Small surface solution - whole building

Addressing the issue raised here:

https://forums.autodesk.com/t5/revit-api-forum/gbxml-from-adjacent-conceptual-mass-adjacent-space-missing-small/m-p/12232100

Setup

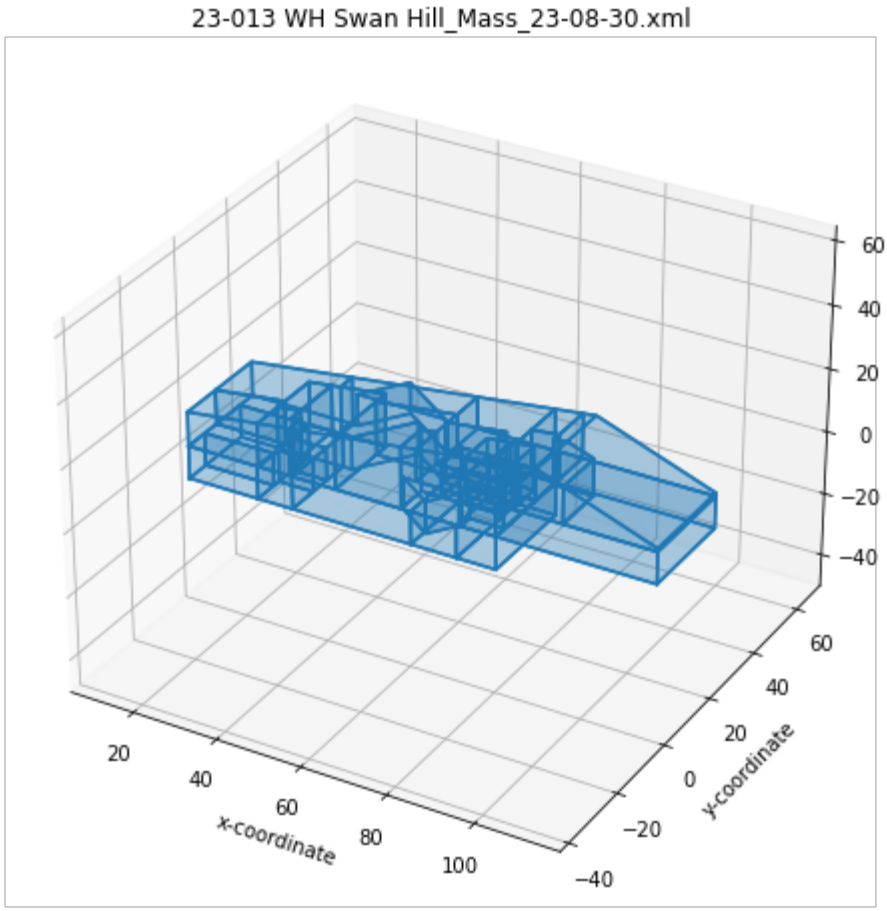
In [1]:
```
# import packages
from xgbxml import get_parser
from xgbxml import geometry_functions, gbxml_functions, render_functions
from lxml import etree
import matplotlib.pyplot as plt
import copy
import math
from uuid import uuid4
```

In [2]:
```
# uses xgbxml to generate a lxml parser to read gbXML version 0.37
parser=get_parser(version='0.37')
```

Open file '23-013 WH Swan Hill_Mass_23-08-30.xml'

In [3]:
```
# opens the file using the custom lxml parser
fp='23-013 WH Swan Hill_Mass_23-08-30.xml'
tree=etree.parse(fp,parser)
gbxml=tree.getroot()
```

In [4]:
```
# renders the Campus element
ax=gbxml.Campus.render()
ax.figure.set_size_inches(8, 8)
ax.set_title(fp)
plt.show()
```



Identify all gaps in the surfaces of the building

This uses a new method of the Building element -> `get_gaps_in_surfaces` .

In [5]:
```
# identify gaps in surfaces of building
gaps=gbxml.Campus.Building.get_gaps_in_surfaces()
gaps
```

Out[5]:
```
[{'space_ids': ['aim2197'],
  'shell': [(72.2287629, -0.3141381, 0.0),
   (72.2287629, -0.4999998, 0.0),
   (72.0986211, -0.4999998, 0.0),
   (72.2287629, -0.3141381, 0.0)]},
 {'space_ids': ['aim2553', 'aim7413'],
  'shell': [(80.2291667, 14.5625, 10.0),
   (80.0208333, 14.5625, 10.0),
   (80.0208333, 16.020833, 10.0),
   (80.2291667, 16.020833, 10.0),
   (80.2291667, 14.5625, 10.0)]},
 {'space_ids': ['aim6674'],
  'shell': [(72.2287629, -0.4999998, 10.0),
   (72.2287629, -0.3141381, 10.0),
   (72.0986211, -0.4999998, 10.0),
   (72.2287629, -0.4999998, 10.0)]}]
```

The result is a list of dictionaries. Each dictionary contains two items:

- 'space_ids': a list of the ids of the adjacent Spaces.
- 'shell': a list of the coordinates of the exterior polygon of the gaps.

Here the first and third items appear to be triangle gaps with only one adjacent space - so these are exterior gaps also adjacent to the outside.

Adding the missing surfaces to the building.

First gap

In [6]:
```
# print gap
gap=gaps[0]
gap
```

Out[6]:
```
{'space_ids': ['aim2197'],
 'shell': [(72.2287629, -0.3141381, 0.0),
  (72.2287629, -0.4999998, 0.0),
  (72.0986211, -0.4999998, 0.0),
  (72.2287629, -0.3141381, 0.0)]}
```

In [7]:
```
# add Surface
# surface element
surface=gbxml.Campus.add_Surface(
    id=str(uuid4()),
    surfaceType=None,  # to do
    constructionIdRef=None,  # to do
    exposedToSun=None  # to do
    )
# adjacent space id child element
for space_id in gap['space_ids']:
    surface.add_AdjacentSpaceId(
        spaceIdRef=space_id
        )
# planar geometry child element
planar_geometry = surface.add_PlanarGeometry()
planar_geometry.set_shell(gap['shell'])

# check
print(surface.tostring())
```

```
<Surface xmlns="http://www.gbxml.org/schema" id="f20a7dbc-94d5-43ee-bf64-748c3e61658
b">
  <AdjacentSpaceId spaceIdRef="aim2197"/>
  <PlanarGeometry>
    <PolyLoop>
      <CartesianPoint>
        <Coordinate>72.2287629</Coordinate>
        <Coordinate>-0.3141381</Coordinate>
        <Coordinate>0.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>72.2287629</Coordinate>
        <Coordinate>-0.4999998</Coordinate>
```

```
        <Coordinate>0.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>72.0986211</Coordinate>
        <Coordinate>-0.4999998</Coordinate>
        <Coordinate>0.0</Coordinate>
      </CartesianPoint>
    </PolyLoop>
  </PlanarGeometry>
</Surface>
```

Second gap

In [8]:
```
# print gap
gap=gaps[1]
gap
```

Out[8]:
```
{'space_ids': ['aim2553', 'aim7413'],
 'shell': [(80.2291667, 14.5625, 10.0),
  (80.0208333, 14.5625, 10.0),
  (80.0208333, 16.020833, 10.0),
  (80.2291667, 16.020833, 10.0),
  (80.2291667, 14.5625, 10.0)]}
```

In [9]:
```
# add Surface
# surface element
surface=gbxml.Campus.add_Surface(
    id=str(uuid4()),
    surfaceType=None,  # to do
    constructionIdRef=None,  # to do
    exposedToSun=None  # to do
    )
# adjacent space id child element
for space_id in gap['space_ids']:
    surface.add_AdjacentSpaceId(
        spaceIdRef=space_id
        )
# planar geometry child element
planar_geometry = surface.add_PlanarGeometry()
planar_geometry.set_shell(gap['shell'])

# check
print(surface.tostring())
```

```
<Surface xmlns="http://www.gbxml.org/schema" id="407a76aa-3287-4b5e-ac62-0440fb629f7
2">
  <AdjacentSpaceId spaceIdRef="aim2553"/>
  <AdjacentSpaceId spaceIdRef="aim7413"/>
  <PlanarGeometry>
    <PolyLoop>
      <CartesianPoint>
        <Coordinate>80.2291667</Coordinate>
        <Coordinate>14.5625</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
```

```
        <Coordinate>80.0208333</Coordinate>
        <Coordinate>14.5625</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>80.0208333</Coordinate>
        <Coordinate>16.020833</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>80.2291667</Coordinate>
        <Coordinate>16.020833</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
    </PolyLoop>
  </PlanarGeometry>
</Surface>
```

Third gap

In [10]:
```
# print gap
gap=gaps[2]
gap
```

Out[10]:
```
{'space_ids': ['aim6674'],
 'shell': [(72.2287629, -0.4999998, 10.0),
  (72.2287629, -0.3141381, 10.0),
  (72.0986211, -0.4999998, 10.0),
  (72.2287629, -0.4999998, 10.0)]}
```

In [11]:
```
# add Surface
# surface element
surface=gbxml.Campus.add_Surface(
    id=str(uuid4()),
    surfaceType=None,  # to do
    constructionIdRef=None,  # to do
    exposedToSun=None  # to do
    )
# adjacent space id child element
for space_id in gap['space_ids']:
    surface.add_AdjacentSpaceId(
        spaceIdRef=space_id
        )
# planar geometry child element
planar_geometry = surface.add_PlanarGeometry()
planar_geometry.set_shell(gap['shell'])

# check
print(surface.tostring())
```

```
<Surface xmlns="http://www.gbxml.org/schema" id="96ad28f6-56fb-42b8-94d0-93c73d39886
6">
  <AdjacentSpaceId spaceIdRef="aim6674"/>
  <PlanarGeometry>
    <PolyLoop>
      <CartesianPoint>
        <Coordinate>72.2287629</Coordinate>
```

```
        <Coordinate>-0.4999998</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>72.2287629</Coordinate>
        <Coordinate>-0.3141381</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
      <CartesianPoint>
        <Coordinate>72.0986211</Coordinate>
        <Coordinate>-0.4999998</Coordinate>
        <Coordinate>10.0</Coordinate>
      </CartesianPoint>
    </PolyLoop>
  </PlanarGeometry>
</Surface>
```

Recheck gaps in surfaces of building

There should now be no gaps.

In [12]:
```
# identify gaps in surfaces of building
gaps=gbxml.Campus.Building.get_gaps_in_surfaces()
gaps
```

Out[12]:
```
[]
```

Save the updated gbxml file

In [13]:
```
# writes the gbXML etree to a local file
tree.write('23-013 WH Swan Hill_Mass_23-08-30-UPDATED.xml', pretty_print=True)
```

In [ ]:
```

```