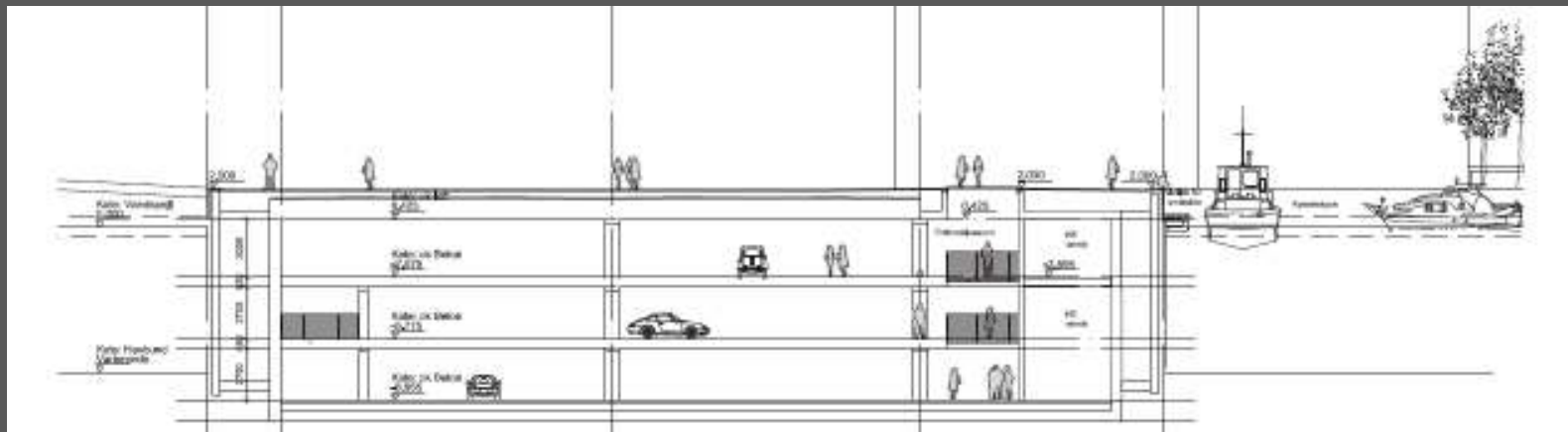


- Lundgaard og Tranberg, the same architects that designed the playhouse, is associated with the project as architectural consultants.



*The Kvæsthusconsortium:
Lundgaard & Tranberg with Schønherr Landscape, COWI and
NCC with Grontmij.*

THE PROJECT



- 3 floors below the pier
- Space for 500 cars
- Car access from 'Sankt Annæ Plads'
- Flexible public space above
- Pedestrian access through small pavilions

■ "...Basicly a hole in the ground..."

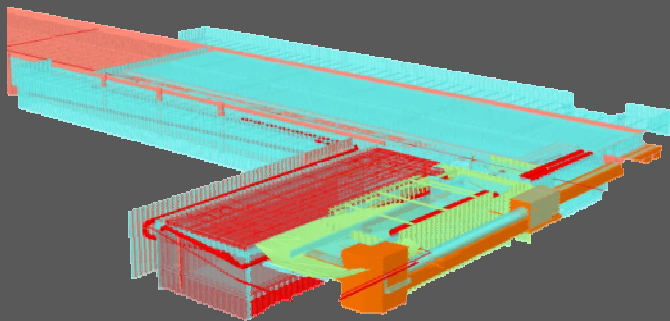
■ "...Basicly a hole in the *water*..."
...dug in three layers of old pier in a wet and sensitive area...

MODELS

"Construction is easy. The hole is the problem"



- Tender phase
- Model #1: Aimed at 4D simulation:
 - - Visual model
 - - Quantity Model

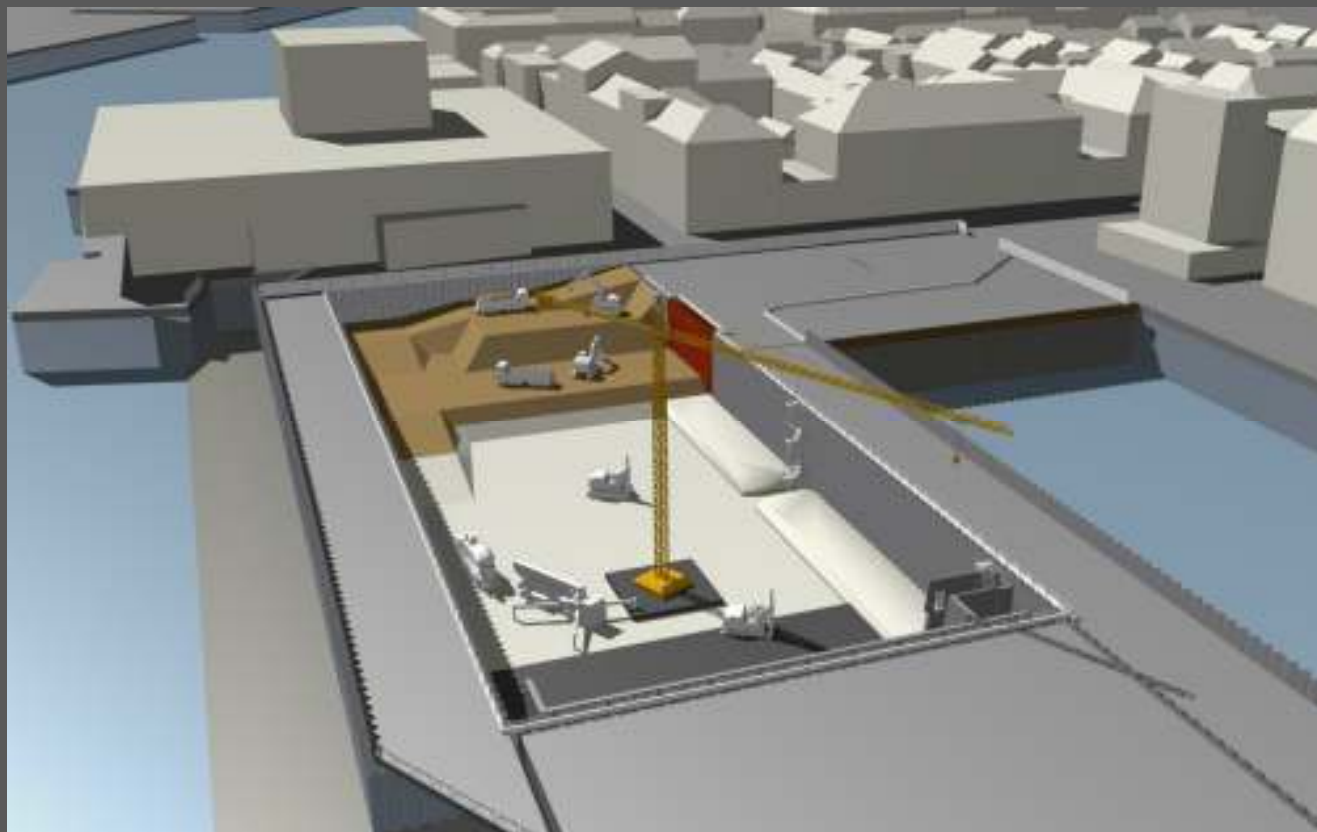


Main Phase

Model #2, 3 & 4: Aimed at VDC

- *New project*
- *Existing Pier*
- *Existing Pipes*
- ...

TENDER PHASE: 4D



- INITIAL GOALS:
- Show challenges
- Illustrate solutions
- Better knowledge
- Force decisions
- Better construction-proces
- Better economy

- Confident Client
- Metacommunication

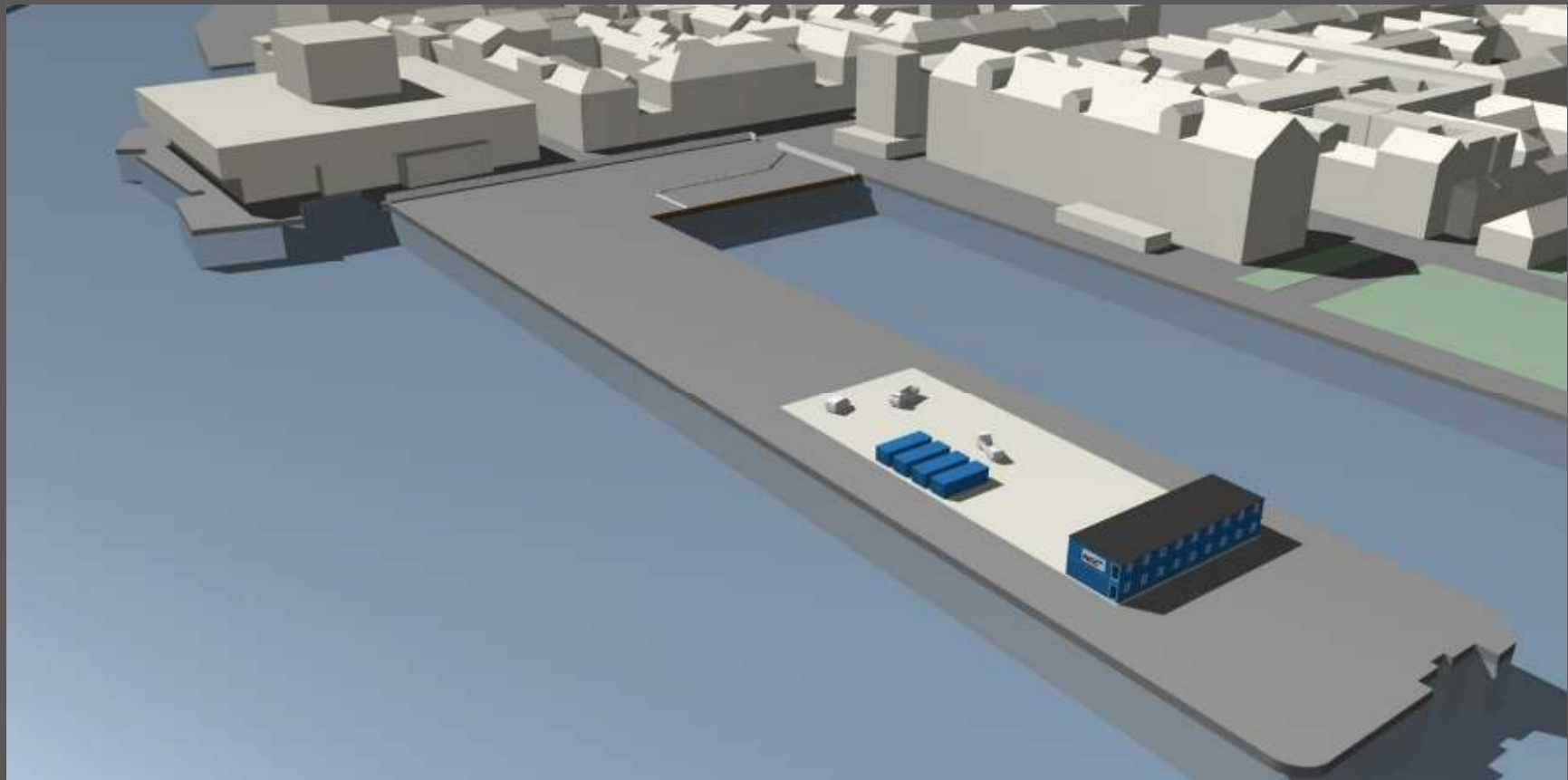
TENDER PHASE: 4D

- Situationen inden opstart



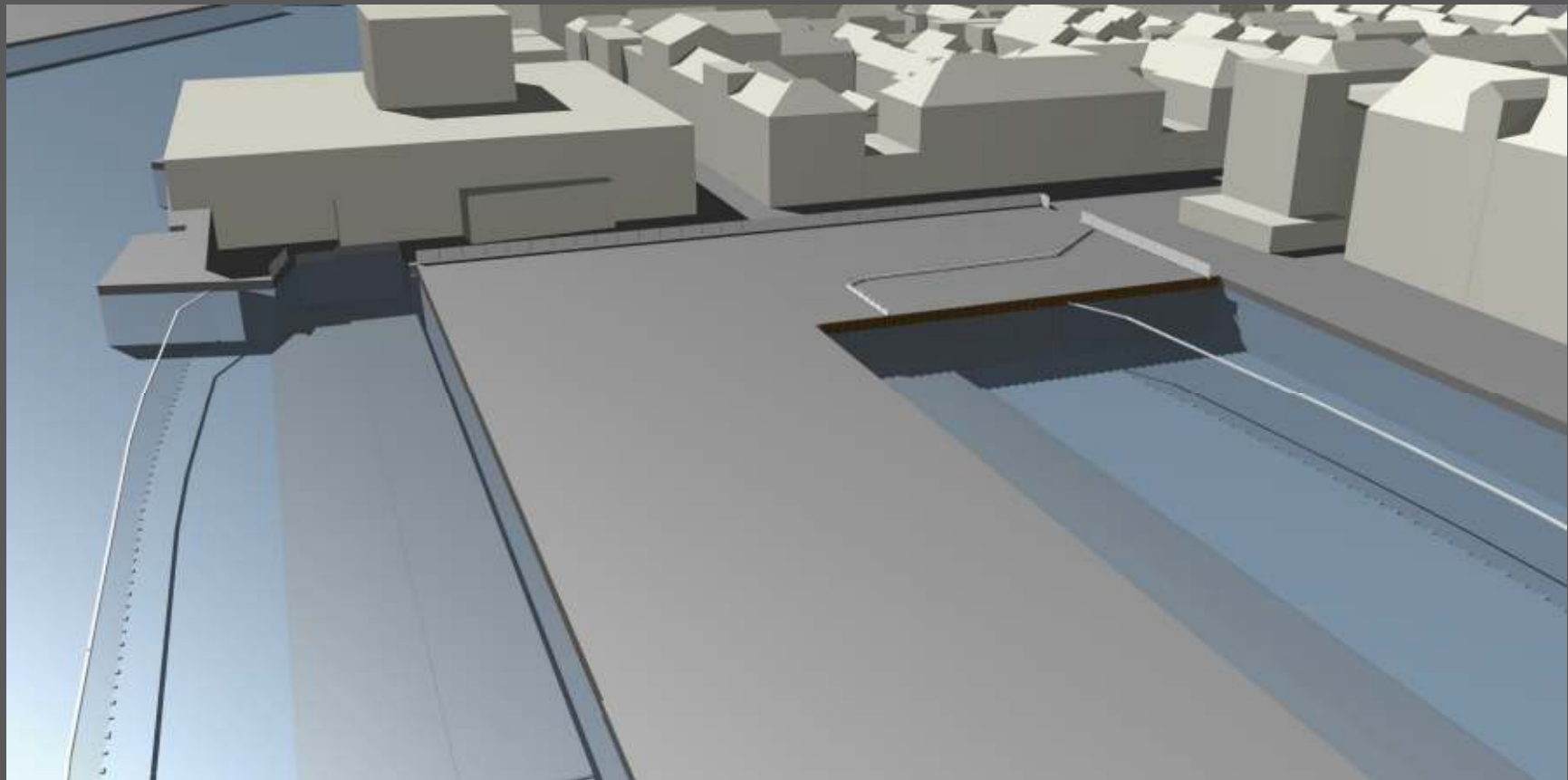
TENDER PHASE: 4D

- Indretning af byggeplads
- Bro nedtages og lægges i depot



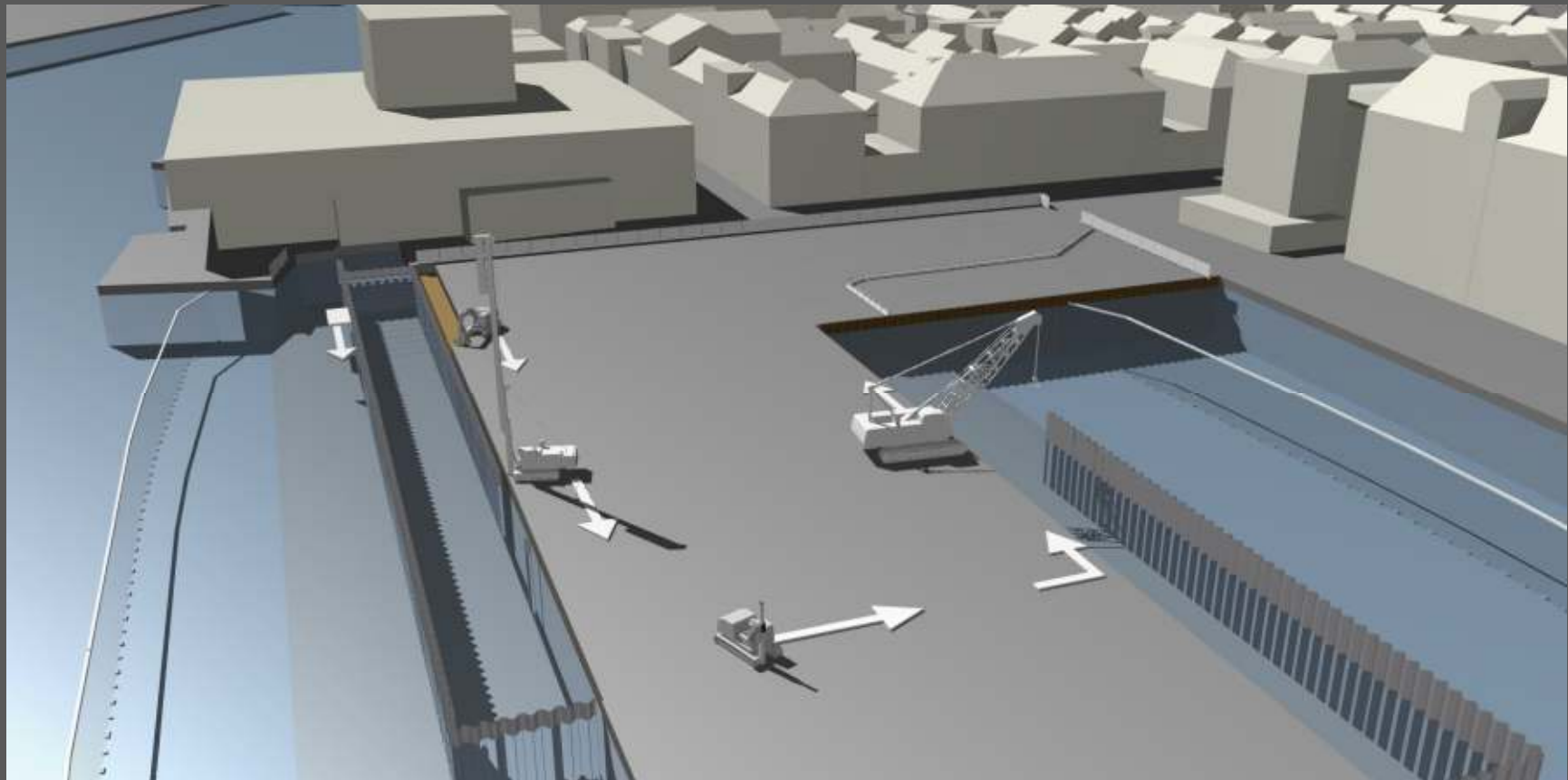
TENDER PHASE: 4D

- Siltgardin
- Sandpude



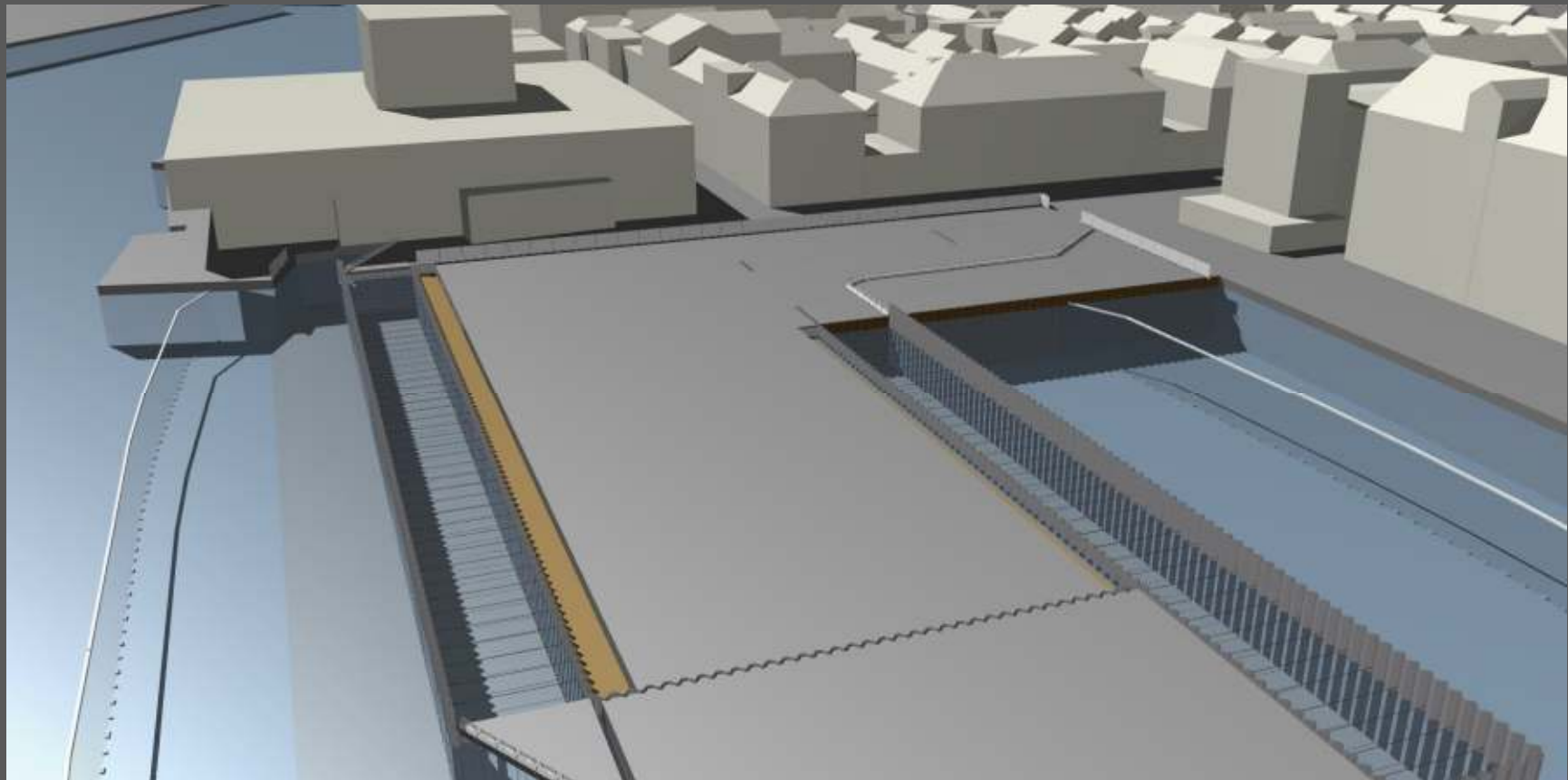
TENDER PHASE: 4D

- Fangedæmning
- Boring og udfyldning med bentonit
- Permanente spuns



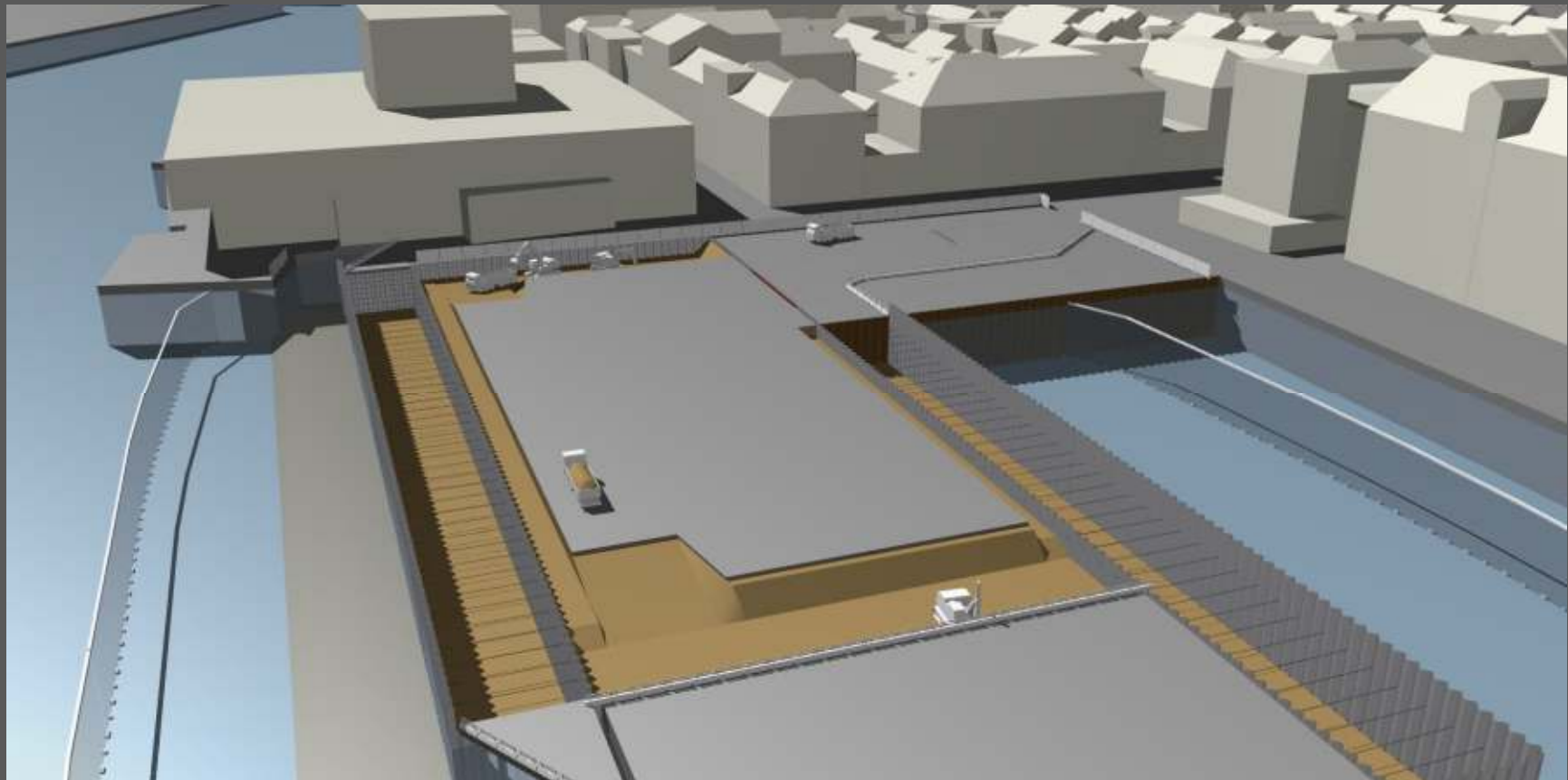
TENDER PHASE: 4D

- Grundvandssækning



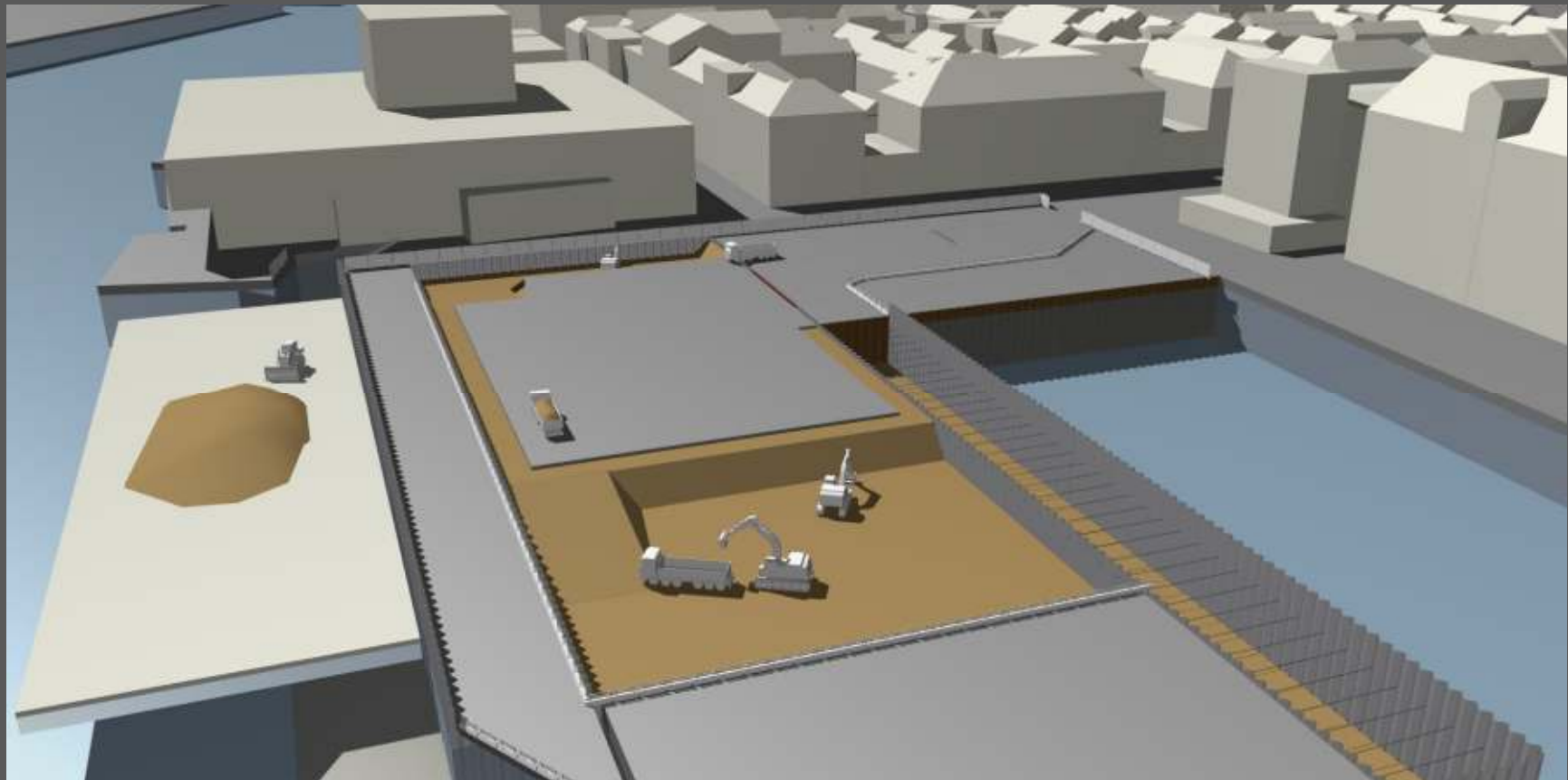
TENDER PHASE: 4D

- Udgravning



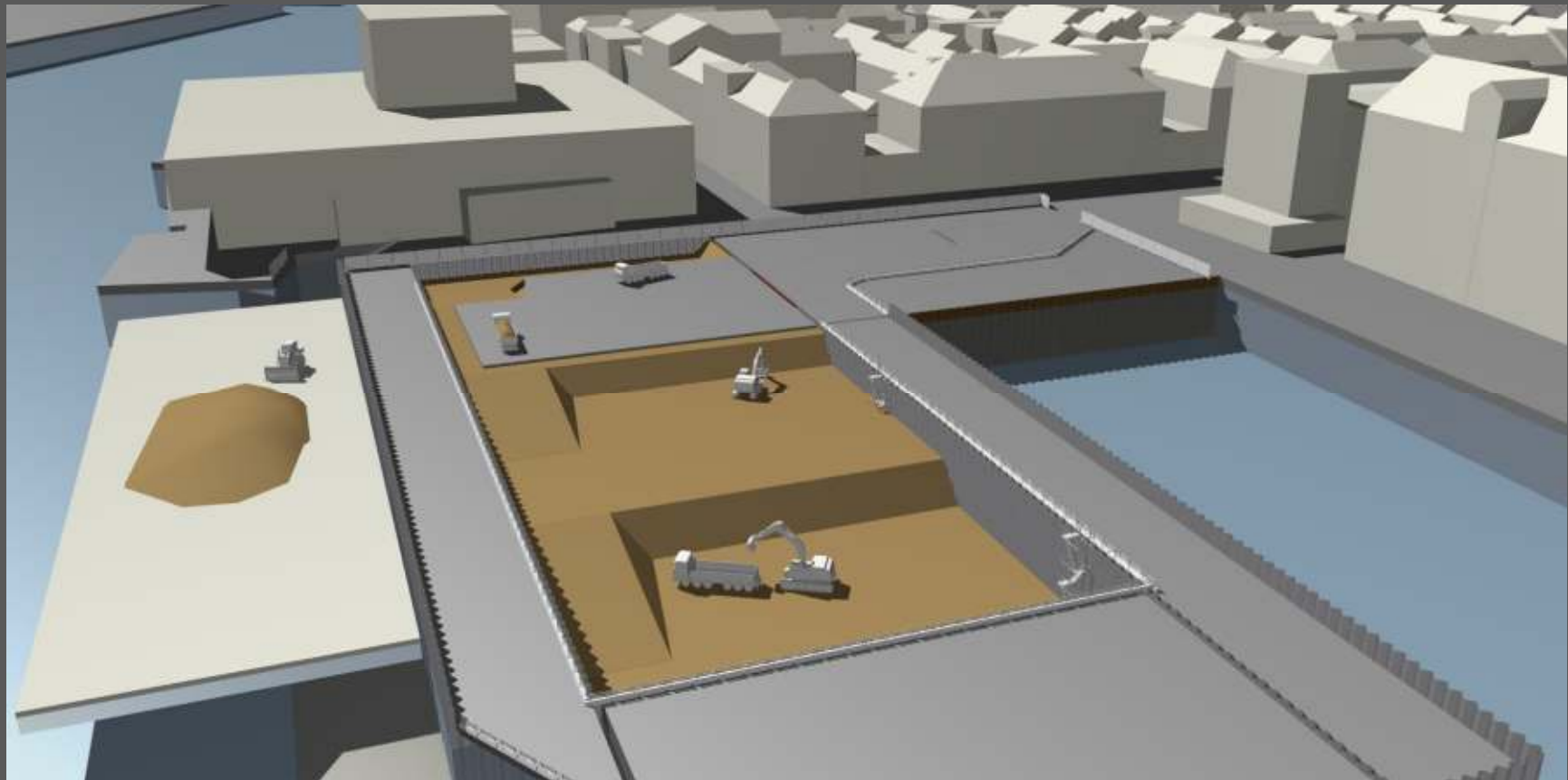
TENDER PHASE: 4D

- Udgravning



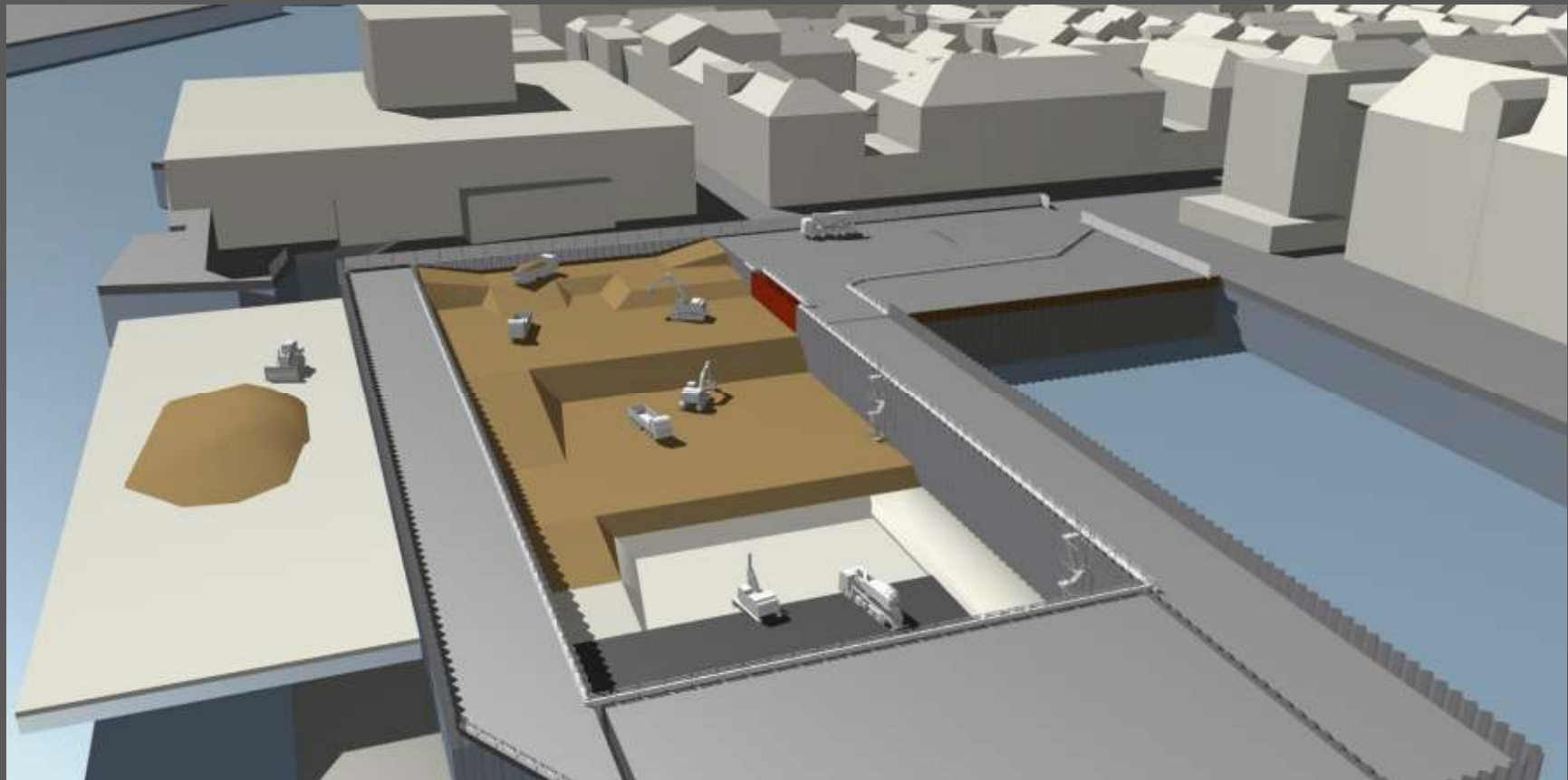
TENDER PHASE: 4D

- Udgravning



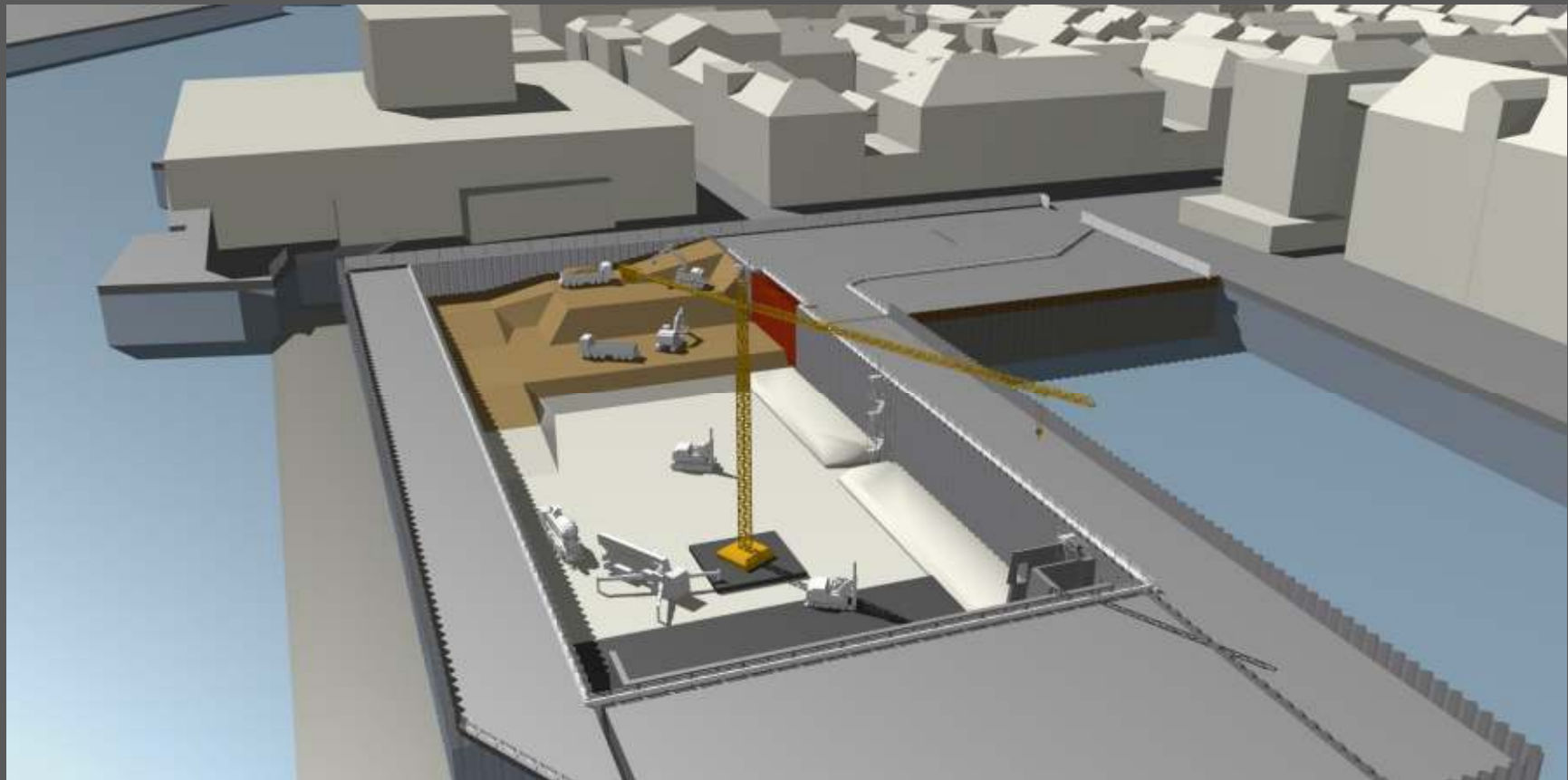
TENDER PHASE: 4D

- Udgravning af kalk
- Drænlag
- Renselag
- Start ankre



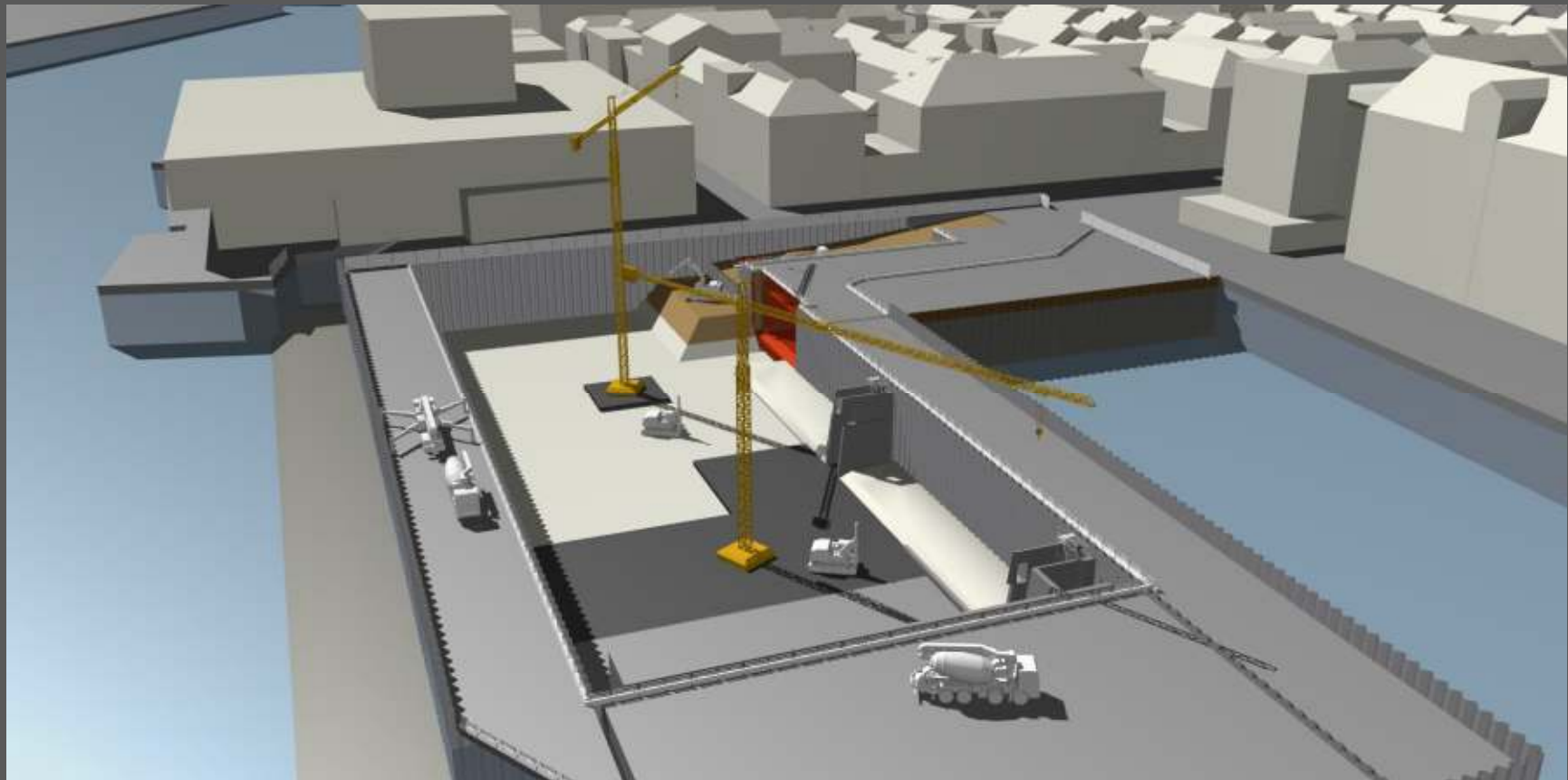
TENDER PHASE: 4D

- Jordankre
- Bundplade
- Kran nord
- Ydervægge



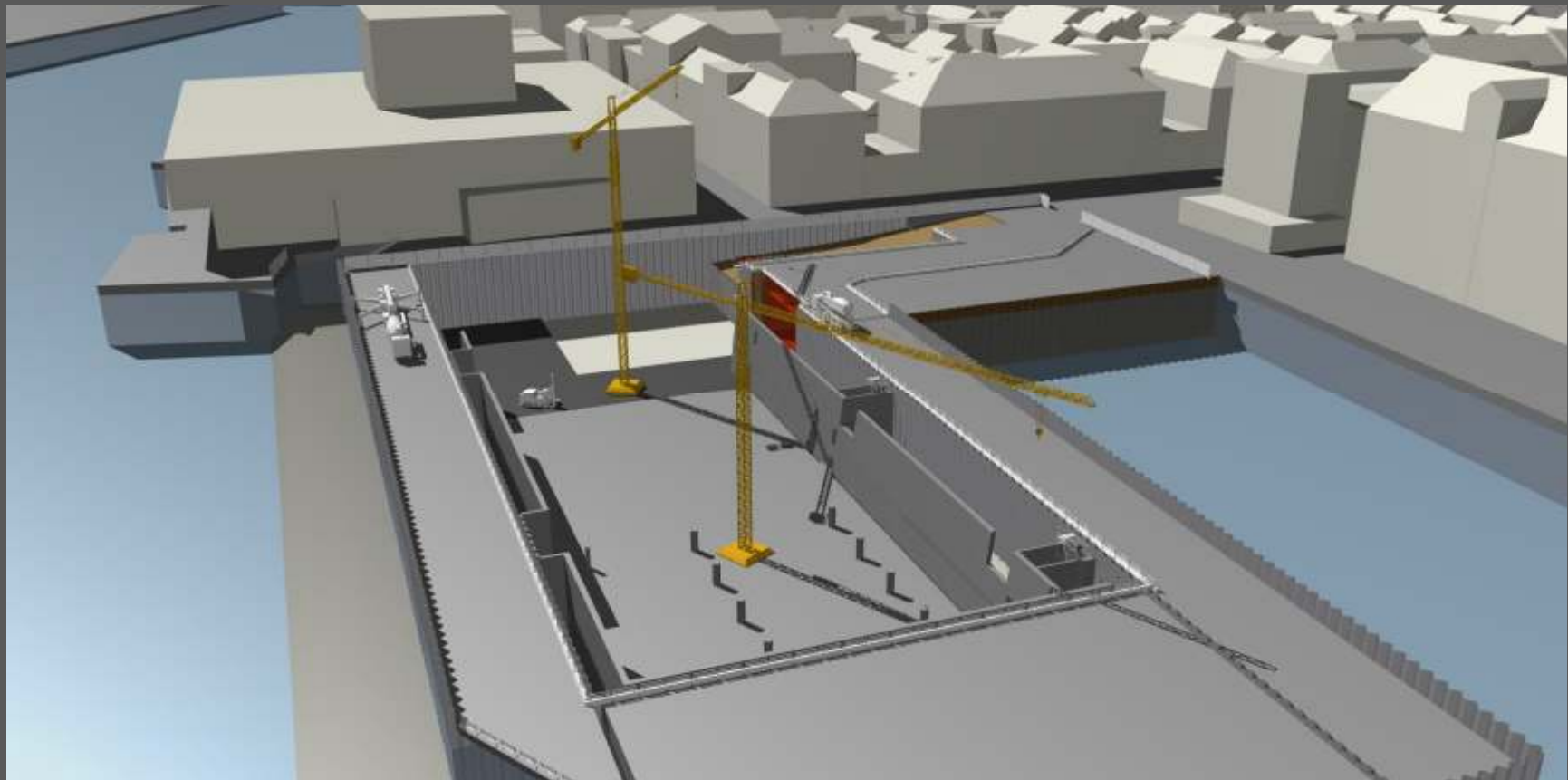
TENDER PHASE: 4D

- Jordankre
- Bundplade
- Kran syd
- Ydervægge



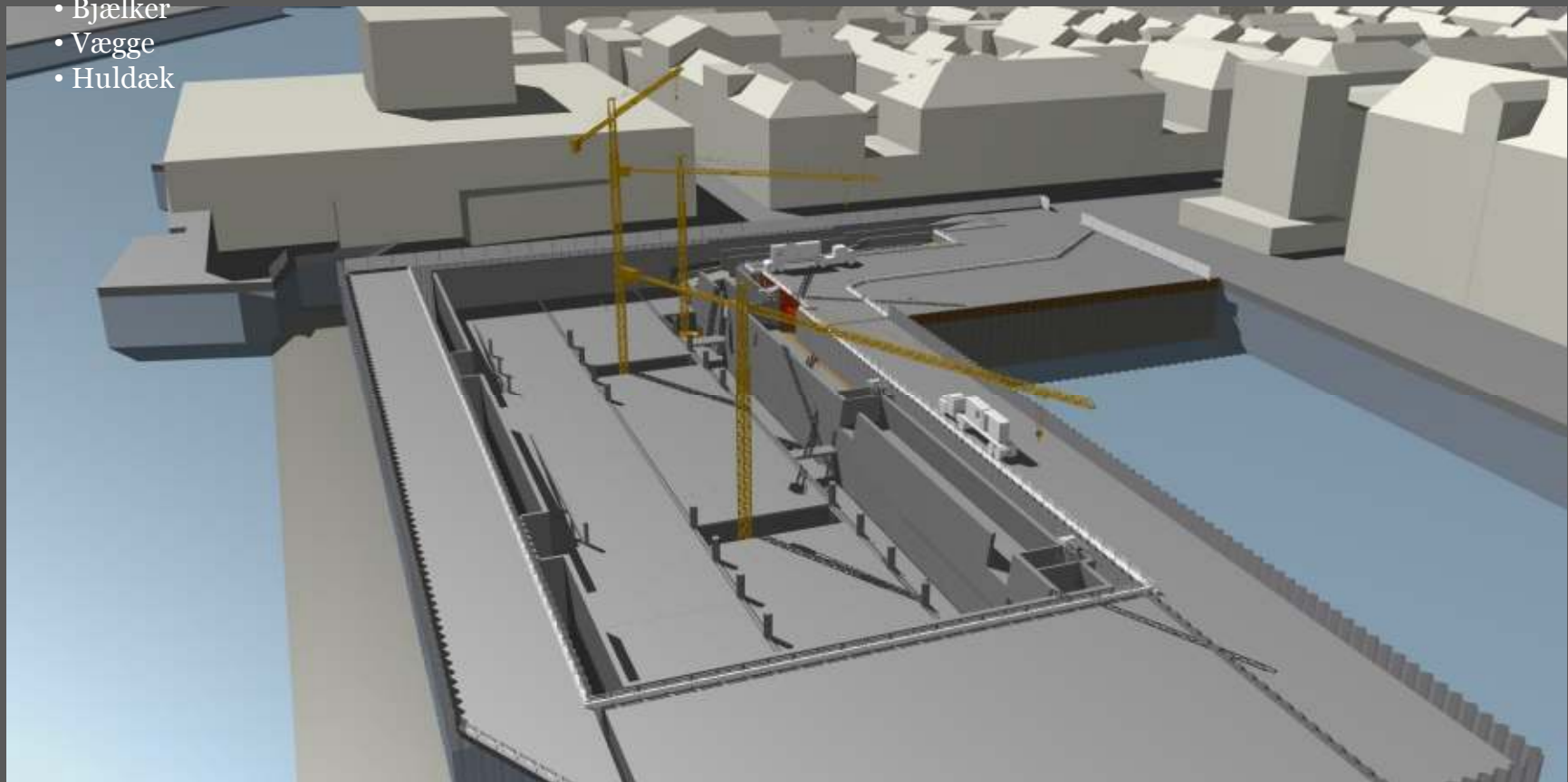
TENDER PHASE: 4D

- Jordankre
- Bundplade
- Ydervægge



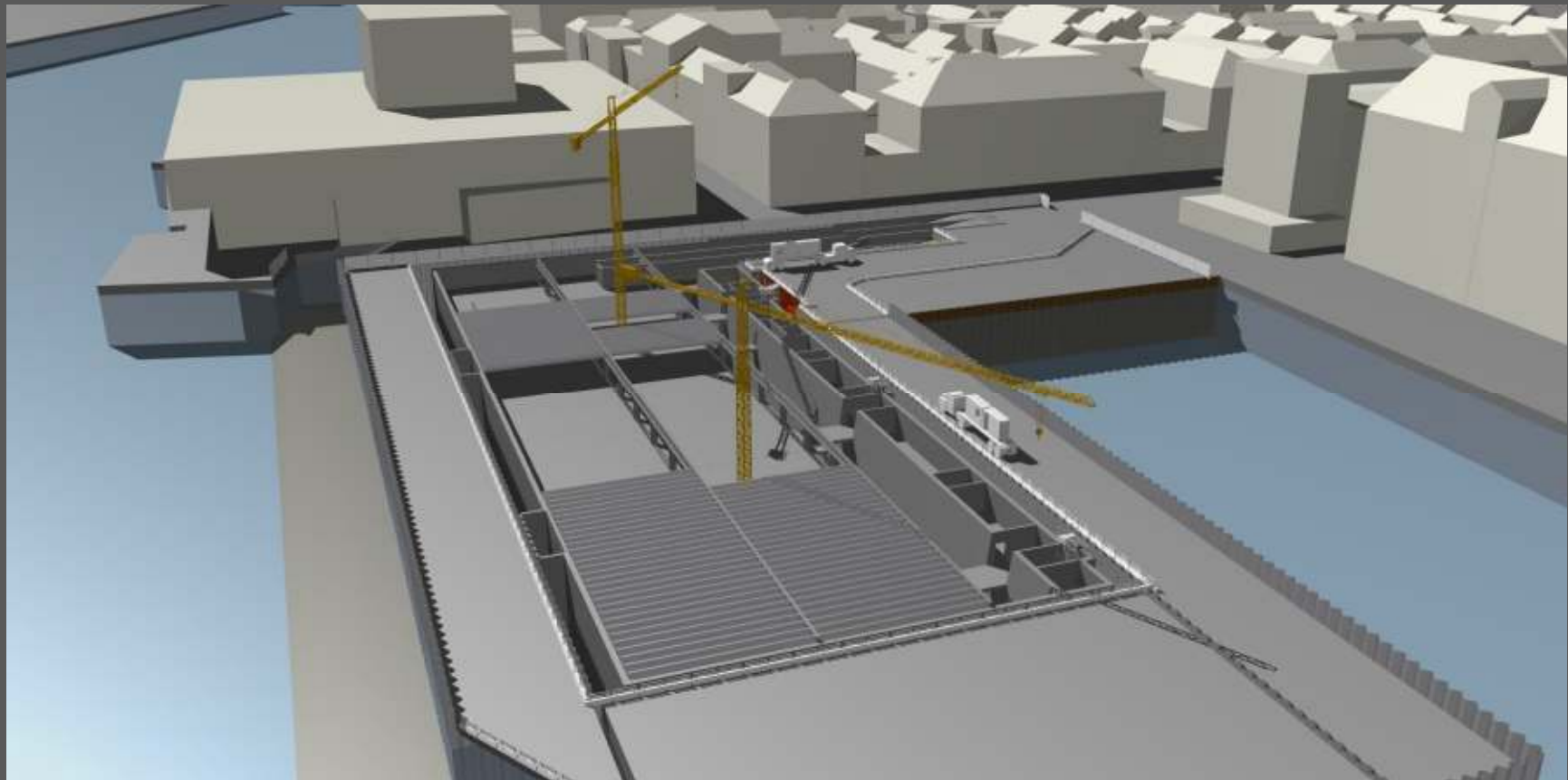
TENDER PHASE: 4D

- Søjler
- Bjælker
- Vægge
- Huldæk



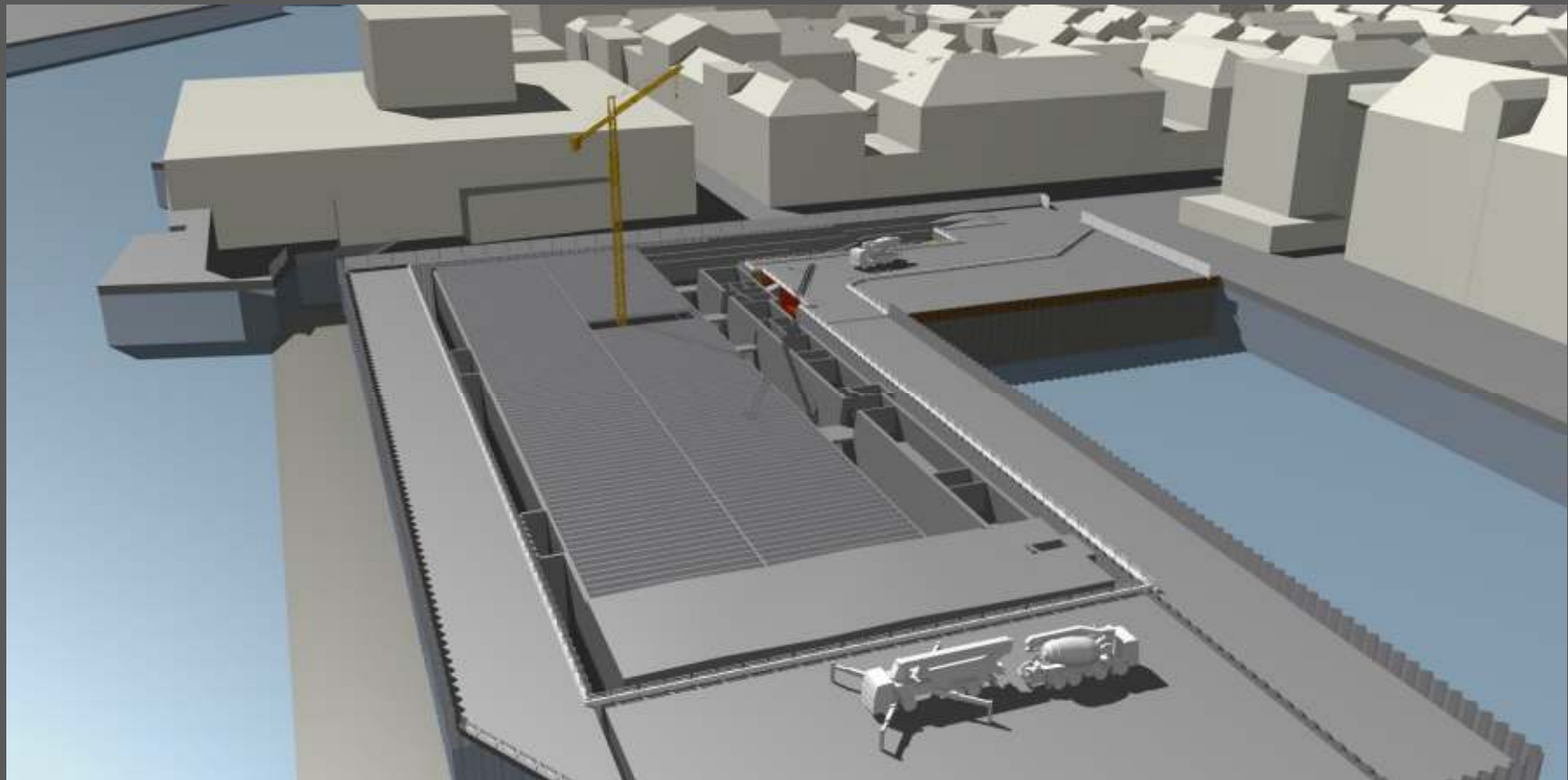
TENDER PHASE: 4D

- O T Bjælker



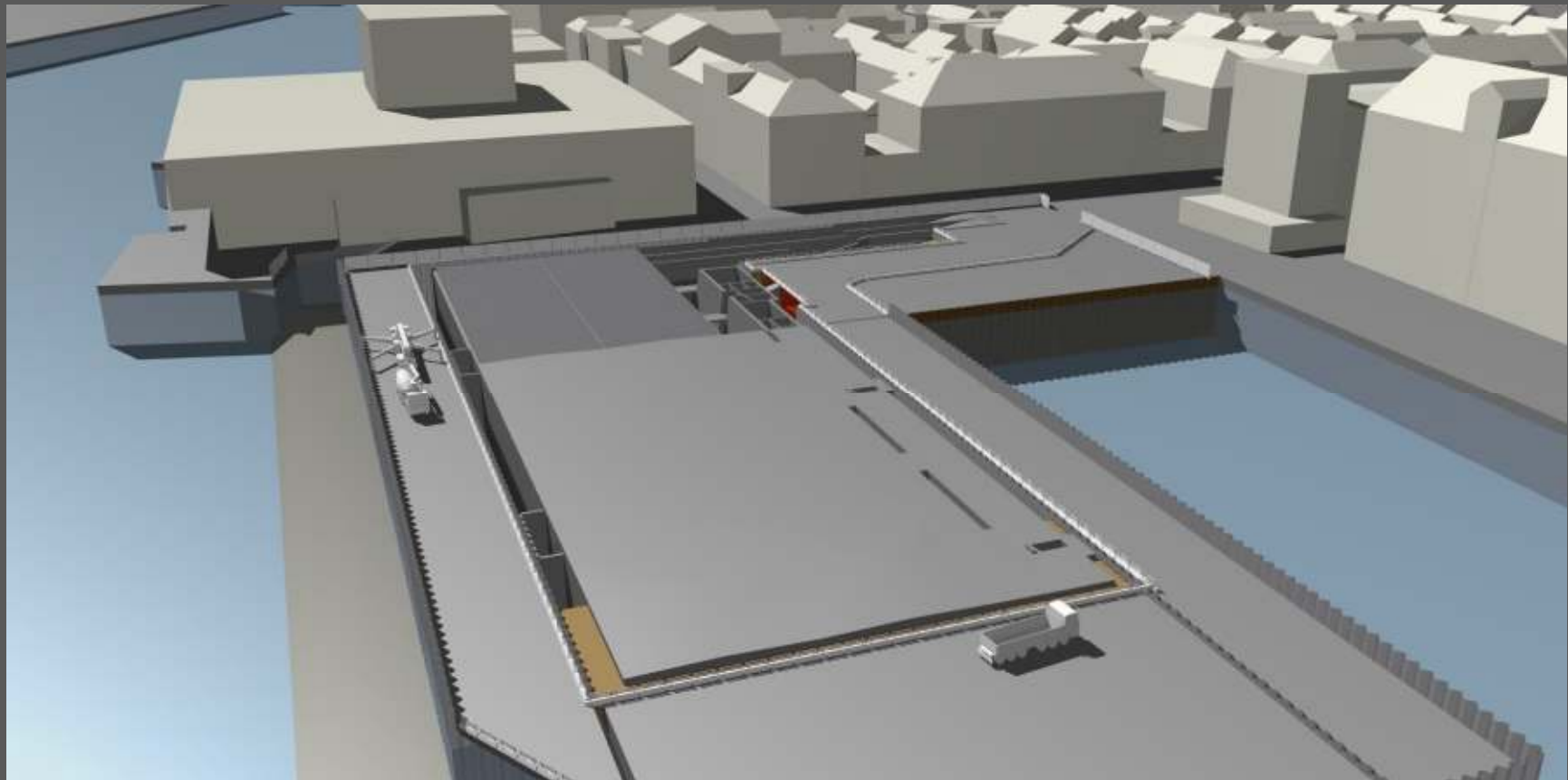
TENDER PHASE: 4D

- Topplade



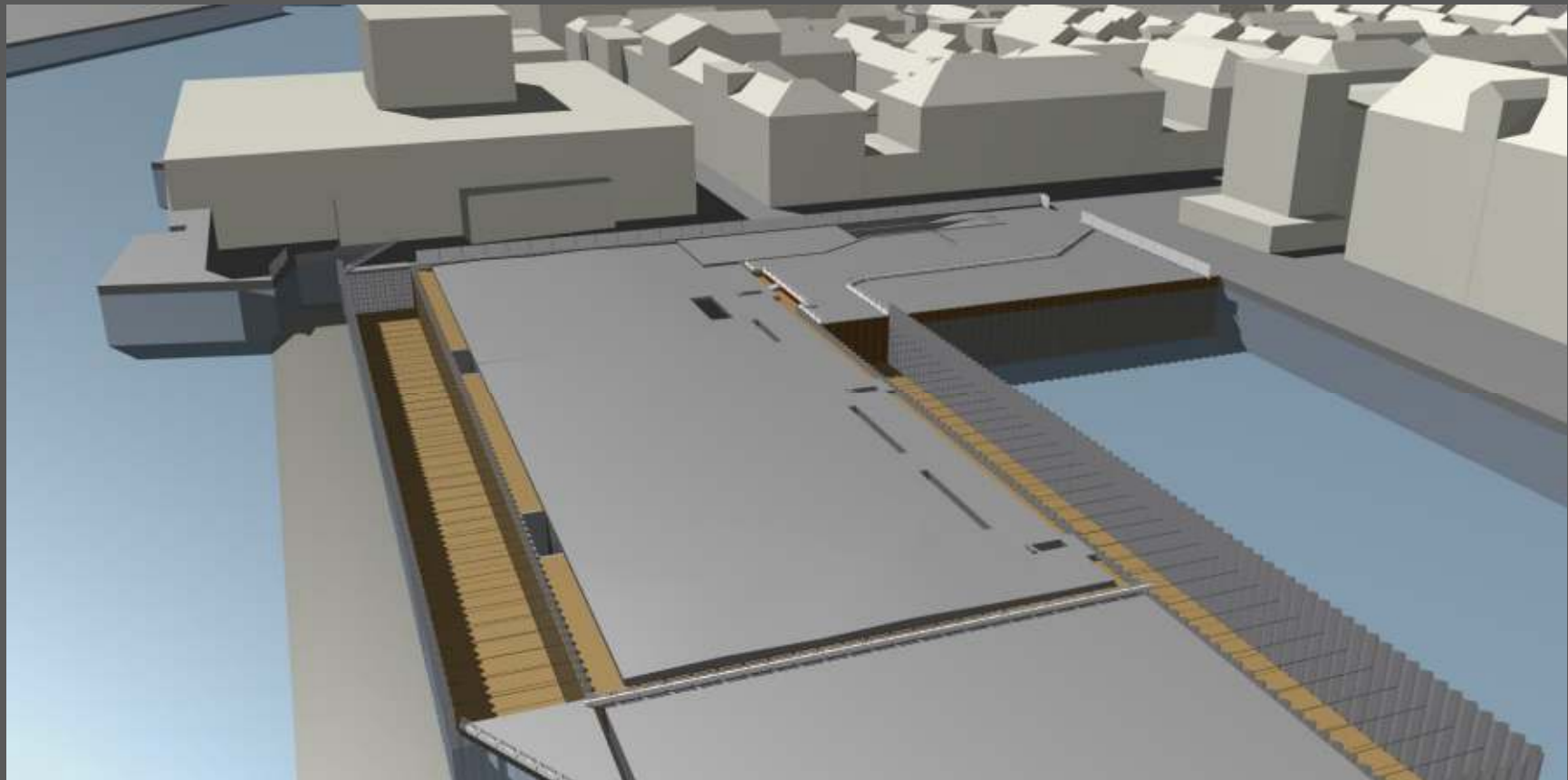
TENDER PHASE: 4D

- Topplade
- Start tilfyldning



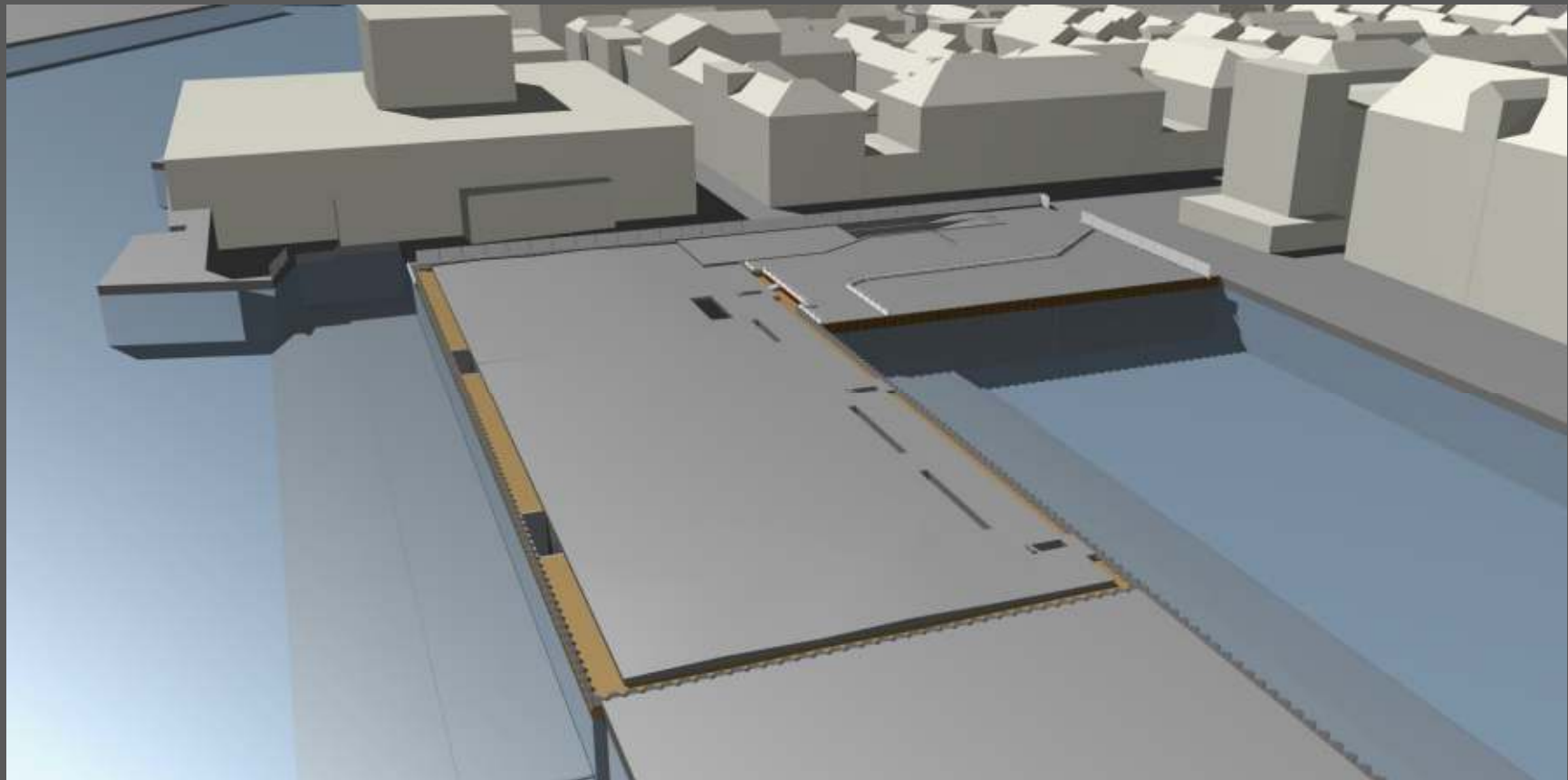
TENDER PHASE: 4D

- Ydre konstruktion afsluttet
- Overbeton
- Tømning fangedæmning



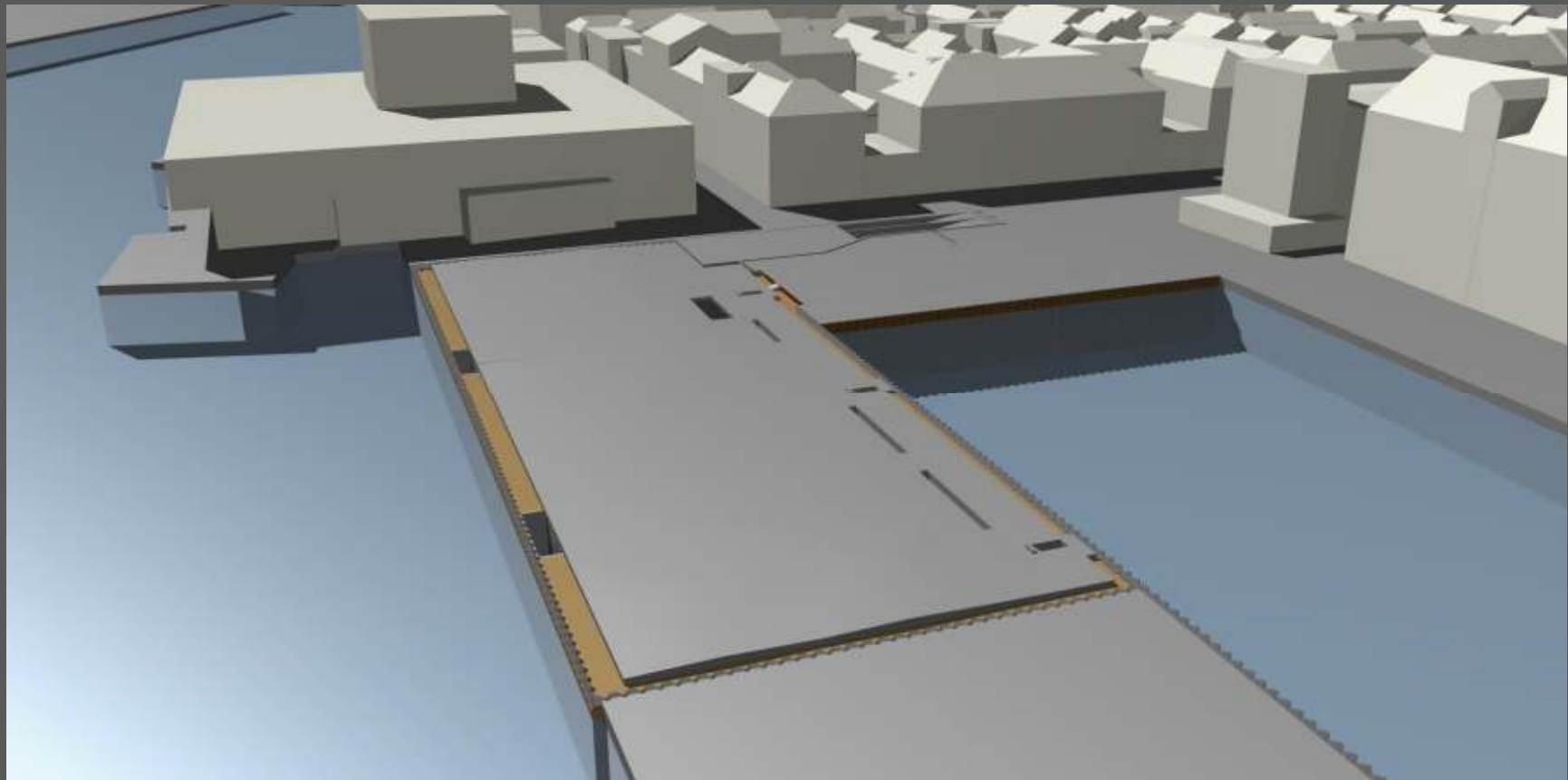
TENDER PHASE: 4D

- Fangedæmning væk
- Sandpude fjernes

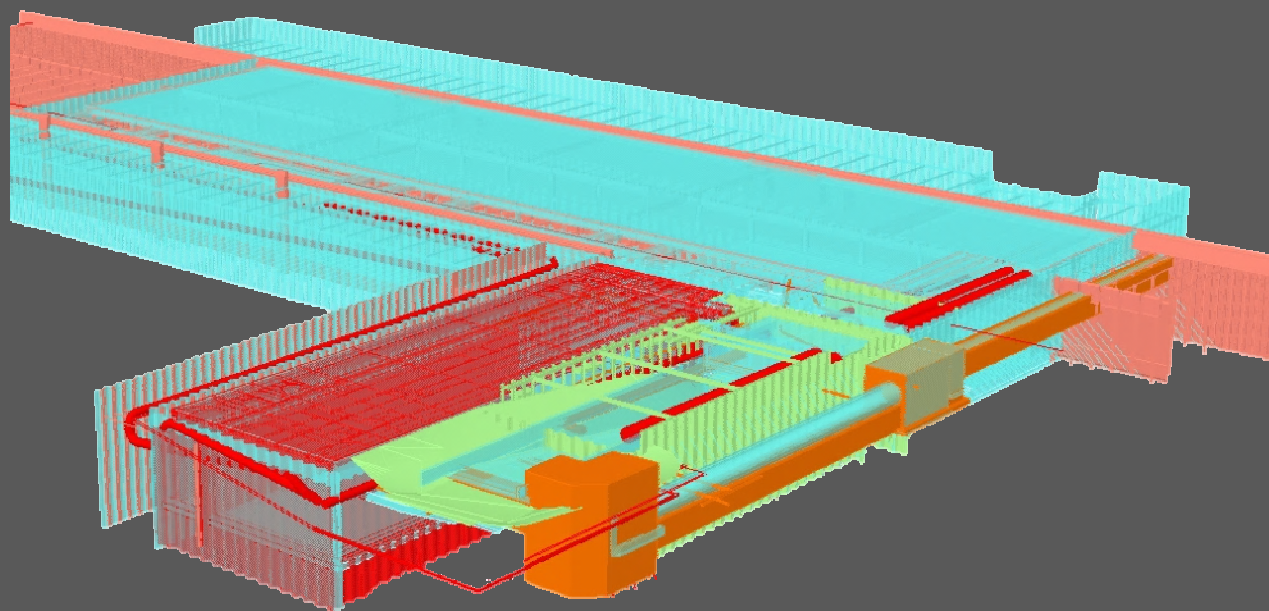


TENDER PHASE: 4D

- Aflevering

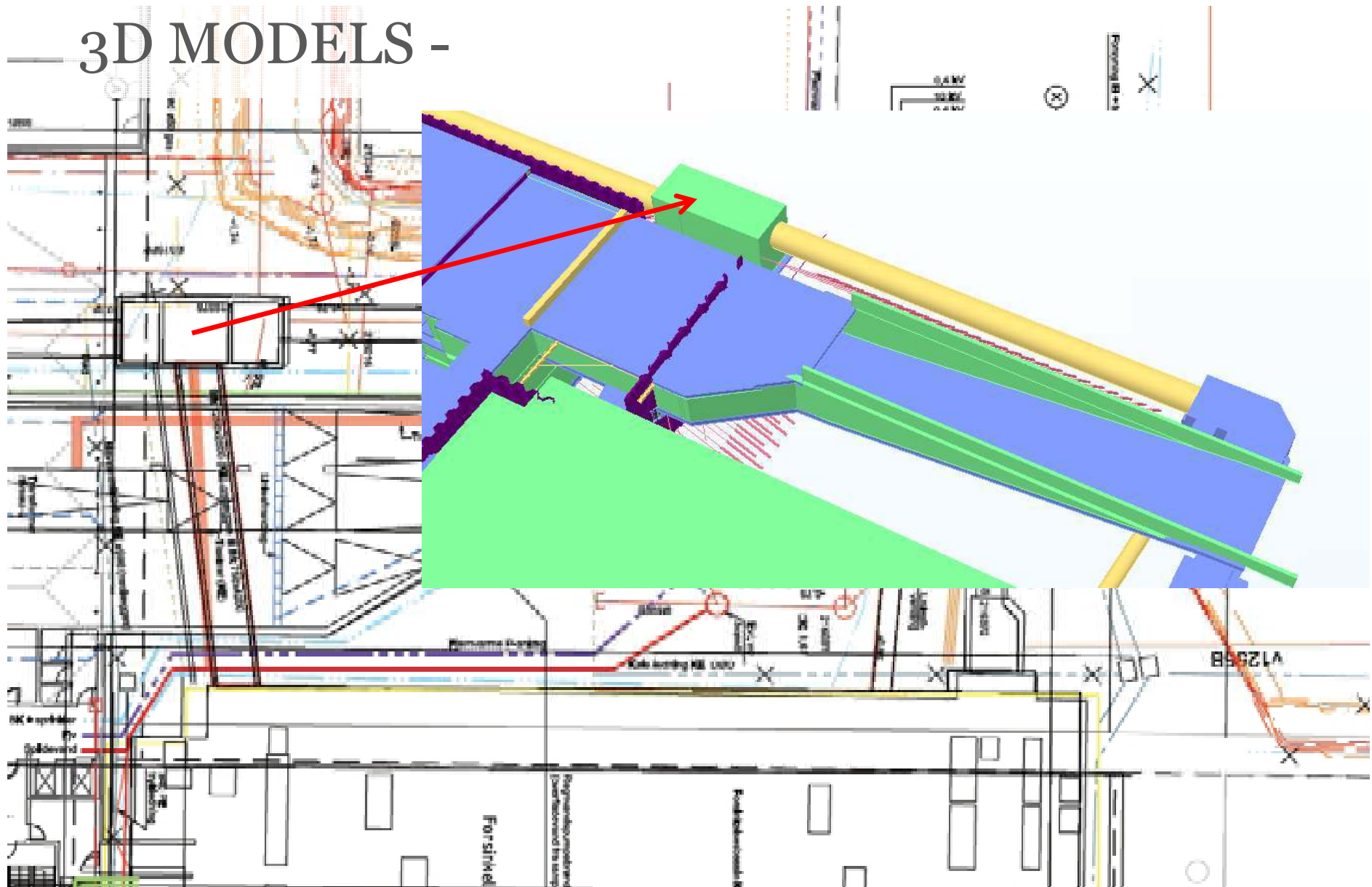


MAIN PHASE



- INITIAL GOALS:
- Quantity takeoff
- Project Optimization
- Visual communication
- Confident Client
- Metacommunication
- Logistics - 4D planning
- BIM validation
- Clash detection
- Safety
- Excavation

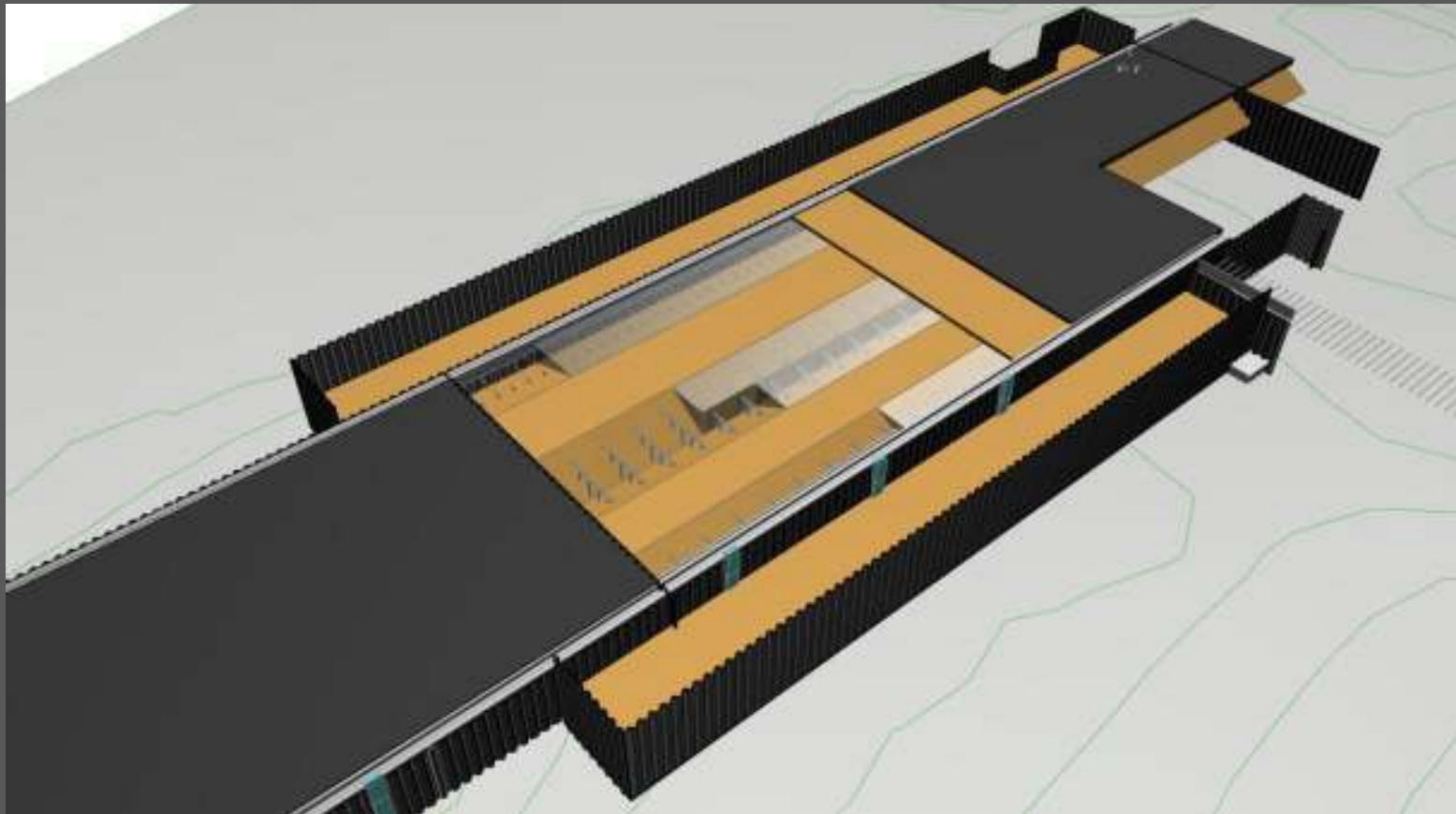
3D MODELS -



Optimizing budget - QT

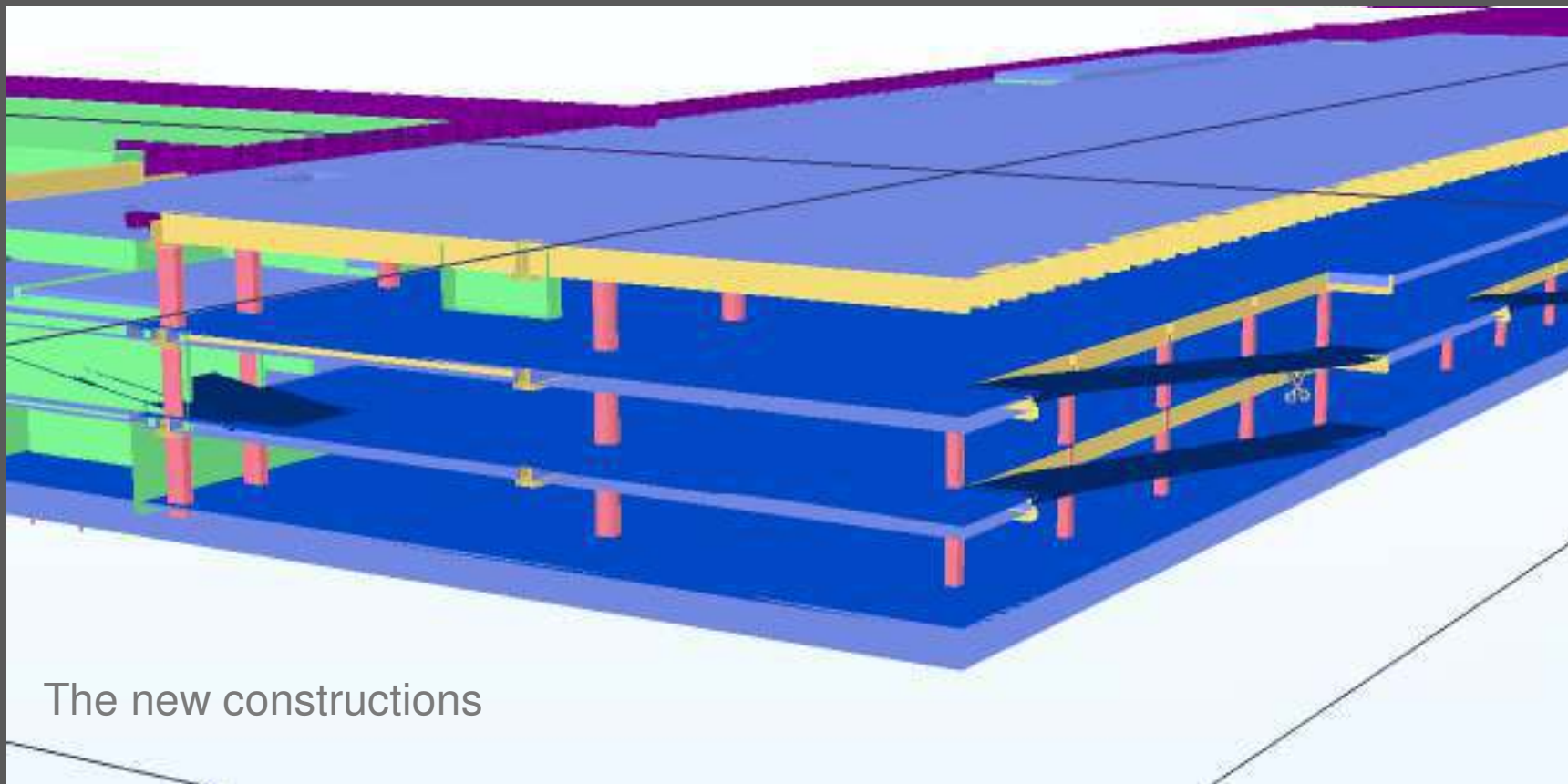
QTO Slabs						
Family	Type	Count	Area [m2]	Level	DBK	slide
Floor	Generic 400mm	1	2134	Niveau -2	-210.01.AC03	25
Floor	Generic 400mm	1	2163	Niveau -1	-210.01.AC03	
Floor	Generic 400mm	1	2163	Niveau -2	-210.01.AC03	
Floor	Generic 400mm	1	2255	Niveau -1	-210.01.AC03	
Generic 400mm: 4		4	8715			
Floor	Gravel 300mm	1	5024	Tagdæk	-210.01.AA03	20
Gravel 300mm: 1		1	5024			
Floor	Insitu Concrete 80mm	1	220	Niveau -2	-210.01.AA03	36
Floor	Insitu Concrete 80mm	1	4494	Niveau -2	-210.01.AA03	26
Insitu Concrete 80mm: 2		2	4714			
Floor	Insitu Concrete 100mm	1	4606	Niveau -1	-210.01.AA03	23
Insitu Concrete 100mm: 1		1	4606			
Floor	Insitu Concrete 150mm	1	5024	Tagdæk	-210.01.AA03	21

Logistics – 4D -planning



Model - Coordination

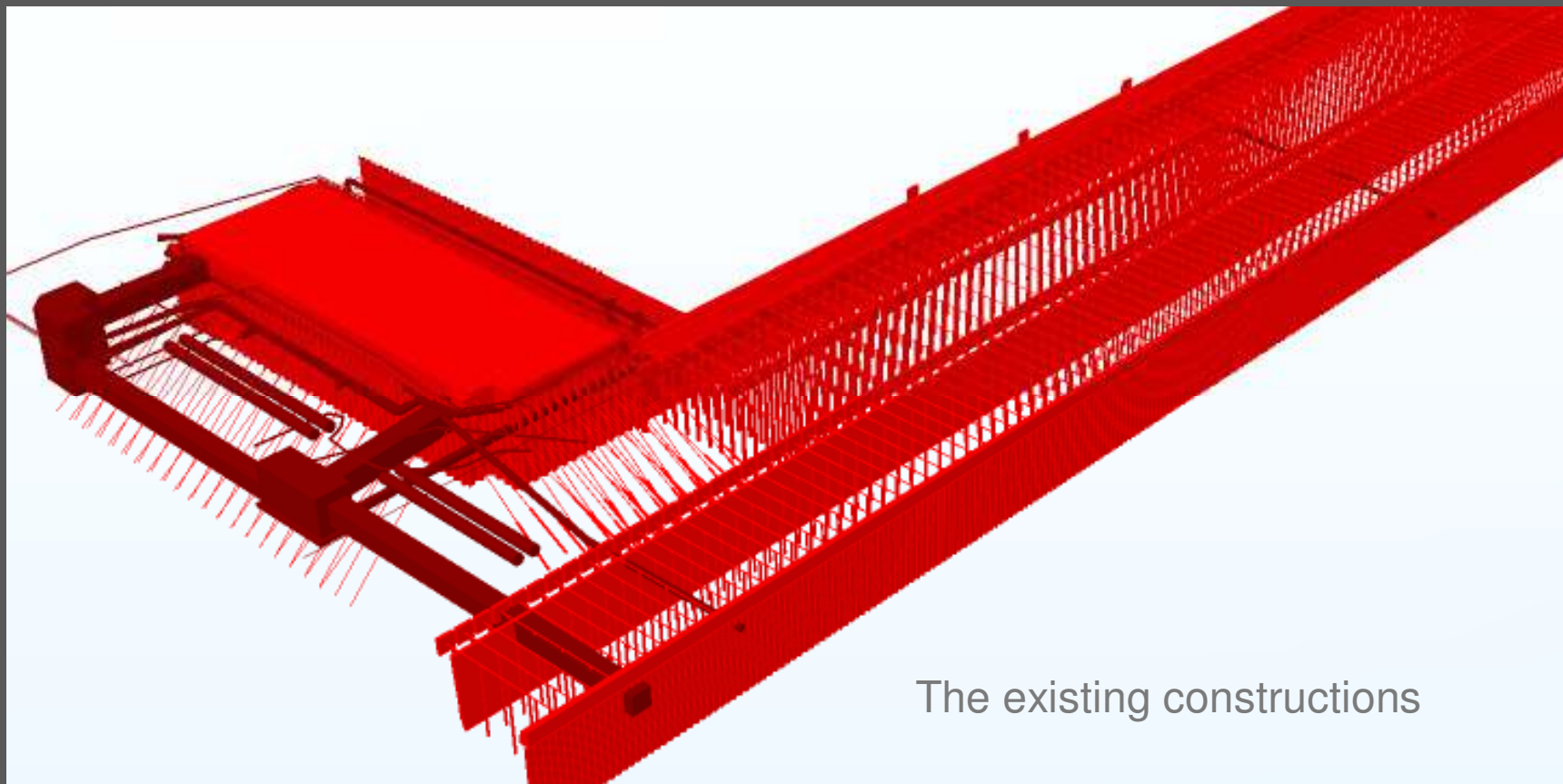
- Gives a better overview of the project
- Visualises the existing constructions
- More consistent project material
- Models on all meeting has optimized design and communication



The new constructions

Model - Coordination

- Gives a better overview of the project
- Visualises the existing constructions
- More consistent projectmaterial
- Models on all meeting has optimized design and communication



The existing constructions

Model - Coordination

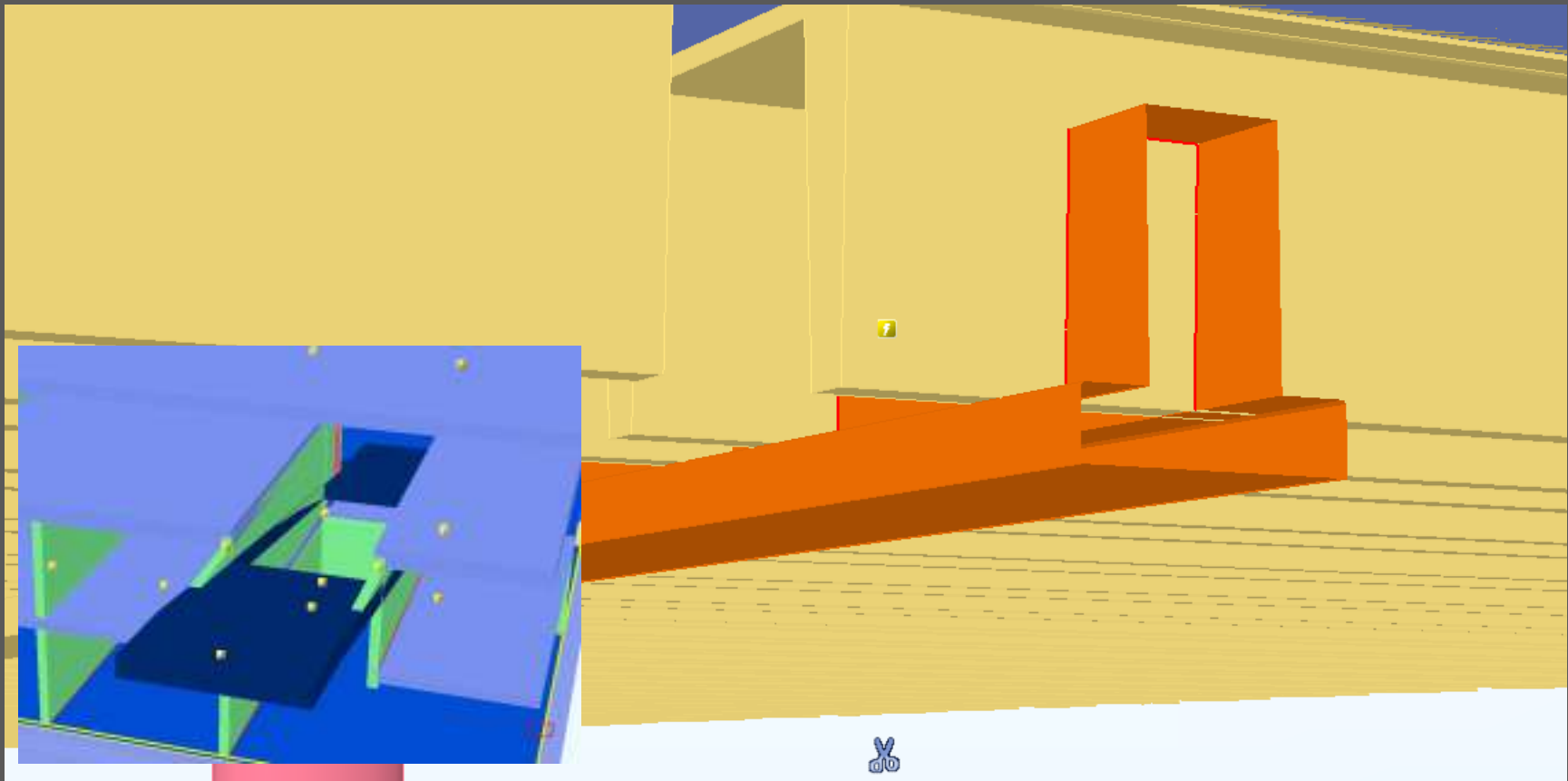
- Gives a better overview of the project
- Visualises the existing constructions
- More consistent projectmaterial
- Models on all meeting has optimized design and communication



The new and existing constructions combined

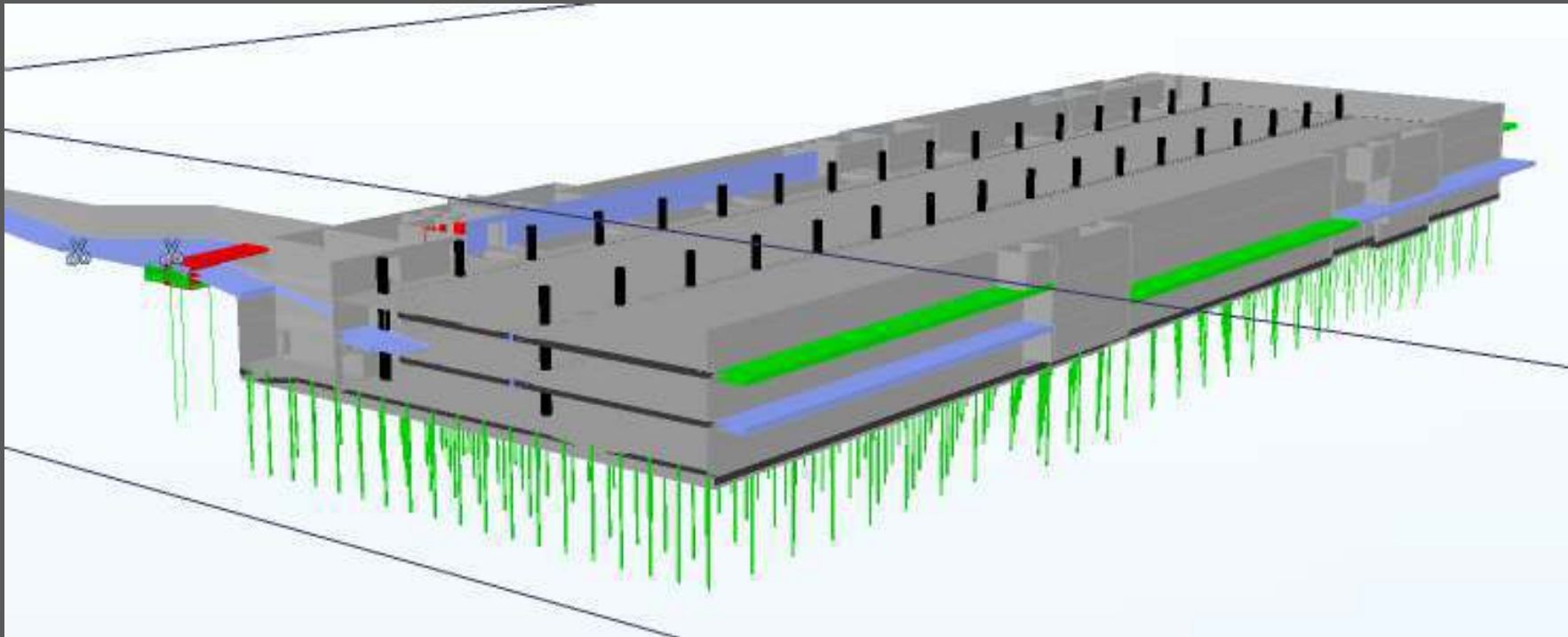
Quality assurance

- Better and consistent project
- Fewer errors
- Collision control
- Visual and digital control of the models



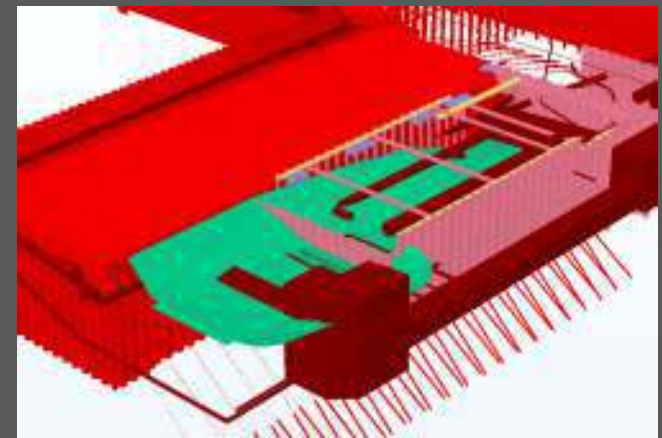
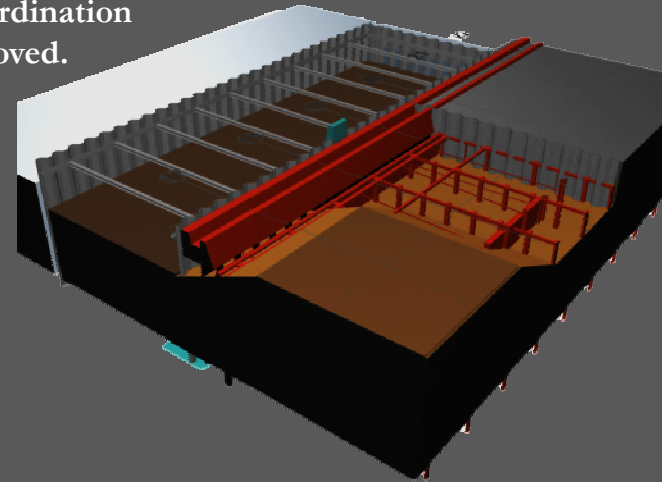
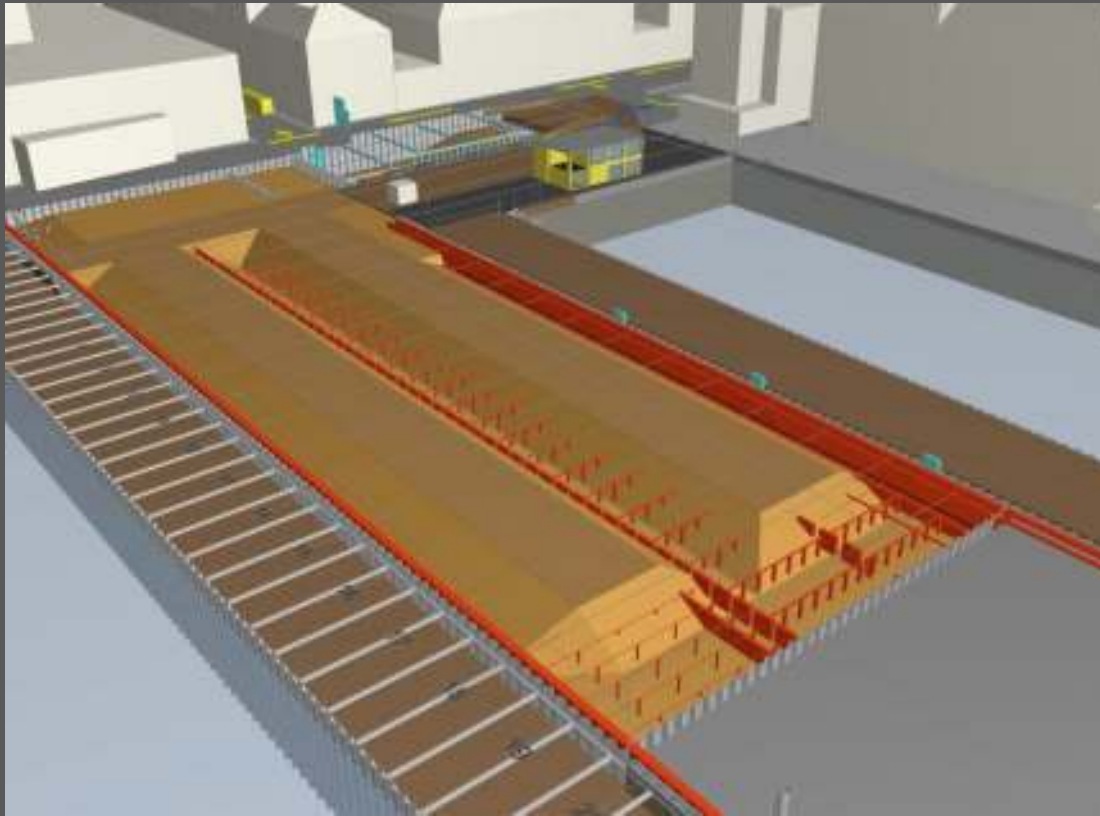
Revision - control

- Automated version control – what is new?, what has been modified and deleted?
- Updated model-based calculations – better and more consistent prizing
- Updated plan for production and logistics



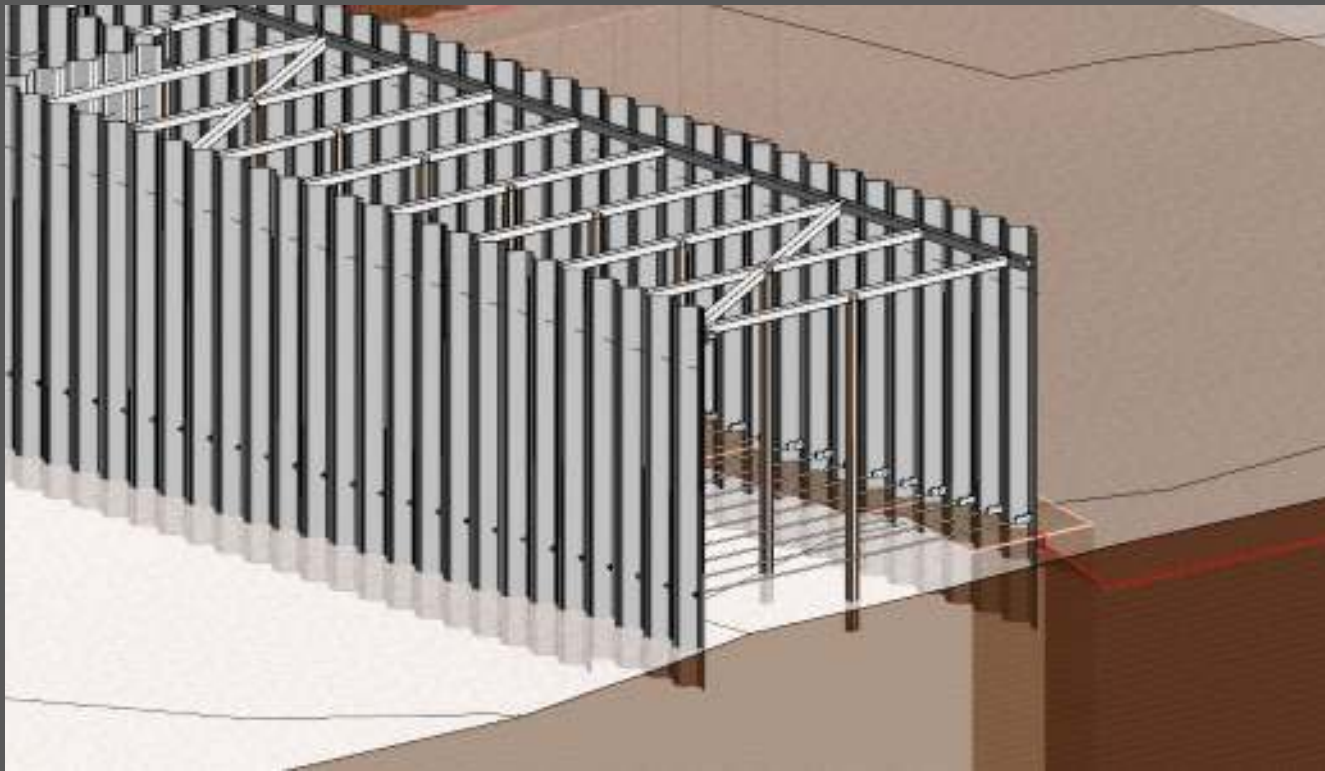
Optimized productionplan

- A model-based productionplan forces people to make decisions.
- Visualizes challenges and problems
- Model are used by the blue-collar people to make their planning and coordination
- Models can verify the amount and volumes of the earth that has to be moved.



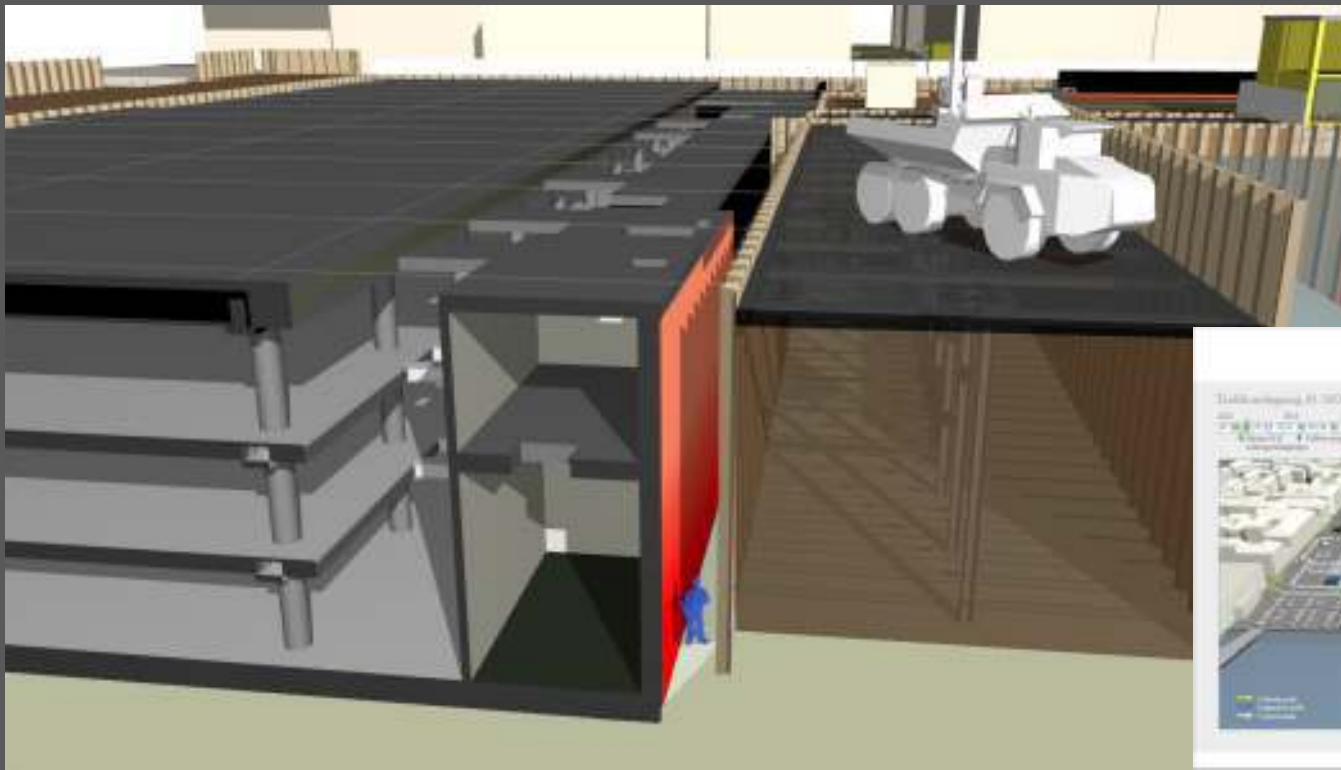
Optimizing the project

- The modelling of the seabed and the level of chalk in the seabed gives great opportunities for optimizing
- The length of the steel sheet piling could be adjusted to the actual length on-site by simulating it in the models
- Simulations made on the models, eliminates expensive stabilization of the steel sheet piling
- The modelling of the existing installations and construction enforced new solutions and methods.
- Optimizing the construction-designing
- Optimizing the plan for executing the work



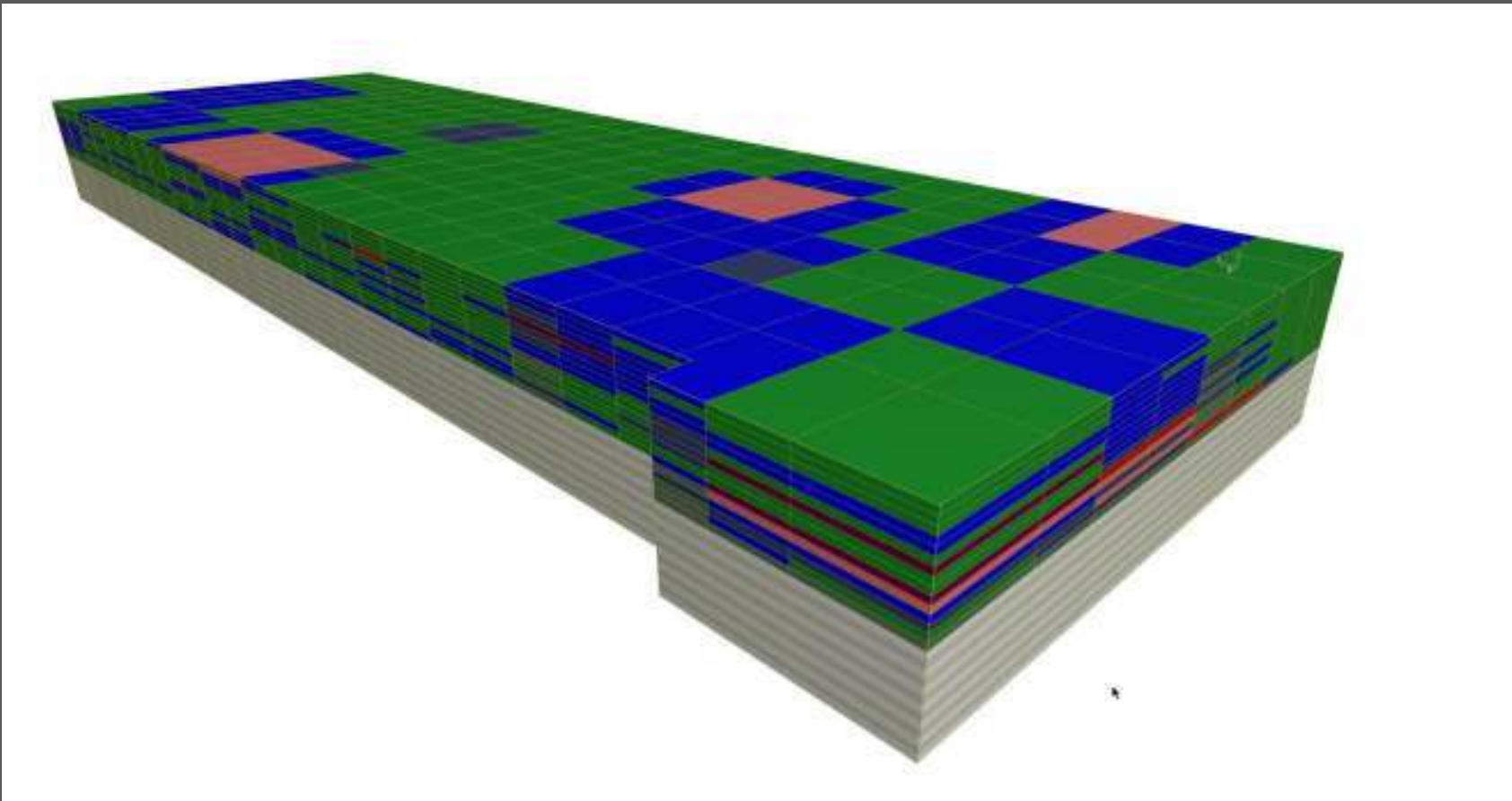
HSE – safety on-site

- 3D models visualizes the challenges and the focus areas of the project
- Gives the people on-site a good presentation of the HSE -issues
- Safety on-site
- Safety against 3rd part, neighbours, non-NCC-personell and other groups related to the project.



Pollution on-site

- 3D models visualizes the areas of the ground where the earth is polluted and the level of pollution
- The model gives the people on-site a better view of methods of excavating and where to take precaution.





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Situation on Friday 26th September, 2014



Summary

The background image shows a close-up, low-angle view of a stone wall on a beach. The stones are large, rounded, and light-colored, with some showing signs of weathering and moss. The wall recedes into the distance, creating a strong sense of perspective. The ground in the foreground is dark, wet sand.

Model based construction at NCC is
a way of working

Those who have worked this
way want to continue.

