

CityGML 3DCityDB-Loader plugin for QGIS

A quick overview

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Last update: 29 May 2022

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Overview

- Motivation
- Plugin overview
- Software installation
- Usage
- Advanced options
- Software uninstall
- Current limitations

Motivation

Motivation

Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

IDEA:

- Users could benefit from working with the 3DCityDB "directly"
 - No need to work with files
 - Editing of features could become easier
 - SQL/relational model are rather well-known in the user community
 - Eventually.... "3D city models belong best in a database" 😊

Motivation

BUT:

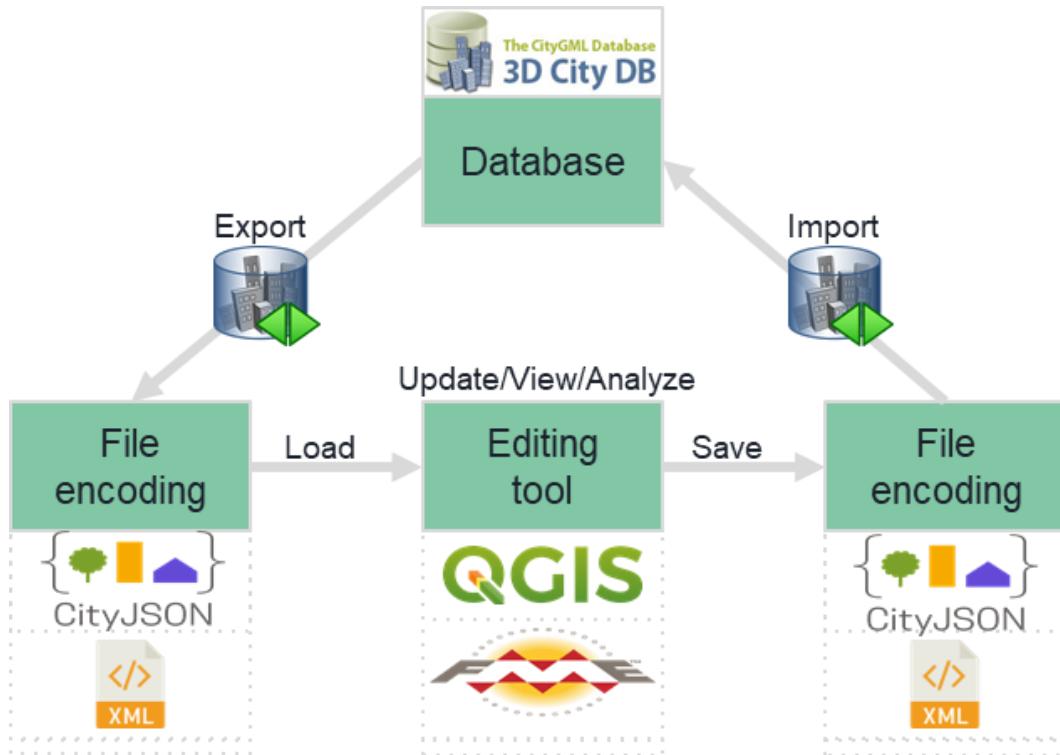
- 3DCityDB structure is rather complex
 - Lots of nested tables, complex structure
 - Data management is complex, although some functions are provided (e.g. delete functions)
 - There can be multiple "scenarios" in the same database instance ("citydb_1", "citydb_2", "citydb_3", ...)
- CityGML does not 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

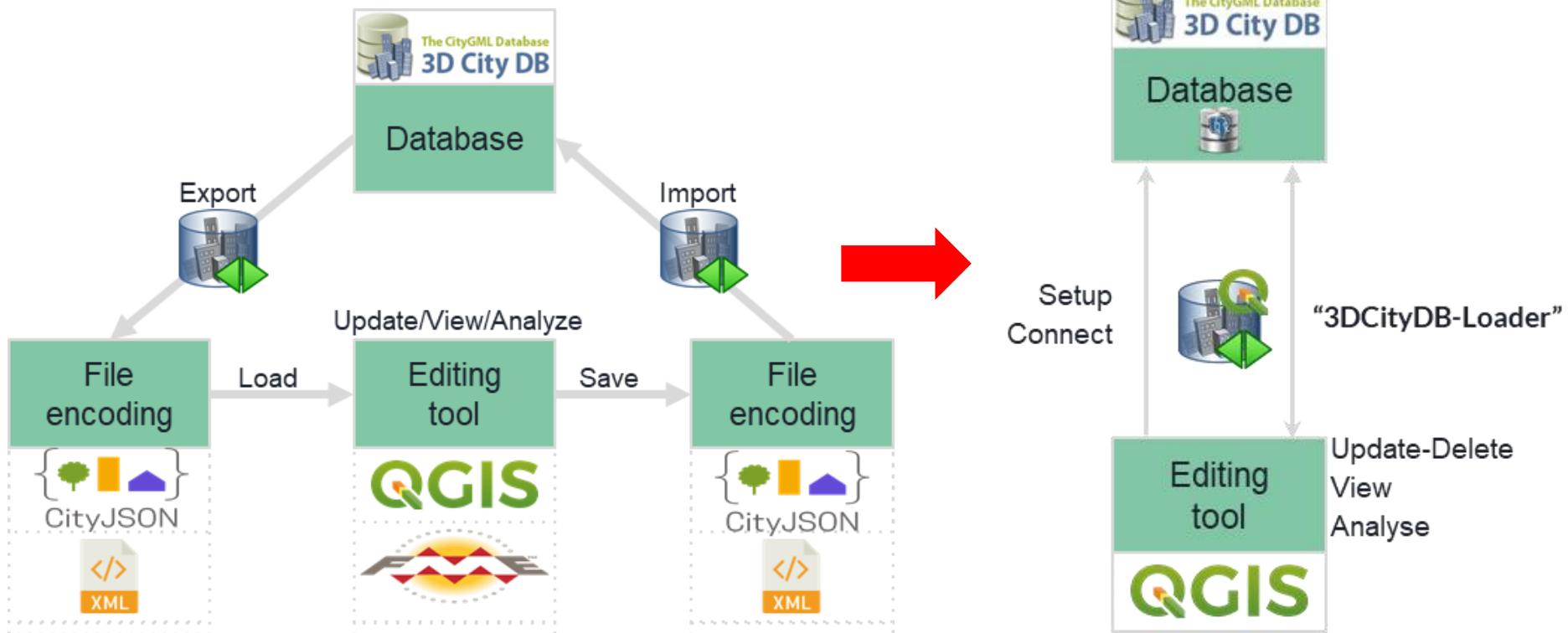
SO:

- 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

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

Main functionalities

- Create “layers” to hide 3DCityDB complexity when interacting with data
 - Deal with multi-LoD / different geometries / implicit representations
 - Merge all standard attributes of a cityobject into a single "table"
- Support for multiple users with different privileges (read-only, read-write)
- Editing of attributes: possible
- Deletion of features: possible
- Editing of geometries: NOT possible
- Support for multiple 3DCityDB scenarios (aka “citydb” schemas)

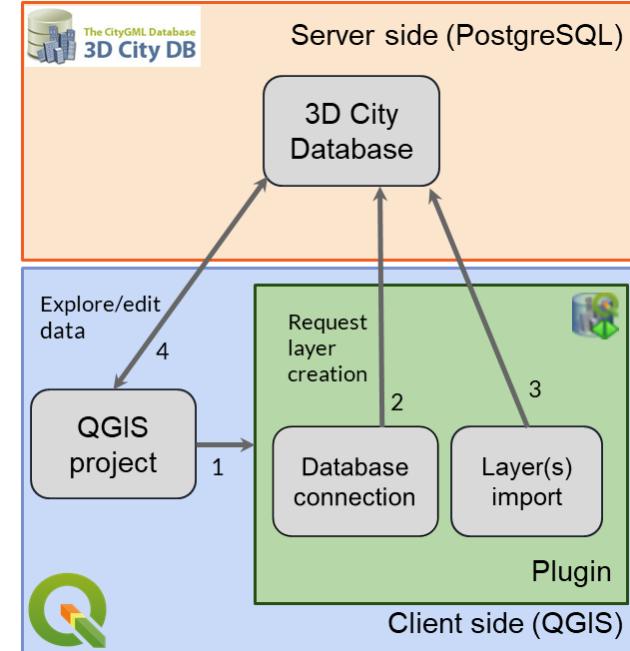
Plugin overview

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

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



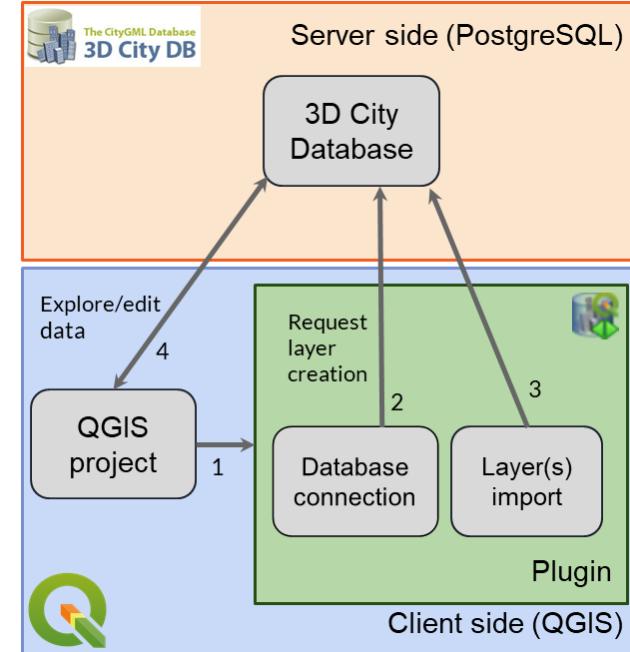
Plugin overview

Motivation
Plugin overview
 Software installation
 Usage
 Advanced options
 Software uninstall
 Current limitations

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 (aka "scenarios")

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>

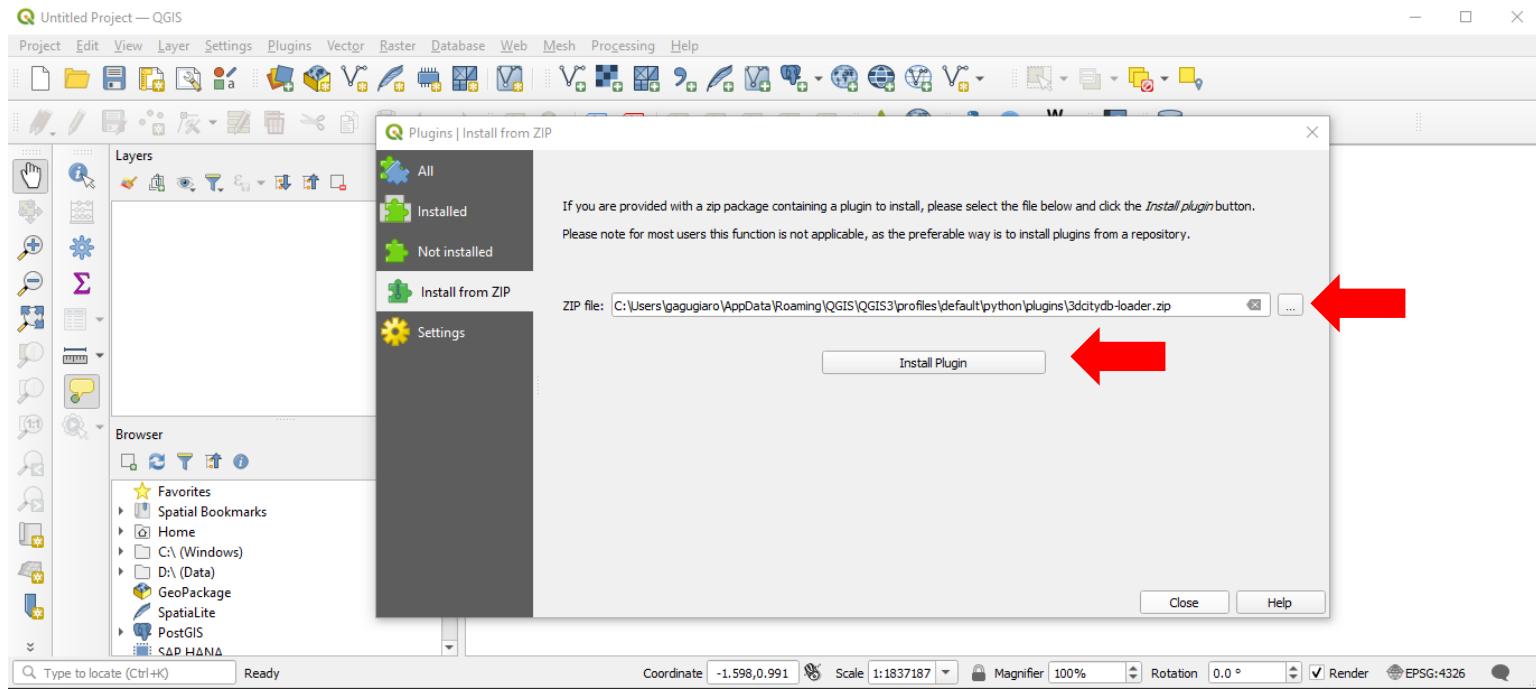
Installation

Software requirements

- CityGML 3D City Database v. 4.x or higher
 - Works on all currently supported versions of PostgreSQL and PostGIS
 - <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
 - Should work with no problems also on 3.16
 - Currently testing with older versions
 - <https://qgis.org/en/site/forusers/download.html>
- PgAdmin (suggested, not required)
 - <https://www.pgadmin.org/download/>

Installation

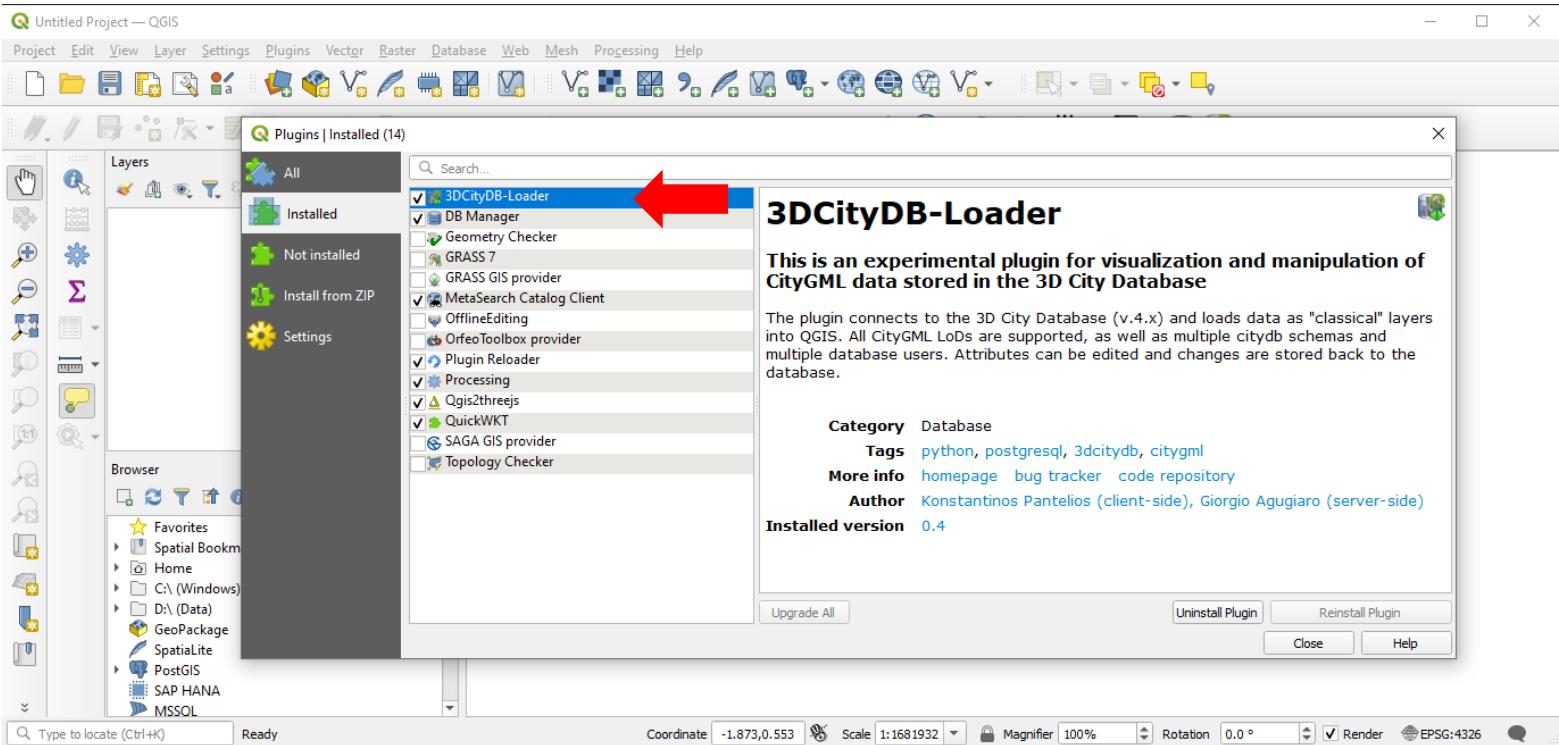
- The "3DCityDB-Loader" for QGIS is currently available as zip file
- In QGIS, open the Plugins\Manage and install plugins window, and choose "Install from ZIP". Select the provided zip file and click the "Install Plugin" button



Installation

- Upon installation, you must activate the plugin

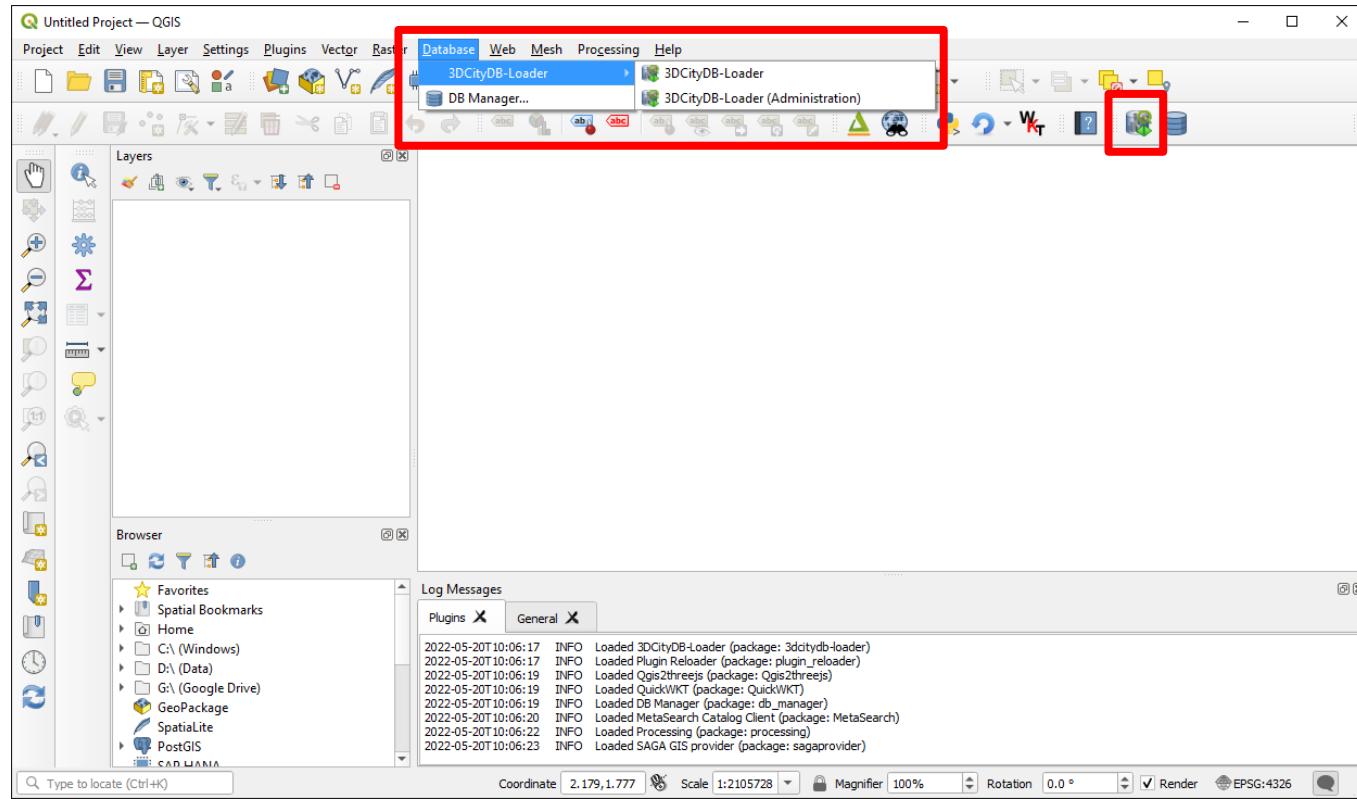
Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



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)

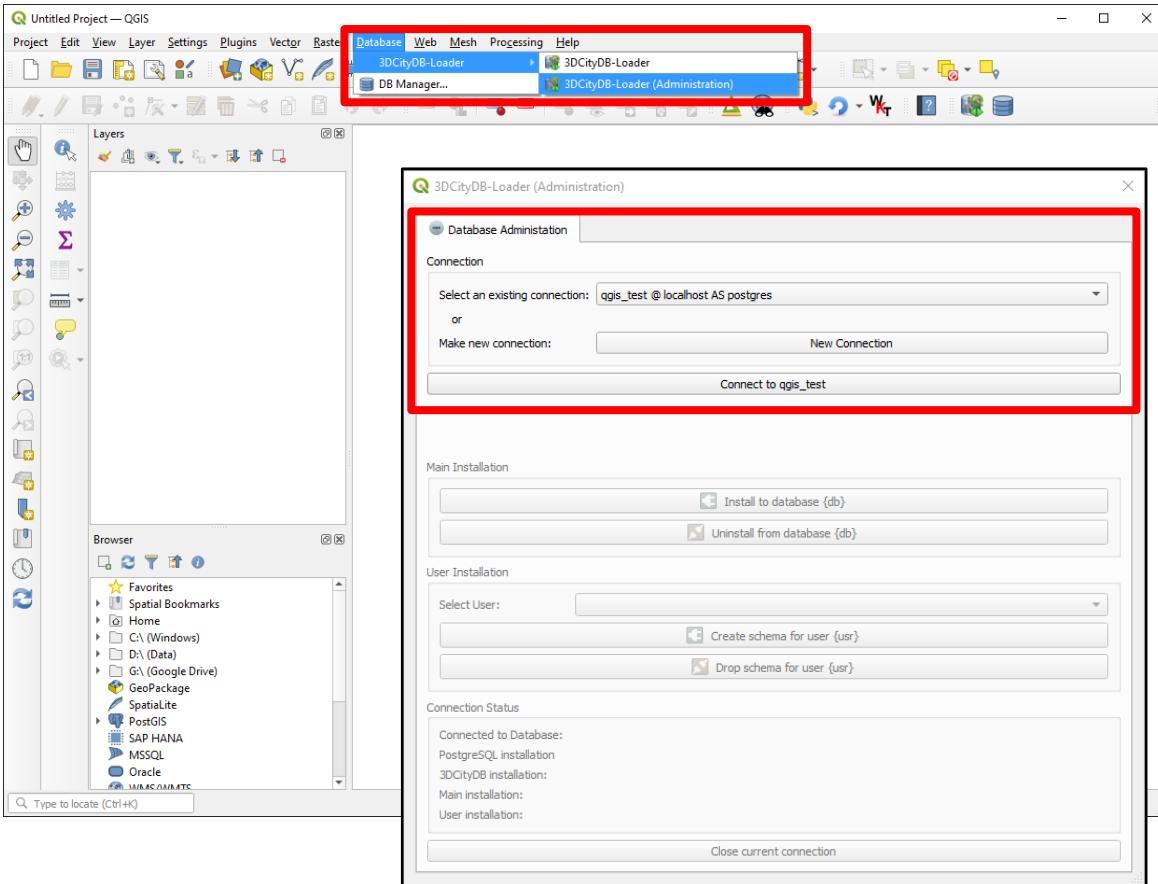
Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Usage: As database administrator

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

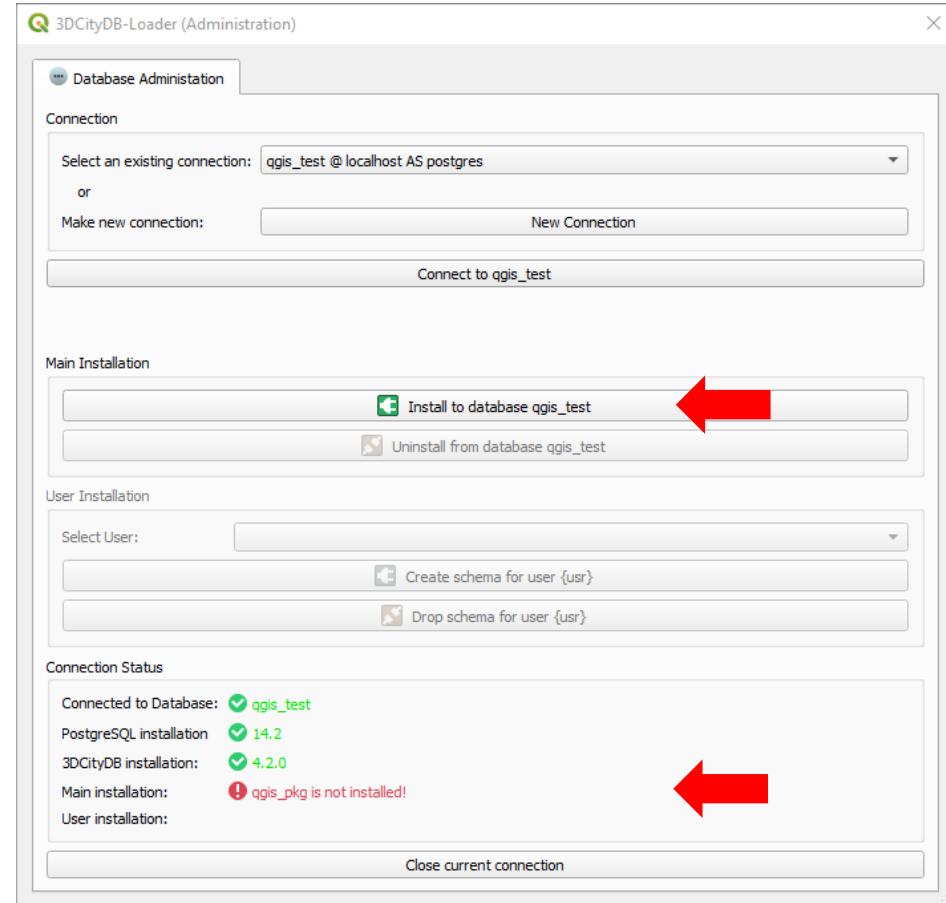
- 1) Create a new connection or use an existing one to the desired 3DCityDB instance (here: "qgis_test")



Usage: As database administrator

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

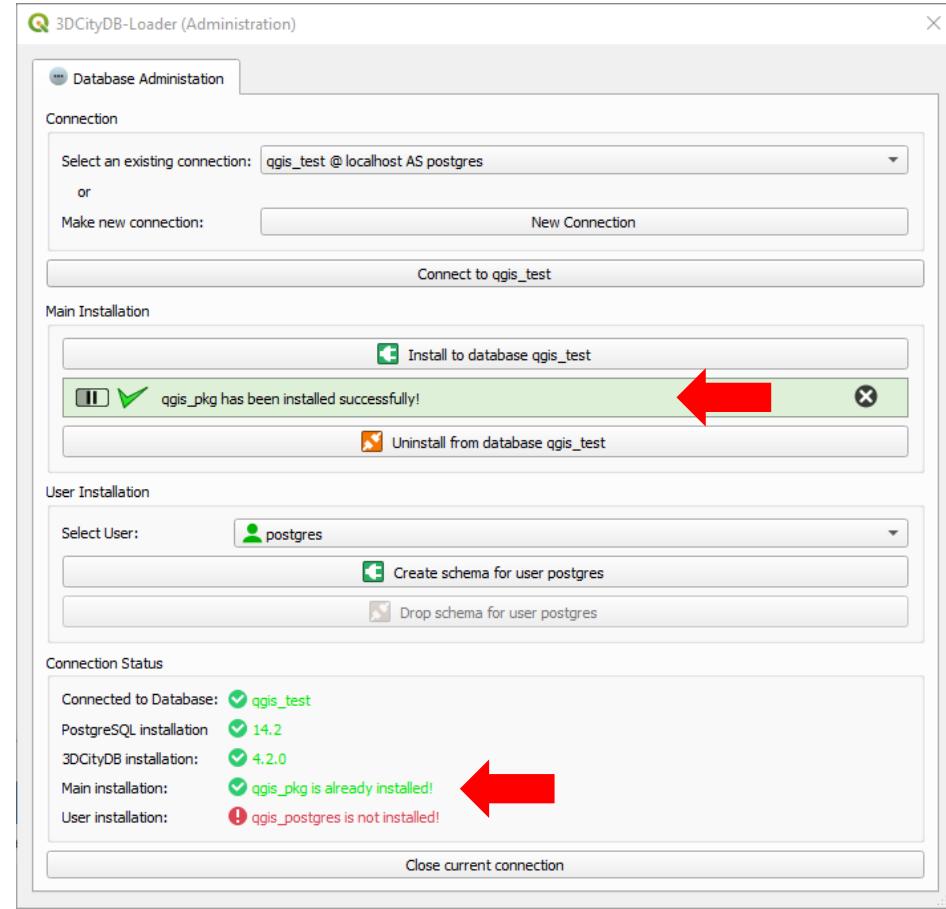
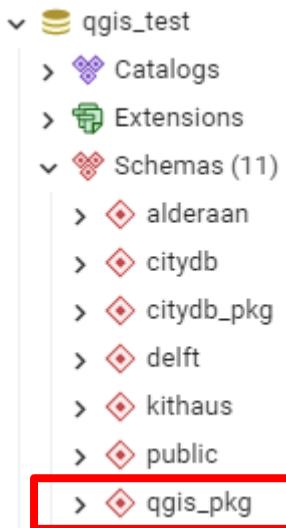
2) Install the QGIS Package ("Main installation")



Usage: As database administrator

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

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

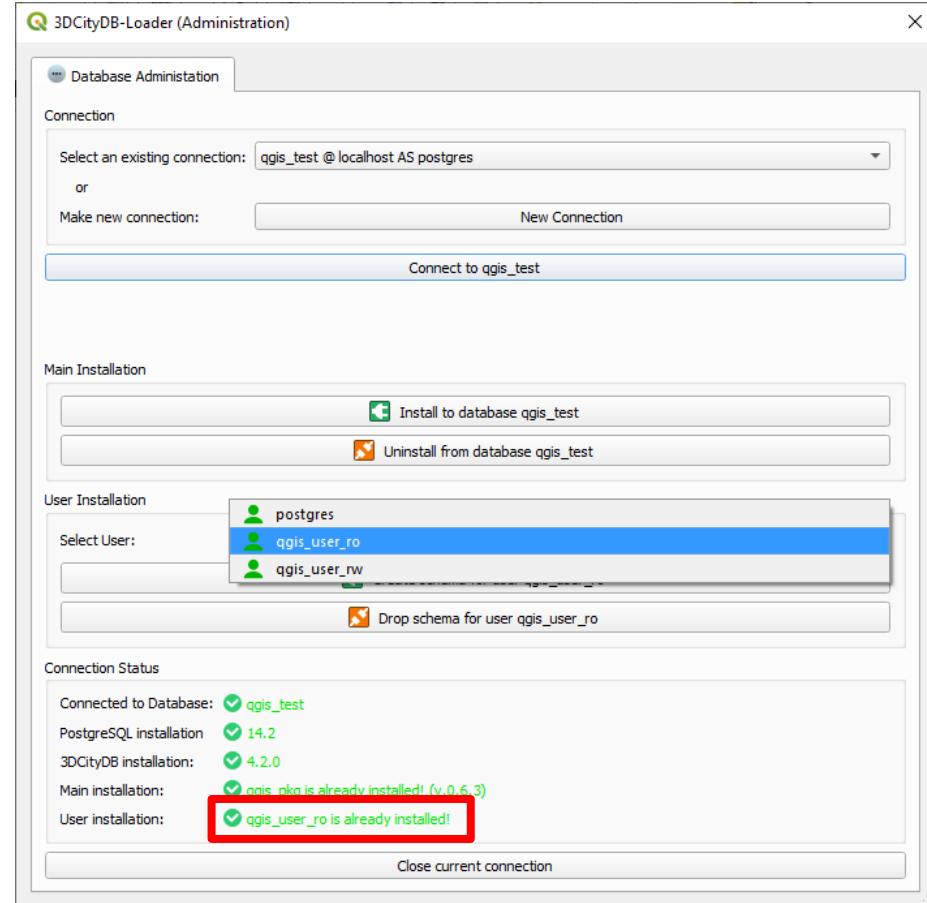


Usage: As database administrator

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 advanced options (later on)



Usage: As database administrator

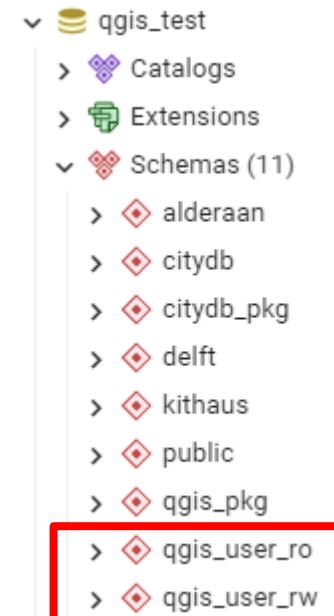
- 3) (Optionally) create user schemas.

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Connection parameter:

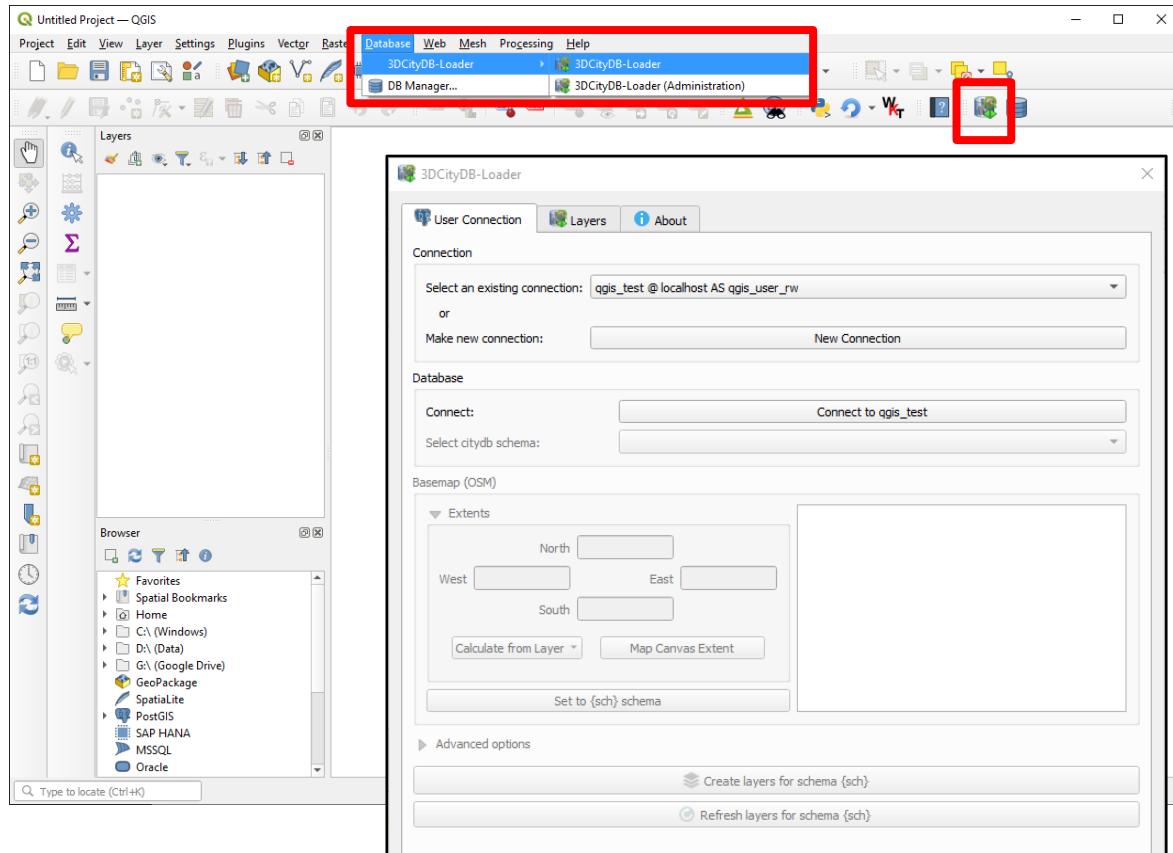
- Login/password: "qgis_user_ro"
- Login/password: "qgis_user_rw"



Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

Usage: As user

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



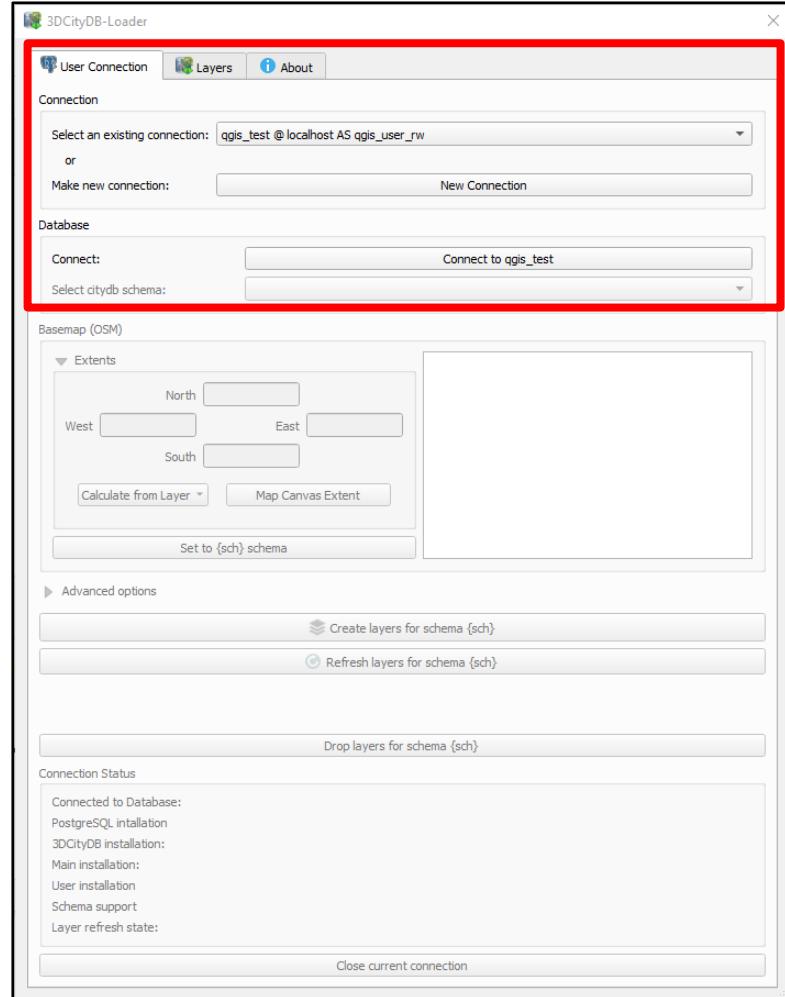
Usage: As user

In the "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)



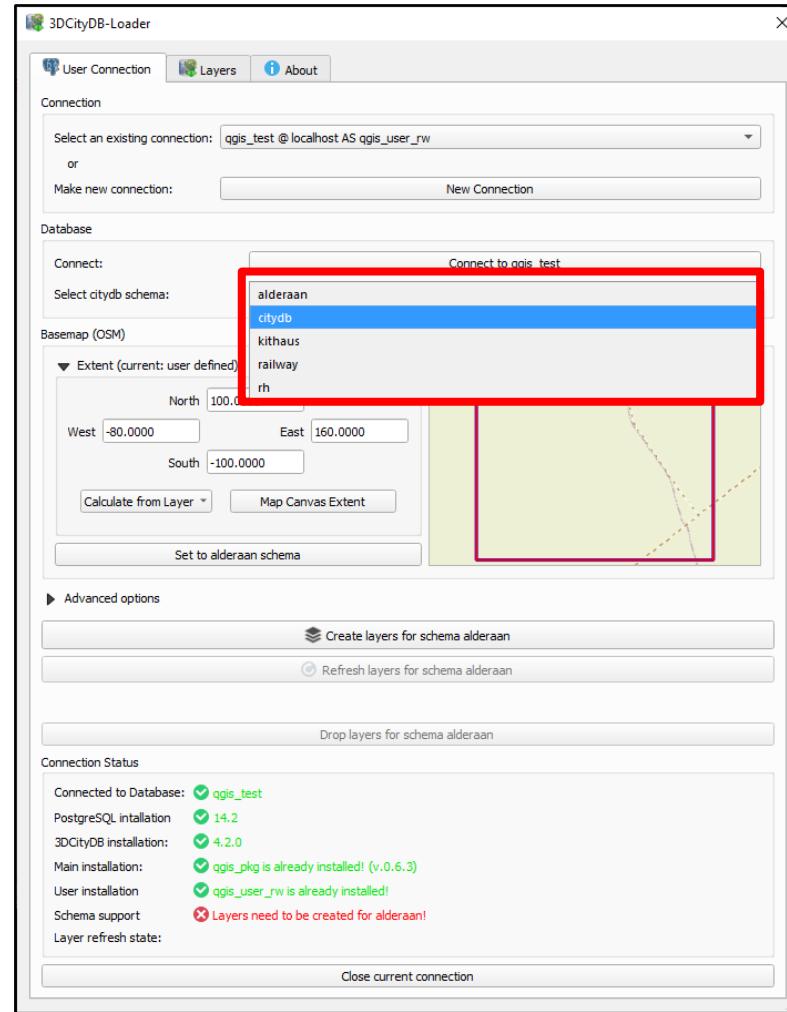
Usage: As user

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 schemas
<https://3dcitydb-docs.readthedocs.io/en/latest/3dcitydb/multi-schema.html>

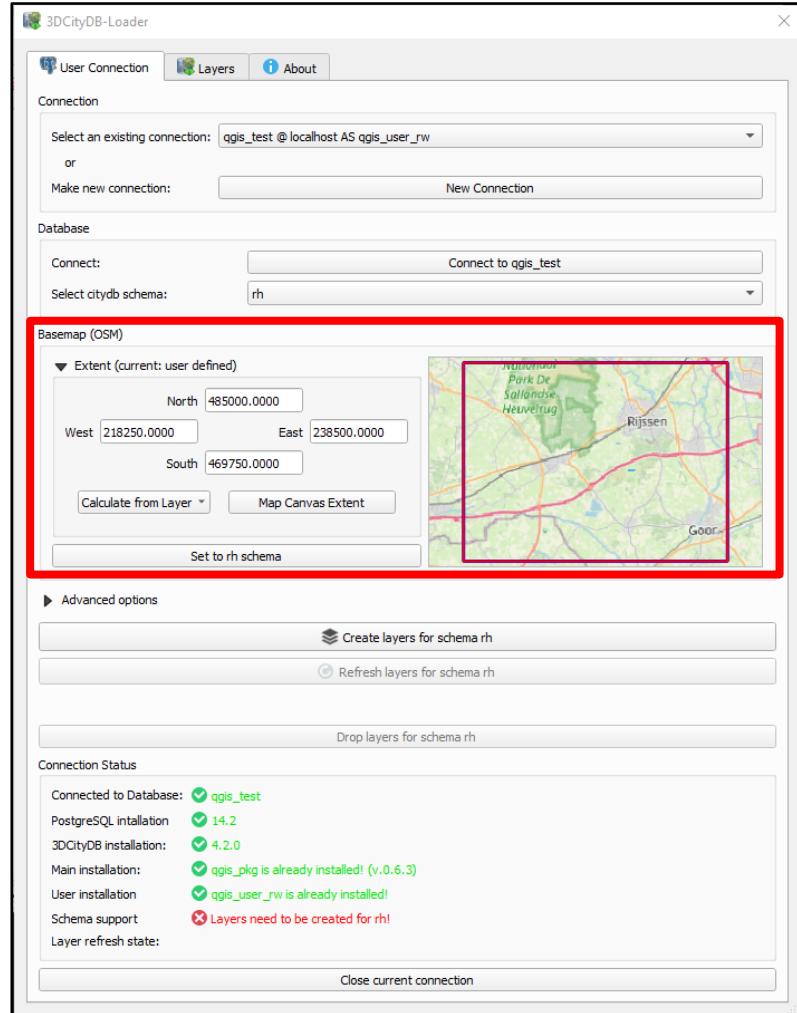


Usage: As user

In the "User connection" tab

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

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



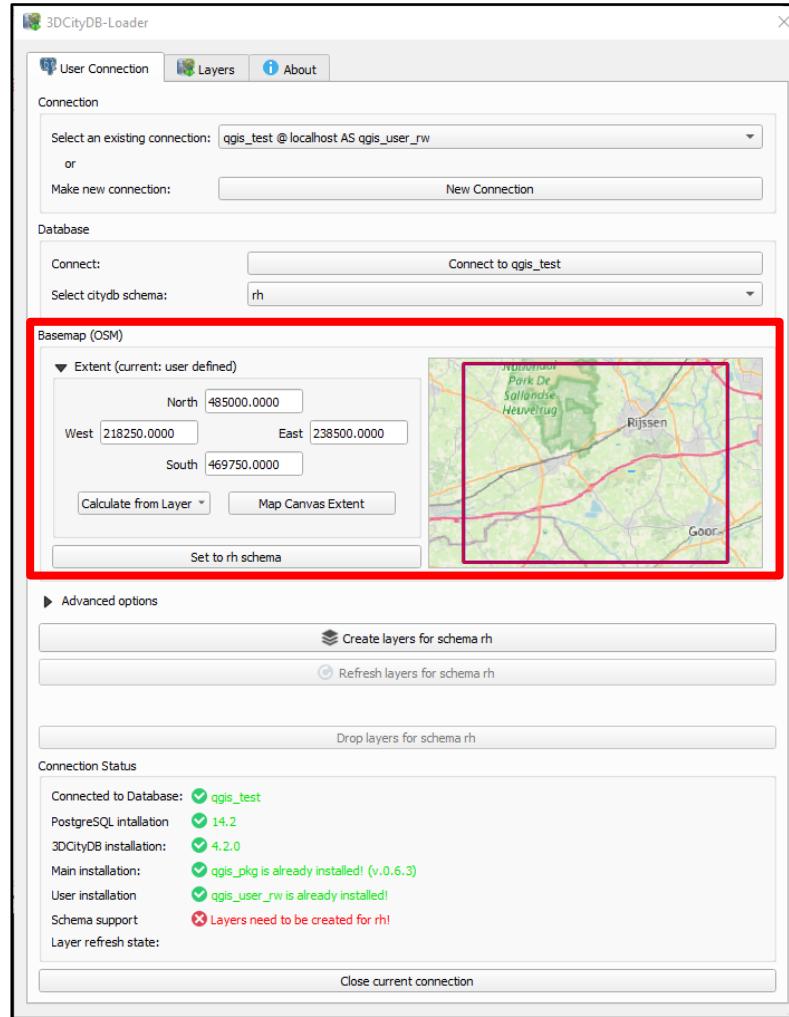
Usage: As user

In the "User connection" tab

- 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!

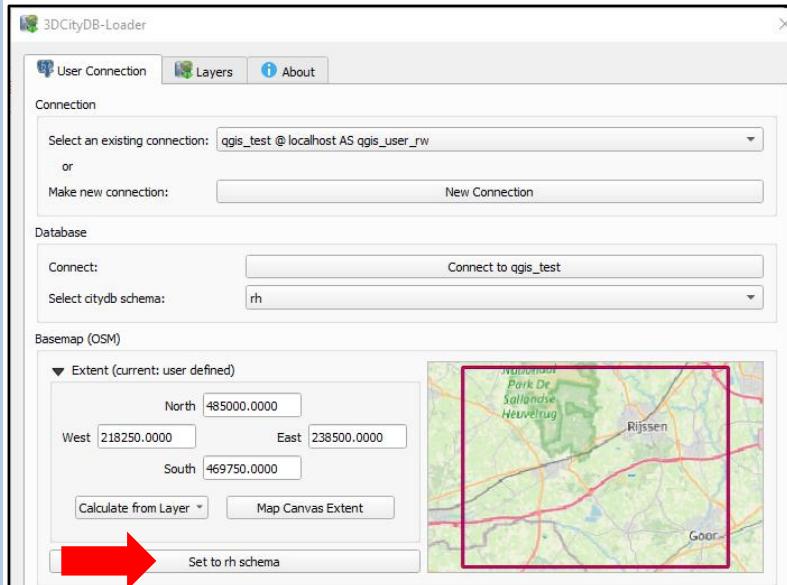
Behind the scenes: In the database, materialized views of the geometries will be generated according to the selected extents. In case of very large cities, it might take a long time (and a lot of space on the server)!



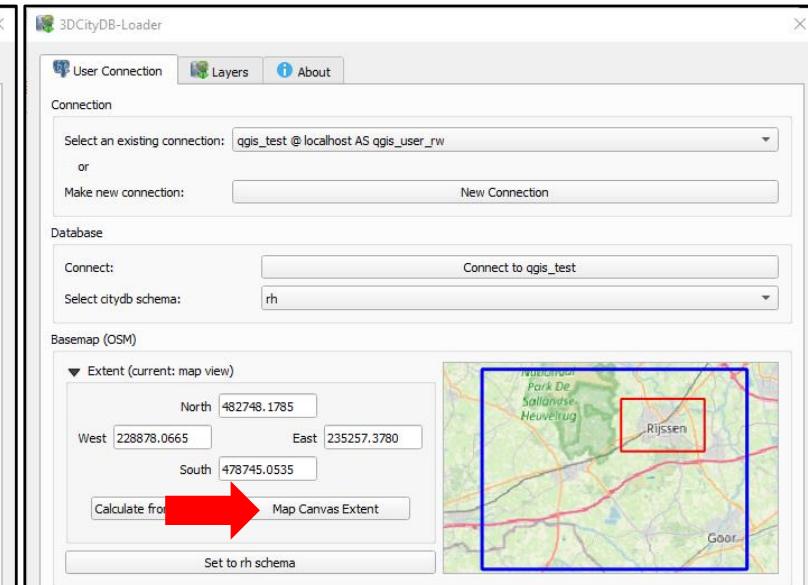
Usage: As user

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations

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

Usage: As user

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations

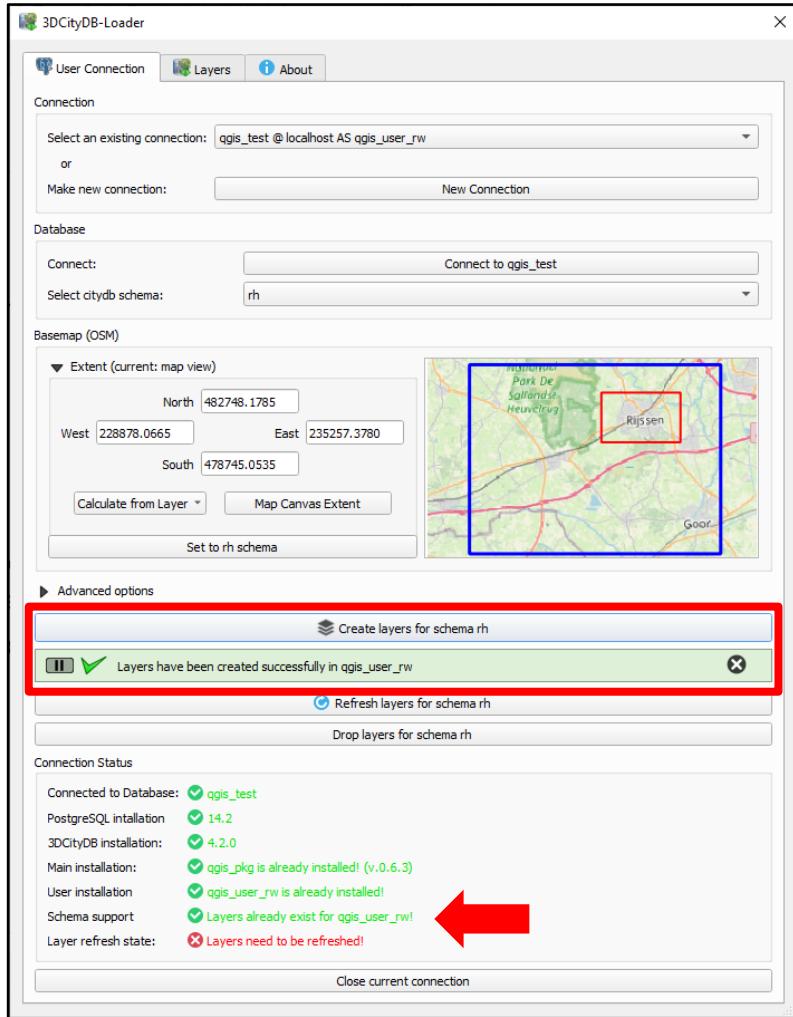
In the "User connection" tab

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.



Usage: As user

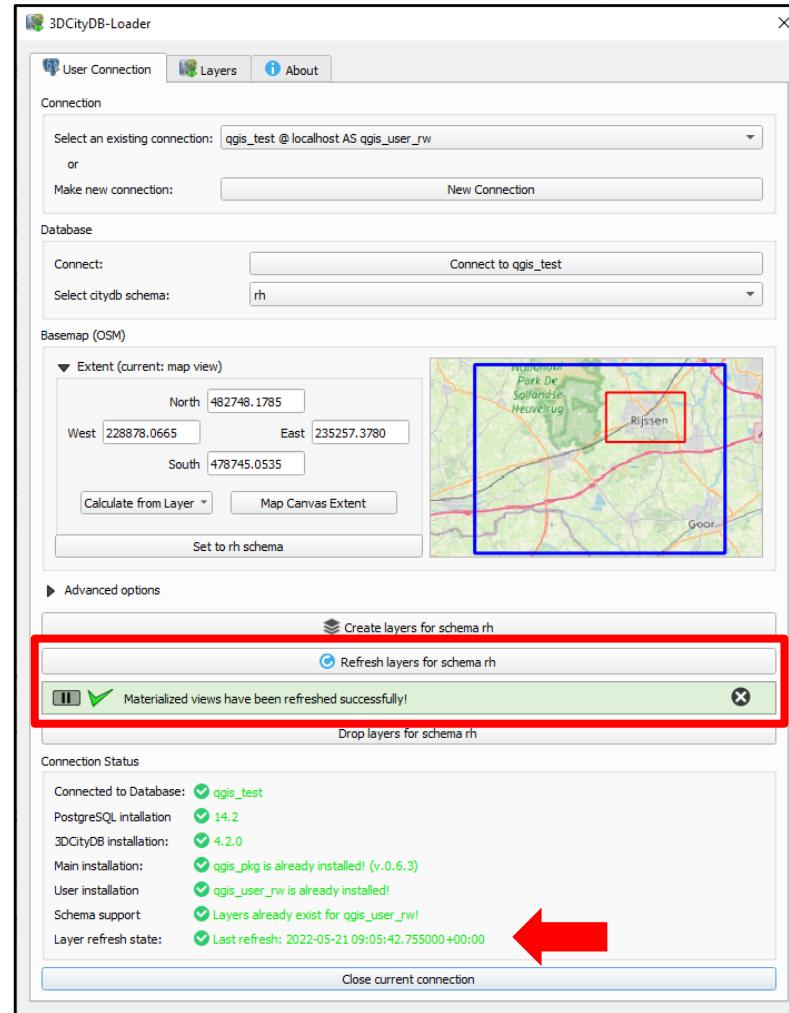
In the "User connection" tab

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.



Usage: As user

Behind the scenes:

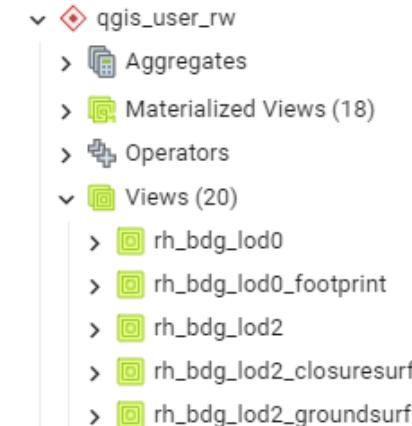
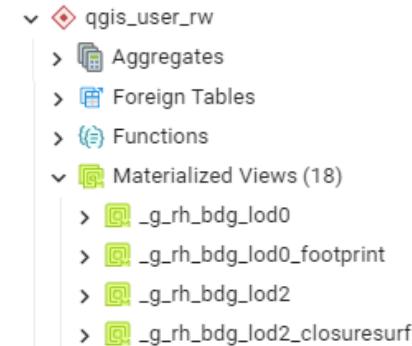
In the database user schema, both materialised views (containing the feature geometries) and the layers (as views, containing the feature attributes linked to the corresponding geometries in the materialised views) can be accessed.

Materialised views name coding:

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

Views name coding:

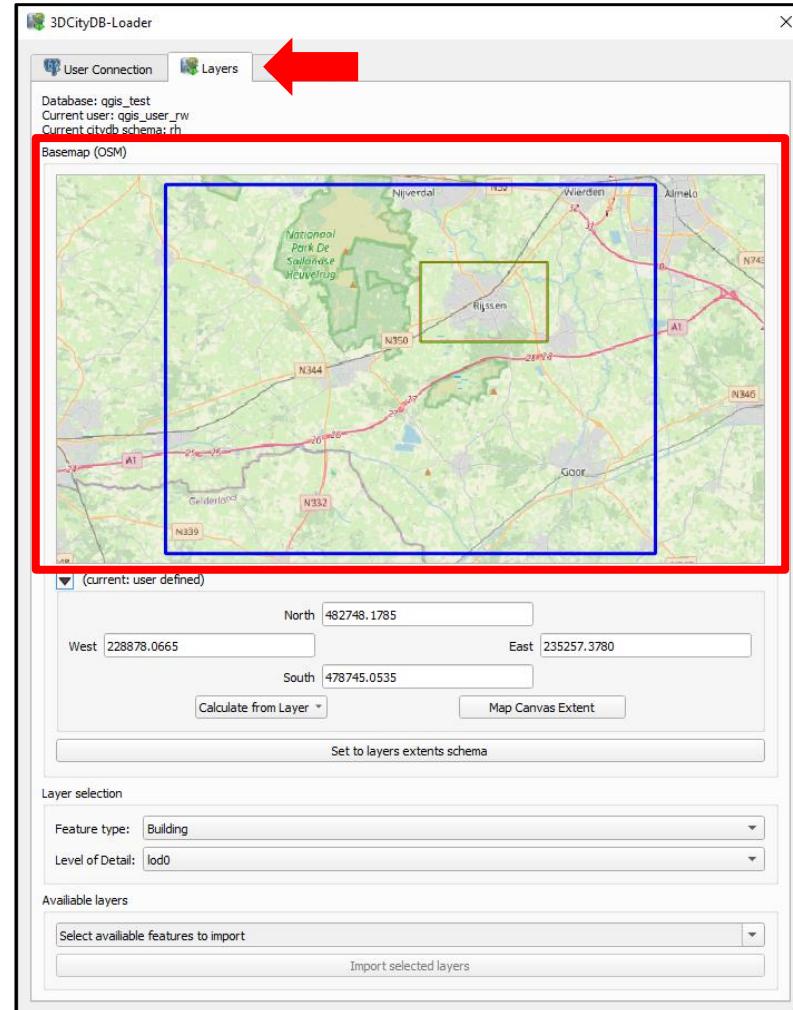
- citydb schema name + feature name + lodx + (optional) semantic details
- Linked via column co_id (PK and FK to the materialised views)



Usage: As user

In the "Layers" tab

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

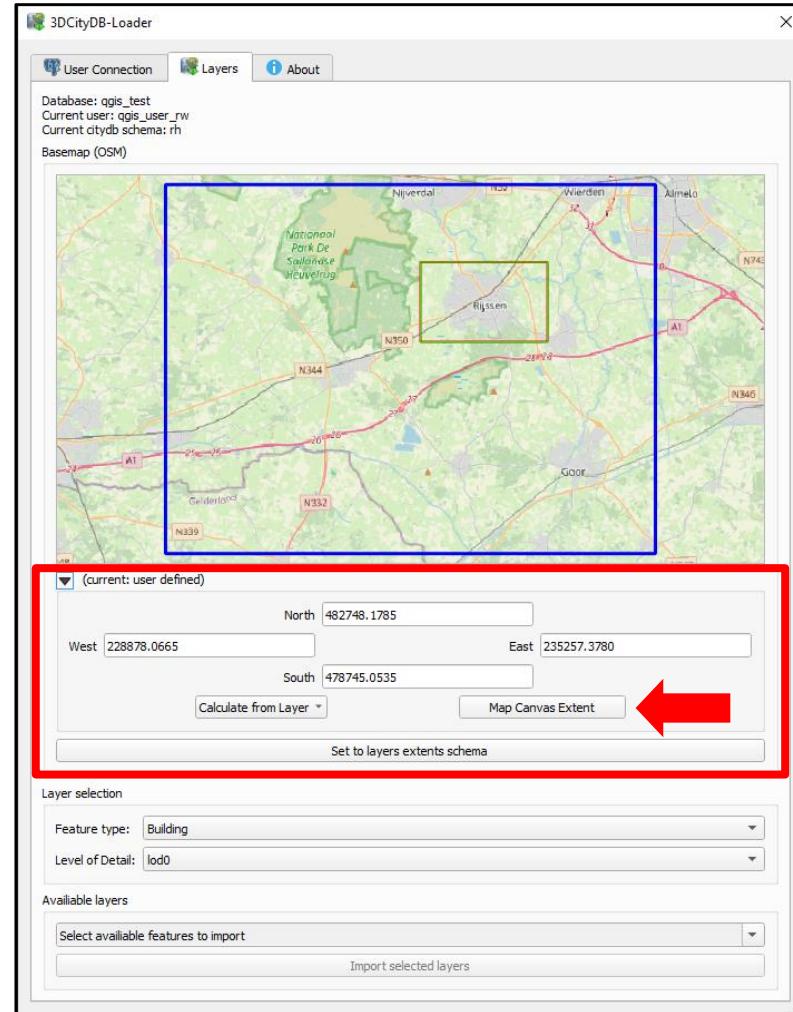


Usage: As user

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



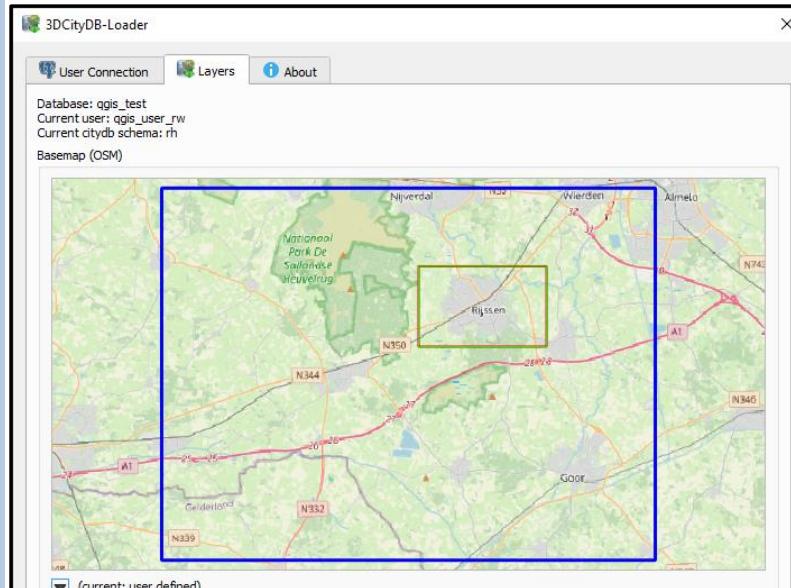
Usage: As user

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

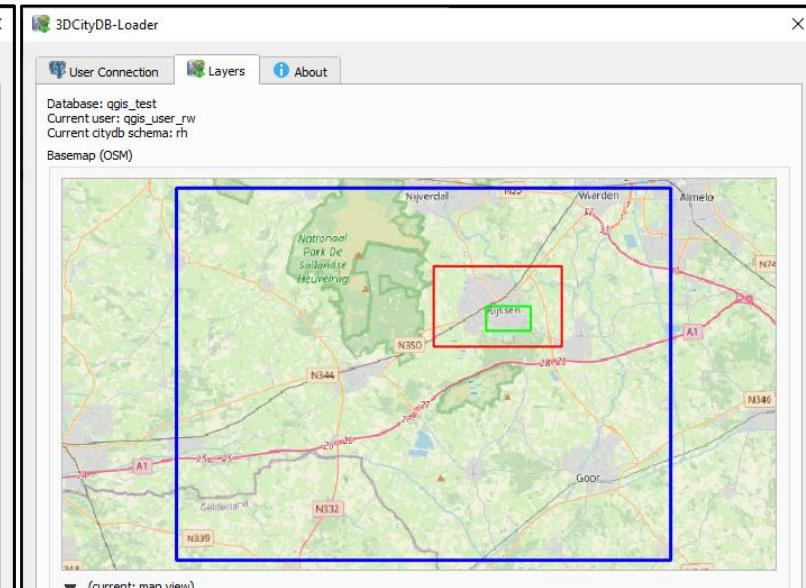
Red: database-side layers extents (i.e. extents of the materialised views)

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)



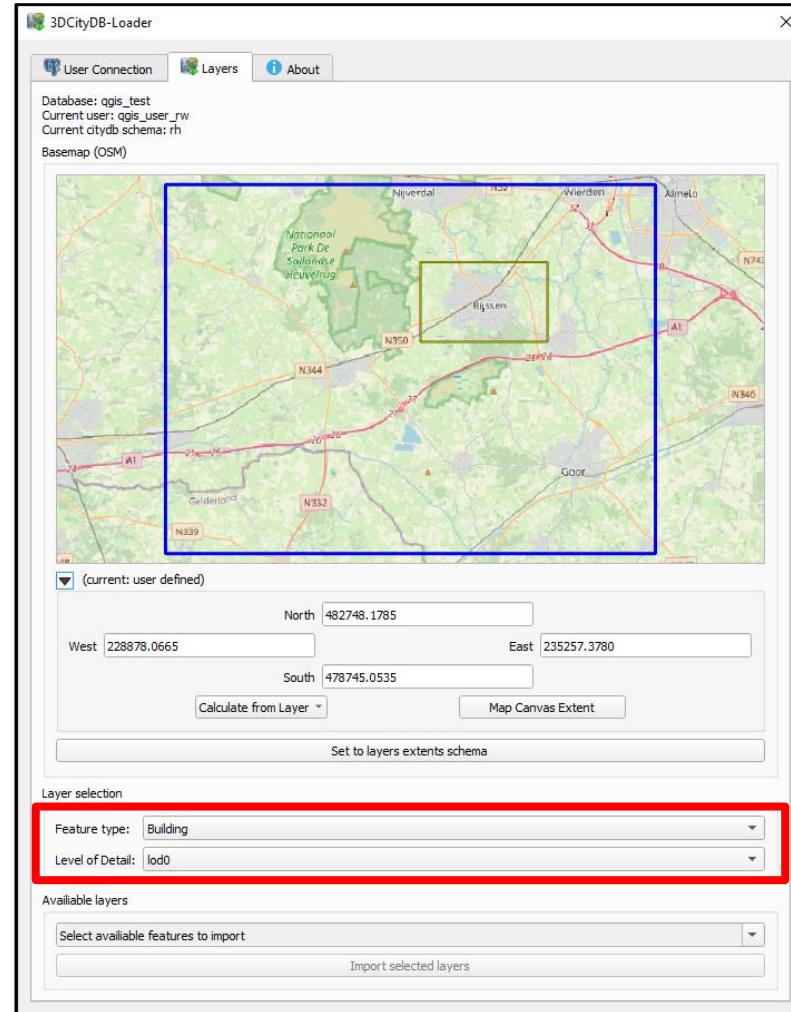
User-selected QGIS-layers extents

Usage: 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



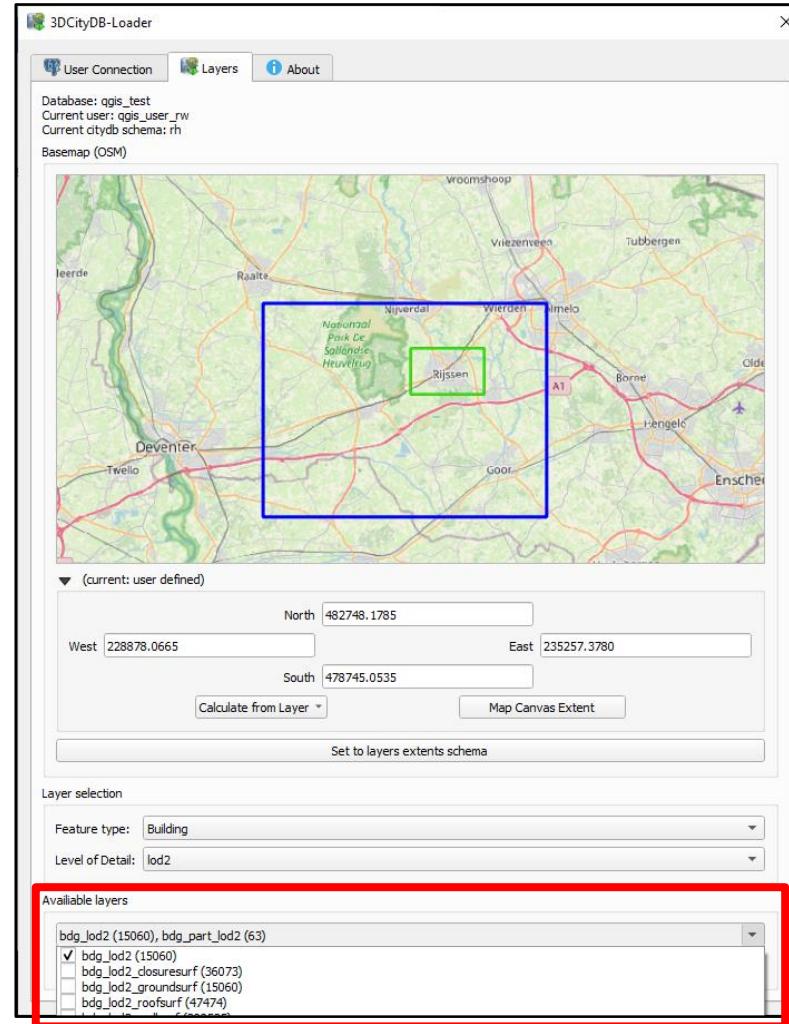
Usage: As user

In the "Layers" tab

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

- The number of features available 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.

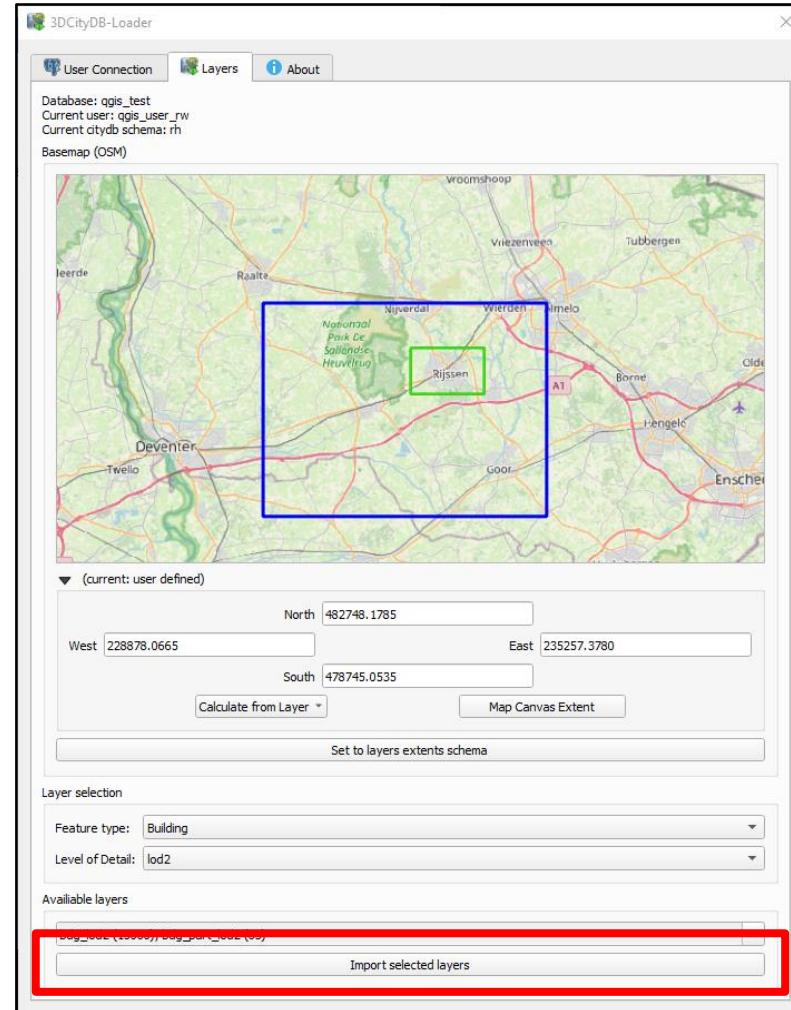


Usage: As user

In the "Layers" tab

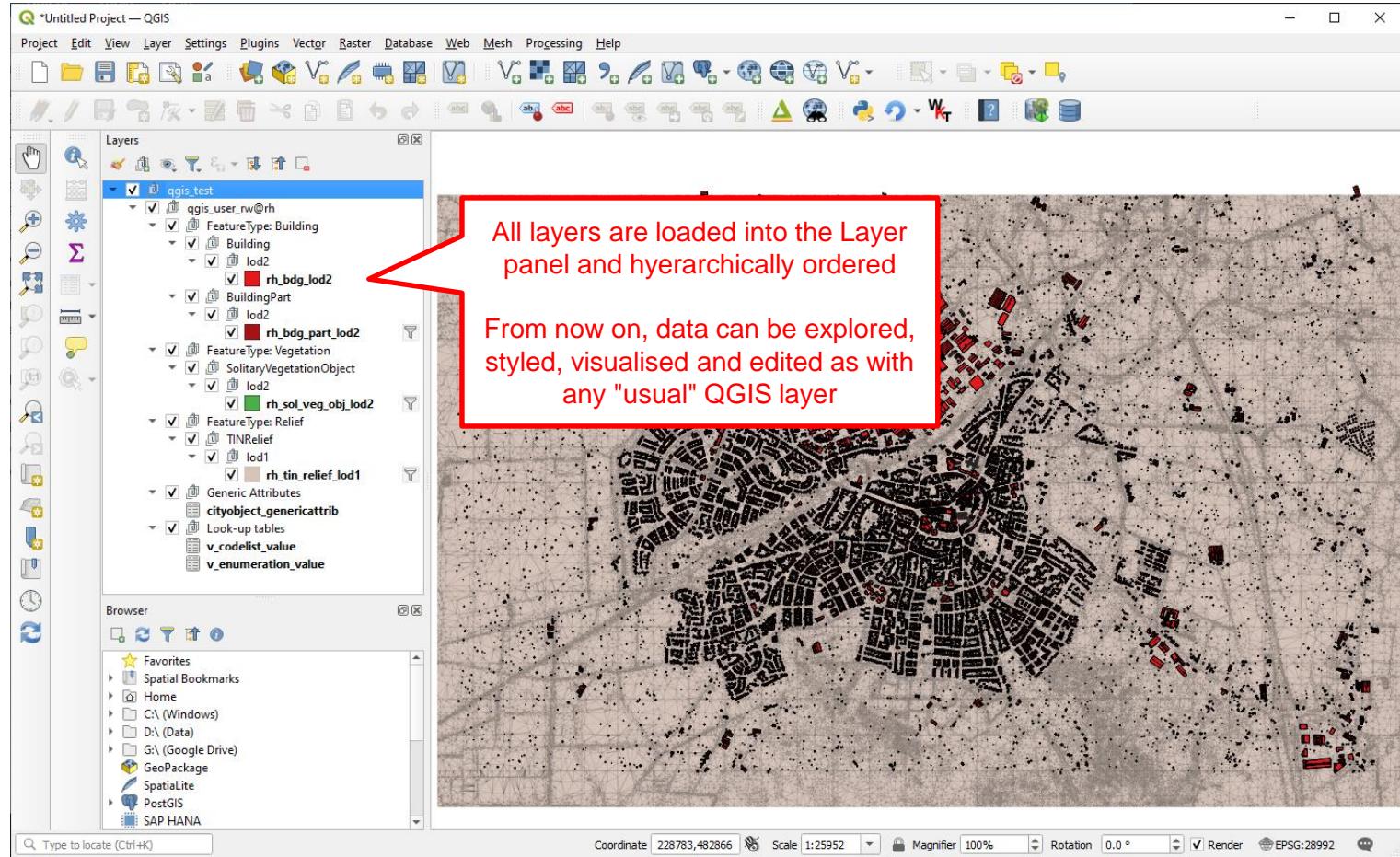
12) Import the selected layers into QGIS

- 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)



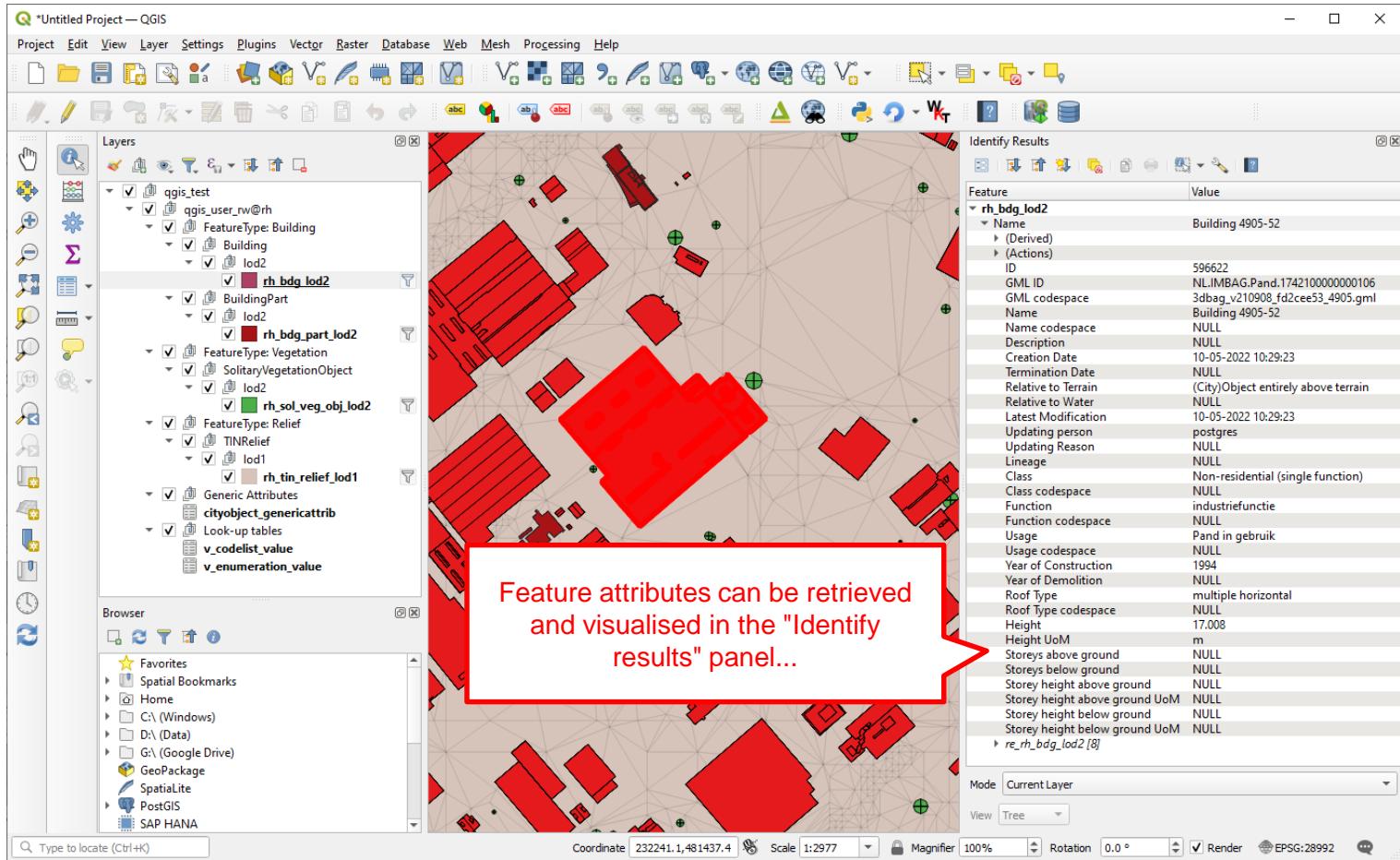
Usage in QGIS: Layers

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Usage in QGIS: Attributes

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations



The screenshot shows the QGIS interface with a map of buildings highlighted in red. A callout bubble points to the 'Identify Results' panel on the right, which displays detailed attributes for the selected features.

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]	

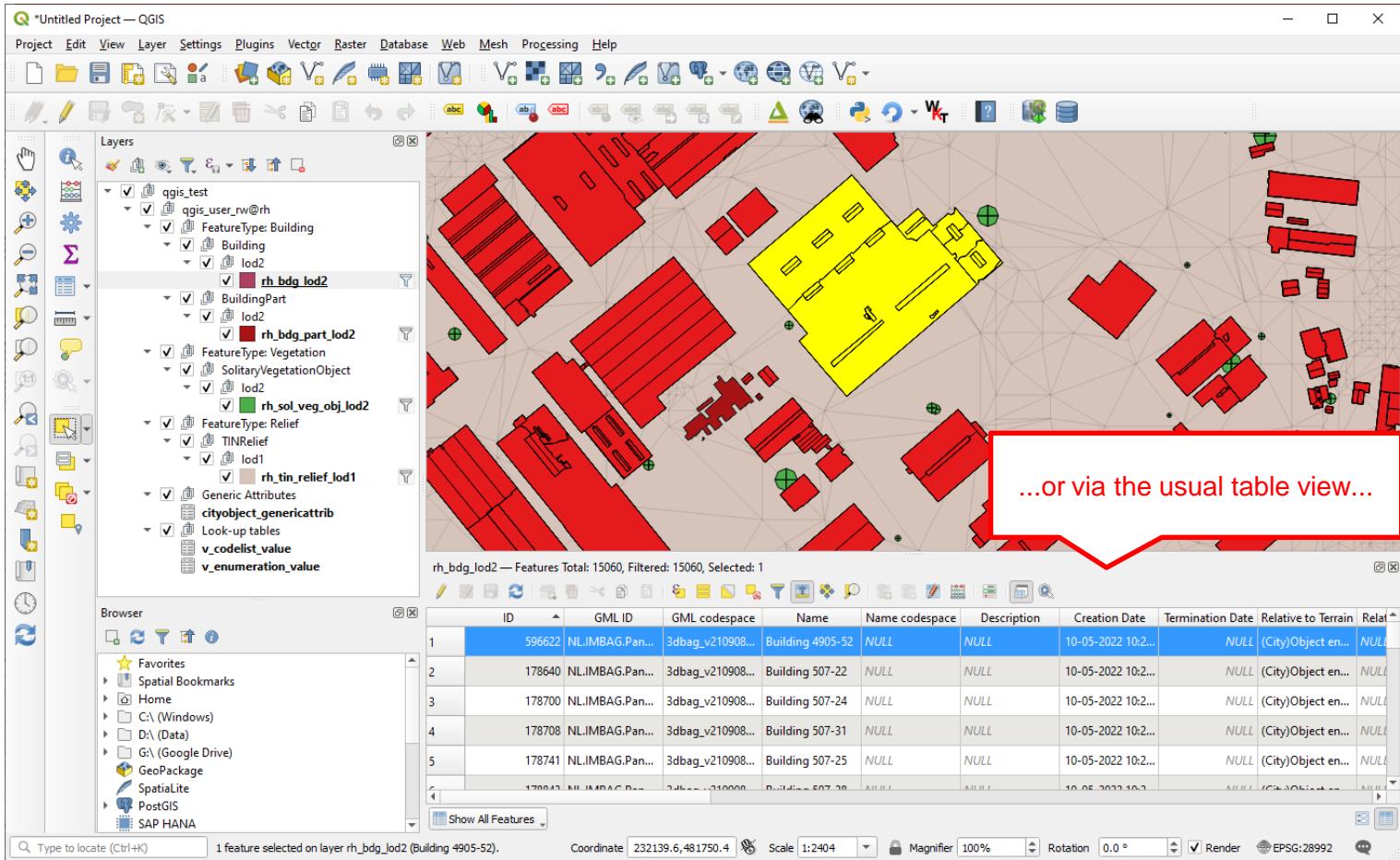
Mode: Current Layer
 View: Tree

Type to locate (Ctrl+K)

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

Usage in QGIS: Attributes

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



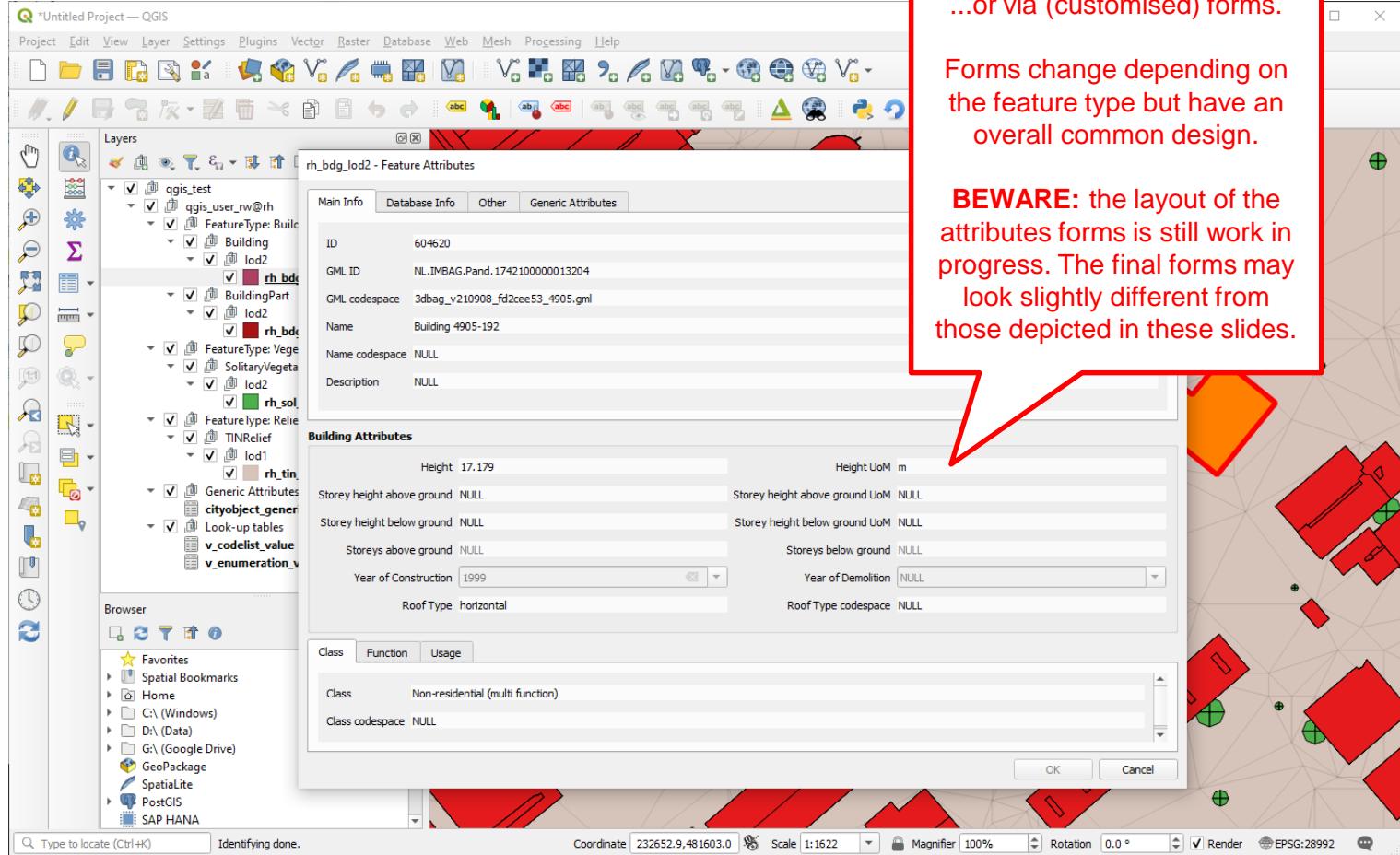
The screenshot shows the QGIS interface with a map of buildings and vegetation. A red callout box points to the attribute table at the bottom right of the interface.

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

ID	GML ID	GML codespace	Name	Name codespace	Description	Creation Date	Termination Date	Relative to Terrain	Relat...
1	596622	NL.1MBAG.Pan...	3dbag_v210908...	Building 4905-52	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...
2	178640	NL.1MBAG.Pan...	3dbag_v210908...	Building 507-22	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...
3	178700	NL.1MBAG.Pan...	3dbag_v210908...	Building 507-24	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...
4	178708	NL.1MBAG.Pan...	3dbag_v210908...	Building 507-31	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...
5	178741	NL.1MBAG.Pan...	3dbag_v210908...	Building 507-25	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...
...	178040	NL.1MBAG.Pan...	3dbag_v210908...	Building 507-30	NULL	NULL	10-05-2022 10:2...	NULL	(City)Object en...

Usage in QGIS: Attributes

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations



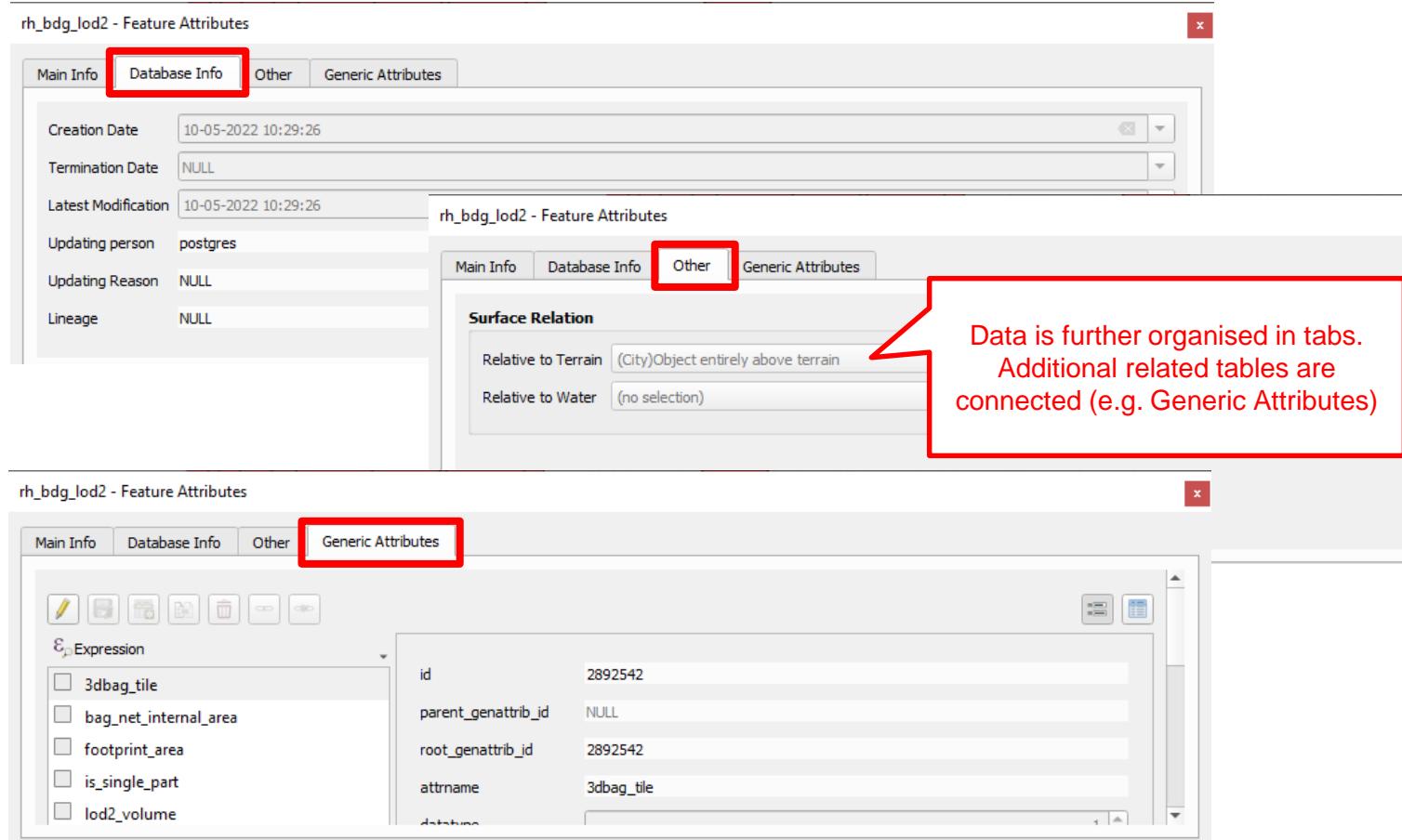
...or via (customised) forms.

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.

Usage in QGIS: Attributes

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



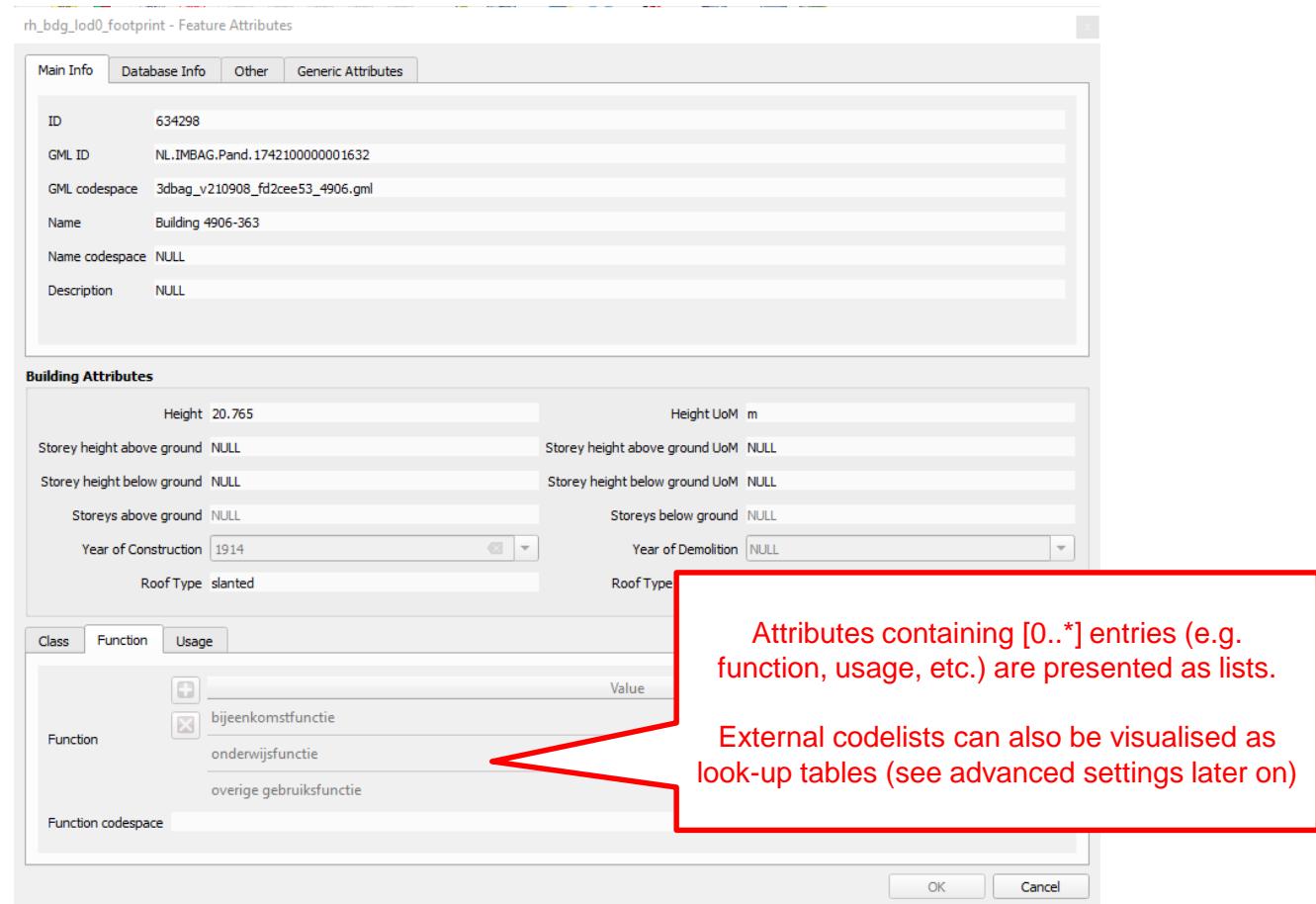
The screenshot shows three separate windows of the QGIS Attribute Manager for a feature named "rh_bdg_lod2".

- Top Window:** Shows the "Database Info" tab selected. It contains fields for 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), and Lineage (NULL).
- Middle Window:** Shows the "Other" tab selected. It contains sections for "Surface Relation" with fields for Relative to Terrain ("(City)Object entirely above terrain") and Relative to Water ("(no selection)". A red box highlights the "Other" tab.
- Bottom Window:** Shows the "Generic Attributes" tab selected. It includes an "Expression" section with checkboxes for "3dbag_tile", "bag_net_internal_area", "footprint_area", "is_single_part", and "lod2_volume". To the right is a table with columns "id", "parent_genattrib_id", "root_genattrib_id", "attrname", and "datatype". The first row has values: id (2892542), parent_genattrib_id (NULL), root_genattrib_id (2892542), attrname (3dbag_tile), and datatype (NULL). A red box highlights the "Generic Attributes" tab.

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

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

Usage in QGIS: Attributes



rh_bdg_lod0_footprint - Feature Attributes

Main Info Database Info Other Generic Attributes

ID 634298
GML ID NL.1MBAG.Pand.1742100000001632
GML codespace 3dbag_v210908_fd2cee53_4906.gml
Name Building 4906-363
Name codespace NULL
Description NULL

Building Attributes

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
Roof Type slanted Roof Type

Class Function Usage

Function	Value
bijeenkomstfunctie	
onderwijsfunctie	
overige gebruiksfunctie	

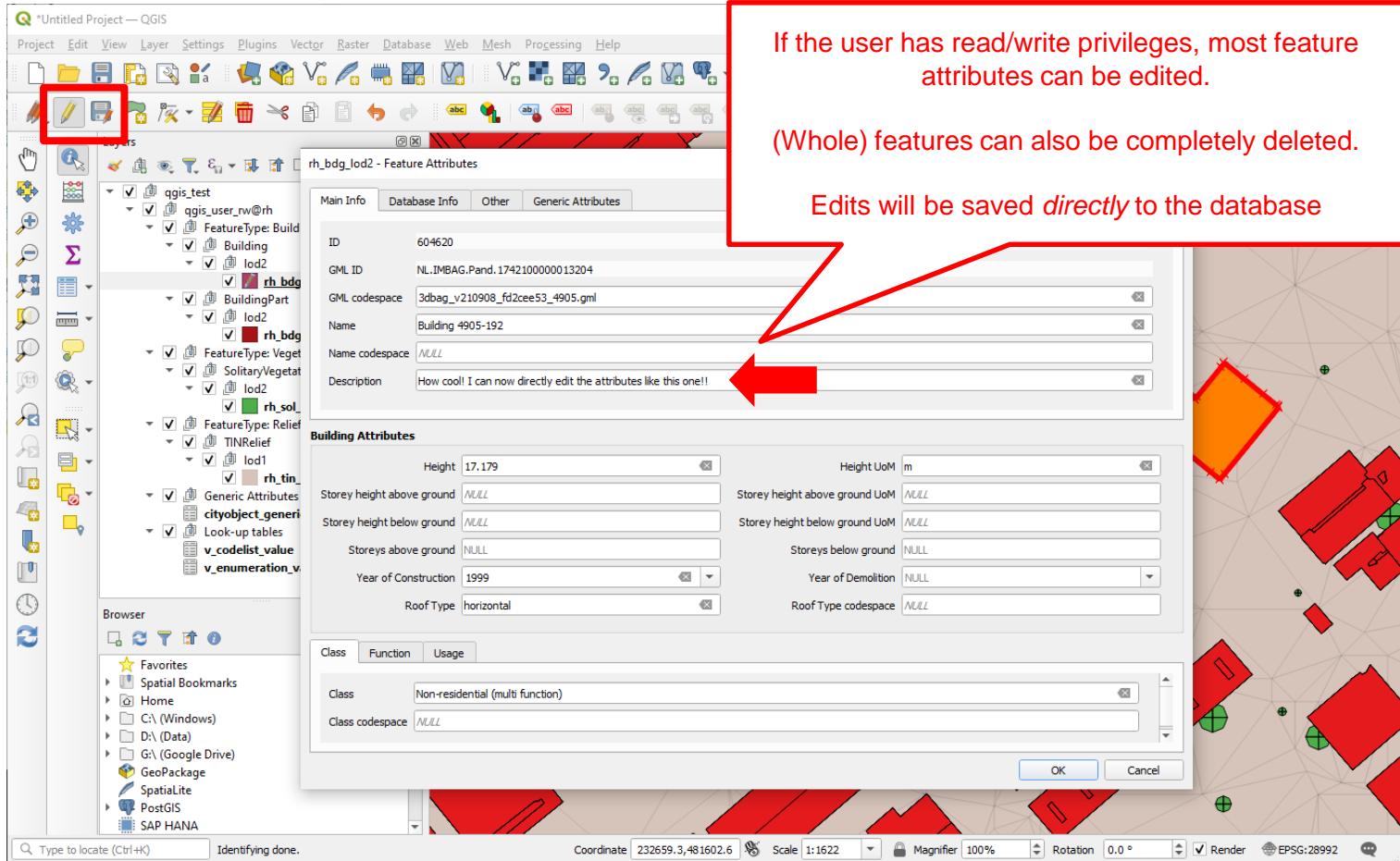
Function codespace

Attributes containing [0..*] entries (e.g. function, usage, etc.) are presented as lists.
External codelists can also be visualised as look-up tables (see advanced settings later on)

OK Cancel

Usage in QGIS: Attribute editing

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations



The screenshot shows the QGIS interface with a red box highlighting the edit tool icon in the toolbar. A red callout box points to the attribute table for a selected building feature, stating: "If the user has read/write privileges, most feature attributes can be edited." Another red callout box points to the "Description" field, stating: "(Whole) features can also be completely deleted." A third red callout box points to the "OK" button at the bottom right of the dialog, stating: "Edits will be saved *directly* to the database".

rh_bdg_lod2 - Feature Attributes

ID	604620
GML ID	NL.UMBAG.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

Class	Non-residential (multi function)
Class codespace	NULL

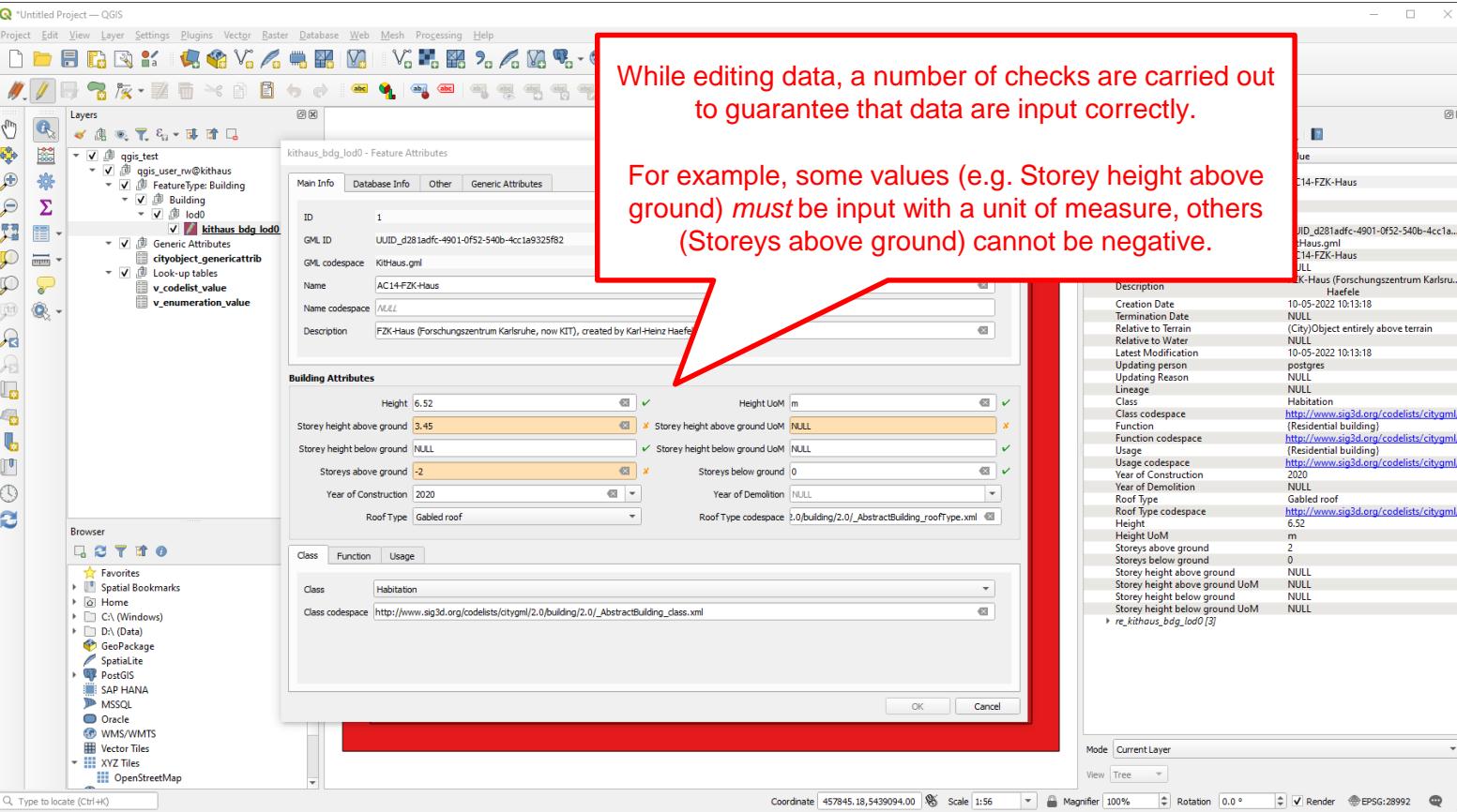
Coordinate 232659.3, 481602.6 Scale 1:1622 Magnifier 100% Rotation 0.0° Render EPSG:28992

Usage in QGIS: Attribute editing

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations

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.



The screenshot shows the QGIS attribute editor for a building feature. The 'Building Attributes' section contains several fields with validation errors:

- 'Height' has a green checkmark and a value of '6.52'.
- 'Storey height above ground' has an orange error icon and a value of '3.45'.
- 'Storey height below ground' has a green checkmark and a value of 'NULL'.
- 'Storeys above ground' has an orange error icon and a value of '-2'.
- 'Year of Construction' has a green checkmark and a value of '2020'.
- 'Roof Type' has a green checkmark and a value of 'Gabled roof'.
- 'Height uom' has a green checkmark and a value of 'm'.
- 'Storey height above ground uom' has an orange error icon and a value of 'NULL'.
- 'Storeys below ground' has a green checkmark and a value of '0'.
- 'Year of Demolition' has a green checkmark and a value of 'NULL'.
- 'Roof type codespace' has a green checkmark and a value of '2.0/building/2.0/_AbstractBuilding_rooftype.xml'.

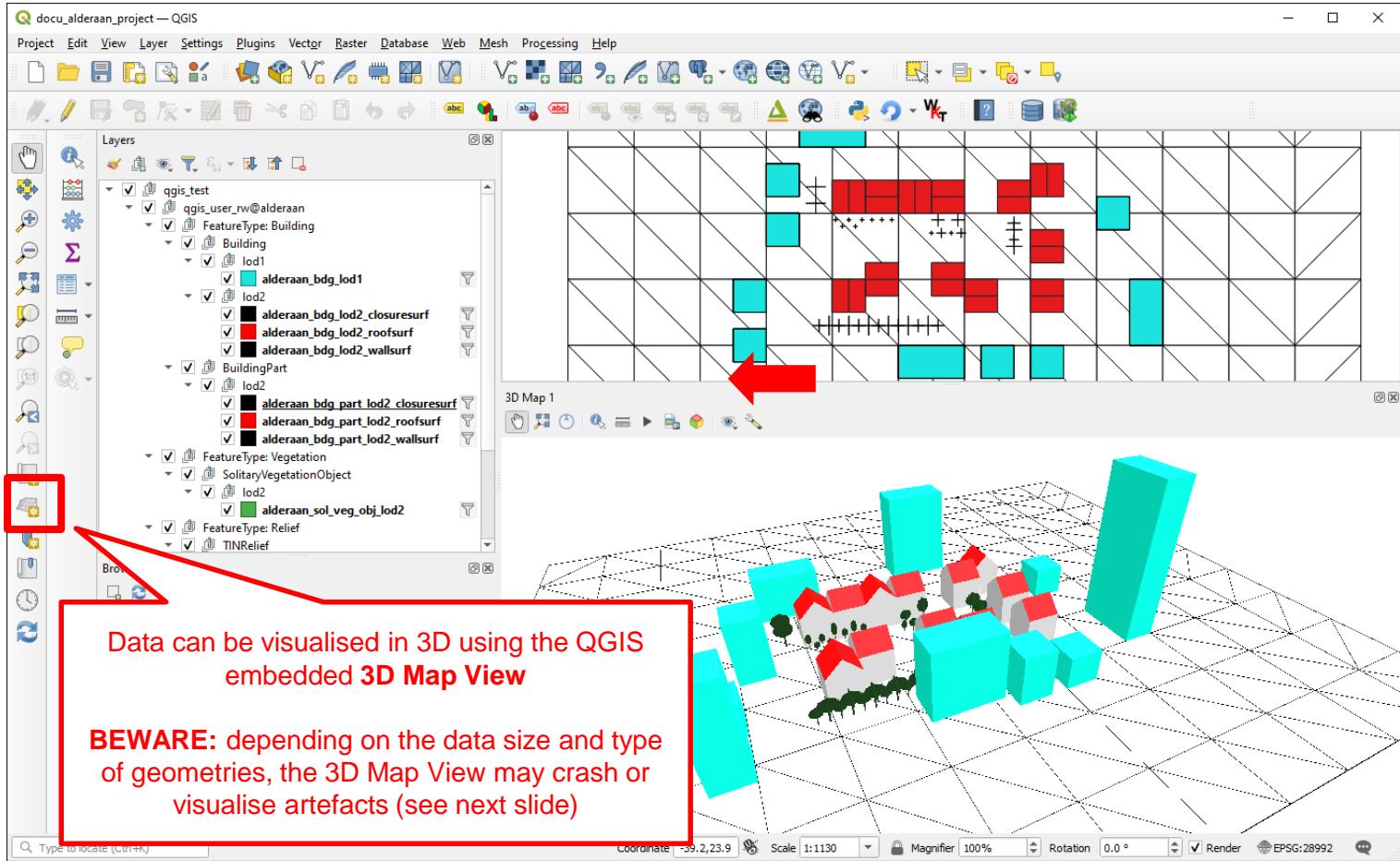
A red box highlights the validation errors for the storey height and storey count fields. A red arrow points from the validation message to the 'Storeys above ground' field.

On the right, the 'Attribute Table' shows the full list of attributes for the feature, including the validation messages for each field.

Attribute	Value	Description
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 Haefe	
Height	6.52	
Storey height above ground	3.45	Storey height above ground uom
Storey height below ground	NULL	Storey height below ground uom
Storeys above ground	-2	Storeys below ground
Year of Construction	2020	Year of Demolition
Roof Type	Gabled roof	Roof type codespace
Height uom	m	
Storeys above ground uom		
Storeys below ground uom		
Storey height above ground uom		
Storey height below ground uom		
Storey height below ground uom		

Usage in QGIS: 3D visualisation

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



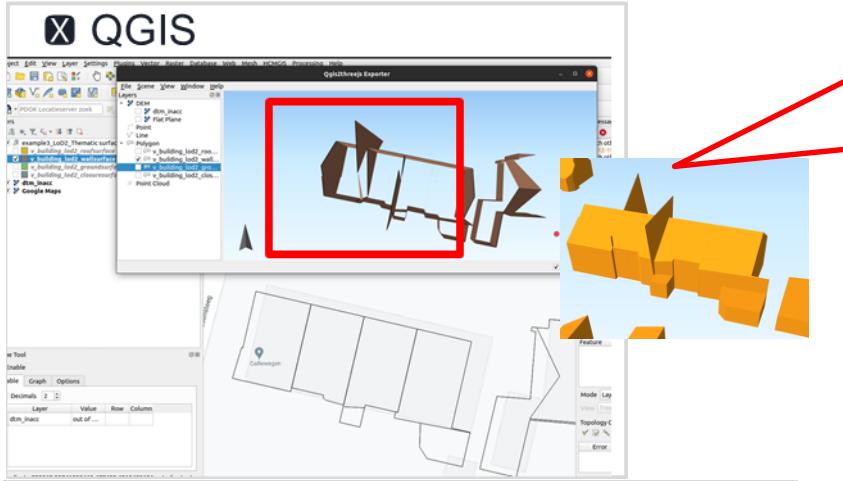
The screenshot shows the QGIS interface with a project titled "docu_alderaan_project". The "Layers" panel on the left displays a hierarchical tree of data layers, including "Building" and "Vegetation" categories. A red box highlights the "3D View" icon in the toolbar at the bottom-left of the interface. A red arrow points from this highlighted icon to a callout box containing the text: "Data can be visualised in 3D using the QGIS embedded 3D Map View". Another red arrow points from the "3D View" icon to the 3D Map View window, which shows a 3D perspective of the buildings and vegetation from the 2D map view above.

Data can be visualised in 3D using the QGIS embedded **3D Map View**

BEWARE: depending on the data size and type of geometries, the 3D Map View may crash or visualise artefacts (see next slide)

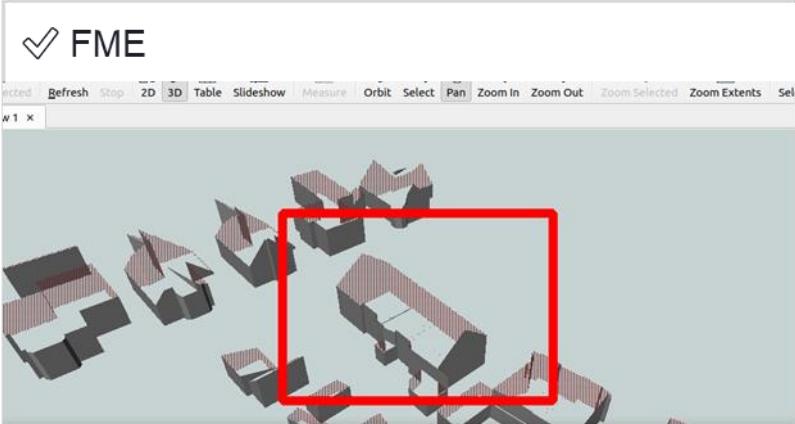
Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations

Usage 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.

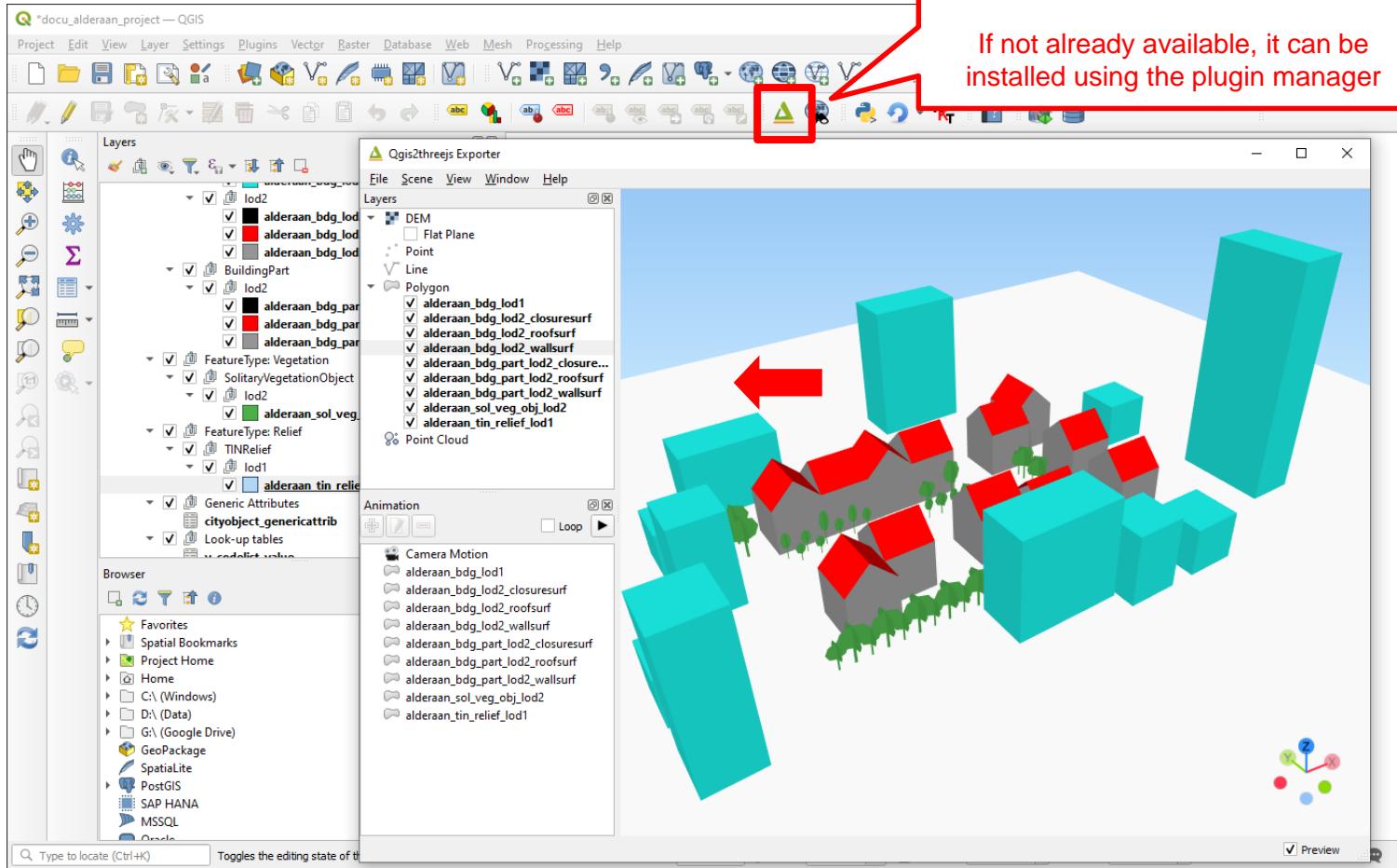
In order to minimise this problem, please refer to advanced options (see later)



✓
**Google earth
 (as KML)**

Usage in QGIS: 3D visualisation

Motivation
 Plugin overview
 Software installation
Usage
 Advanced options
 Software uninstall
 Current limitations



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)

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

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)

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations

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;

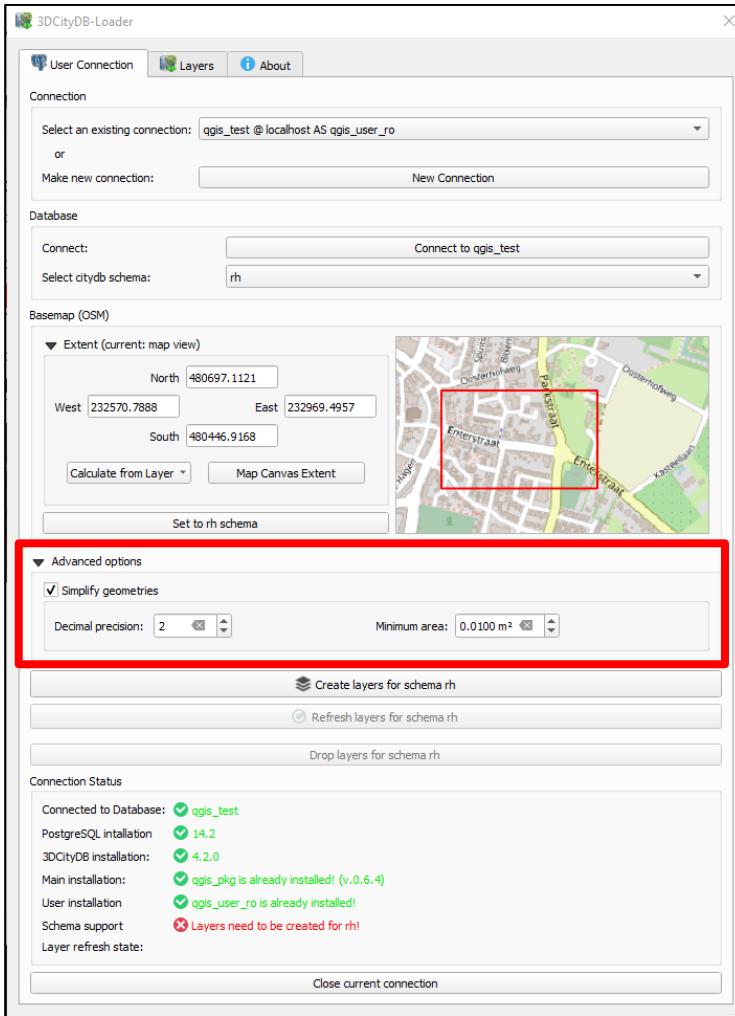
Geometry simplification

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.

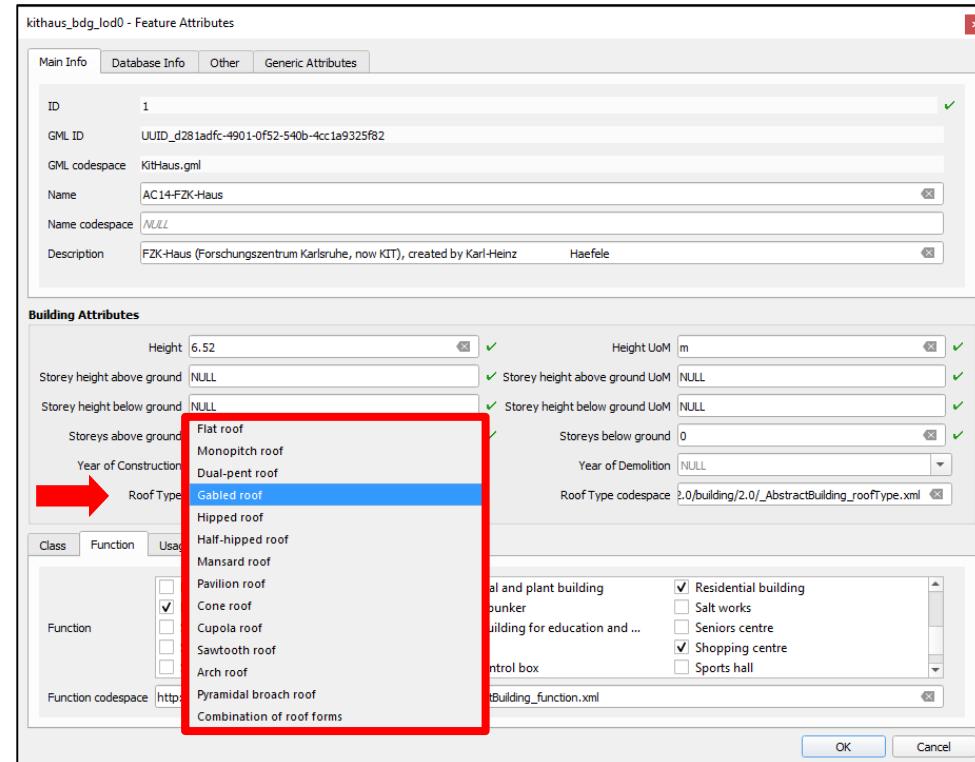
See next slide for an example

Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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**



Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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



Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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", "winkelfunctie"} {"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])

Motivation

Principles

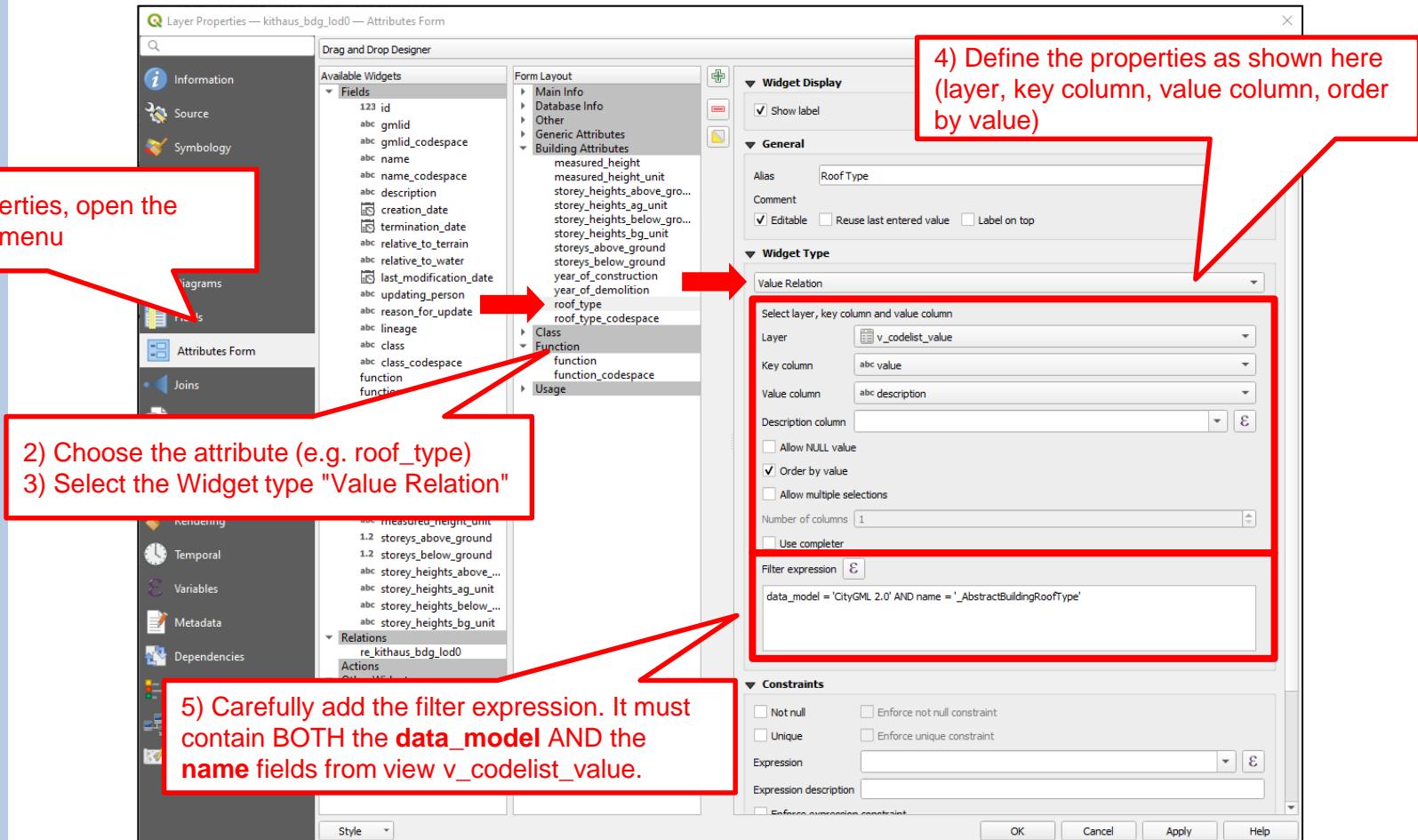
Usage

Advanced options

Software uninstall

Current limitations

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



The screenshot shows the 'Attributes Form' dialog for the layer 'kithaus_bgd_lod0'. The 'Fields' section lists various attributes, and the 'Building Attributes' section is expanded, showing attributes like 'measured_height', 'measured_height_unit', and 'roof_type'. A red box highlights the 'roof_type' attribute. The 'Widget Type' section is set to 'Value Relation'. A red box highlights the 'Value Relation' configuration area, which includes fields for 'Layer' (set to 'v_codelist_value'), 'Key column' ('abc value'), 'Value column' ('abc description'), and a 'Filter expression' field containing the SQL-like expression 'data_model = 'CityGML 2.0'' AND name = '_AbstractBuildingRoofType''. The 'General' section shows the alias 'Roof Type' and the 'Editable' checkbox checked. The 'Widget Display' section has the 'Show label' checkbox checked. The 'Constraints' section contains several constraint options.

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

2) Choose the attribute (e.g. roof_type)
 3) Select the Widget type "Value Relation"

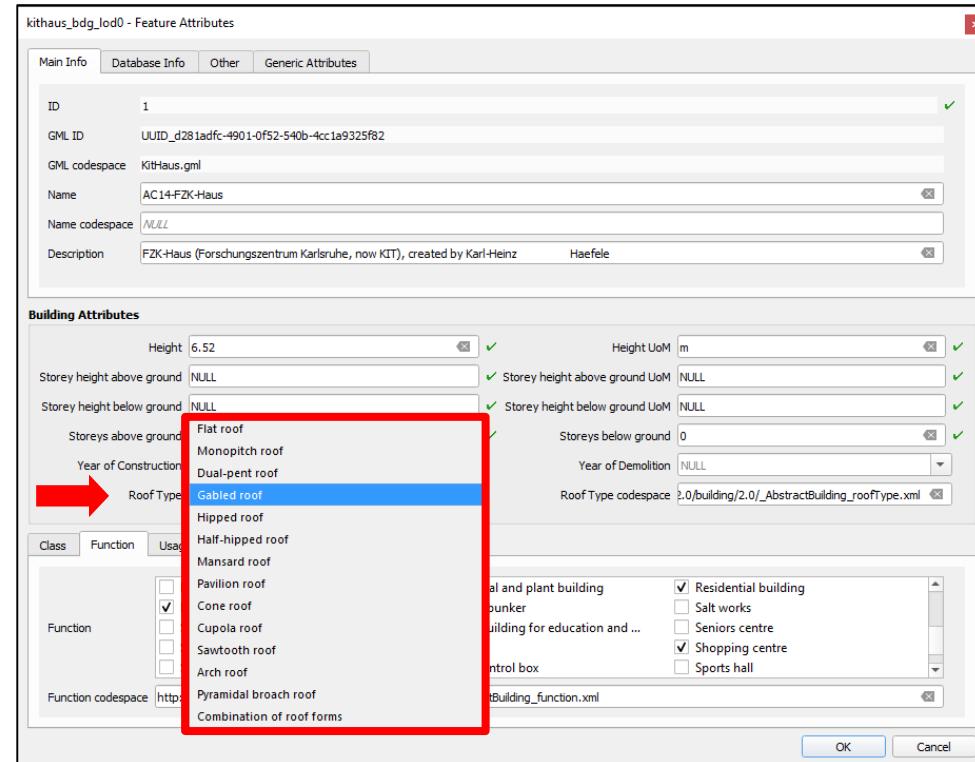
5) Carefully add the filter expression. It must contain BOTH the **data_model** AND the **name** fields from view **v_codelist_value**.

Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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

Et voilà! 😊

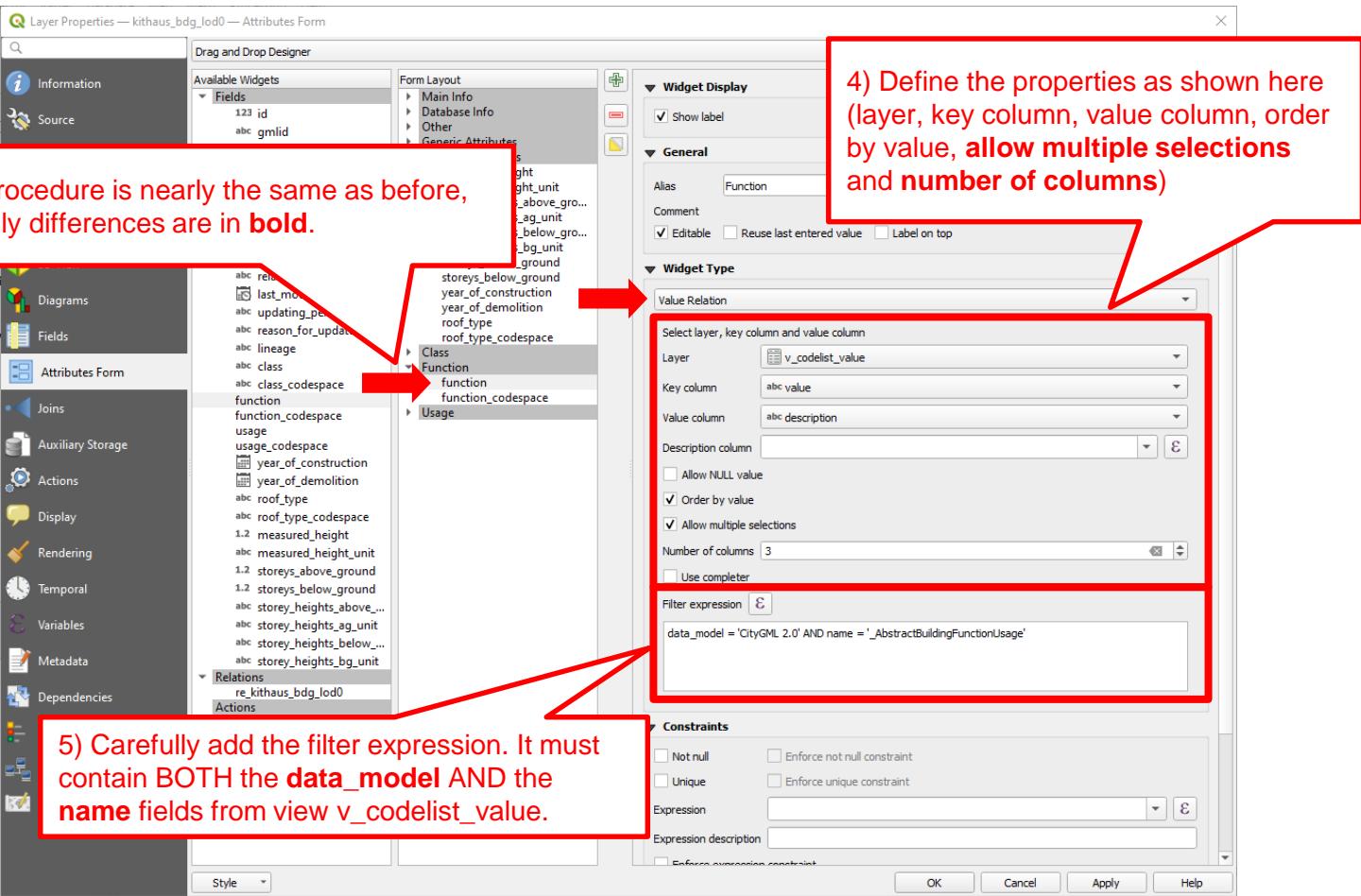


Codelists and look-up tables

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

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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**)

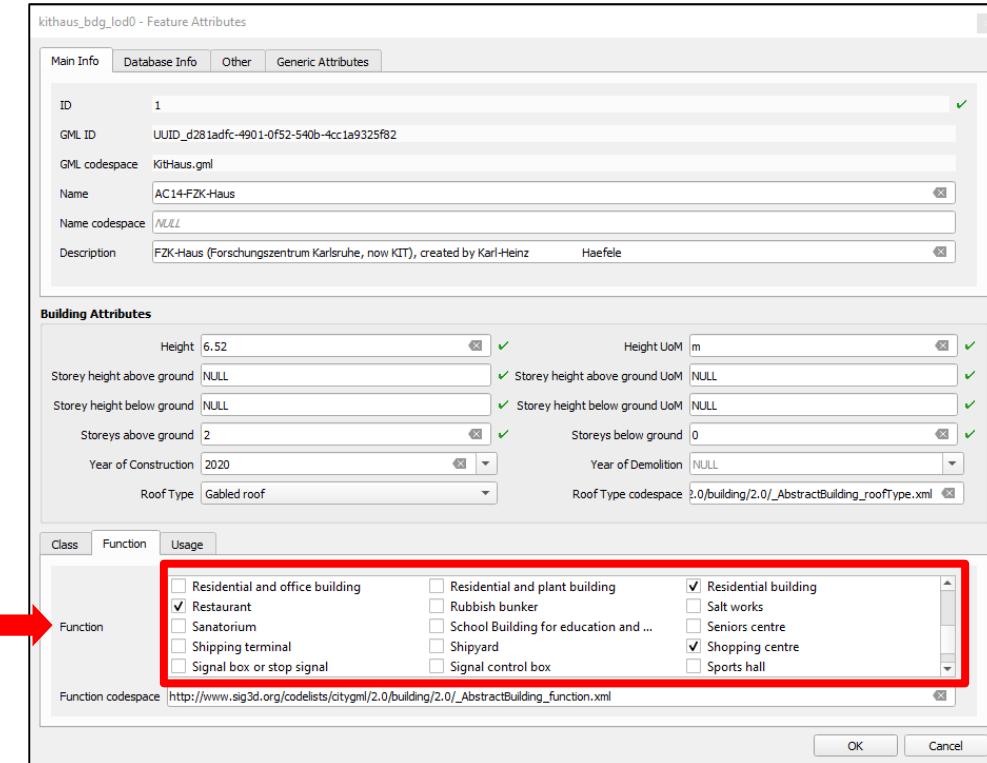
5) Carefully add the filter expression. It must contain **BOTH** the **data_model** AND the **name** fields from view v_codelist_value.

Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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

Et voilà! 😊



Codelists and look-up tables

Motivation
 Plugin overview
 Software installation
 Usage
Advanced options
 Software uninstall
 Current limitations

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

Codelists and look-up tables

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

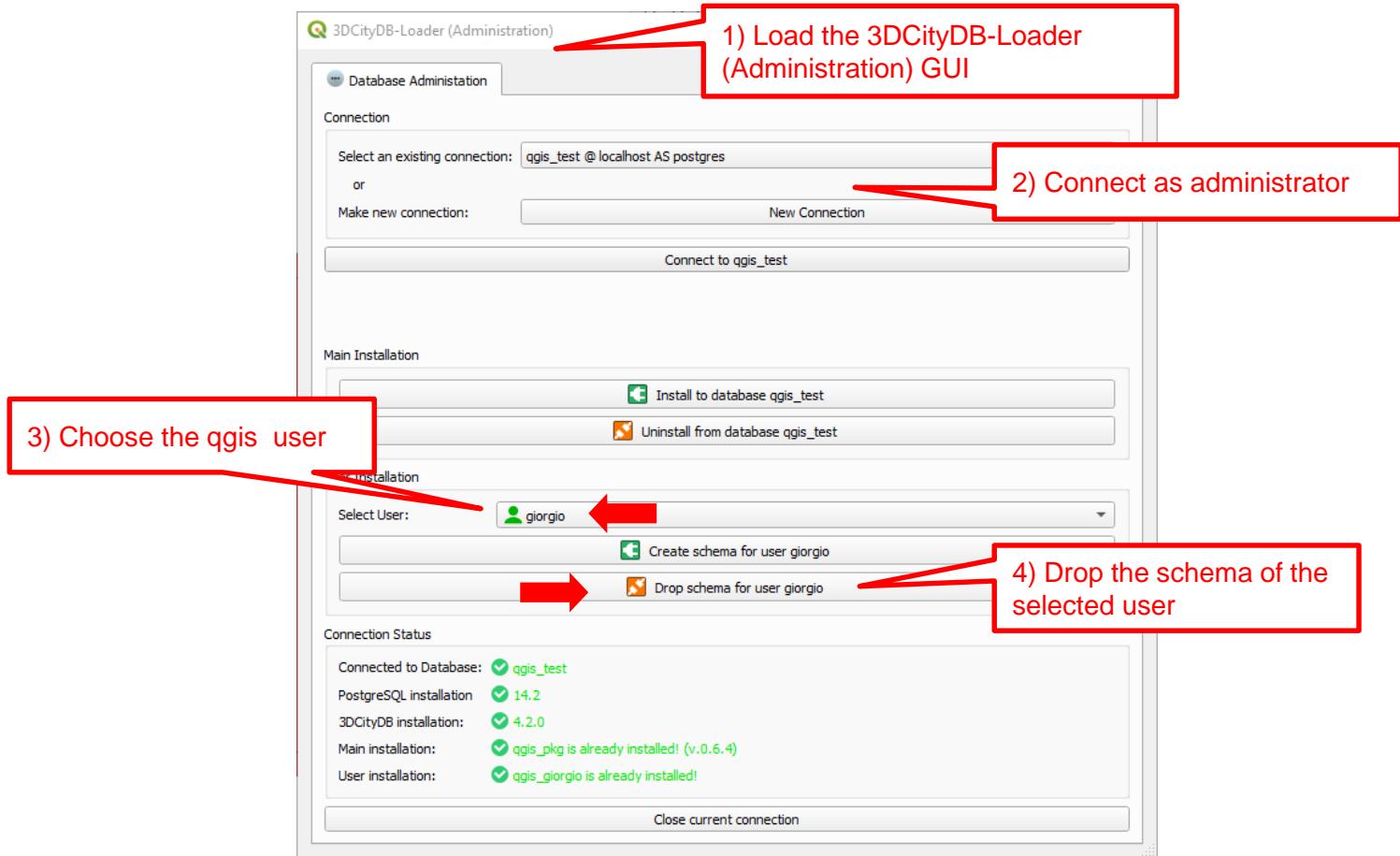
Software uninstall

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

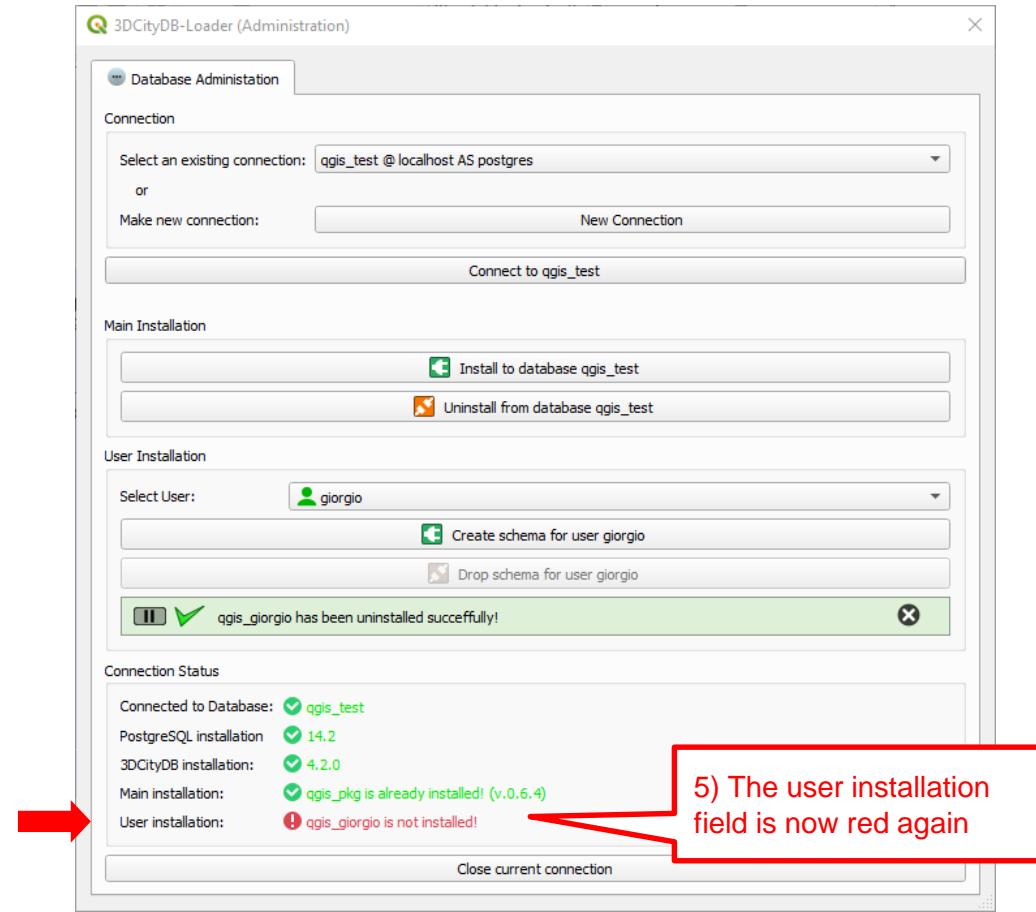
Software uninstall: Drop user schema

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



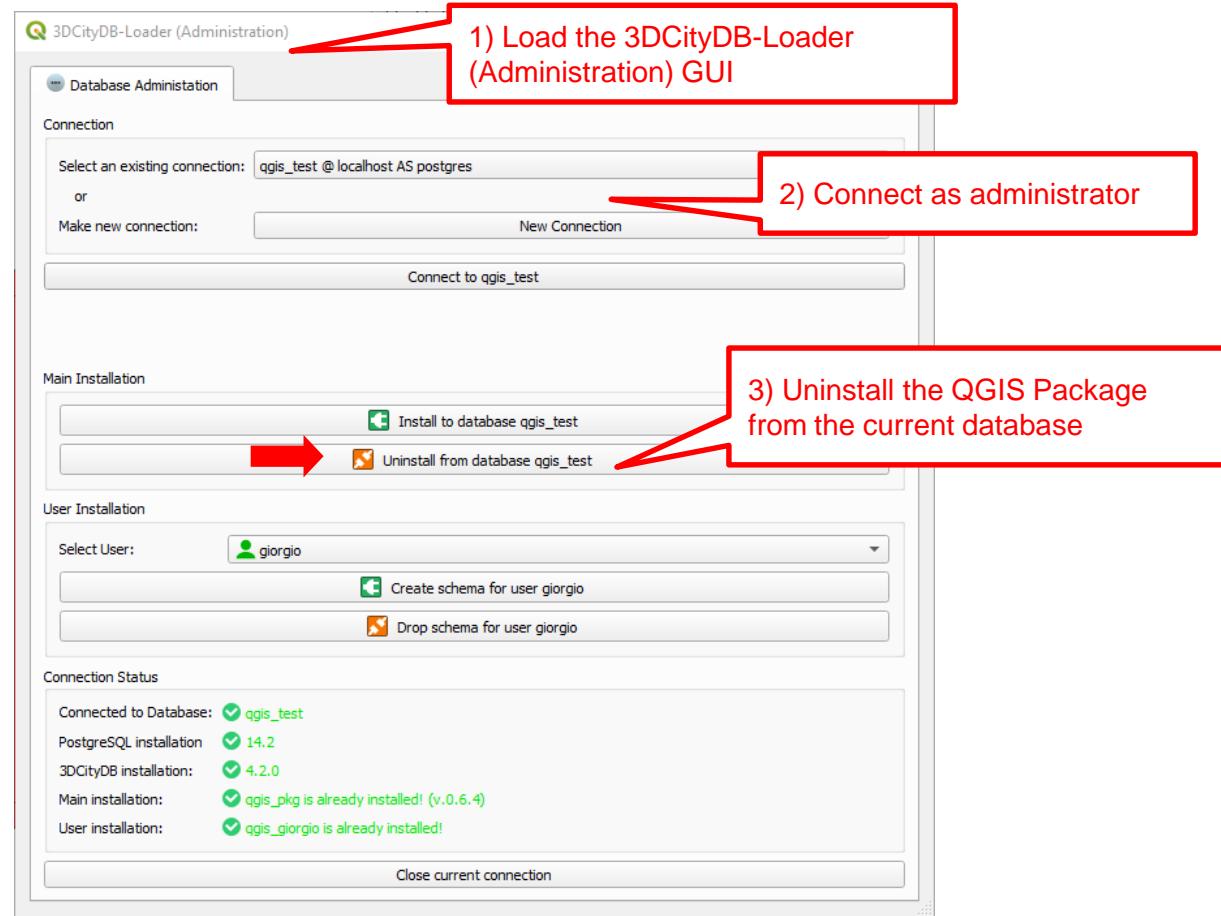
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Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



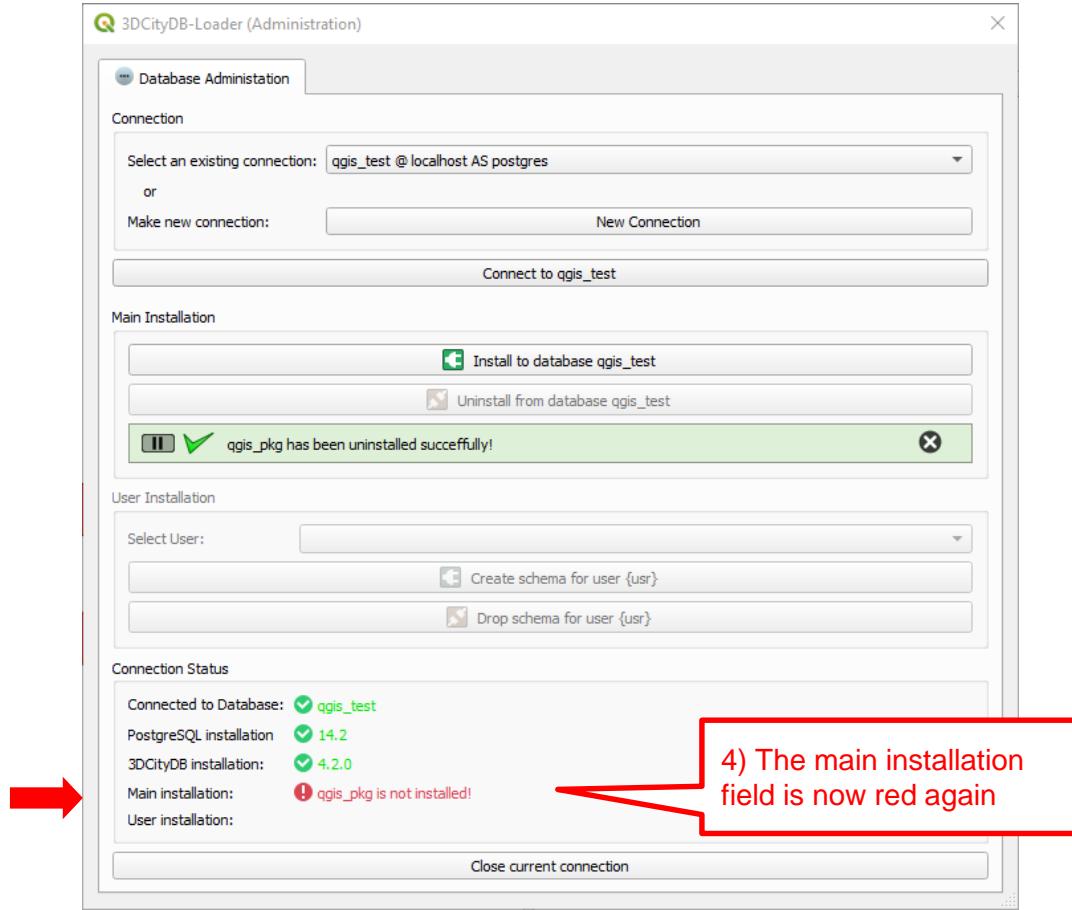
Software uninstall: Uninstall QGIS Package

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Software uninstall: Uninstall QGIS Package

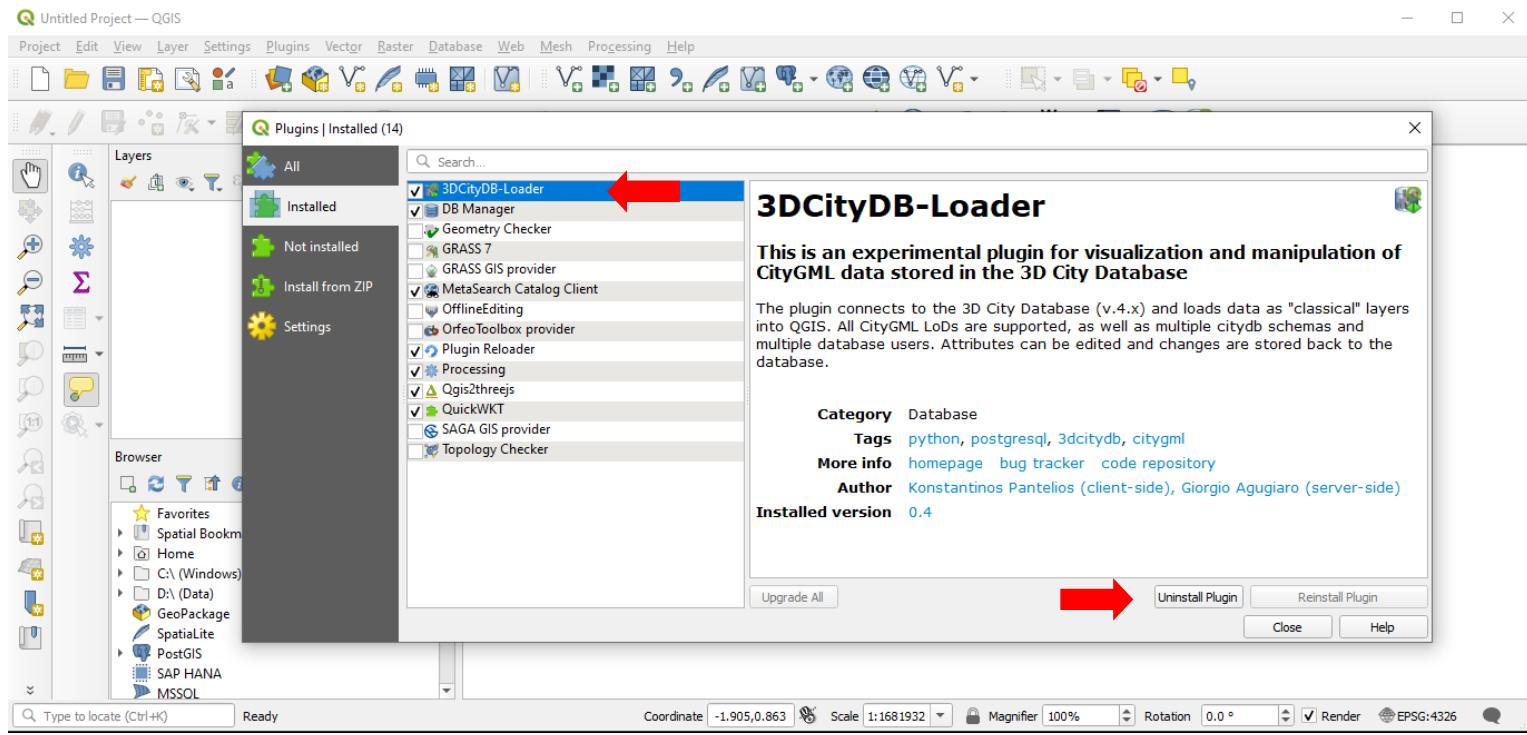
Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Software uninstall: Uninstall 3DCityDB-Loader

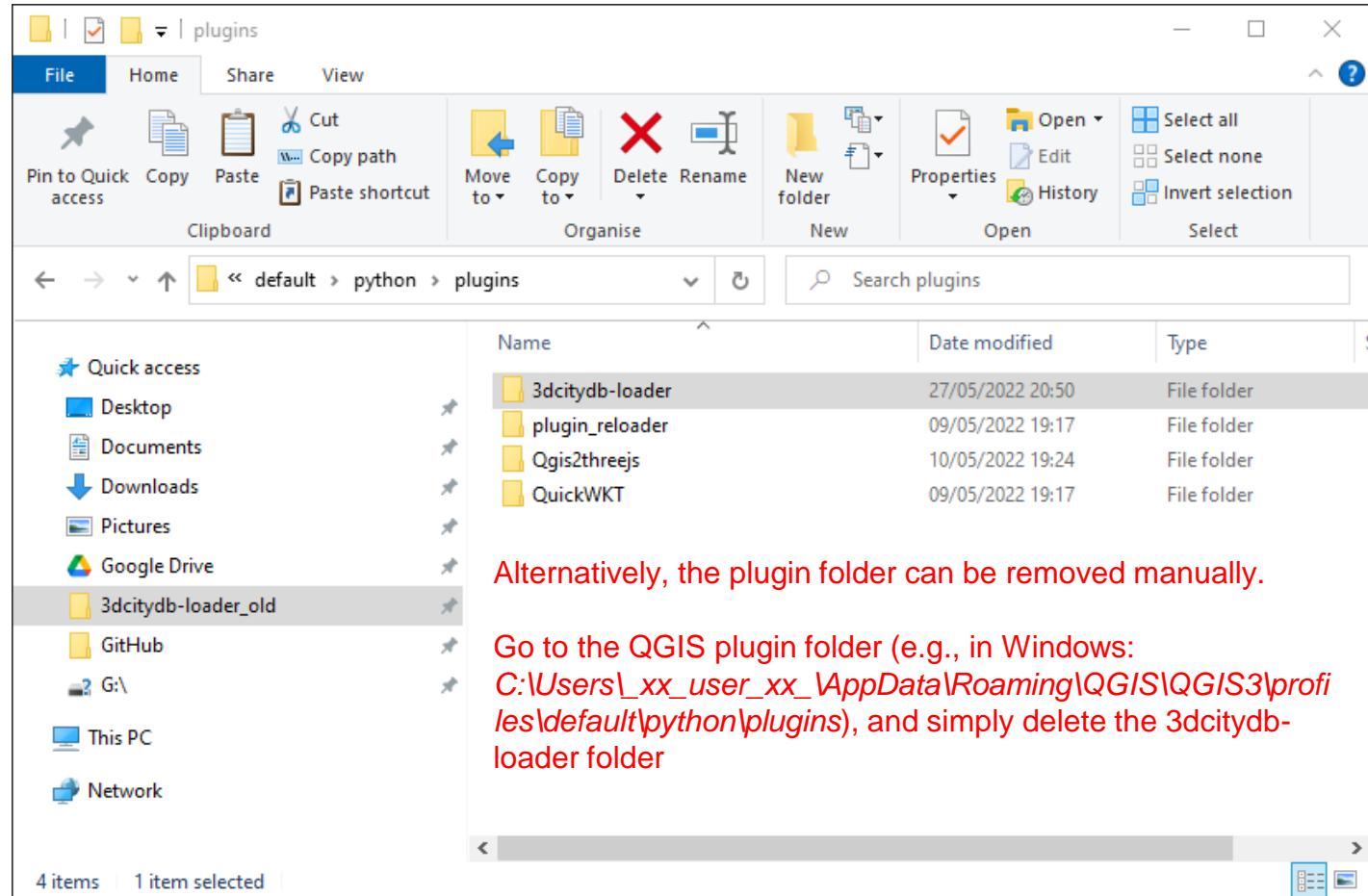
The plugin can be uninstalled from the \Plugins\Manage and Install Plugins... Menu in QGIS

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Software uninstall: Uninstall 3DCityDB-Loader

Motivation
Plugin overview
Software installation
Usage
Advanced options
Software uninstall
Current limitations



Current limitations

As of June 2022

The QGIS Package does not support yet the following CityObjects

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

In general

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

Current limitations

As of June 2022

3DCityDB-Loader plugin

- Some attribute forms might be missing.
- The design of the attribute forms is still being improved. It may change in future

Following functionalities are still missing

- Advanced user management
- Codelist/look-up table management and settings

Testing machines as of June 2022

OS	Proc	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 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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Acknowledgements

Claus Nagel and Zhihang Yao (virtualcitysystems) for the suggestions and fruitful discussions