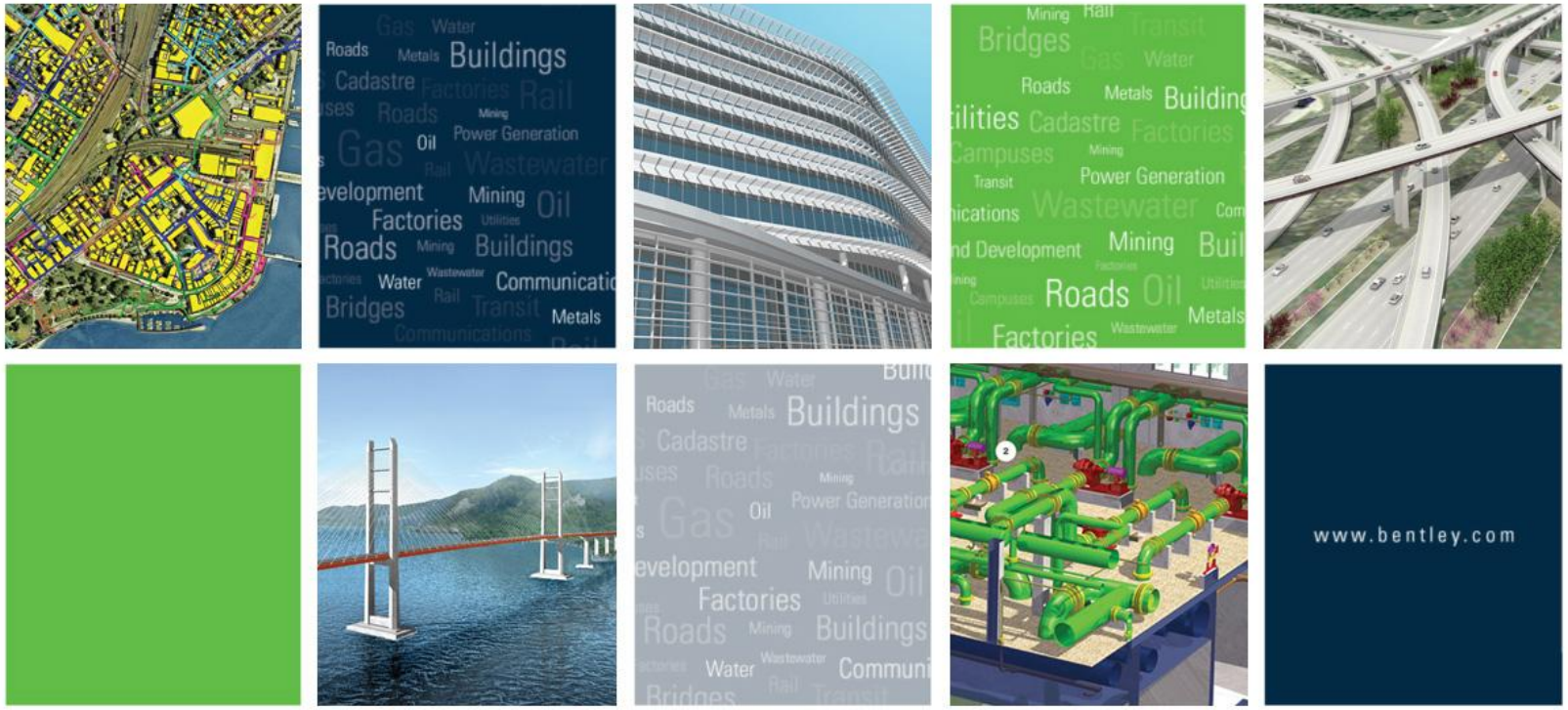

3D City & Urban Modeling

Parametric 3D City Modeling

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Bentley
Sustaining Infrastructure

Statement

EuroSDR Workshop 21-22 June 2005, Bonn

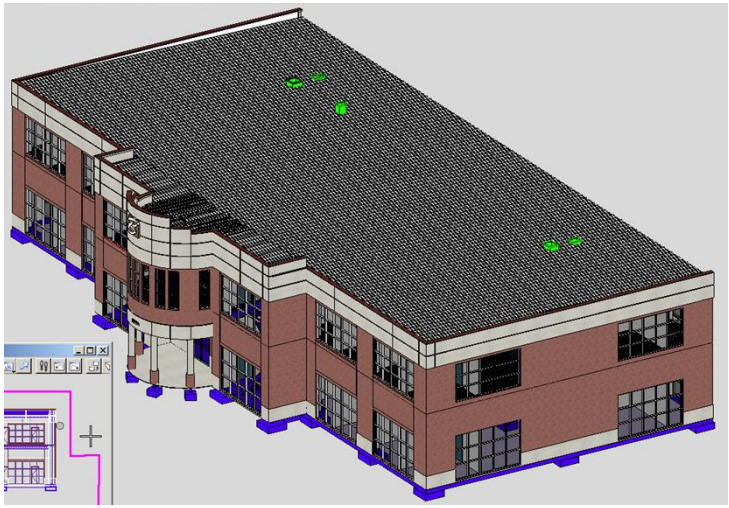
Cross-discipline constraints

“We make progress professionally by specialising, but many of the most interesting opportunities are in the gaps”

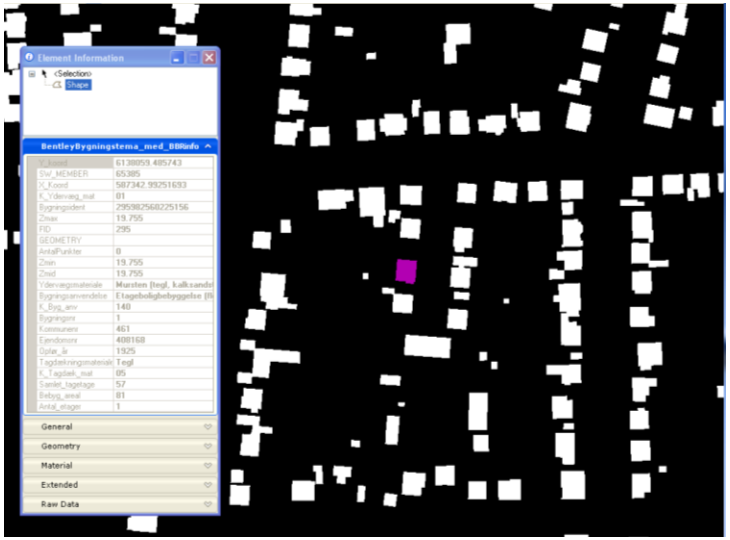
Background

The 2D and 3D world

- 3D CAD/BIM
  - File based; engineering projects
  - High level of object details; e.g. buildings, bridges, roads…
  - Minor geographic area



- 2D GIS
  - GIS/databases; high level of geographic information's
  - Low level of object details
  - Large geographic area; covering a metropolis, region, nation…



The best from both worlds…

A collection of functionality and information that allows the management of a city's infrastructure

- GIS/CAD/BIM integration
- From the overview of the 3D urban assets to detailed infrastructure – from campus to large metropolis
- Intelligent objects from overview urban city objects to detailed engineering
- For seamless modeling, analysis, visualization and distribution to all stakeholders

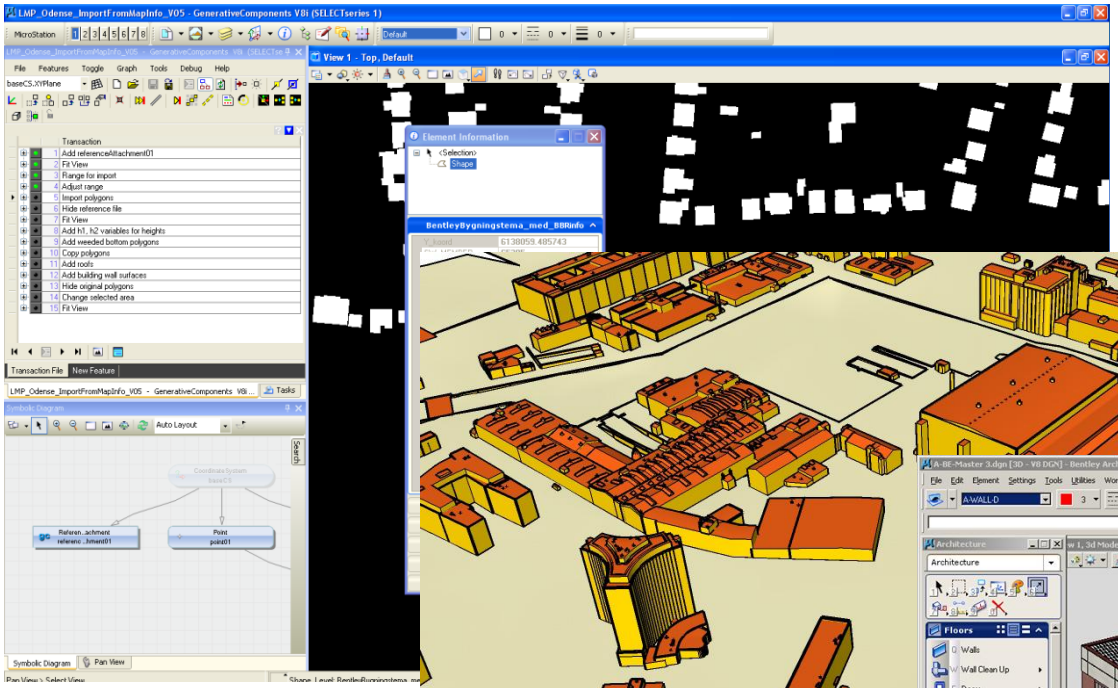
Bentleys approach is **3D City & Urban GIS**

The key products for 3D City GIS…

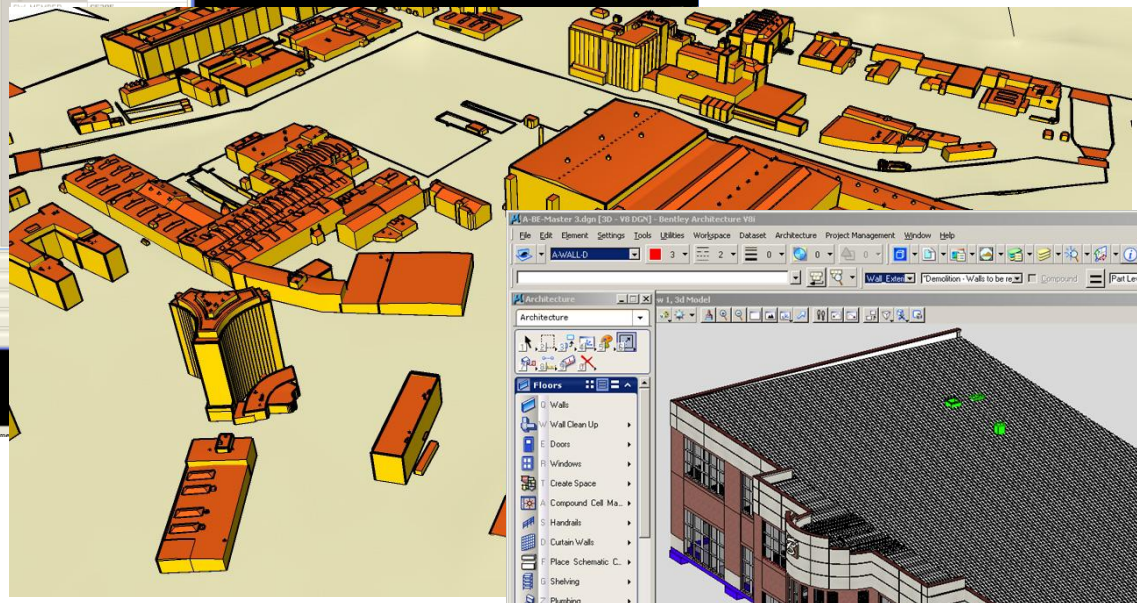
- Platform, CAD:
  - MicroStation
  - GenerativeComponents
  - ProjectWise Navigator
- Platform, 3D GIS:
  - Bentley Map
    - CityGML
  - Bentley Descartes
- Platform, Web:
  - Geo Web Publisher
- Platform, Collaboration:
  - ProjectWise family
- Architecture, applications:
  - Bentley Architecture
    - BIM, IFC
  - Bentley Hevacomp
- Utility, applications:
  - Water, Wastewater, Stormwater products
- Civil, applications:
  - InRoads family
  - PowerCivil
- 3. party applications:
  - WFS Booster
  - TerraScan
  - …

The typical scenario's today – the “pain”

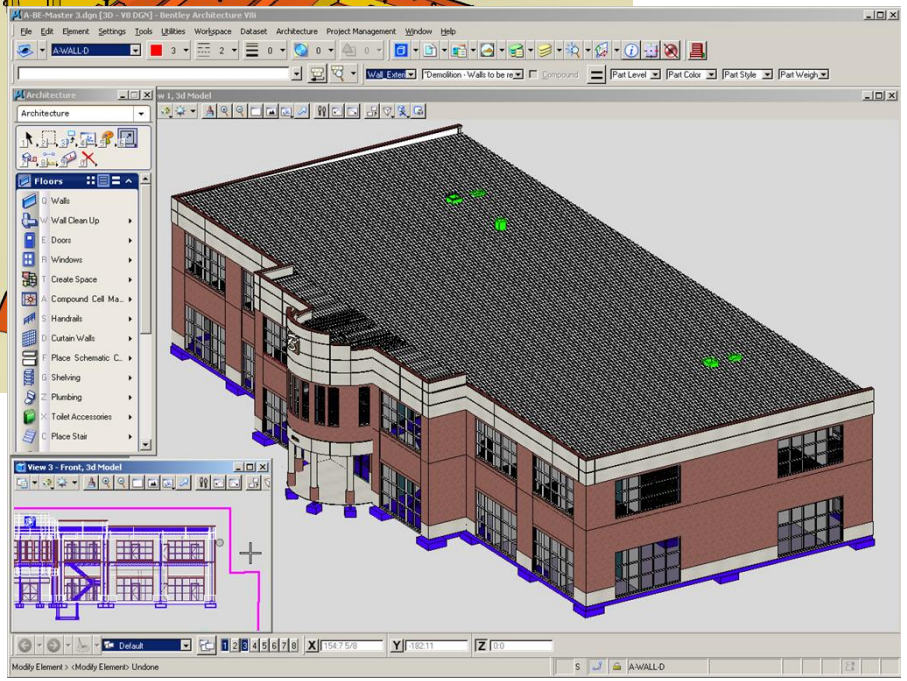
The marked situation for many years…



2D GIS systems



3D CAD stand-alone models



3D BIM models

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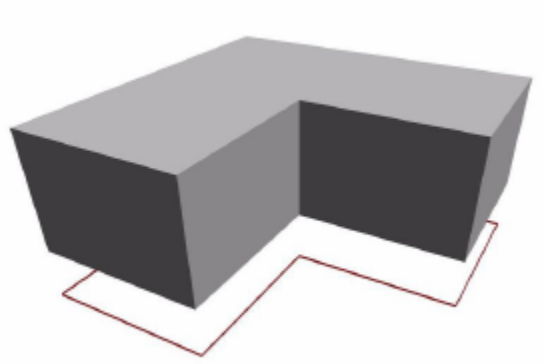
The “pain” for traditional 3D city models

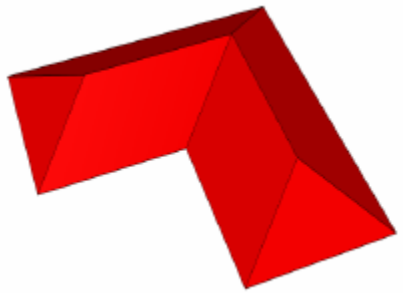
- Stand-alone models – no dynamic approach
- Very often no semantic information's
- No level of detail
- Expensive to maintain/update for end users
  - Low updating frequency (typical once a year)
  - Less usage due to actuality
- 3D is complex for many non-professional users
  - Less usage due to a low knowledge factor in the organization
- Other features than buildings are important
  - Terrain, including roads, bridges and other civil infrastructure
  - City & Urban “furniture's”; lamp posts, fences, vegetation etc.
  - Underground infrastructure; Utility etc.

Parametric 3D City & Urban Modeling – the concept

The scope

- Straight forward… or is it !?
  1. Extrude the footprint polygons
  2. Extract the geo-coded businessdata
  3. Define and generate the body and roof geometry





Usage of existing standardized Data Models, geo-coded metadata and Public Registers

- Standardized geodata model are available via KMS (DK)
  - FOT – Fælles Objekt Typer – Common Object Types
  - To promote continuity between the geographic databases throughout Denmark, an initiative to standardise geodata across the country has been launched.
  - Will improve the efficiency of geodata sharing and public administration in general
- Public Building Register(BBR, DK)
  - Technical information about the buildings; e.g. roof and wall material, construction year, usage type, no. of floors etc.
  - The data can be retrieved via OIS or EM
- Municipal Base Maps
  - The data are structured in DB and GIS systems, typical GIS vendors are Pitney Bowes and ESRI

A challenge is KMS' "public" WFS service

Parametric 3D City & Urban Modeling

- What is the idea behind?
  - Modeling of 3D objects by retrieving geometry and metadata from the existing Base Map/DB and public registers
  - Definition of the rule sets decide the modeling process; variety, complexity and design of the 3D objects
  - What do you gain? A simplified geometric 3D City & Urban model, but semantic rich and possibility for Level of Detail
- What Bentley technology are used?
  - MicroStation V8i
  - GenerativeComponents V8i
- What data are needed?
  - Building footprint; derived from the Base Map or WFS
  - Geo-coded metadata; derived from the DB and BBR

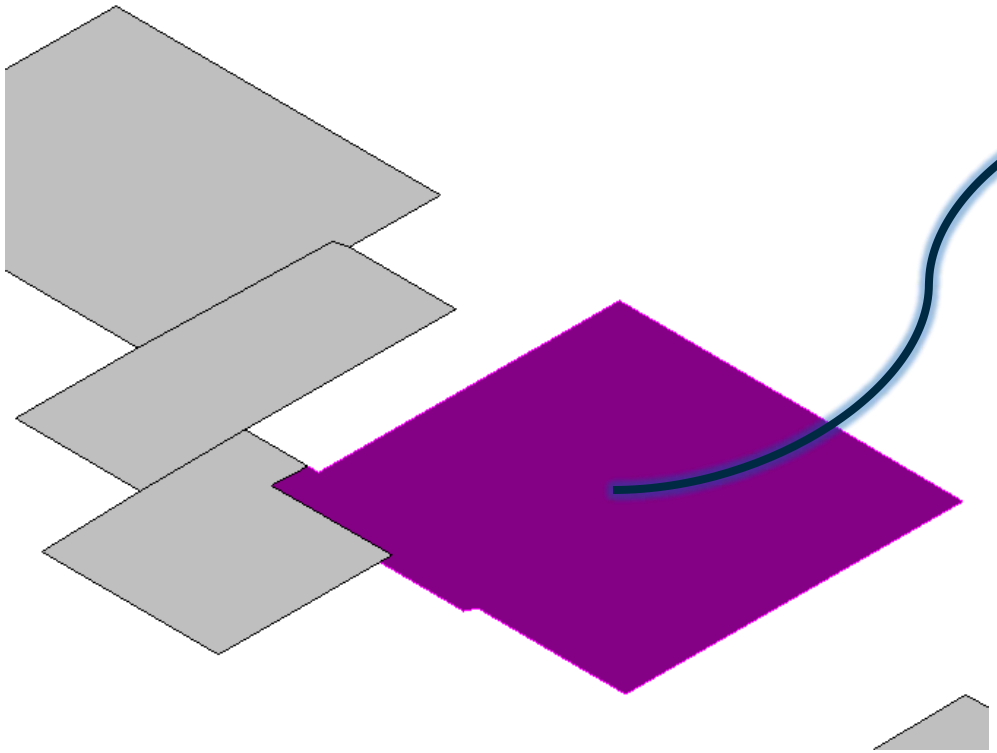
CAD & GIS Data

Related geo-coded metadata (BBR)

Data sources:

TAB, Shape, DXF, DWG, DGN, WFS, DB…

Geometry, e.g. building footprint



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X_Koord	587591.64595168
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Zmax	22.876
FID	79
GEOMETRY	
AntalPunkter	0
Zmin	17.731
Zmid	20.512
Ydervægsmateriale	Mursten (tegl, kalksands
Bygningsanvendelse	Fritliggende enfamilieshu
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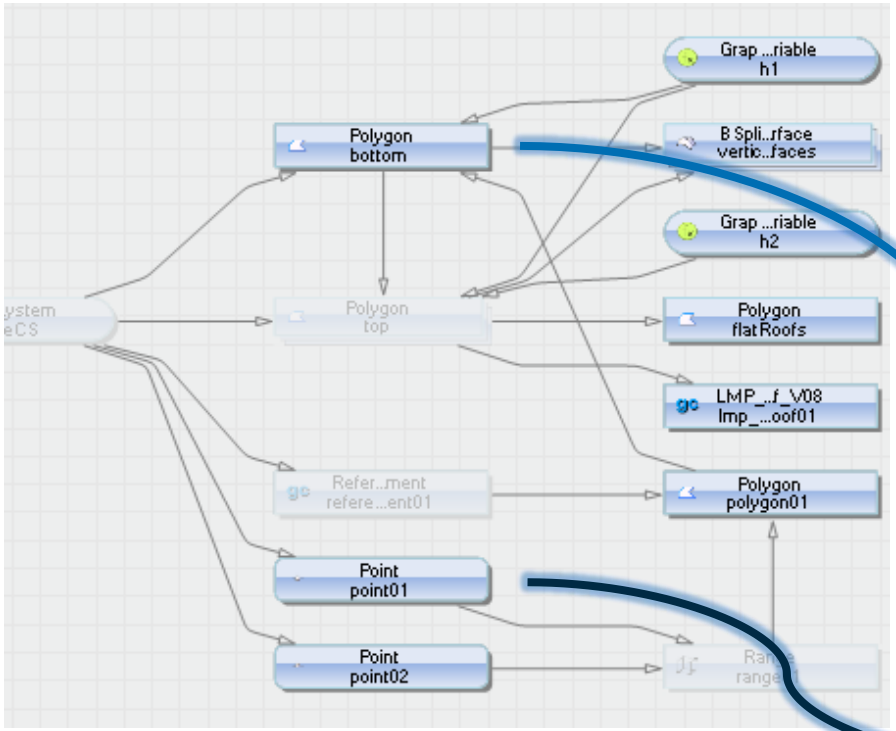
Bygningsnr	1
Kommunenr	461
Ejendomsnr	247490
Opfør_år	1913
Tagdækningsmateriale	Tegl
K_Tagdæk_mat	05
Samlet_tagetage	60
Bebyg_areal	96
Antal_etager	1

Parametric rule set definition

Object relations based on 1) generic rule sets, 2) Base Map or KMS' WFS and 3) Public Registers (BBR)



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Ejendomsnr	247490
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Ydervægsmateriale	Mursten (tegl, kalksands
Bygningsanvendelse	Fritliggende enfamilieshu
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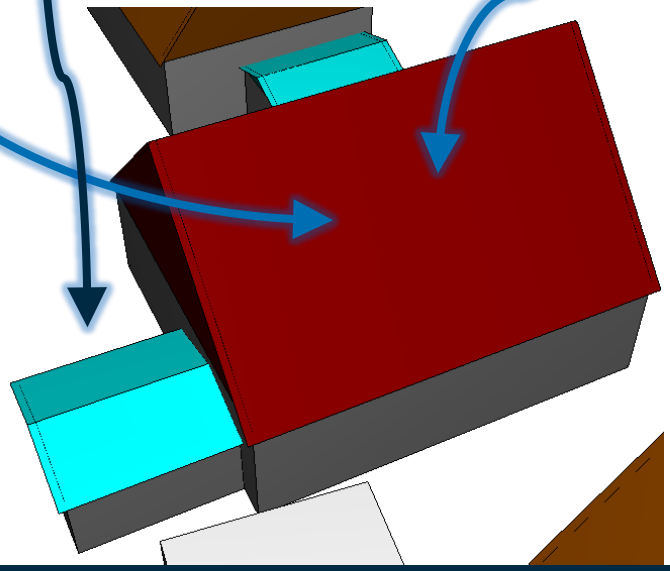

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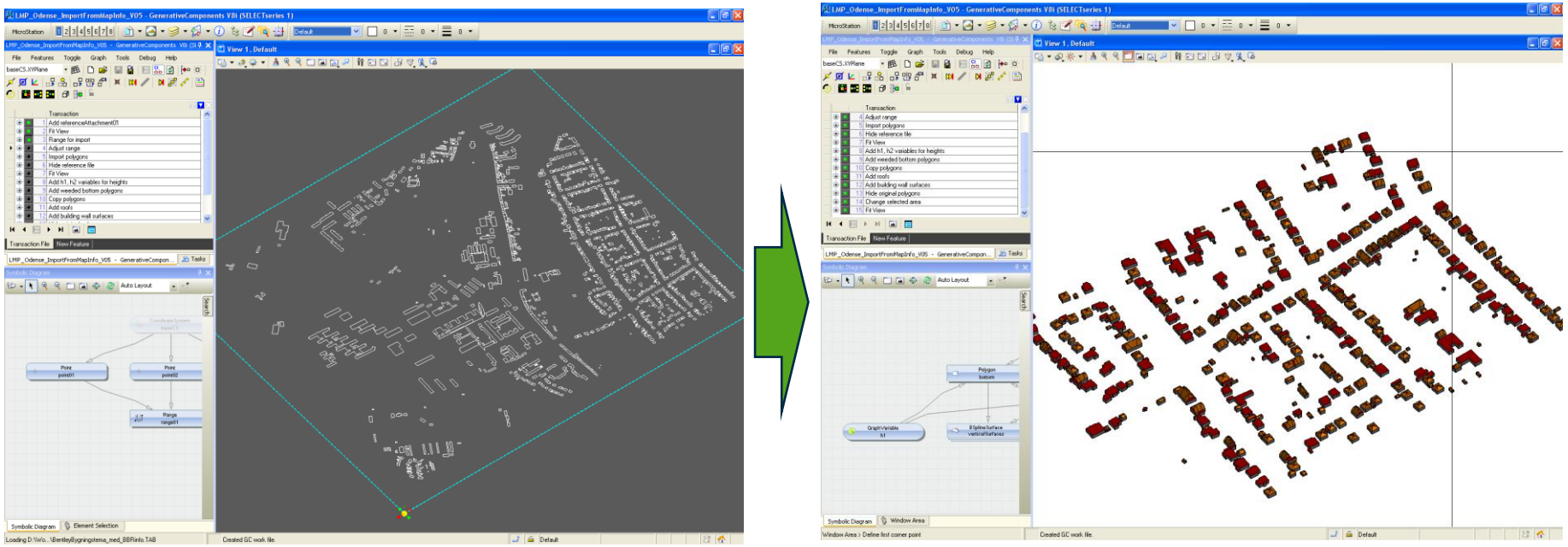
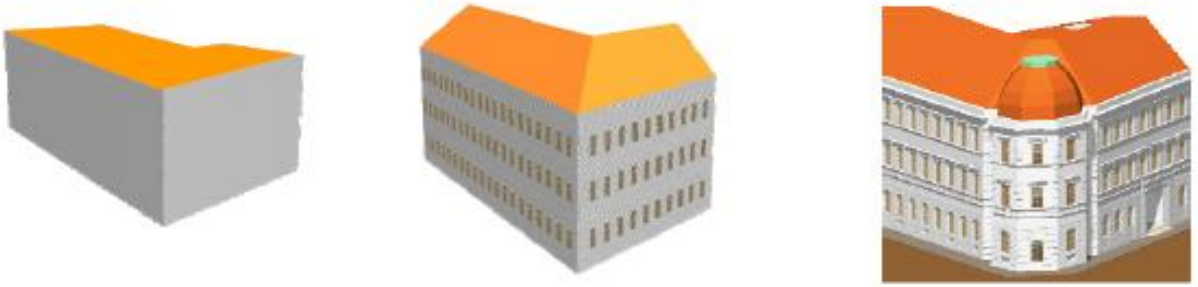
The Workflow for the end user…

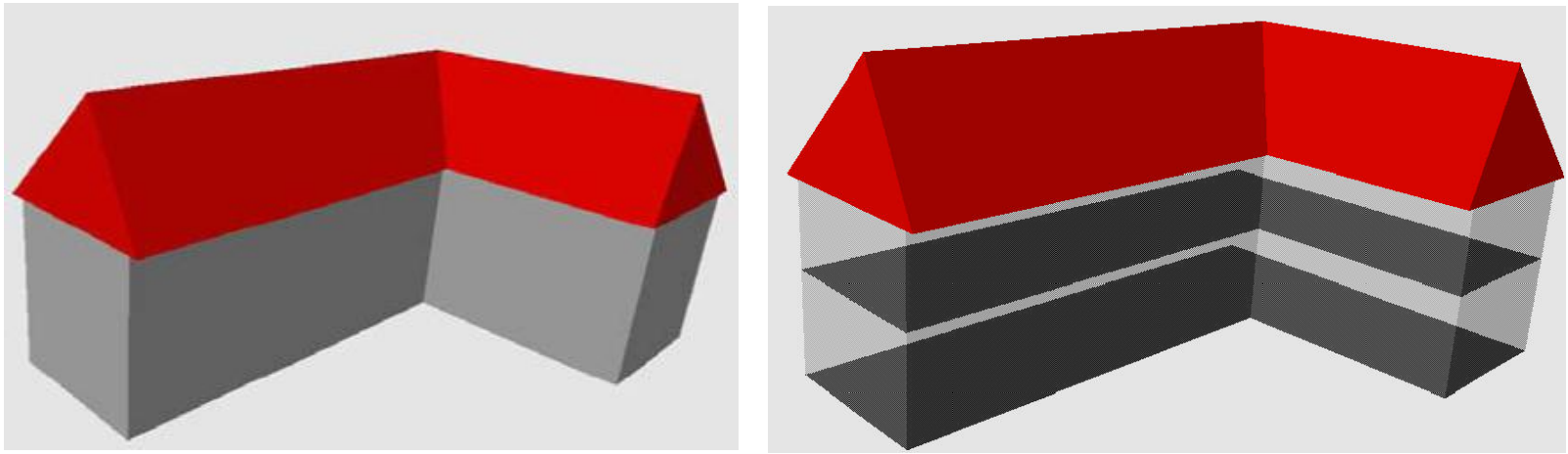
1. Open the predefined script file in GC
2. Choose the geographic area of interest (polygon)
3. Push the “go” button
4. … Live demo



Example of derived “standard” products

- 3D City & Urban Maps – many object variations, since it depends on the pre-defined rule sets, type of features and the semantic level of details

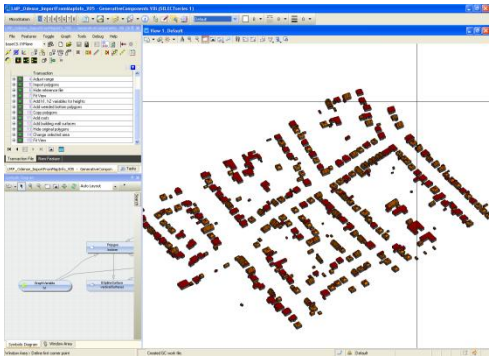


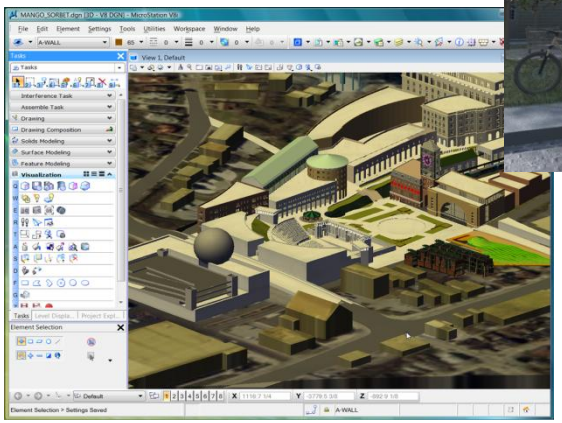


Example of derived “standard” products (2)

- Overlay Maps; Actuality and quality control with e.g. existing city models, point clouds, registers etc.
- Project Planning Maps; Urban planning issues
- 3. party applications:
  - Radio & mobile unit signal propagation maps; as input to Telecom, Railway service operators etc.
  - Noise propagation maps; as input e.g. SoundPLAN
  - Streaming of 3D objects to Web client; support of 3. party data models

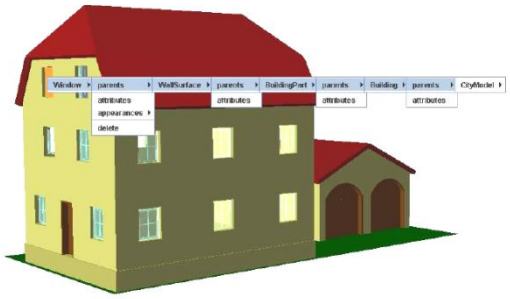
The continuous process…



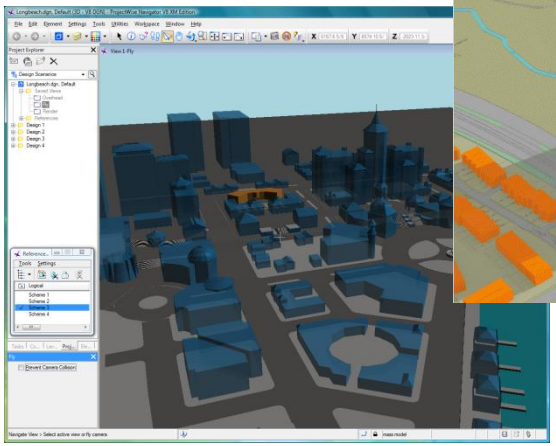


Interoperability, e.g. SketchUp, DWG

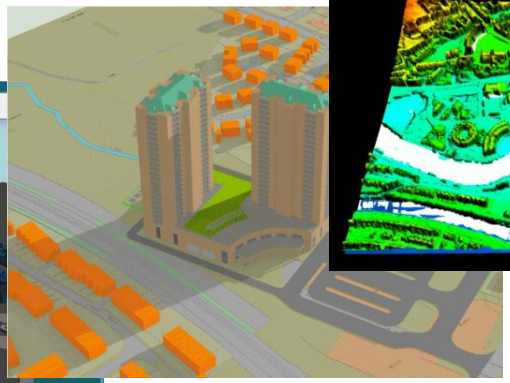
3D Warehouse integration &
Photo realistic rendering

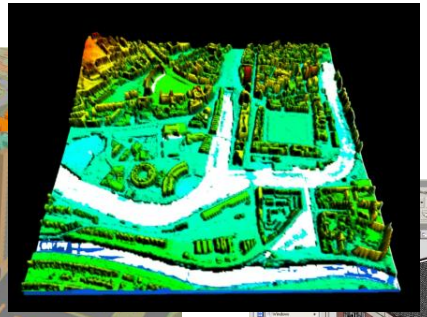


Object refinement

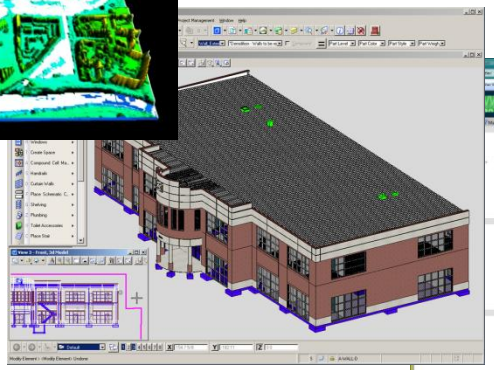


Data exploration

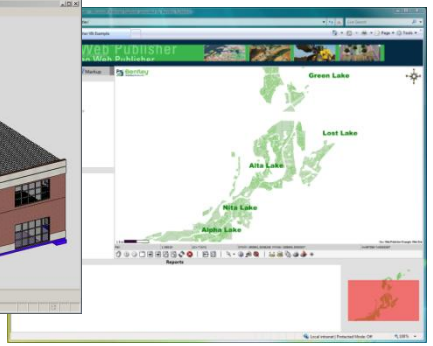




Studies
&
Analysis



BIM integration



Publishing

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Case Studies

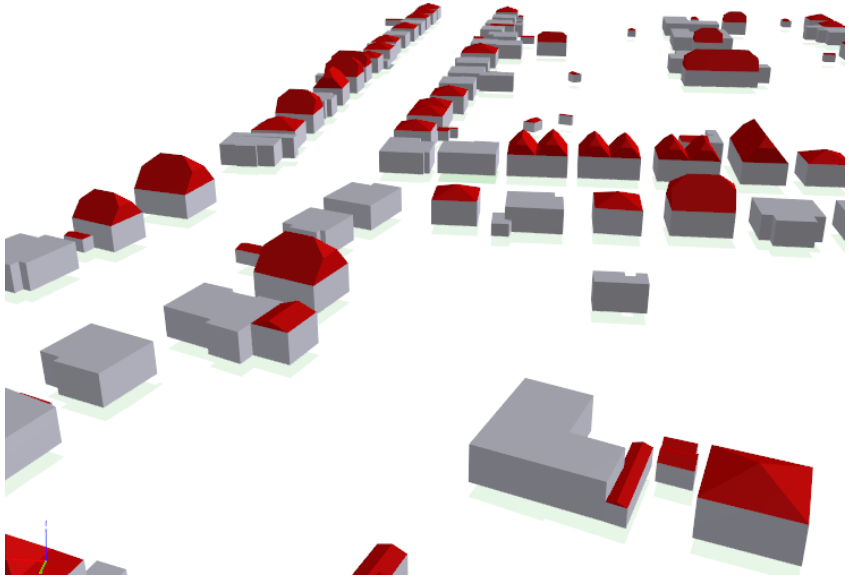
The common goals are for all…

- Point of reference are the end users/costumers
  - Keep the technical barrier as low as possible
- Use of existing data to extrude 3D objects
  - To minimize the organizations costs are very important
- The concept is to “visualize the database” and create simplified 3D City and Urban Objects/Maps
  - A dynamic and semantic rich 3D model
  - Opportunity for Level of Detail
  - Many features derived from the base map can be extruded, e.g. fences, lamp posts, technical installations, utility etc.
- It’s not an issue to generate a “beautiful” model

1) 3D City & Urban Maps – pilot project

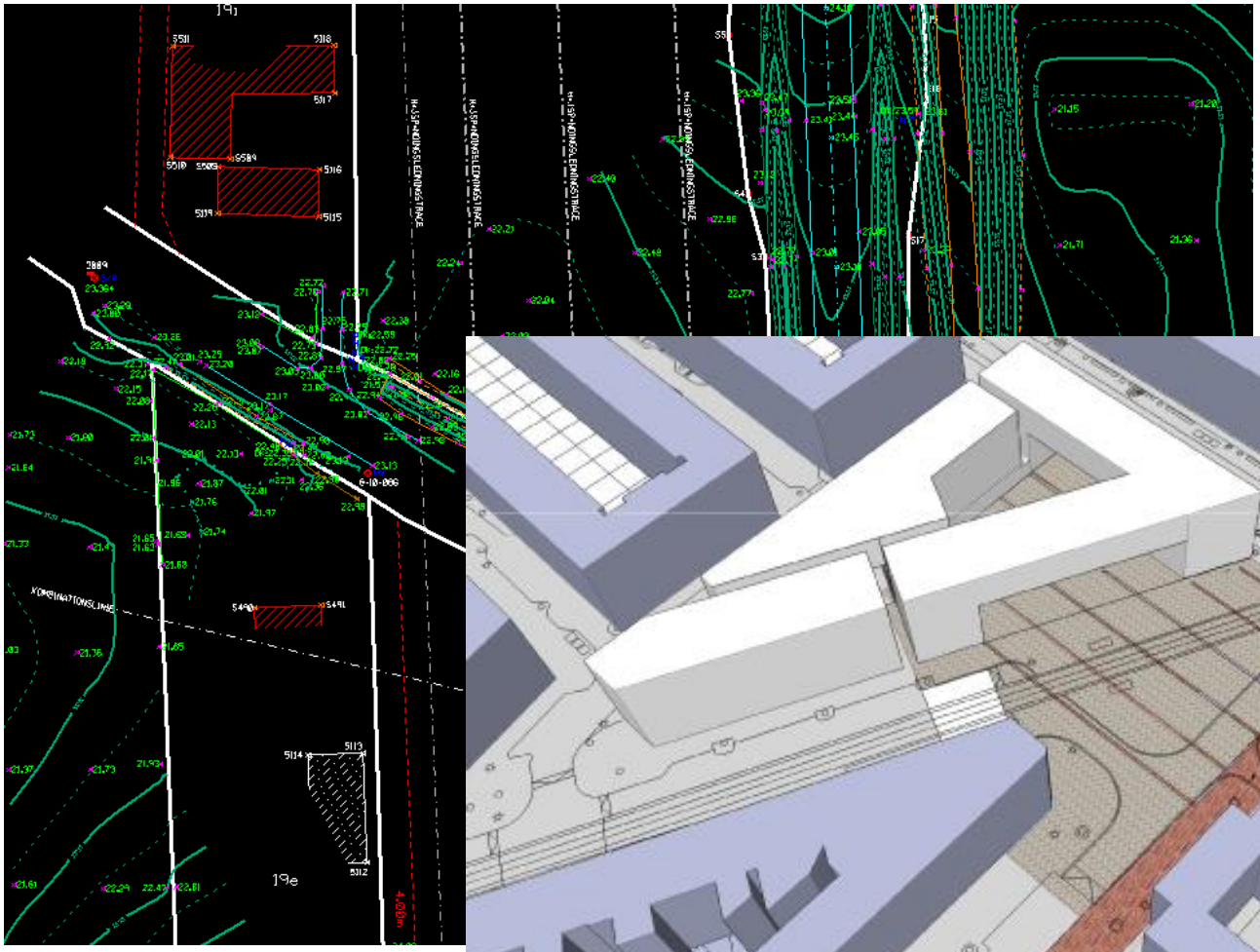
- The primary goals (Buildings):
  - Fully automatically create 3D building objects as block models
  - Roof material and shape of geometry define various roof types; Flat, with roof ridge and pyramid
  - Construction year and usage type reflects the roof angle and wall height
  - Material information to define the roof and wall colors
  - Garages etc = flat/black roof
  - The city model is dynamic

This is the first prototype result

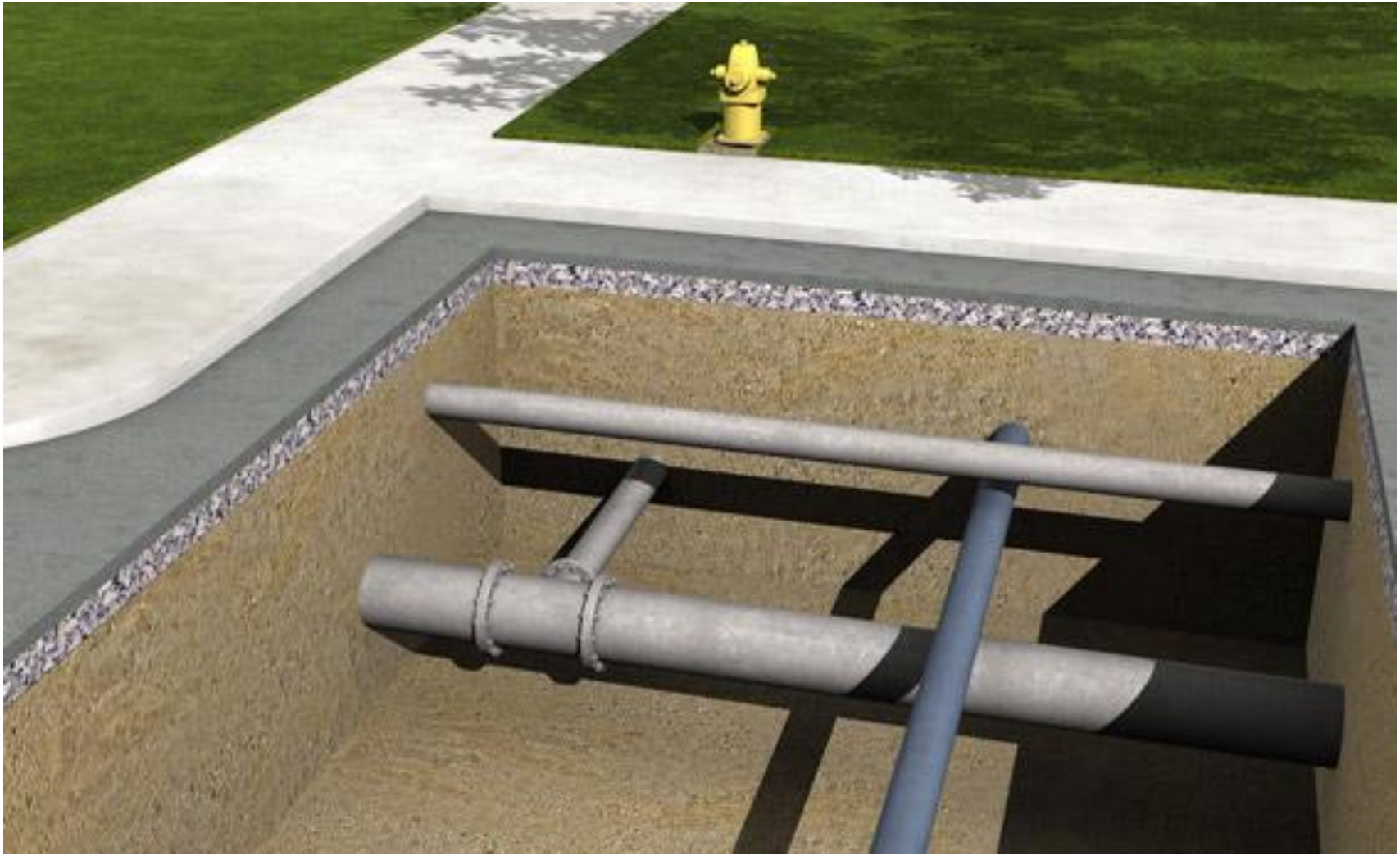


Geodata ©Odense kommune

2) Project Planning Maps – pilot project



3) Underground Maps – pilot project



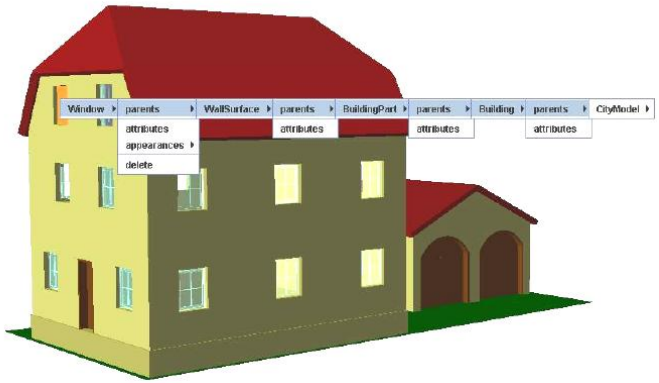
4) Value adding to existing 3D City models

- 3D Warehouse and library integration…

The future focus areas

Focus areas related to marked requirements
Next achievements

- Terrain model
  - Footprint and roads embedded as break lines – automatically!
  - Adaptive filtering and smoothing of the terrain surface – automatically!
- Building objects
  - Placement on terrain model (correct Z-value), Level of detail, Level of semantic richness etc.
- Other urban features/objects
  - Vegetation, Lamp posts, Fences etc.



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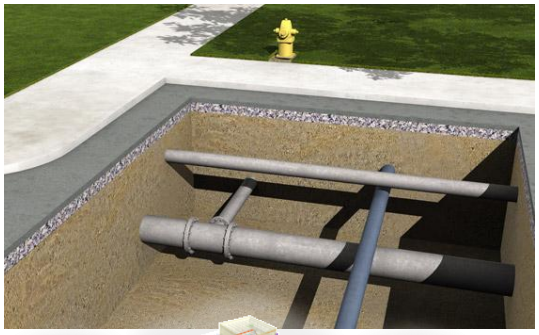
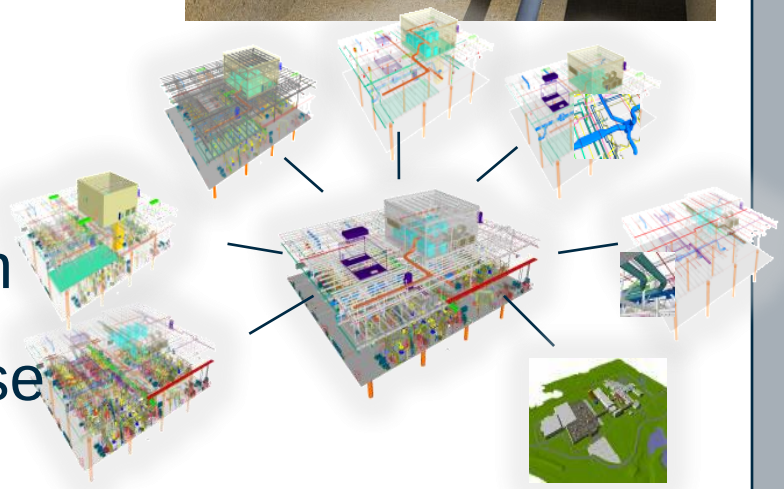
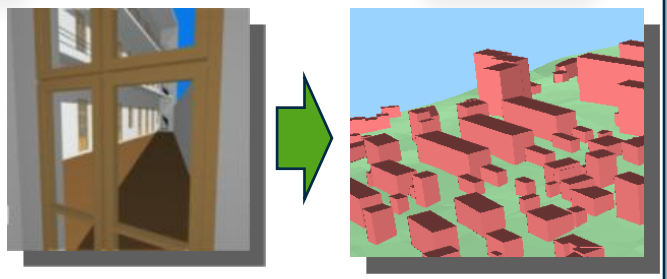
Focus areas related to marked requirements
Next achievements

- Underground features/objects
  - Water, Sewer, District heating, Gas, Power cables etc.
- Building Information Models (BIM) integration
- BIM generalization/simplification
- Object refinement and QA by use of other data types and public registers
  - LiDAR point clouds, oblique imagery, photogrammetry, data registers etc.







Summary

3D Modeling with Bentley – Sum-up

- Based on the same platform -> MicroStation/GC
- Bentley users can go…:
  - From Images to 3D Objects
  - From Point Cloud to 3D Objects
  - From Data Models to 3D Objects
  - From Land Surveying Measurement to 3D Objects
  - From disparate available data to 3D Objects

-> Seamless workflow

-> Tight integration between platform and applications

-> Quality Control

The SWOT analyse

- Strengths
  - Easy to perform the modeling task – “one button click”
  - No specialized skills needed for the end-user
  - A semantic very rich model – inherit semantic data from original GIS Systems, DB’s…
  - Not only building objects – in principle can all map/DB features be generated and visualized
  - Dynamic model – can be updated on-the-fly from the 2D Base Map, attribute schemas…
  - Various map products can be generated from the orig. base data
  - Very fast “processing” – from few minutes
- Weaknesses
  - A very new concept
  - Will not represent the reality 100% - based on assumptions
  - The data quality will have a direct impact of the modeling result

BE an active part of the “3D City and Urban Modeling” Community – it will benefit us all!

COMMUNITIES | MEMBERS | FORUMS | WIKI | BLOGS | RESOURCES | Go To BENTLEY.COM

3D City & Urban Modeling

The "3D City & Urban Modeling Community" is a place on Be Communities for discussion and sharing ideas - for creating value adding processes and optimized workflows for 3D City & Urban Models users and stakeholders.

Today, many municipalities across Europe have purchased urban 3D models for mainly engaging local citizens in planning decisions or for marketing purposes. These models have, however, been generated as an one-off investment and represents typical a 3D standalone model, without any dynamic approach or semantic contents. Also, the typical update frequence is low, which means the 3D City models becomes no longer of any interest quite rapidly.

The real interesting part is the possibility to integrate different type of data; to generate a dynamic real-time and semantic rich 3D model, which can be used for other cases than just "fancy" visualizations. An example is the capability to reuse already existing GIS data, public registers, Building Information Models (BIM) and 3D Warehouses; to generate and publish a much more rich and intelligent and object based 3D model. Another example is to combine the generated 3D objects with classified LiDAR point clouds for quality check or building refinement to obtain a higher level of geometric details, and so forth...

We will soon, during Q1 2010, post different items at the blog and forums based on various Pilot Projects we have kick started in mainly Denmark and Finland. The main topics so far are: a) Parametric City Modeling; various 3D City & Urban Maps, b) BIM simplification and integration towards existing 3D City models, c) updating of building footprint to the GIS base map by use of generalized BIM models, d) "feeding" of automatically generated 3D objects by supporting 3. party data model for 3D data streaming to standard web browser... Several of these action points are going to be done in collaboration with local Technology Partners.

Please, contribute also with your work, ideas, suggestions etc. at the related forums and blogs - it is more than welcome. Thank you!

If you have not previously joined this community, you need to click the 'Join 3D City & Urban Modeling' button below to view this community's forum, blog, and image and file areas.

You must also be a member of Be Communities

TAGS

Geospatial and GIS, Microstation, BIM, GenerativeComponents, ProjectWise Navigator, 3D Modeling, Bentley Map, bentley architecture, BIM Modeling, Surveying, OGC, IFC, PowerCivil, Web GIS, municipalities, Bentley Geo Web Solutions, Bentley Geospatial Server, buildings, government, Parametric Modeling, 3D City, Building vectorization, LiDAR, WFS, Point Clouds, 3D GIS, CityGML, Digital Terrain Model, DTM, DSM, Streaming, architects

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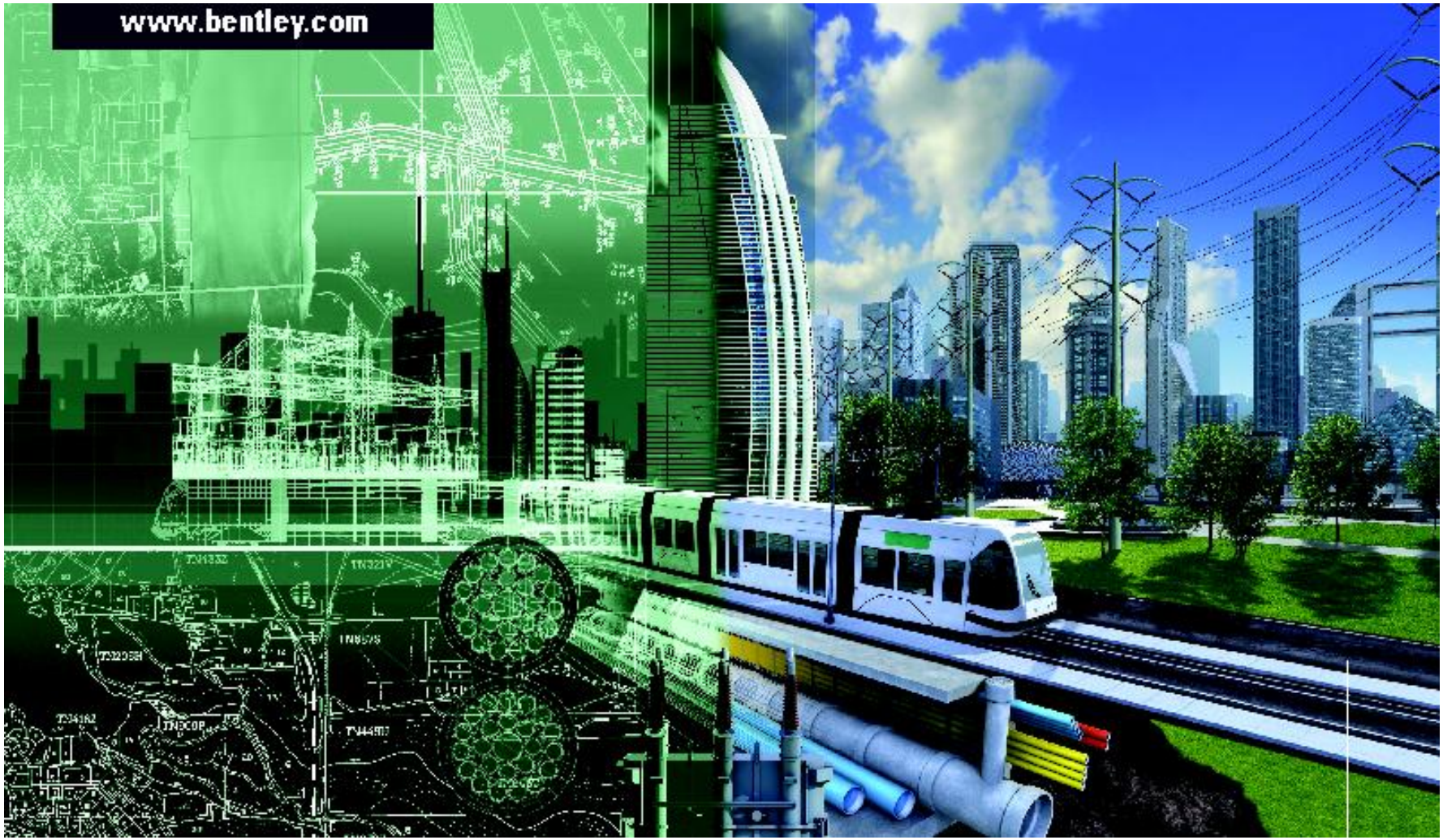

Thank you