

CityGML 3D City Database Suite in a nutshell

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3D City Database

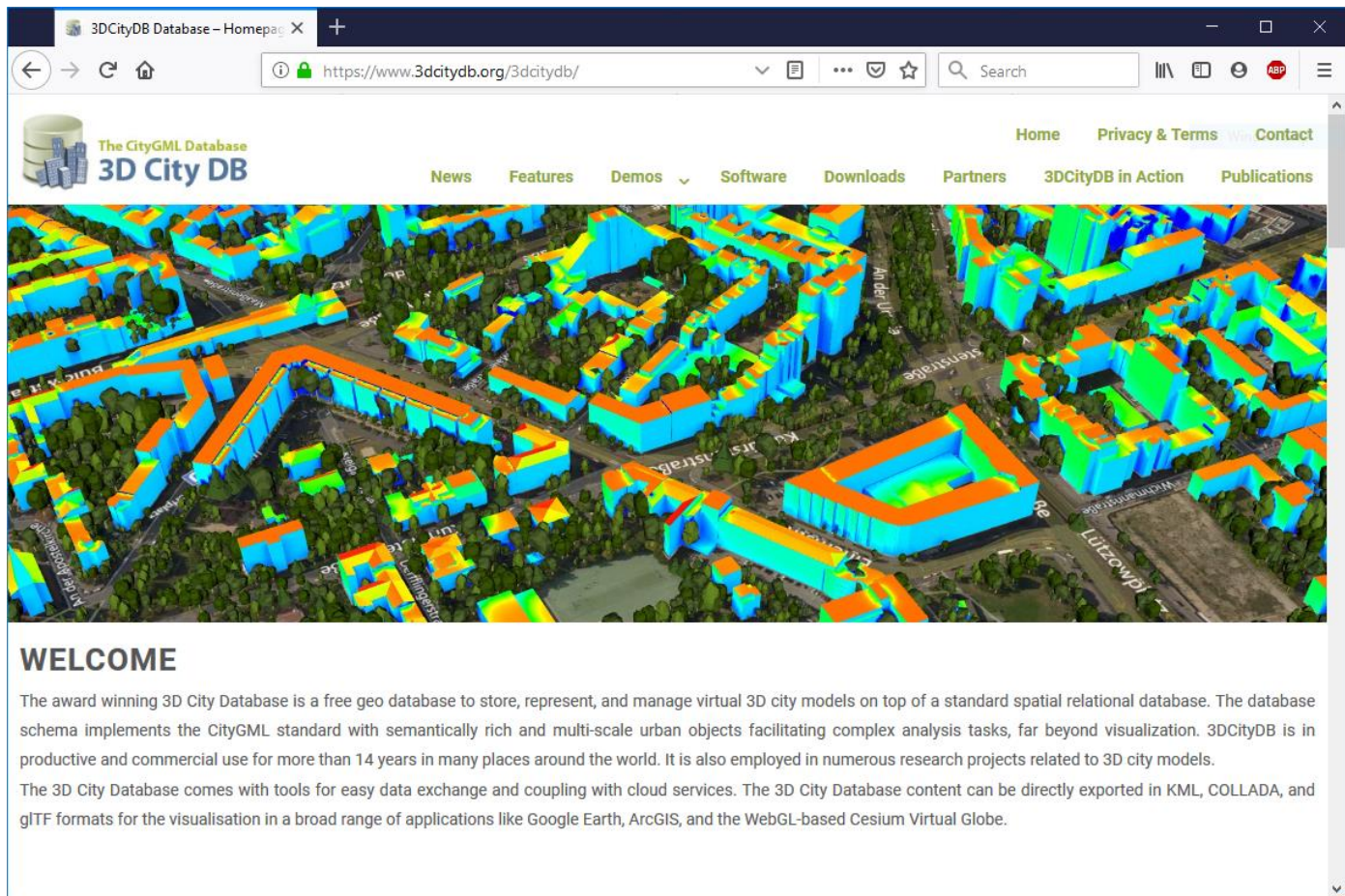
- Free and open-source database implementation of the CityGML data model
 - For PostgreSQL / PostGIS (and for Oracle Spatial)
 - Consists of 66 predefined tables and several functions written in PL/SQL
 - Can validate CityGML instance documents
 - Comes with an importer / exporter for CityGML data from / to the database
 - Imports XML-CityGML/CityJSON
 - Exports XML-CityGML/CityJSON, KML/Collada (e.g. for Google Earth) and glTF/glb (for CesiumJS)
 - Exports attributes as csv files
 - Possibility to use it via GUI or via command line (allows scripting)
 - From version 4.x documentation is online

- Resources:

- <https://www.3dcitydb.org/3dcitydb/>
- <https://github.com/3dcitydb/3dcitydb-suite/releases> (suggested for download)
- <https://3dcitydb-docs.readthedocs.io/en/latest/index.html>



3D City Database: Homepage



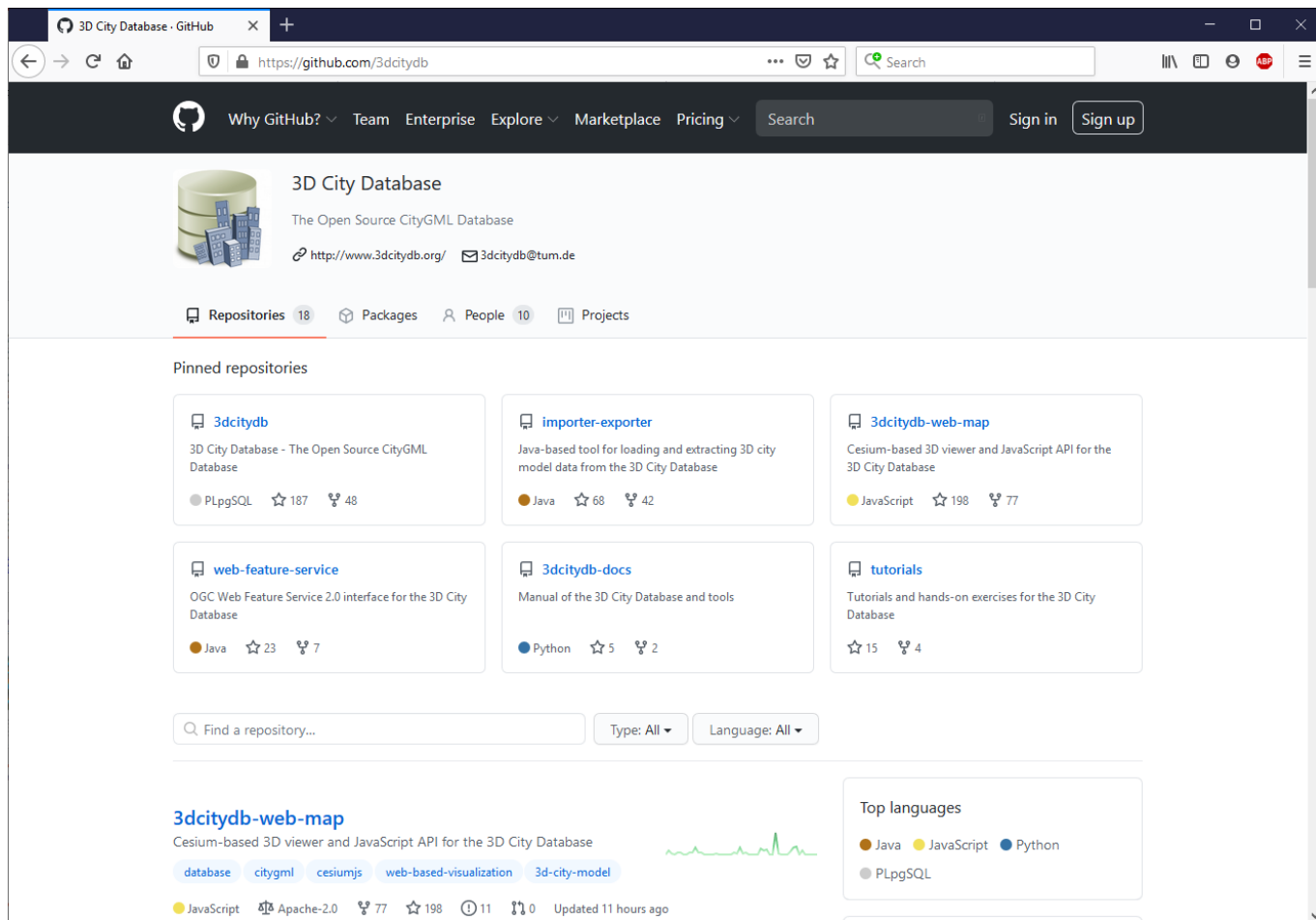
The screenshot shows the homepage of the 3D City Database. The browser address bar displays <https://www.3dcitydb.org/3dcitydb/>. The page features a navigation menu with links for Home, Privacy & Terms, Contact, News, Features, Demos, Software, Downloads, Partners, 3DCityDB in Action, and Publications. A large 3D visualization of a city block is shown, with buildings rendered in a color gradient from blue to red, indicating height or density. The visualization includes street names like 'Ander Ue' and 'Lützowpl'. Below the visualization, the text reads:

WELCOME

The award winning 3D City Database is a free geo database to store, represent, and manage virtual 3D city models on top of a standard spatial relational database. The database schema implements the CityGML standard with semantically rich and multi-scale urban objects facilitating complex analysis tasks, far beyond visualization. 3DCityDB is in productive and commercial use for more than 14 years in many places around the world. It is also employed in numerous research projects related to 3D city models.

The 3D City Database comes with tools for easy data exchange and coupling with cloud services. The 3D City Database content can be directly exported in KML, COLLADA, and glTF formats for the visualisation in a broad range of applications like Google Earth, ArcGIS, and the WebGL-based Cesium Virtual Globe.

3D City Database: GitHub

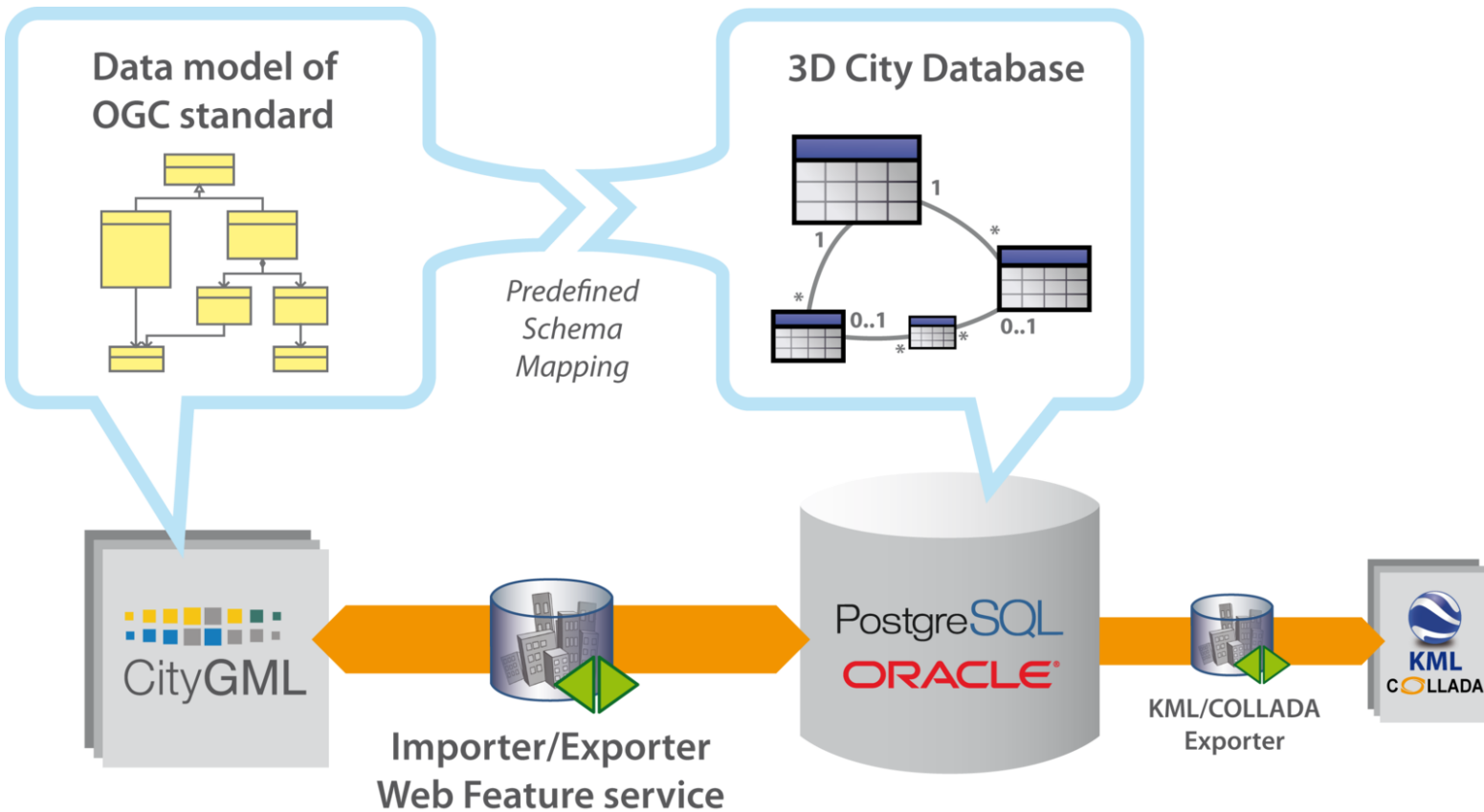


The screenshot shows the GitHub profile page for the 3D City Database organization. The page features a navigation bar with links for Why GitHub?, Team, Enterprise, Explore, Marketplace, and Pricing. The main header displays the organization's name, a description as 'The Open Source CityGML Database', and contact information including a website and email. Below this, statistics show 18 repositories, 10 people, and various project types. A 'Pinned repositories' section highlights several key projects:

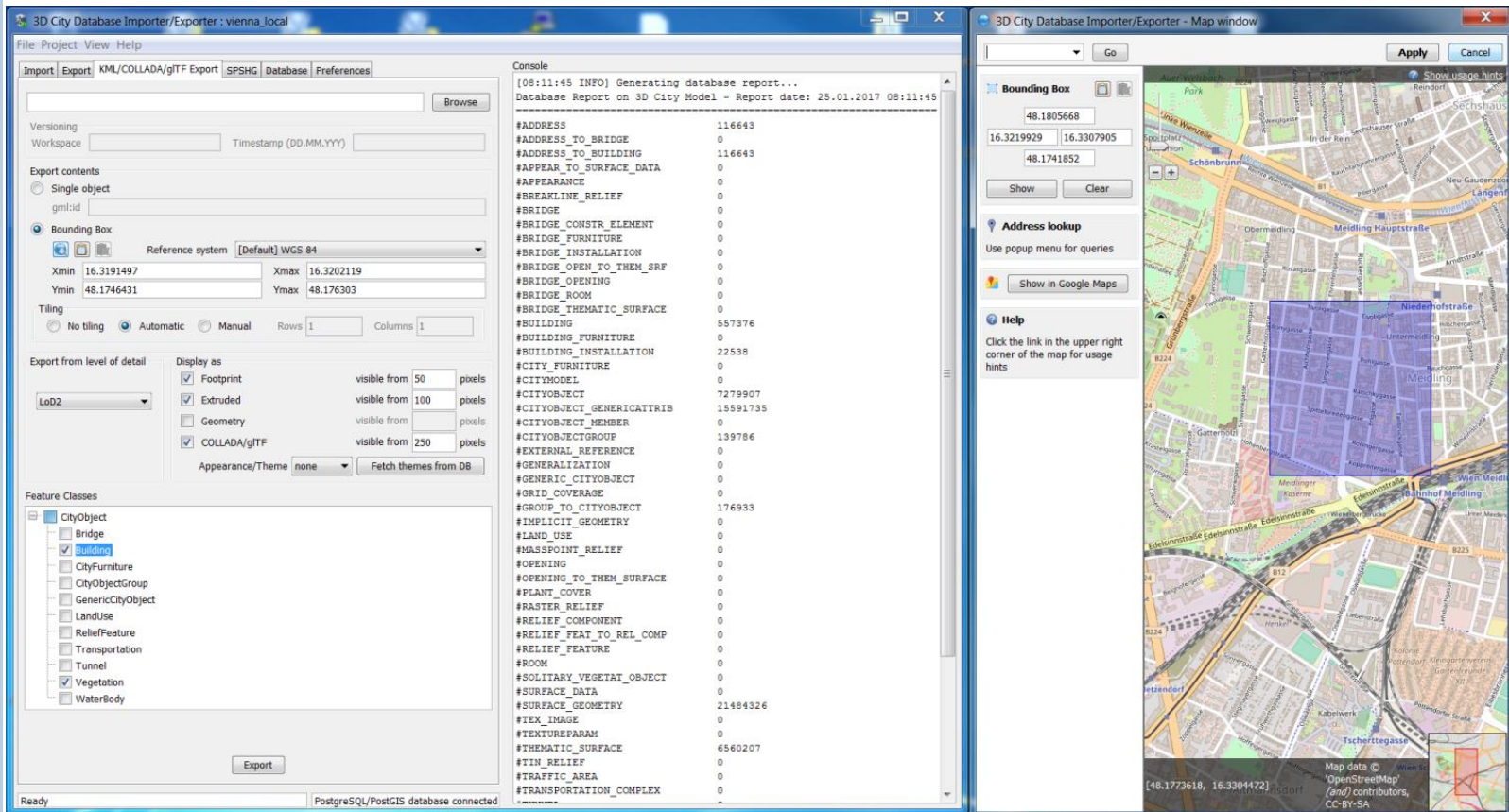
- 3dcitydb**: 3D City Database - The Open Source CityGML Database. Languages: PLpgSQL. 187 stars, 48 forks.
- importer-exporter**: Java-based tool for loading and extracting 3D city model data from the 3D City Database. Languages: Java. 68 stars, 42 forks.
- 3dcitydb-web-map**: Cesium-based 3D viewer and JavaScript API for the 3D City Database. Languages: JavaScript. 198 stars, 77 forks.
- web-feature-service**: OGC Web Feature Service 2.0 interface for the 3D City Database. Languages: Java. 23 stars, 7 forks.
- 3dcitydb-docs**: Manual of the 3D City Database and tools. Languages: Python. 5 stars, 2 forks.
- tutorials**: Tutorials and hands-on exercises for the 3D City Database. 15 stars, 4 forks.

At the bottom, a search bar and filters are visible. A specific repository, **3dcitydb-web-map**, is highlighted with a detailed view showing its description, tags (database, citygml, cesiumjs, web-based-visualization, 3d-city-model), languages (JavaScript), license (Apache-2.0), 77 forks, 198 stars, 11 issues, and 0 pull requests, updated 11 hours ago. A 'Top languages' section shows JavaScript, Python, and PLpgSQL.

3D City Database



3D City Database: Importer/Exporter



The image displays two windows from the 3D City Database Importer/Exporter application.

3D City Database Importer/Exporter - vienna_local

File Project View Help

Import Export KML/COLLADA/gTIF Export SPSHG Database Preferences

Versioning
Workspace Timestamp (DD.MM.YYY)

Export contents
 Single object
 gml:id

Bounding Box
 Reference system: [Default] WGS 84
 Xmin: 16.3191497 Xmax: 16.3202119
 Ymin: 48.1746431 Ymax: 48.176303

Tiling
 No tiling Automatic Manual
 Rows: 1 Columns: 1

Export from level of detail: LoD2

Display as
 Footprint visible from: 50 pixels
 Extruded visible from: 100 pixels
 Geometry visible from: pixels
 COLLADA/gTIF visible from: 250 pixels
 Appearance/Theme: none

Feature Classes

- CityObject
 - Bridge
 - Building
 - CityFurniture
 - CityObjectGroup
 - GenericCityObject
 - LandUse
 - ReliefFeature
 - Transportation
 - Tunnel
 - Vegetation
 - WaterBody

Ready PostgreSQL/PostGIS database connected

Console

```

[08:11:45 INFO] Generating database report...
Database Report on 3D City Model - Report date: 25.01.2017 08:11:45
-----
#ADDRESS 116643
#ADDRESS_TO_BRIDGE 0
#ADDRESS_TO_BUILDING 116643
#APPEAR_TO_SURFACE_DATA 0
#APPEARANCE 0
#BREAKLINE_RELIEF 0
#BRIDGE 0
#BRIDGE_CONSTR_ELEMENT 0
#BRIDGE_FURNITURE 0
#BRIDGE_INSTALLATION 0
#BRIDGE_OPEN_TO_THEM_SRF 0
#BRIDGE_OPENING 0
#BRIDGE_ROOM 0
#BRIDGE_THEMATIC_SURFACE 0
#BUILDING 557376
#BUILDING_FURNITURE 0
#BUILDING_INSTALLATION 22538
#CITY_FURNITURE 0
#CITYMODEL 0
#CITYOBJECT 7279907
#CITYOBJECT_GENERICATTRIB 15591735
#CITYOBJECT_MEMBER 0
#CITYOBJECTGROUP 139786
#EXTERNAL_REFERENCE 0
#GENERALIZATION 0
#GENERIC_CITYOBJECT 0
#GRID_COVERAGE 0
#GROUP_TO_CITYOBJECT 176933
#IMPLICIT_GEOMETRY 0
#LAND_USE 0
#MASSPOINT_RELIEF 0
#OPENING 0
#OPENING_TO_THEM_SURFACE 0
#PLANT_COVER 0
#RASTER_RELIEF 0
#RELIEF_COMPONENT 0
#RELIEF_FEAT_TO_REL_COMP 0
#RELIEF_FEATURE 0
#ROOM 0
#SOLITARY_VEGETAI_OBJECT 0
#SURFACE_DATA 21484326
#SURFACE_GEOMETRY 6560207
#TEX_IMAGE 0
#TEXTUREPARAM 0
#THEMATIC_SURFACE 0
#TIN_RELIEF 0
#TRAFFIC_AREA 0
#TRANSPORTATION_COMPLEX 0
  
```

3D City Database Importer/Exporter - Map window

Bounding Box

 48.1805668
 16.3219929 16.3307905
 48.1741852

Address lookup
 Use popup menu for queries

Help
 Click the link in the upper right corner of the map for usage hints

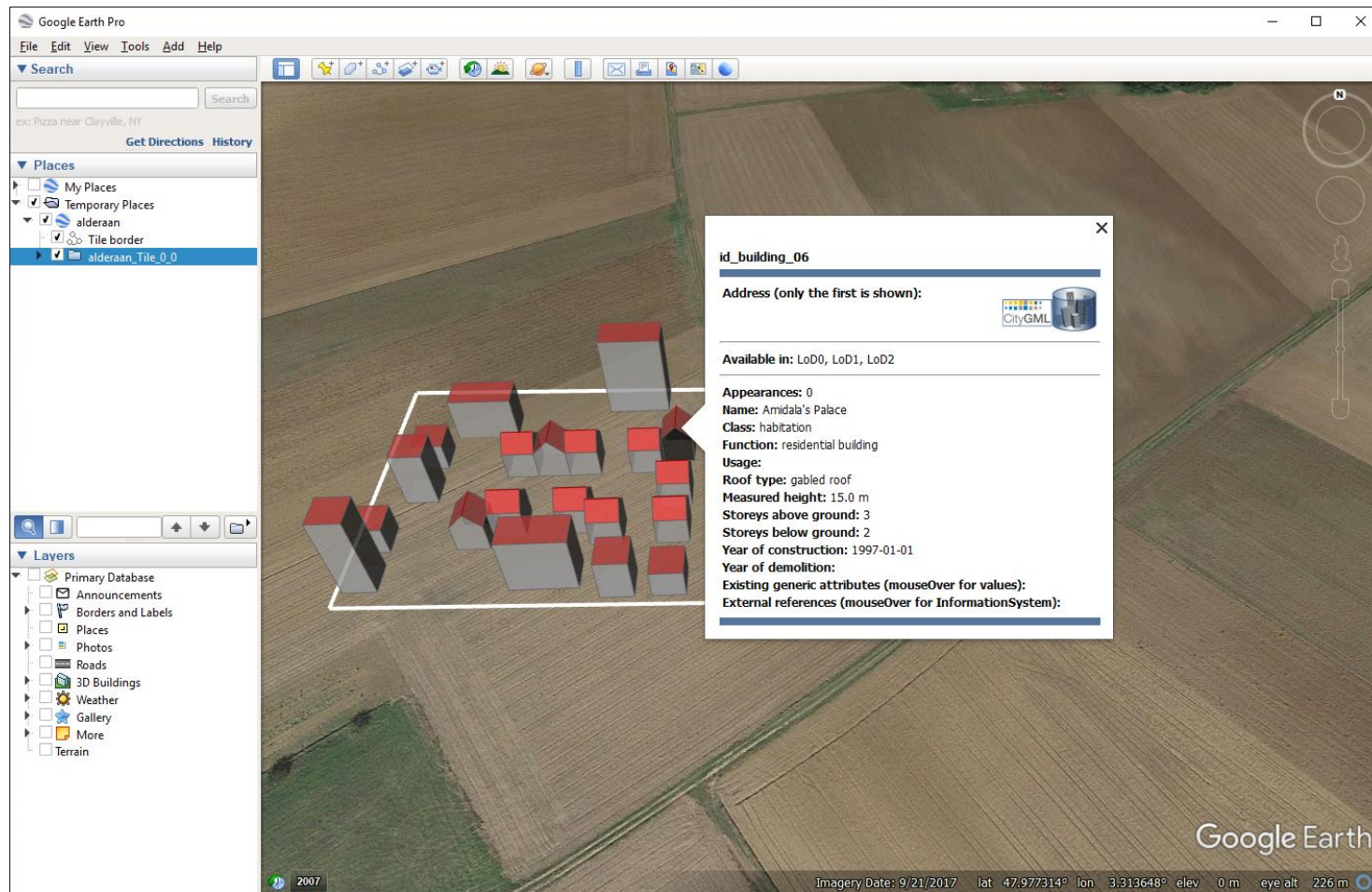
Map data © OpenStreetMap (and) contributors, CC-BY-SA

[48.1773618, 16.3304472]

3D City Database: KML/Collada/gITF exporter




3D City Database: KML/Collada/gITF exporter



The screenshot shows the Google Earth Pro interface with a 3D city model overlaid on a satellite view of a rural area. A white rectangular box highlights a cluster of buildings. A popup window is open over one of the buildings, displaying its metadata.

id_building_06

Address (only the first is shown): 

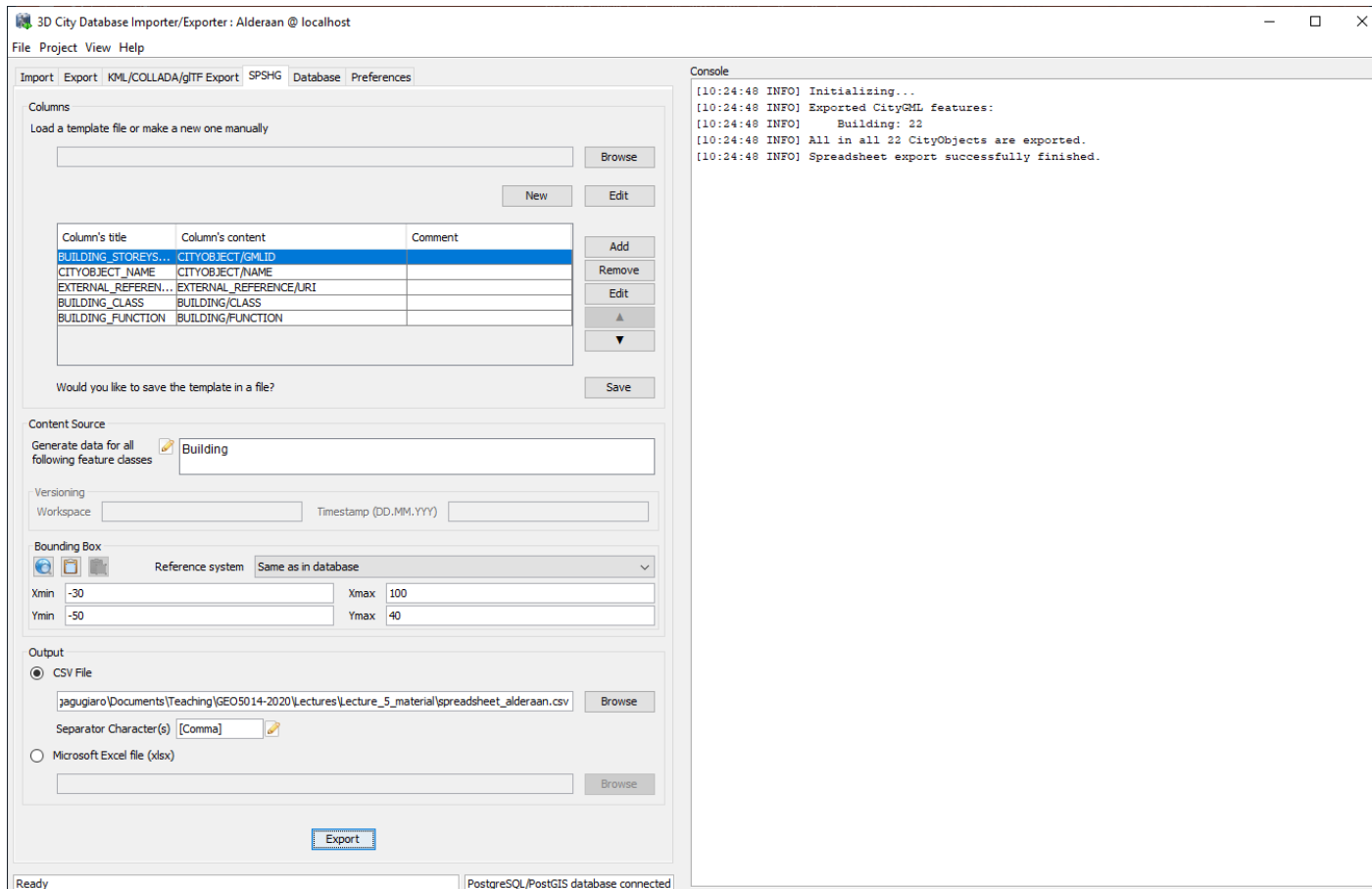
Available in: LoD0, LoD1, LoD2

Appearances: 0
Name: Amidala's Palace
Class: habitation
Function: residential building
Usage:
Roof type: gabled roof
Measured height: 15.0 m
Storeys above ground: 3
Storeys below ground: 2
Year of construction: 1997-01-01
Year of demolition:
Existing generic attributes (mouseover for values):
External references (mouseover for InformationSystem):

Google Earth

Imagery Date: 9/21/2017 lat 47.977314° lon 3.313648° elev 0 m eye alt 226 m

3D City Database: Spreadsheet generator



3D City Database Importer/Exporter: Alderaan @ localhost

File Project View Help

Import Export KML/COLLADA/gITF Export SPSHG Database Preferences

Columns

Load a template file or make a new one manually

Browse

New Edit

Column's title	Column's content	Comment
BUILDING_STOREYS...	CITYOBJECT/GMLID	
CITYOBJECT_NAME	CITYOBJECT/NAME	
EXTERNAL_REFEREN...	EXTERNAL_REFERENCE/URI	
BUILDING_CLASS	BUILDING/CLASS	
BUILDING_FUNCTION	BUILDING/FUNCTION	

Add Remove Edit

Would you like to save the template in a file? Save

Content Source

Generate data for all following feature classes Building

Versioning

Workspace Timestamp (DD.MM.YYY)

Bounding Box

Reference system Same as in database

Xmin -30 Xmax 100

Ymin -50 Ymax 40

Output

CSV File

jagugiaro\Documents\Teaching\GEO5014-2020\Lectures\Lecture_5_material\spreadsheet_aldeeraan.csv Browse

Separator Character(s) [Comma]

Microsoft Excel file (xlsx)

Browse

Export

Console

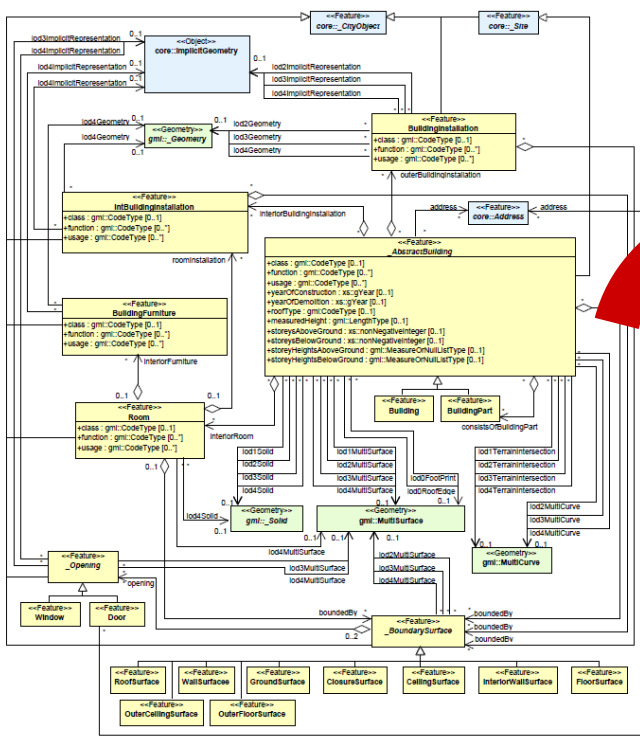
```
[10:24:48 INFO] Initializing...
[10:24:48 INFO] Exported CityGML Features:
[10:24:48 INFO]   Building: 22
[10:24:48 INFO] All in all 22 CityObjects are exported.
[10:24:48 INFO] Spreadsheet export successfully finished.
```

Ready PostgreSQL/PostGIS database connected

3D City Database: Spreadsheet generator

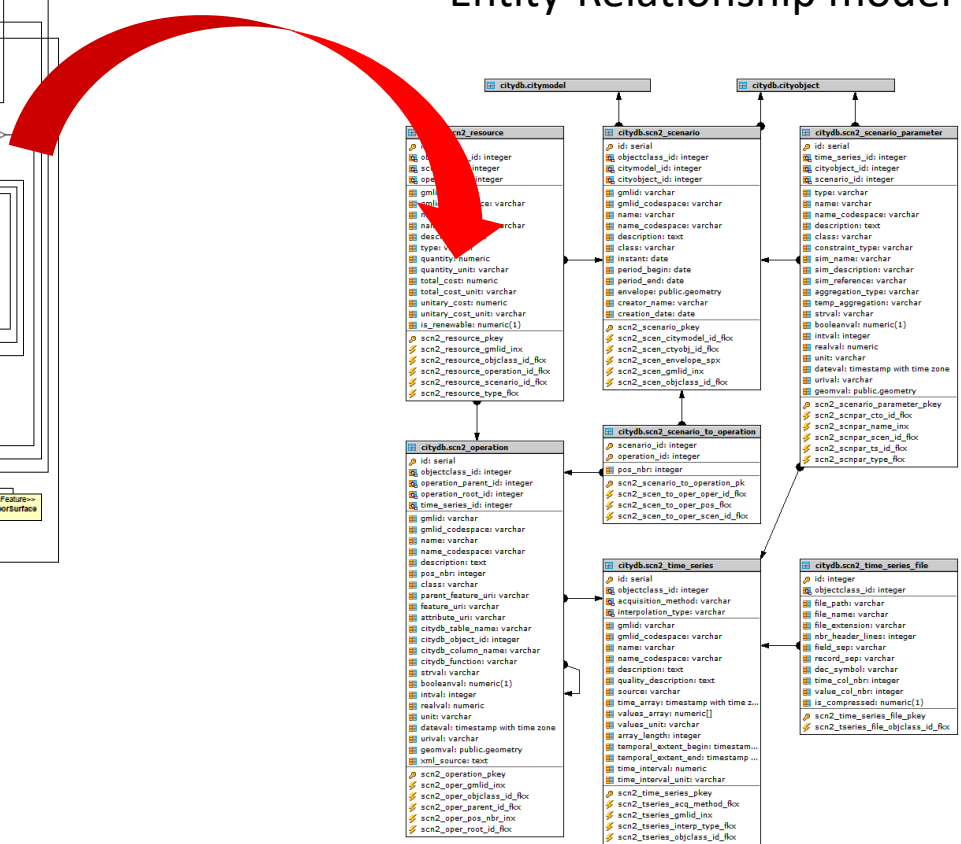
```

D:\gagugiaro\Documents\Teaching\GEO5014-2020\Lectures\Lecture_5_material\spreadsheet_alderaan.csv - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
spreadsheet_alderaan.csv
1 |"GMLID", "BUILDING_STOREYS_ABOVE_GROUND", "CITYOBJECT_NAME", "EXTERNAL_REFERENCE_URI", "BUILDING_CLASS", "BUILDING_FUNCTION"
2 |"id_box_building_24", "id_box_building_24", "Box building 24"
3 |"id_building_12", "id_building_12", "Death Star II", "", "habitation", "residential building"
4 |"id_box_building_23", "id_box_building_23", "Box building 23"
5 |"id_building_10", "id_building_10", "Boba Fett's Lair", "", "habitation", "residential building"
6 |"id_box_building_25", "id_box_building_25", "Box building 25"
7 |"id_box_building_27", "id_box_building_27", "Box building 27"
8 |"id_box_building_26", "id_box_building_26", "Box building 26"
9 |"id_box_building_28", "id_box_building_28", "Box building 28"
10 |"id_box_building_30", "id_box_building_30", "Box building 30"
11 |"id_building_04", "id_building_04", "Fin's Cabin", "", "habitation", "residential building"
12 |"id_building_06", "id_building_06", "Amidala's Palace", "", "habitation", "residential building"
13 |"id_building_11", "id_building_11", "Death Star I", "", "habitation", "residential building"
14 |"id_building_02", "id_building_02", "Rey's Hut", "", "habitation", "residential building"
15 |"id_building_03", "id_building_03", "Poe's Hangar", "", "habitation", "residential building"
16 |"id_building_07", "id_building_07", "Palapatine's Residence", "", "habitation", "residential building"
17 |"id_building_05", "id_building_05", "Yoda's Hut", "", "habitation", "residential building"
18 |"id_building_08", "id_building_08", "Darth Vader's Palace", "", "habitation", "residential building"
19 |"id_box_building_20", "id_box_building_20", "Box building 20"
20 |"id_box_building_21", "id_box_building_21", "Box building 21"
21 |"id_box_building_29", "id_box_building_29", "Box building 29"
22 |"id_building_09", "id_building_09", "Jabba's Palace", "", "habitation", "residential building"
23 |"id_box_building_22", "id_box_building_22", "Box building 22"
24
Normal text file      length: 1.794 lines: 24      Ln: 1 Col: 1 Sel: 0 | 0      Windows (CR LF)      UTF-8      INS
  
```

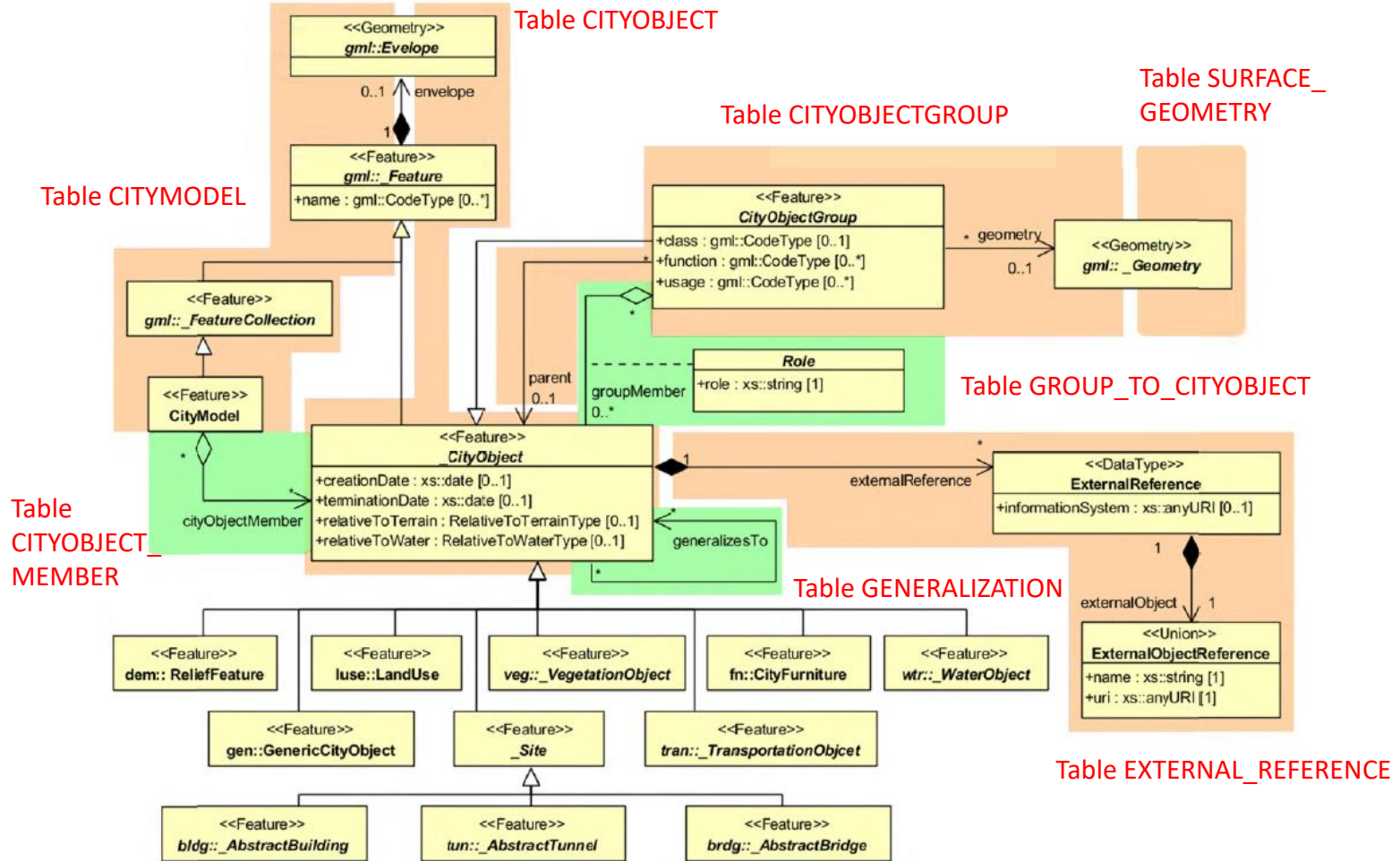


Object-Oriented model

Entity-Relationship model



3DCityDB: Example mapping rules



Tables CITYOBJECT + BUILDING

Table CITYOBJECT

	id [PK] integer	objectclass_id integer	gmfid character varying (256)	gmfnr name character varying (1000)	name description character varying (4000)	envelope geometry
1	1	1	id_building_02	GE... Rey's Hut	This is Building 2	01030000A0407100000100000005000...
2	2	2	id_building_01	GE... Snoko's Palace	This is Building 1	01030000A0407100000100000005000...
3	3	3	id_box_building_25	GE... Box building 25	This is a simple, primastic building meant to provi...	01030000A0407100000100000005000...
4	4	4	id_box_building_28	GE... Box building 28	This is a simple, primastic building meant to provi...	01030000A0407100000100000005000...
5	5	5	id_building_04	GE... Fin's Cabin	This is Building 4	01030000A0407100000100000005000...
6	6	6	id_building_2_roofsurface_1	GE... RoofSurface 1 (Building 2)	This is Roofsurface 1 (South) (Building 2)	01030000A0407100000100000005000...
7	7	7	id_building_4_roofsurface_1	GE... RoofSurface 1 (Building 4)	This is Roofsurface 1 (South) (Building 4)	01030000A0407100000100000005000...

Table BUILDING

	id [PK] integer	building integer	building_root_id integer	class character varying (100)	class_function character varying (100)	function_usage character varying (100)	usage character varying (100)	year_of_construction date	year date	roof_type character varying (100)	roof_measure double	measure character varying (100)	storeys_above numeric (8)	storey_num integer	storey_char character varying (100)	storey_char character varying (100)	storey_char character varying (100)	storey_char character varying (100)	storey_char character varying (100)
1	1	[null]	1	habitation	ht... residential building	htt... [null]	[null]	1955-01-01	[null]	gabled roof	ht... 15 m	[null]	3	0	3.0	m	[null]	[null]	[null]
2	2	[null]	2	habitation	ht... residential building	htt... [null]	[null]	1955-01-01	[null]	gabled roof	ht... 15 m	[null]	3	0	3.0	m	[null]	[null]	[null]
3	3	[null]	3	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]
4	4	[null]	4	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]
5	5	[null]	5	habitation	ht... residential building	htt... [null]	[null]	1955-01-01	[null]	gabled roof	ht... 15 m	[null]	3	0	3.0	m	[null]	[null]	[null]
6	26	[null]	26	habitation	ht... residential building	htt... [null]	[null]	1955-01-01	[null]	gabled roof	ht... 15 m	[null]	3	0	3.0	m	[null]	[null]	[null]
7	28	[null]	28	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]
8	29	[null]	29	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]	[null]

Tables CO + BUILDING + SURFACE_GEOMETRY

Table CITYOBJECT

id	objectclass_id	gmlid	gmjlr name	name	description	envelope geometry
[PK] integer	integer	character varying (256)	character varying (1000)	character varying (4000)	geometry	
1	1	id_building_02	RE... Rey's Hut		This is Building 2	01030000A0407100000100000005000...
2	2	id_building_01	GE... Snoke's Palace		This is Building 1	01030000A0407100000100000005000...
3	3	id_box_building_25	GE... Box building 25		This is a simple, primastic building meant to provi...	01030000A0407100000100000005000...
4	4	id_box_building_26	GE... Box building 26		This is a simple, primastic building meant to provi...	01030000A0407100000100000005000...

Table BUILDING

id	building	building_root_id	class	class function	function usage	usage year_of_construct	lod0 footprint_id	lod0	lod1	lod2	lod3	lod4	lod1_solid_id
[PK] integer	integer	integer	character varying (10)	character varying (10)	character	date	integer	integer	integer	integer	integer	integer	integer
1	1	[null]	habitation	ht... residential building	htt... [null]	[null] 1955-01-01	5	[null]	[null]	[null]	[null]	[null]	7
2	2	[null]	habitation	ht... residential building	htt... [null]	[null] 1955-01-01	3	[null]	[null]	[null]	[null]	[null]	23
3	3	[null]	[null]	[null]	[null]	[null]	1	[null]	[null]	[null]	[null]	[null]	8
4	4	[null]	[null]	[null]	[null]	[null]	21	[null]	[null]	[null]	[null]	[null]	22

Table SURFACE_GEOMETRY

id	gmlid	gmjlr parent_id	root_id	is_solid	is_composite	is_triangulated	is_xlink	is_reverse	solid_geometry	geometry	impliciting geometry	cityobject_id
[PK] integer	character varying (256)	integer	integer	numeric	numeric	numeric	numeric	numeric	geometry	geometry	geometry	integer
9	19	id_building_02_lod1_Polygon_11	9	0	0	0	0	0		01030000A0407100000100000005000...		1
10	21	id_building_02_lod1_Polygon_12	9	0	0	0	0	0		01030000A0407100000100000005000...		1
11	3	id_building_1_footprint_multisurf_1	[null]	3	0	0	0	0				2
12	4	id_building_1_polygon_3	3	3	0	0	0	1	1	01030000A0407100000100000005000...		2
13	23	id_building_01_lod1_Solid_1	[null]	23	1	0	0	0	0	010F0000A0407100000...		2
14	24	id_building_01_lod1_CompSurf_1	23	23	0	1	0	0	0			2
15	25	id_building_01_lod1_Polygon_1	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
16	26	id_building_01_lod1_Polygon_2	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
17	27	id_building_01_lod1_Polygon_3	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
18	28	id_building_01_lod1_Polygon_4	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
19	29	id_building_01_lod1_Polygon_5	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
20	30	id_building_01_lod1_Polygon_6	24	23	0	0	0	0	0	01030000A0407100000100000005000...		2
21	1	id_lod0_MultiSurf_25	[null]	1	0	0	0	0	0			3

SOLID
COMPOSITE SURFACE

POLYGONS



NULL

PostGIS geometry type:
POLYGONZ

Additional 3DCityDB features

- Several functions are provided to facilitate data maintenance
 - Delete functions to delete objects
 - Other useful functions to deal with spatial indices, etc.
- From version 4.x it is possible to store multiple "citydb" schemas
 - Each schema can be used to store a different "scenario" of the same city model
 - You can choose which schema to access from the Importer/Exporter GUI
 - Details: <https://3dcitydb-docs.readthedocs.io/en/latest/3dcitydb/multi-schema.html>
- Version 4.x adds some preliminary ADE support
 - Given any XSD-file, tables and delete functions can be generated *automatically*
 - There is however still need for additional Java-based modules in order to enable the Importer/Exporter to read/write ADE-data into/from the database

Thank you for your attention!



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