



3DCityDB Tools

for

QGIS

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Motivation: 3D city models

Motivation

Plug-in overview

Demo

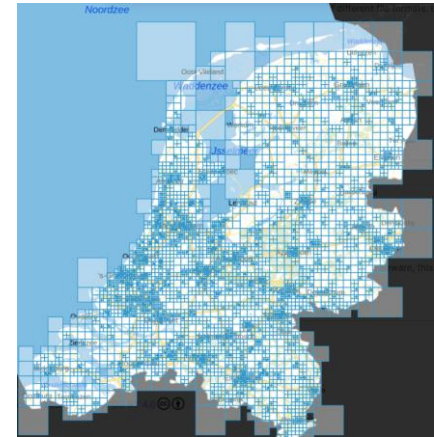
Tests

Conclusions

Resources

- Semantic 3D city models can become rather **huge datasets**
 - Generally, area is split into file-based "portions" (e.g. tiles)
- For example:

| | |
|-----------------------|------------|
| – Rijssen-Holten (NL) | 25 files |
| – Den Haag (NL) | 48 files |
| – Vienna (AT) | 1460 files |
| – 3D BAG (whole NL) | 8138 files |
- Next logical step: store and manage everything by means of a **spatial database!**



Motivation

IDEA:

- **3D City Database:** Why not letting users benefit from *directly* working with the 3DCityDB?
 - No need to work with files
 - Editing of features attributes could become way easier
 - (At least) basic SQL is well-known also outside the GIS user community



Motivation

BUT:

- CityGML does not follow the Simple Feature for SQL model (SFS)
 - Nested features
 - One feature can have multiple representations
 - A representation is a combination of:
 - Level of Detail (LoD)
 - Geometry types (polygons, ..., implicit geometries)
 - Semantics

| CityGML 2.0 module | Representations |
|--------------------|-----------------|
| Bridge | 194 |
| Building | 148 |
| CityFurniture | 8 |
| Generics | 10 |
| LandUse | 5 |
| Relief | 30 |
| Transportation | 50 |
| Tunnel | 138 |
| Vegetation | 8 |
| WaterBody | 16 |
| Total | 607 |

(Excluding CityObjectGroup module)

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Plug-in overview



SO:

- Why not using **QGIS**?
 - It can be extended with Python-based plug-in -> **3DCityDB-Tools** plug-in

Main functionalities

- Create "**classic**" **GIS layers** to hide 3DCityDB complexity
 - Deal with different geometries (multiple LoDs, implicit representations, etc.)
 - Merge all standard attributes of a feature into a single "table"
- **Deal with** the possibly *huge size of city models* stored in a database
- **Editing of attributes**: possible (depending on user privileges)
- **Deletion of features**: possible (depending on user privileges)
- Editing of geometries: NOT possible
- Support for **multiple users** with **different privileges** (read-only, read-write)

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Plug-in overview

Server-side

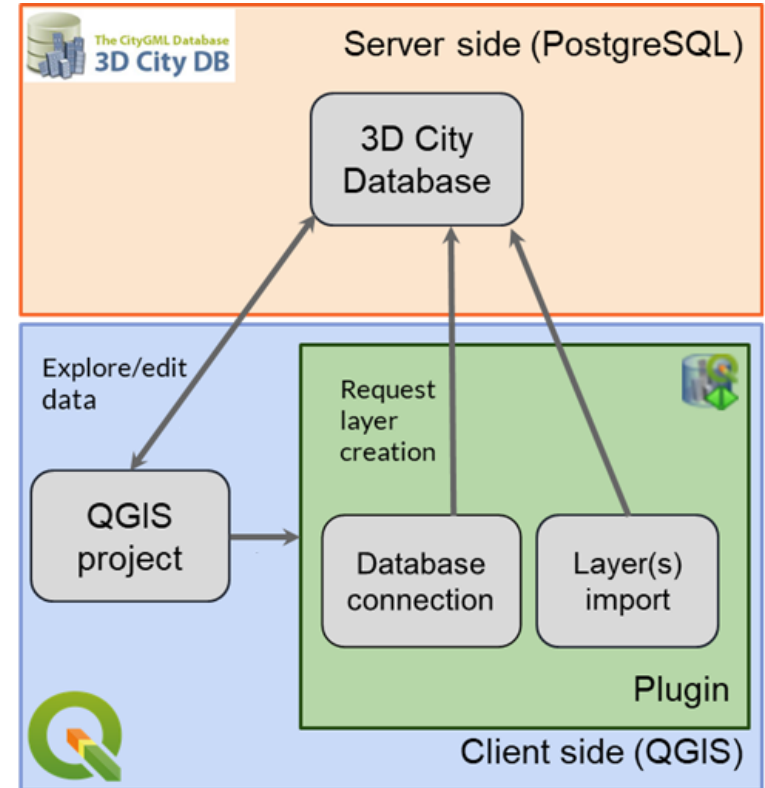
PostgreSQL "QGIS Package"

written in PL/pgSQL

Client-side

QGIS plug-in "3DCityDB-Tools"

written in Python

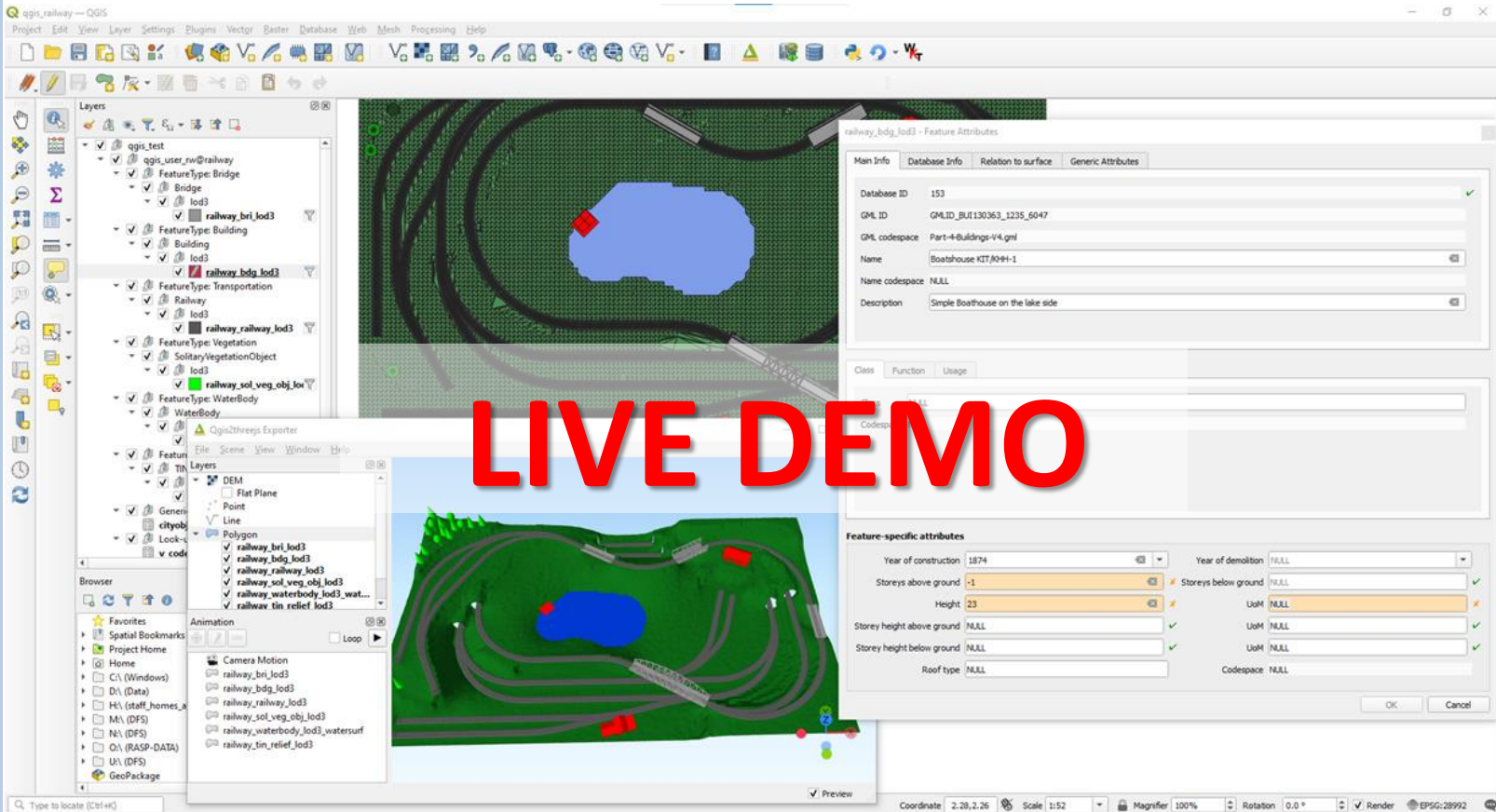


Plug-in overview

Currently available tools:

- **Layer Loader**
 - Creates layers and loads them into QGIS
- **Bulk Deleter**
 - Deletes features from the database
- **QGIS Package Administrator**
 - Takes care of installation & users' settings





The screenshot displays the QGIS 3D environment. The main view shows a 3D model of a railway track with a bridge crossing a lake. The 'Layers' panel on the left lists various layers, including 'railway_bdg_lod3' which is highlighted. A 'Feature Attributes' dialog is open for the selected 'railway_bdg_lod3' feature, showing its database information and feature-specific attributes.

Feature Attributes Dialog:

| Main Info | | Database Info | | Relation to surface | | Generic Attributes | |
|----------------|-------------------------|---------------|-----------------------------------|---------------------|--|--------------------|--|
| Database ID | 153 | GML ID | GML_ID_BUI130363_1235_6047 | | | | |
| GML codespace | Part-4-Buildings-v4.gml | Name | Boathouse KIT/09-1 | | | | |
| Name codespace | NULL | Description | Simple Boathouse on the lake side | | | | |

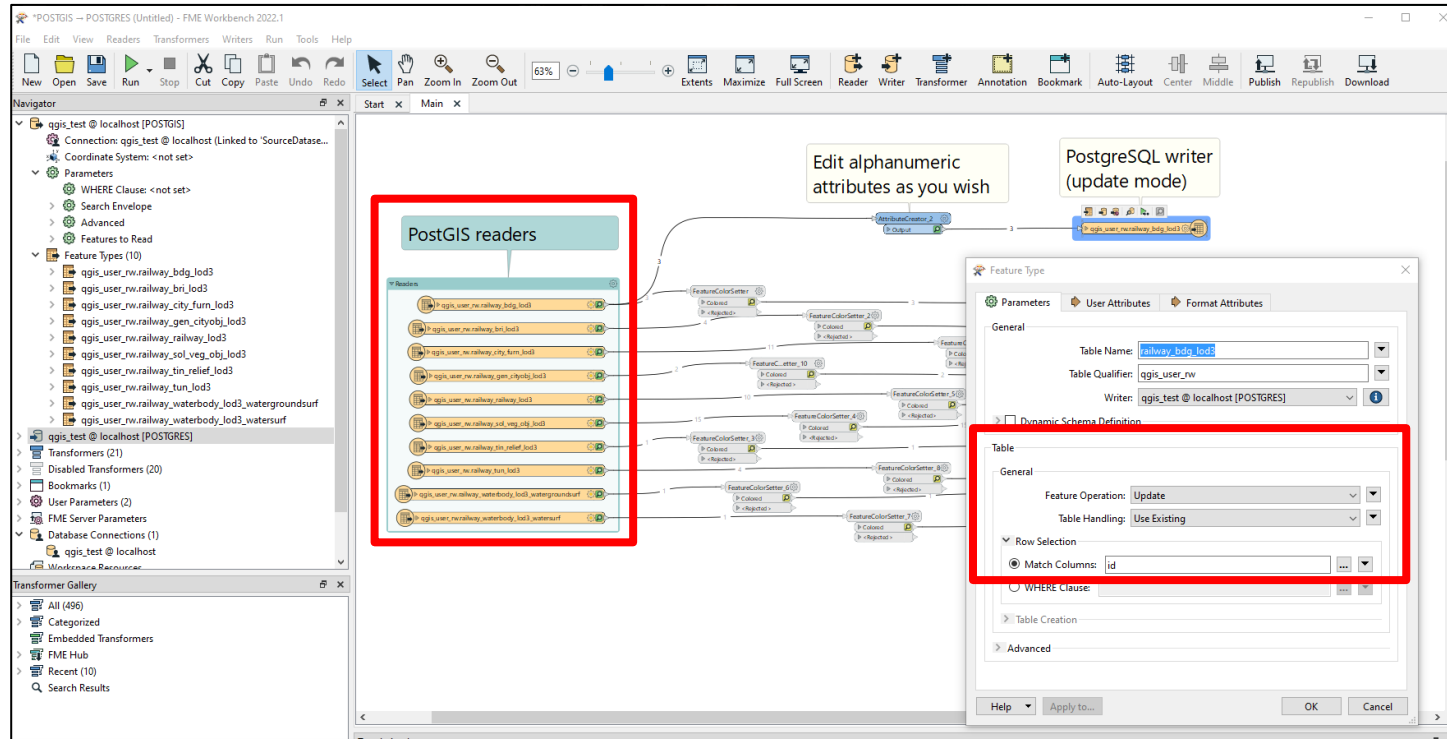
| Feature-specific attributes | | | |
|-----------------------------|------|---------------------|------|
| Year of construction | 1874 | Year of demolition | NULL |
| Stores above ground | -1 | Stores below ground | NULL |
| Height | 23 | UoM | NULL |
| Storey height above ground | NULL | UoM | NULL |
| Storey height below ground | NULL | UoM | NULL |
| Roof type | NULL | Codespace | NULL |

LIVE DEMO

QGIS Package (server-side only)

- This is a simple example of how the QGIS Package can be used via FME
 - Simply connect to the 3D City Database and import the views with **PostGIS readers**
 - Updates can be stored using **PostgreSQL writers in update mode**

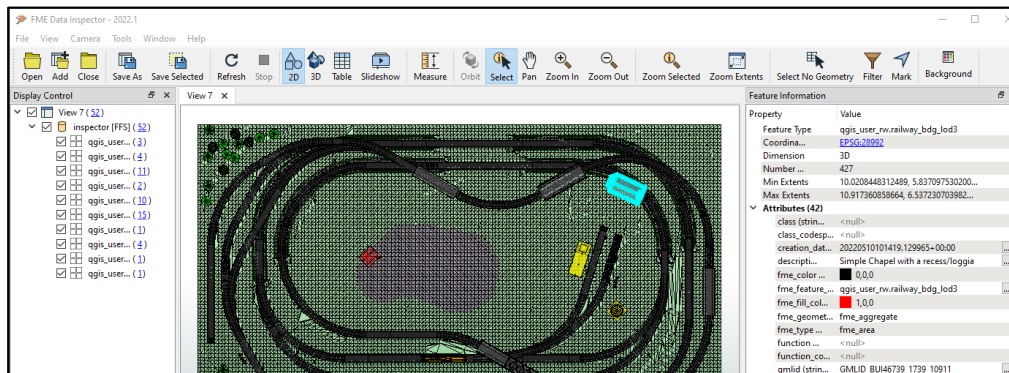
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The screenshot displays the FME Workbench interface with a workflow for data synchronization. The workflow starts with a 'PostGIS readers' block (highlighted with a red box) that reads data from a PostgreSQL database. This data is then processed through several 'FeatureColorSetter' blocks. The final output is written to a PostgreSQL database using a 'PostgreSQL writer (update mode)' block (also highlighted with a red box). A callout box points to the 'PostgreSQL writer' block with the text 'PostgreSQL writer (update mode)'. Another callout box points to the 'PostGIS readers' block with the text 'Edit alphanumeric attributes as you wish'. A 'Feature Type' dialog box is open, showing the 'Parameters' tab. The 'Table Name' is 'railway_bdg_lod3', the 'Table Qualifier' is 'qgis_user_rw', and the 'Writer' is 'qgis_test @ localhost [POSTGRES]'. The 'Table' section of the dialog is highlighted with a red box, showing 'Feature Operation' set to 'Update', 'Table Handling' set to 'Use Existing', and 'Match Columns' set to 'id'.

QGIS Package

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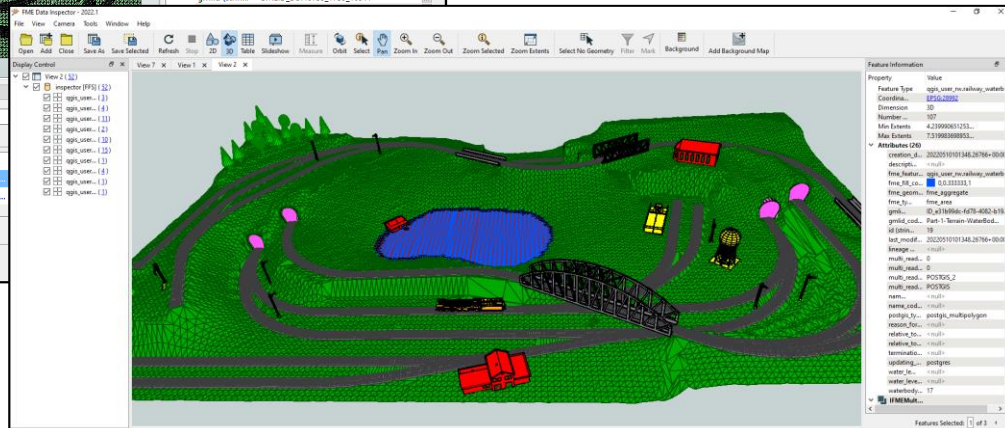


2D visualisation via FME Data Inspector

Table View

inspector [FFS] - qgis_user_rw.railway_bdg_lod3

| id | gmlid | gmlid_codespace | name | name_codespace | description | creation_date |
|----|-------|------------------|------------------------|------------------|------------------|---------------------|
| 2 | 80 | GMLID_BUH46739 | Part-4-Buildings-V4... | Chapel KIT/KH... | Simple Chapel... | 20220510101419.1... |
| 3 | 153 | GMLID_BUI1303... | Part-4-Buildings-V4... | Boathouse KIT... | Simple Boatho... | 20220510101419.1... |



3D visualisation via FME Data Inspector

Table View

inspector [FFS] - qgis_user_rw.railway_bdg_lod3

| id | gmlid | gmlid_codespace | name | name_codespace | description | creation_date | termination_date | relative_to_terrain | relative_to_water | last_modification_date | updating_person | reason_for_update | language | class | class_codespace |
|----|-----------------|------------------|------------------------|------------------|------------------|---------------------|------------------|----------------------|-------------------|----------------------------|-----------------|-------------------|----------|--------|-----------------|
| 77 | GMLID_BUH184... | | Station KIT/KH... | | | 20220510101419.1... | | entirelyAboveTerrain | | 20220510101419.123995-G... | postgises | | result | result | |
| 2 | 80 | GMLID_BUH46739 | Part-4-Buildings-V4... | Chapel KIT/KH... | Simple Chapel... | 20220510101419.1... | | entirelyAboveTerrain | | 20220510101419.123995-G... | postgises | | result | result | |
| 3 | 153 | GMLID_BUI1303... | Part-4-Buildings-V4... | Boathouse KIT... | Simple Boatho... | 20220510101419.1... | | entirelyAboveTerrain | | 20220510101419.147517-G... | postgises | | result | result | |

Conclusions

- 3DCityDB-Tools plug-in provides
 - Easier interaction with CityGML/CityJSON data stored in the 3DCityDB via QGIS
 - FOSS addition to the CityGML / 3D City Database software "archipelago"
- User can interact via QGIS, or directly with the QGIS Package via **FME**, **python**, etc.

Conclusions

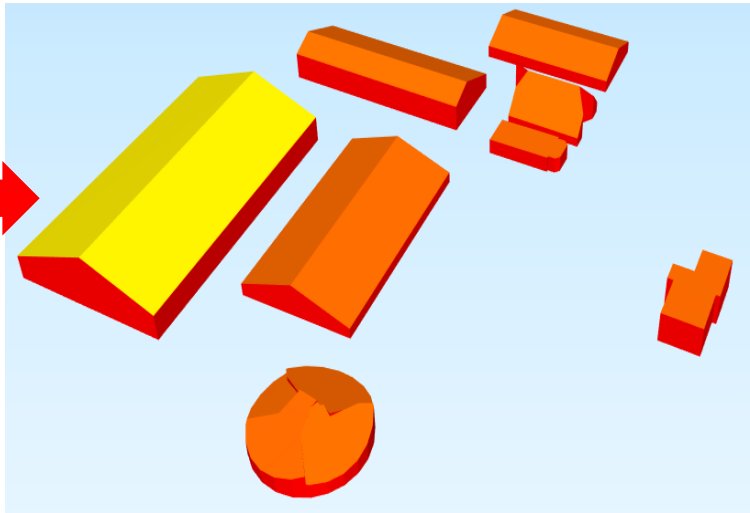
"Plain"
3DCityDB

Example: query of all (building) roofs constructed since 2015

```

1 SELECT
2   ts.id AS roof_id,
3   co_ts.gmlid AS roof_gmlid,
4   b.id AS building_id,
5   co.gmlid AS building_gmlid,
6   b.year_of_construction,
7   ST_Collect(sg.geometry) AS roof_geom
8 FROM
9   citydb.thematic_surface AS ts
10  INNER JOIN citydb.cityobject AS co_ts
11    ON (co_ts.id = ts.id)
12  INNER JOIN citydb.surface_geometry AS sg
13    ON (ts.lod2_multi_surface_id = sg.root_id)
14  INNER JOIN citydb.building AS b
15    ON (b.id = ts.building_id)
16  INNER JOIN citydb.cityobject AS co
17    ON (co.id = b.id)
18 WHERE
19   ts.objectclass_id = 33 AND -- roofsurfaces
20   b.objectclass_id = 26 AND -- buildings
21   b.year_of_construction >= '2015-01-01'::date
22 GROUP BY
23   ts.id,
24   co_ts.gmlid,
25   b.id,
26   co.gmlid,
27   b.year_of_construction
28 ORDER BY
29   b.id,
30   ts.id;

```



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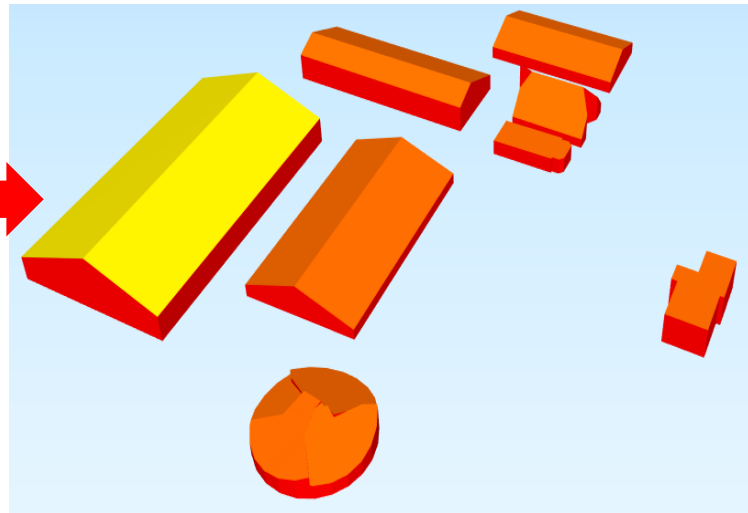
Conclusions

QGIS Package

Example: query of all (building) roofs constructed since 2015

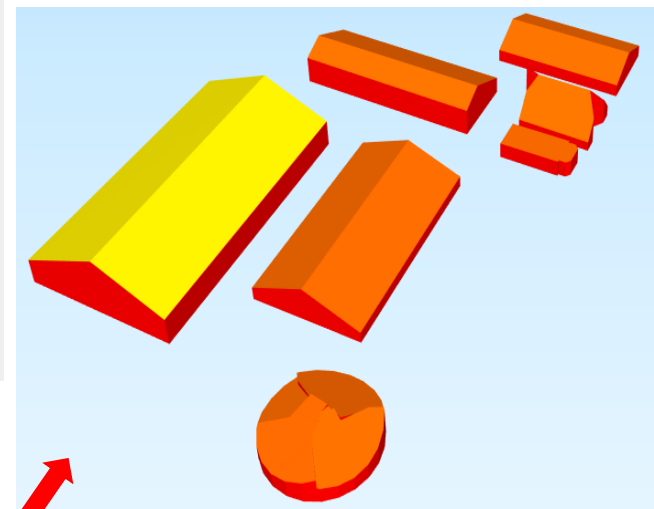
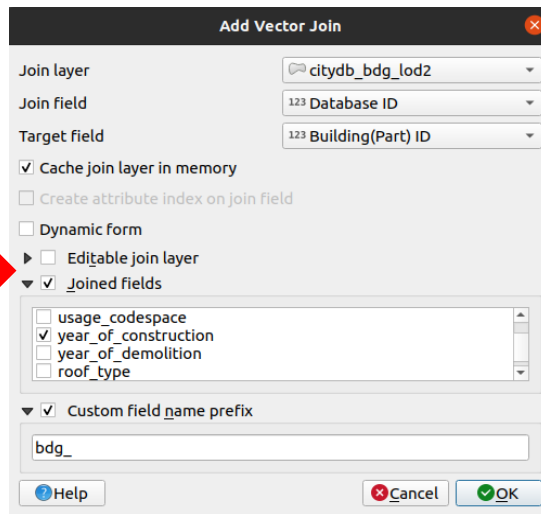
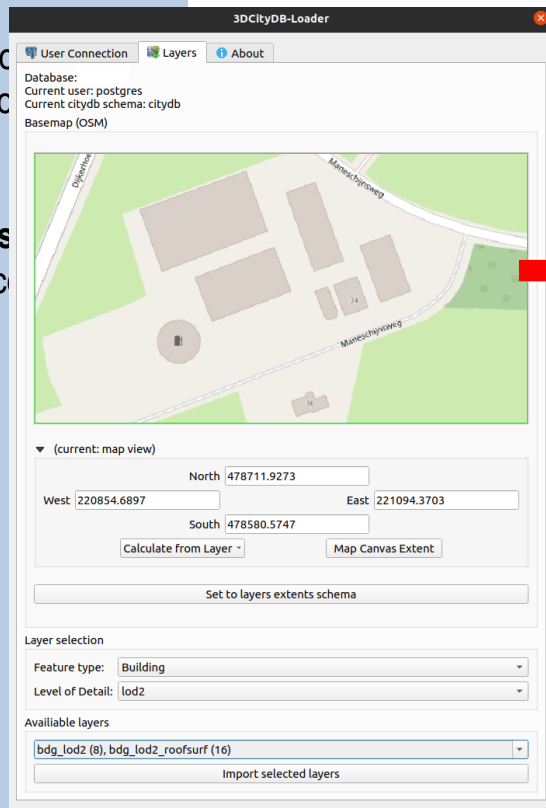
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```
1 SELECT
2   rs.id AS roof_id,
3   rs.gmlid AS roof_gmlid,
4   rs.building_id AS bdg_id,
5   b.gmlid AS bdg_gmlid,
6   b.year_of_construction,
7   rs.geom AS roof_geom
8 FROM
9   qgis_user_ro.citydb_bdg_lod2_roofsurf AS rs
10  INNER JOIN qgis_user_ro.citydb_bdg_lod2 AS b
11    ON b.id = rs.building_id
12 WHERE
13   b.year_of_construction >= '2015-01-01'::date
14 ORDER BY
15   b.id,
16   rs.id;
```



Example: query of all (building) roofs constructed since 2015

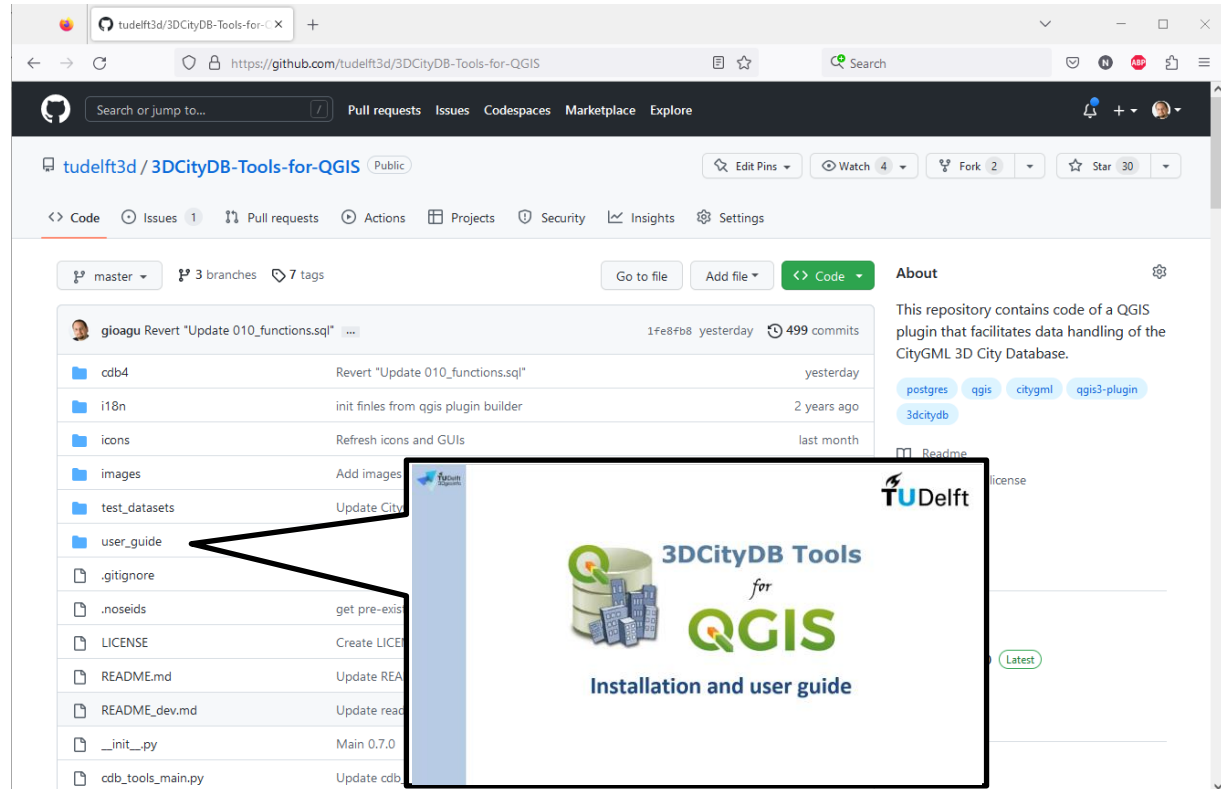
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```
"bdg_year_of_construction" >= make_date(2015,1,1)
```


GitHub repository: <https://github.com/tudelft3d/3DCityDB-Tools-for-QGIS>

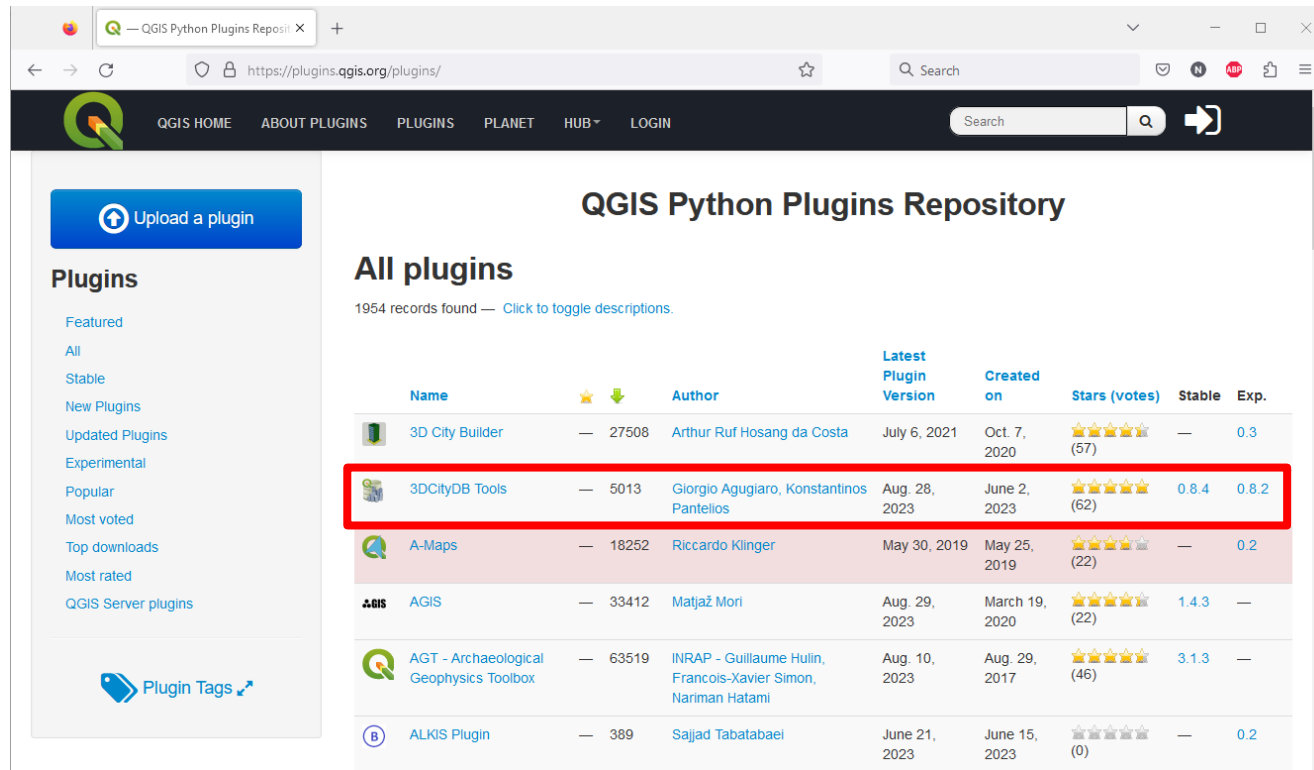
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The screenshot displays the GitHub repository page for `tudelft3d/3DCityDB-Tools-for-QGIS`. The repository is public and has 499 commits. The file list shows a folder named `user_guide`, which is highlighted by a callout box. This callout box contains a graphic with the TU Delft logo, the text "3DCityDB Tools for QGIS", and "Installation and user guide".

QGIS Python Plugins Repository: <https://plugins.qgis.org/plugins/>

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The screenshot shows the QGIS Python Plugins Repository website. The main heading is "QGIS Python Plugins Repository" and "All plugins". Below this, it states "1954 records found" and "Click to toggle descriptions". A table lists various plugins with columns for Name, Author, Latest Plugin Version, Created on, Stars (votes), Stable, and Exp. The "3DCityDB Tools" plugin is highlighted with a red box.

| Name | ★ ↓ | Author | Latest Plugin Version | Created on | Stars (votes) | Stable | Exp. |
|---|---------|--|-----------------------|----------------|---------------|--------|-------|
| 3D City Builder | — 27508 | Arthur Ruf Hosang da Costa | July 6, 2021 | Oct. 7, 2020 | ★★★★★ (57) | — | 0.3 |
| 3DCityDB Tools | — 5013 | Giorgio Aguiaro, Konstantinos Pantelios | Aug. 28, 2023 | June 2, 2023 | ★★★★★ (62) | 0.8.4 | 0.8.2 |
| A-Maps | — 18252 | Riccardo Klinger | May 30, 2019 | May 25, 2019 | ★★★★★ (22) | — | 0.2 |
| AGIS | — 33412 | Matjaž Mori | Aug. 29, 2023 | March 19, 2020 | ★★★★★ (22) | 1.4.3 | — |
| AGT - Archaeological Geophysics Toolbox | — 63519 | INRAP - Guillaume Hulin, Francois-Xavier Simon, Nariman Hatami | Aug. 10, 2023 | Aug. 29, 2017 | ★★★★★ (46) | 3.1.3 | — |
| ALKIS Plugin | — 389 | Sajjad Tabatabaei | June 21, 2023 | June 15, 2023 | ★★★★★ (0) | — | 0.2 |

Thank you for your attention!



3DCityDB Tools

for

QGIS