

CityGML 3DCityDB-Loader plugin for QGIS

A quick overview

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Overview

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- Plugin overview
- Software installation
- Software use
- Advanced options
- Software uninstall
- Current limitations
- Resources

Motivation

Motivation

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IDEA:

- Why not letting users benefit from directly working with the CityGML 3D City Database (aka 3DCityDB)?
 - No need to work with files
 - Editing of features attributes could become way easier
 - SQL/relational model are rather well-known in the user community
 - Last but not least.... "3D city models belong best in a database" ☺

Motivation

BUT:

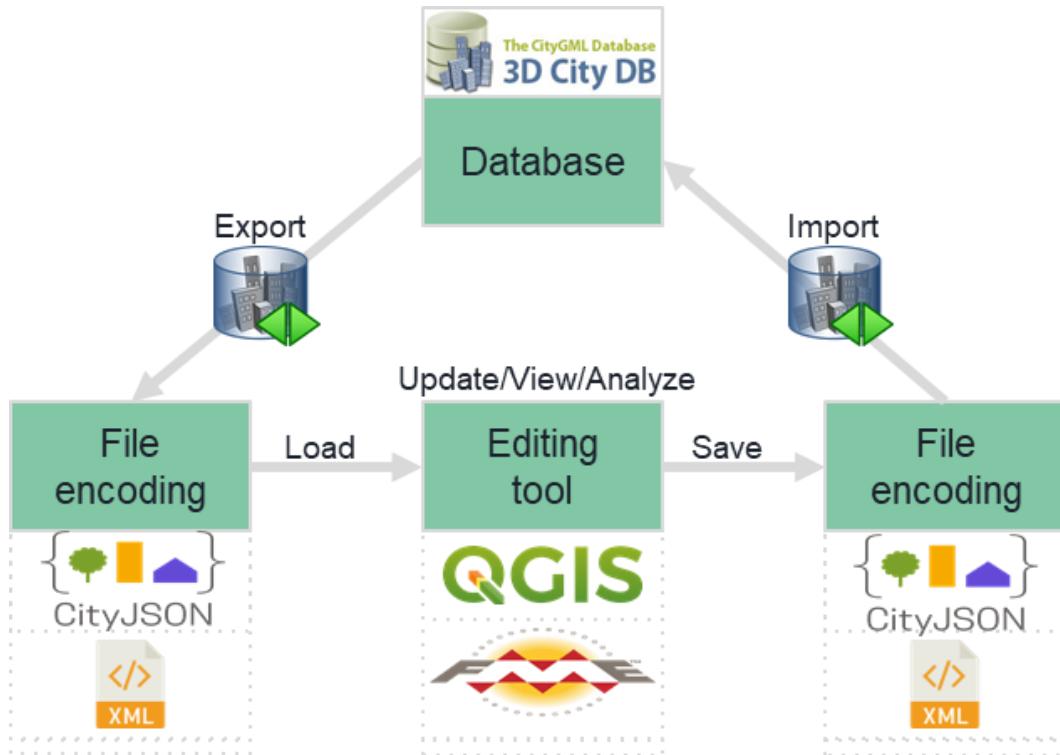
- 3DCityDB structure is rather complex
 - Lots of nested tables, complex structure
 - Data management is difficult, although some functions are provided (e.g. delete functions)
 - There can be multiple "scenarios" in the same database instance ("citydb_1", "citydb_2", "citydb_3", ...)
- CityGML does not follow the Simple Feature Model (SFM)
 - Nested features
 - One feature can have multiple representations (multiple LoDs, multiple geometry types)
- The existing Importer/Exporter offers some functionalities, but its *raison d'être* is basically different (...as the name says!)

Motivation

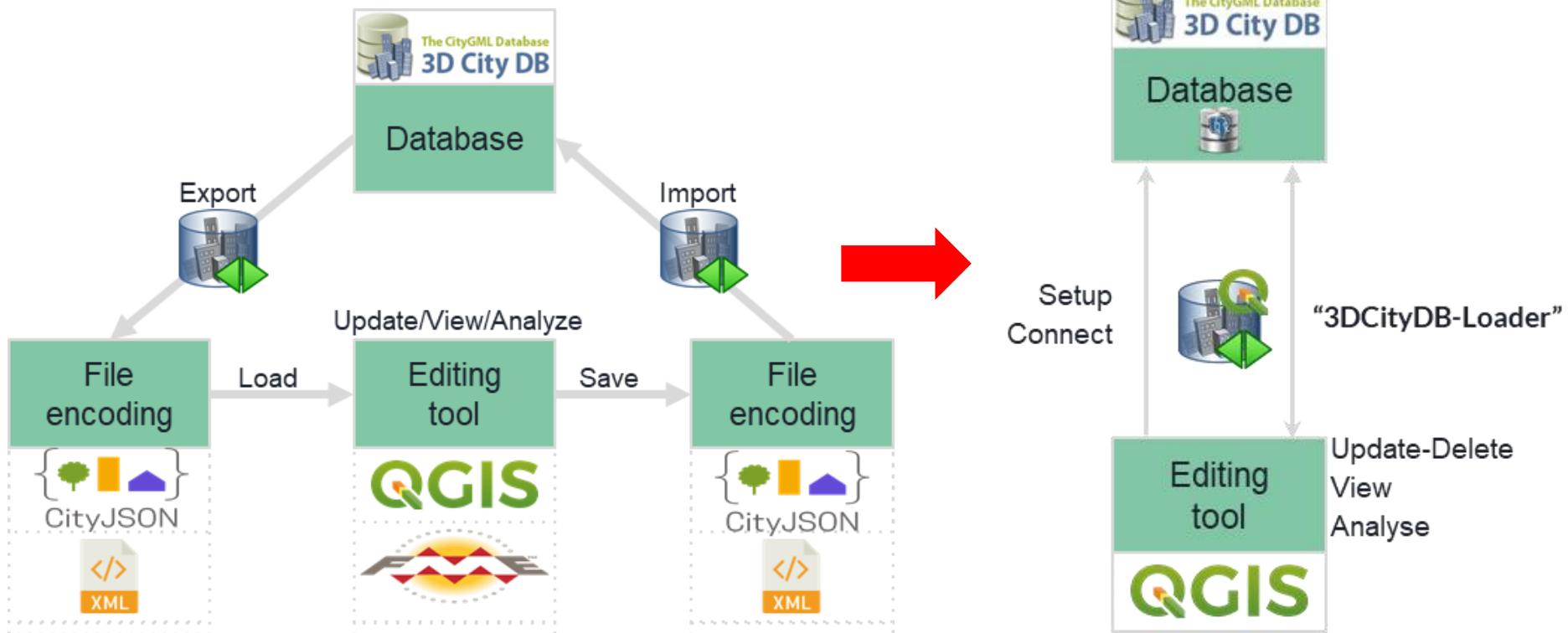
SO:

- Why not using QGIS?
 - Well-known and established open-source software
 - Rather mature, version 3.22 released in autumn 2021, well documented
 - Native support for PostgreSQL/PostGIS, support also for Oracle Spatial
 - Has strong 2D and some (less mature) 3D visualisation functionalities
 - Can be extended with Python-based plugins

Motivation



Motivation



Plugin overview

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Main functionalities

- Create "SFM-like" layers to hide 3DCityDB complexity when interacting with data
 - Deal efficiently with multi-LoD / different geometries / implicit representations
 - Up to 530+ possible combinations from CityGML
 - Merge all standard attributes of a cityobject into a single "table"
- Deal with the (possible) *huge* size of city models stored in a database
- Support for multiple users with different privileges (read-only, read-write)
- Editing of attributes: possible (depending on user privileges)
- Deletion of features: possible (depending on user privileges)
- Editing of geometries: NOT possible
- Support for multiple 3DCityDB scenarios (aka "citydb schemas")

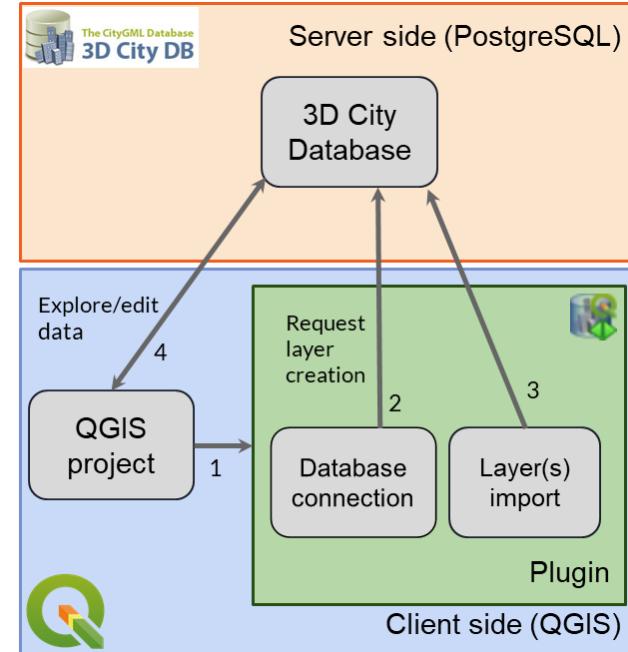
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Server-side

PostgreSQL "QGIS Package"

- Create and manage layers as views (for attributes) linked to materialized views (for geometry) following the SFM
- Manage users and privileges
- Manage multiple scenarios ("citydb schemas")
- Add default users with ro & rw privileges



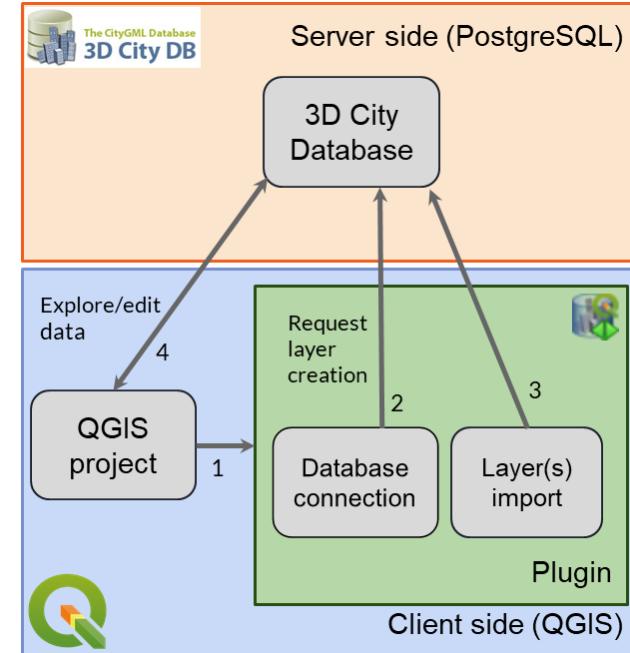
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Client-side

QGIS plugin “3DCityDB-Loader”

- Manage database connections + QGIS Package installation
- GUI-based layer creation and management
- GUI-based management of multiple scenarios
- GUI-based attribute editing via “attribute forms”
- Include CityGML enumerations and children tables (e.g. generic attributes) + optionally codelists
- Create a hierarchical QGIS Table of Contents
- Apply standard colours per feature type



BEWARE

The following slides assume that you are already familiar with the 3DCityDB Suite

In particular you must:

- Have an already installed 3DCityDB database instance
- Be able to use the 3DCityDB Importer/Exporter
- Be able to import CityGML data into the 3DCityDB
- (Optionally) be able to create additional citydb schemas

Otherwise, here a tutorial: <https://github.com/3dcitydb/tutorials>

Last but not least...

- You need at least a basic knowledge of the main CityGML concepts ☺
- Otherwise, here a crash course: <http://www.urbangeobigdata.it/?p=195>

Installation

Software requirements

- CityGML 3D City Database v.4.x or higher for PostgreSQL
 - Tested on PostgreSQL v.12 and higher
 - Currently testing with older PostgreSQL versions
 - <https://github.com/3dcitydb/3dcitydb-suite/releases>
 - <https://3dcitydb-docs.readthedocs.io/en/latest/>
 - **BEWARE:** 3DCityDB v. 3.x and older NOT supported!
- QGIS 3.22
 - Works from v. 3.20 onwards
 - Currently NOT compatible with older versions
 - <https://qgis.org/en/site/forusers/download.html>
- PgAdmin (suggested, not required)
 - <https://www.pgadmin.org/download/>

Installation

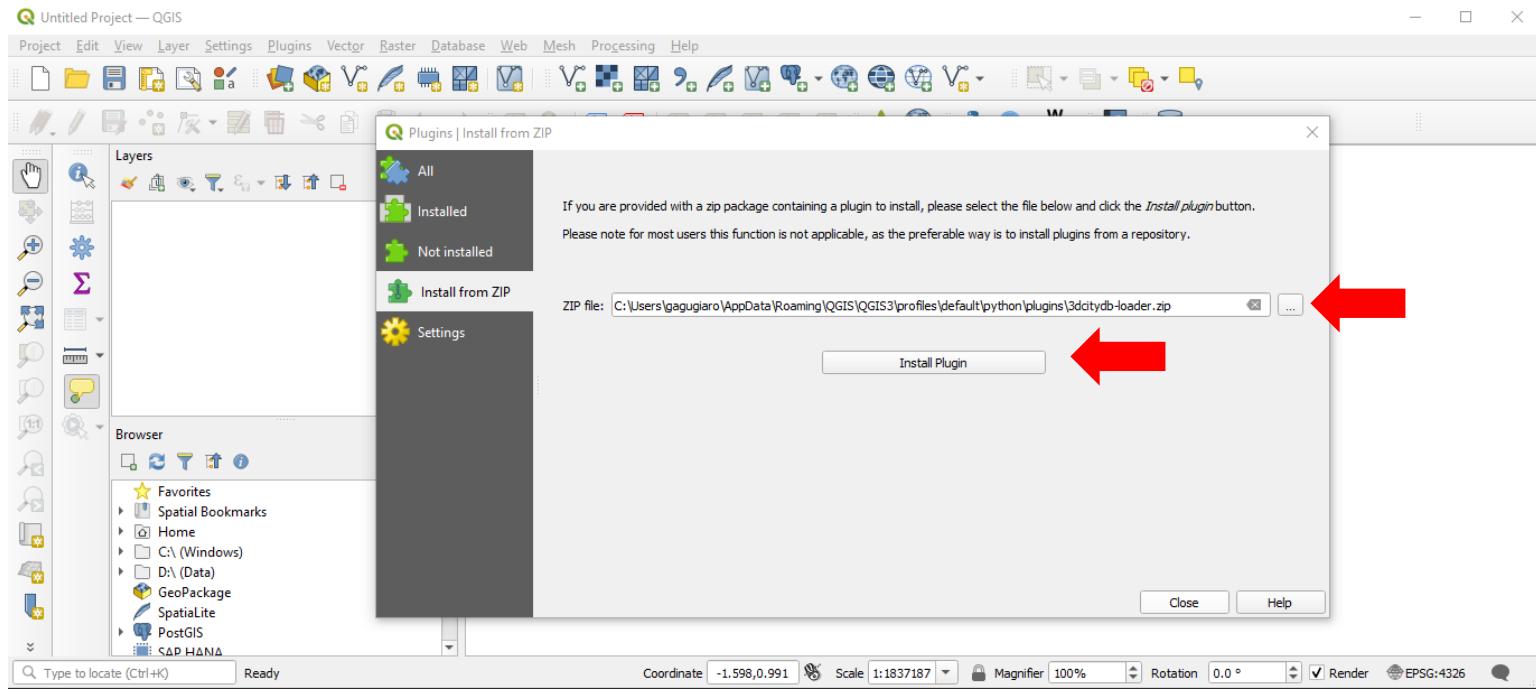
3DCityDB-Loader compatibility matrix as of June 2022

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QGIS version	3DCityDB-Loader works?	Comments
QGIS 3.24	✓	Works
QGIS 3.22 LTR	✓	Works
QGIS 3.20	✓	Works
QGIS 3.18	✗	"Import selected layers" button always disabled
QGIS 3.16 LTR	✗	User's GUI won't load. Issues with (outdated?) method QgsExtentGroupBox.setMapCanvas()

Installation

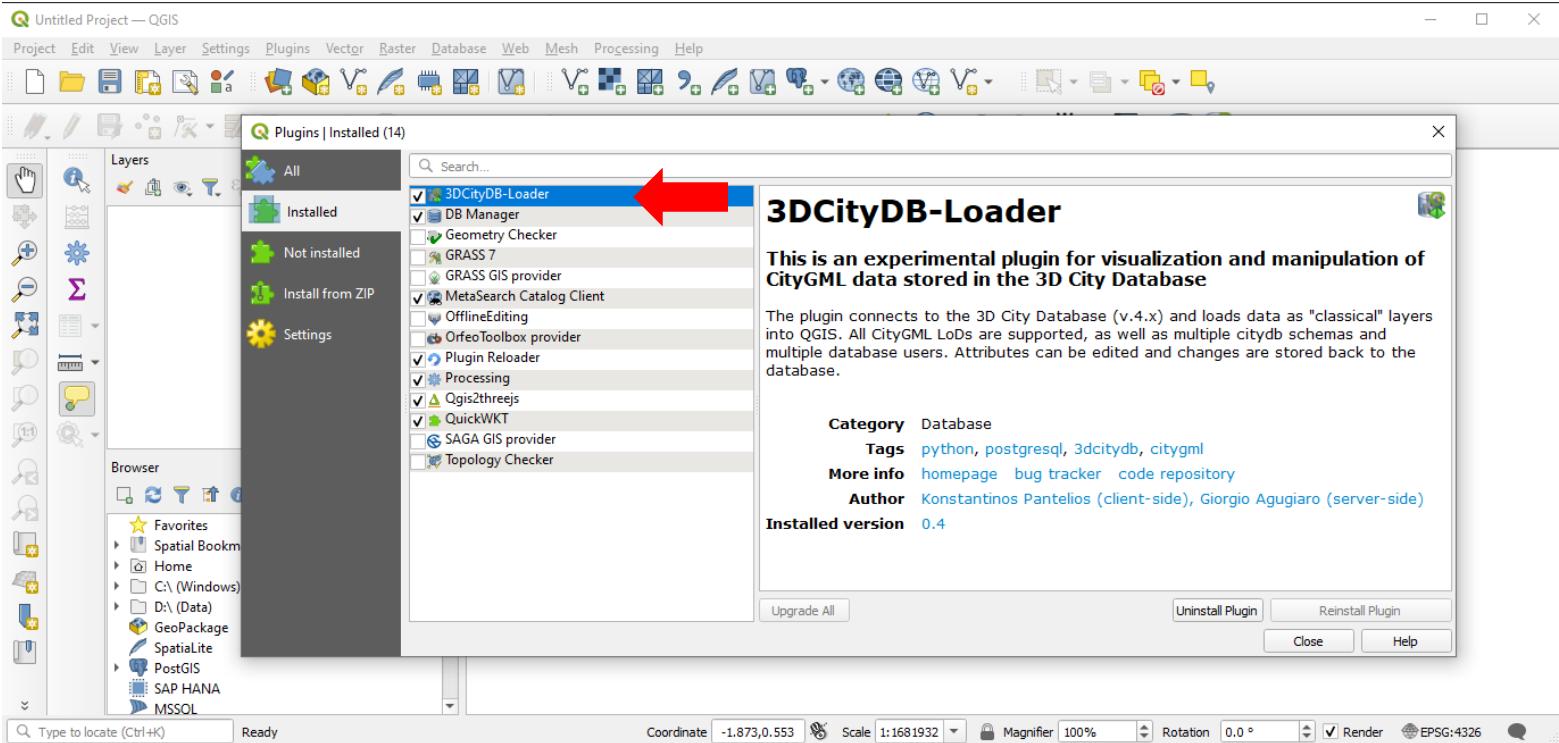
- The "3DCityDB-Loader" for QGIS is currently available as zip file
- In QGIS, open the Plugins\Manage and install plugins window, and choose "Install from ZIP". Select the provided zip file and click the "Install Plugin" button



Installation

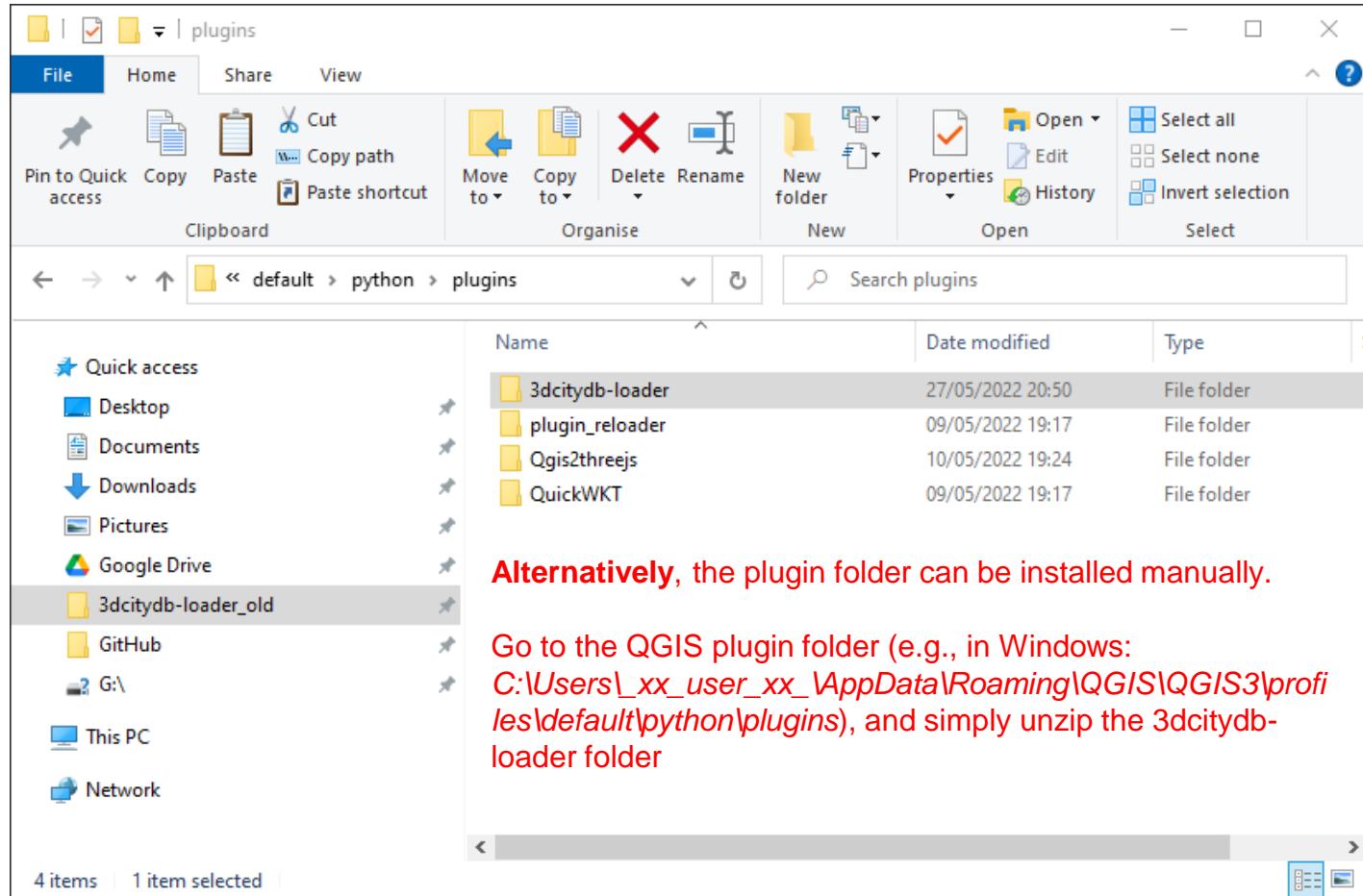
- Upon installation, you must activate the plugin

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Installation

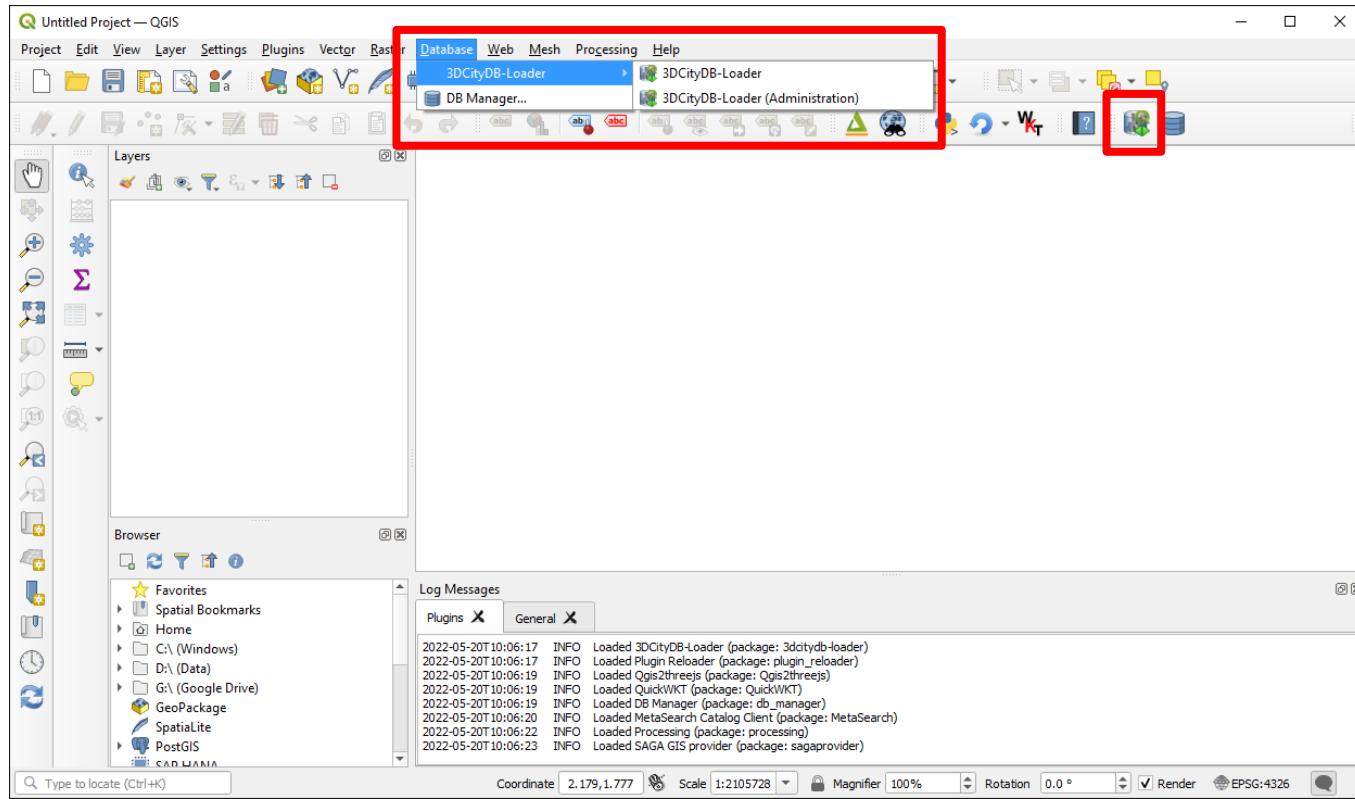
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Installation

The Database menu will now contain a new entry, and the icon will be visible in the database icon bar (if the icon bar is activated)

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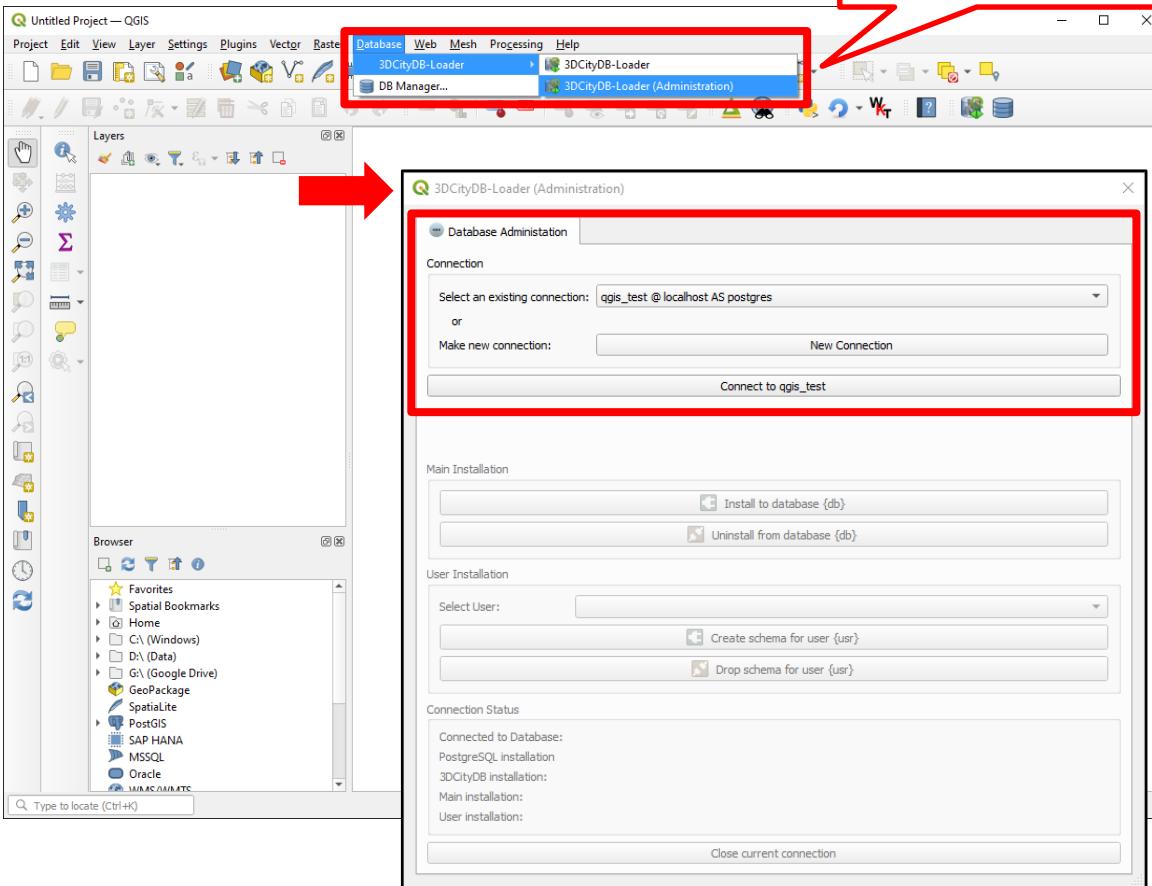
Use: As database administrator

Watch out! Pick the Administration one!

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The database administrator (superuser) is responsible for setting up in advance the server-side part of the plugin for *any* user

1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis_test")

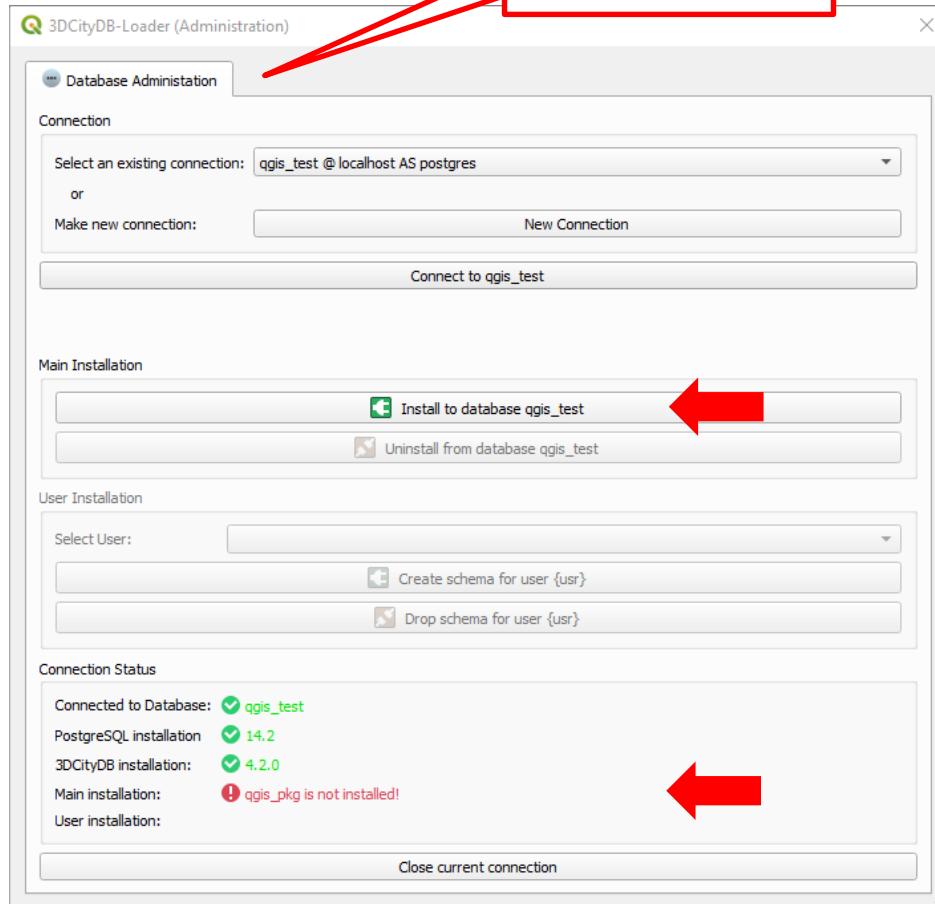


Use: As database administrator

Watch out! Pick the Administration one!

2) Install the QGIS Package ("Main installation")

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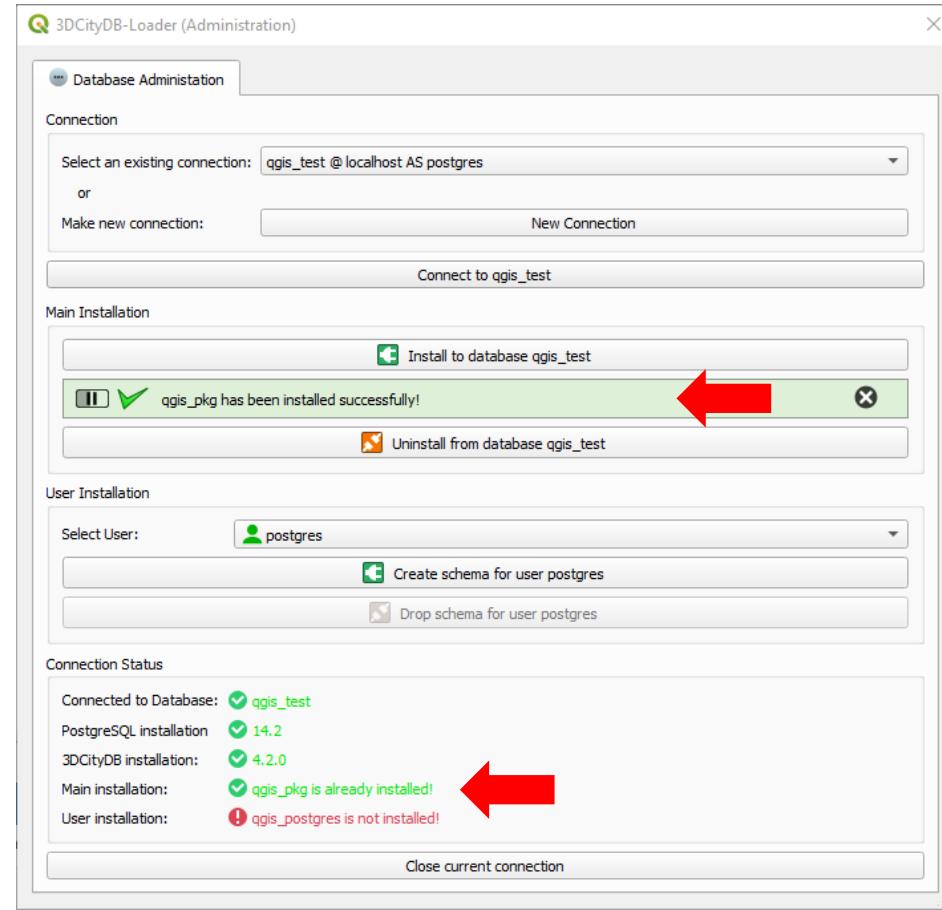
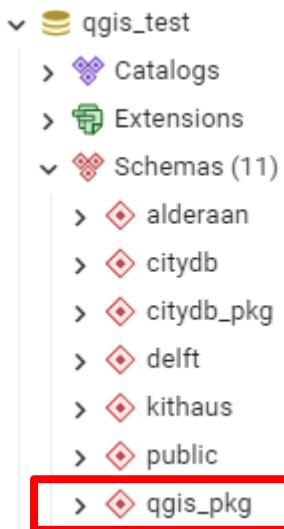


Use: As database administrator

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2) Install the QGIS Package ("Main installation")

Upon successful installation, in the 3DCityDB, a "qgis_pkg" database schema is created

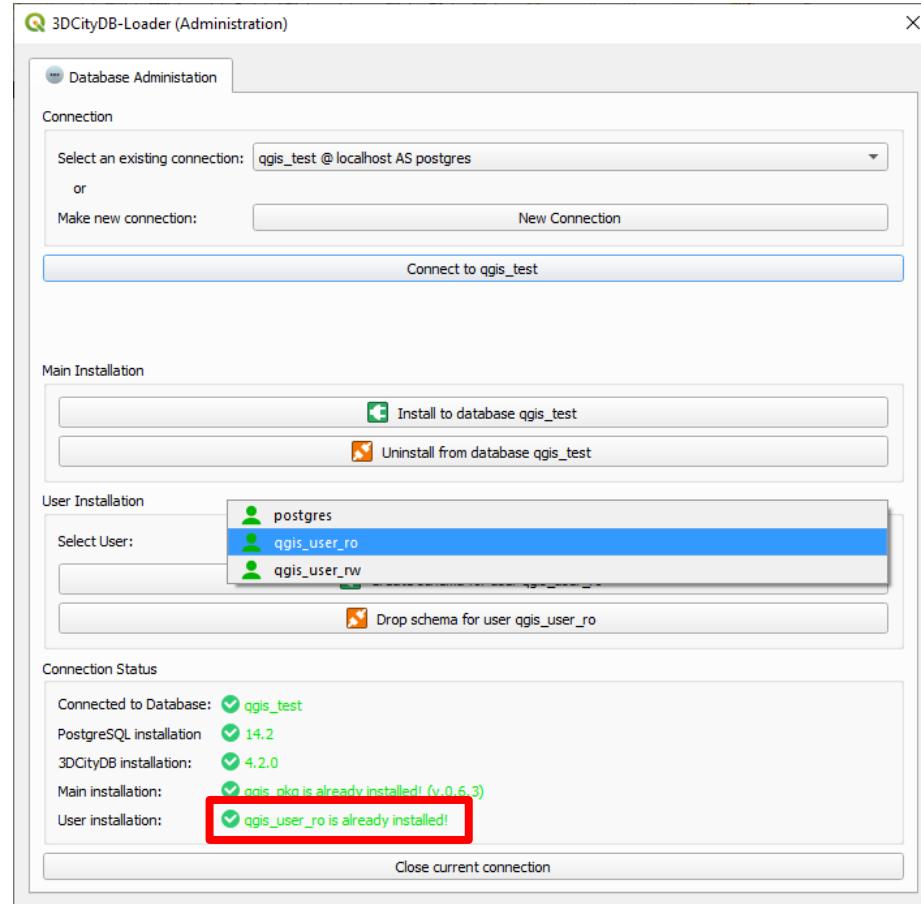


Use: As database administrator

3) (Optionally) create user schemas

In order to use the plugin, a user needs a schema, named "qgis_" + username

- 2 users are **automatically** added, and their schemas created by default ("qgis_user_ro", "qgis_user_rw")
- You can also create the user schema for database user "postgres" (NOT recommended!)
- For other database users, see the **Advanced options** slides (later on)



Use: As database administrator

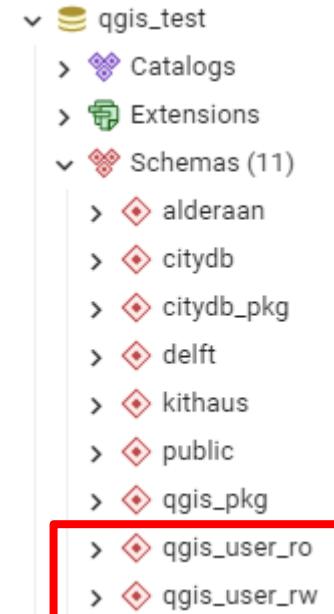
- 3) (Optionally) create user schemas.

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- For other database users, see the **Advanced options** slides (later on)

Connection parameter:

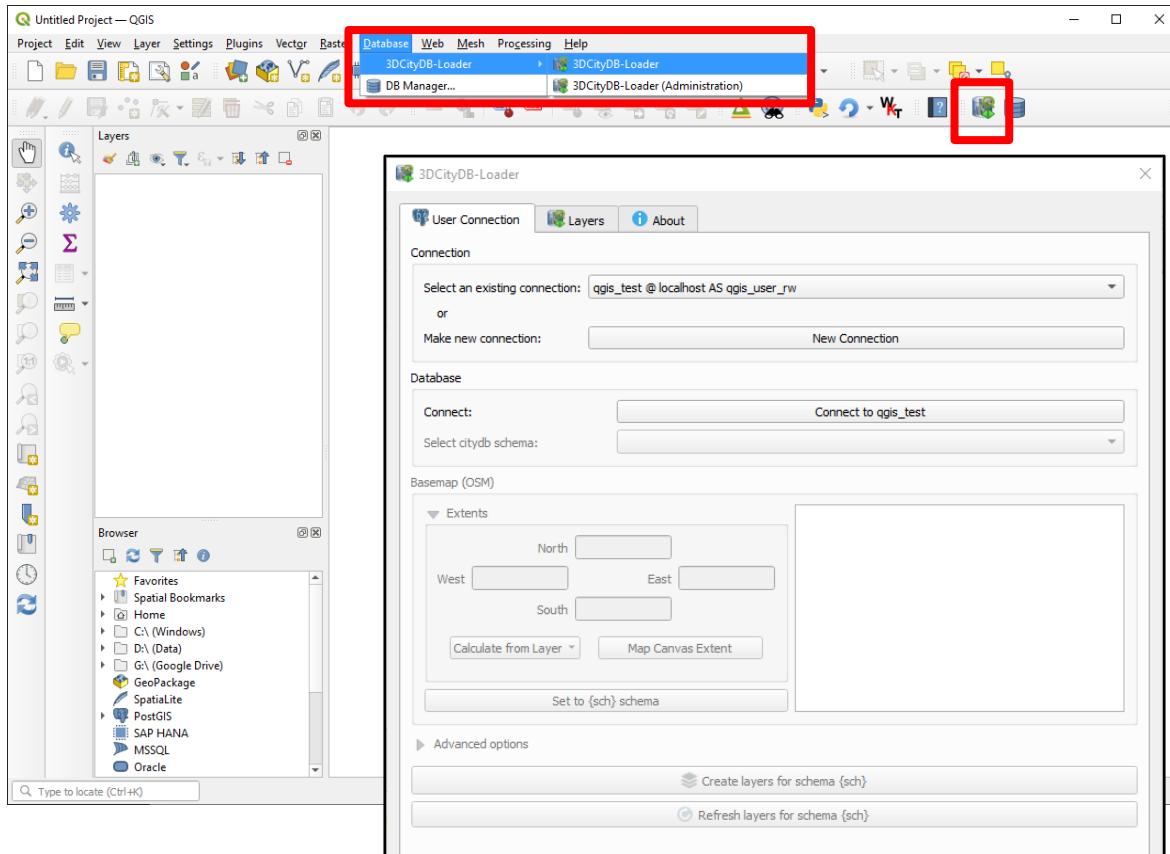
- Login/password: "qgis_user_ro"
- Login/password: "qgis_user_rw"



Use: As user

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As "normal" user
open the plugin
from the menu or
by clicking on the
icon



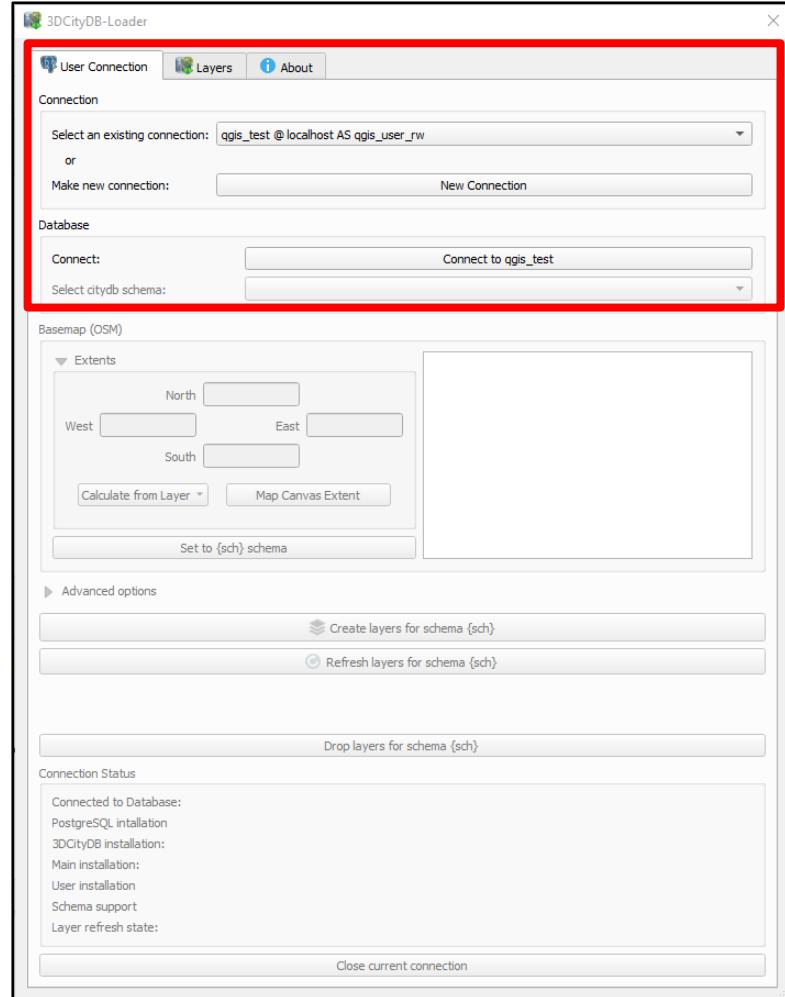
Use: As user

In the "Software user connection" tab

- 1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis_test")

- 2) Use the credentials of the default users:
 - "qgis_user_ro" has read-only privileges
 - "qgis_user_rw" has read-write privileges

(You may also connect with your own credentials if the administrator has set up your user schema)



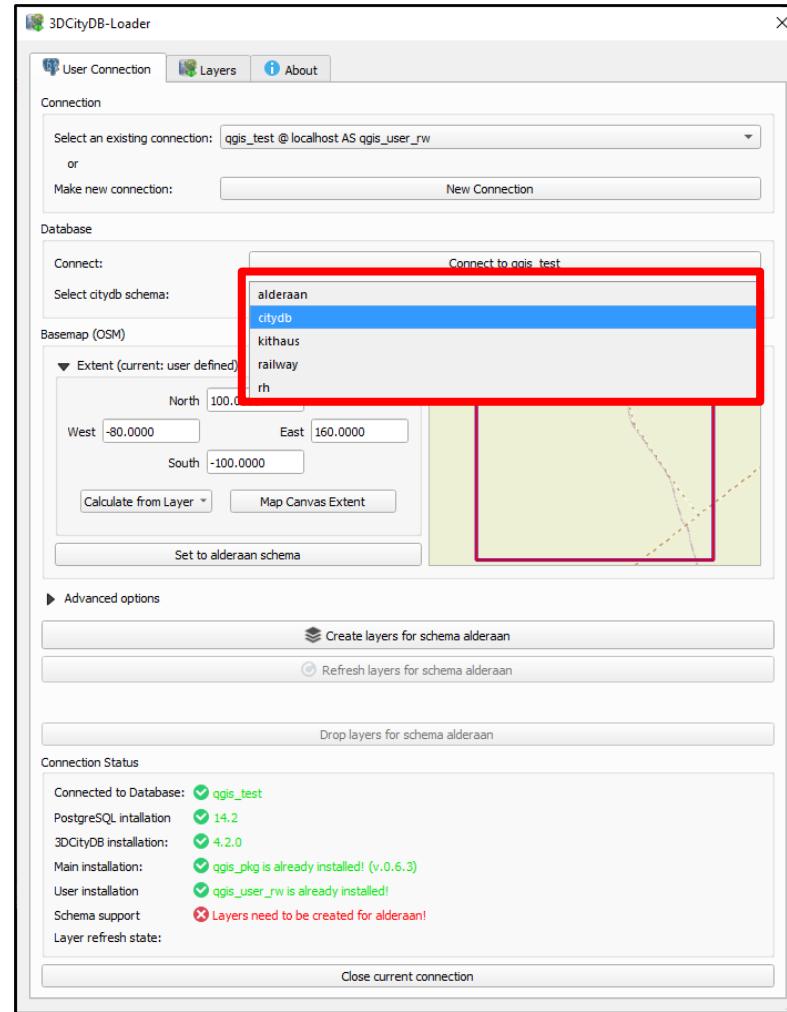
Use: As user

In the "User connection" tab

- 3) Choose one of the existing scenarios (i.e. citydb schemas). If they contain CityGML data, they will be listed.
The "citydb" one is the most common one

Nota bene: the next slides refer to the "rh" schema

How to create additional citydb schemas
<https://3dcitydb-docs.readthedocs.io/en/latest/3dcitydb/multi-schema.html>

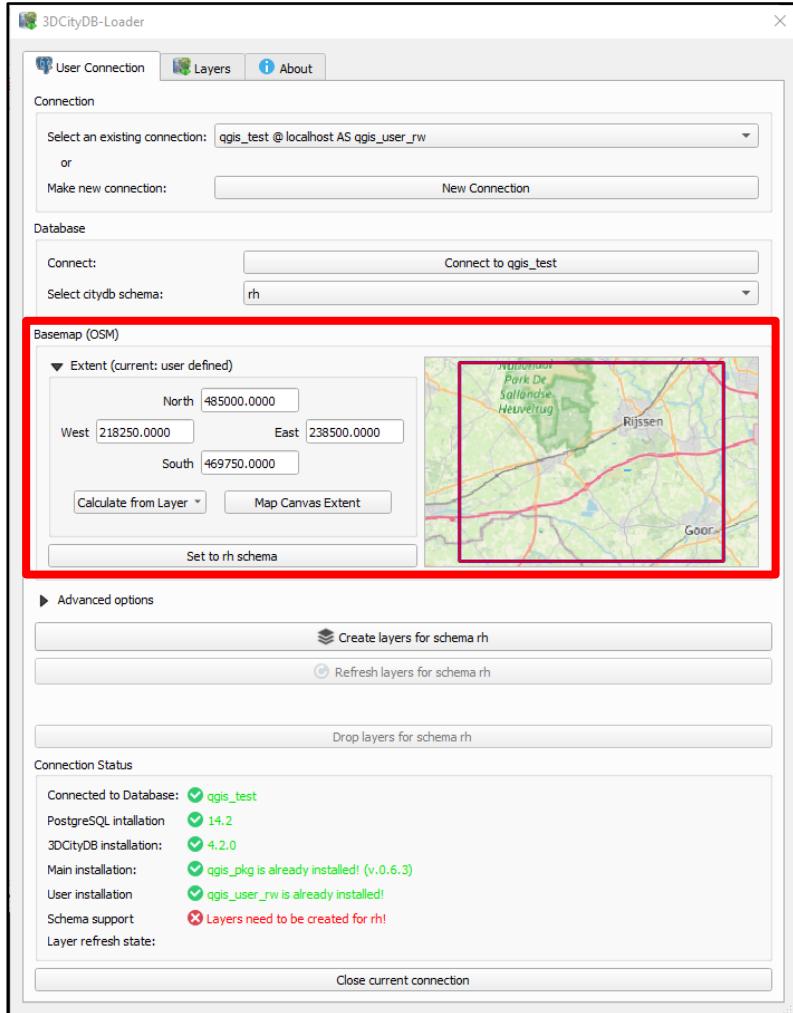


Use: As user

In the "User connection" tab

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4) Upon selection of the database schema, you will see the extents of the dataset



Use: As user

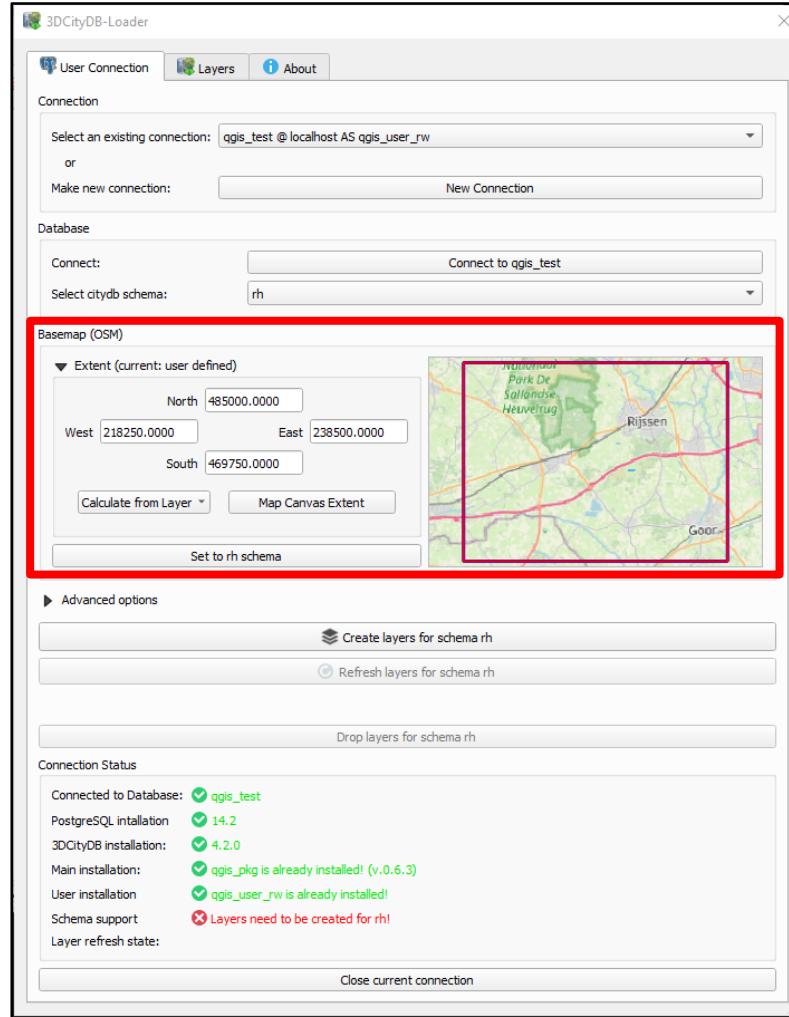
In the "User connection" tab

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- 5) Depending on your needs, you can set the spatial extents of the study area for which the layers will be created
- Default: same size of the whole dataset
 - Otherwise: zoom in the map and choose your own area

Beware: the bigger the size, the more time it will take to populate the layers!

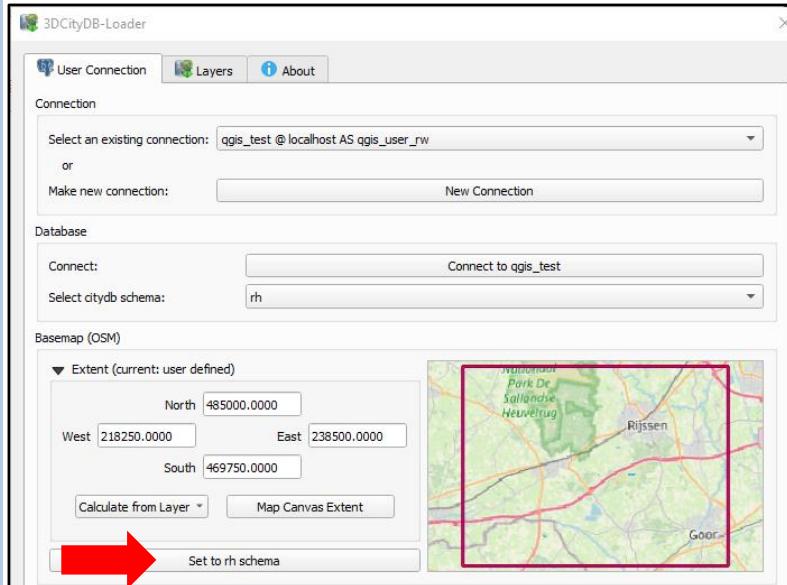
Behind the scenes: In the database, materialised views of the geometries will be generated according to the selected extents. In case of very large cities, it might take a long time (and a lot of space on the server)!



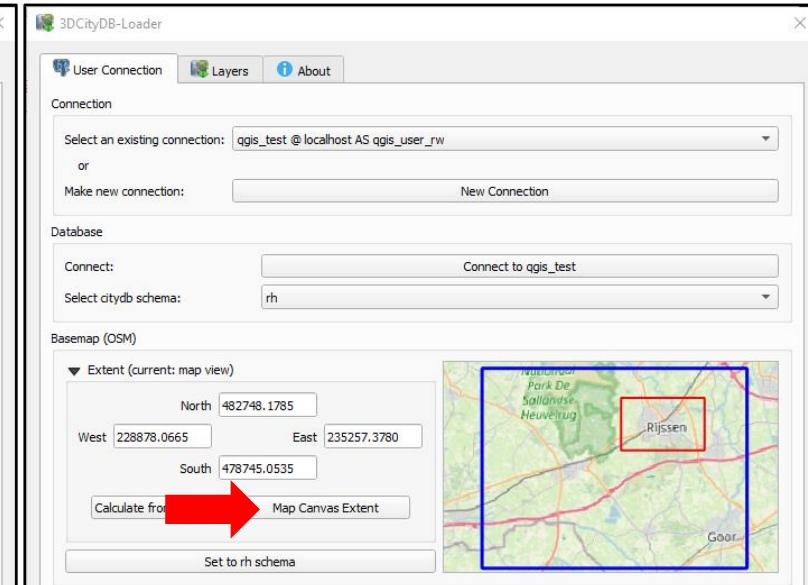
Use: As user

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Blue: database schema extents (i.e. extents of the whole city model/dataset)
Red: database-side layers extents (i.e. extents of the materialised views)



Both areas coincide (default)



User-selected layers extents

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Use: As user

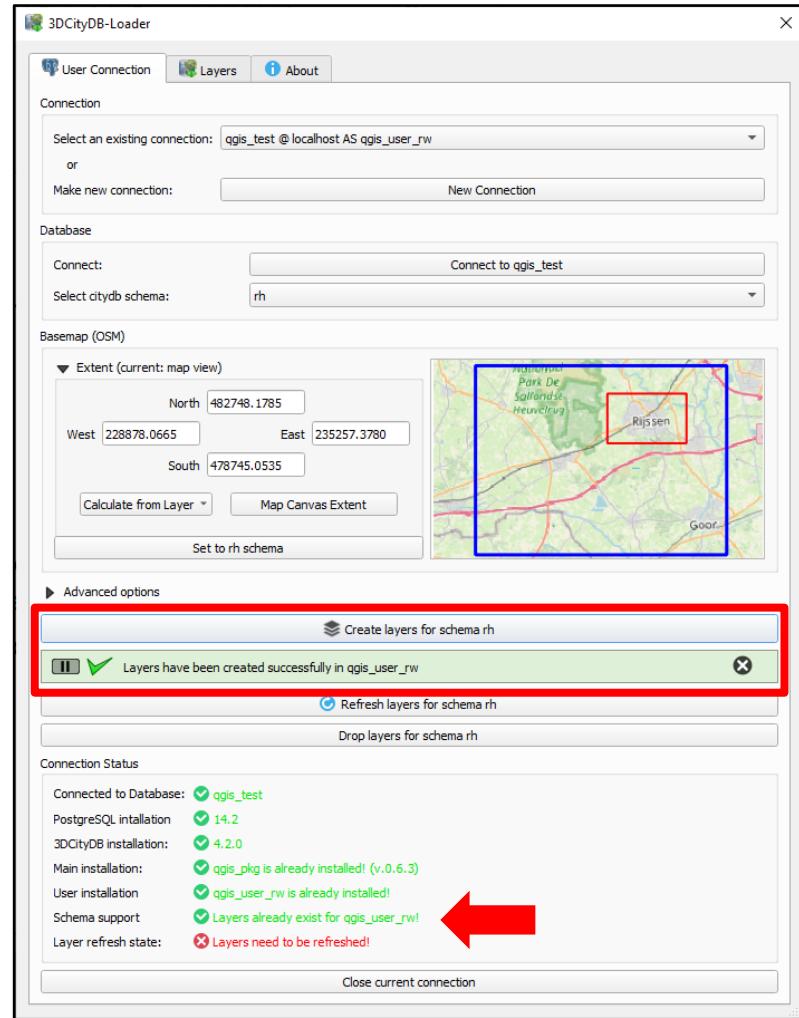
In the "User connection" tab

6) Create the layers

Otherwise, if available, layers created in a previous session can be used

Behind the scenes: In the database, (empty) materialised views of the geometries and views will be created as layers.

Only layers for *existing* data will be created.



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Use: As user

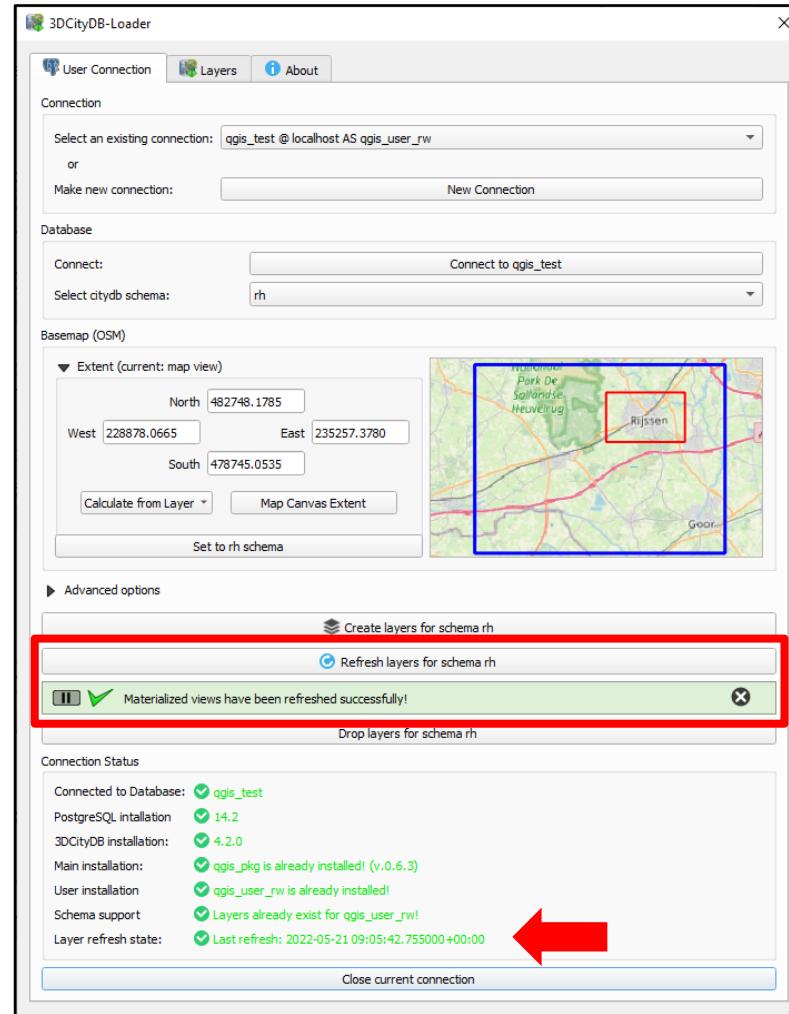
In the "User connection" tab

7) Populate/refresh the layers

Otherwise, if available, layers created in a previous session can be used (or refreshed again)

Beware: depending on the size of the selected area, and the amount of data in the city model, this operation might take long.

Behind the scenes: In the database, the materialised views of the geometries are refreshed.



Use: As user

Behind the scenes:

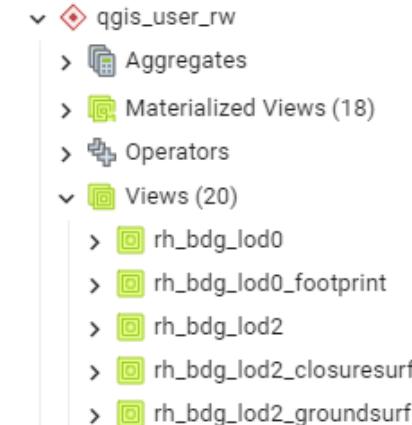
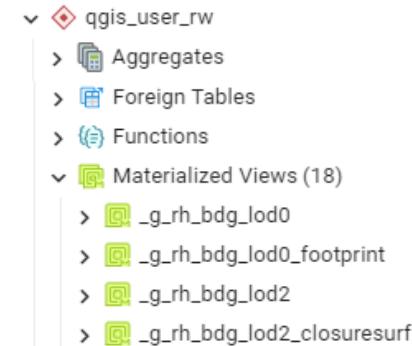
In the database user schema, both materialised views (containing the feature geometries) and the layers (as updatable views, containing the feature attributes linked to the corresponding geometries in the materialised views) can be accessed.

Materialised views name coding:

- "_g_" prefixed + citydb schema name + feature name + lodx + (optional) semantic details

Views name coding:

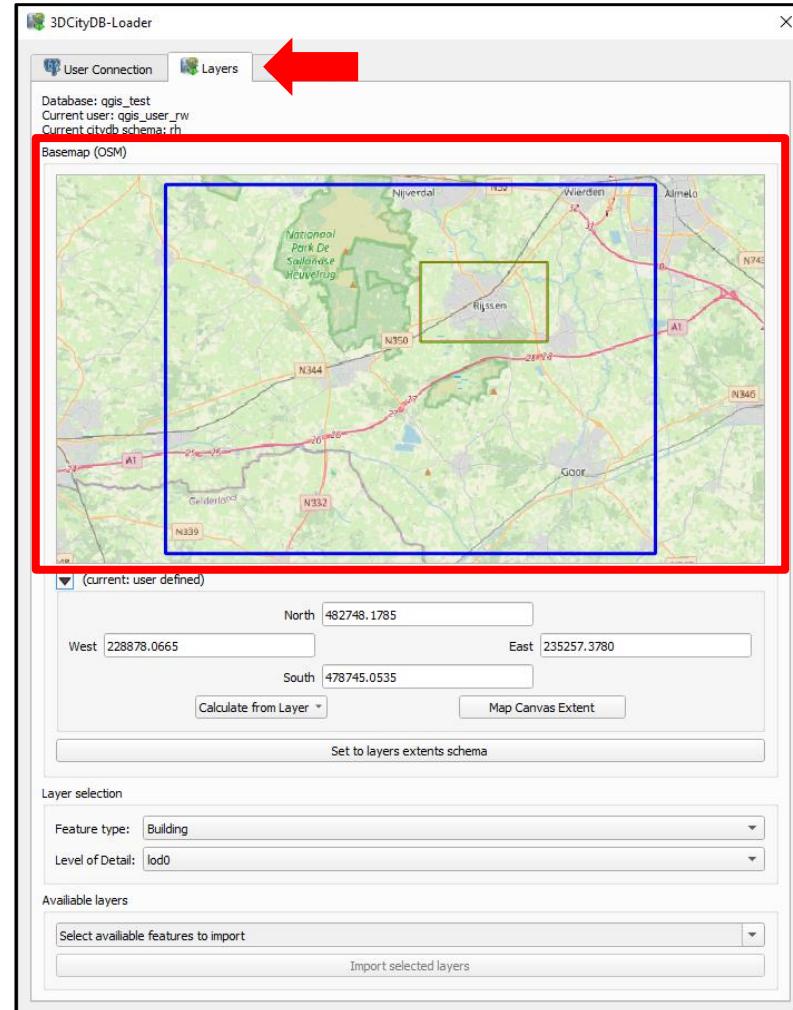
- citydb schema name + feature name + lodx + (optional) semantic details
- Linked via column co_id (PK and FK to the materialised views)



Use: As user

In the "Layers" tab

- 8) The dataset and the (database-side) layer extents are shown again in the map

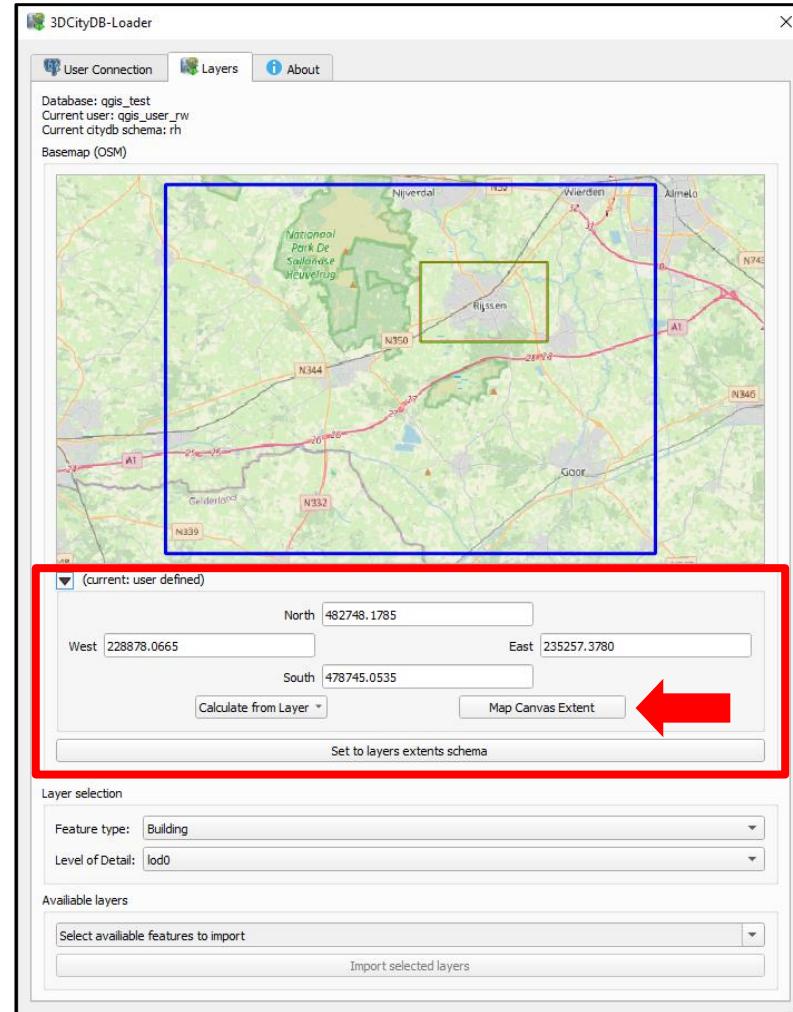


Use: As user

In the "Layers" tab

9) Depending on your needs, you can further reduce the extents of the layers to be loaded into QGIS

- Default: same size of the materialised view extents
- Otherwise: zoom in the map and choose your own area



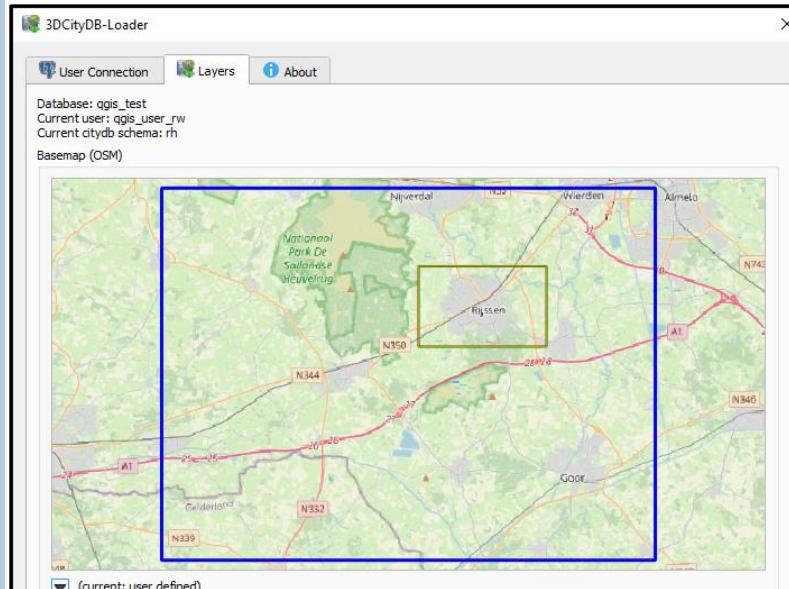
Use: As user

Blue: database schema extents (i.e. extents of the whole city model/dataset)

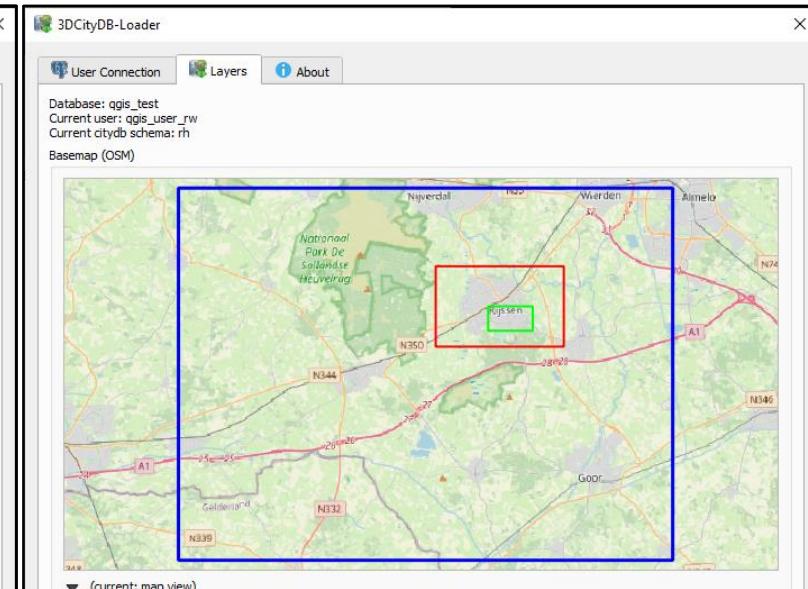
Red: database-side layers extents (i.e. extents of the materialised views)

Green: QGIS-side layers extents (i.e. extents of the data loaded into QGIS)

Remember: **QGIS-extents \subseteq Mat. views extents \subseteq City model extents**



Database- and QGIS-side extents coincide (default)



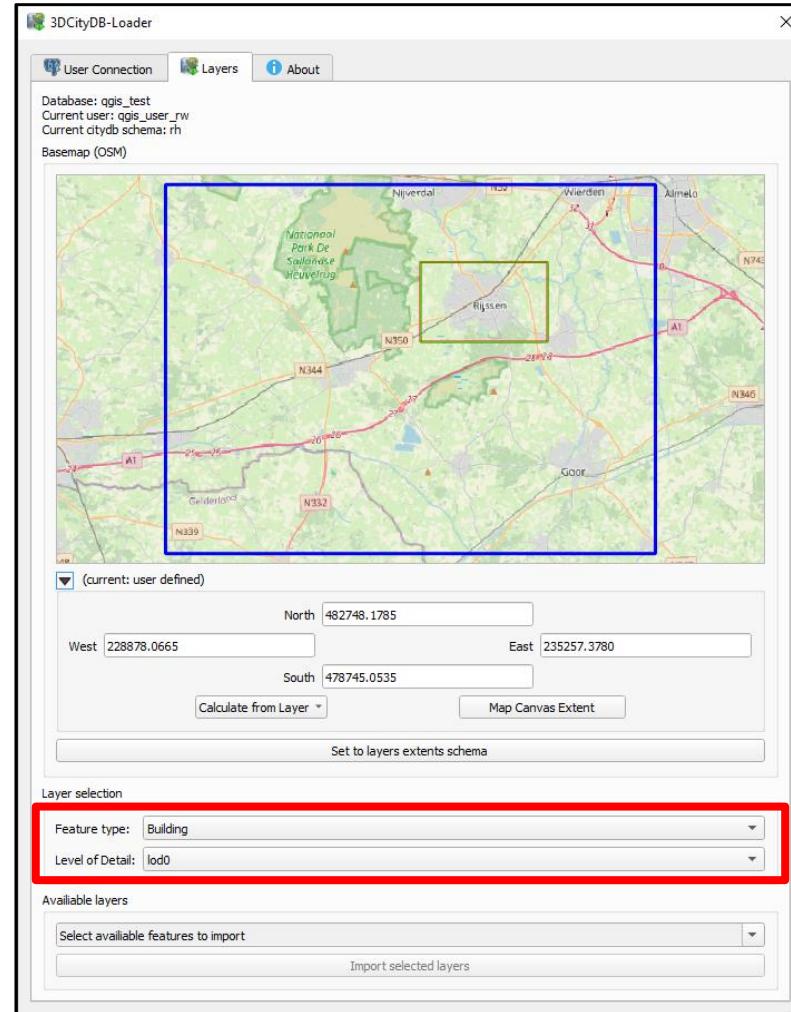
User-selected QGIS-layers extents

Use: As user

In the "Layers" tab

10) Select feature type and LoD

- Layers are grouped according to the CityGML modules (or "Feature Types", such as "Bridge", "Building", "Tunnel", "Relief", etc.)
- Depending on the data stored in the database, only certain Feature Types and LoDs will be selectable



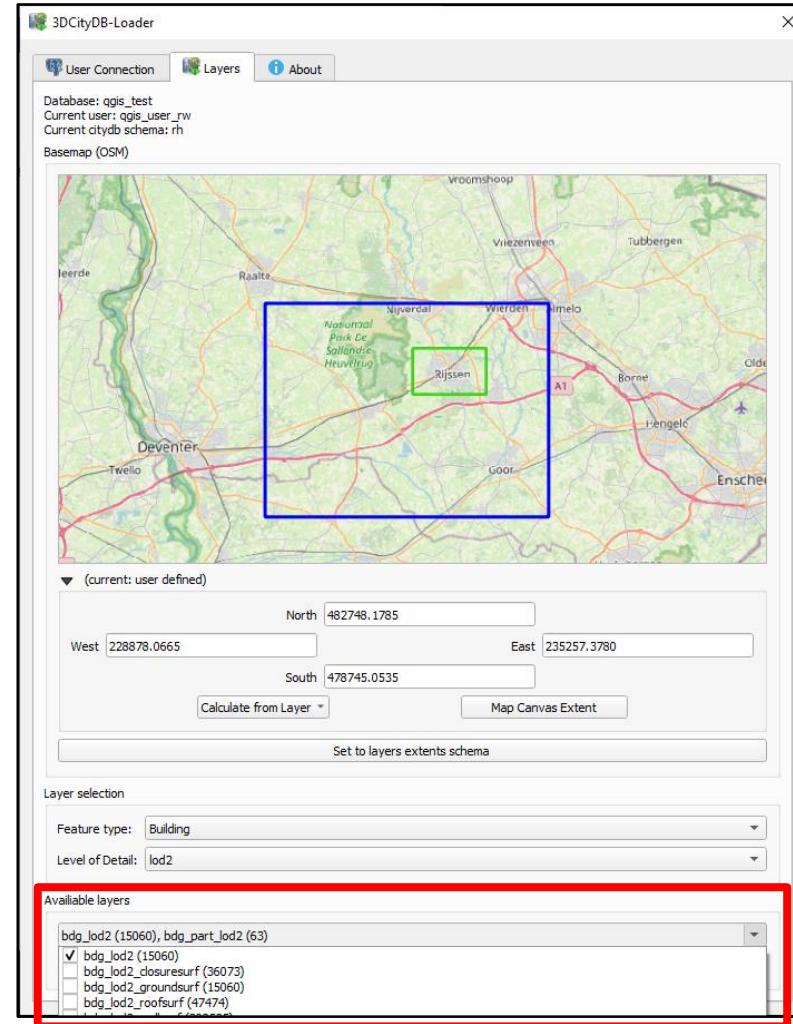
Use: As user

In the "Layers" tab

11) Select the layer(s) to import in QGIS

- The number of available features is shown next to the layer name

Behind the scenes: Depending on the QGIS layers extents, the plugin shows only the available layers for which there are data within the given extents.

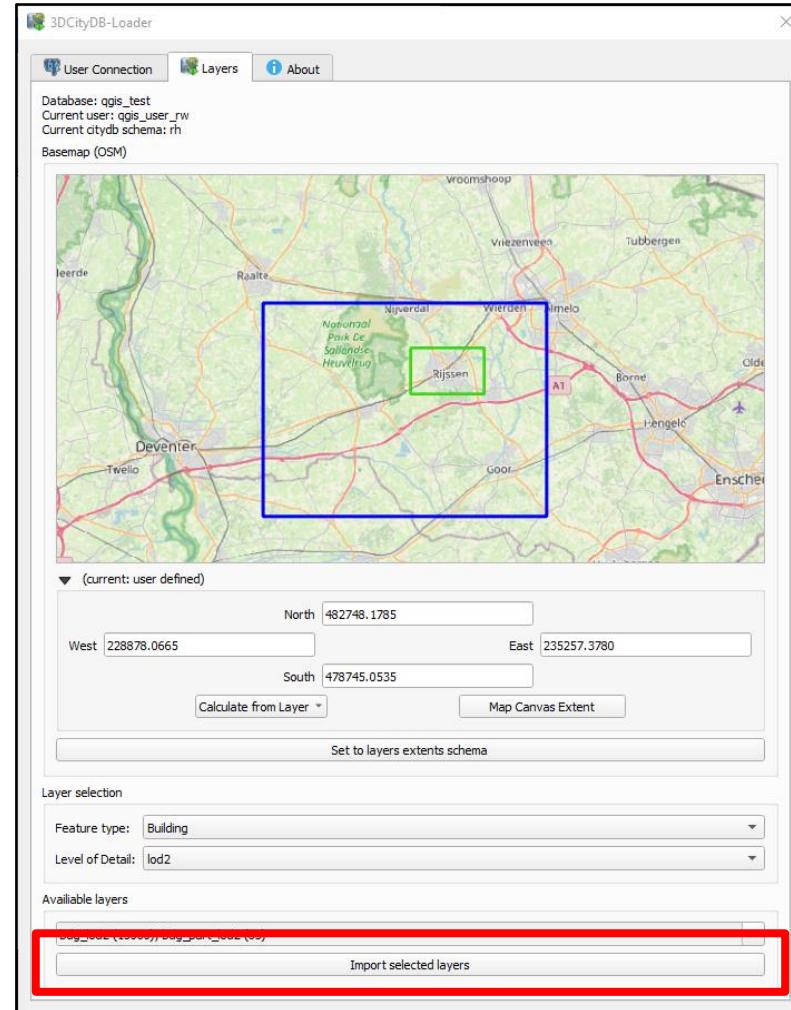


Use: As user

In the "Layers" tab

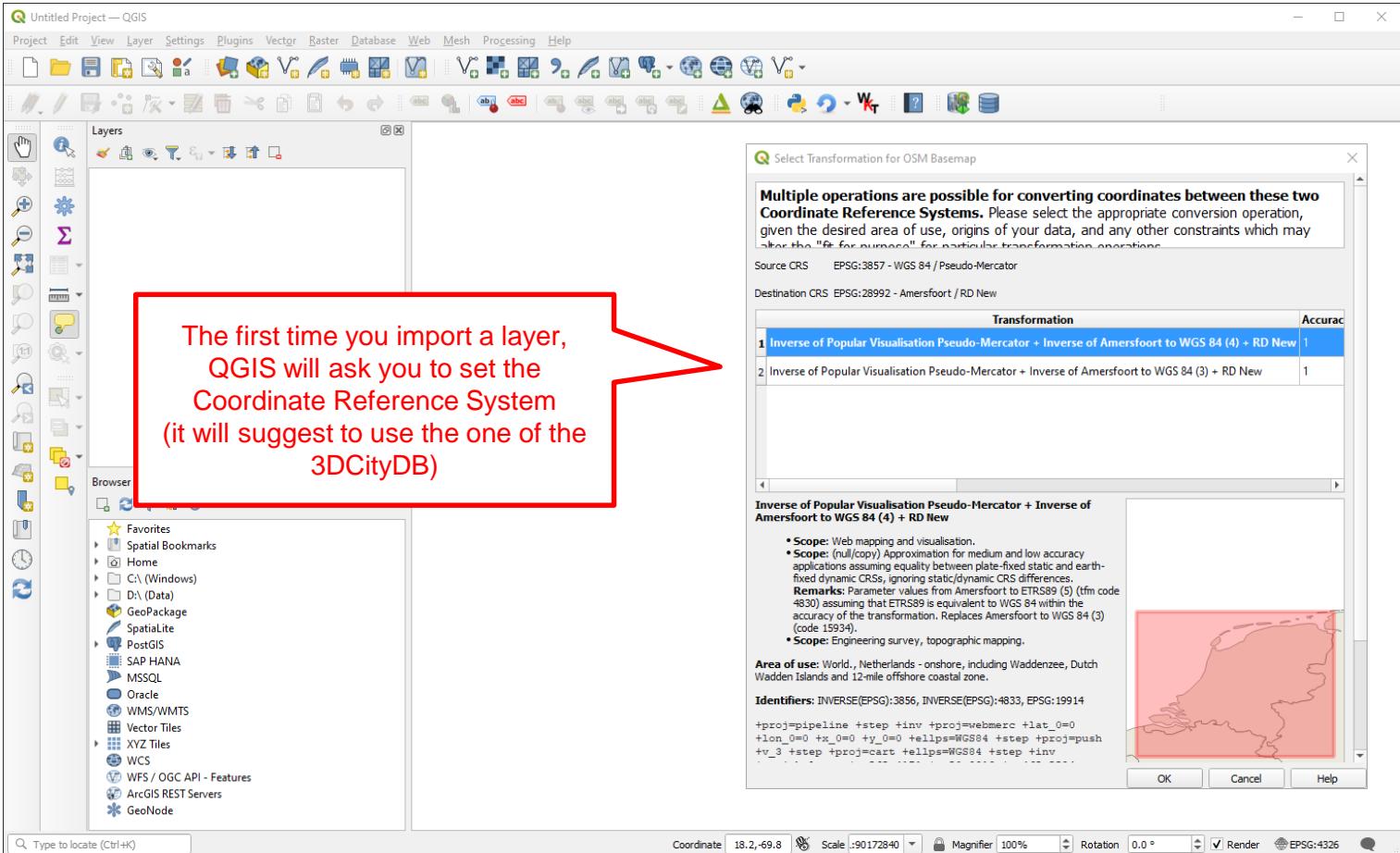
12) Import the selected layers into QGIS

- The import operation can be repeated with different layers
- The layers will be automatically added to the QGIS Table of Contents
- The Plugin window can be closed, the connection parameters and settings will be kept until the connection is intentionally closed by the user (in the "User connection" tab)



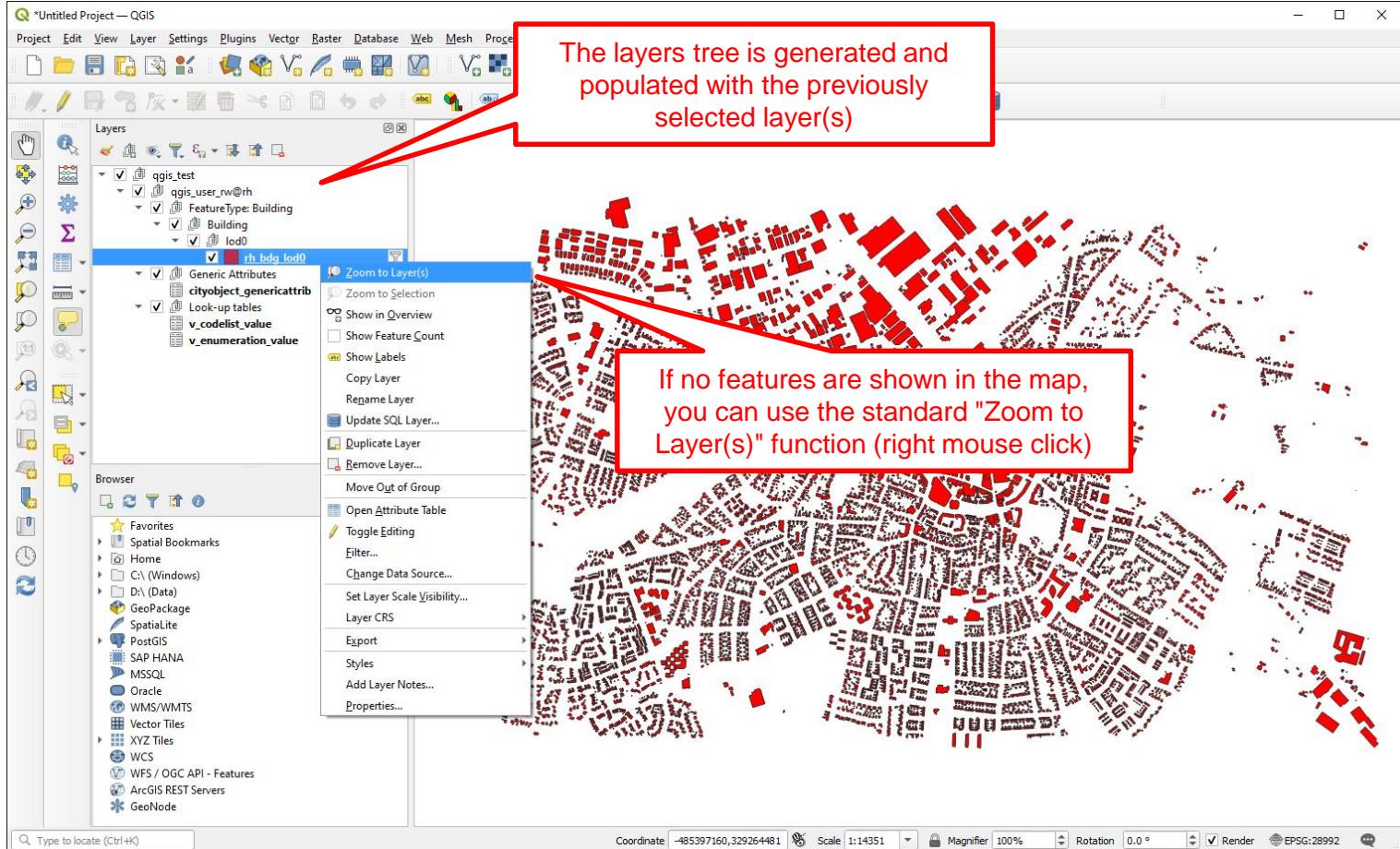
Use in QGIS: Layers

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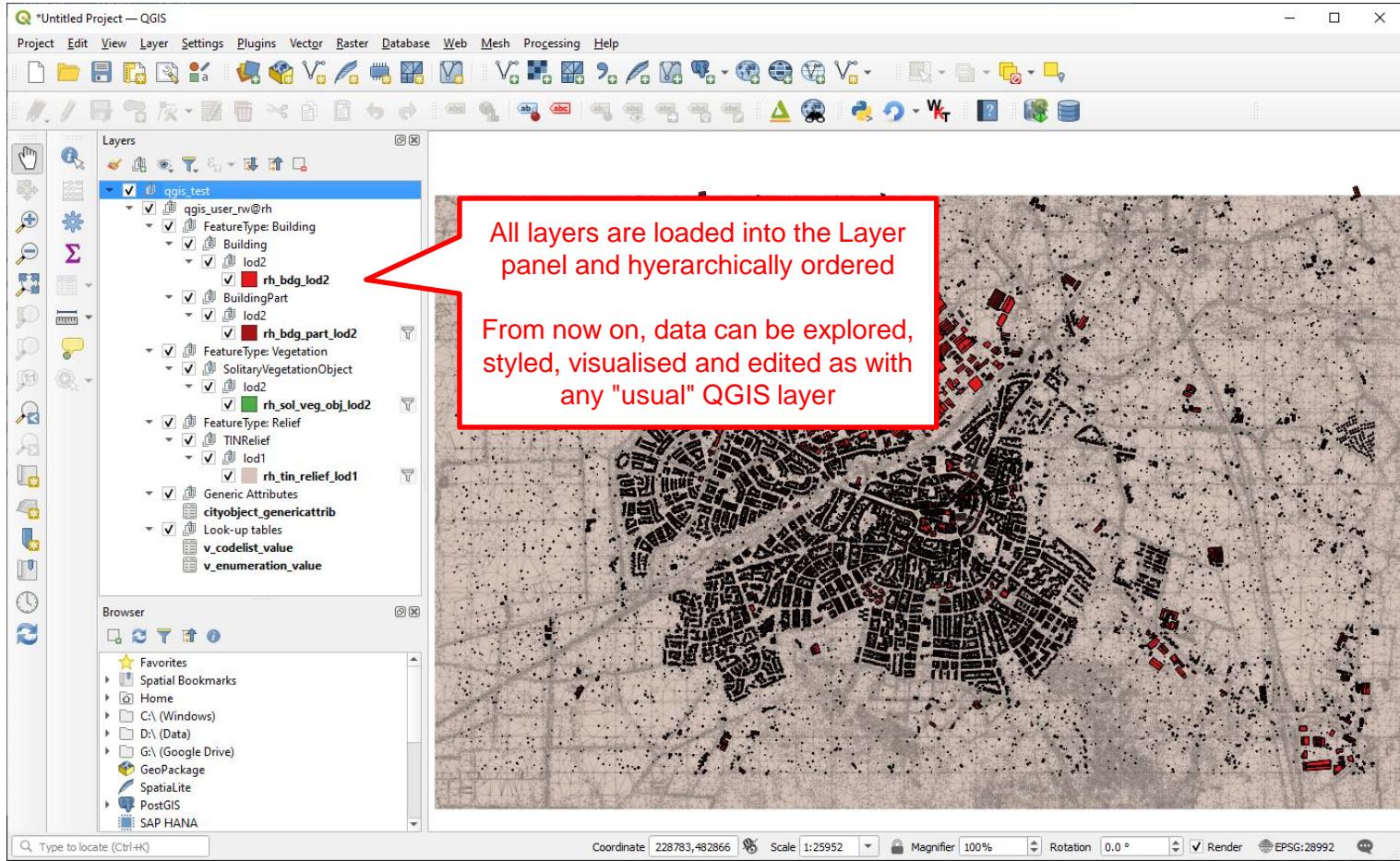
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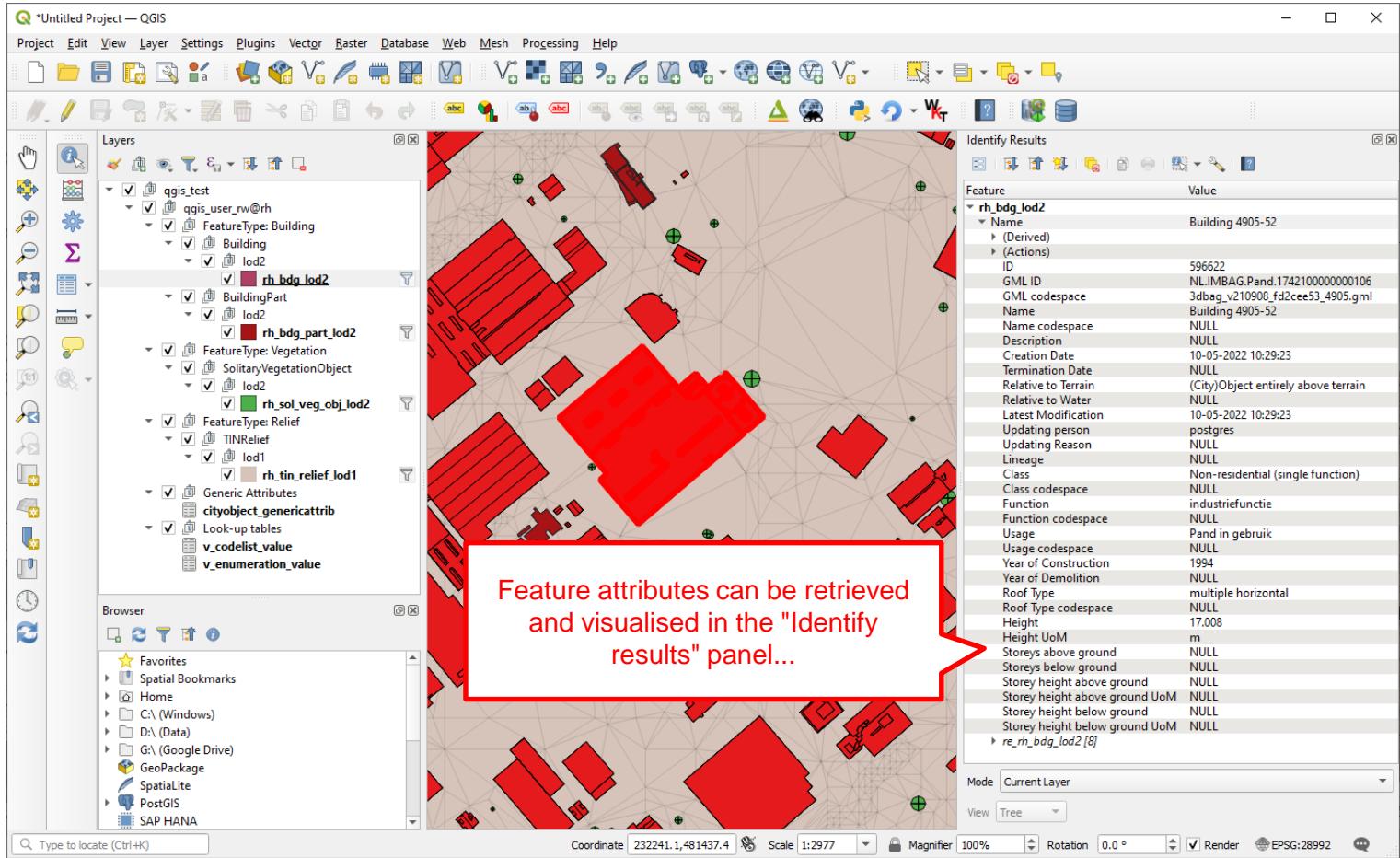
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Use in QGIS: Attributes

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The screenshot shows a QGIS interface with a map displaying red polygonal features representing buildings and vegetation. A callout bubble points to the 'Identify Results' panel on the right, which lists the attributes of a selected building feature. The panel title is 'Identify Results' and it includes columns for 'Feature' and 'Value'. The selected feature is 'rh_bdg_lod2' with the value 'Building 4905-52'. The 'Identify Results' panel also shows other attributes for this feature, such as GML ID, Name, Description, and Class.

Feature	Value
rh_bdg_lod2	Building 4905-52
Name	Building 4905-52
(Derived)	
Actions	
ID	596622
GML ID	NLIMBAG.Pand.174210000000106
GML codespace	3dbag_v210908_fd2ceef53_4905.gml
Name	Building 4905-52
Name codespace	NULL
Description	NULL
Creation Date	10-05-2022 10:29:23
Termination Date	NULL
Relative to Terrain	(City)Object entirely above terrain
Relative to Water	NULL
Latest Modification	10-05-2022 10:29:23
Updating person	postgres
Updating Reason	NULL
Lineage	NULL
Class	Non-residential (single function)
Class codespace	NULL
Function	industriefunctie
Function codespace	NULL
Usage	Pand in gebruik
Usage codespace	NULL
Year of Construction	1994
Year of Demolition	NULL
Roof Type	multiple horizontal
Roof Type codespace	NULL
Height	17.008
Height UoM	m
Storeys above ground	NULL
Storeys below ground	NULL
Storey height above ground	NULL
Storey height above ground UoM	NULL
Storey height below ground	NULL
Storey height below ground UoM	NULL
re_rh_bdg_lod2 [8]	

Mode: Current Layer
 View: Tree

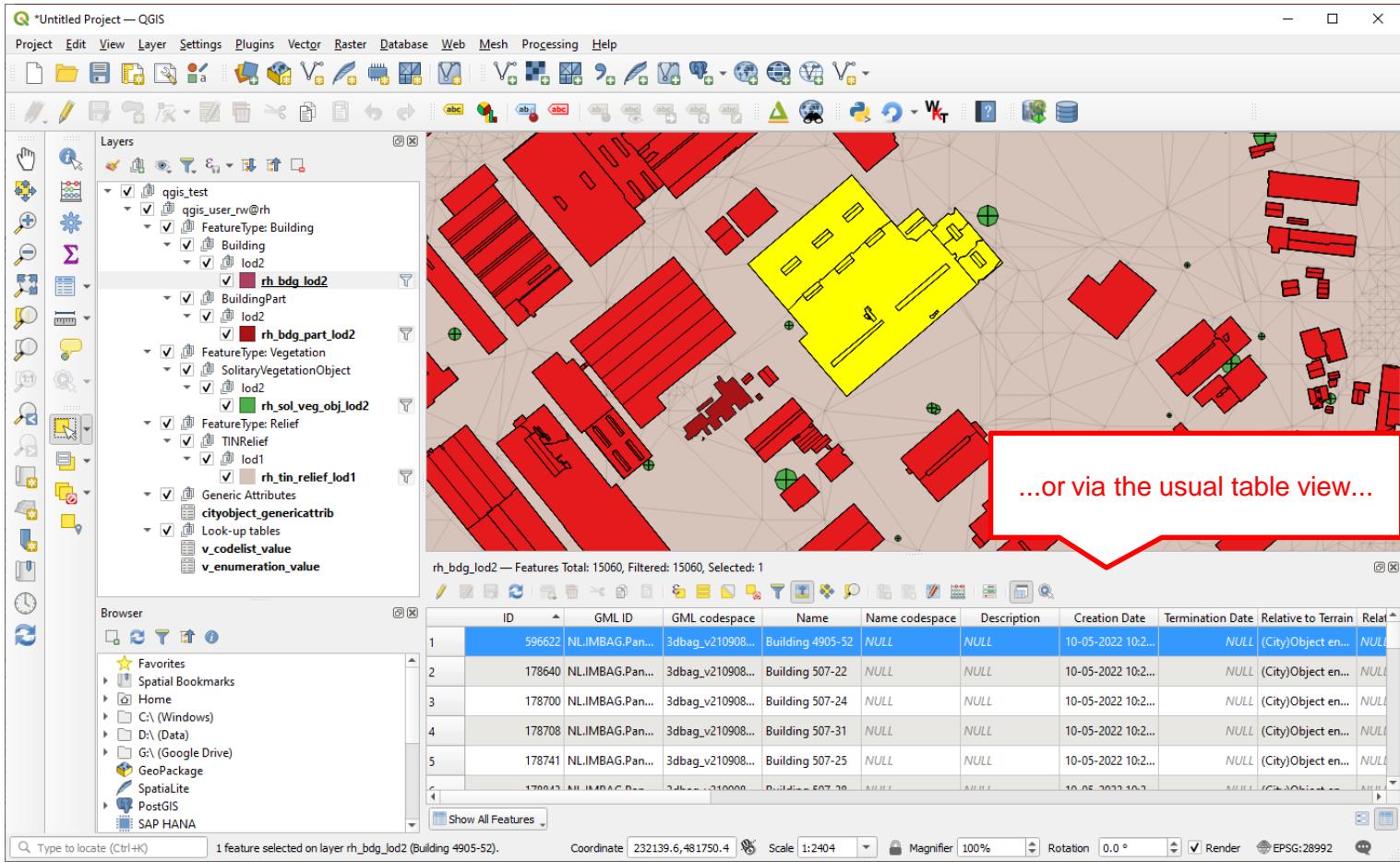
Coordinate: 232241.1, 481437.4 Scale: 1:2977 Magnifier: 100% Rotation: 0.0° Render: EPSG:28992

Type to locate (Ctrl+K)

Feature attributes can be retrieved
 and visualised in the "Identify
 results" panel...

Use in QGIS: Attributes

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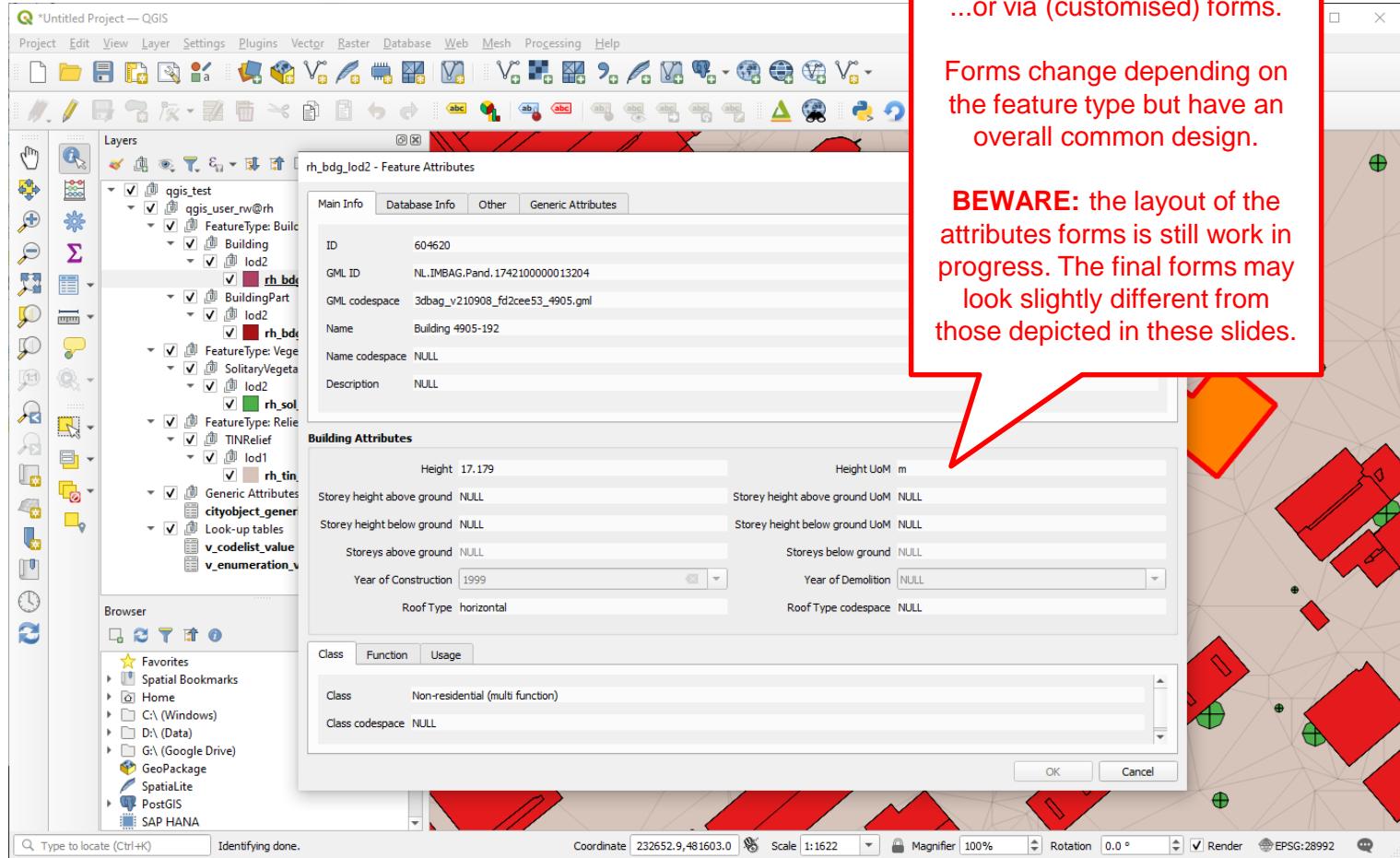
The screenshot shows the QGIS interface with a map of buildings and vegetation. A red callout box points to the attribute table at the bottom right, which displays five selected building features. The table includes columns for ID, GML ID, GML codespace, Name, Name codespace, Description, Creation Date, Termination Date, Relative to Terrain, and Relative to Map.

ID	GML ID	GML codespace	Name	Name codespace	Description	Creation Date	Termination Date	Relative to Terrain	Relative to Map
1	596622	NL.3DGeoInfo.3dbag_v210908...	Building 4905-52	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
2	178640	NL.3DGeoInfo.3dbag_v210908...	Building 507-22	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
3	178700	NL.3DGeoInfo.3dbag_v210908...	Building 507-24	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
4	178708	NL.3DGeoInfo.3dbag_v210908...	Building 507-31	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL
5	178741	NL.3DGeoInfo.3dbag_v210908...	Building 507-25	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...	NULL

...or via the usual table view...

Use in QGIS: Attributes

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...or via (customised) forms.

Forms change depending on the feature type but have an overall common design.

BEWARE: the layout of the attributes forms is still work in progress. The final forms may look slightly different from those depicted in these slides.

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Data is further organised in tabs.
Additional related tables are connected (e.g. Generic Attributes)



rh_bdg_lod2 - Feature Attributes

Main Info	Database Info	Other	Generic Attributes
Creation Date	10-05-2022 10:29:26		
Termination Date	NULL		
Latest Modification	10-05-2022 10:29:26		
Updating person	postgres		
Updating Reason	NULL		
Lineage	NULL		

rh_bdg_lod2 - Feature Attributes

Main Info	Database Info	Other	Generic Attributes
Surface Relation			
Relative to Terrain (City)Object entirely above terrain			
Relative to Water (no selection)			

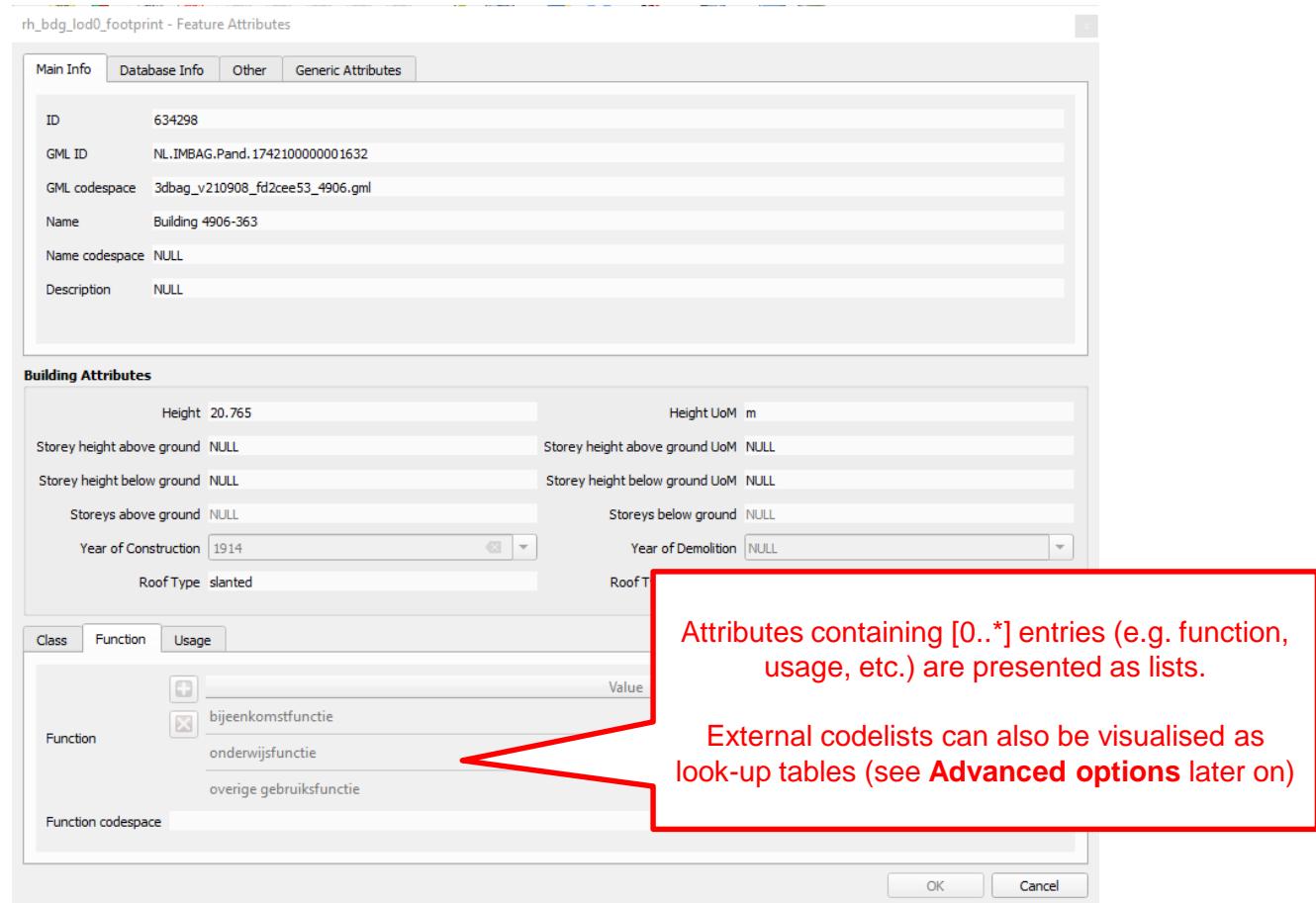
rh_bdg_lod2 - Feature Attributes

Main Info	Database Info	Other	Generic Attributes
			
Expression			
<input type="checkbox"/> 3dbag_tile			
<input type="checkbox"/> bag_net_internal_area			
<input type="checkbox"/> footprint_area			
<input type="checkbox"/> is_single_part			
<input type="checkbox"/> lod2_volume			
			

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The screenshot shows the 'Feature Attributes' dialog for a building feature named 'Building 4906-363'. The dialog is divided into several sections:

- Main Info:** Contains fields for ID (634298), GML ID (NL.IMGAG.Pand.1742100000001632), GML codespace (3dbag_v210908_fd2cee53_4906.gml), Name (Building 4906-363), Name codespace (NULL), and Description (NULL).
- Building Attributes:** Contains fields for Height (20.765), Height UoM (m), Storey height above ground (NULL), Storey height above ground UoM (NULL), Storey height below ground (NULL), Storey height below ground UoM (NULL), Storeys above ground (NULL), Storeys below ground (NULL), Year of Construction (1914), Year of Demolition (NULL), and Roof Type (slanted).
- Function:** A section showing a list of function types: bijeenkomstfunctie, onderwijsfunctie, and overige gebruiksfunctie.

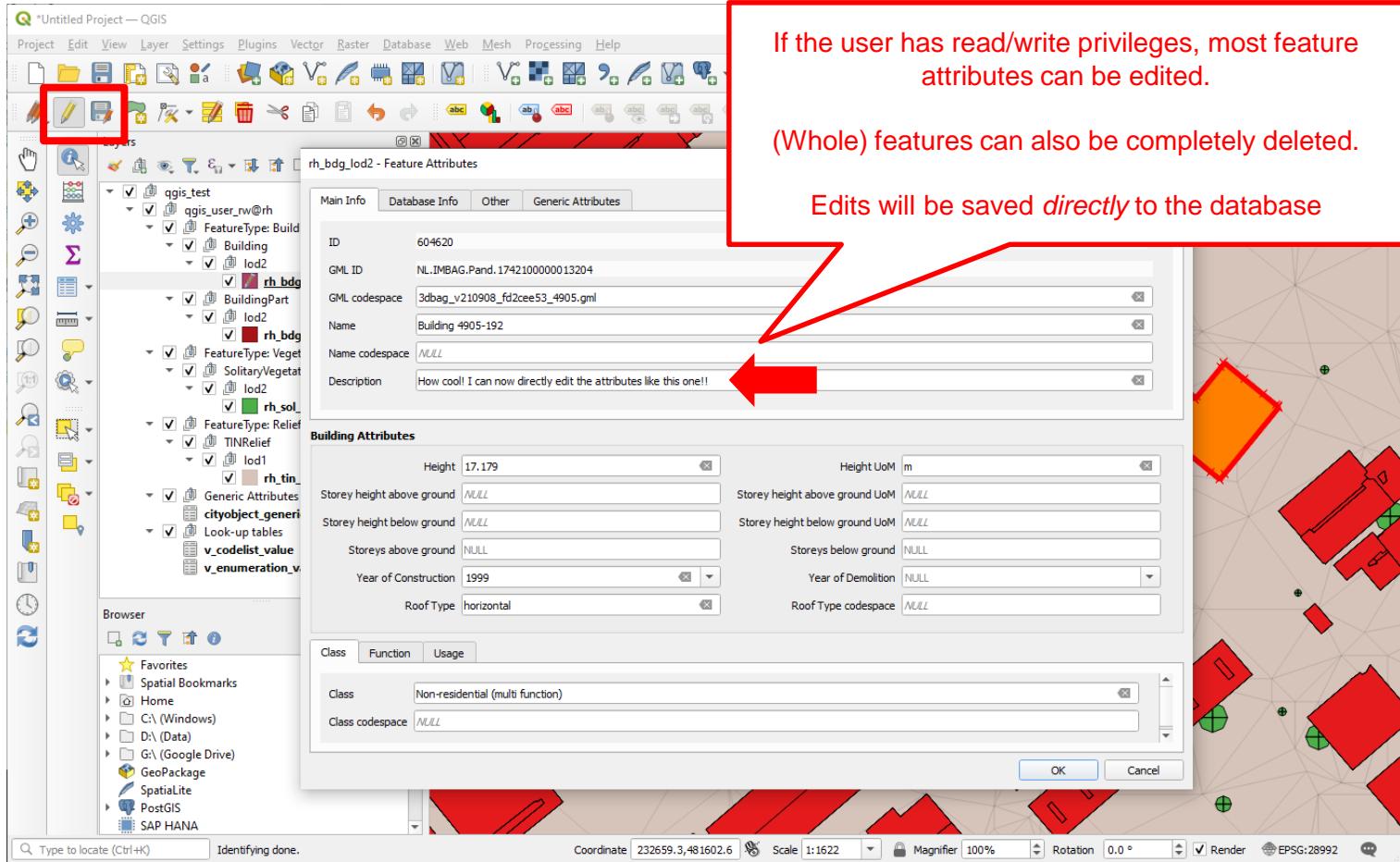
A red box highlights the 'Function' section, and a red arrow points from this box to a callout text on the right:

Attributes containing [..*] entries (e.g. function, usage, etc.) are presented as lists.

External codelists can also be visualised as look-up tables (see **Advanced options** later on)

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The screenshot shows the QGIS interface with a red box highlighting the edit tool icon in the toolbar. The left panel displays a tree view of layers, with the 'rh_bdg_lod2' layer selected. The main window shows the 'Feature Attributes' dialog for a specific building feature. The 'Building Attributes' section contains fields like Height (17.179), Storey height above ground (NULL), and Year of Construction (1999). A large red callout box with an arrow points from the text 'Edits will be saved directly to the database' to the 'Height' field. Another red callout box with an arrow points from the text '(Whole) features can also be completely deleted.' to the 'Delete' button in the bottom right corner of the dialog.

If the user has read/write privileges, most feature attributes can be edited.

(Whole) features can also be completely deleted.

Edits will be saved *directly* to the database

rh_bdg_lod2 - Feature Attributes

ID	604620
GML ID	NL.IMBAG.Pand.1742100000013204
GML codespace	3dbag_v210908_fd2ce53_4905.gml
Name	Building 4905-192
Name codespace	NULL
Description	How cool! I can now directly edit the attributes like this one!!

Building Attributes

Height	17.179	Height UoM	m
Storey height above ground	NULL	Storey height above ground UoM	NULL
Storey height below ground	NULL	Storey height below ground UoM	NULL
Storeys above ground	NULL	Storeys below ground	NULL
Year of Construction	1999	Year of Demolition	NULL
Roof Type	horizontal	Roof Type codespace	NULL

Class Function Usage

Class	Non-residential (multi function)
Class codespace	NULL

OK Cancel

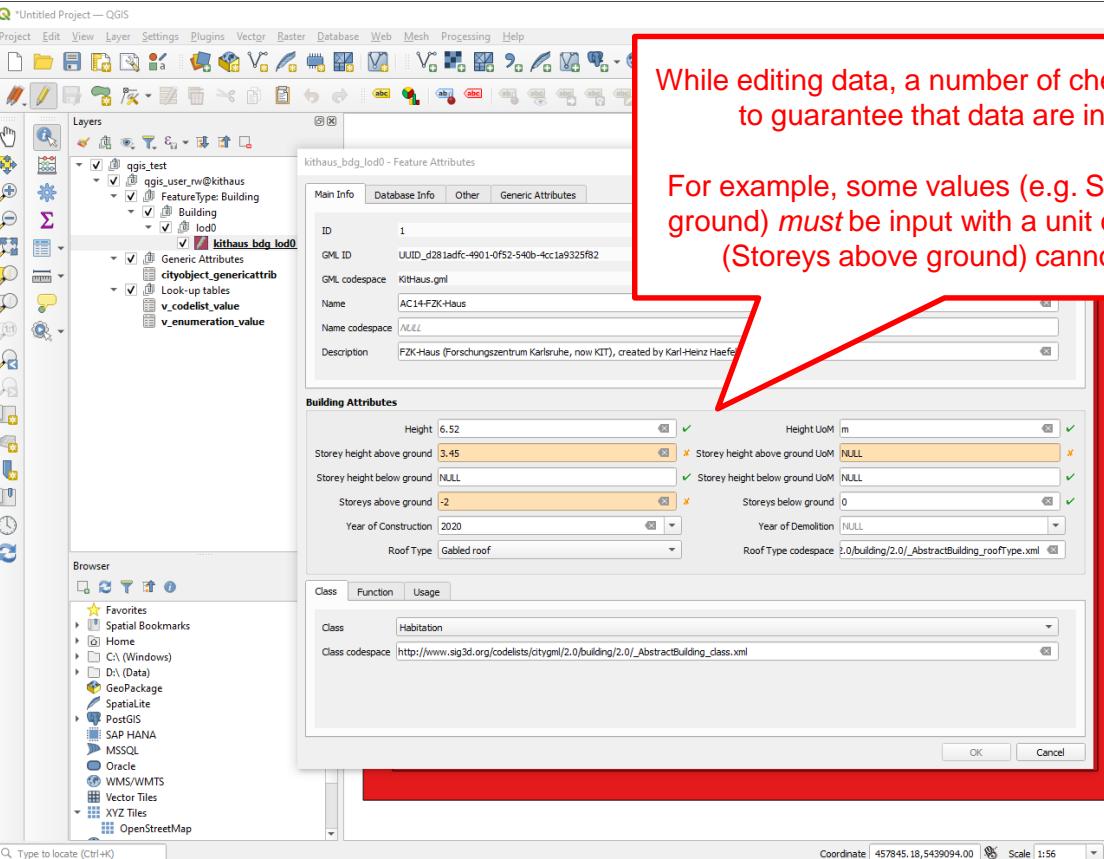
Type to locate (Ctrl+K) Identifying done. Coordinate 232659.3, 481602.6 Scale 1:1622 Magnifier 100% Rotation 0.0 ° Render EPSG:28992

Use in QGIS: Attribute editing

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While editing data, a number of checks are carried out to guarantee that data are input correctly.

For example, some values (e.g. Storey height above ground) *must* be input with a unit of measure, others (Storeys above ground) cannot be negative.

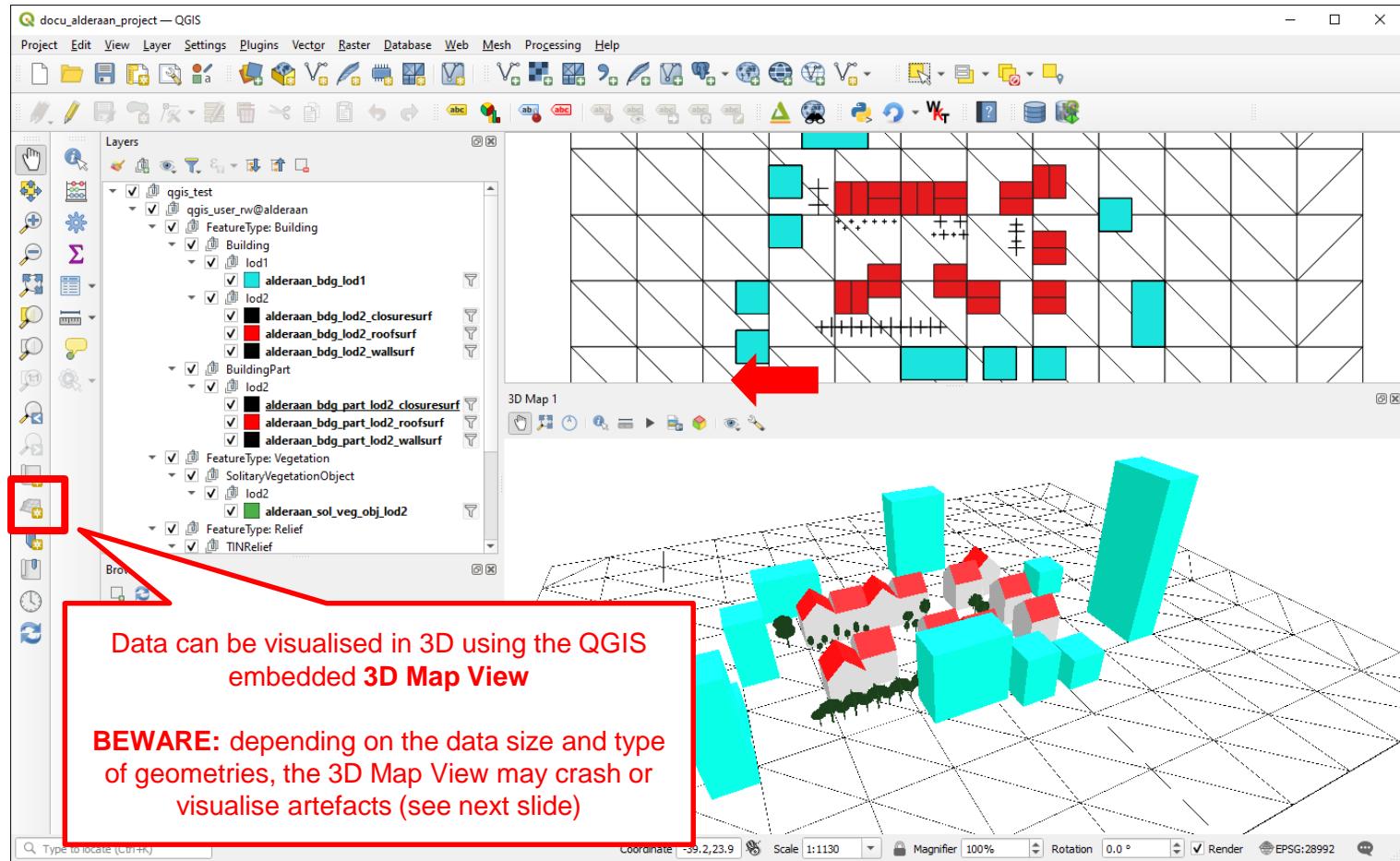


Attribute	Value	Unit	Status
Height	6.52	m	Valid
Storey height above ground	3.45	m	Invalid (highlighted)
Storey height below ground	NULL	m	Valid
Storeys above ground	-2		Invalid (highlighted)
Year of Construction	2020		Valid
Roof Type	Gabled roof		Valid
Height UoM	m		Valid
Storey height above ground UoM	NULL		Valid
Storey height below ground UoM	NULL		Valid
Storeys below ground	0		Valid
Year of Demolition	NULL		Valid
Roof Type codespace	2.0/building/2.0/_AbstractBuilding_roofType.xml		Valid

The screenshot shows the QGIS attribute editor for a building feature. A red box highlights the 'Building Attributes' section where validation errors are present. The 'Storey height above ground' field has an orange background and a red error icon, indicating it must be a valid unit of measure. The 'Storeys above ground' field also has an orange background and a red error icon, indicating it cannot be negative. The 'Height' field is valid. The 'Height UoM' field is valid. The 'Storey height above ground UoM' and 'Storey height below ground UoM' fields are valid. The 'Storeys below ground' field is valid. The 'Year of Demolition' field is valid. The 'Roof Type codespace' field is valid. The right side of the interface shows the full list of attributes and their values for the selected feature.

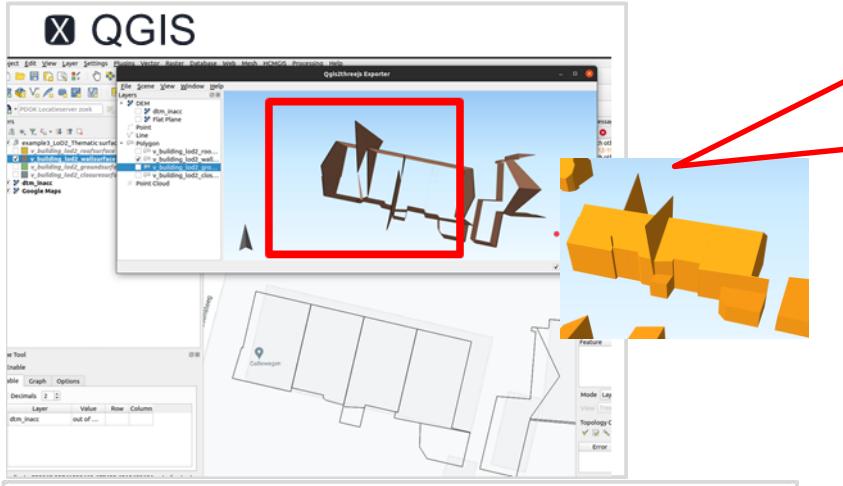
Use in QGIS: 3D visualisation

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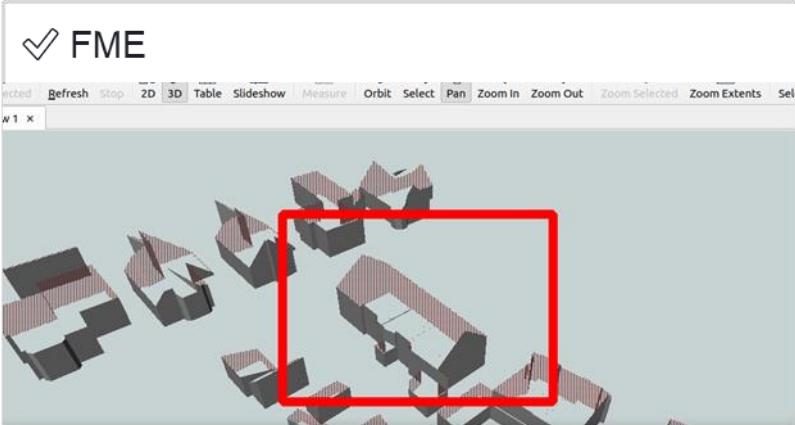
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Use in QGIS: 3D visualisation



In our tests, such artefacts are however a 3D visualisation issue (QGIS 3D renderer?) and *not* related to the data. 3D visualisation in FME and in Google Earth show indeed correct results.

In order to minimise this problem, please refer to **Advanced options** (see later)



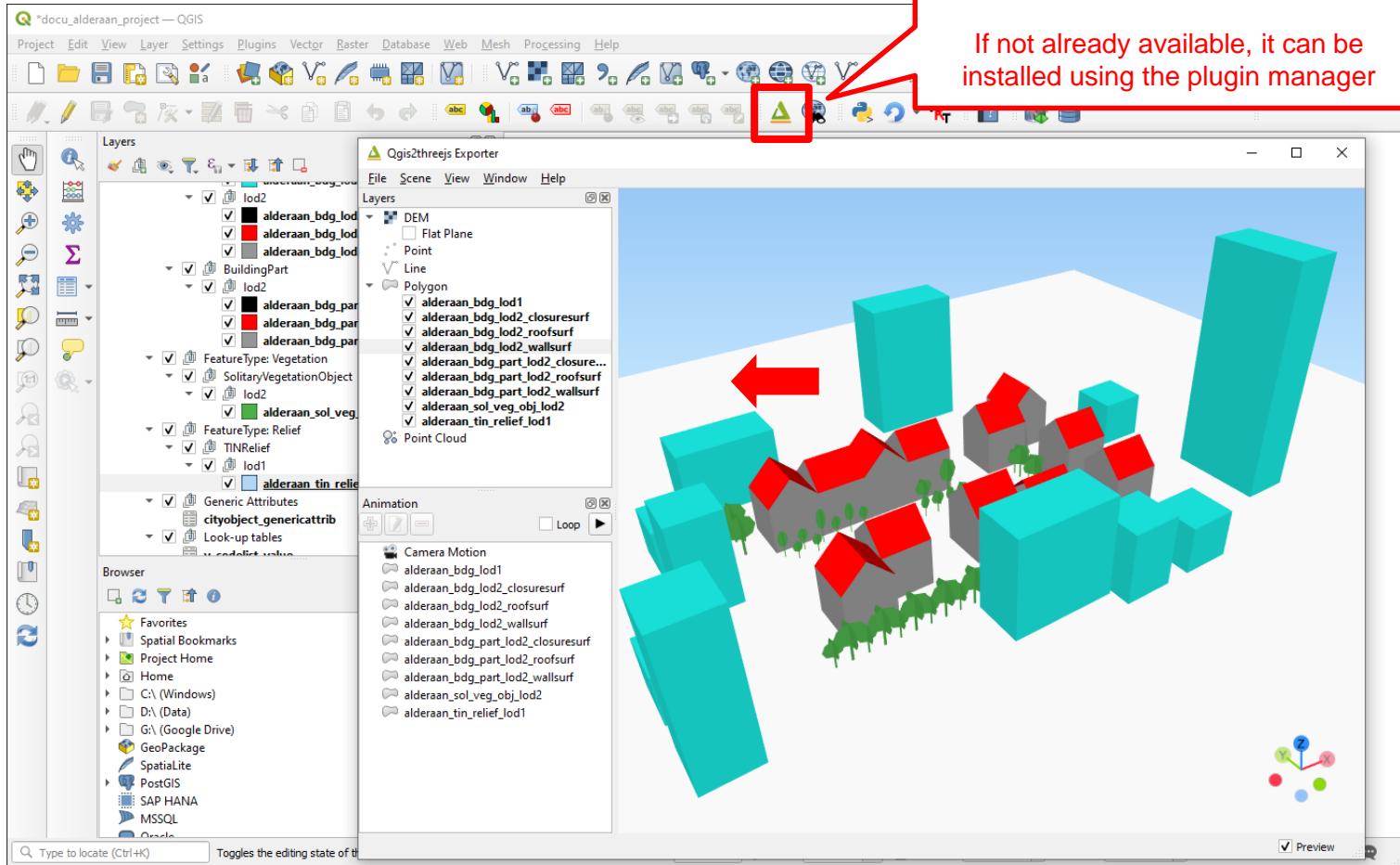
✓
Google
earth
(as KML)

Use in QGIS: 3D visualisation

Alternatively, the **Qgis2threejs** plugin can be used for 3D visualisation.

If not already available, it can be installed using the plugin manager

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Advanced options

- As administrator
 - Add and manage non-default database users
 - Fine-tune privileges
- As user
 - Simplify geometries in materialised views
 - Set up look-up tables in the attribute forms
 - Add personalised codelists

Database user management (as Administrator)

IMPORTANT: The following operations are currently NOT supported by the QGIS 3DCityDB-Loader plugin and must be carried out by the database administrator via a SQL-console, e.g. from PgAdmin.

In general, the database administrator (or a superuser) can:

- Allow or disallow database users to use the QGIS plugin
- Choose specifically which citydb schema(s) a user can access
- Grant/Revoke read-only or read-write privileges per user and per citydb schema
- Uninstall the default users "qgis_user_ro" and/or "qgis_user_rw"

The required SQL functions are all available in schema **qgis_pkg** and will be explained in the next slides.

Database user management (as Administrator)

In order to be visible from the Plugin, a user must be added to the group "qgis_pkg_usrgroup". Predefined PL/pgSQL functions take care of it.

Function **qgis_pkg.grant_qgis_usr_privileges(usr_name, priv_type [, cdb_schema])** can be used and offers multiple possibilities.

SQL examples

-- database user "giorgio" is added to group "qgis_pkg_usrgroup", can access data in citydb schema "citydb" of the current database with read-only privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges('giorgio', 'ro','citydb');
```

-- database user "kostantinos" is added to group "qgis_pkg_usrgroup", can access data in citydb schema "citydb_2" of the current database with read-write privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges(' kostantinos ', 'rw','citydb_2');
```

-- database user "camilo" is added to group "qgis_pkg_usrgroup", can access data in ALL citydb schemas of the current database with read-write privileges

```
SELECT qgis_pkg.grant_qgis_usr_privileges('camilo ', 'rw');
```

Database user management (as Administrator)

To revoke the privileges, the corresponding function is **qgis_pgk.revoke_qgis_usr_privileges(usr_name [, cdb_schema])** and offers multiple possibilities.

SQL examples

-- database user "giorgio" cannot access anymore data in citydb schema "citydb" of the current database

```
SELECT qgis_pgk.revoke_qgis_usr_privileges('giorgio', 'citydb');
```

-- database user "camilo" cannot access anymore ANY citydb schemas of the current database

```
SELECT qgis_pgk.revoke_qgis_usr_privileges('camilo');
```

IMPORTANT: The database users are NOT automatically removed from the group "qgis_pkg_usrgroup", as they could still be using other database instances of the 3D City Database. If required, the administrator has to remove them manually.

-- database user "giorgio" is removed from group "qgis_pkg_usrgroup" and won't be able to use the QGIS plugin anymore

```
REVOKE qgis_pkg_usrgroup FROM giorgio;
```

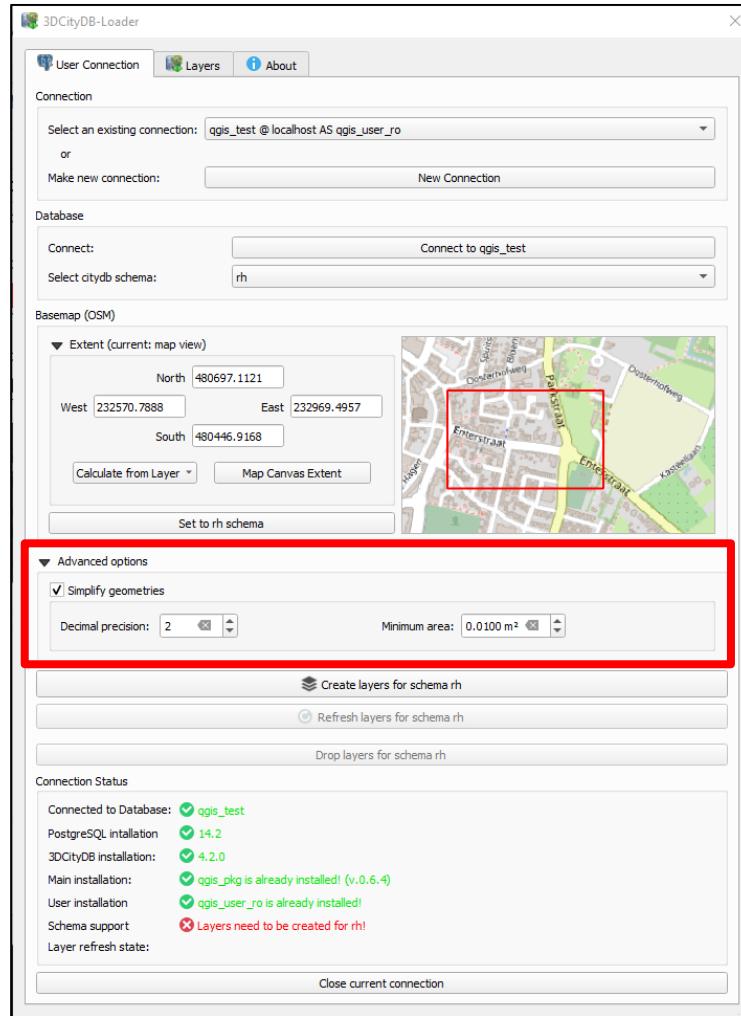
Geometry simplification

In order to simplify geometries and (partially) cope with the 3D visualisation issues of the 3D View Map in QGIS, the user can set some simplification parameters *before* generating the views.

All polygons composing the geometries will be checked. The user can set the number of decimal positions in the coordinates. Resulting degenerate geometries are skipped. The second parameter filters out all polygons smaller than the chosen threshold.

BEWARE: this operation

- can significantly increase the time needed to refresh the layers
- does NOT change the original data in the database!



Codelists and look-up tables

For certain CityGML properties (e.g. class, function, usage, roof type, etc.) the QGIS attribute forms can be linked to look-up tables containing

- values from the non-normative CityGML specifications
- values optionally defined by the user

This applies to properties containing single (e.g. class, roof type) or, possibly, multiple values (e.g. function, usage)

If required, in this way the user does not have to "remember" specific codes, thus reducing the chances of wrong data input.

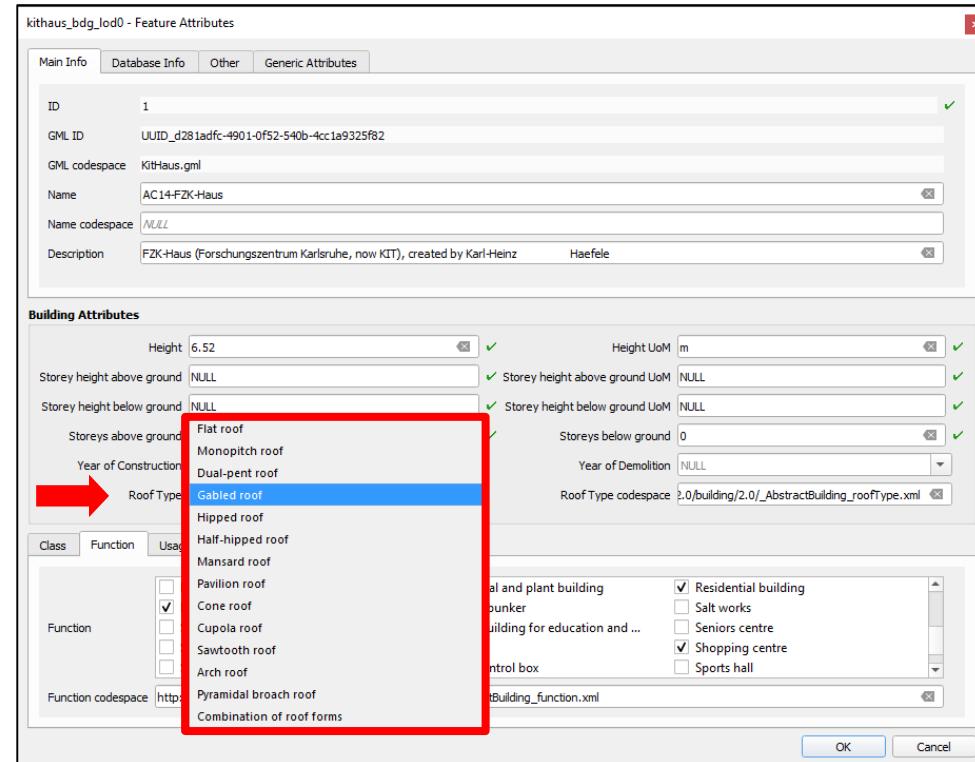
See next slides for examples

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In the case of a CityGML property with cardinality **[0..1]**, the associated codelist values are presented as a drop-down list.

Example: property **Roof type**



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In the case of a CityGML property with cardinality **[0..*]**, the associated codelist values are presented as a multiple-selection list.

Example: property (Building) function

kithaus_bdg_Iod0 - Feature Attributes

Main Info Database Info Other Generic Attributes

ID: 1
 GML ID: UUID_d281adfc-4901-0f52-540b-4cc1a9325f82
 GML codespace: KitHaus.gml
 Name: AC14-FZK-Haus
 Name codespace: NULL
 Description: FZK-Haus (Forschungszentrum Karlsruhe, now KIT), created by Karl-Heinz Haefele

Building Attributes

Height: 6.52	Height UoM: m
Storey height above ground: NULL	Storey height above ground UoM: NULL
Storey height below ground: NULL	Storey height below ground UoM: NULL
Storeys above ground: 2	Storeys below ground: 0
Year of Construction: 2020	Year of Demolition: NULL
Roof Type: Gabled roof	Roof Type codespace: 2.0/building/2.0/_AbstractBuilding_roofType.xml

Function

<input type="checkbox"/> Residential and office building	<input type="checkbox"/> Residential and plant building	<input checked="" type="checkbox"/> Residential building
<input checked="" type="checkbox"/> Restaurant	<input type="checkbox"/> Rubbish bunker	<input type="checkbox"/> Salt works
<input type="checkbox"/> Sanatorium	<input type="checkbox"/> School Building for education and ...	<input type="checkbox"/> Seniors centre
<input type="checkbox"/> Shipping terminal	<input type="checkbox"/> Shipyard	<input checked="" type="checkbox"/> Shopping centre
<input type="checkbox"/> Signal box or stop signal	<input type="checkbox"/> Signal control box	<input type="checkbox"/> Sports hall

Function codespace: http://www.sig3d.org/codelists/citygml/2.0/building/2.0/_AbstractBuilding_function.xml

OK Cancel



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Behind the scenes:

In the 3DCityDB, string-based columns of attributes containing multiple values (separated by the --\-- field separator) are transformed into arrays in the QGIS Package layers.

Trigger functions take care of data conversion from/to arrays when needed.

3DCityDB table BUILDING (excerpt)

id [PK] bigint	class character varying (256)	function character varying (1000)
1531	Mixed-use	overige gebruiksfunctie--/\--woonfunctie
4431	Mixed-use	winkelfunctie--/\--woonfunctie
7839	Non-residential (multi function)	gezondheidszorgfunctie--/\--kantoorfunctie--/\--winkelfunctie
15423	Non-residential (multi function)	gezondheidszorgfunctie--/\--kantoorfunctie
15499	Mixed-use	gezondheidszorgfunctie--/\--kantoorfunctie--/\--winkelfunctie--/\--woonf...
16545	Mixed-use	overige gebruiksfunctie--/\--woonfunctie
14490	Mixed-use	bijeenkomstfunctie--/\--gezondheidszorgfunctie--/\--kantoorfunctie--/\--...
15956	Mixed-use	overige gebruiksfunctie--/\--woonfunctie

QGIS Package layer BUILDING (excerpt)

function character varying[]
{ "overige gebruiksfunctie", "woonfunctie" }
{ "winkelfunctie", "woonfunctie" }
{ "gezondheidszorgfunctie", "kantoorfunctie", "winkelfunctie" }
{ "gezondheidszorgfunctie", "kantoorfunctie" }
{ "gezondheidszorgfunctie", "kantoorfunctie", "winkelfunctie", "woonfunctie" }
{ "overige gebruiksfunctie", "woonfunctie" }
{ "bijeenkomstfunctie", "gezondheidszorgfunctie", "kantoorfunctie", "overige gebruiksfunctie" }
{ "overige gebruiksfunctie", "woonfunctie" }



Codelists and look-up tables



- All codelists values are retrieved from the view **v_codelist_value** in the qgis schema of every user (e.g. "qgis_user_rw")
- By default, all CityGML codelists are already available
- To set up the QGIS attributes form, please refer to the next slides

View V_CODELISTS_VALUE (excerpt)

id bigint	data_model character varying	name character varying	value character varying	description text	name_space character varying
1	CityGML 2.0	MimeType	model/vrml	VRML97	https://www.sig3d.org/codelists/stan...
2	CityGML 2.0	MimeType	application/x-3ds	3ds max	https://www.sig3d.org/codelists/stan...
3	CityGML 2.0	MimeType	application/dxf	AutoCad DXF	https://www.sig3d.org/codelists/stan...
4	CityGML 2.0	MimeType	application/x-autocad	AutoCad DXF	https://www.sig3d.org/codelists/stan...
39	CityGML 2.0	_AbstractBuildingClass	1110	Maintainence and waste mana...	https://www.sig3d.org/codelists/stan...
40	CityGML 2.0	_AbstractBuildingClass	1120	Healthcare	https://www.sig3d.org/codelists/stan...
41	CityGML 2.0	_AbstractBuildingClass	1130	Communicating	https://www.sig3d.org/codelists/stan...
42	CityGML 2.0	_AbstractBuildingClass	1140	Security	https://www.sig3d.org/codelists/stan...
43	CityGML 2.0	_AbstractBuildingClass	1150	Storage	https://www.sig3d.org/codelists/stan...
44	CityGML 2.0	_AbstractBuildingClass	1160	Industry	https://www.sig3d.org/codelists/stan...
45	CityGML 2.0	_AbstractBuildingClass	1170	Traffic	https://www.sig3d.org/codelists/stan...
46	CityGML 2.0	_AbstractBuildingClass	1180	Other function	https://www.sig3d.org/codelists/stan...
47	CityGML 2.0	_AbstractBuildingClass	9999	Unknown	https://www.sig3d.org/codelists/stan...
48	CityGML 2.0	_AbstractBuildingFunct...	1000	Residential building	https://www.sig3d.org/codelists/stan...
49	CityGML 2.0	_AbstractBuildingFunct...	1010	Tenement	https://www.sig3d.org/codelists/stan...

Codelists and look-up tables

Example: property **Roof type**
(cardinality [0..1])

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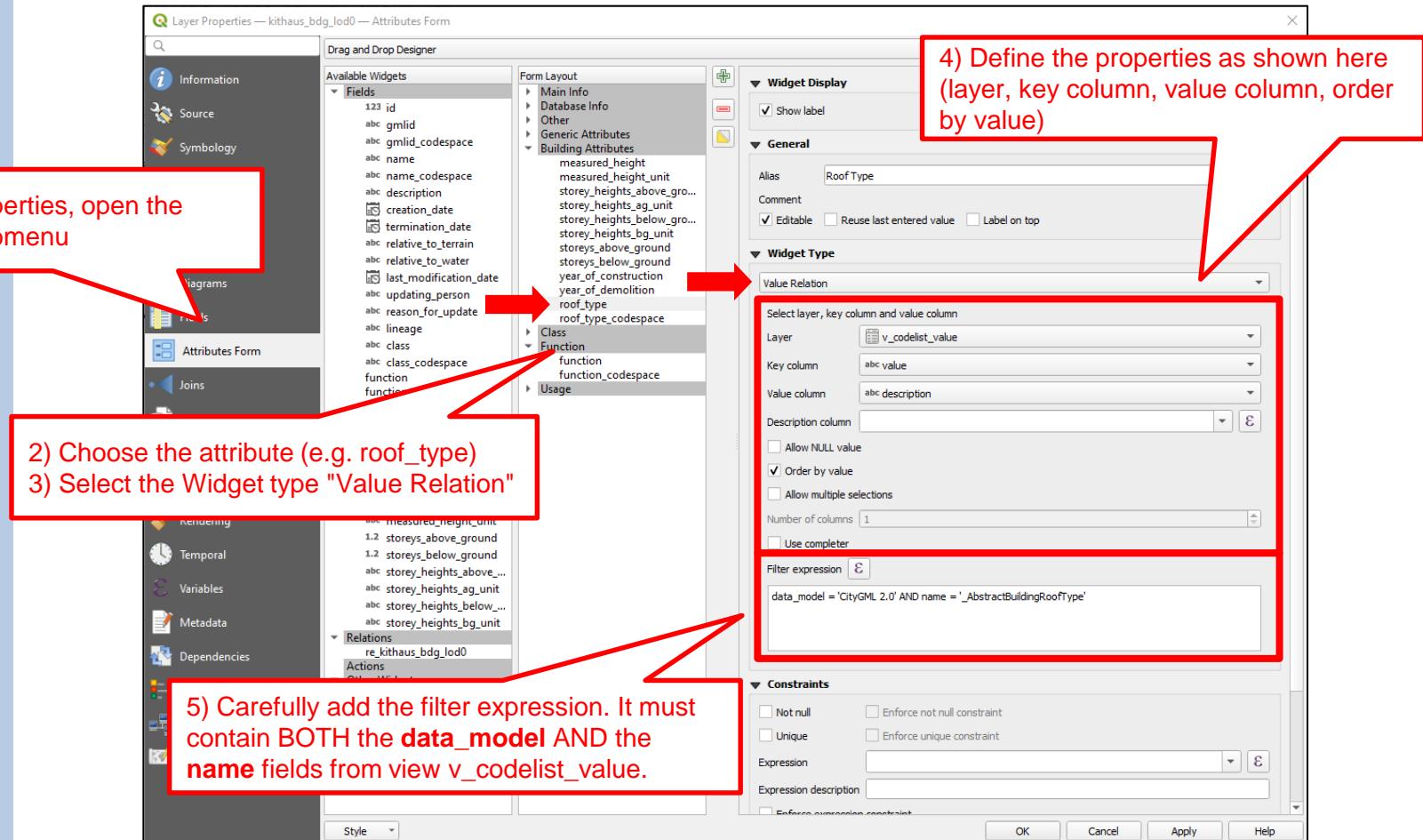
1) In the Layer properties, open the Attributes Form submenu

2) Choose the attribute (e.g. roof_type)

3) Select the Widget type "Value Relation"

4) Define the properties as shown here (layer, key column, value column, order by value)

5) Carefully add the filter expression. It must contain BOTH the **data_model** AND the **name** fields from view v_codelist_value.



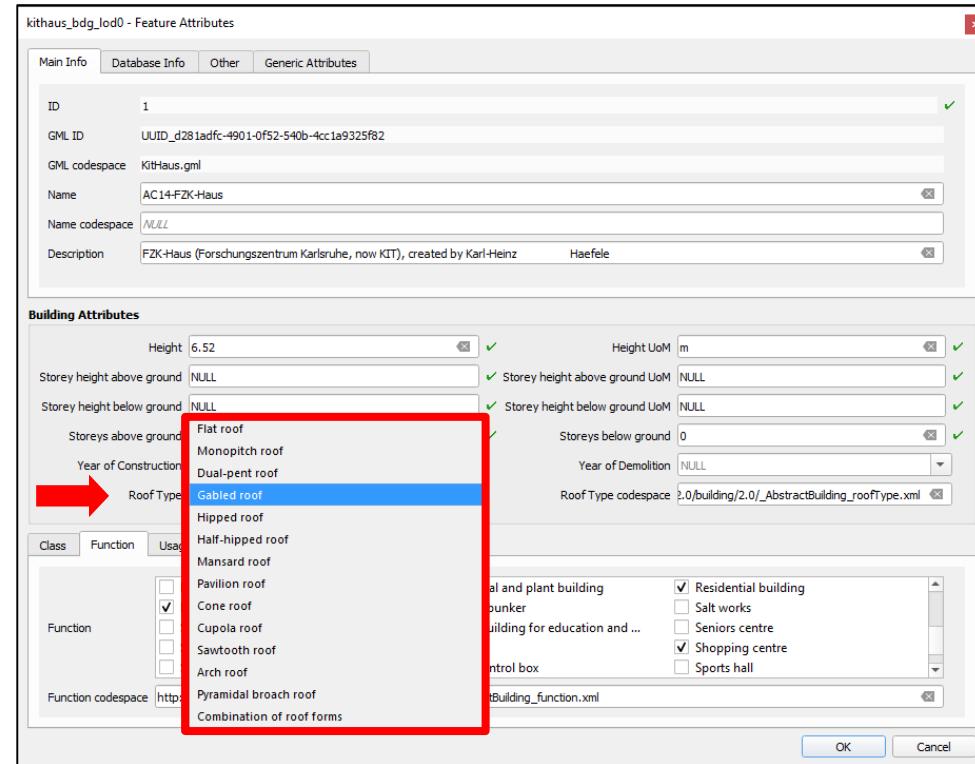
The screenshot shows the 'Attributes Form' dialog for the 'kithaus_bgd_lod0' layer. The 'Fields' section lists various attributes like id, gmlid, name, etc. The 'Widget Type' section is set to 'Value Relation'. The 'Select layer, key column and value column' panel shows 'Layer: v_codelist_value', 'Key column: abc.value', and 'Value column: abc.description'. The 'Filter expression' field contains the SQL-like expression: 'data_model = 'CityGML 2.0' AND name = '_AbstractBuildingRoofType''. The 'Constraints' section at the bottom is mostly empty.

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Apply the Layer Properties,
 reload the attributes form
 from QGIS as usual.

Et voilà! 😊



Codelists and look-up tables

Example: property **(Building)**
function (cardinality [0..*])

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The procedure is nearly the same as before,
 the only differences are in **bold**.

4) Define the properties as shown here
 (layer, key column, value column, order by value, **allow multiple selections** and **number of columns**)

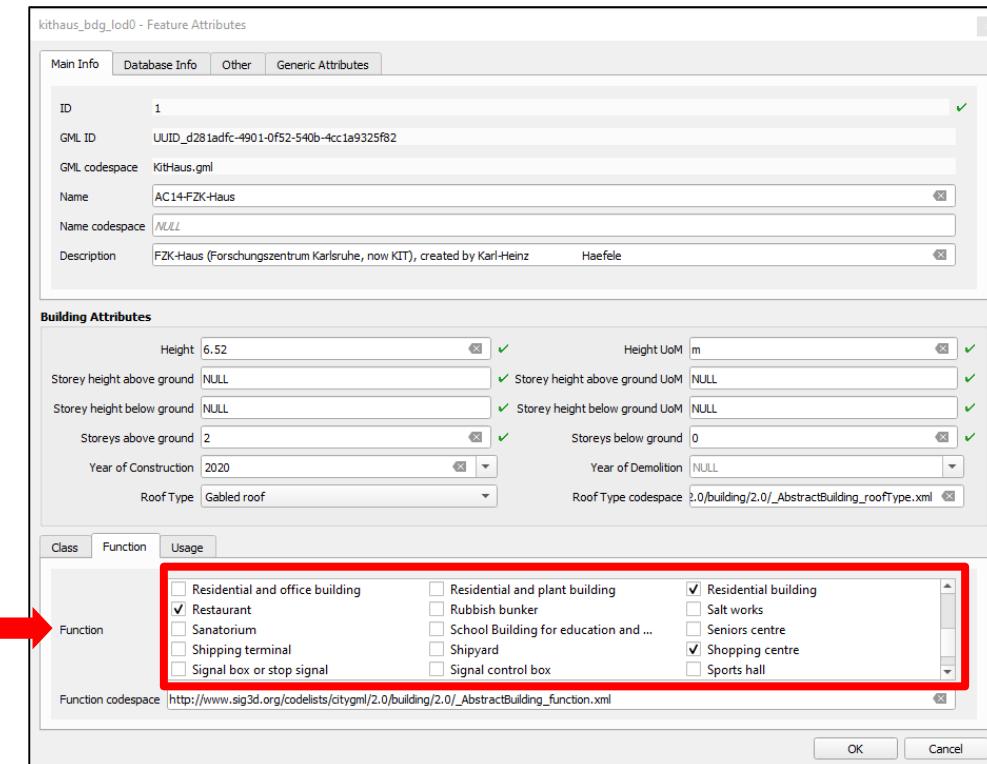
5) Carefully add the filter expression. It must contain BOTH the **data_model** AND the **name** fields from view v_codelist_value.

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Apply the Layer Properties,
 reload the attributes form
 from QGIS as usual.

Et voilà! 😊



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To add or customise codelist values, **two tables** in the qgis user schema must be edited: **codelist** and **codelist_value**

Table **codelist** contains some metadata values such as the codelist name, its name_space and data_model.

It is referenced by table **codelist_value** which contains the actual values.

Table CODELIST (excerpt)

id [PK] bigint	data_model character varying	name character varying	name_space character varying	description text
1	CityGML 2.0	MimeType	https://www.sig3d.org/codelists/standard/core/2.0/ImplicitGeometry_mimeType.xml	[null]
2	CityGML 2.0	_AbstractBridgeClass	https://www.sig3d.org/codelists/standard/bridge/2.0/_AbstractBridge_class.xml	
3	CityGML 2.0	_AbstractBridgeFunctionUsage	https://www.sig3d.org/codelists/standard/bridge/2.0/_AbstractBridge_function.xml	
4	CityGML 2.0	_AbstractBuildingClass	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuilding_class.xml	
5	CityGML 2.0	_AbstractBuildingFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuilding_function.xml	
6	CityGML 2.0	_AbstractBuildingRoofType	https://www.sig3d.org/codelists/standard/building/2.0/_AbstractBuildingRoof_type.xml	
7	CityGML 2.0	RoomClass	https://www.sig3d.org/codelists/standard/building/2.0/Room_class.xml	
8	CityGML 2.0	RoomFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/RoomFunction_usage.xml	
9	CityGML 2.0	BuildingFurnitureClass	https://www.sig3d.org/codelists/standard/building/2.0/BuildingFurniture_class.xml	
10	CityGML 2.0	BuildingFurnitureFunctionUsage	https://www.sig3d.org/codelists/standard/building/2.0/BuildingFurnitureFunction_usage.xml	

Table CODELIST_VALUE (excerpt)

id [PK] bigint	code_id integer	value character varying	description text
1	1	model/vrml	VRML97
2	1	application/x-3ds	3ds max
3	1	application/dxf	AutoCad DXF
4	1	application/x-autocad	AutoCad DXF
5	1	application/x-dxf	AutoCad DXF
6	1	application/acad	AutoCad DWG
13	1	image/tiff	*.tiff, *.tif images
14	1	image/bmp	*.bmp images
15	2	1000	Arced bridge
16	2	1010	Cable-stayed bridge
17	2	1020	Deck bridge
18	2	1030	Cable-stayed overpass

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To add (or remove) values from the **codelist** and **codelist_value** tables, the user can for example issue a SQL statement such as:

```
-- Optionally, delete previously loaded values belonging to the same codelist in user schema "qgis_giorgio"  
DELETE FROM qgis_giorgio.codelist WHERE data_model = 'NL-BAG';  
-- Insert first the codelist metadata and then the values in one single SQL statement  
WITH cl AS (  
    INSERT INTO qgis_giorgio.codelist (data_model, name, name_space, description)  
    VALUES  
    ('NL-BAG', 'BAG', 'https://..some_url_here....', 'Codelist containing the values of the Dutch Basisregistratie Adressen en Gebouwen')  
    RETURNING id)  
INSERT INTO qgis_giorgio.codelist_value (code_id, value, description)  
SELECT cl.id, v.value, v.description FROM cl, (VALUES  
    ('apple' , 'Codelist value for "apple"' ),  
    ('orange' , 'Codelist value for "orange"' ),  
    ('pear' , 'Codelist value for "pear"' ),  
    ('banana' , 'Codelist value for "banana"' )  
) AS v(value, description);
```

This SQL statement can be adapted by changing only the parts in red

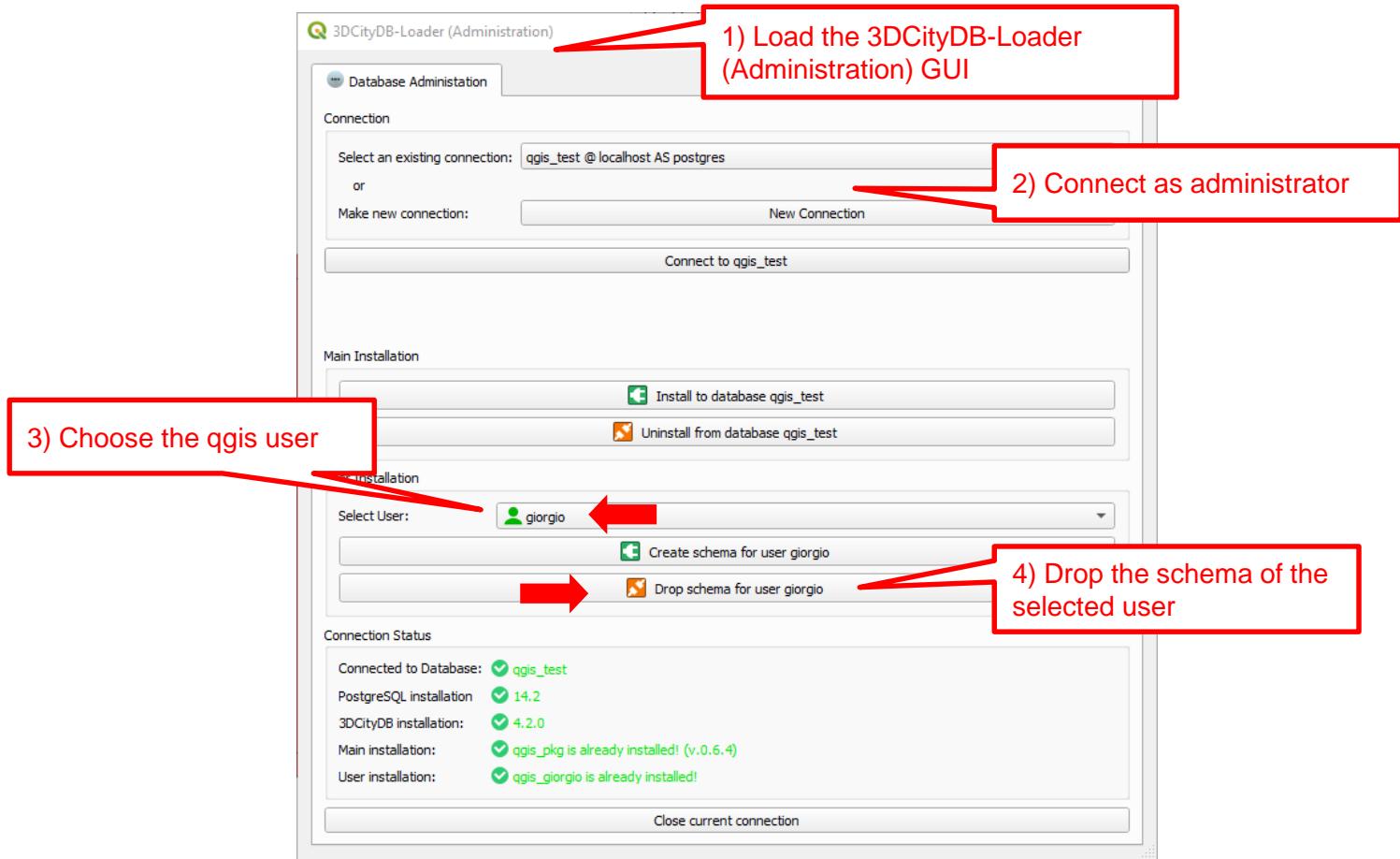
Software uninstall

Uninstallation consists of two parts:

- 1) Partial/complete removal of the QGIS Package from PostgreSQL
 - This operation can be carried out only by the database administrator
 - The administrator can drop only the schema of a selected user (e.g. "qgis_giorgio")
 - The administrator can remove all user schemas AND the qgis_pkg schema
- 2) Removal of the 3DCityDB-Loader plugin from QGIS
 - This operation can be carried out by any user
 - The plugin can be uninstalled from the \Plugins\Manage and Install Plugins... Menu in QGIS
 - Alternatively, it can be uninstalled manually by simply removing the plugin folder

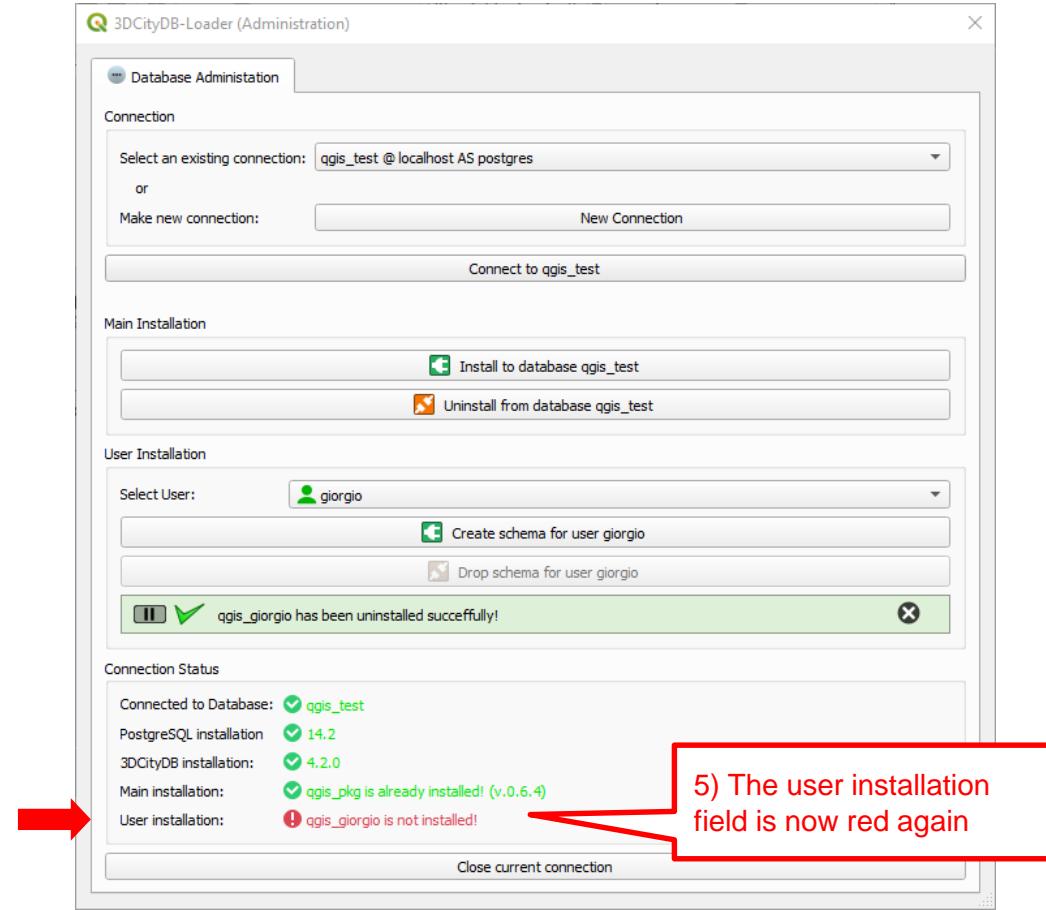
Software uninstall: Drop user schema

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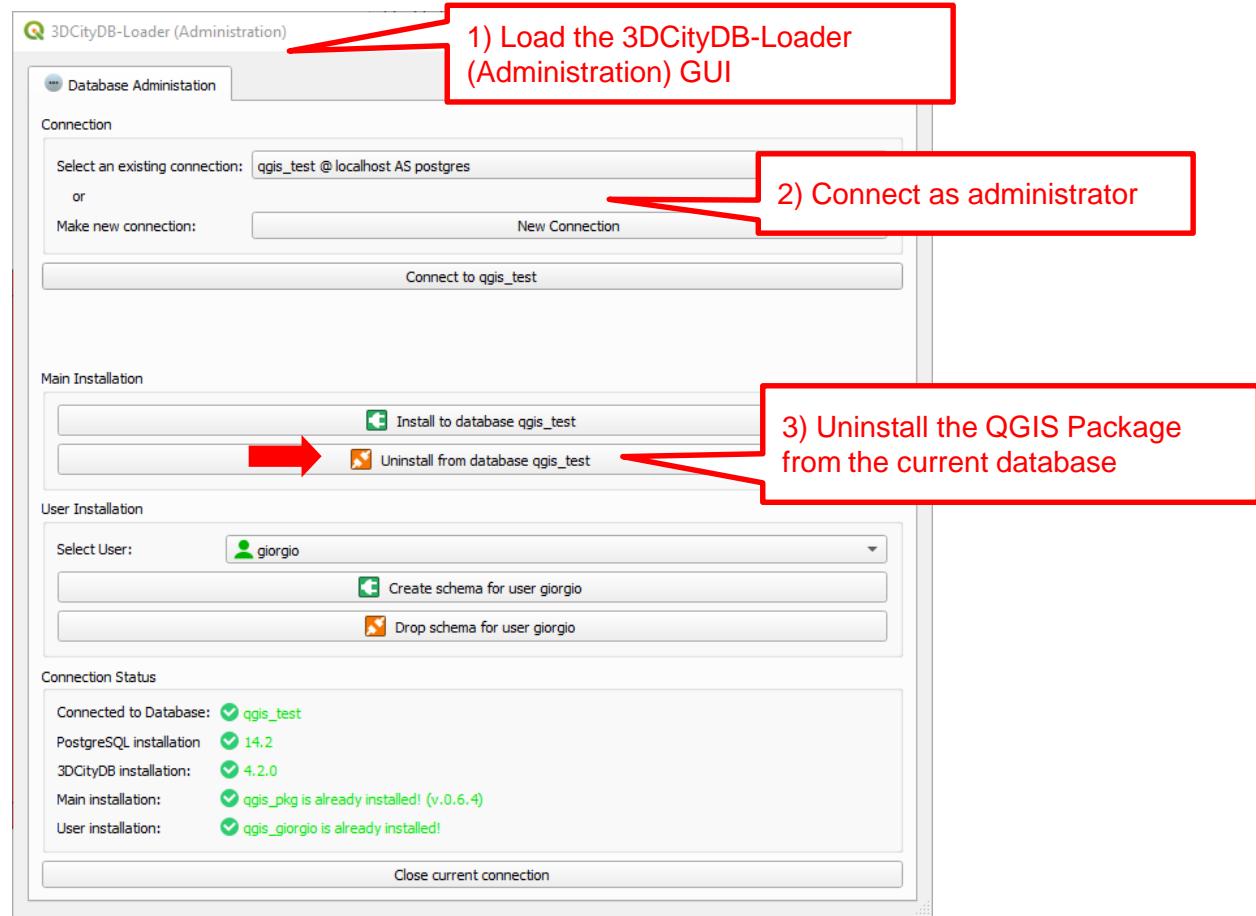
Software uninstall: Drop user schema

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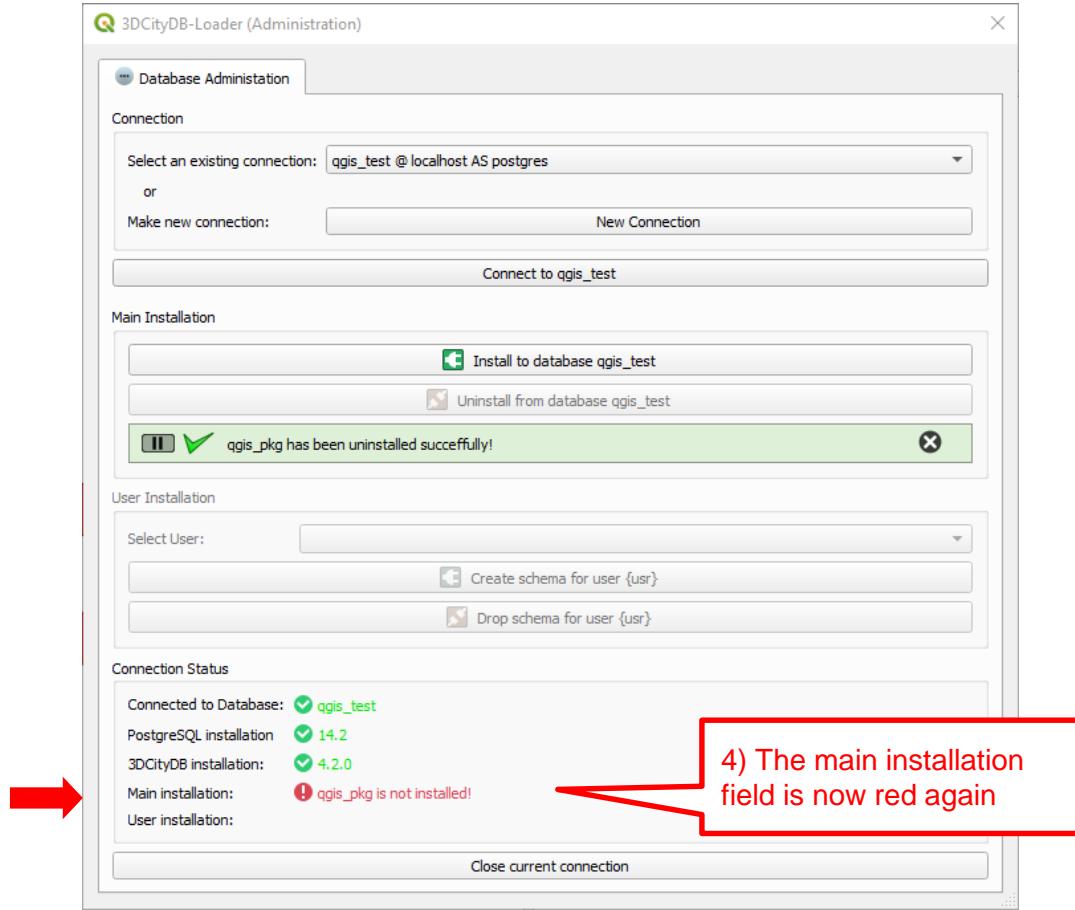
Software uninstall: Uninstall QGIS Package

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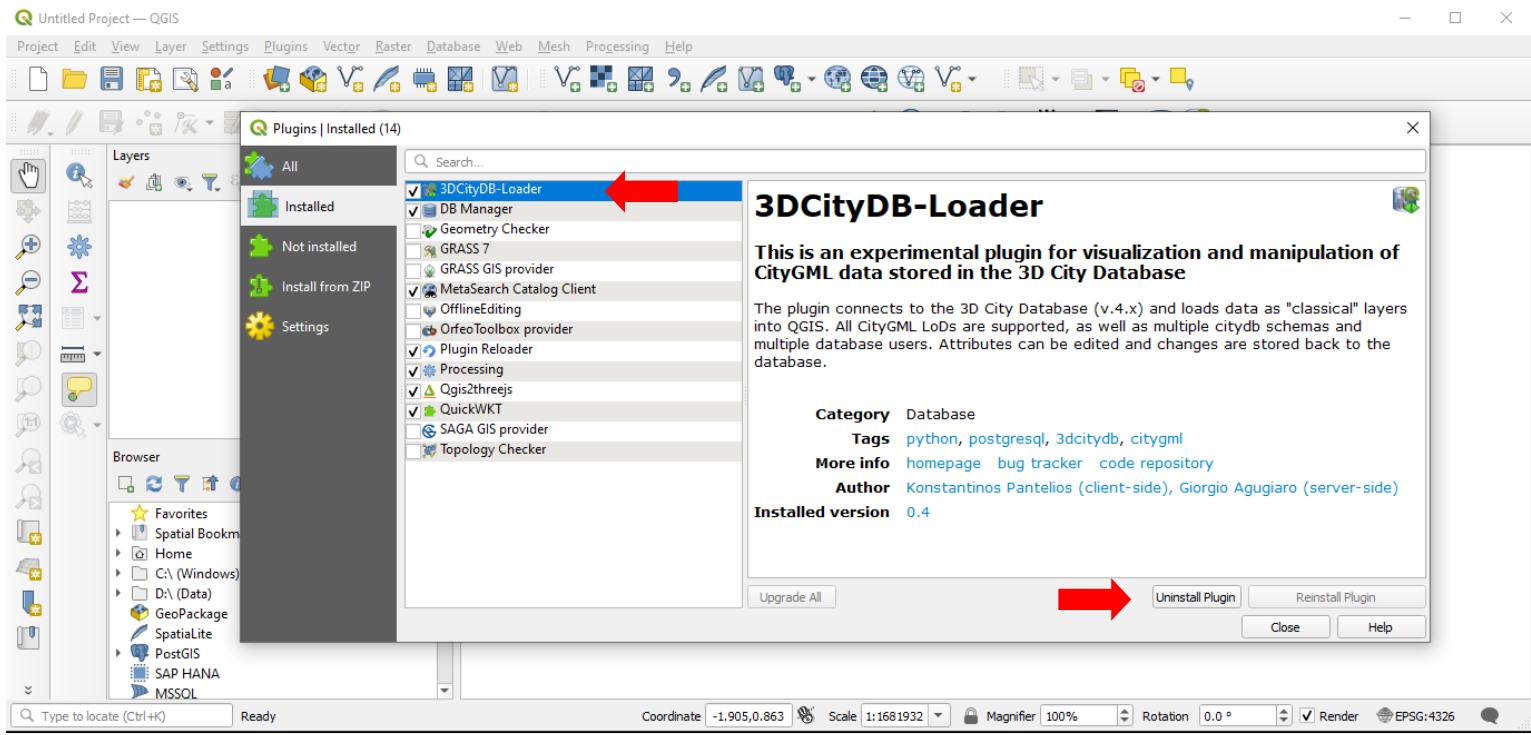
Software uninstall: Uninstall QGIS Package

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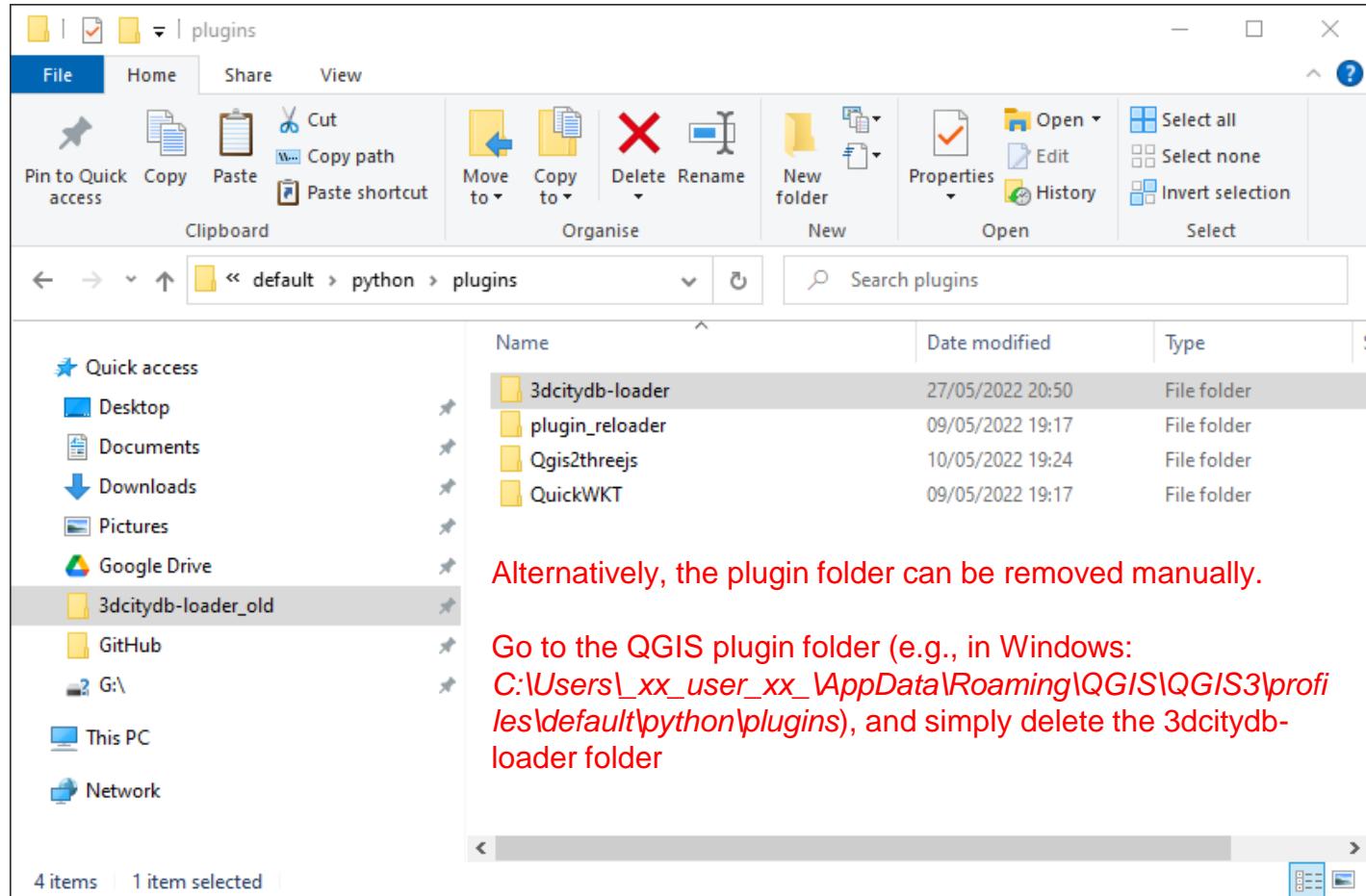
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Current limitations

As of June 2022

In general

- CityGML appearances are not supported
- CityGML ADEs (Application Domain Extensions) are not supported

The QGIS Package does not yet support the following CityObjects

- Point-, breakline- and raster-based Relief features
- CityObjectGroups

Current limitations

As of June 2022

In the 3DCityDB-Loader plugin, following functionalities are still missing

- GUI for advanced user management
- GUI for codelist/look-up table management and settings

In particular, when it comes to attributes editing

- The design of the attribute forms is still being improved
- Forms of children tables need redesign

Resources

Test data files

- In the QGIS plugin folder, you will find 2 test datasets that you can import into the 3DCityDB (using the Importer/Exporter) to test the 3DCityDB-Loader plugin. They are located in subfolder \test_datasets
- The test datasets are:
 - CityGML_2.0_Test_Dataset_2022-03-11.zip (aka "Railway")
 - FZK-Haus-LoD-all-KIT-IAI-KHH-B36-V1.zip (aka "Kit House")

Test data online @ TUD

You can otherwise connect to our server at TU Delft using these credentials.

You will have **read-only privileges** only!

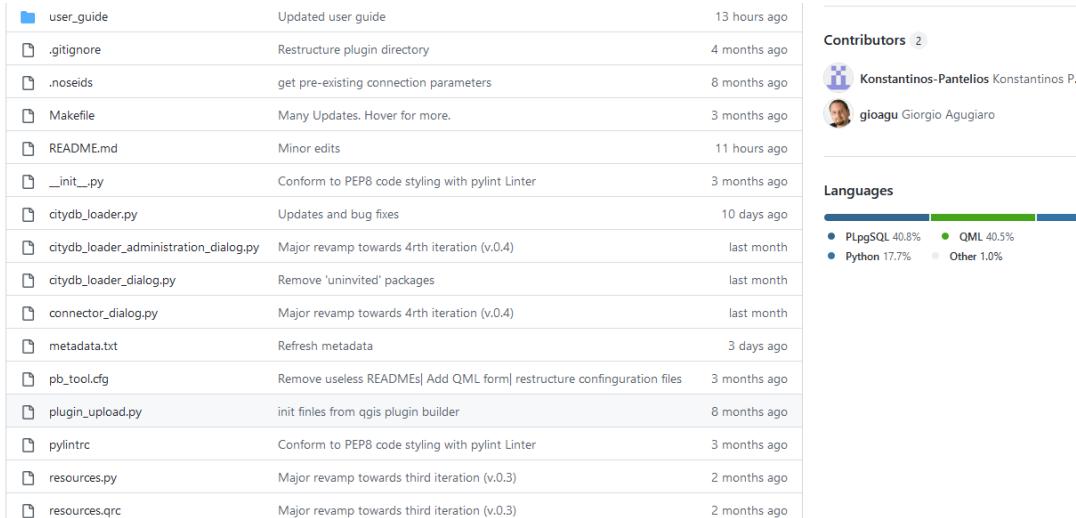
Database:	qgis_test
Host:	3dcities.bk.tudelft.nl
Port:	5810
User:	qgis_user_ro
Password:	qgis_user_ro

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GitHub

The GitHub repository will be made available soon, as soon as Kostantinos completes and discusses his MSc thesis in Geomatics at TU Delft! 😊



The screenshot shows a GitHub repository page for a QGIS plugin. At the top, there's a table of recent commits:

File	Description	Time Ago
user_guide	Updated user guide	13 hours ago
.gitignore	Restructure plugin directory	4 months ago
.noseids	get pre-existing connection parameters	8 months ago
Makefile	Many Updates. Hover for more.	3 months ago
README.md	Minor edits	11 hours ago
__init__.py	Conform to PEP8 code styling with pylint Linter	3 months ago
citydb_loader.py	Updates and bug fixes	10 days ago
citydb_loader_administration_dialog.py	Major revamp towards 4th iteration (v.0.4)	last month
citydb_loader_dialog.py	Remove 'uninvited' packages	last month
connector_dialog.py	Major revamp towards 4th iteration (v.0.4)	last month
metadata.txt	Refresh metadata	3 days ago
pb_tool.cfg	Remove useless READMEs Add QML form restructure configuration files	3 months ago
plugin_upload.py	init finles from qgis plugin builder	8 months ago
pylintrc	Conform to PEP8 code styling with pylint Linter	3 months ago
resources.py	Major revamp towards third iteration (v.0.3)	2 months ago
resources.qrc	Major revamp towards third iteration (v.0.3)	2 months ago

Below the commits, there's a section for "Contributors" showing two people: Konstantinos-Pantelios Kostantinos P... and gioagu Giorgio Agugiaro. A "Languages" chart shows the code distribution: PostgreSQL 40.8%, QML 40.5%, Python 17.7%, and Other 1.0%.

README.md



3DCityDB-Loader for QGIS

This repository is created to manage code concerning the development of a QGIS plugin that facilitates data visualization of relational database 3DCityDB.

Testing machines as of June 2022

OS	Processor(s)	HD	RAM	PostgreSQL	PostGIS	QGIS
Windows 10 2009 64bit	Core I7-8650U 1.7 GHz	SSD 2 TB	32 GB	14 64bit	3.2	QGIS 3.22.7 64bit
Linux (Ubuntu 20.04.3 LTS x86_64)	Intel i7-7500U (4) 3.500GHz	SSD 250 GB	8 GB	12 64bit	3.1	QGIS 3.22.3 64 bit
Mac OS (11.6.2 64bit)	Core i9-??	1TB SSD	32 GB	13 64bit	3.1	QGIS 3.22 64 bit
Linux server (Ubuntu 18.4)	TUD Virtual Machine			10 64bit	3.0	N/A

Thank you for your attention!



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