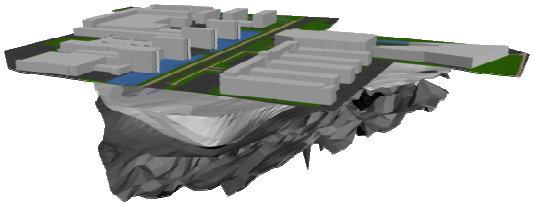
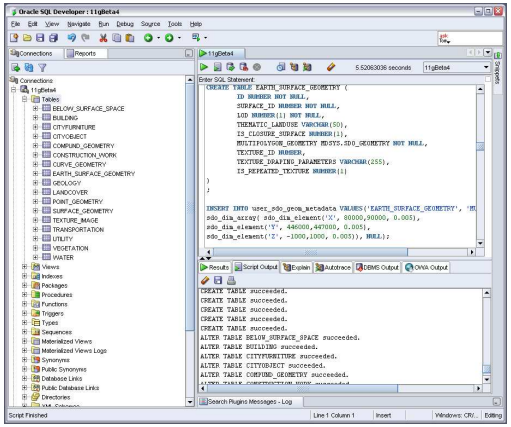
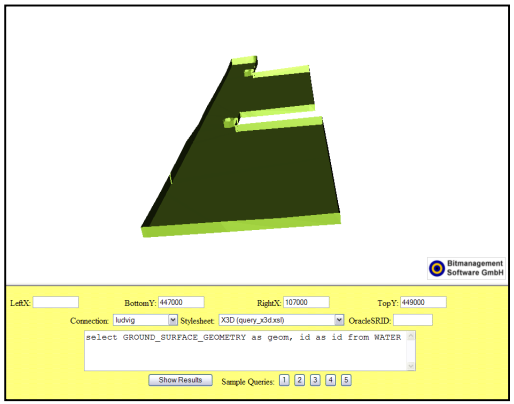
Integrated 3D Information model (3DIM)

Database load and retreival







Ludvig Emgård

2007-12-11

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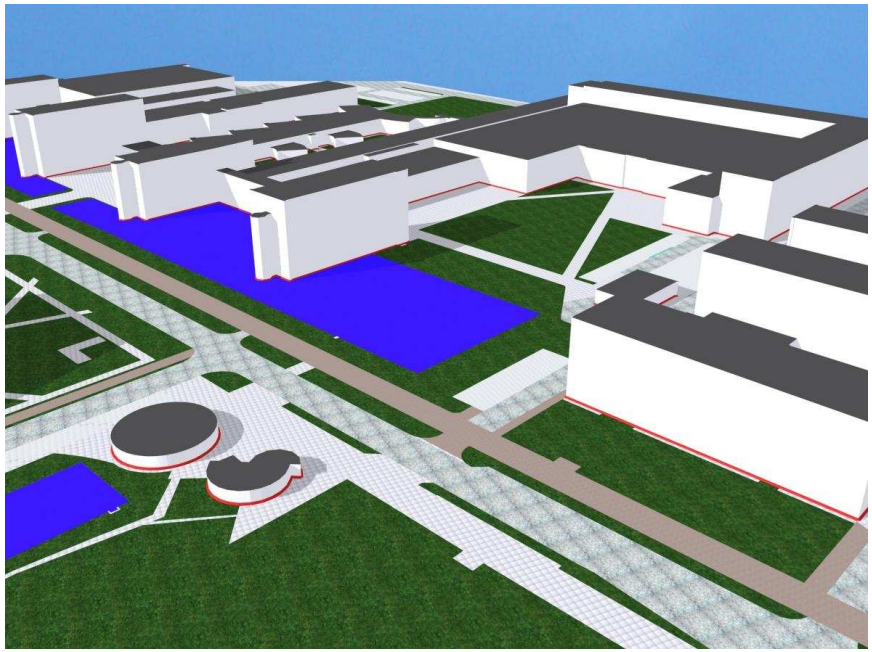
Delft University of Technology

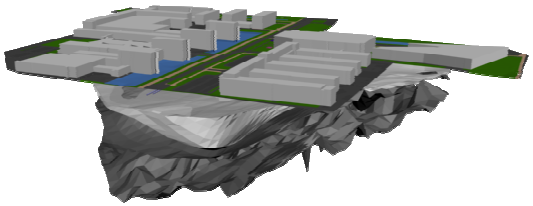
3DIM development - initial iteration 2007

1. Studies of existing models CityGML + subsurface information models
2. Conceptual modelling (UML) top-level objects of 3DIM
3. Database implementation (UML)
4. Collection and preparation of test data (TU Delft Campus)
5. FME Data processing to reach 3DIM structure on test data
6. Database import of test data (to Oracle Spatial)
7. Verification and retrieval in CityGML (without subsurface features)

Two implementation alternatives compared

Input data





Polygons

- Buildings
- Classified earth surface parts
- Below surface space
- Construcion work
- Water Body
- Geology

Lines

- Utilities
- Vegetation
- Cityfurniture

Points

- Vegetation
- City Furniture

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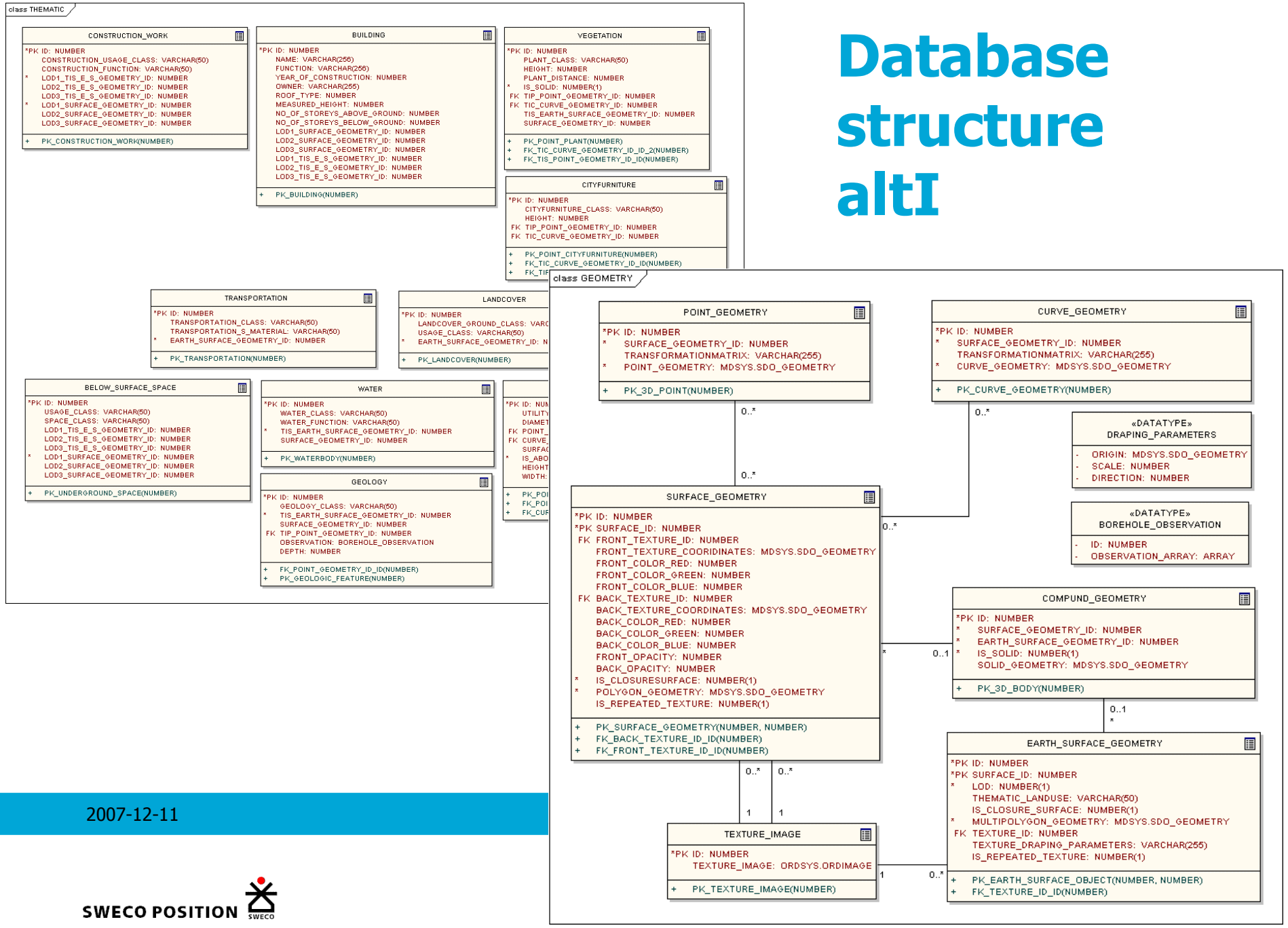
Database structure altI



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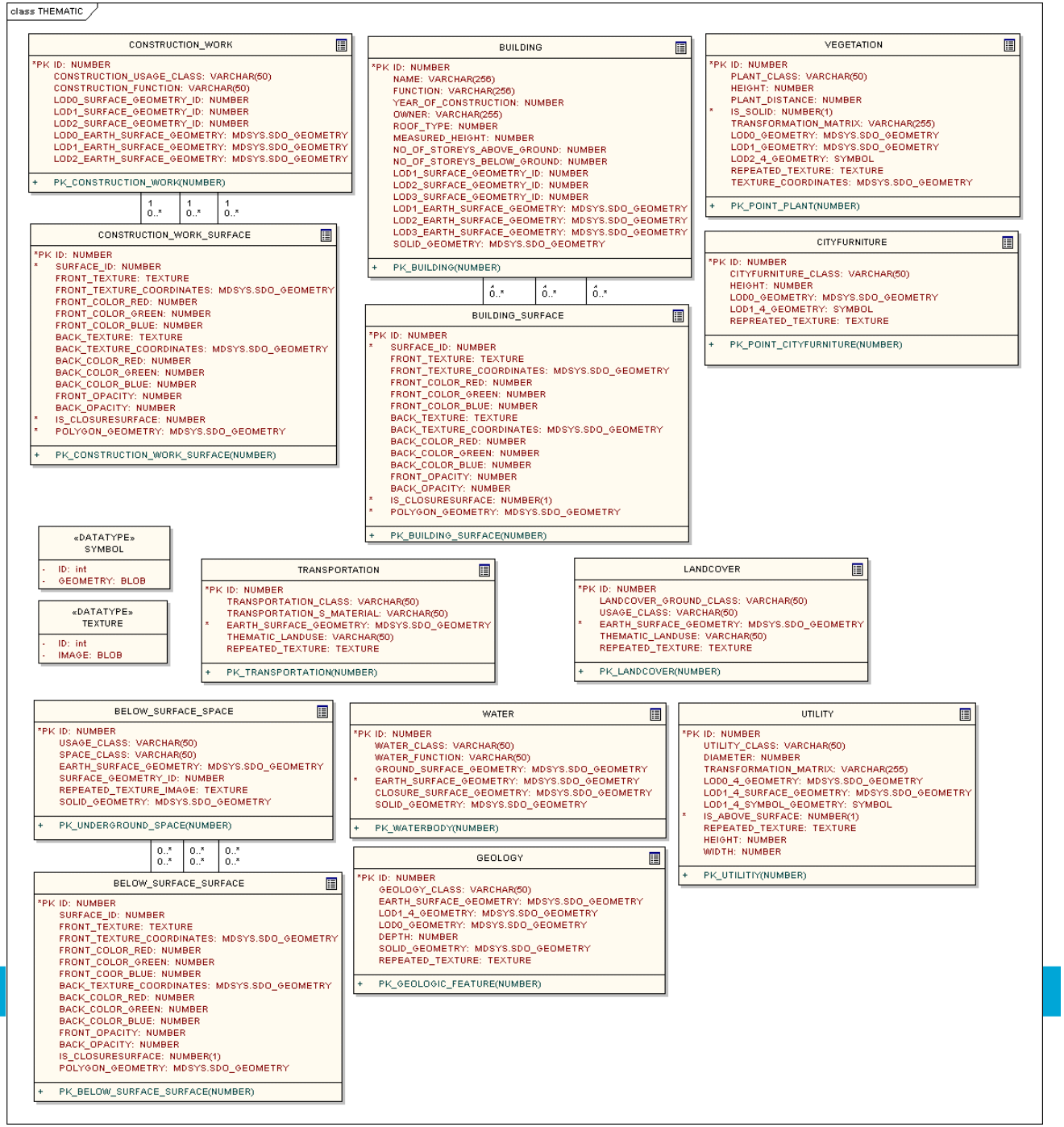
Database structure Alt II



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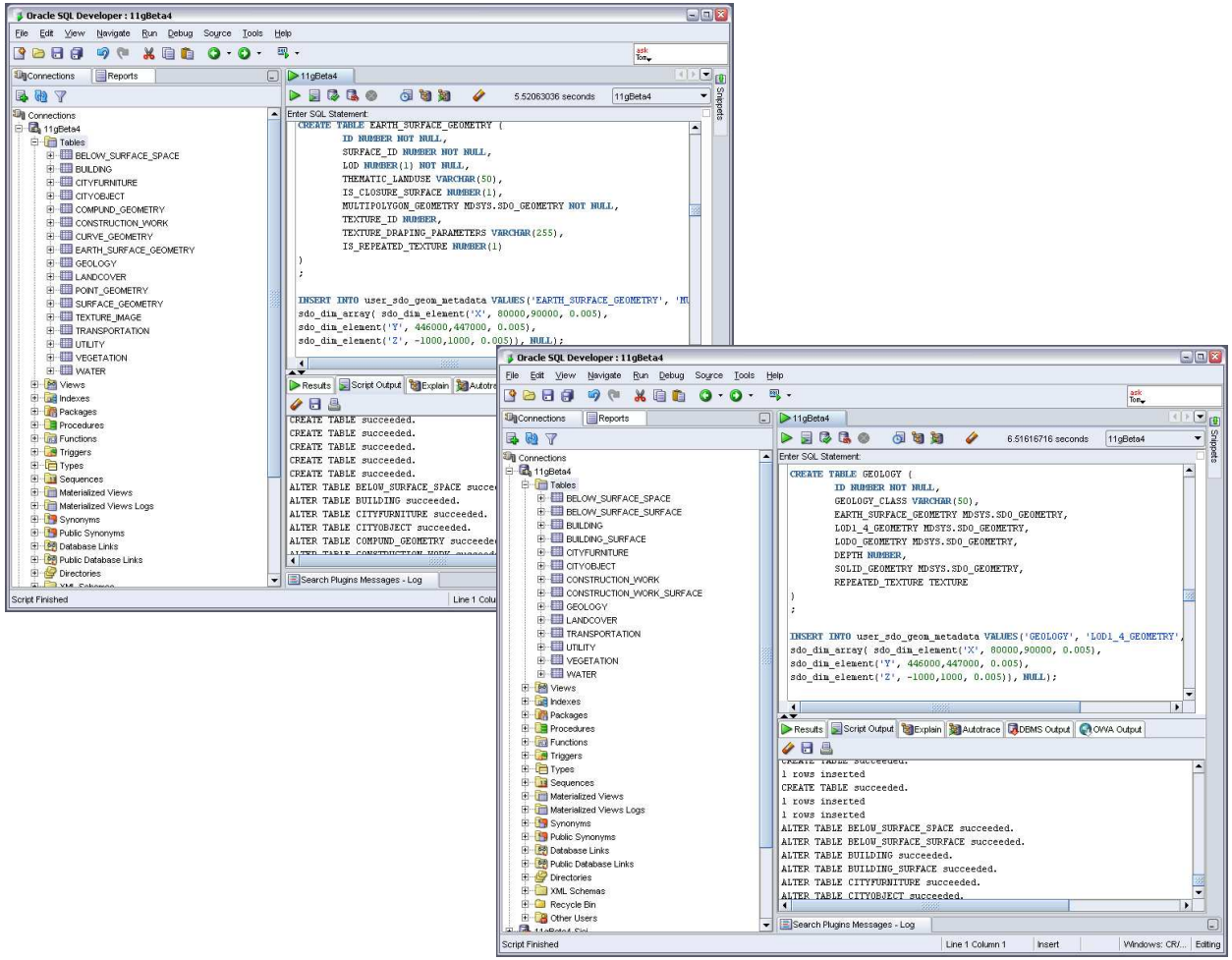
Structures implemented in Oracle Spatial



Imported from Enterprise architect

- Tables
- Keys
- Constraints

Manually modelled

User defined data types

- texture type
- image type

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Division into loading processes

Multiple access to geometry tables

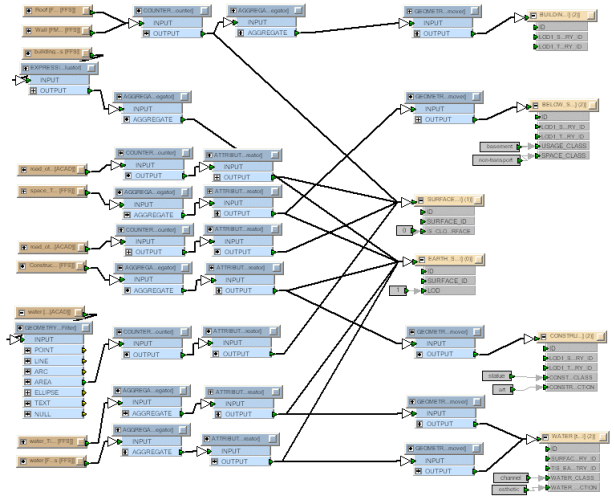
Alt I

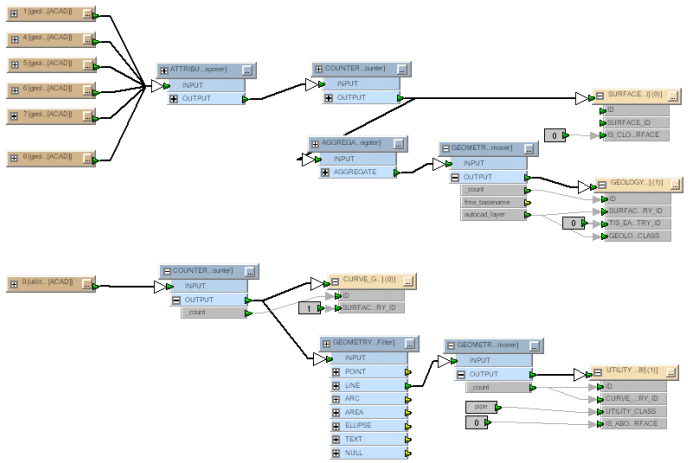
AltI - DATABASE_FILL_ABOVE_BELOW.fmw	Buildings BelowSurfaceSpace Water ConstructionWork
AltI - DATABASE_FILL_EARTH_SURFACE.fmw	Transportation Landcover
AltI - DATABASE_FILL_GEO&UTIL.fmw	Geology Utility
AltI - DATABASE_FILL_TIC&TIP.fmw	Vegetation CityFurniture

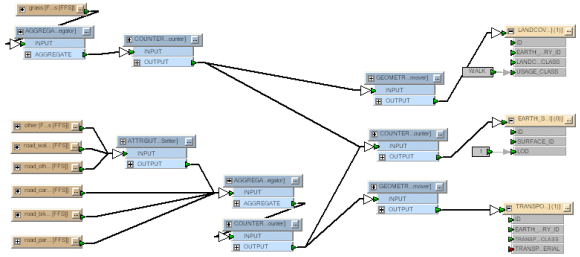
Alt II

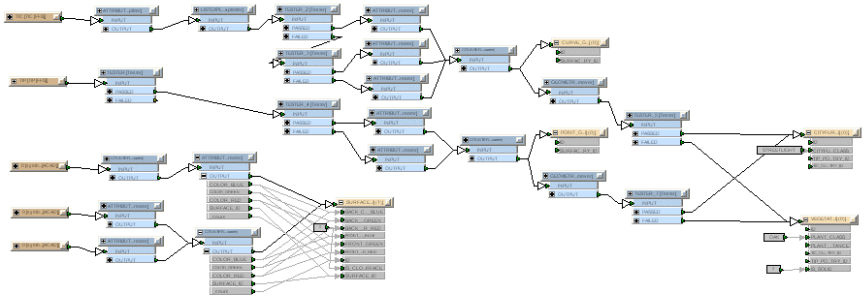
AltII - DATABASE_FILL_ABOVE_BELOW.fmw	Buildings BelowSurfaceSpace Water ConstructionWork
AltII - DATABASE_FILL_ABOVE_BELOW_WATER.fmw	Water
AltII - DATABASE_FILL_EARTH_SURFACE.fmw	Transportation Landcover
AltII - DATABASE_FILL_GEO&UTIL.fmw	Geology Utility
AltII - DATABASE_FILL_TIC&TIP.fmw	Vegetation CityFurniture

Scripts Alt I (18 outputs)









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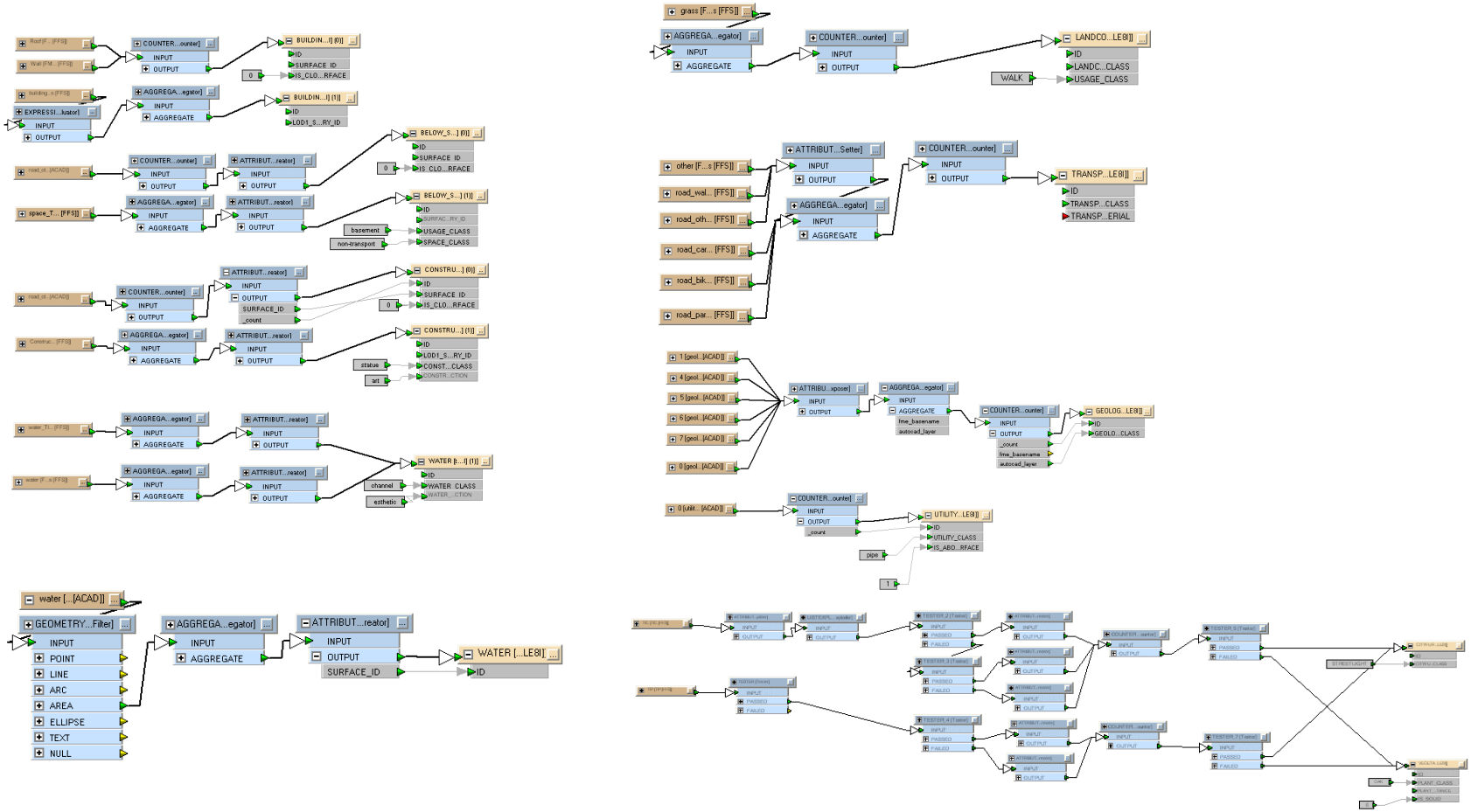
Scripts Alt II (less complex 14 outputs)



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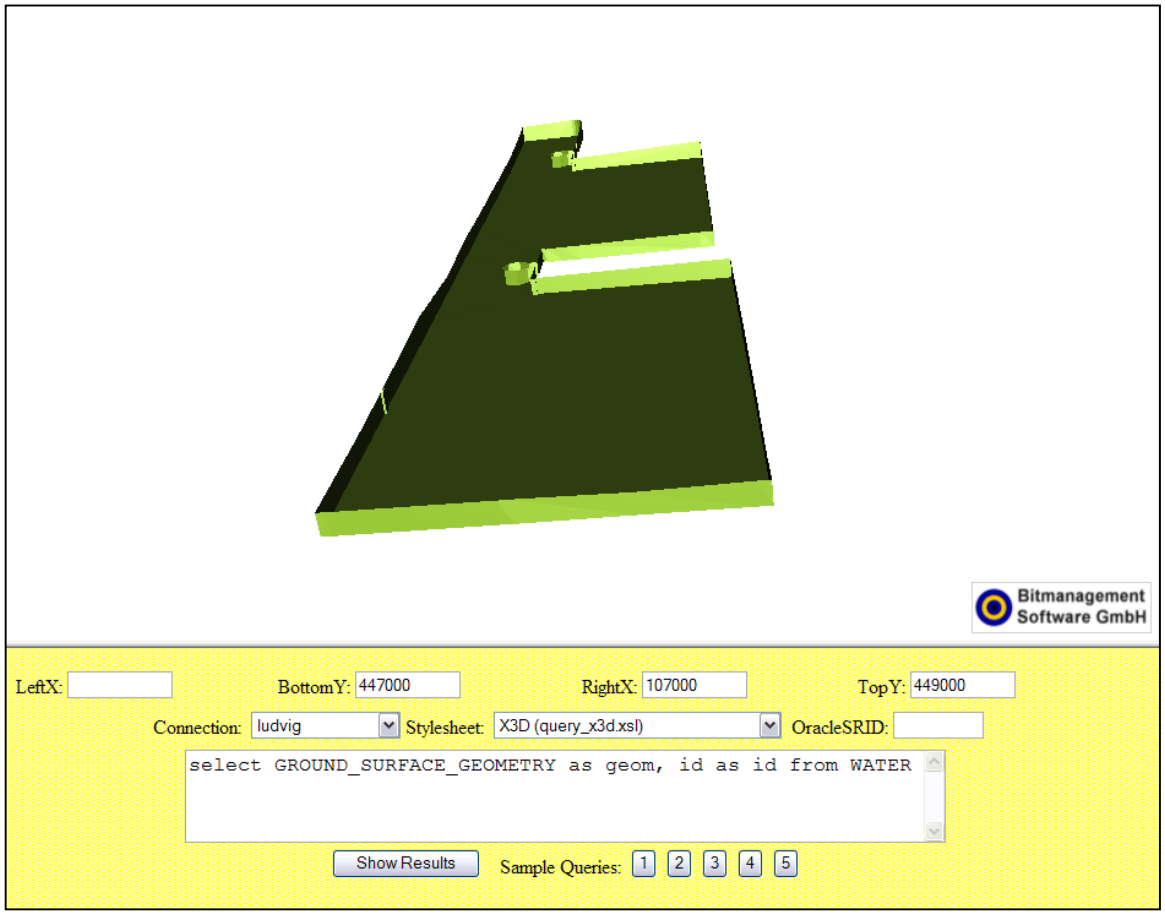
Verification



Java servlet from Marian de Vries:

Oracle >GML >XSLT >X3D

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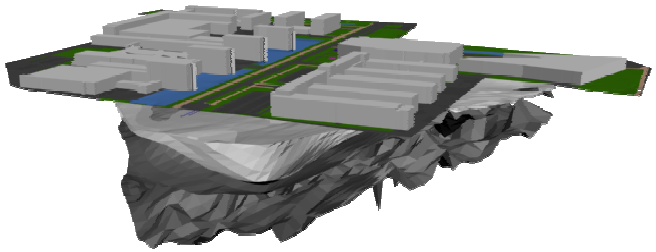
Choosen objects in CityGML output

CityObjectsMembers in CityGML that could be exported from the 3DIM example scene (no subsurface)

- TINRelief
- Building
- PlantCover
- CityFurniture
- SolitaryVegetationObject
- TrafficArea
- WaterBody



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SQL Views: Mapping from Database to CityGML

Example views alt I

```
create or replace view VIEW_BUILDING_LOD1 as (
SELECT a.ID, a.NAME, b.GEOM AS LOD_1_SURFACE_GEOMETRY,
c.MULTIPOLYGON_GEOMETRY AS LOD_1_EARTH_SURFACE_GEOMETRY
FROM BUILDING a, VIEW_BUILDING_AGGRE_SURFACE b,
EARTH_SURFACE_GEOMETRY c
WHERE a.LOD1_TIS_E_S_GEOMETRY_ID = c.SURFACE_ID AND
a.LOD1_SURFACE_GEOMETRY_ID = b.SURFACE_ID
);

create or replace view VIEW_BUILDING_AGGRE_SURFACE as (
SELECT SURFACE_ID as SURFACE_ID, SDO_AGGR_UNION(
SDOAGGRTYPE(d.POLYGON_GEOMETRY, 0.005)) AS GEOM
FROM SURFACE_GEOMETRY d
WHERE SURFACE_ID IN (SELECT LOD1_SURFACE_GEOMETRY_ID FROM
BUILDING)
GROUP BY SURFACE_ID
);
```

Example views alt II

```
create or replace view view_solitary_vegetation as (
SELECT * FROM VEGETATION c WHERE c.LOD0_GEOMETRY.Get_GType()
='1');

create or replace view view_point_city_furniture as (
SELECT * FROM CITYFURNITURE c WHERE c.LOD0_GEOMETRY.Get_GType()
='1');
```

GO Publisher database-xml mapping

Name	Enabled	DB type or const value	XML path	Type in XML
Database	☑		gml:FeatureCollection	gml:FeatureCollectionType
EARTH_SURFACE_GEOMETRY	☑	*Table*	cityObjectMember/TINRelief	TINReliefType
ID	☑	NUMBER	@gml:id	xs:ID
SURFACE_ID	☐	NUMBER		
LOD	☐	NUMBER		
THEMATIC_LANDUSE	☐	VARCHAR2		
IS_CLOSURE_SURFACE	☐	NUMBER		
MULTIPOLYGON_GEOMETRY	☑	SDO_GEOMETRY	tin/gml:TriangulatedSurface	gml:TriangulatedSurfaceType
TEXTURE_ID	☐	NUMBER		
TEXTURE_DRAPING_PARAMETERS	☐	VARCHAR2		
IS_REPEATED_TEXTURE	☐	NUMBER		
VIEW_BUILDING_LOD1	☑	*Table*	cityObjectMember/Building	BuildingType
ID	☑	NUMBER	@gml:id	xs:ID
NAME	☐	VARCHAR2		
LOD_1_SURFACE_GEOMETRY	☐	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
LOD_1_EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
VIEW_LANDCOVER	☑	*Table*	cityObjectMember/PlantCover	PlantCoverType
ID	☑	NUMBER	@gml:id	xs:ID
LANDCOVER_GROUND_CLASS	☑	VARCHAR2	class	PlantCoverClassType
USAGE_CLASS	☑	VARCHAR2	function	PlantCoverFunctionType
MULTIPOLYGON_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
VIEW_POINT_CITY_FURNITURE	☑	*Table*	cityObjectMember/CityFurniture	CityFurnitureType
ID	☑	NUMBER	@gml:id	xs:ID
CITYFURNITURE_CLASS	☑	VARCHAR2	class	CityFurnitureClassType
TIP_POINT_GEOMETRY_ID	☐	NUMBER		
POINT_GEOMETRY	☑	SDO_GEOMETRY	lod1Geometry/gml:Point	gml:PointType
VIEW_POINT_VEGETATION	☑	*Table*	cityObjectMember/SolitaryVegetationObject	SolitaryVegetationObjectType
ID	☑	NUMBER	@gml:id	xs:ID
PLANT_CLASS	☑	VARCHAR2	class	PlantClassType
TIP_POINT_GEOMETRY_ID	☐	NUMBER		
POINT_GEOMETRY	☑	SDO_GEOMETRY	lod1Geometry/gml:Point	gml:PointType
VIEW_TRANSPORTATION	☑	*Table*	cityObjectMember/TrafficArea	TrafficAreaType
ID	☑	NUMBER	@gml:id	xs:ID
TRANSPORTATION_CLASS	☑	VARCHAR2	function	TrafficAreaFunctionType
TRANSPORTATION_S_MATERIAL	☐	VARCHAR2		
MULTIPOLYGON_GEOMETRY	☑	SDO_GEOMETRY	lod2MultiSurface	gml:MultiSurfacePropertyType
VIEW_WATER	☑	*Table*	cityObjectMember/WaterBody	WaterBodyType
ID	☑	NUMBER	@gml:id	xs:ID
WATER_CLASS	☑	VARCHAR2	class	WaterBodyClassType
WATER_FUNCTION	☑	VARCHAR2	function	WaterBodyFunctionType
WATER_GROUND_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
WATER_EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType

Database	☑		gml:FeatureCollection	gml:FeatureCollectionType
LANDCOVER	☑	*Table*	cityObjectMember/PlantCover	PlantCoverType
ID	☑	NUMBER	@gml:id	xs:ID
LANDCOVER_GROUND_CLASS	☑	VARCHAR2	class	PlantCoverClassType
USAGE_CLASS	☑	VARCHAR2	function	PlantCoverFunctionType
EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	gml:priorityLocation/gml:TriangulatedSurface	gml:TriangulatedSurfaceType
THEMATIC_LANDUSE	☐	VARCHAR2		
REPEATED_TEXTURE	☐	TEXTURE		
TRANSPORTATION	☑	*Table*	cityObjectMember/TrafficArea	TrafficAreaType
ID	☑	NUMBER	@gml:id	xs:ID
TRANSPORTATION_CLASS	☑	VARCHAR2	function	TrafficAreaFunctionType
TRANSPORTATION_S_MATERIAL	☐	VARCHAR2		
EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	gml:location/gml:TriangulatedSurface	gml:TriangulatedSurfaceType
THEMATIC_LANDUSE	☐	VARCHAR2		
REPEATED_TEXTURE	☐	TEXTURE		
WATER	☑	*Table*	cityObjectMember/WaterBody	WaterBodyType
ID	☑	NUMBER	@gml:id	xs:ID
WATER_CLASS	☑	VARCHAR2	class	WaterBodyClassType
WATER_FUNCTION	☑	VARCHAR2	function	WaterBodyFunctionType
GROUND_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
CLOSURE_SURFACE_GEOMETRY	☐	SDO_GEOMETRY		
SOLID_GEOMETRY	☐	SDO_GEOMETRY		
VIEW_SOLITARY_VEGETATION	☑	*Table*	cityObjectMember/SolitaryVegetationObject	SolitaryVegetationObjectType
ID	☑	NUMBER	@gml:id	xs:ID
PLANT_CLASS	☑	VARCHAR2	class	PlantClassType
HEIGHT	☐	NUMBER		
PLANT_DISTANCE	☐	NUMBER		
IS_SOLID	☐	NUMBER		
TRANSFORMATION_MATRIX	☐	VARCHAR2		
LOD0_GEOMETRY	☑	SDO_GEOMETRY	gml:location/gml:Point	gml:PointType
LOD1_GEOMETRY	☐	SDO_GEOMETRY		
LOD2_4_GEOMETRY	☐	SYMBOL		
REPEATED_TEXTURE	☐	TEXTURE		
TEXTURE_COORDINATES	☐	SDO_GEOMETRY		
VIEW_POINT_CITY_FURNITURE	☑	*Table*	cityObjectMember/CityFurniture	CityFurnitureType
ID	☑	NUMBER	@gml:id	xs:ID
CITYFURNITURE_CLASS	☑	VARCHAR2	class	CityFurnitureClassType
HEIGHT	☐	NUMBER		
LOD0_GEOMETRY	☑	SDO_GEOMETRY	gml:location/gml:Point	gml:PointType
LOD1_4_GEOMETRY	☐	SYMBOL		
REPREATED_TEXTURE	☐	TEXTURE		
VIEW_BUILDING_LOD1	☑	*Table*	cityObjectMember/Building	BuildingType
ID	☑	NUMBER	@gml:id	xs:ID
NAME	☐	VARCHAR2		
FUNCTION	☐	VARCHAR2		
YEAR_OF_CONSTRUCTION	☐	NUMBER		
OWNER	☐	VARCHAR2		
MEASURED_HEIGHT	☐	NUMBER		
LOD1_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
LOD1_EARTH_SURFACE_GEOMETRY	☑	SDO_GEOMETRY	lod1MultiSurface	gml:MultiSurfacePropertyType
VIEW_TIN	☑	*Table*	cityObjectMember/TINRelief	TINReliefType
THEID	☑	NUMBER	@gml:id	xs:ID
CLASS	☐	VARCHAR2		
GEOM	☑	SDO_GEOMETRY	tin/gml:TriangulatedSurface	gml:TriangulatedSurfaceType

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Conclusion

Comparision results

- More complex to load data into Alt I – constraints > geometry first. Also more destination datasets
- More complex to retreive data into CityGML using views in Alt I

Conclusion

- None of the alternatives have a strong advantage
- All geometry in the same table not an advantage for e.g. buildings but for earth surface
- A combination of Alt I and Alt II could be the solution