virtual city systems

digital views. real perspectives.

EuroSDR Workshop LOD2 BUILDING MODEL GENERATION
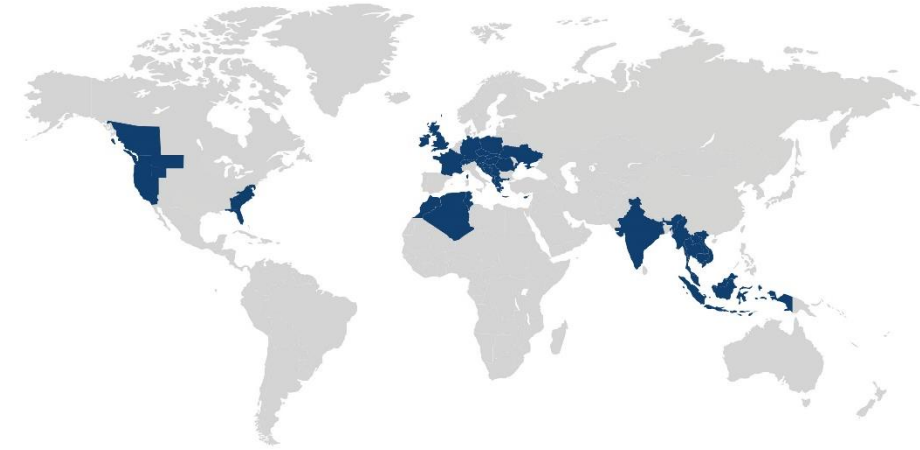
BuildingReconstruction
A tool for LoD2 building reconstruction

Dr. Lutz Ross, lross@vc.systems

Virtual City Systems

- Founded in 2005
- Headquarter Berlin, Office in Grafing
- Leading **CityGML** experts
- Experts for 3D geoinformation and **Digital Twins** of cities
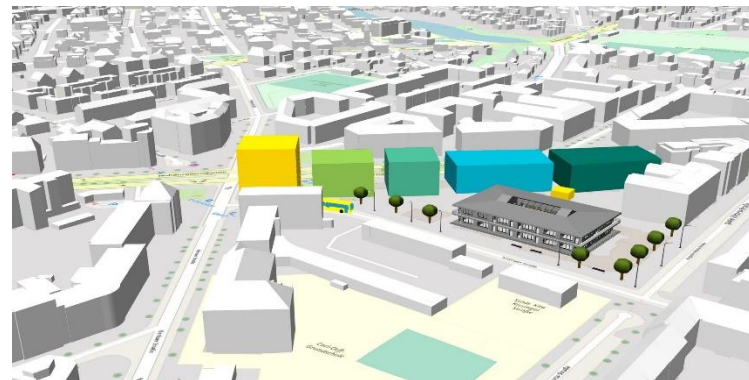

CADFEM GROUP

20+ COMPANIES
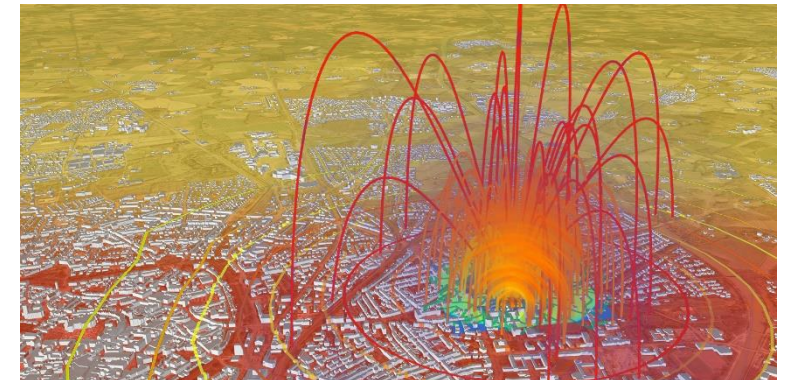**450+** EMPLOYEES
35+ LOCATIONS
25+ COUNTRIES

3D Spatial Data Infrastructures

Digital Urban Planning

Urban Simulation

BuildingReconstruction – LoD2 building production

- Semi-automatic approach
  - based on cell decomposition of ground plans
  - Basic roof primitives are fitted to the DSM
  - Manual refinement by the user
- First software version developed by Martin Kada at the IFP Stuttgart
- Based on work by N. Haala und C. Brenner

C. Brenner and N. Haala (1999): Rapid Production of Virtual Reality City Models. GIS-HEIDELBERG-, 12, 22-28.

BuildingReconstruction

- Since 2007 in productive use at VCS
  - Creation of LoD1 and LoD2 models as service for municipalities

- BuildingReconstruction is sold as software since 2010
  - Important improvement for the German market: groundplan based reconstruction
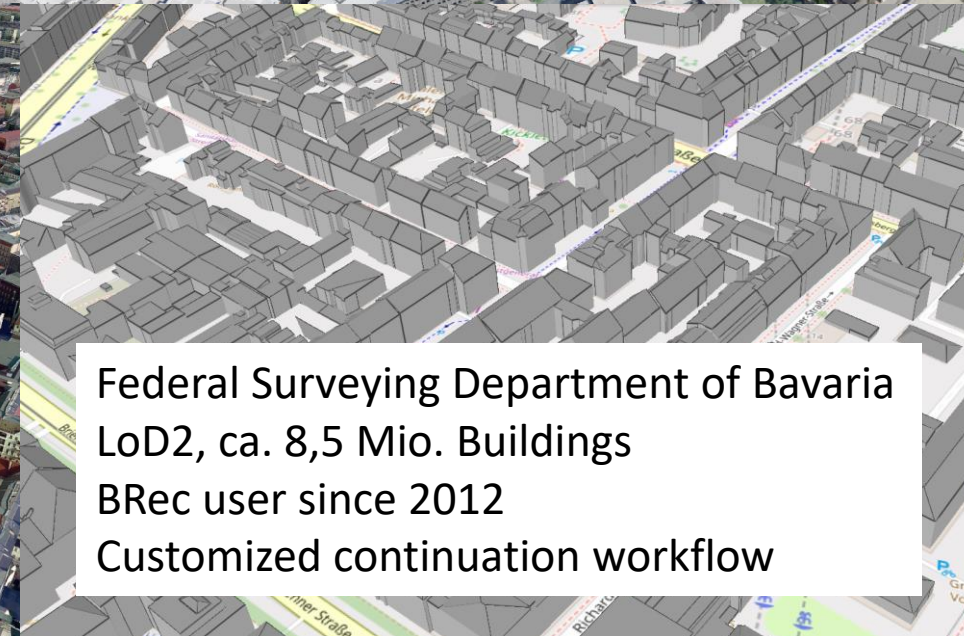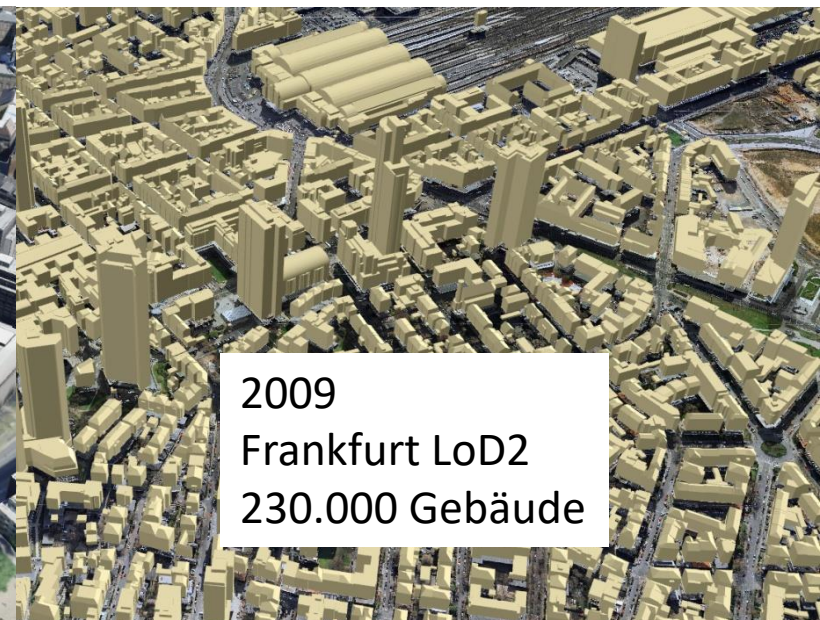 - Core requirement for nation-wide LoD2 building models in Germany
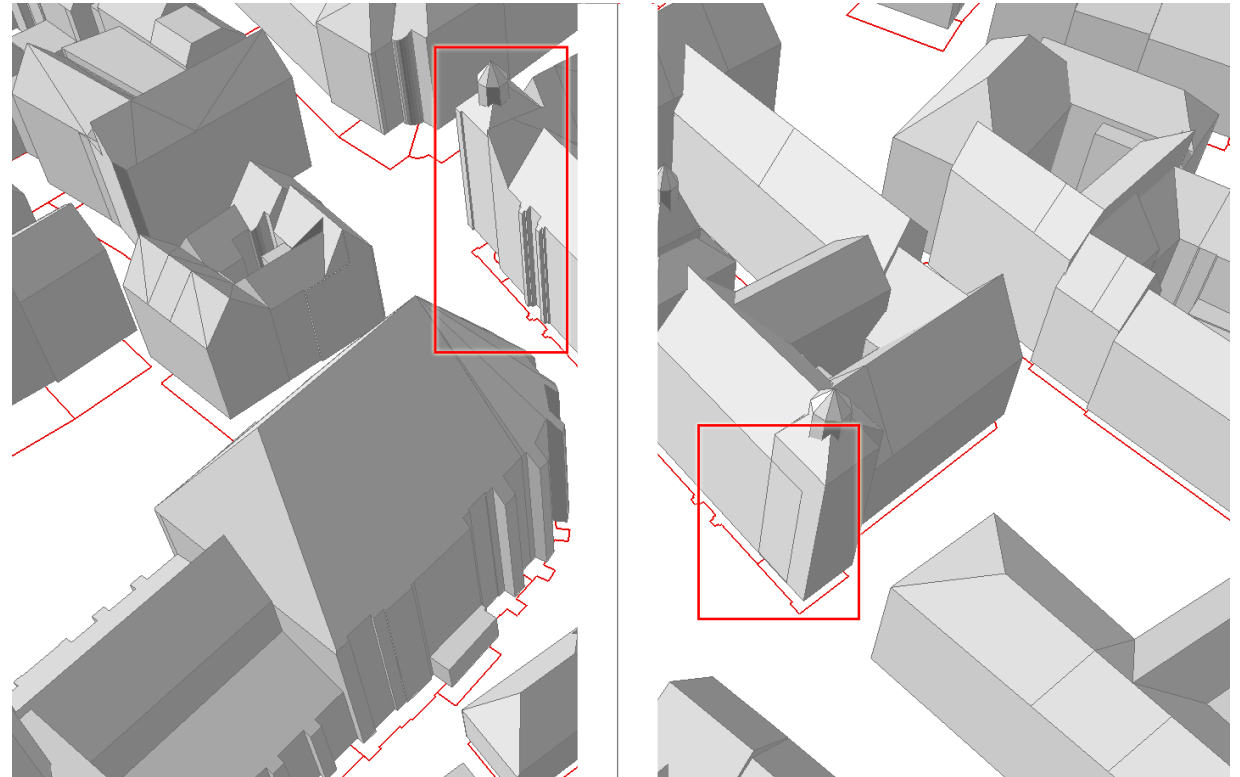
2007 - 2009
Berlin LoD2
550.000 Gebäude
Texturierung aus Schrägluftbildern
Zusammen mit 3D Geo GmbH
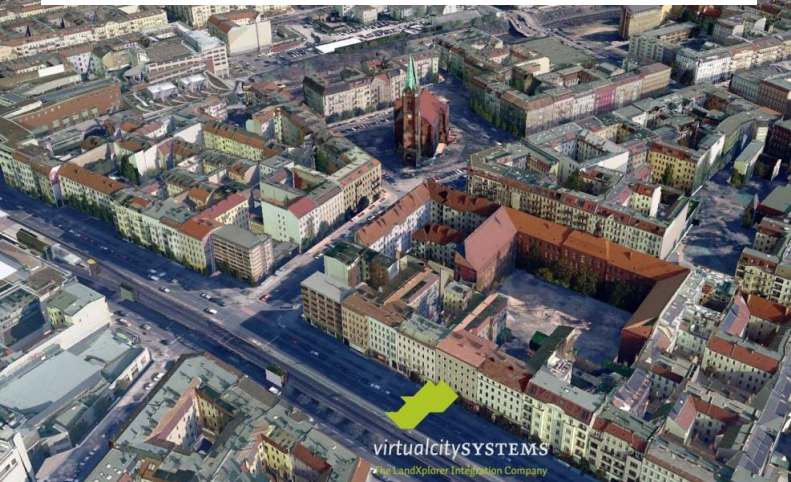
Federal Surveying Department of Bremen
LoD2, approx. 320.000 Buildings

2009
Frankfurt LoD2
230.000 Gebäude

Federal Surveying Department of Bavaria
LoD2, ca. 8,5 Mio. Buildings
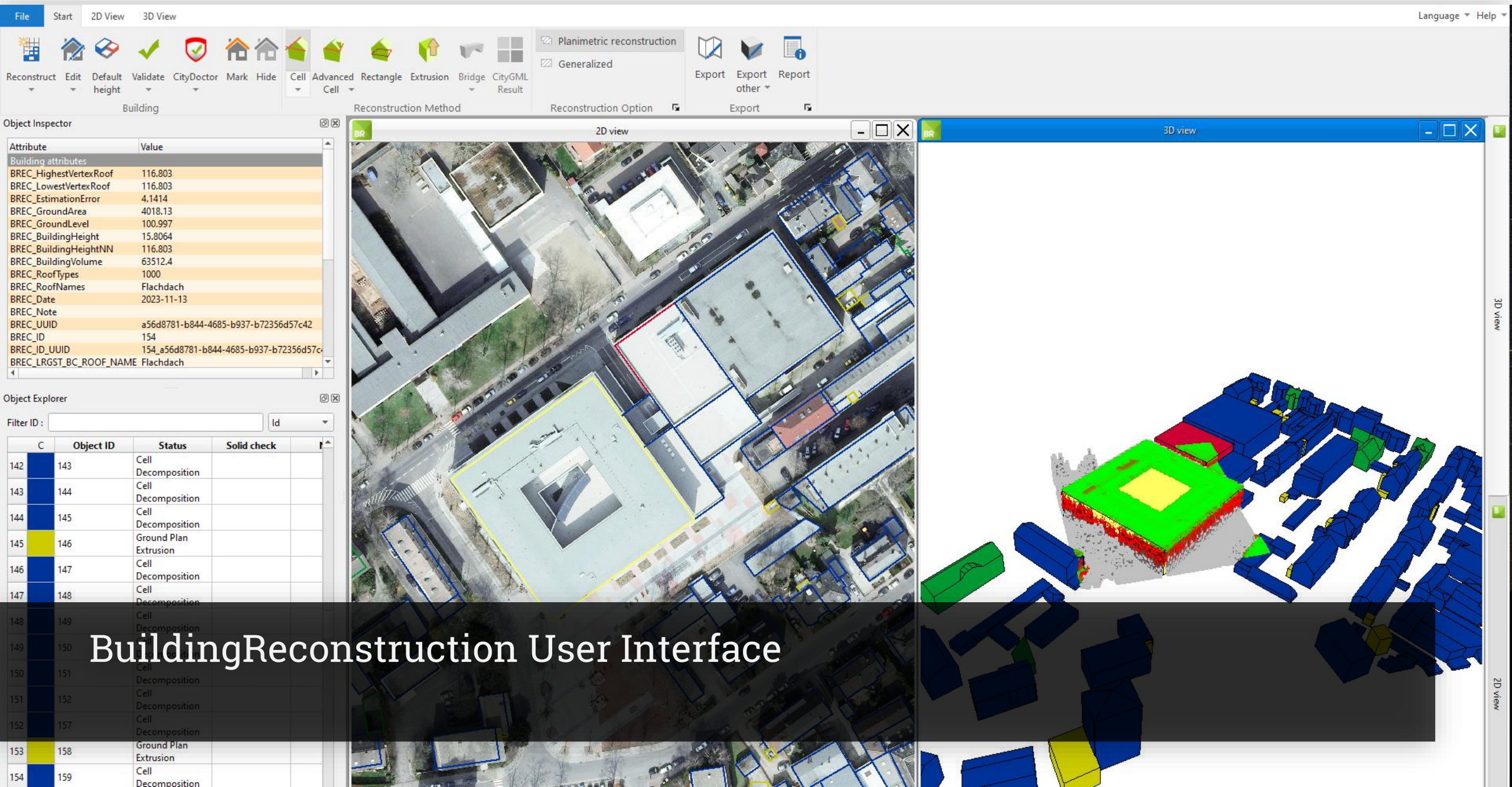BRec user since 2012
Customized continuation workflow

2009
Leeuwarden LoD2
45.000 Gebäude

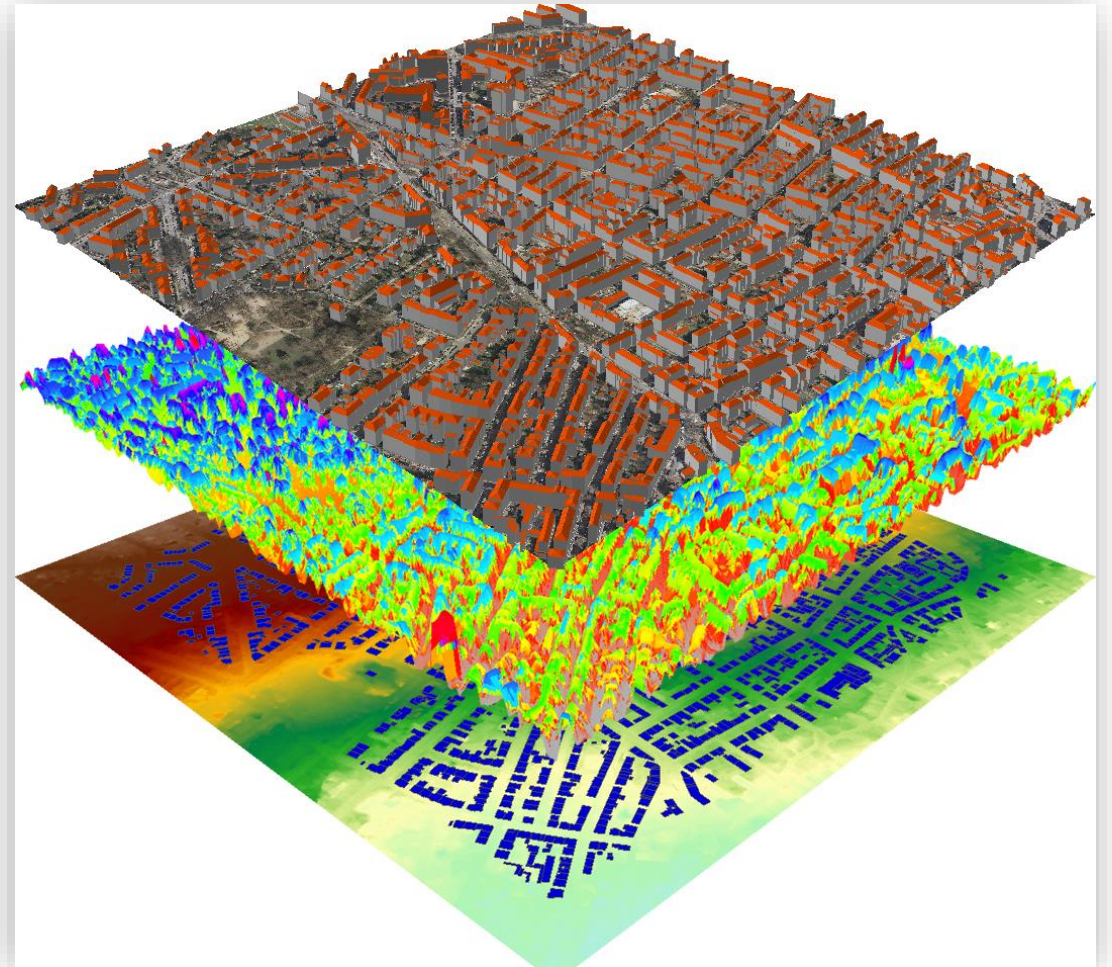BuildingReconstruction User Interface
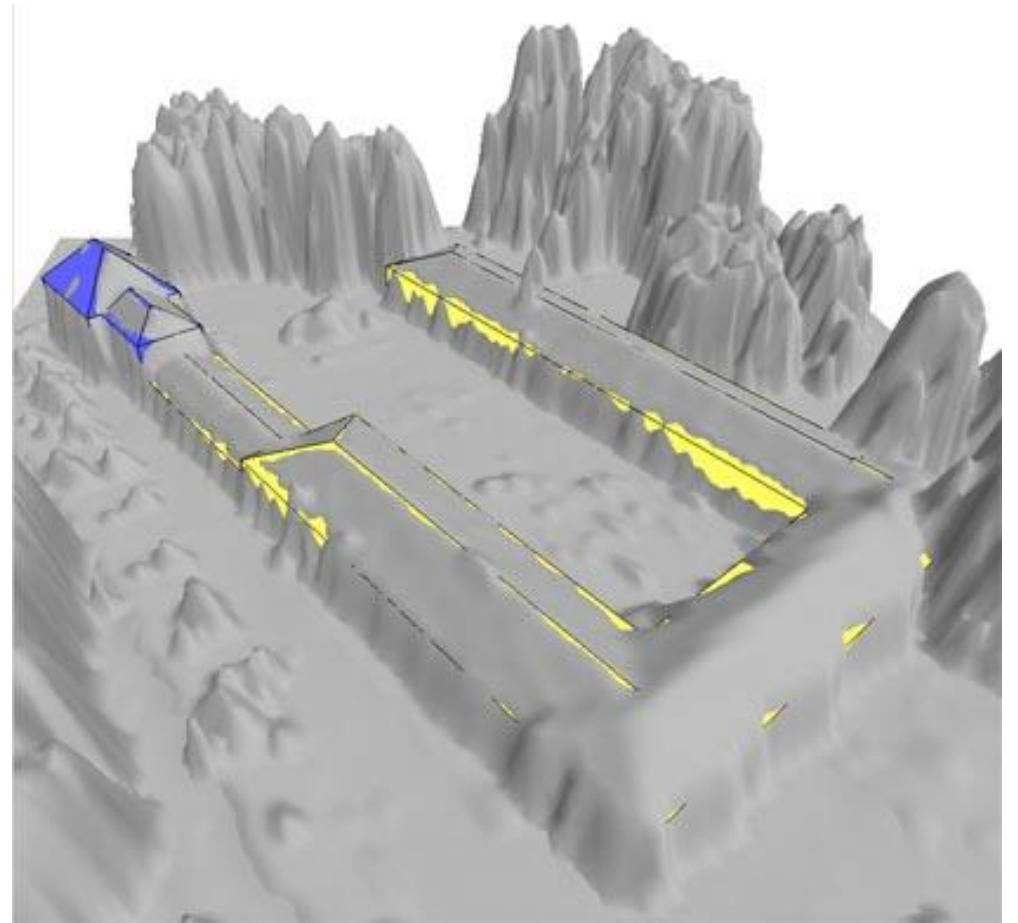
BuildingReconstruction

→**3D building extraction from Airborne Laserscanning (or pointclouds / DSM from dense image matching)**

- Required inputs:
  - Digital Surface Model
  - Building Footprints
  - Digital Terrain Model
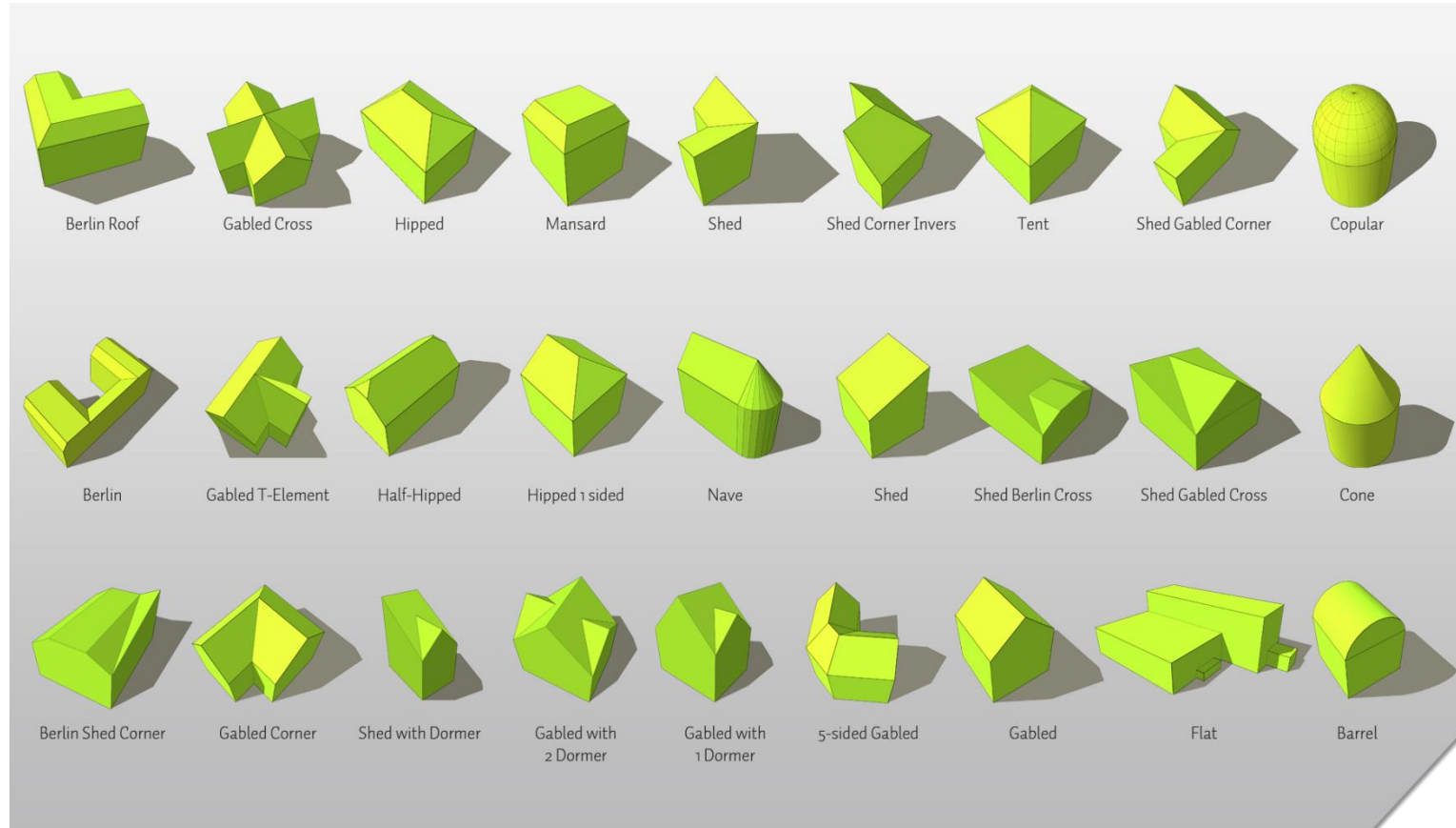
- Optional
  - Orthophoto

Reconstruction

- LoD 1 and LoD2 models will be generated fully automatic

- using the parametric roof type library

- After automatic reconstruction → **manual quality control and refinement**

Roof type library

- 32 main and connecting roof types are available

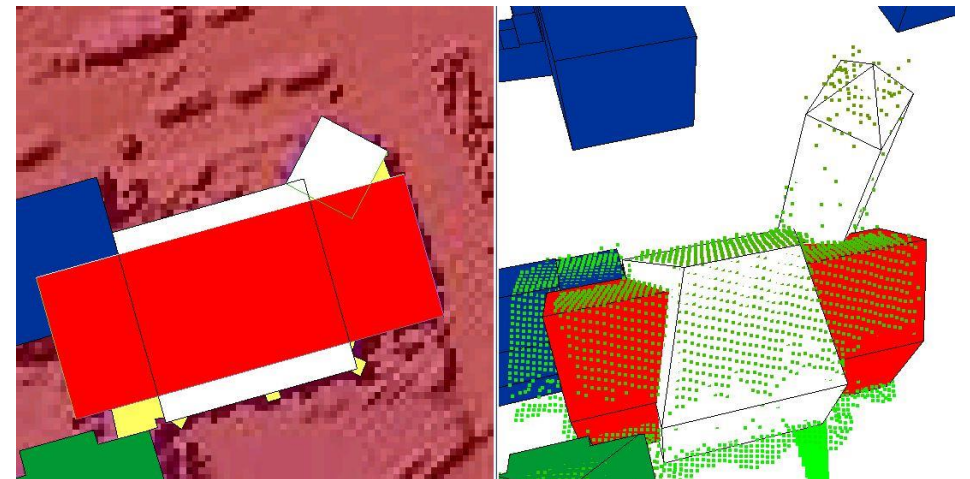- Even special roof types like cupola, barrel and mansard can be used

Reconstruction Methods

- Four different reconstruction methods are available
  - Cell division
  - Advanced cell division
  - Rectangle
  - Extrusion

- With rectangle division and cell division up to 80% correct classification for simple footprints
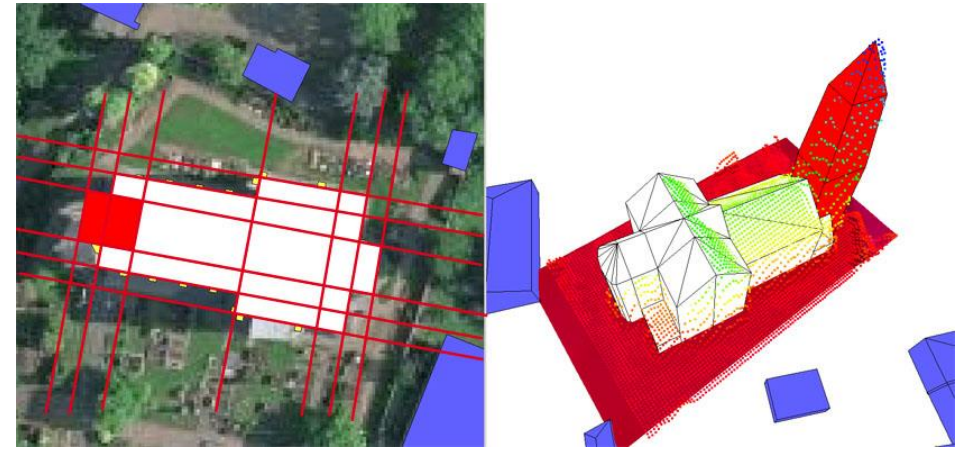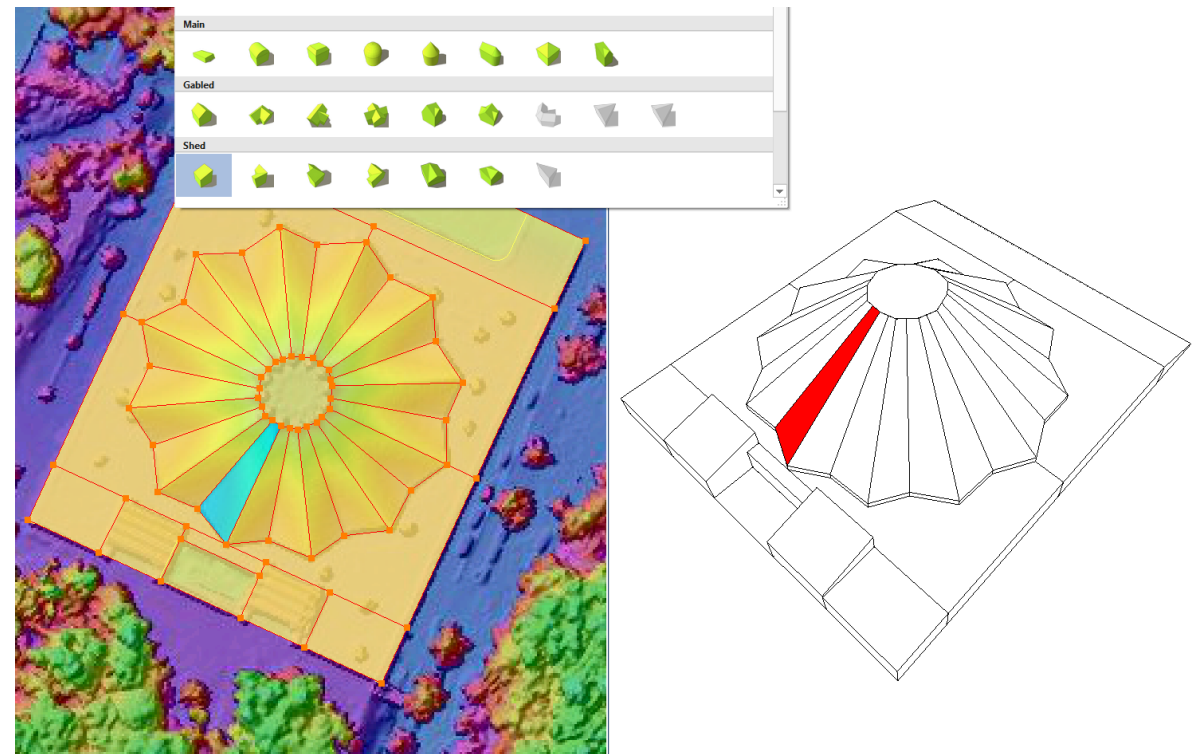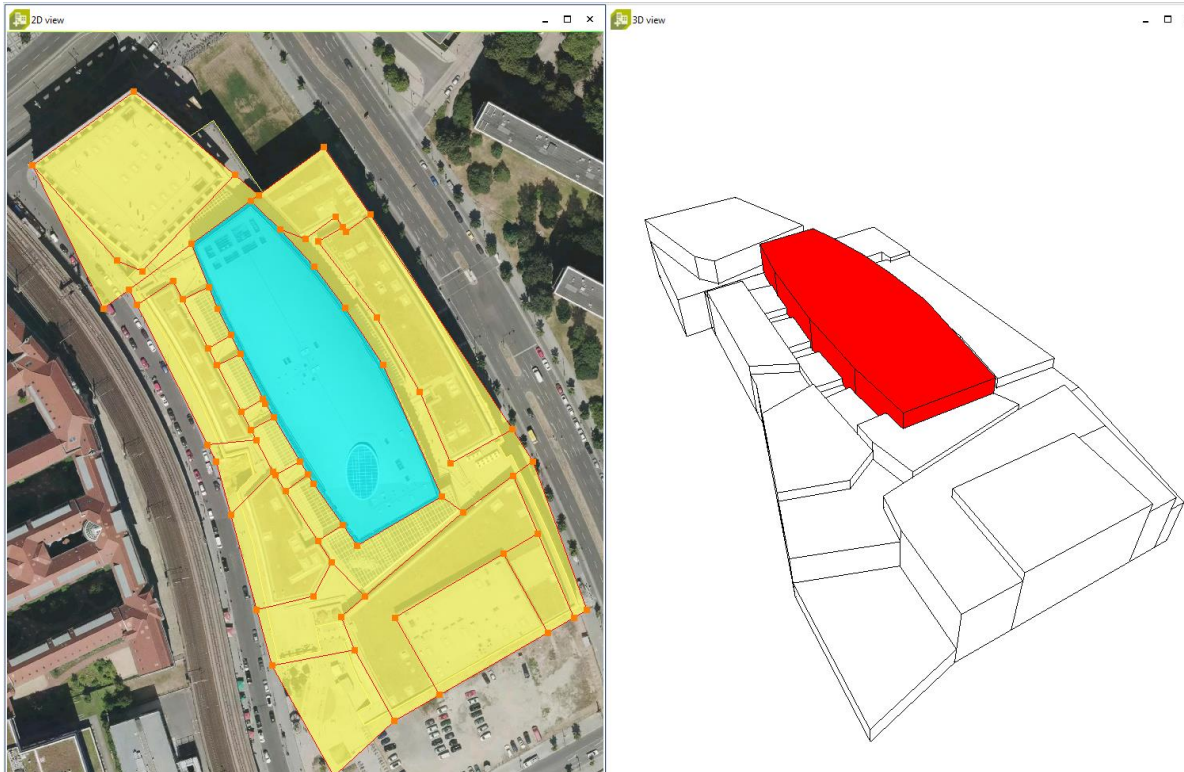

Cell division

Rectangle

Reality is complex

- Several roof shapes per floor plan
- Inner-city areas
- Density of buildings
- Modern architecture

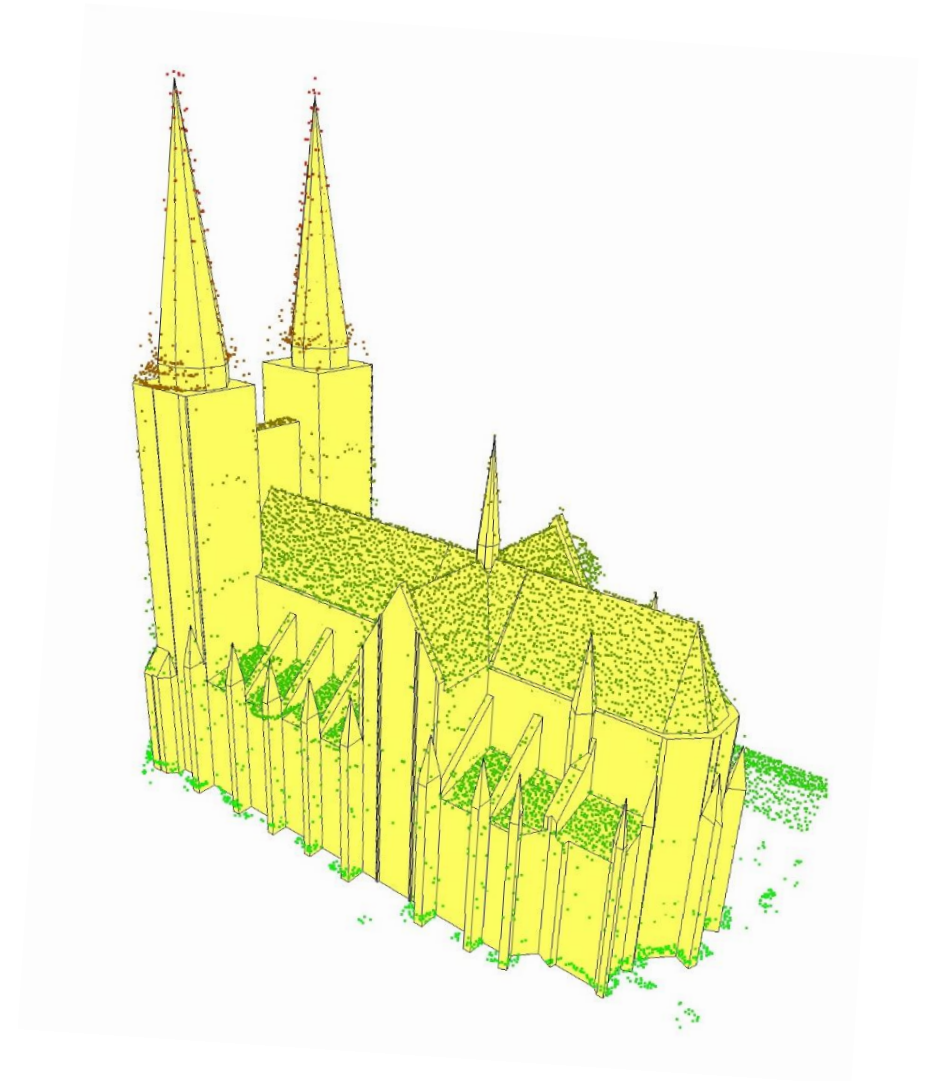# Advanced Cell Editor

"new" editor since Version 2015 is a huge improvement

Modelling of LoD2+ buildings possible

- Modelling of small roof structures

- Use for POIs such as churches, museums, administrative-, public buildings or shopping centers

Efficiency

- In order to work efficient with BuildingReconstruction 1km² tiles are created for the entire project area

- To avoid duplicated buildings an overlapping area of 100 meters is recommended at the edge of each tile
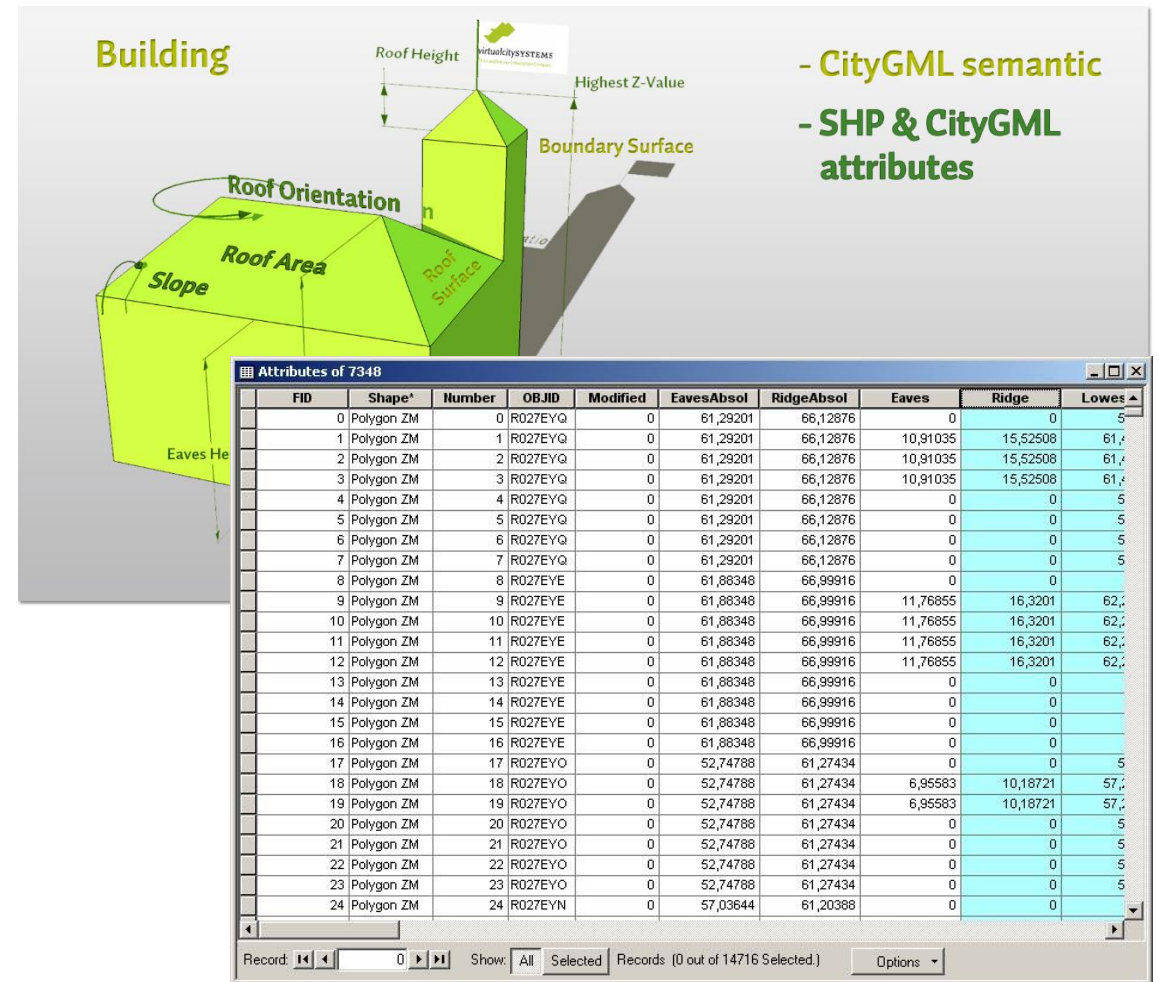
Performance

- Initial building extraction runs fully automatic

- Approx. 3.000 buildings (LoD1 and LoD2) can be processed at one time within 5 - 10 minutes

→ approx. 10 buildings per second
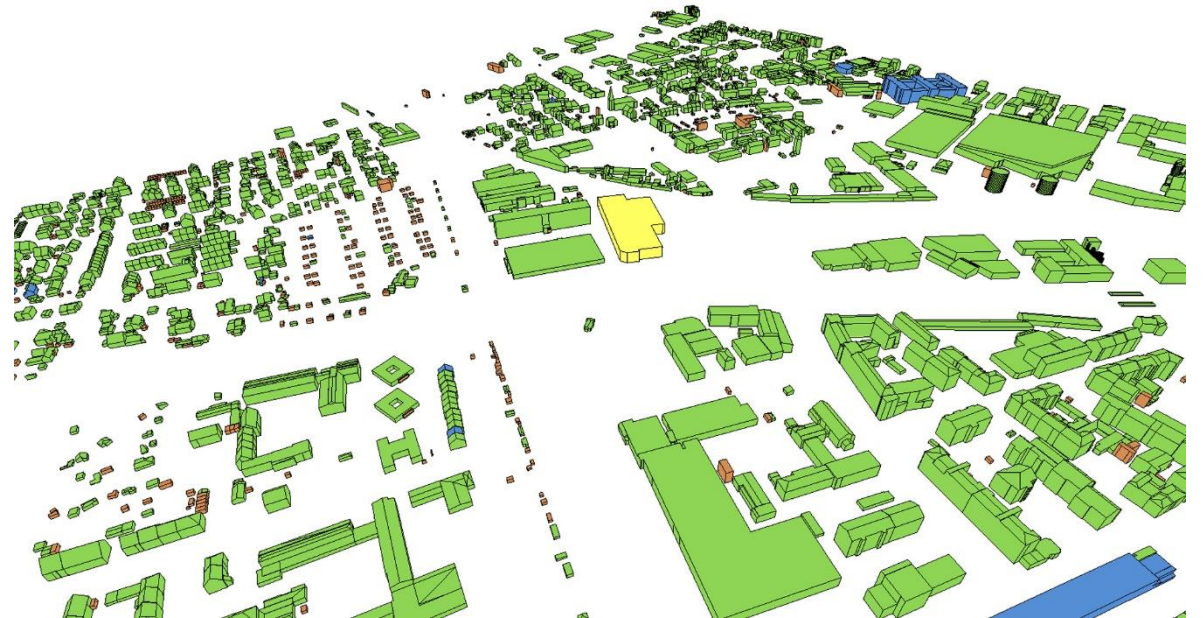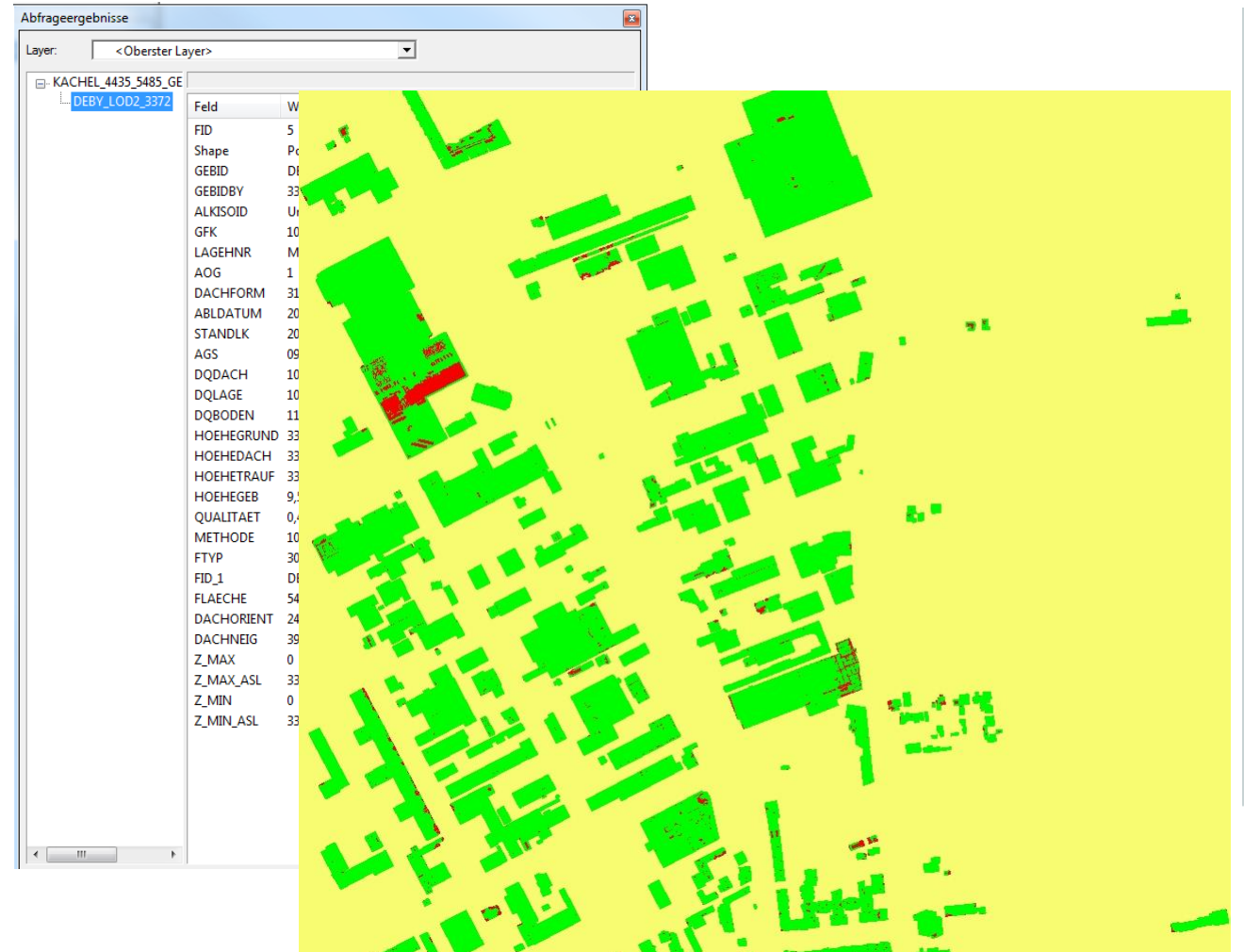
Semantics and Attributes

- Semantic information will be calculated automatically
  - ridge/ eaves height
  - roof pitch
  - orientation
  - roof area

- Convenient attribute mapping
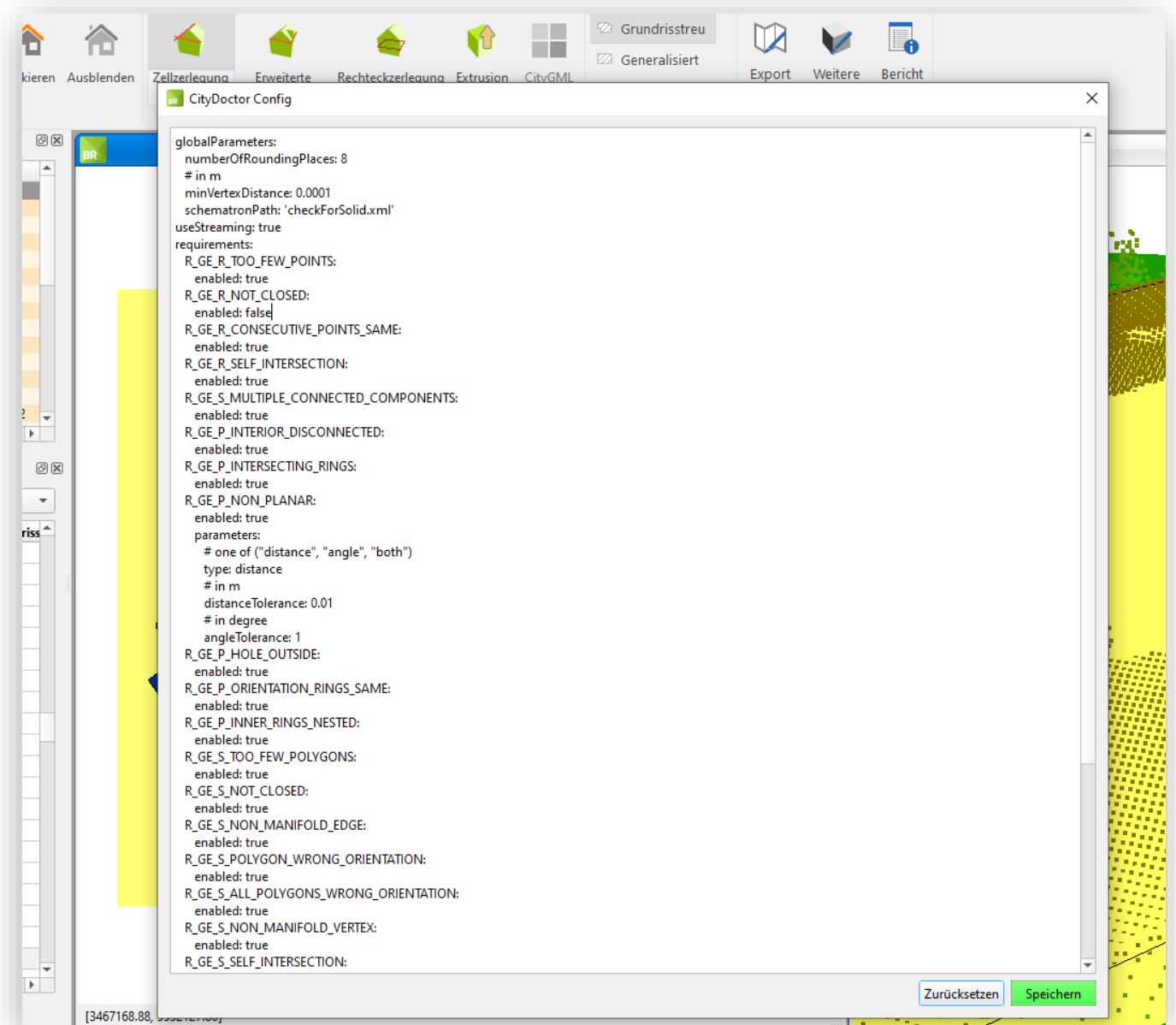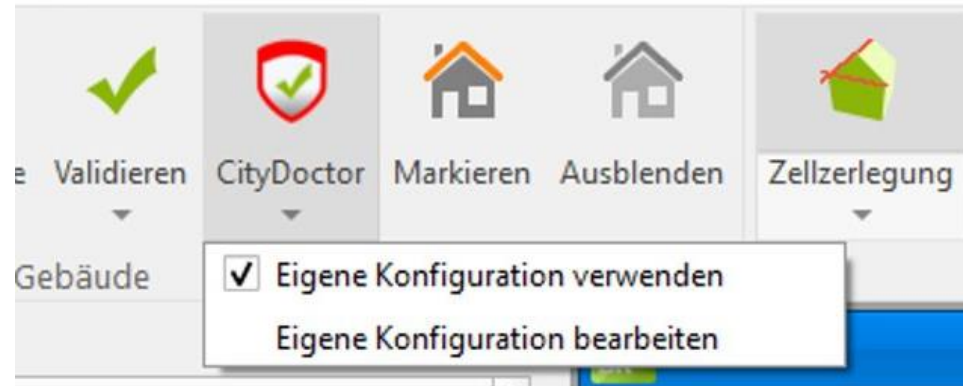- Shape File Attributes can be kept

Export options

- Building Model
  - CityGML 2.0
  - ESRI 3D-Shape

- Project report

- 2D building components

- Distance point map

CityDoctor

- Tool to perform quality checks

- Integrated in the latest version of BRec

BuildingReconstruction – Selected customers

- Federal Surveying Agencies
  - Bavaria
  - Schleswig-Holstein
  - Mecklenburg Western Pomerania
  - Free Hanseatic City of Bremen
  - Free Hanseatic City of Hamburg

- Cities
  - Frankfurt
  - Heilbronn
  - Karlsruhe
  - Ludwigsburg
  - Osnabrück
  - Freiburg
  - Baden-Baden
  - Rostock
  - Kaiserslautern

- International
  - Helsinki (Finland)
  - LSC Luxembourg (Luxemburg)
  - SDFI Danish Survey (Denmark)
  - Kristianstad (Sweden)
  - GEOPOZ Poznan (Poland)
  - IKT Linz (Austria)

- Companies
  - Geoinfo Applications AG (Switzerland)
  - Infoserve (Japan)
  - MGGP Aero (Poland)
  - Infosolutions (Poland)
  - AeroVant S.A. de C.V. (Mexico)
  - Trigonos (Austria)

Conclusions

- **BuildingReconstruction** is an efficient tool to generate LoD2 building models from building footprints, a digital surface model and a digital terrain model

- It is optimized to work with DSM resolution of 0.5 meters

- It doesn't provide any CityGML editing functions and no texturing

- It is in use by customers worldwide, but core user group is in Germany

- More than 20 million LoD2 models reconstructed

Thank you
for your attention

Questions or remarks?

www.**vc.systems**