

GeoBIM benchmark 2019  
**Automatic Conversion of  
CityGML to IFC**

Nebras Salheb

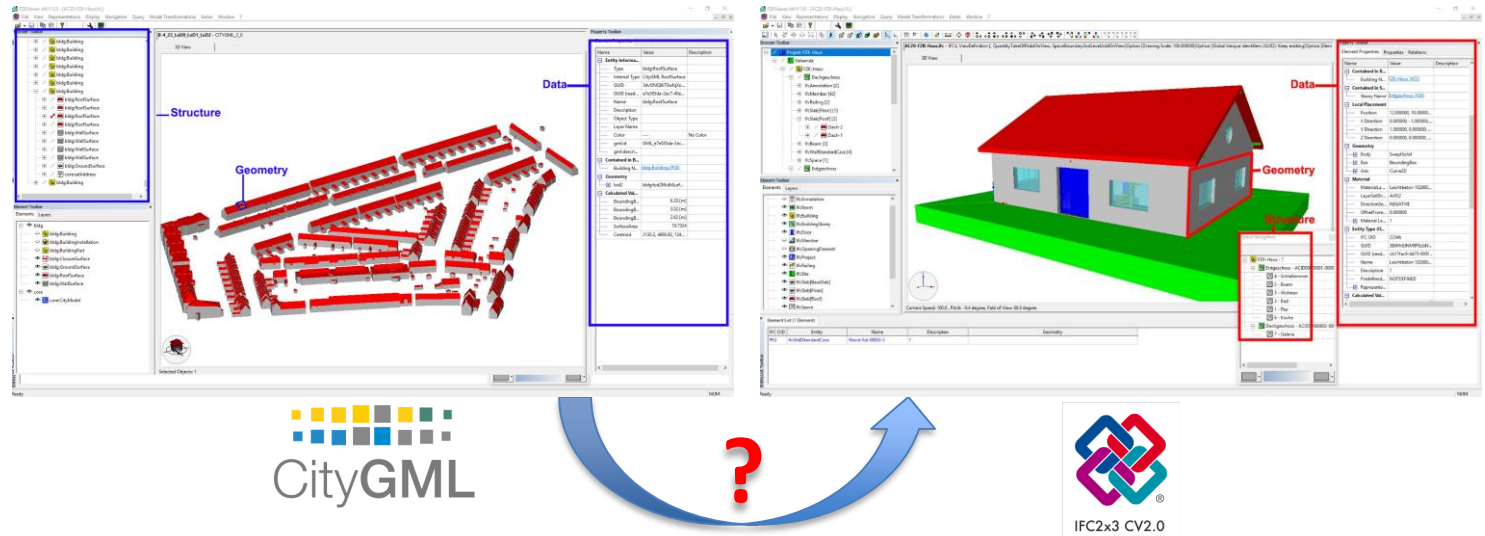


# MOTIVATION

Motivation

Methodology

Conclusions



# MOTIVATION

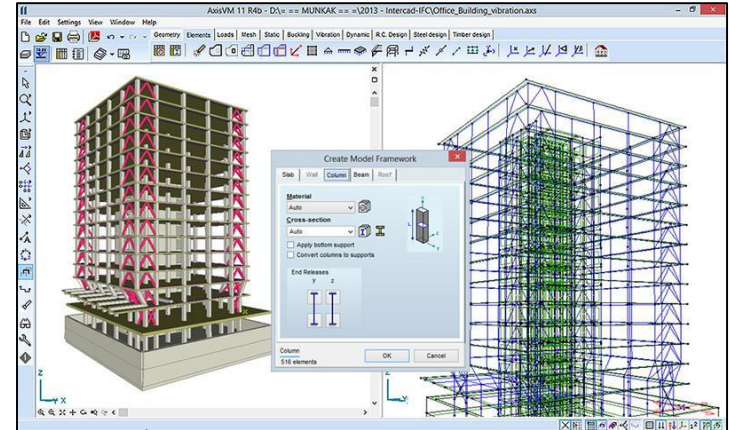
Motivation

Methodology

Conclusions



3D CityModels



BIM

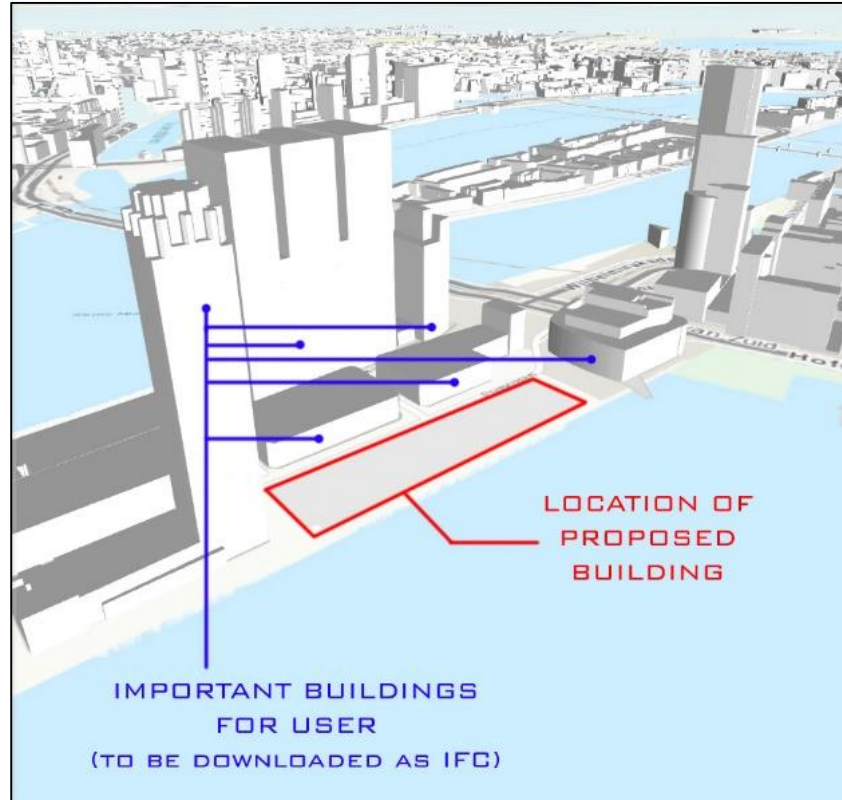


# MOTIVATION

Motivation

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Conclusions

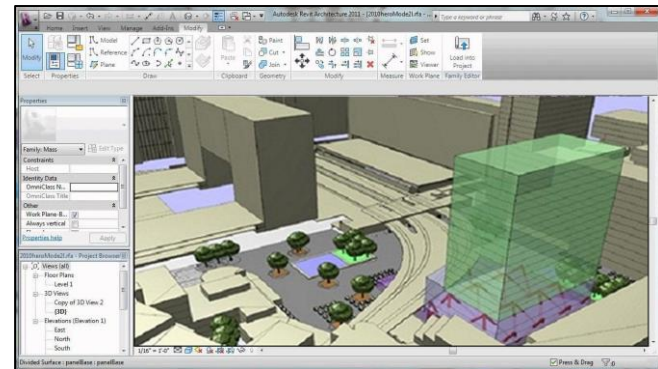
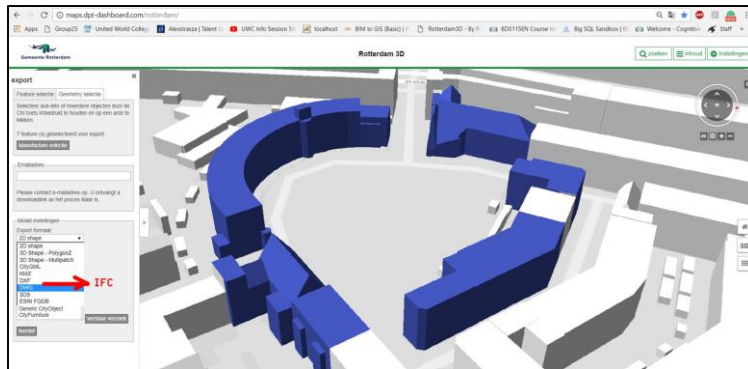


# GOAL

Motivation

Methodology

Conclusions



Export



# REQUIREMENTS

Semantics, Geometry, Coordinates, Topology, Encoding.

Motivation

Methodology

1. *Compare*

2. *Convert*

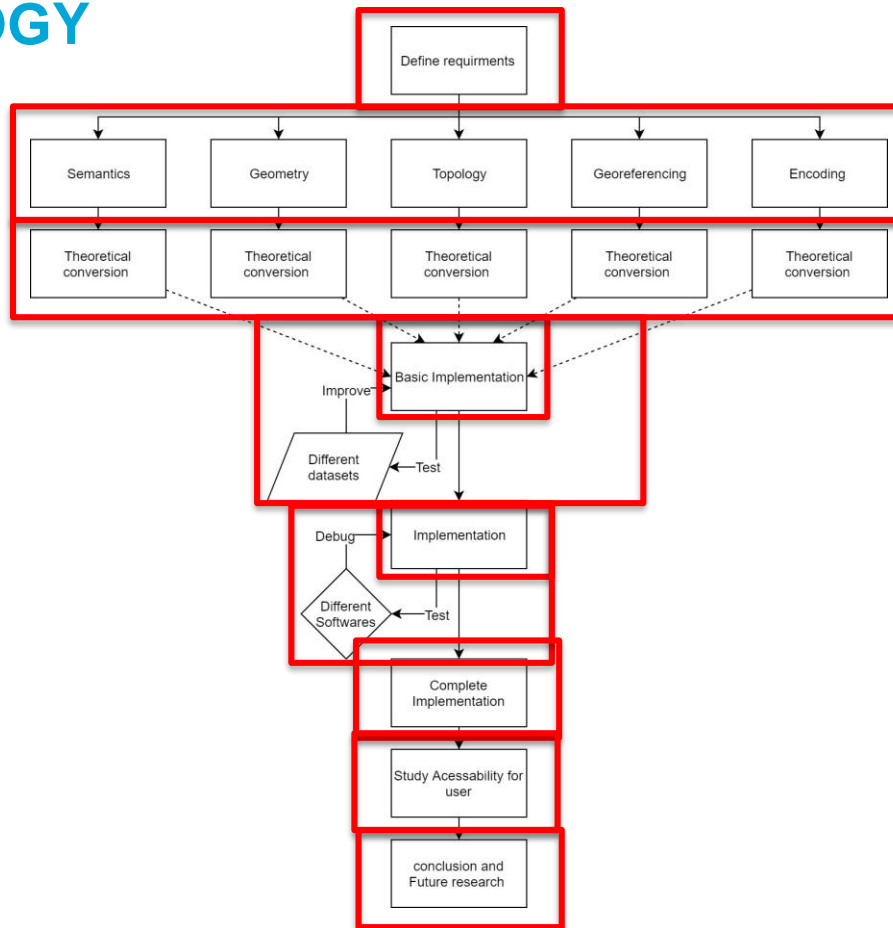
Conclusions

# METHODOLOGY

Motivation

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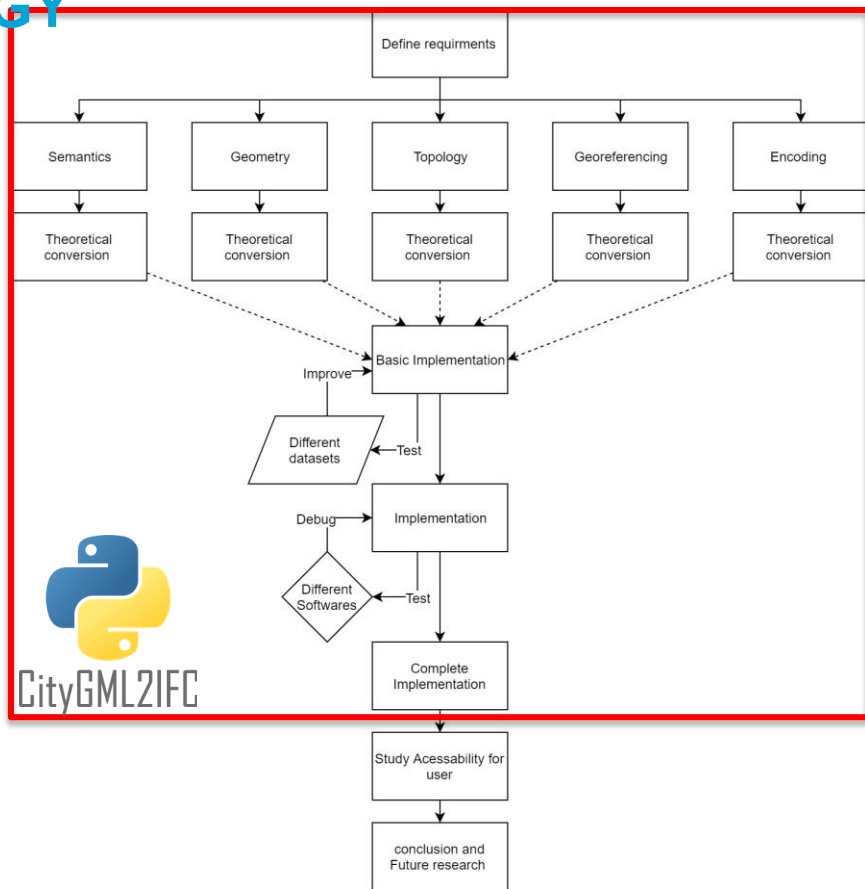


# METHODOLOGY

Motivation

Methodology

Conclusions





# METHODOLOGY CITYGML2IFC

Motivation



<https://github.com/nsalheb/CityGML2IFC>

Methodology

Conclusions

nsalheb / CityGML2IFC

Watch 1 Star 1 Fork 0

Code

Issues 0

Pull requests 0

Projects 0

Wiki

Security

Insights

Settings

No description, website, or topics provided.

Manage topics

10 commits

1 branch

0 releases

1 contributor

GPL-3.0

Branch: master

New pull request

Create new file

Upload files

Find File

Clone or download

nsalheb Add files via upload

Latest commit c2c5a21 now

CityGML2IFC.py

Add files via upload

2 minutes ago

LICENSE.txt

Add files via upload

now

Readme

Update Readme

7 minutes ago

Source.gml

Add files via upload

2 minutes ago

Readme

Program Description

The main implementation part consists of a program named "CityGML2IFC.py" it is a script file written in Python 3. When compiled the program will convert a source file in CityGML to a destination file in IFC.

License

and the program is licensed under General Public License v3.0

Participation

It is made with the help of Kavisha Kumar <https://3d.bk.tudelft.nl/kavisha/>.

Kavisha's Github <https://github.com/kk1mmmy>.

Used Modules

The following modules are imported and used in the program; these modules should be preinstalled before running the program:

xml.etree.ElementTree \_ Is used here for parsing the XML data

os \_ To interact with the operating system where the computer is running for example: reading time and file bath.

time \_ To read the current time and stored in the created IFC files

itertools \_ Is used to create a hashtaged unique id with an incremental value starting from a given value

sys \_ Is used to allow files to be written on the hard disk

numpy \_ To perform mathematical operation such as finding minimum value or subtract arrays

uuid \_ To automatically generate unique IDs

pyproj \_ To convert the resulting files projection

How to use program

1- Make sure that python 3 is installed.

2- Make sure all the necessary modules are installed, particularly:

a. numpy

b. pyproj

3- Download the program CityGML2IFC.py

4- the program will convert a source file in CityGML to destination file in IFC.

5- Change the name of your source CityGML file to: "Source.gml"

6- Compile (Run) the program CityGML2IFC.py.

7- A file called Result.ifc will appear. This file is the result of the conversion.

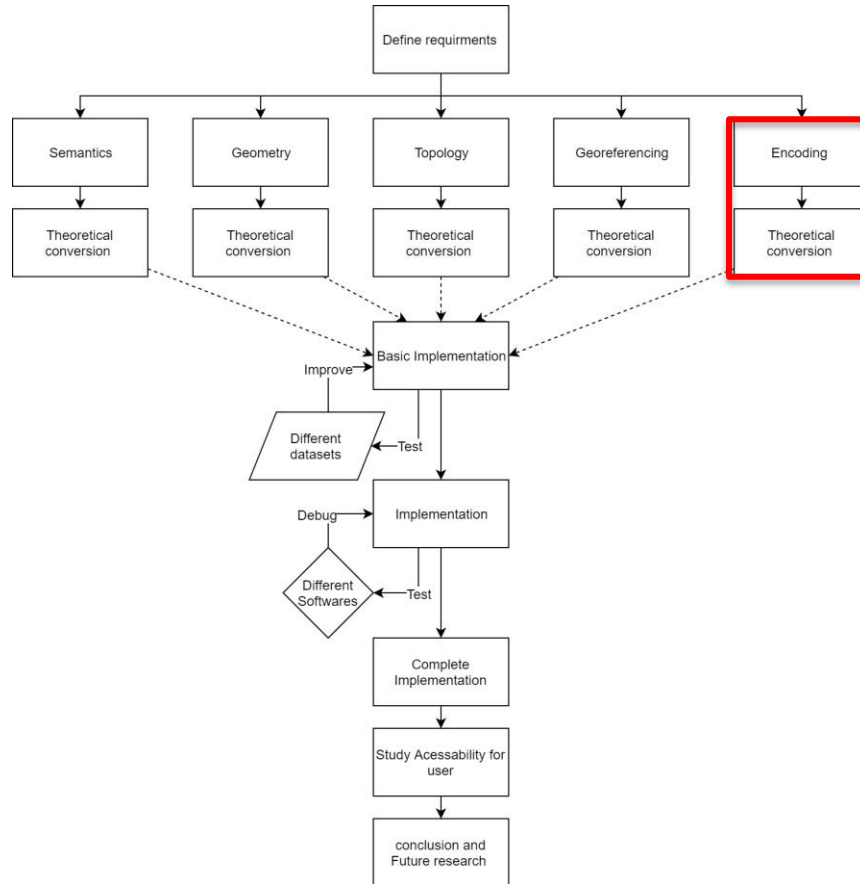
8- Check Result.ifc on the BIM software of your choice.

# METHODOLOGY; ENCODING

Motivation

Methodology

Conclusions



# METHODOLOGY; ENCODING

## Motivation

## Methodology

```
<gml:surfaceMember>
  <gml:Polygon gml:id="RCID_48dcalc6-42da-4372-8cb3-d843360f0e8d">
    <gml:exterior>
      <gml:LinearRing gml:id="RCID_48dcalc6-42da-4372-8cb3-d843360f0e8d_E_1_1">
        <gml:posList>94781.589999999997000000 433787.58000000000200000000 -1.053760000000389900 94780.6199999999995000000
          433789.030000000030000000 -1.082890000005110000 94779.960000000006000000 433786.510000000010000000
          -1.078269999999440100 94781.589999999997000000 433787.58000000000200000000 -1.053760000000389900</gml:posList>
        </gml:LinearRing>
      </gml:exterior>
    </gml:Polygon>
  </gml:surfaceMember>
</gml:surfaceMember>
```



## Conclusions

```
#1001 = IFCSITE ( '2bff34a3f1794bfb8f9906' , #102, 'Rotterdam', 'Description of Default
Site Rotterdam', 'LandUse', $, $, $, .ELEMENT., (4.512861440132937, 51.890110757113355,
13.254666879514) , (4.507494742156529, 51.88753047616053, -1.488680000000364) , $, $, $);
#1002 = IFCBUILDING ( 'b8c94e3a6c894311b7a421' , #102, 'bldg:Building', $, $, $, $, $,
$, $, $, $);
#1003 = IFCCARTESIANPOINT (( 343.8474259610084, 194.21844858600525, 10.56160203065271 ))
#1004 = IFCCARTESIANPOINT (( 338.82559265939926, 190.9169114730321, 10.56160203065271 ))
#1005 = IFCCARTESIANPOINT (( 341.0700000000007, 187.48000000003958, 5.02410203065271 ));
#1006 = IFCCARTESIANPOINT (( 346.10000000000058, 190.77000000001863, 5.02410203065271 ));
#1007 = IFCCARTESIANPOINT (( 343.8474259610084, 194.21844858600525, 10.56160203065271 ))
#1008 = IFCPOLYLOOP (( #1003,#1004,#1005,#1006,#1007 ));
#1009 = IFCFACEOUTERBOUND ( #1008 , .T.);
#1010 = IFCFACE (( #1009 ));
#1011 = IFCCOPENSHHELL (( #1010 ));
#1012 = IFCSHELLBASEDSURFACEMODEL (( #1011 ));
#1013 = IFCSHAPEREPRESENTATION ($,'Body','SurfaceModel',( #1012 ));
#1014 = IFCPRODUCTDEFINITIONSHAPE ($, $, ( #1013 ));
#1015 = IFCSLAB ( 'fb6e546348854cac81718d' , $,'RoofSlab', ' ', $,$, #1014 , $,.ROOF.);
```



# METHODOLOGY; ENCODING

Motivation



Methodology

Conclusions

```
</bldg:Building>
  <bldg:boundedBy>
    <bldg:RoofSurface gml:id="08c133f1-e261-42e9-a962-2f028bf65c06">
      <bldg:Iod2MultiSurface>
        <gml:MultiSurface srsName="EPSG:25833" srsDimension="3">
          <gml:surfaceMember>
            <gml:Polygon>
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList>
-232826.945693134 5800258.80886523 9.574721626 -232825.395382719 5800250.33867422
9.574721626 -232819.31902886 5800251.44689201 9.574721626 -232820.85939135
5800259.91585694 9.574721626 -232826.945693134 5800258.80886523
9.574721626</gml:posList>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
          </gml:surfaceMember>
        </gml:MultiSurface>
      </bldg:Iod2MultiSurface>
    </bldg:RoofSurface>
  </bldg:boundedBy>
</bldg:Building>
```

```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION(('ViewDefinition[CoordinationView_V2.0]'), '2;1');
FILE_NAME('B-4_23_LoD0_LoD1_LoD2.gml', '2017-12-14T13:13:41');
FILE_SCHEMA(('IFC2X3'));
ENDSEC;

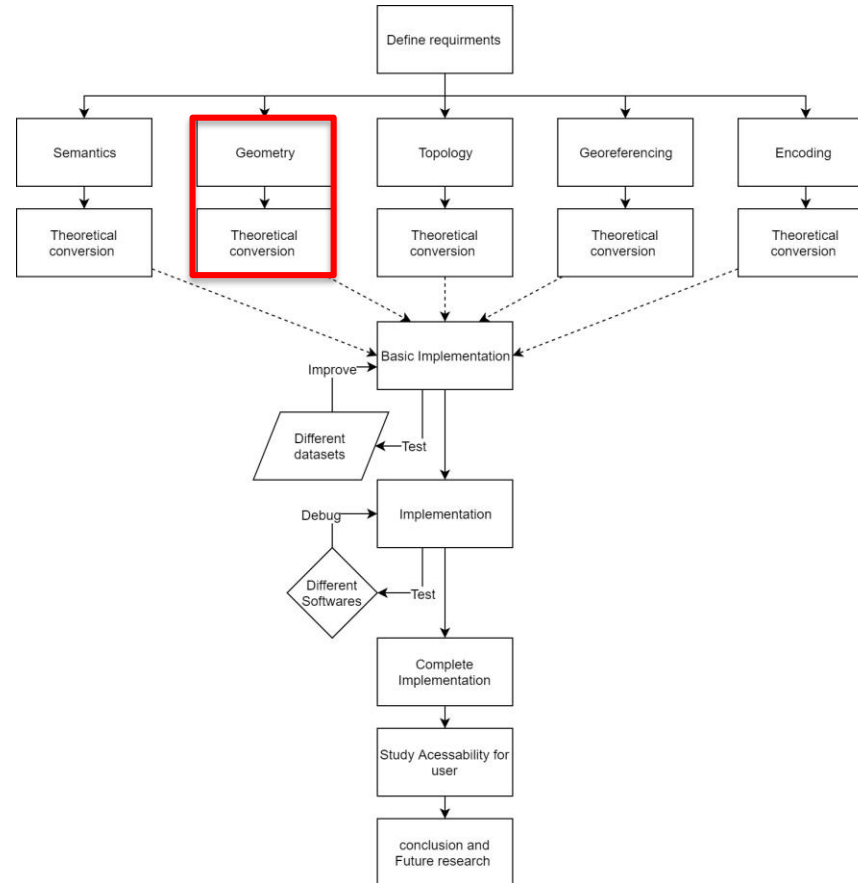
DATA;
#101 = IFCORGANIZATION ($, 'MSC_Geomatics', 'TU_Delft', $, $);
#104 = IFCPERSON ($, 'Nebras_salheb', 'TU_Delft', $, $, $, $);
#103 = IFCPERSONANDORGANIZATION (#104, #101, $);
#105 = IFCAPPLICATION (#101, 'CityGML2IFC', 'CityGML2IFC', 'CityGML2IFC');
#102 = IFCOWNERHISTORY (#103, #105, .READWRITE., .NOCHANGE., $, $, $, 1528899117);
#109 = IFCARTESIANPOINT ((0., 0., 0.));
#110 = IFCDIRECTION ((0., 0., 1.));
#111 = IFCDIRECTION ((1., 0., 0.));
#108 = IFCAxis2PLACEMENT3D (#109, #110, #111);
#112 = IFCDIRECTION ((1., 0., 0.));
#107 = IFCGEOMETRICREPRESENTATIONCONTEXT ($, 'Model', 3, 1.E-005, #108, #112);
#114 = IFCSIUNIT (*, .LENGTHUNIT., $, .METRE.);
#113 = IFCUNITASSIGNMENT ((#114));
#115 = IFCMATERIAL ('K01-1');
#116 = IFCMATERIAL ('K01-2');
#117 = IFCMATERIAL ('K01-3');
#118 = IFCMATERIAL ('K01-4');
#119 = IFCLOCALPLACEMENT ($, #108);
#1000 = IFCPROJECT ('6073a79a6d58416cacb3db', #102, 'core:CityModel', $, $, $, $, (#107), #113);
#1001 = IFCSITE ('c08c4ca22cb3486e88a24b', #102, 'Rotterdam', 'Description of Default Site Rotterdam', 'LandUse', $, $, $, .ELEMENT., (4.512861440132937, 51.890110757113355, 13.254666879514), (4.507494742156529, 51.88753047616053, -1.48868000000364), $, $, $);
#1002 = IFCBUILDING ('8d3be4110c5b4d7eb40455', #102, 'bldg:Building', $, $, $, $, $, $);
#1003 = IFCARTESIANPOINT ((343.8474259610084, 194.21844858600525, 10.56160203065271));
#1004 = IFCARTESIANPOINT ((338.82559265939926, 190.9169114730321, 10.56160203065271));
#1005 = IFCARTESIANPOINT ((341.0700000000007, 187.480000000003958, 5.02410203065271));
#1006 = IFCARTESIANPOINT ((346.10000000000058, 190.770000000001863, 5.02410203065271));
#1007 = IFCPOLYLOOP ((#1003, #1004, #1005, #1006));
#1008 = IFCFACEOUTERBOUND (#1007, .T.);
#1009 = IFCFACE ((#1008));
#1010 = IFCOPENSHELL ((#1009));
#1011 = IFCSHELLBASEDSURFACEMODEL ((#1010));
#1012 = IFCSHAPE REPRESENTATION ($, 'Body', 'SurfaceModel', (#1011));
#1013 = IFCPRODUCTDEFINITIONSHAPE ($, $, (#1012));
#1014 = IFCROOF ('45b13a8fde104a58a6ffb8', $, 'RoofSlab', $, $, $, #1013, $, .ROOF.);
```

# METHODOLOGY; GEOMETRY

Motivation

Methodology

Conclusions



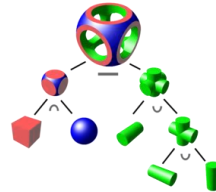
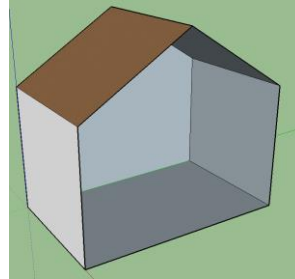
# METHODOLOGY; GEOMETRY

Motivation

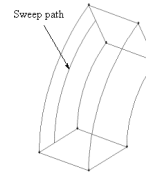
Methodology

Conclusions

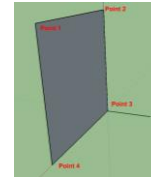
2D Face



CSG



SweptSolid



2D Face

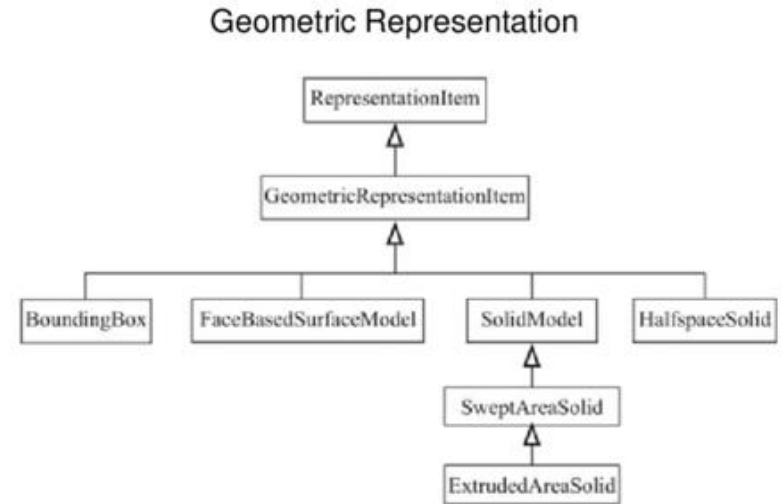
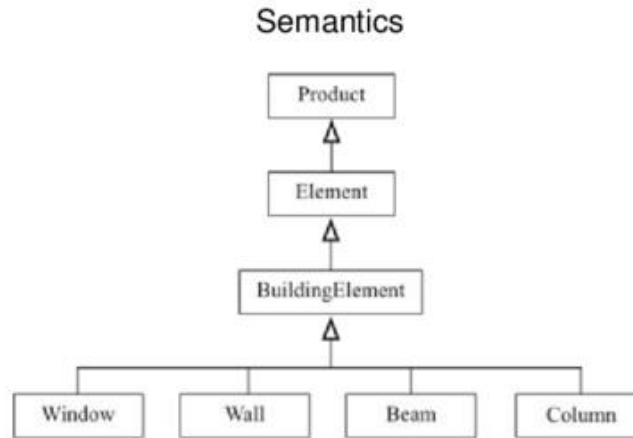


# METHODOLOGY; GEOMETRY

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# METHODOLOGY; GEOMETRY

Motivation

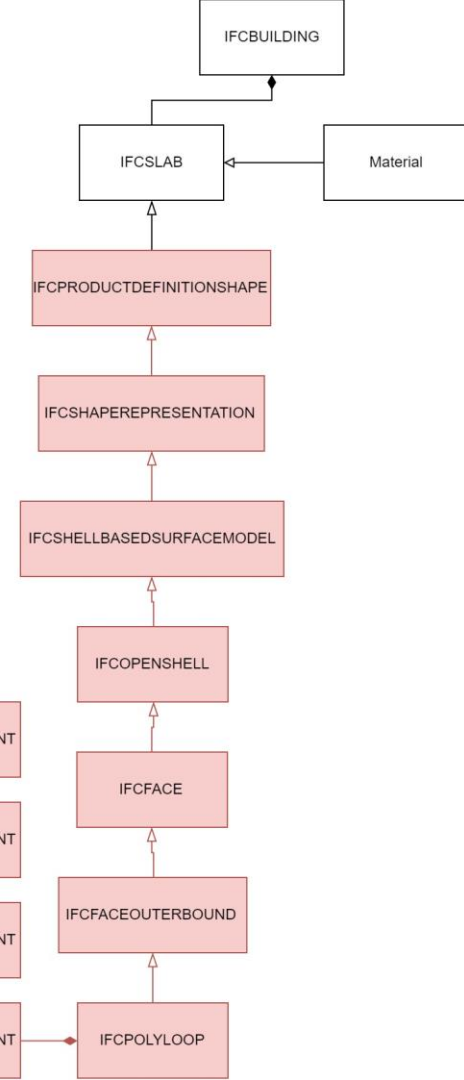
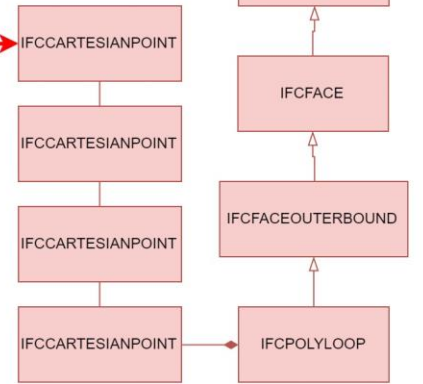
Methodology

Conclusions



```
</bldg:Building>
  <bldg:boundedBy>
    <bldg:RoofSurface gml:id="T08c133f1-e261-42e9-a962-2f028bf65c06">
      <bldg:lod2MultiSurface>
        <gml:MultiSurface srsName="EPSG:25833" srsDimension="3">
          <gml:surfaceMember>
            <gml:Polygon>
              <gml:exterior>
                <gml:LinearRing>
                  <gml:posList>
-232826.945698134 5800258.80886523 9.574721626 +232825.395382719 5800250.33867422
9.574721626 4232819.51902886 5800251.44689201 9.574721626 +232820.85939135
5800259.91585694 9.574721626 +232826.945698134 5800258.80886523
9.574721626</gml:posList>
                </gml:LinearRing>
              </gml:exterior>
            </gml:Polygon>
          </gml:surfaceMember>
        </gml:MultiSurface>
      </bldg:lod2MultiSurface>
    </bldg:RoofSurface>
  </bldg:boundedBy>
</bldg:Building>
```

From 5 to 4 points →



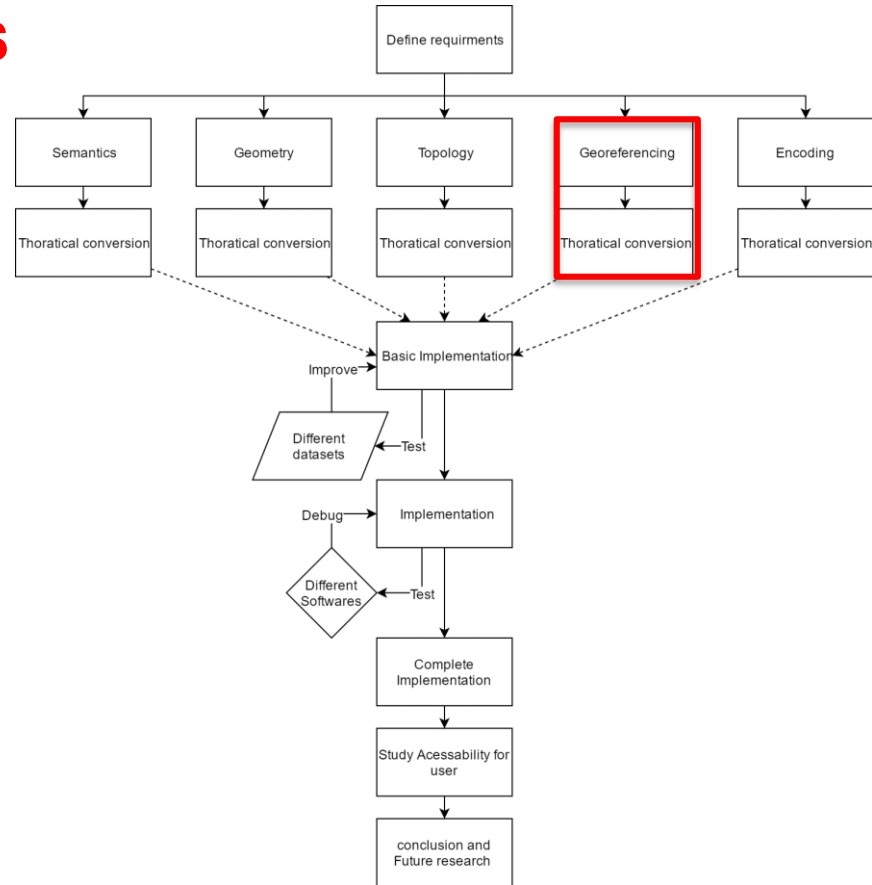


# METHODOLOGY; COORDINATES

Motivation

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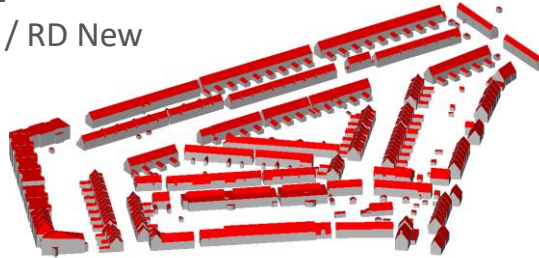


# REQUIREMENTS COORDINATES

Semantics, Geometry, **Coordinates**, Topology, Encoding.

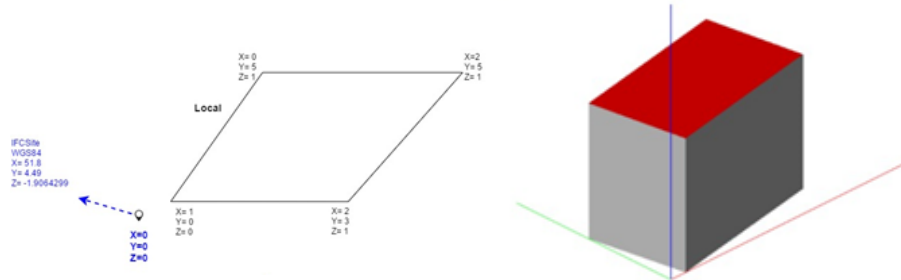
Motivation

EPSG:28992  
Amersfoort / RD New



Methodology

Conclusions

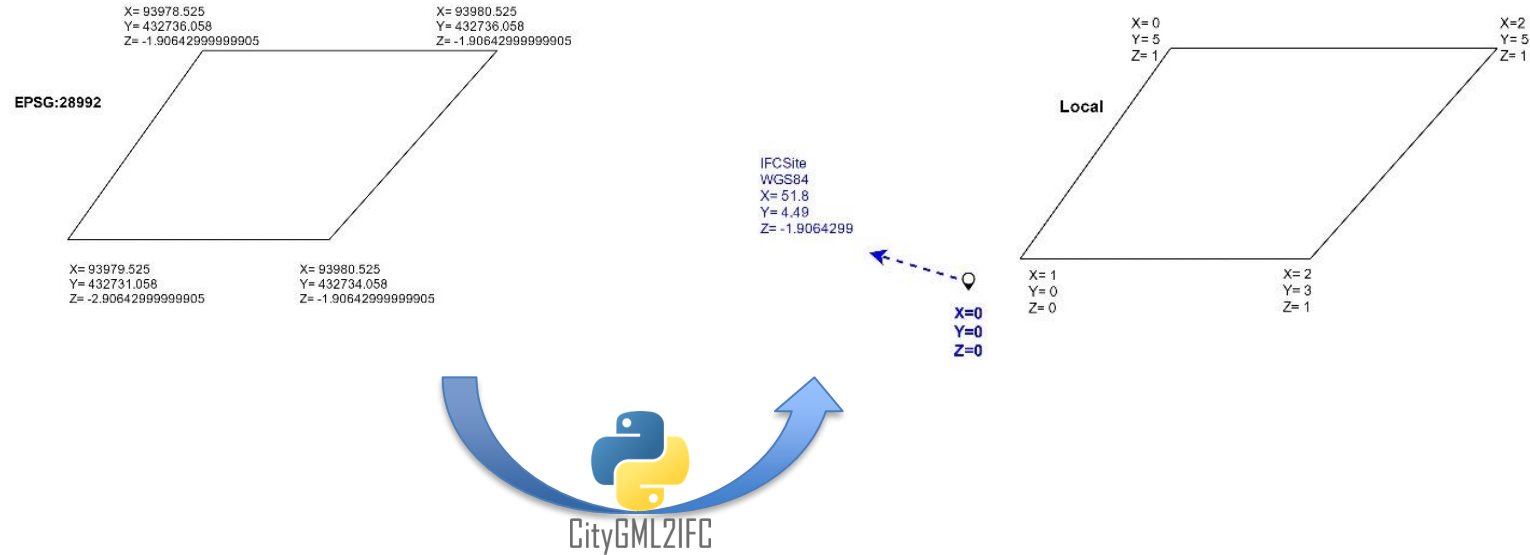


# METHODOLOGY; COORDINATES

Motivation

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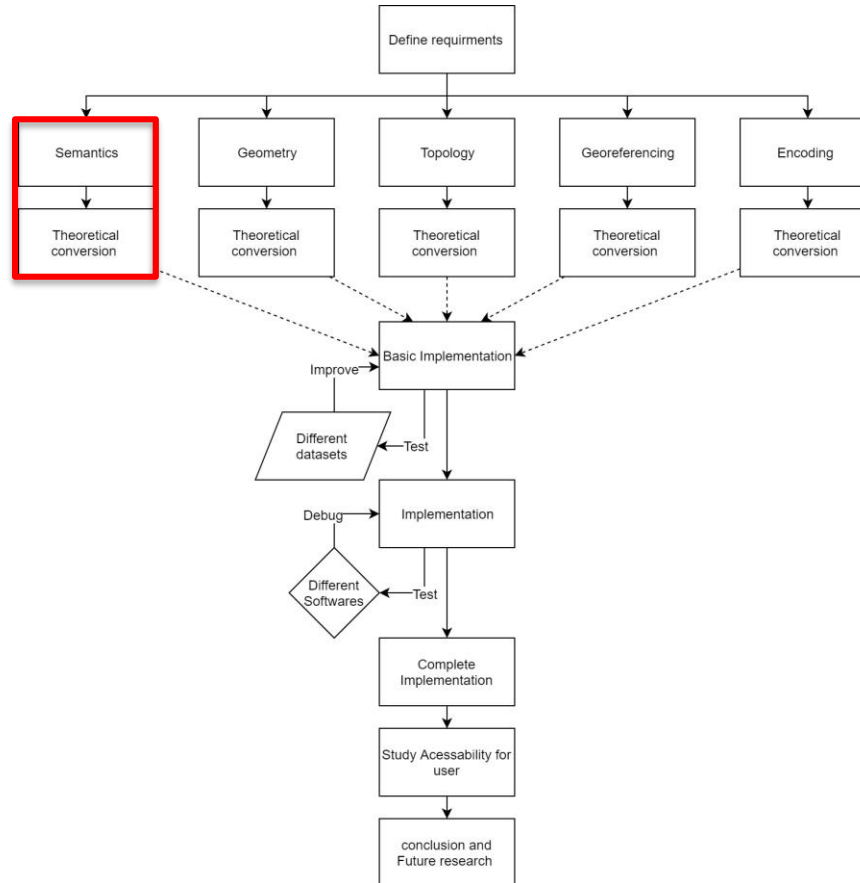
# METHODOLOGY

## SEMANTICS

Motivation

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## Semantics, Geometry, Coordinates, Topology, Encoding.

## Methodology



## Conclusions

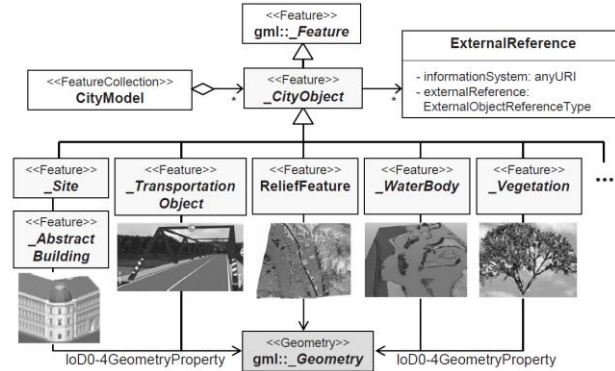


# REQUIREMENTS SEMANTICS

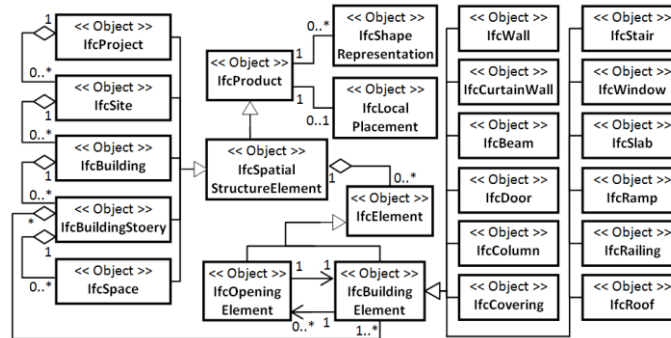
**Semantics**, Geometry, Coordinates, Topology, Encoding.

Motivation

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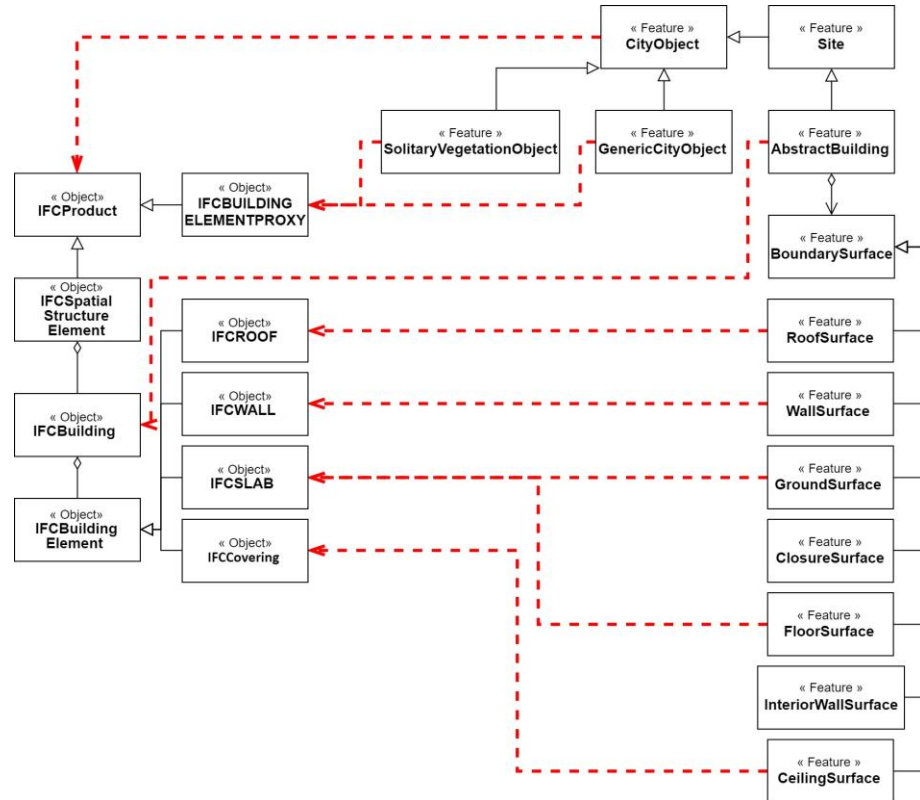
# METHODOLOGY

## SEMANTICS

Motivation

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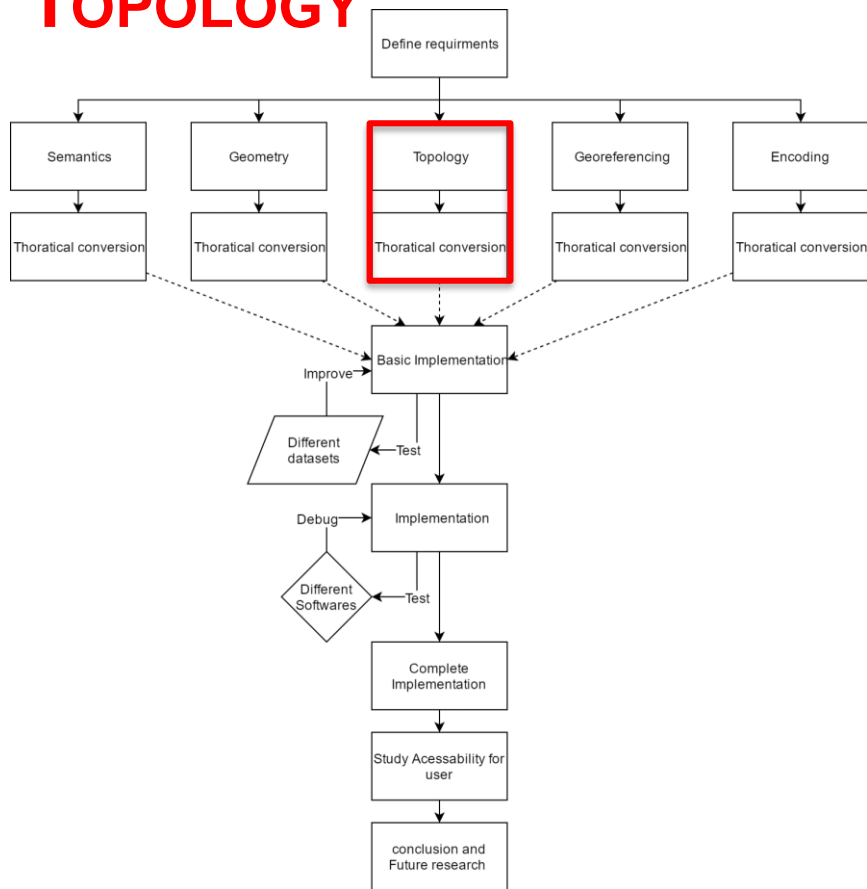


# METHODOLOGY TOPOLOGY

Motivation

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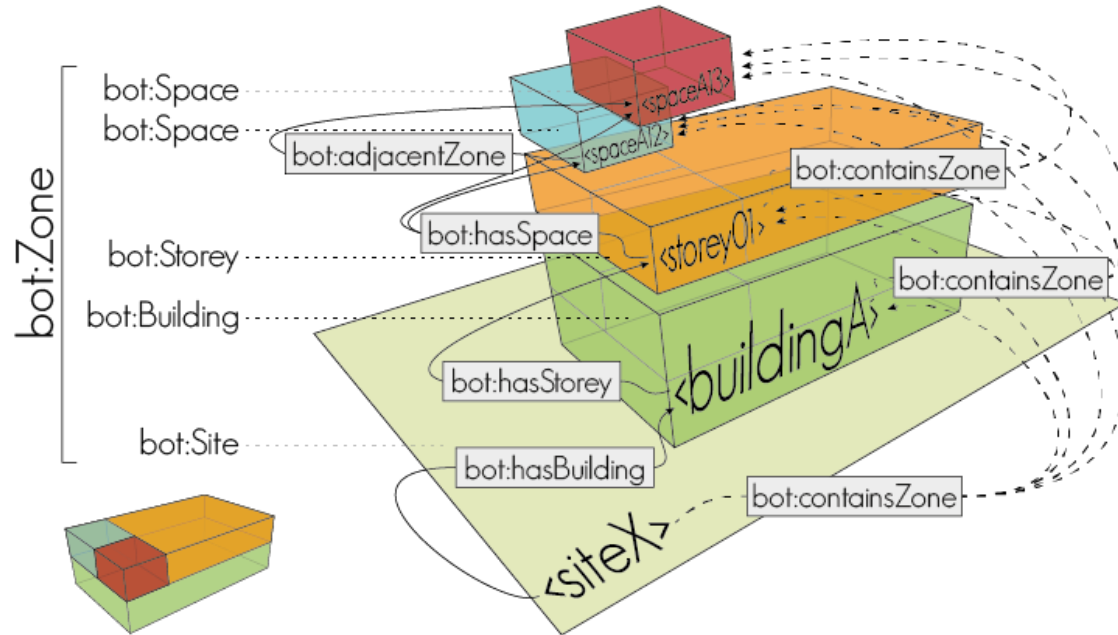


# METHODOLOGY TOPOLOGY

Motivation

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Conclusions



Source: ("Building Topology Ontology," 2019)

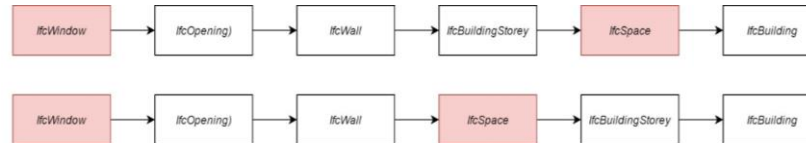
# METHODOLOGY TOPOLOGY

Motivation



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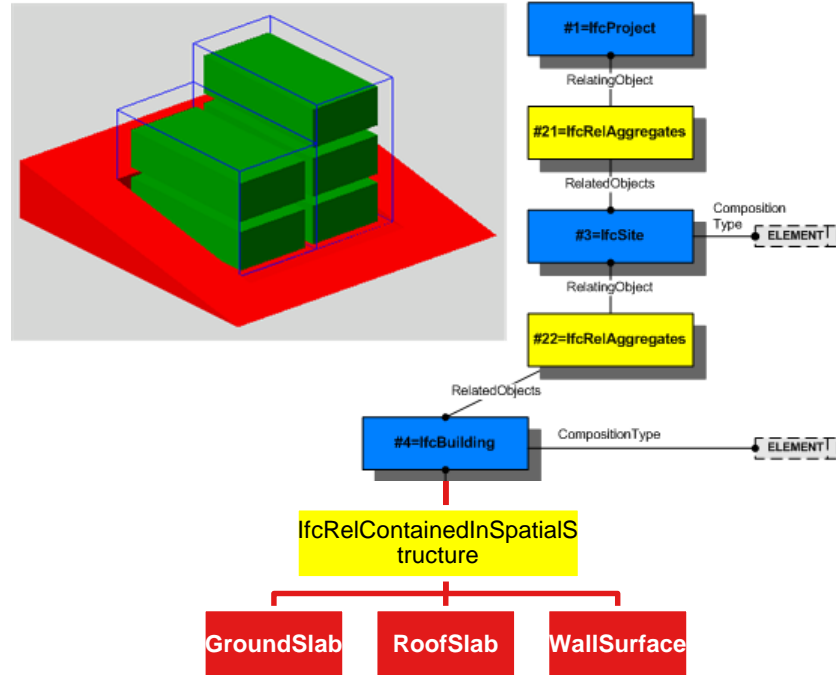


# METHODOLOGY TOPOLOGY

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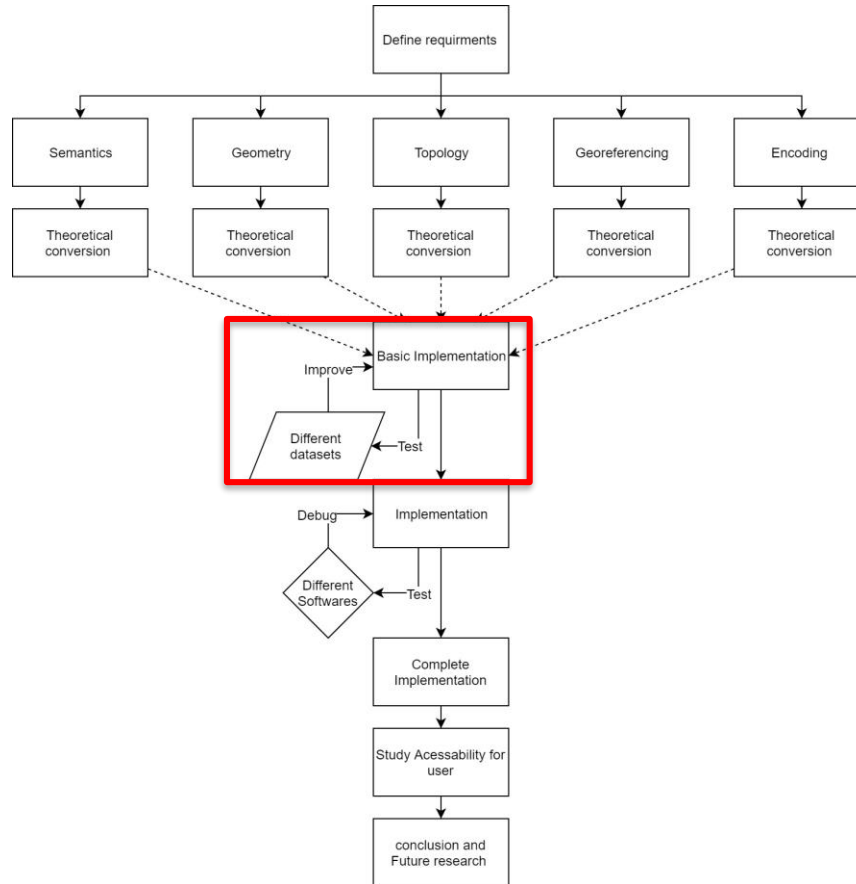
# METHODOLOGY

## VALIDATION

Motivation

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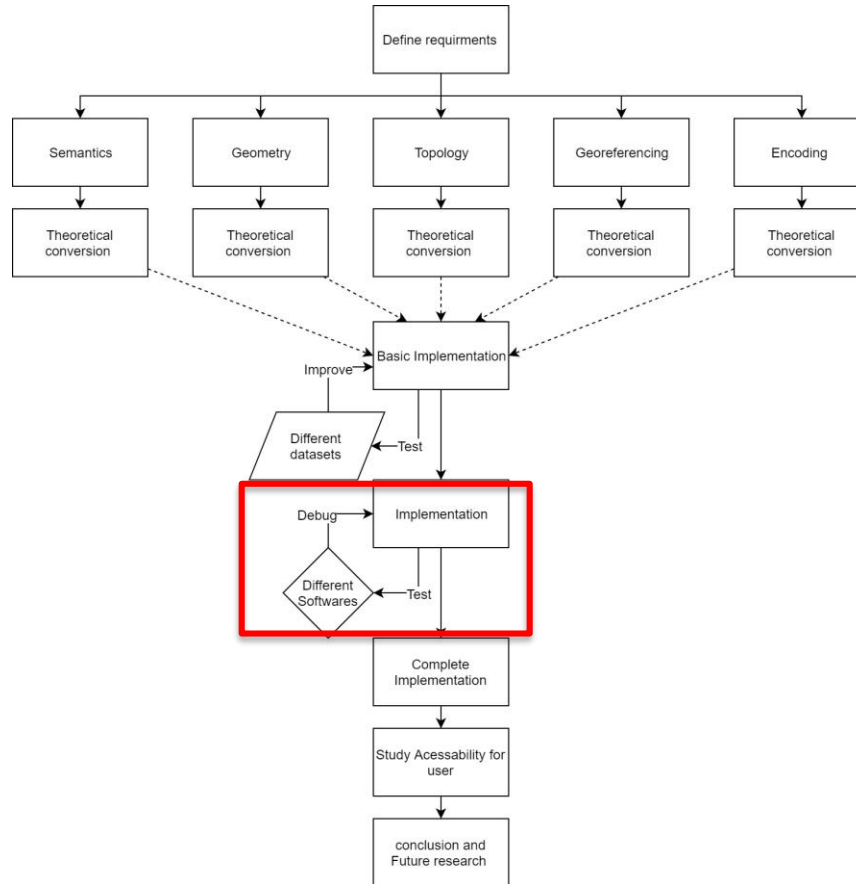
# METHODOLOGY

## VALIDATION

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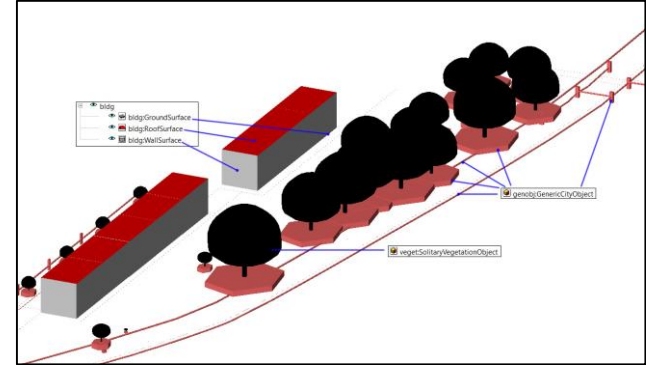
Conclusions



# METHODOLOGY

## VALIDATION (SOFTWARE)

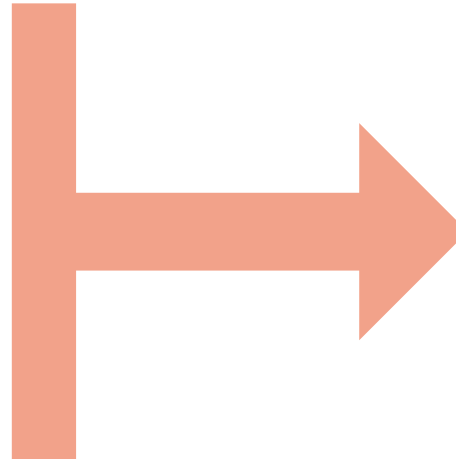
Motivation



Methodology



GRAPHISOFT  
ARCHICAD

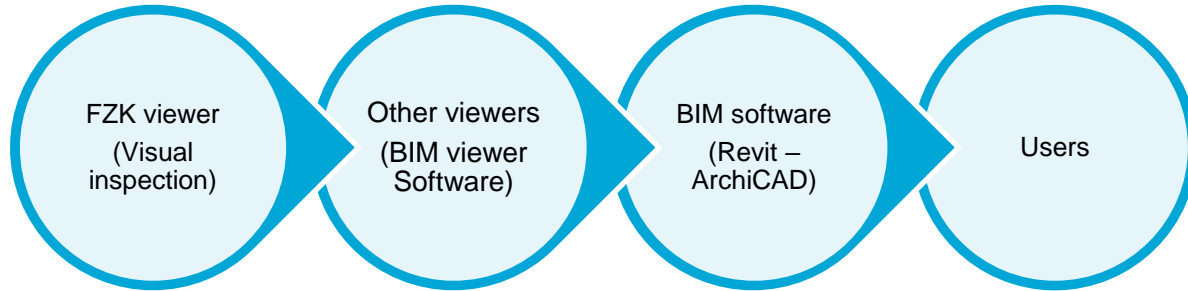


Conclusions

# METHODOLOGY VALIDATION (PROCESS)

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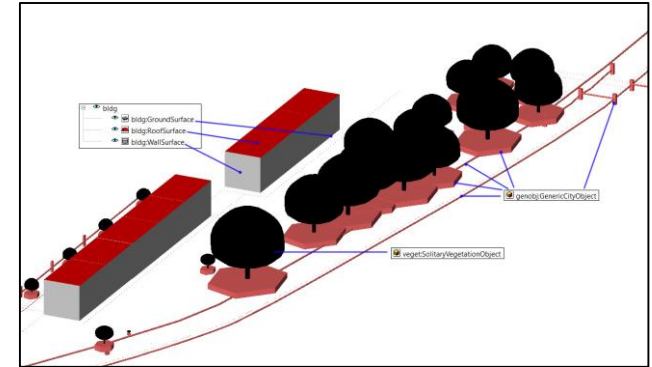
# METHODOLOGY

## VALIDATION (SOFTWARE)

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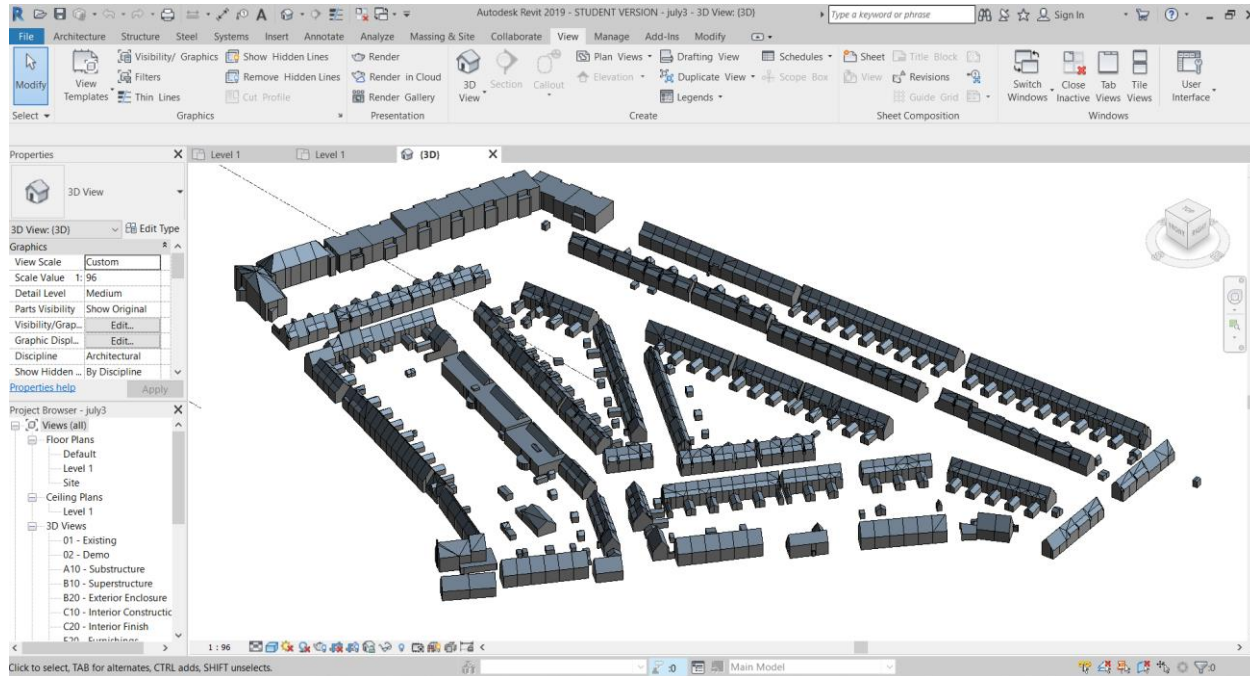
# METHODOLOGY

## VALIDATION (SOFTWARE)

Motivation

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Conclusions



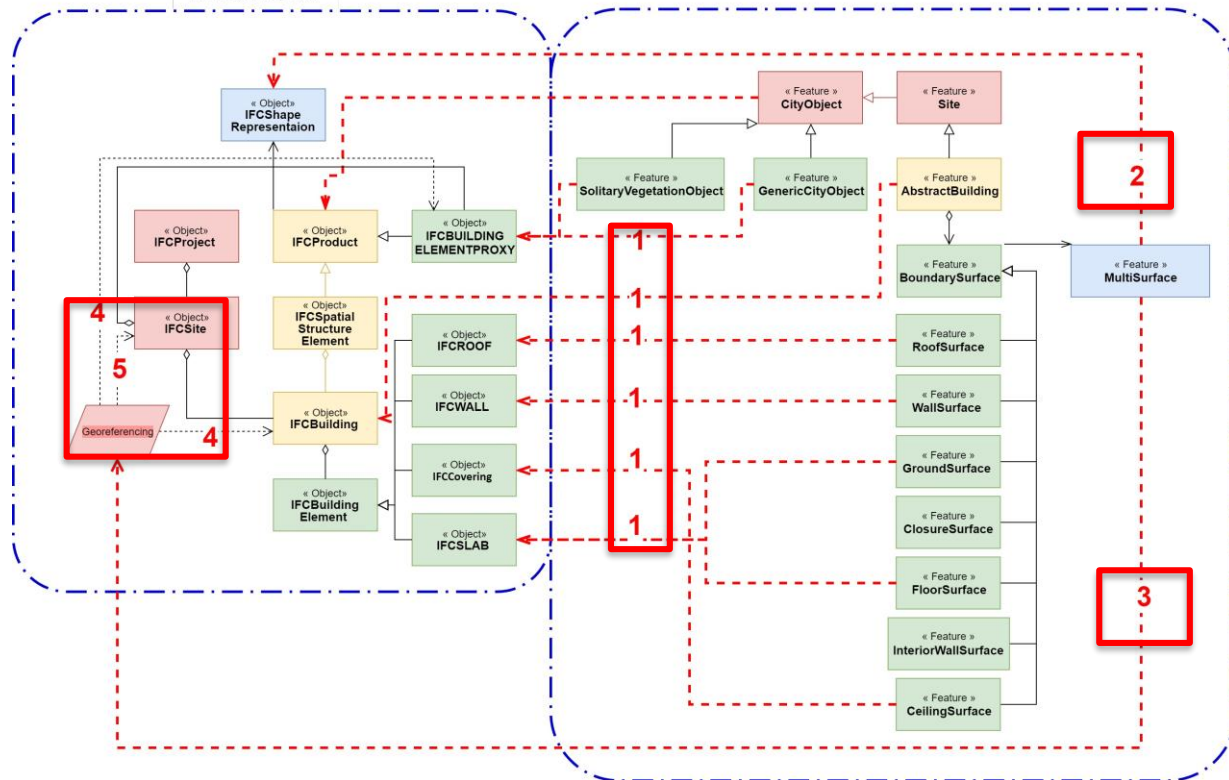
# CONCLUSION RESULTS



Motivation

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Conclusions



# CONCLUSION

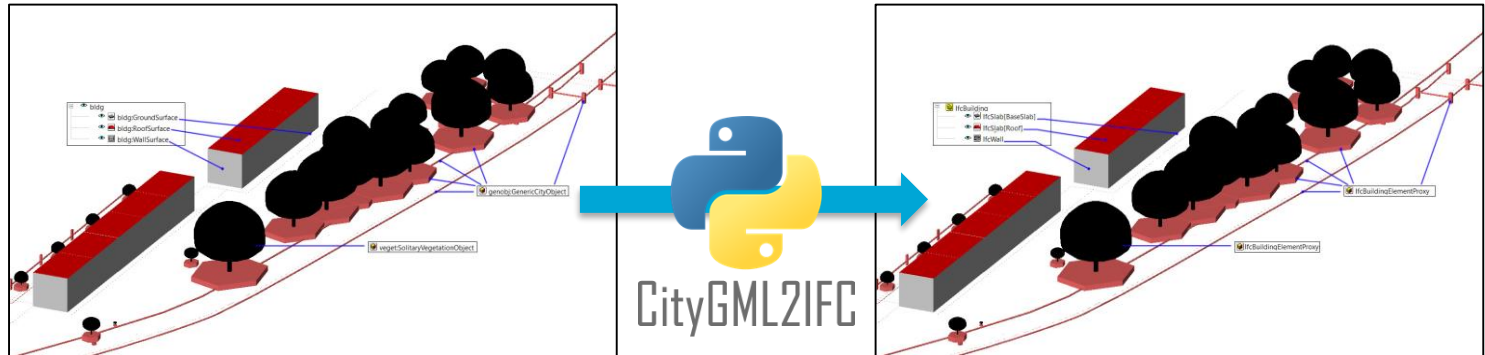
## RESULTS

- An open conversion methodology.
- Can be further extended or implemented in different software.

Motivation

Methodology

Conclusions

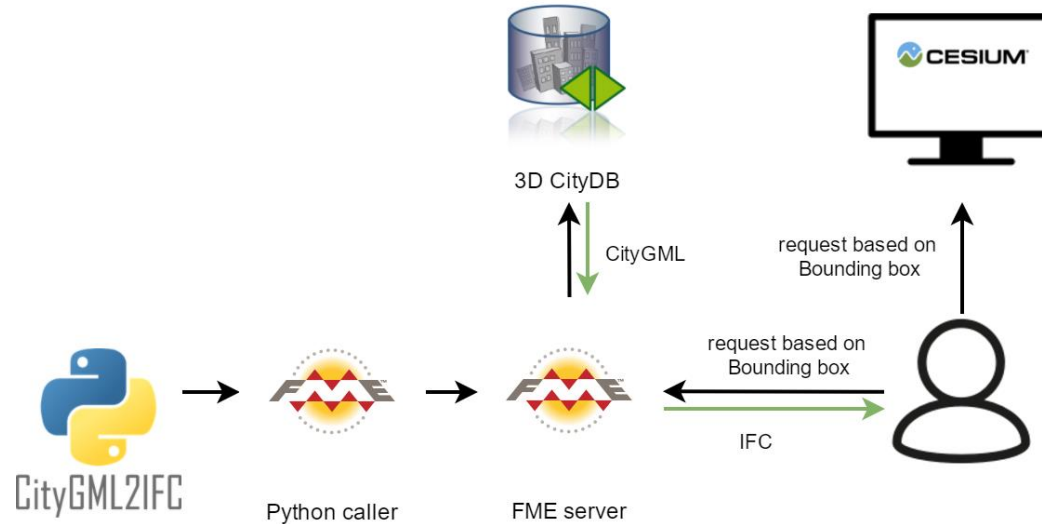


# METHODOLOGY; ACCESSIBILITY

Motivation

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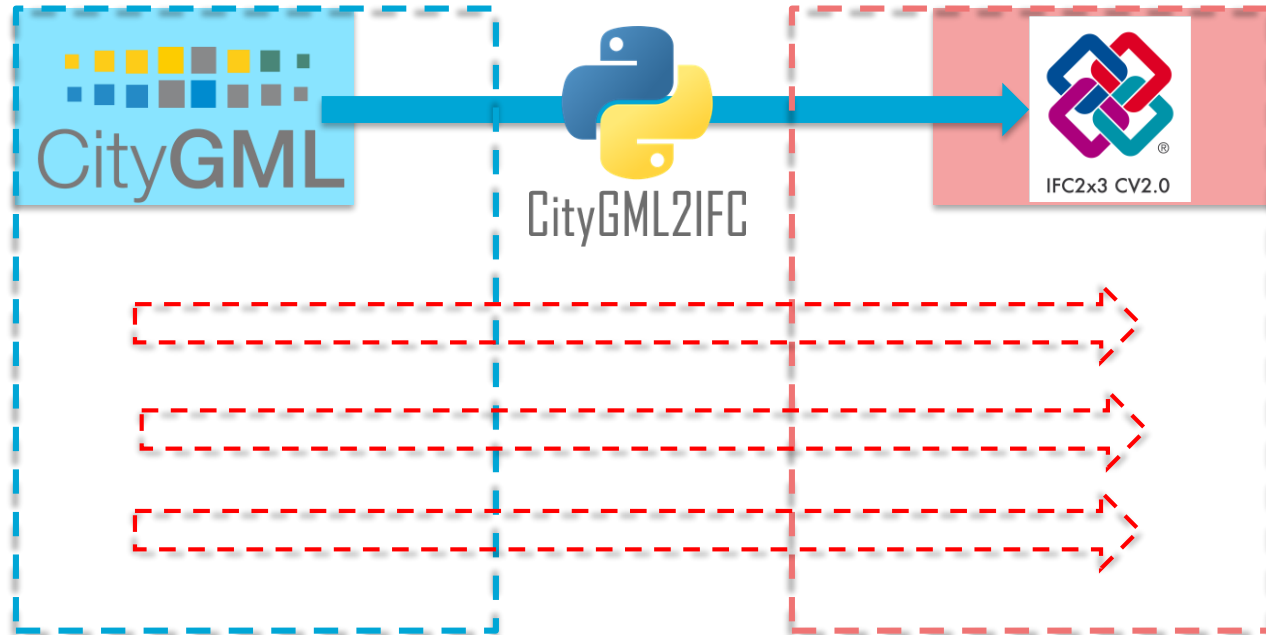


# CONCLUSIONS

Motivation

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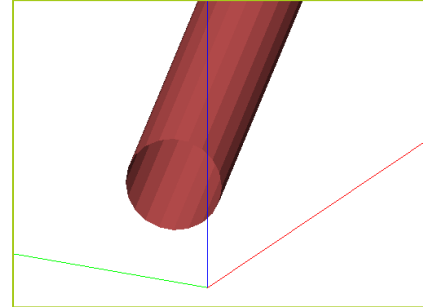
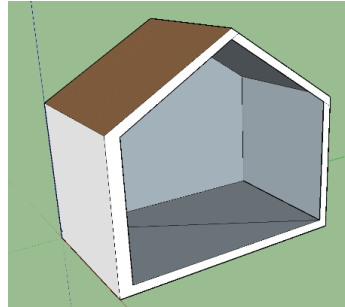
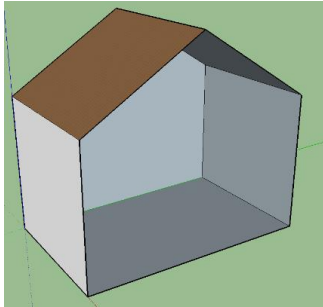
# CONCLUSIONS

## Motivation

- The complexity of IFC also comes with flexibility.
- Hence there could be different ways to convert elements from CityGML to IFC.

## Methodology

## Conclusions



# Questions & comments?

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N.Salheb@Hotmail.com

