

Augmented Reality On-site

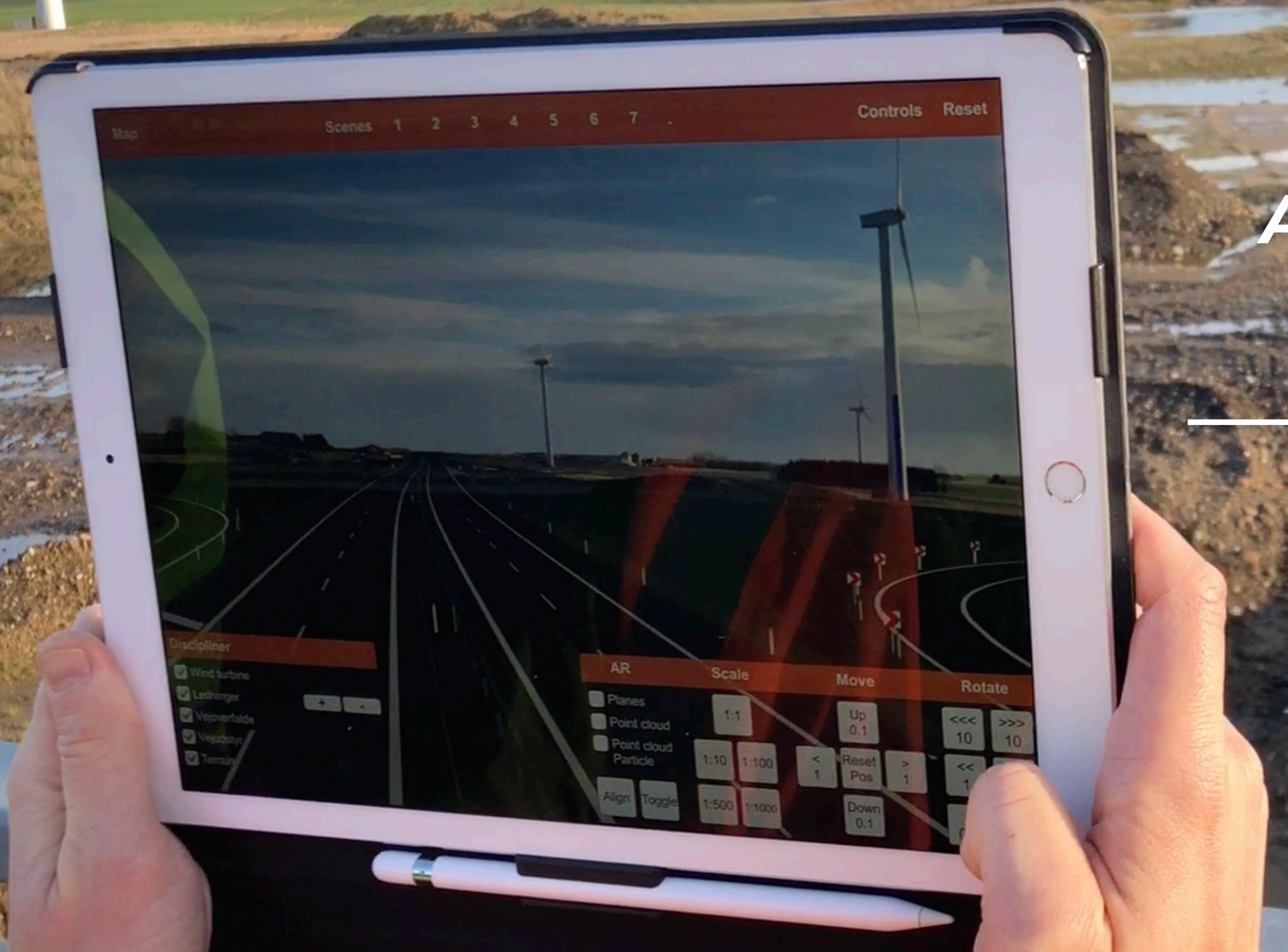
*Advanced Visualization
Workshop - Enschede*

Erik Kjems

Lasse Hedegaard Hansen

Aalborg University

27. November 2017



Who am I?

- Lasse Hedegaard Hansen
- M. Sc. civilengineer student,
Road and transportation, Aalborg University
- Part of a research project:
Virtual reality in design, construction and operation
 - Aalborg University and COWI



AALBORG UNIVERSITY
DENMARK

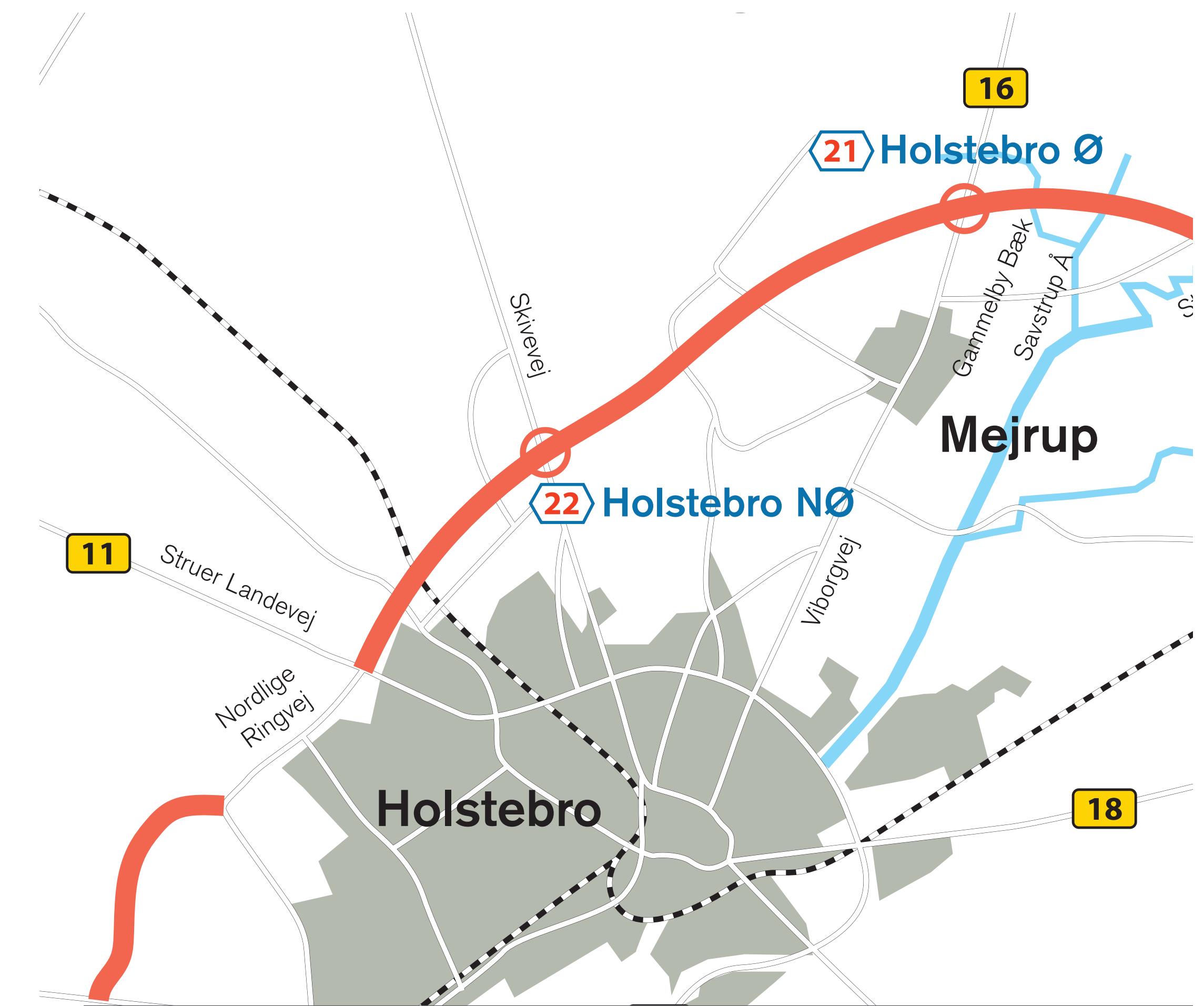
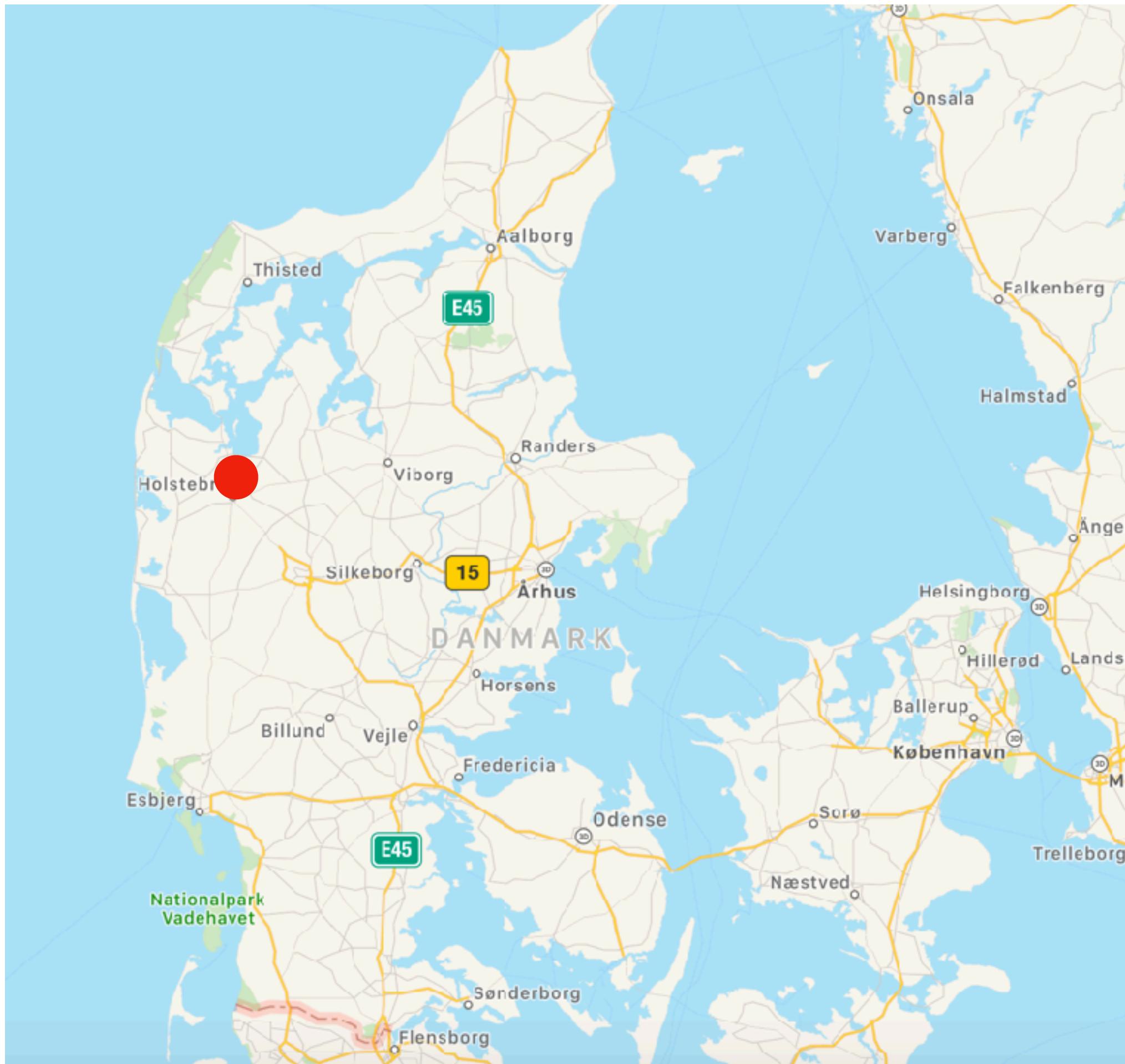
COWI

Case

- Augmented reality used on-site
- More value of our infrastructure models
- Herning-Holstebro Highway
- Testing of three augmented reality (AR) systems

Location

Case: Herning-Holstebro Highway



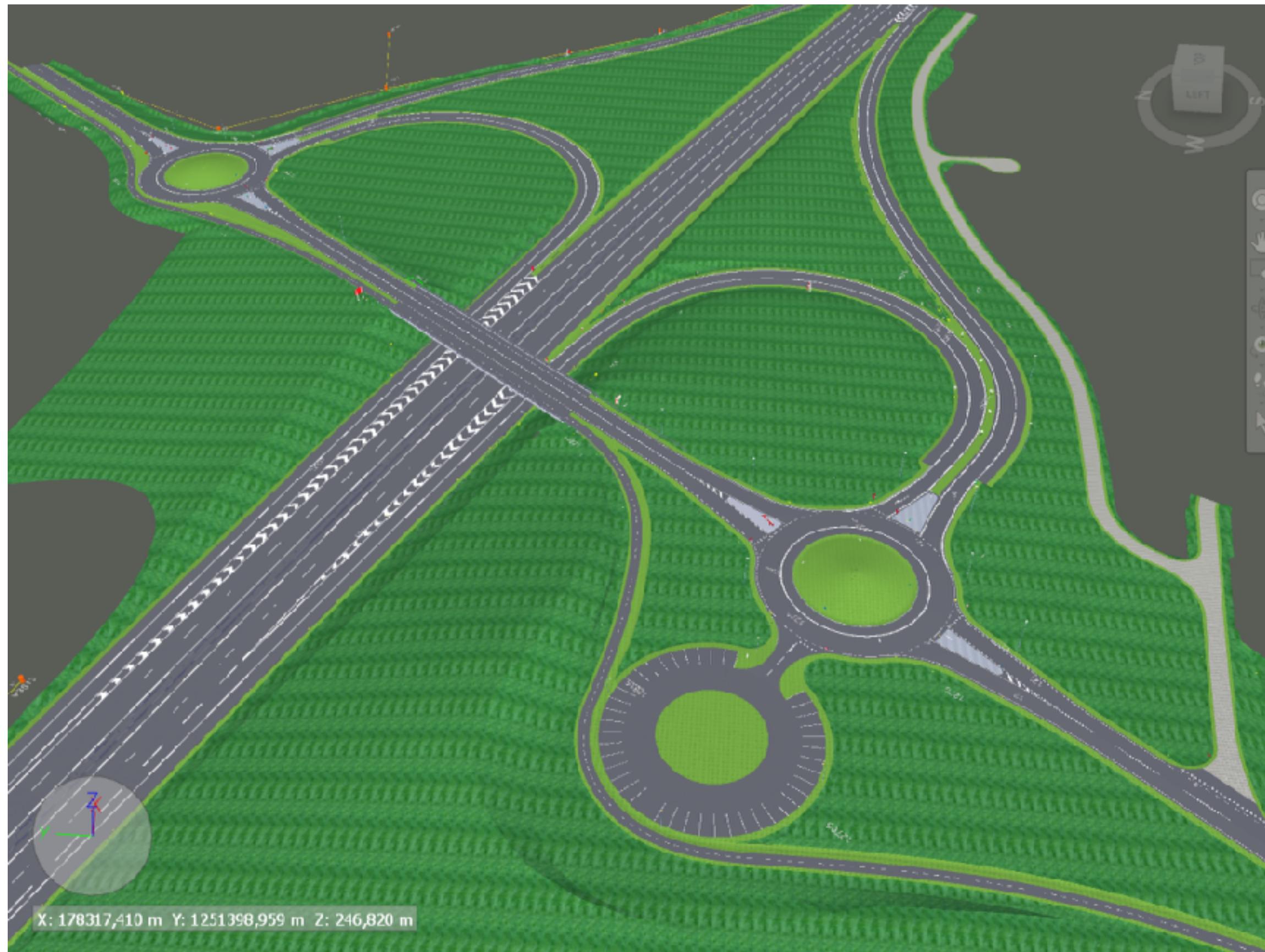
Location

Case: Herning-Holstebro Highway



Model

Case: Herning-Holstebro Highway



AR testing

- Testing of three augmented reality (AR) systems



A library for virtual and
augmented reality



Software - MD Solutions

Augmented Reality

On-site Services

AR framework (SDK)

Hardware (MD)

• SiteVision Trimble (<i>not public</i>)	Tango	Lenovo Phab 2 Pro
• ArOnSite ALVAR (<i>not public</i>)	ALVAR	Android devices
• TwinBIM Dalux	Tango	Lenovo Phab 2 Pro
• uGraph Orbicon	Vuforia (or similar)	Android devices
• AugView AugView	Vuforia	Android and iOS devices
• VDC Live ViaSys	Vuforia (or similar)	iOS devices
• OnSite AAU/COWI	ARKit	≥ iPad Pro and iPhone 6S

Software - MD Solutions

Augmented Reality

On-site Services

AR framework (SDK)

Hardware (MD)

- **SiteVision Trimble** (*not public*)

Tango

Lenovo Phab 2 Pro

- **ArOnSite ALVAR** (*not public*)

ALVAR

Andriod devices

- **TwinBIM Dalux**

Tango

Lenovo Phab 2 Pro

- **uGraph Orbicon**

Vuforia (or similar)

Andriod devices

- **AugView AugView**

Vuforia

Andriod and iOS devices

- **VDC Live ViaSys**

Vuforia (or similar)

iOS devices

- **OnSite AAU/COWI**

ARKit

≥ iPad Pro and iPhone 6S

Testing On-site

November 2017



Testing On-site

November 2017



<https://www.linkedin.com/feed/update/urn:li:activity:6341310779668643840/>



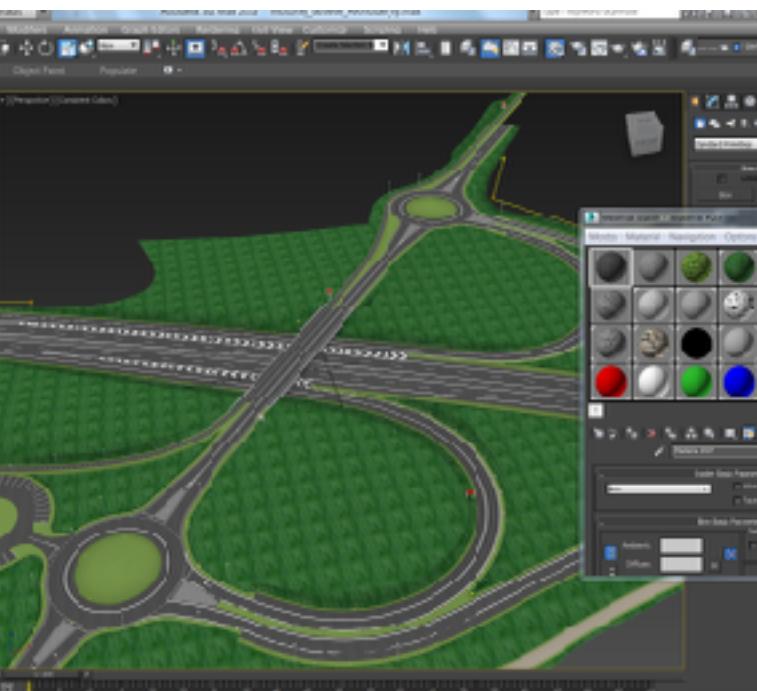
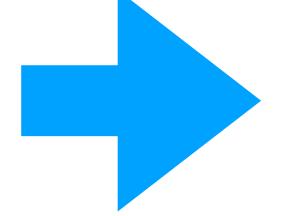
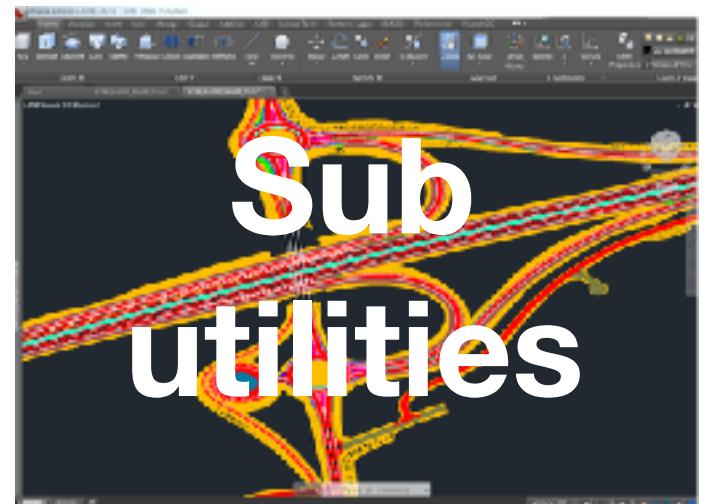
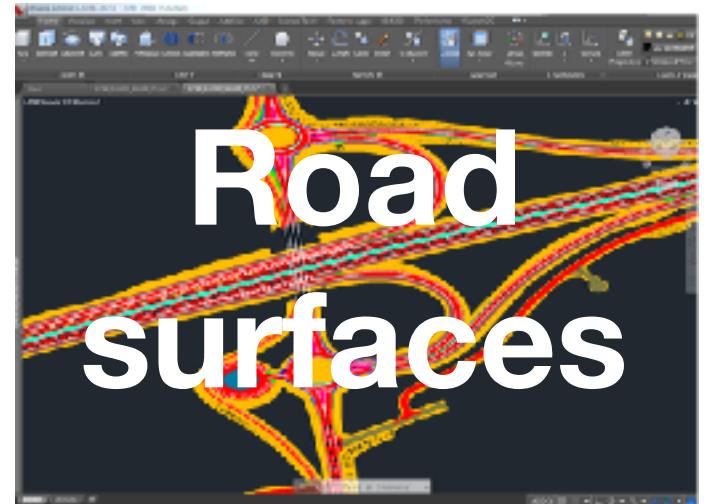
COWI

Conclusion

- Difficulties between “as model” and “as build”
- ARKit has the most stable tracking
 - But can be improved (it will)
- ARKit has the best experience when walking
 - But after longer distances the model appears to drift
- Combination with a RTK GNSS receiver would be obvious!

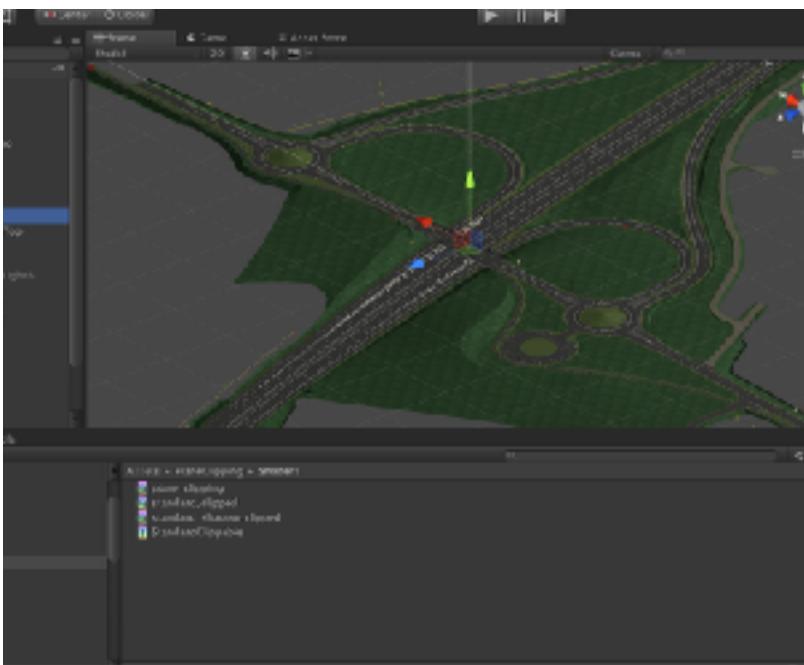
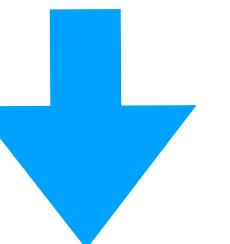
Further steps?

- **Workflow improvements!**



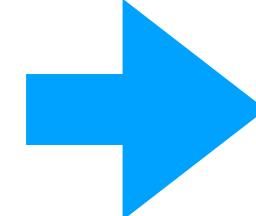
Manual tasks

- Coordinates
- Materials
- Normals

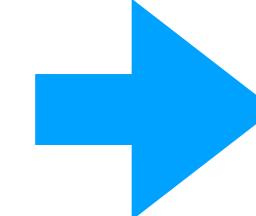


Workflow today

Not efficient!



Xcode



Further steps?

- Workflow improvements!
- **How to visualize subsurface utilities?**

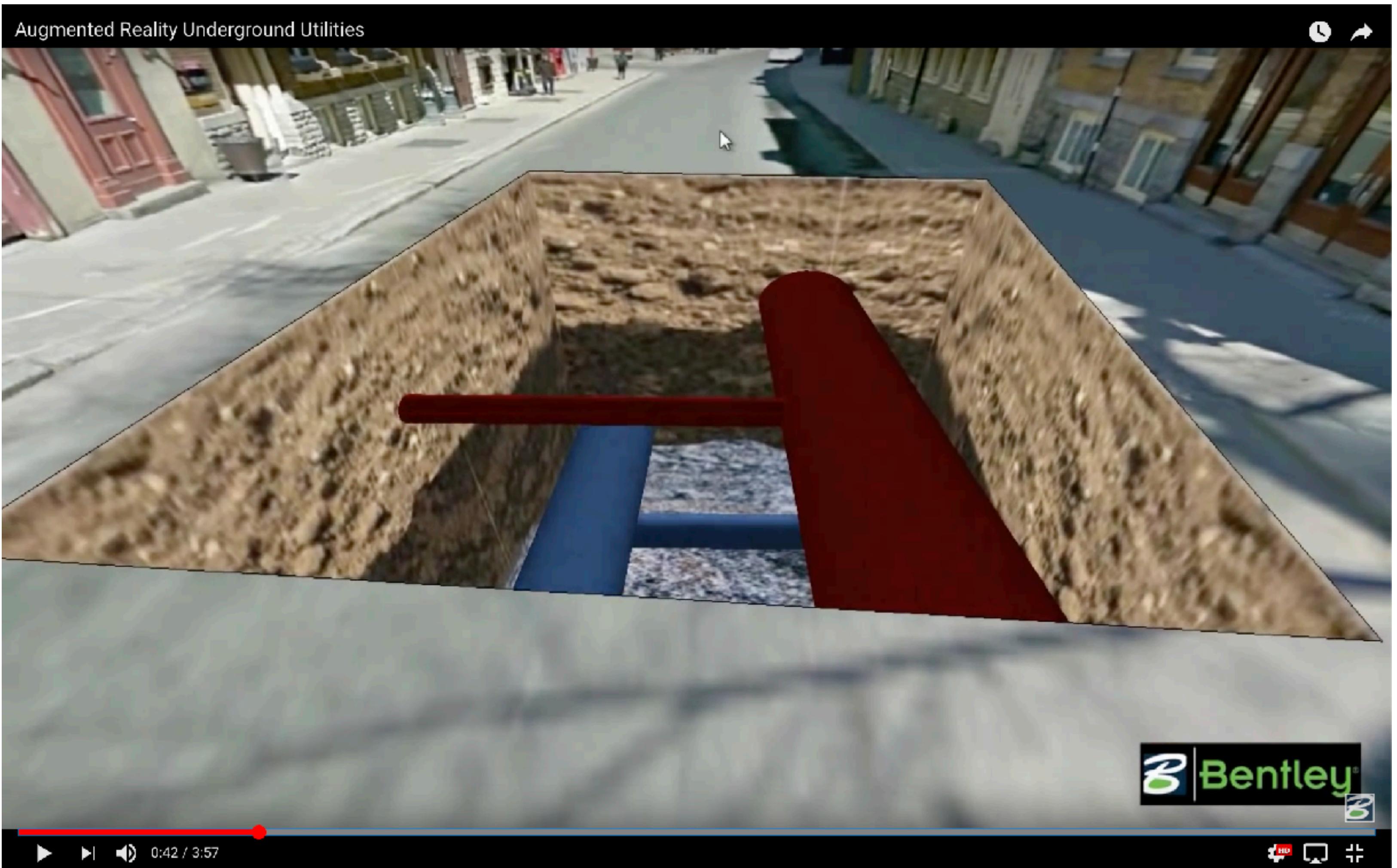
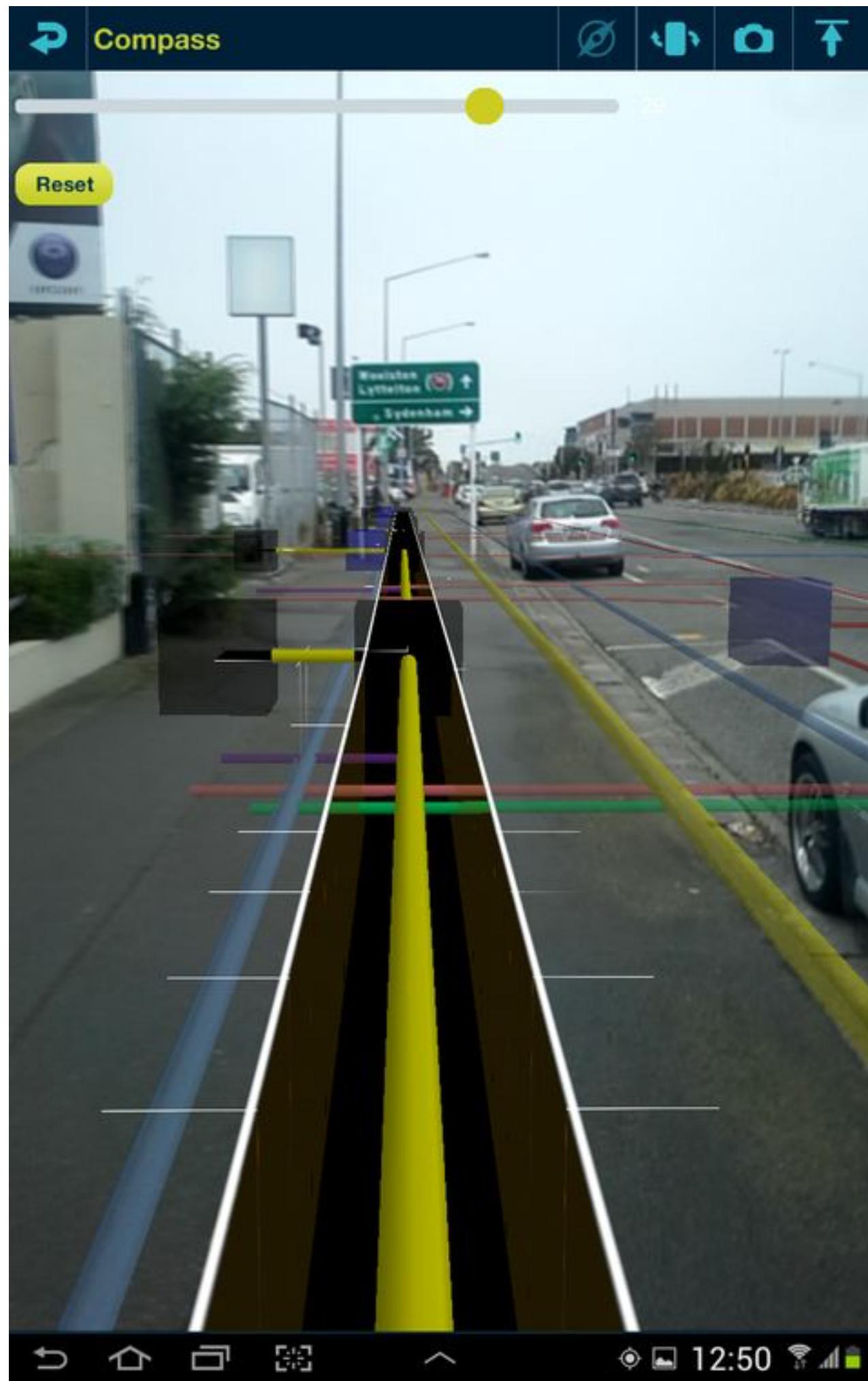
Examples

Transparency



Examples

Clipping box



Examples

Clipping box

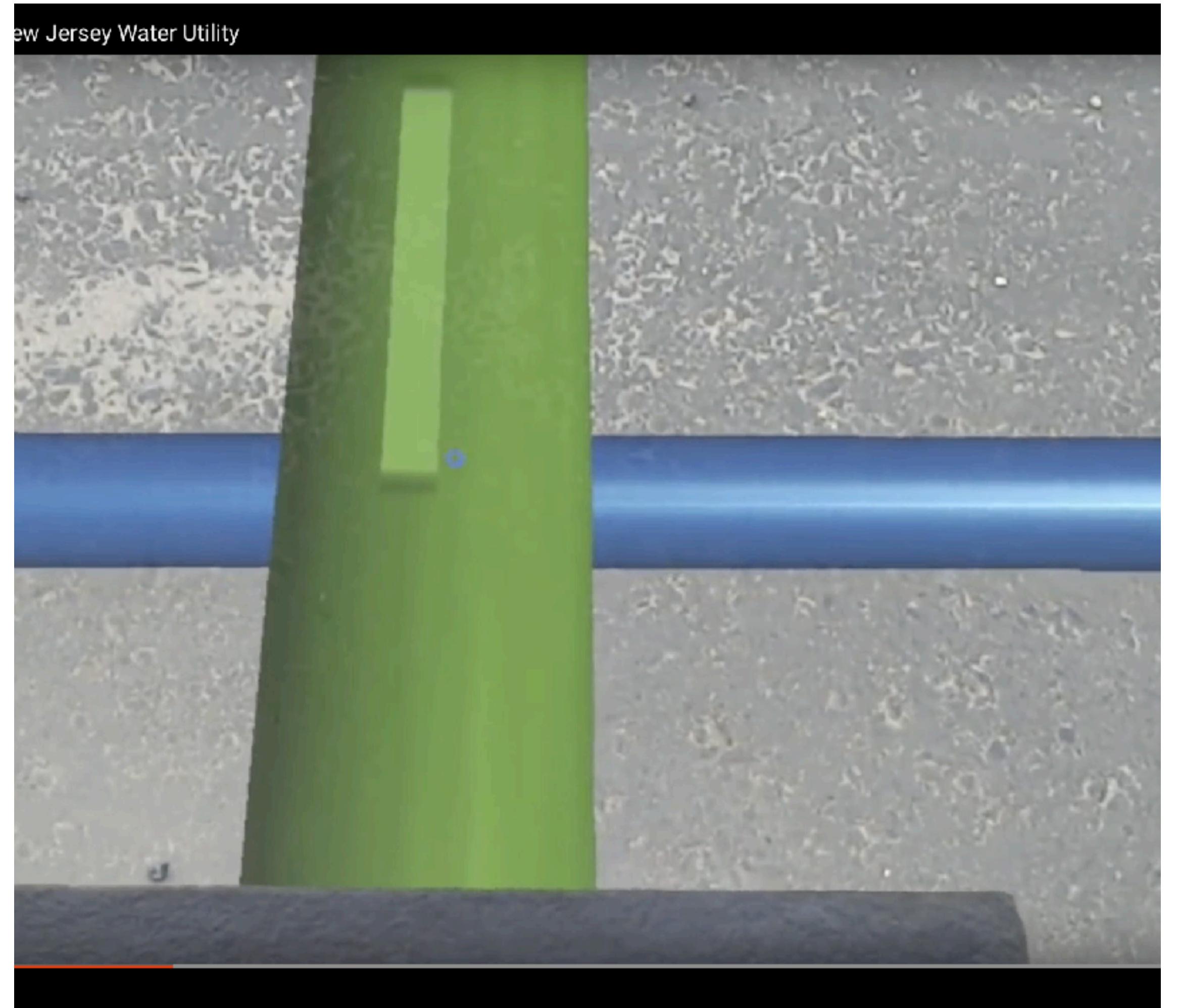


https://www.youtube.com/watch?v=KS_5OHoHHuo

Further steps?

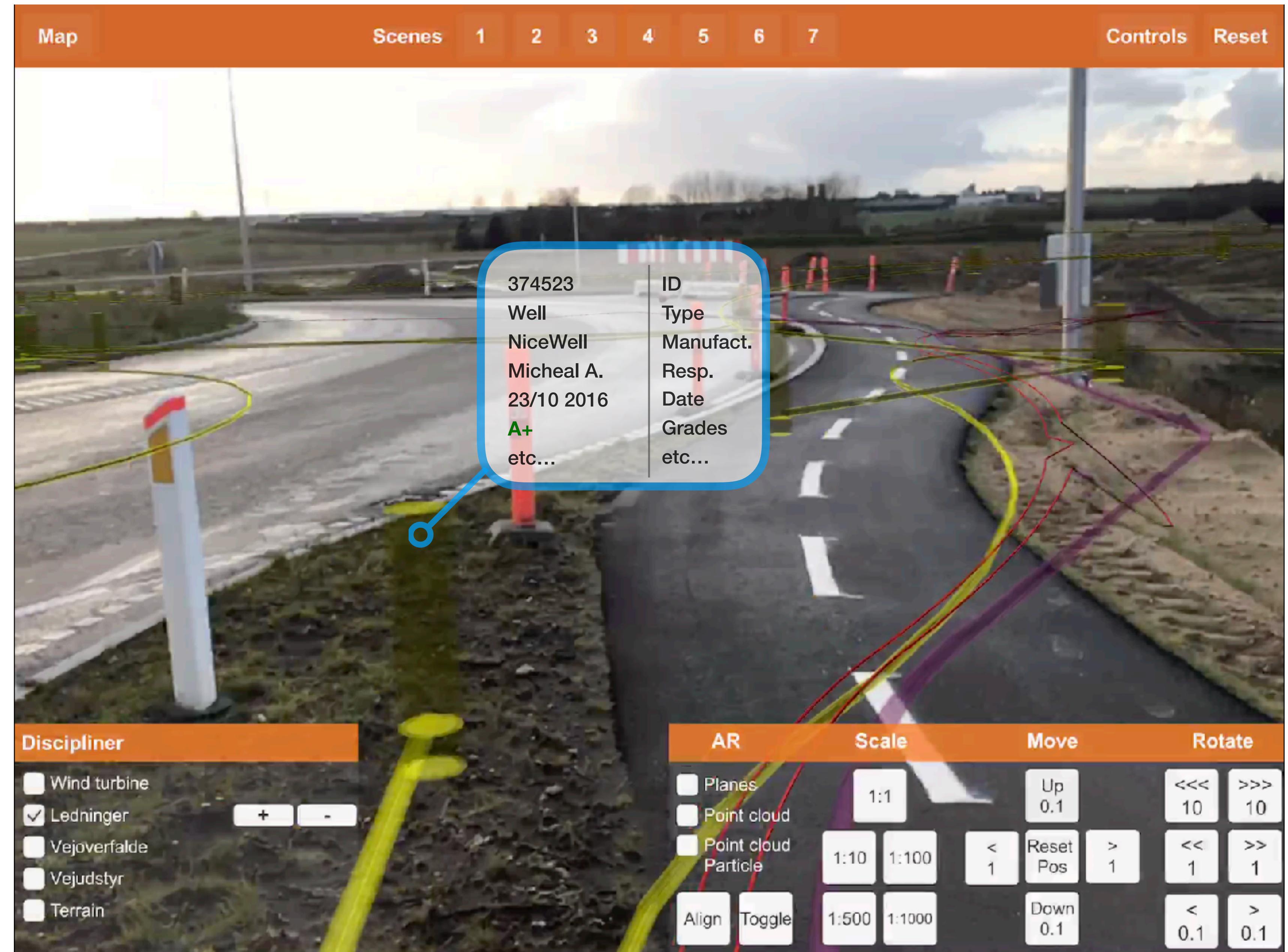
- Workflow improvements!
- How to visualize subsurface utilities?
- **More than just visualization.**
 - What information should be attached to the model?
 - How to visualize information?

Examples point/tap at

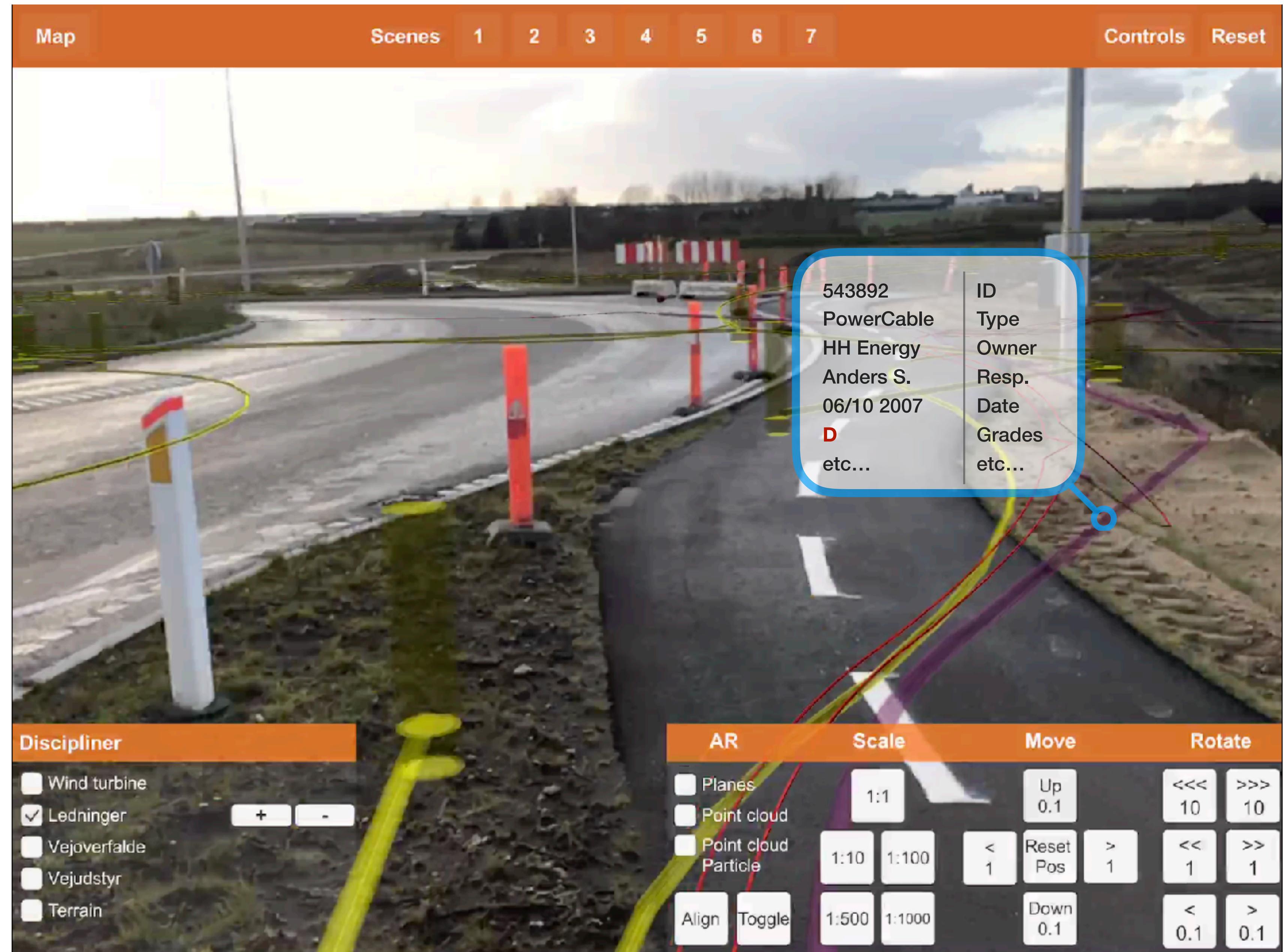


<https://www.youtube.com/watch?v=86UQ0i5MPOA>

Examples point/tap at



Examples point/tap at



Thanks for listening

XR

Extended Reality

AR
Augmented
Reality

VR
Virtuel
Reality

MR
Mixed
Reality

XR

Extended Reality

AR
Augmented
Reality

VR
Virtuel
Reality

MR
Mixed
Reality

XR

Extended Reality

AR
Augmented
Reality

VR
Virtuel
Reality

MR
Buzzword!
VR
Realit

Microsoft

XR

Extended Reality

AR

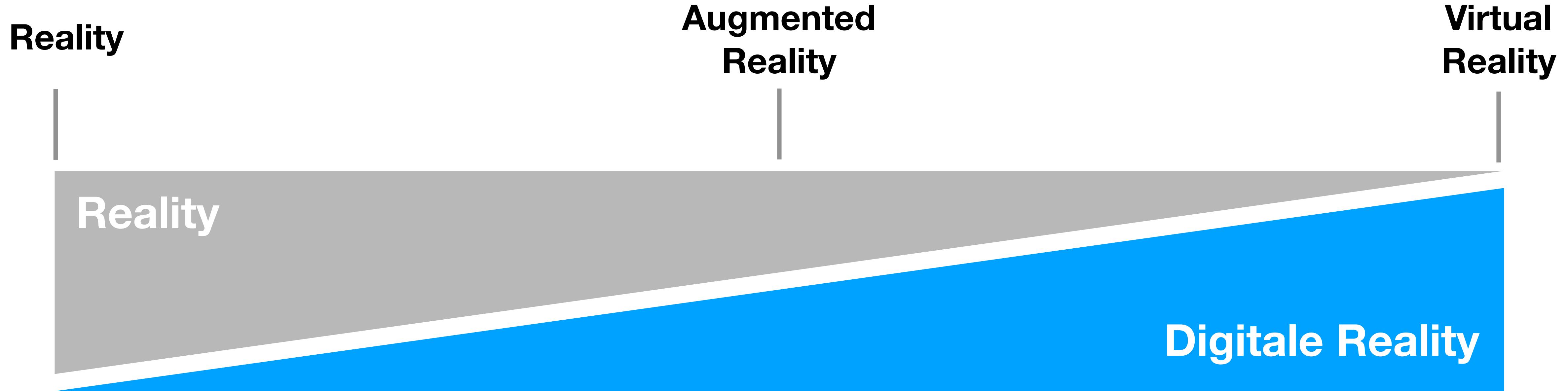
Augmented Reality

VR

Virtuel Reality

AR
Augmented Reality

VR
Virtuel Reality



Hardware

Augmented Reality

Mobile devices (MD)

Andriod devices

- **Phones**
 - Google
 - Samsung
 - etc.

- **Tablets**
- **Tango devices**
 - Depth sensor
 - Fish-eye camera

iOS devices

- iPhone
- iPad

Head mounted display (HMD)

- **Mircosoft HoloLens**
- **DAQRI Smart Helmet/Glasses**
- **VUZIX Blade**
- **Meta 2**
- **etc.**

Near future (HMD)

- **MagicLeap**
- **Apple AR headset (not official)**
- **Varjo**

Software - MD Solutions

Augmented Reality

AR framework (SDK)

- **Tango** Google (mid 2015) limited
 - 2 devices (Lenovo, ASUS)
- **ARCore** Google (late 2017) limited
 - Pixel Phones, Samsung S8
- **ARKit** Apple (mid 2017) limited
 - iPhone, iPad (\geq A9 processor)
- **ALVAR** Cross-platform (2000)
- **Vuforia** Cross-platform (2008)
- **Many more like Vuforia!**

On-site Services

- **SiteVision** Trimble (*not public*)
- **ArOnSite** ALVAR (*not public*)
- **TwinBIM** Dalux
- **uGraph** Orbicon
- **AugView** AugView
- **VDC Live** ViaSys
- **Probably more!**

My Solution

- **OnSite** AAU/COWI

Hvordan virker AR?

ARKit

ARCore

Vuforia

visual-inertial odometry (VIO)

World tracking

Motion sensing
hardware

Computer vision

Accelerometer

Camera

Gyroscope

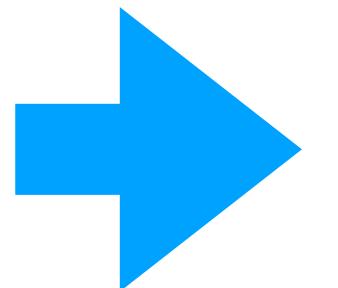
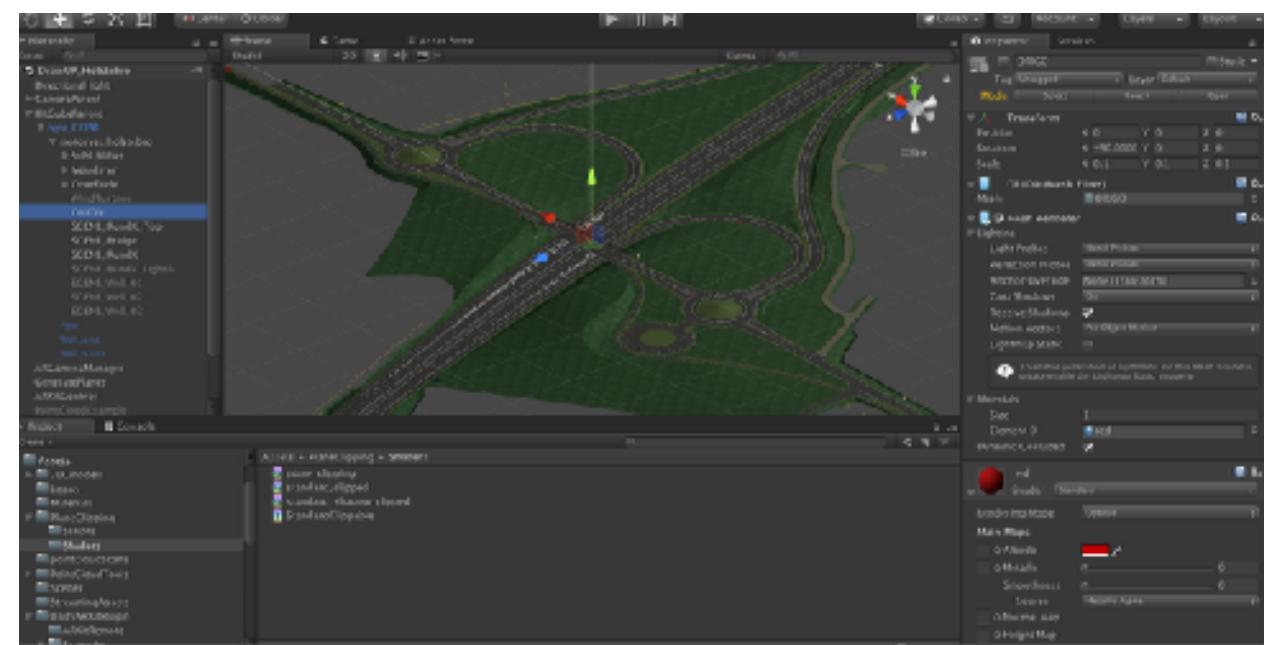
Rotational
vector sensors

Screen

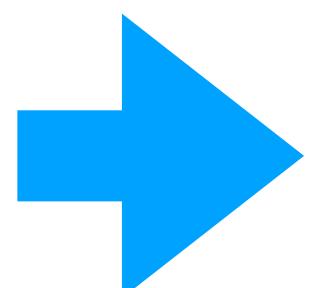
Video
frames

Workflow

Start from the end



Xcode



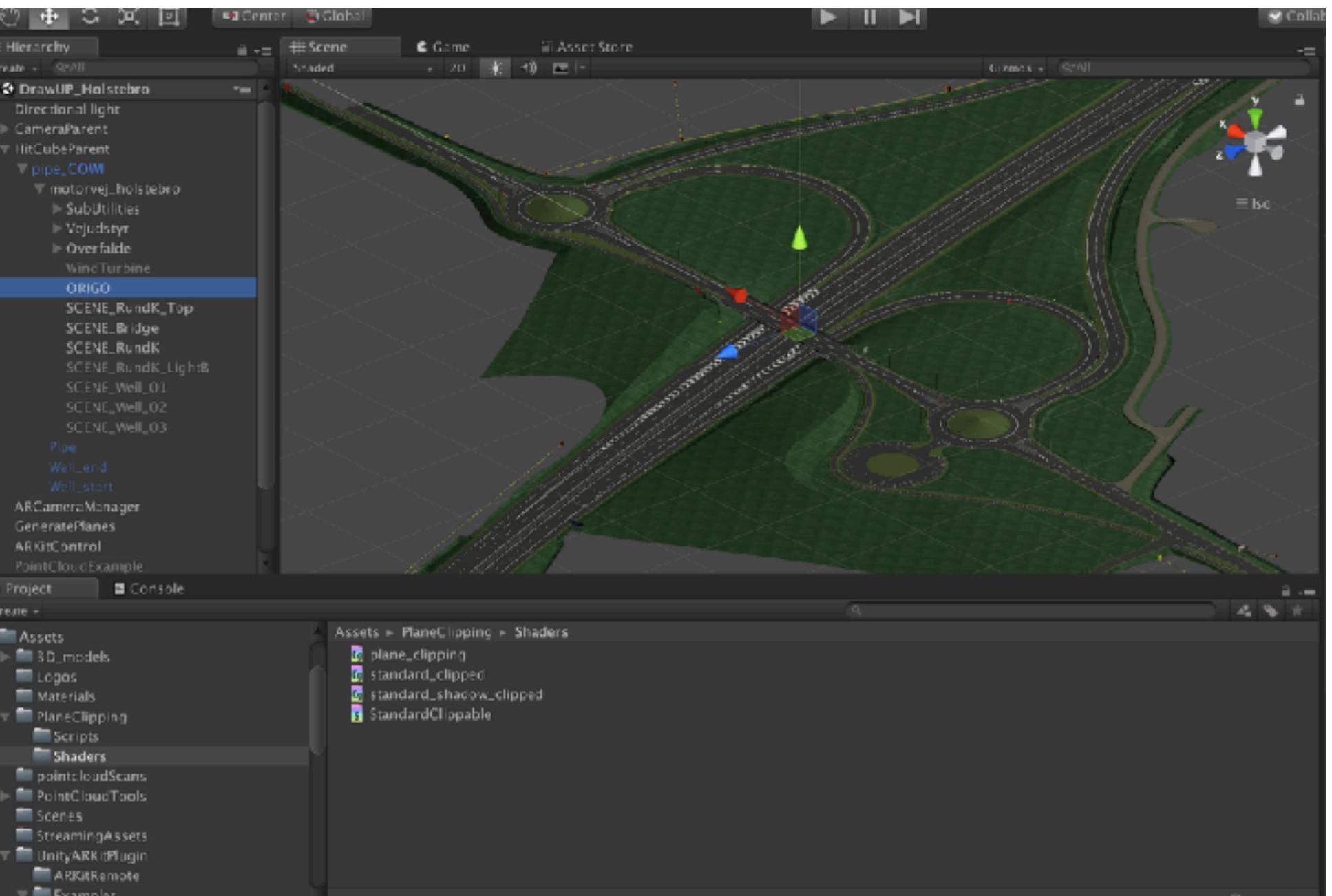
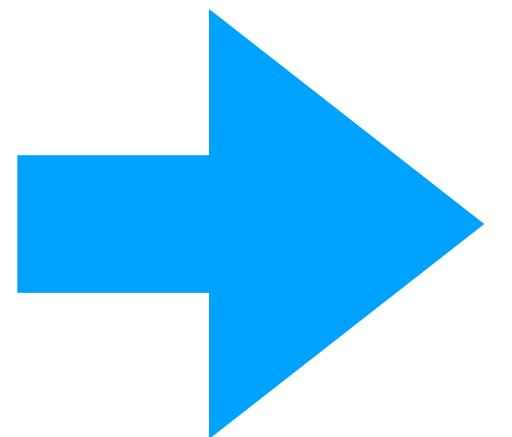
Unity ARKit Plugin



Workflow



Export: FBX

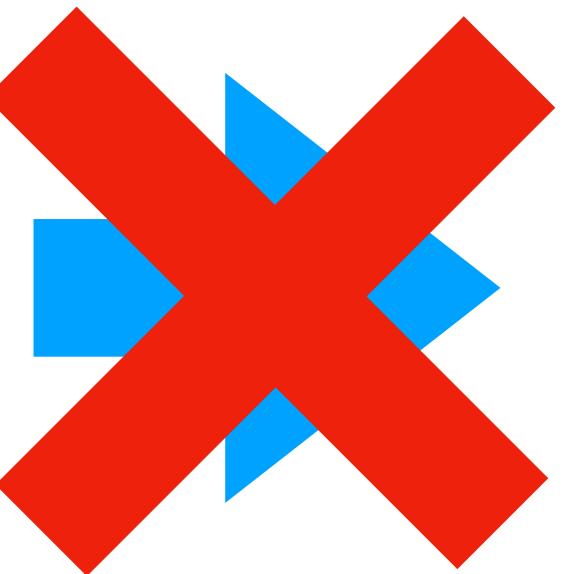


Import: FBX

Workflow

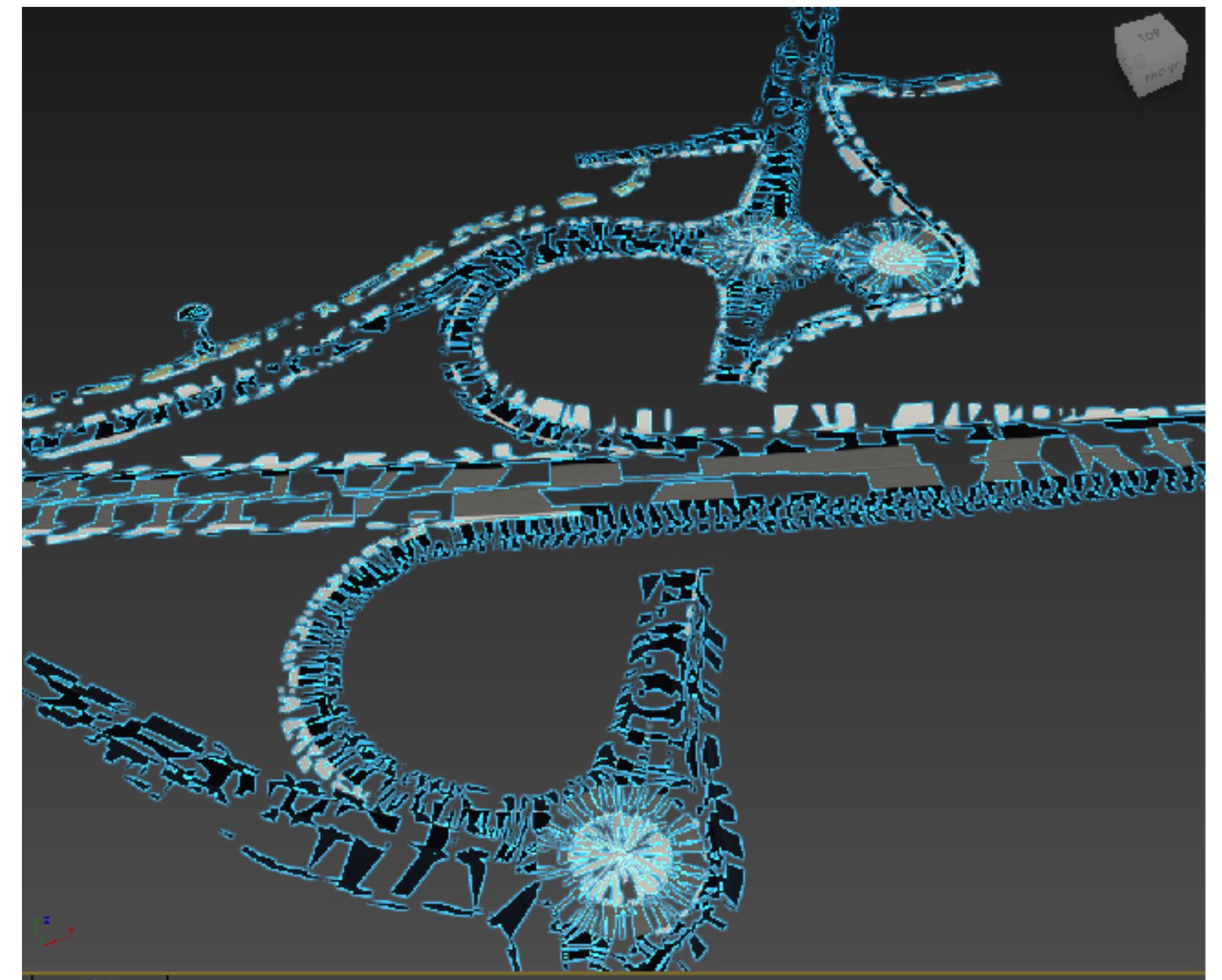


Export: **FBX**



Problems

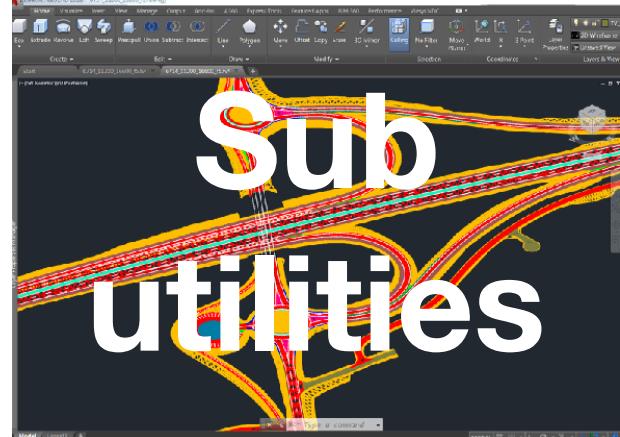
- Coordinates
- Materials
- Normals



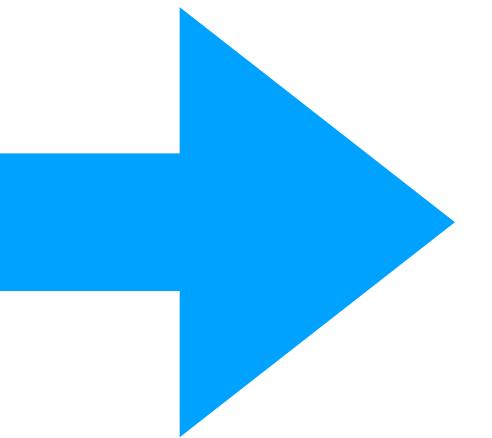
Import: **FBX**



Workflow

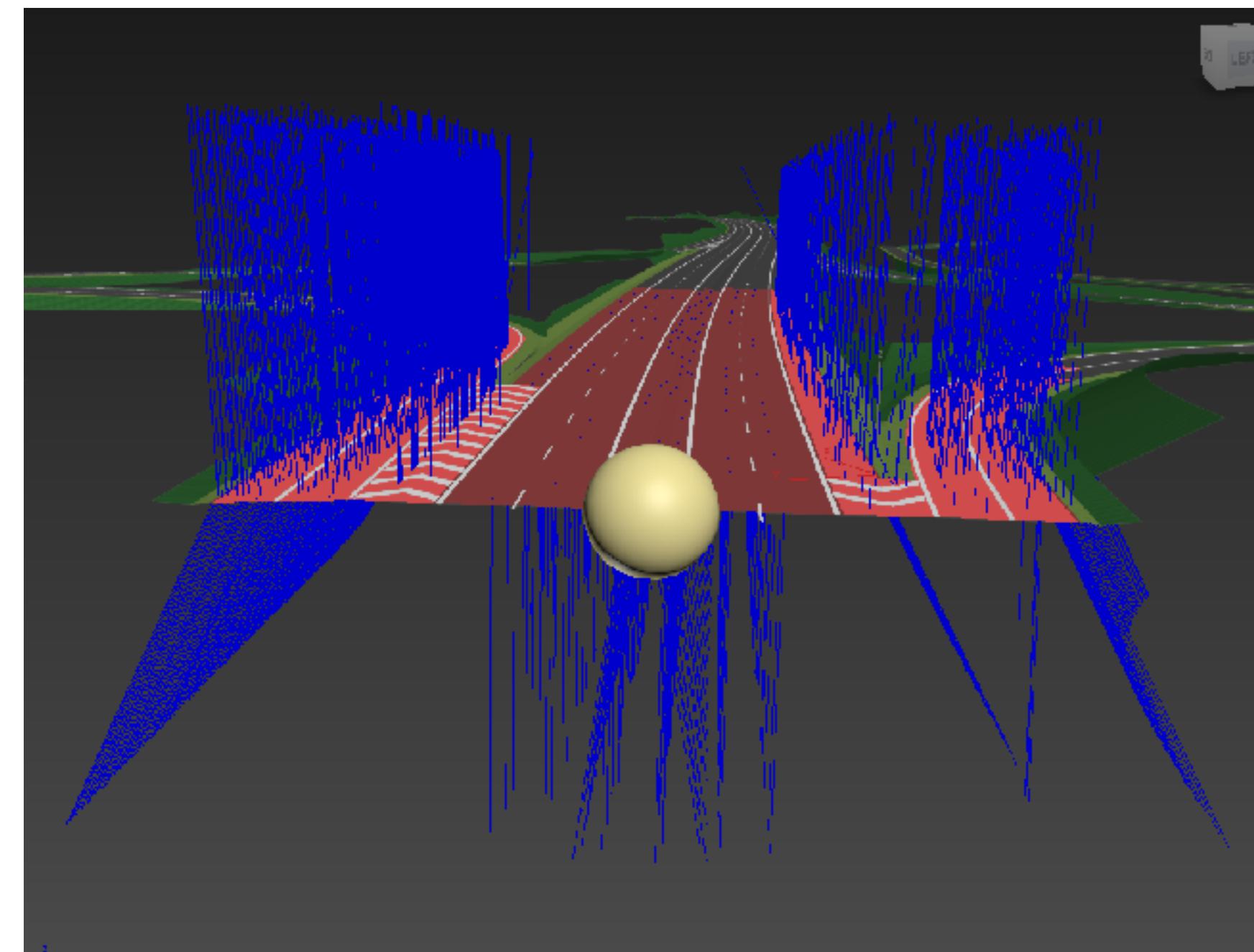


Export: DWG

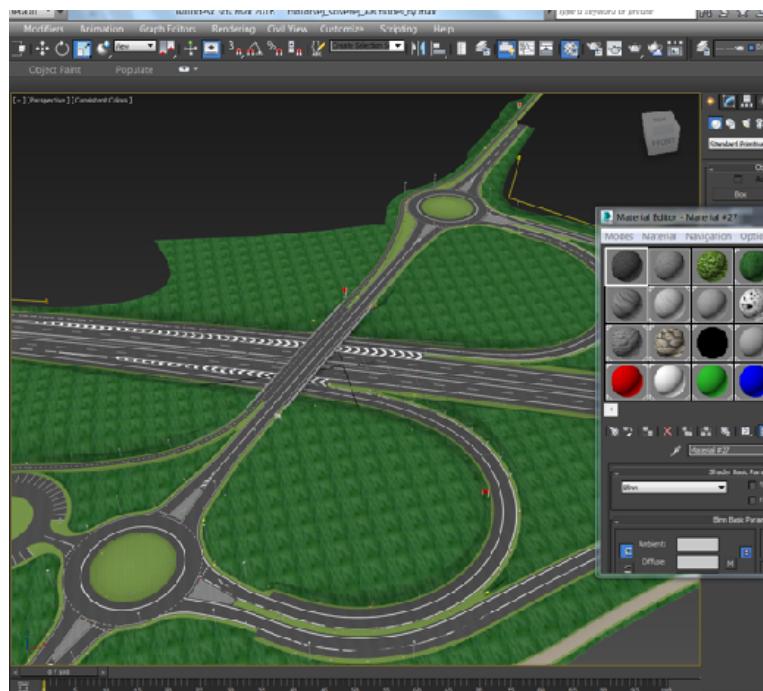
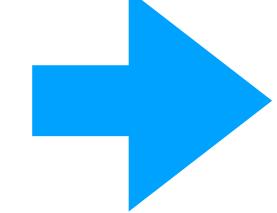
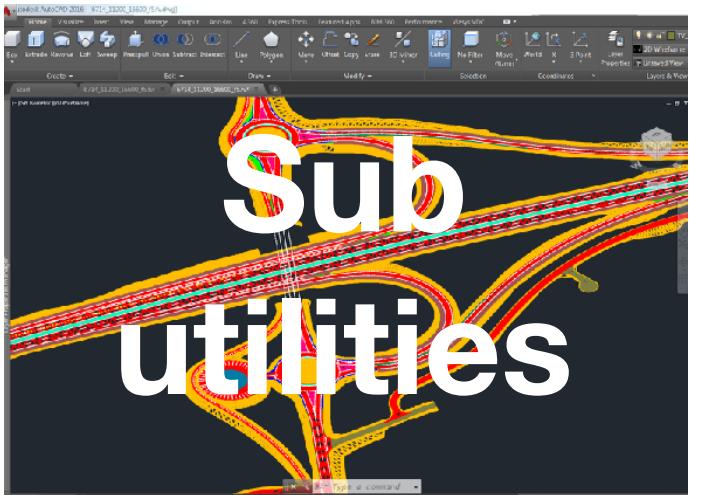
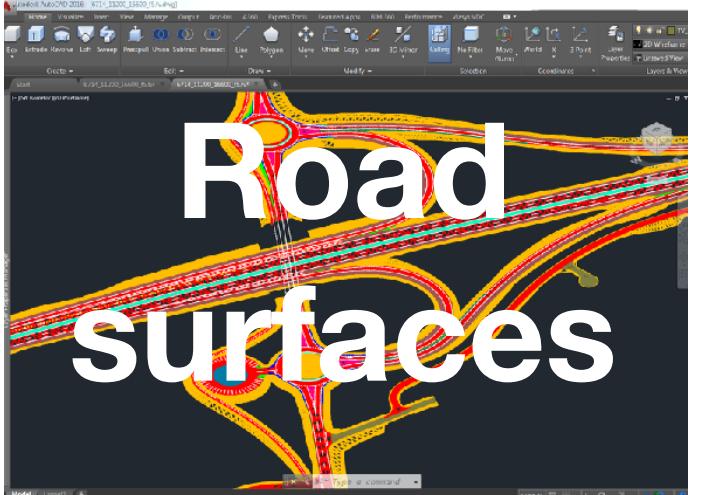


Manual tasks

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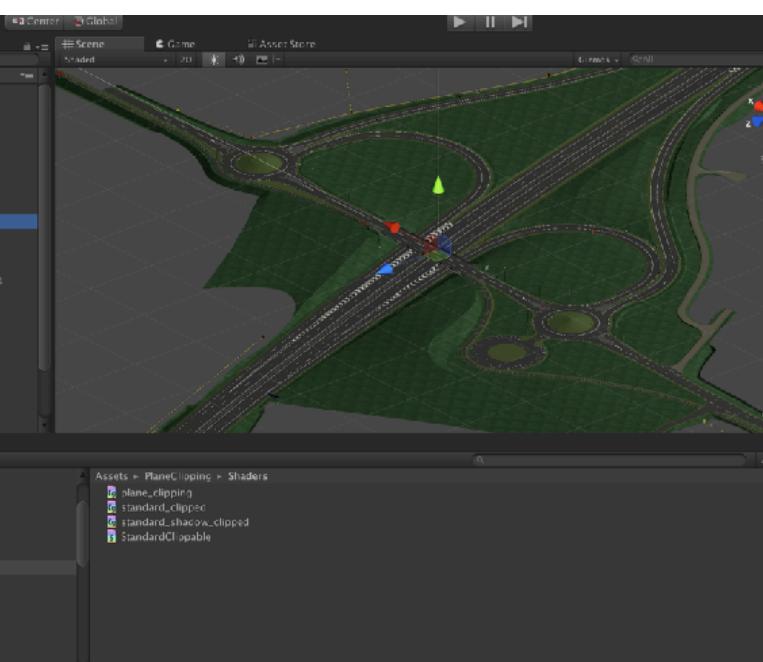
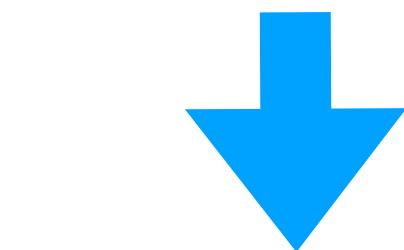


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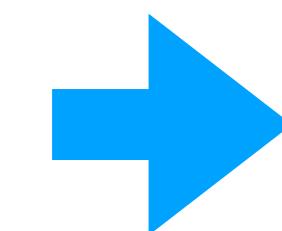
Manual tasks

- Coordinates
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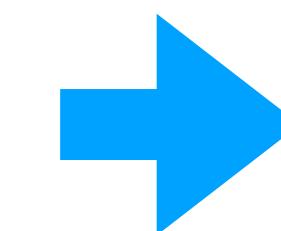


Opsummering Workflow idag

Modeller til mere - besvær?

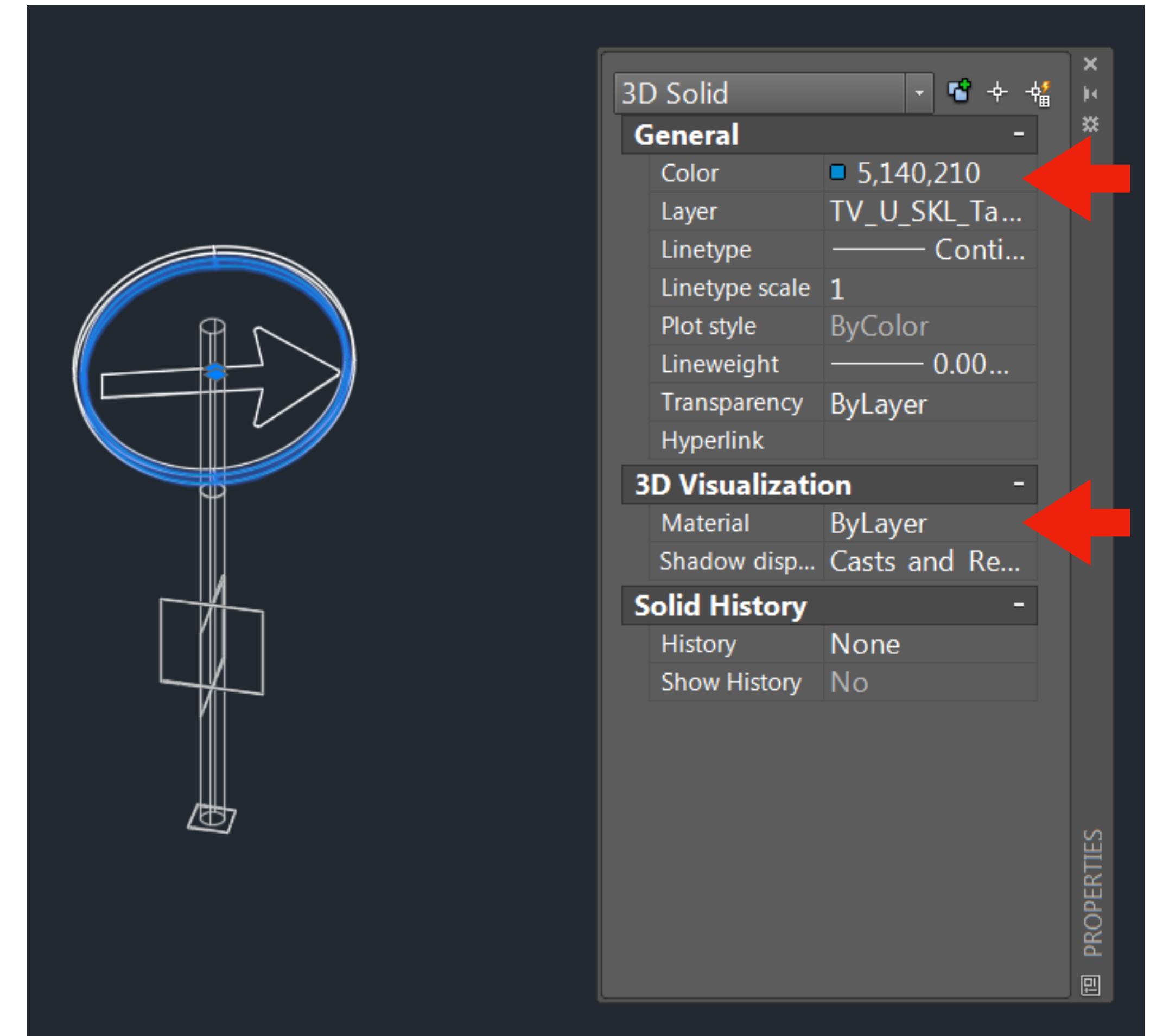
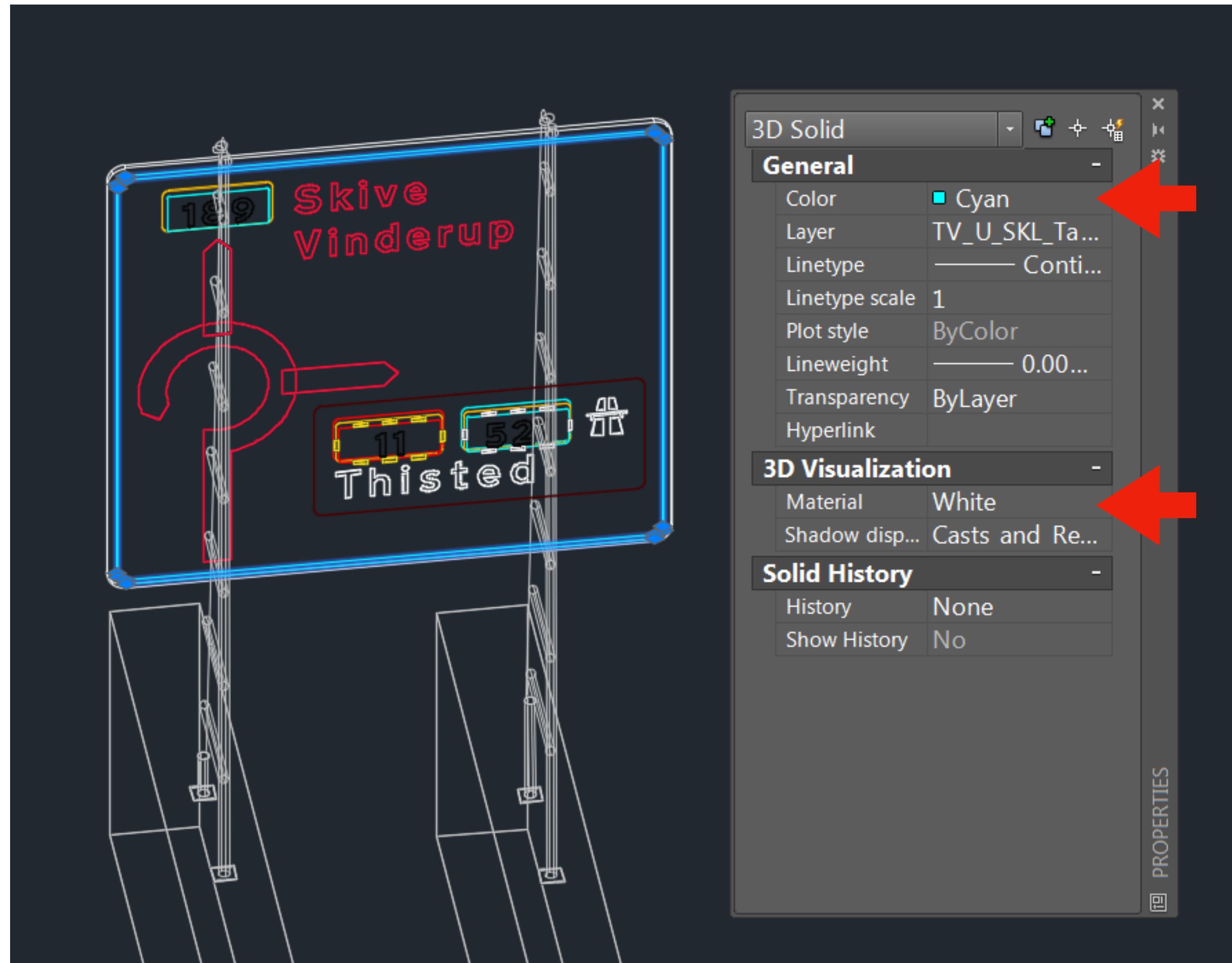


Xcode



Modeller til mere

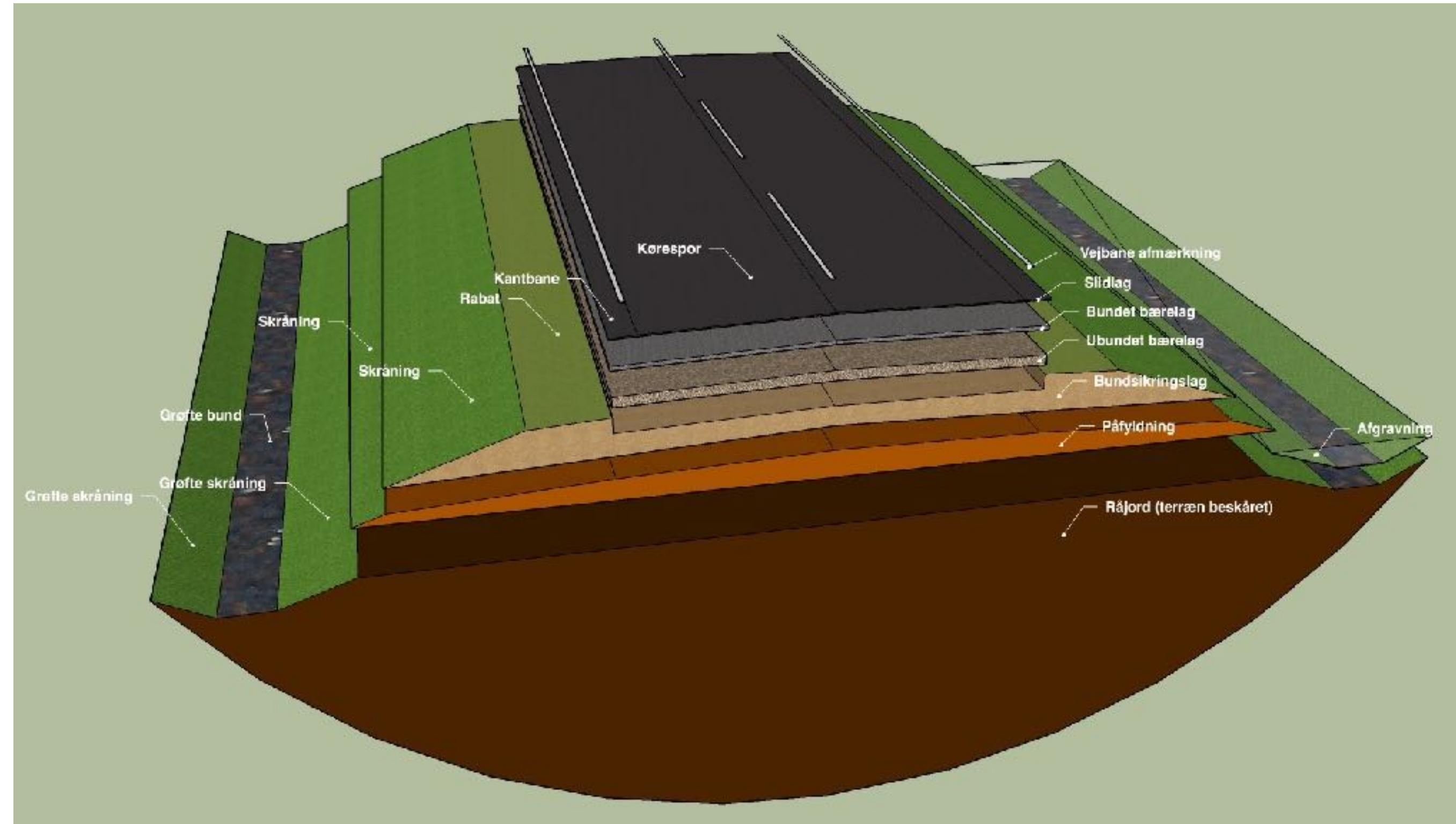
Hvordan kan vi forbedre nuværende workflow?



Modeller til mere

Hvordan kan vi forbedre nuværende workflow?

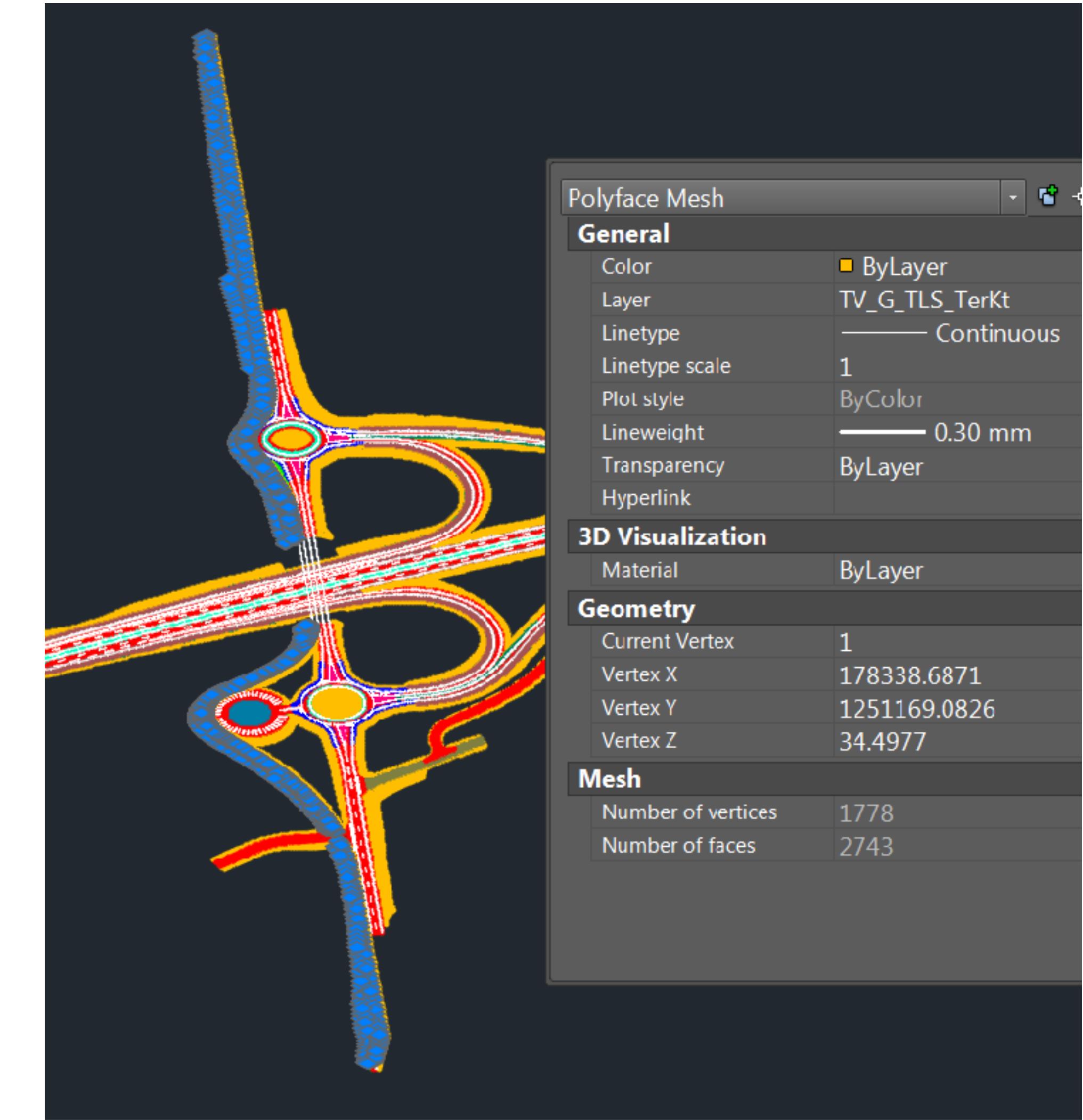
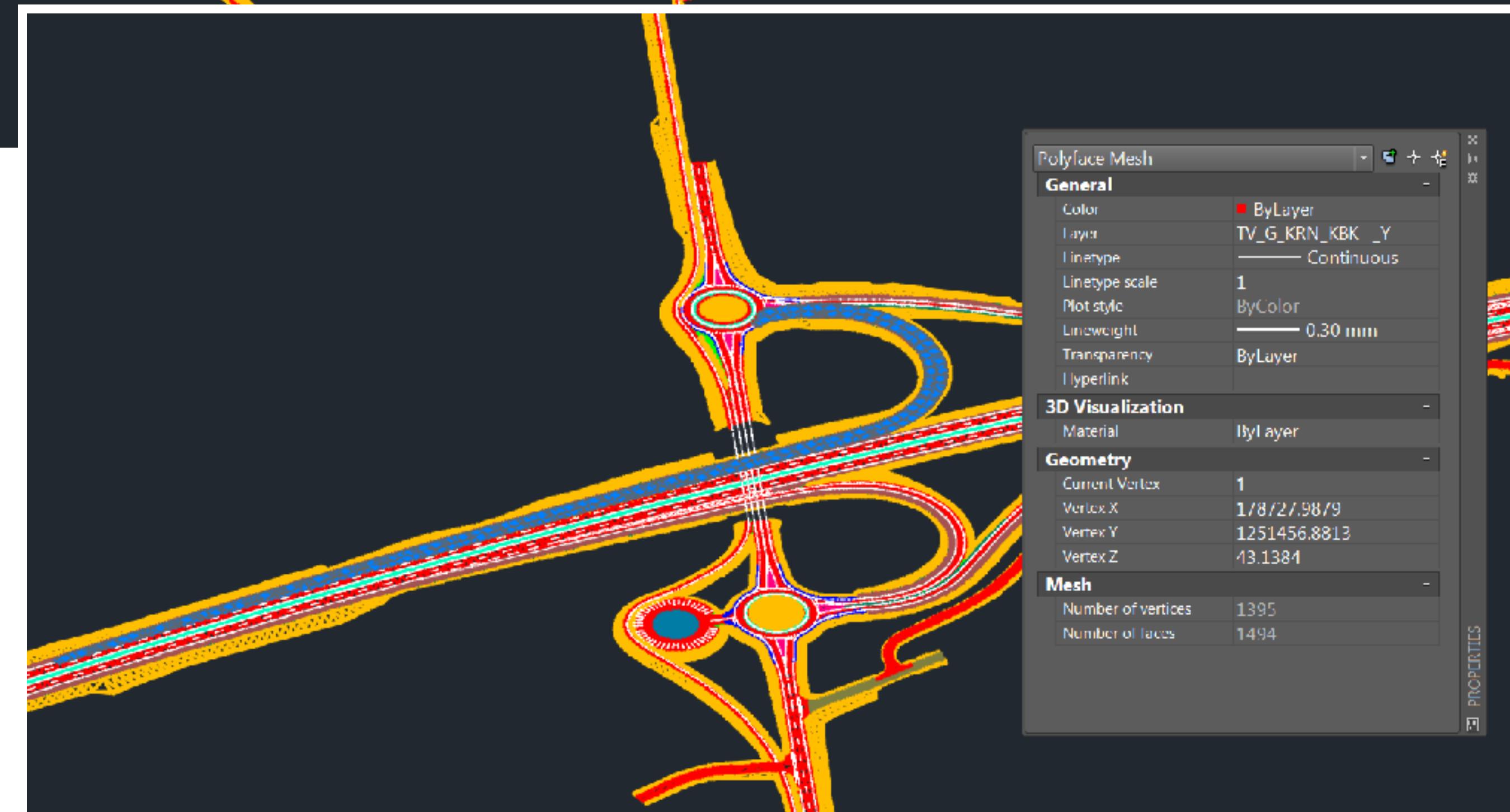
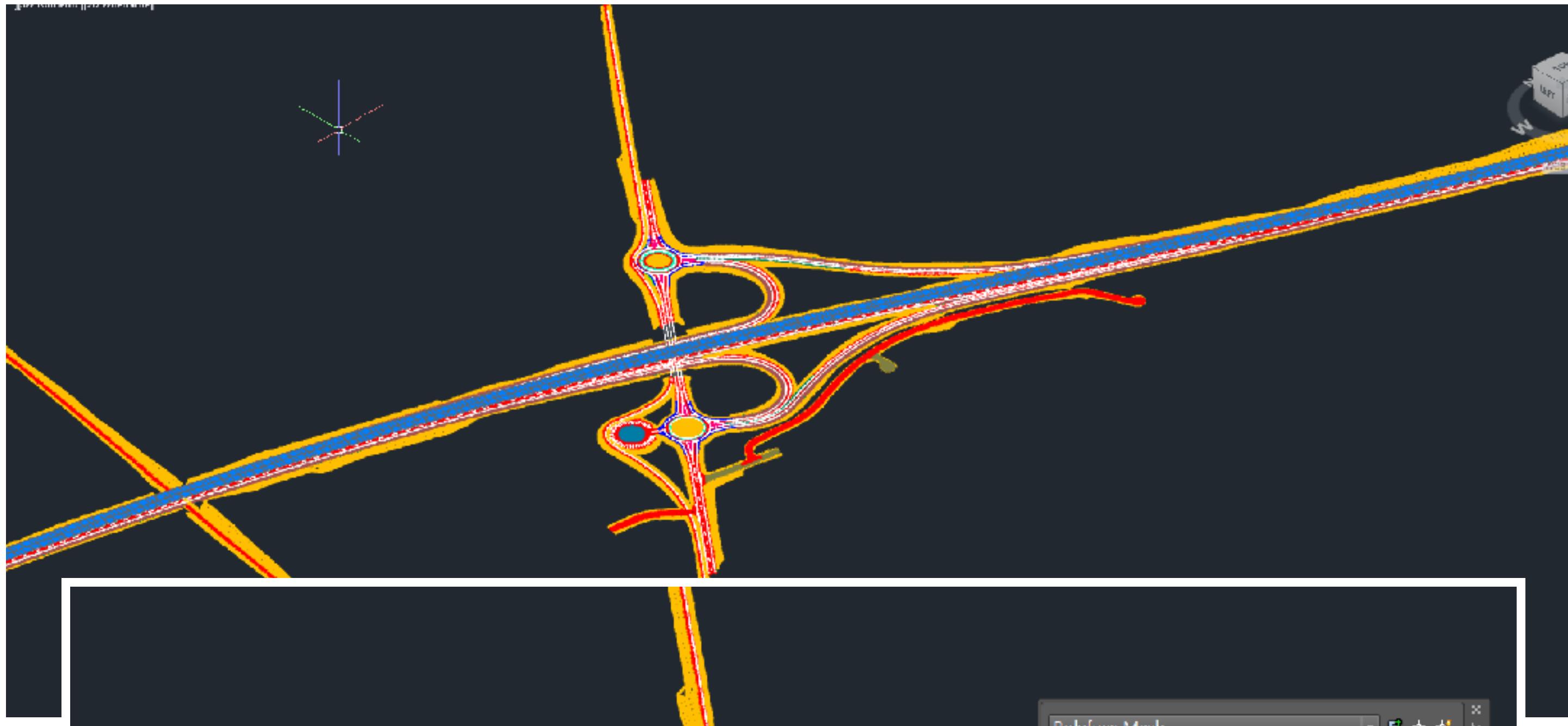
- Er det muligt at lave scripts, der kan assign materialer i 3DS Max?
 - lag
 - materiale
 - **solid objekt**



Modeller til mere

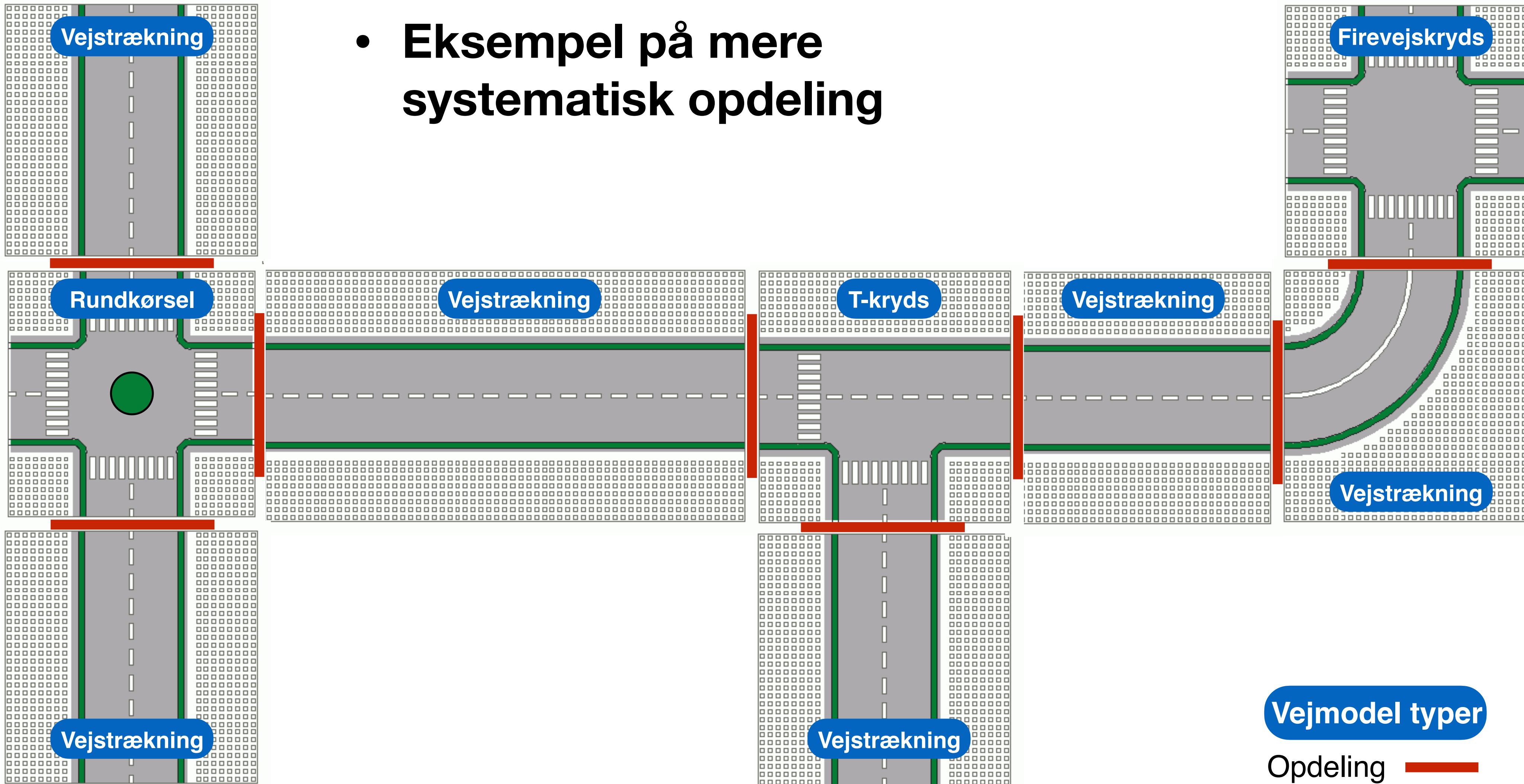
Hvordan kan vi forbedre nuværende workflow?

- Bør vi opdele geometriske objekter anderledes?
 - Nogle geometriske objekter i modellen er store
 - **Se næste slide**



Modeller til mere

- Eksempel på mere systematisk opdeling

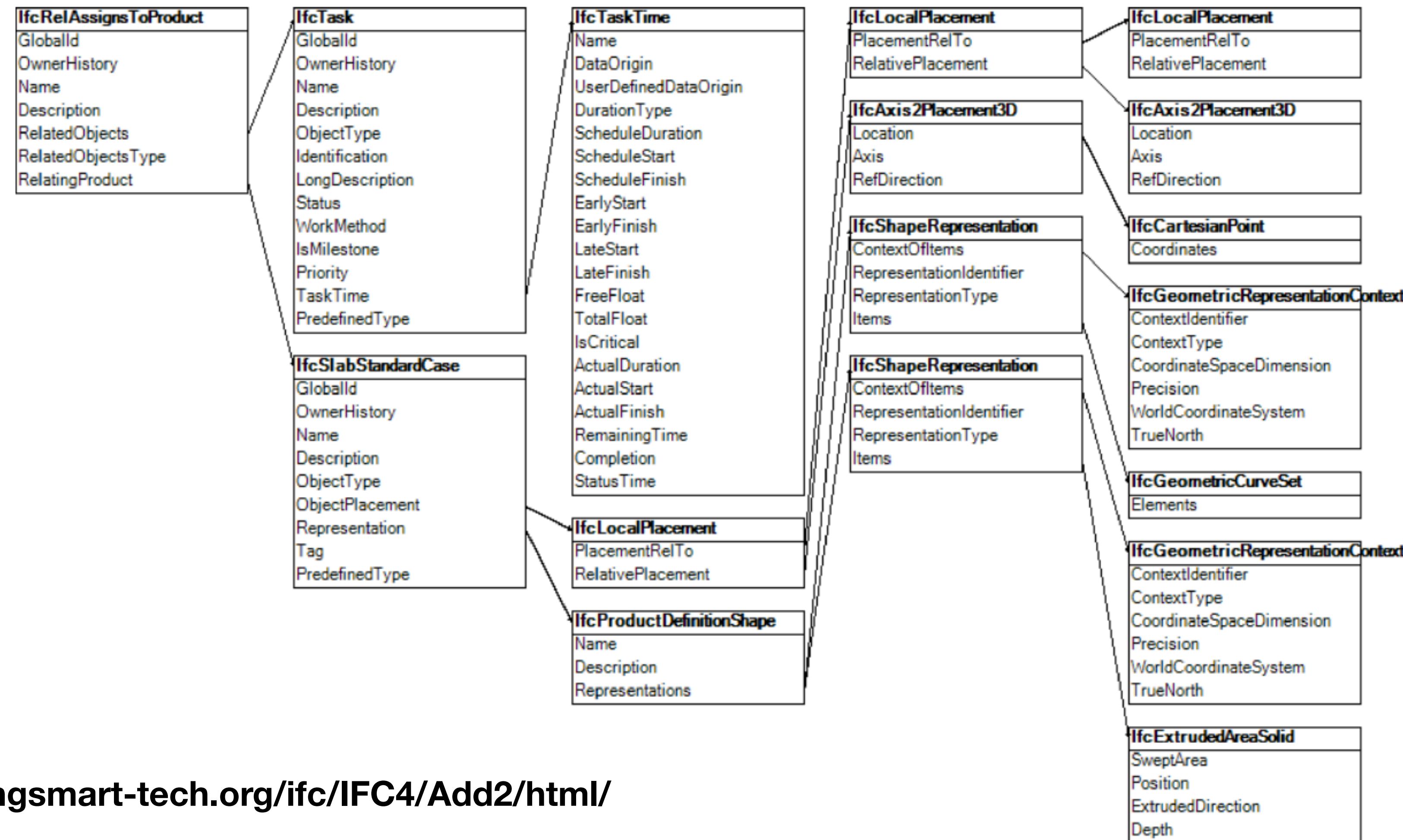


Videre forløb med AR...

- Hvad skal vi tilføje af informationer i modellen?
 - tidsforløb (4D)
 - omkostning (5D)
- Hvordan skal vi præsentere informationen?
 - Hvad kommer frem når vi peger på et geometrisk objekt?

Videre forløb med AR...

IFC 4 filformat - tidsforløb



<http://www.buildingsmart-tech.org/ifc/IFC4/Add2/html/>

Videre forløb med AR...

- Synchro 4D
 - <https://www.youtube.com/watch?v=HSba6VNx04A>
- Reconstruct 4D BIM
 - <https://vimeo.com/185335096>