Implementation of Energy ADE In CitySim

Workshop in Munich
30th November 2015
METHODOLOGY_ The gateway between CitySim and CityGML

Energy ADE data model

CitySim data model:
Tree-based structure

CityGML with Energy ADE data model:
Independent modules
METHODOLOGY_ Adequacy between both data model

CitySim data model

```xml
<Building>
  <HeatTank ... />
  <CoolTank ... />
  <HeatSource ... />
  <CoolSource ... />
  <Zone>
    <Occupants ... />
    <Roof ...>
      <V0 x="0.00" y="0.00" z="0.00"/>
      <V1 x="2.0" y="0.00" z="0.00"/>
      <V2 x="2.0" y="0.00" z="3.0"/>
      <V3 x="1.0" y="0.00" z="3.5"/>
      <V4 x="0.0" y="0.00" z="3.0"/>
    </Roof>
    <Zone>
    </Zone>
  </Building>
```

CityGML with Energy ADE data model

```xml
<cityObjectMember>
  <bldg:Building>
    <bldg:lod2Solid>
      <gml:Solid>
        <gml:exterior>
          <gml:CompositeSurface>
            <gml:surfaceMember>
              <gml:Polygon gml:id="b3411_p_w_111290">
                <gml:exterior>
                  <gml:LinearRing>
                    <gml:posList>
                      0.00 0.00 0.00
                      2.00 0.00 0.00
                      2.00 0.00 3.00
                      1.00 0.00 3.50
                      0.00 0.00 3.00
                      0.00 0.00 0.00
                    </gml:posList>
                  </gml:LinearRing>
                </gml:exterior>
              </gml:Polygon gml:id="b3411_p_w_111290">
            </gml:surfaceMember>
          </gml:CompositeSurface>
        </gml:exterior>
        </gml:Solid>
      </bldg:lod2Solid>
    </bldg:Building>
  </cityObjectMember>
```
METHODOLOGY_ Case study: the **EPFL campus in Lausanne**

- 3D model
- Energy model

\[ \{ \text{3D model} \quad \text{Energy model} \quad \text{CitySim} \downarrow \text{CityGML} \]

- **Physical properties** of buildings (phase of construction)
- **BiPV** on Roof Top (2000m²)
- **Occupancy profile** (SIA 2024/2006)
RESULTS_ Geometrical information
RESULTS_ Energy demand and BiPV production

CitySim Monitoring (ENERGO)

\[ R^2 = 0.89 \]
RESULTS_ Energy demand and BiPV production

BiPV power plant \((R^2=0.93)\)

Romande Energie_ monitoring 2013

Average radiation \((1991-2010)\)
RESULTS_ Annual PV production and energy demand

Yearly heating demand

Hourly cooling demand
CONCLUSIONS

Gateway between urban simulation tools CitySim and the CityGML Energy ADE data format:

• City model simulated, stored and exchanged (Common database of knowledge)

• The EPFL campus in Lausanne and Freiburg (Annual heating and Cooling demands)

Future development

• Displaying results in graphical user interfaces

• Apply this methodology to other case studies


S. Coccolo, J. Kaempf. Urban energy simulation of the EPFL campus in Fribourg using a new paradigm: the CityGML application domain extension energy. CISBAT 2015- Future buildings & districts- From nano to urban scale, 2015
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