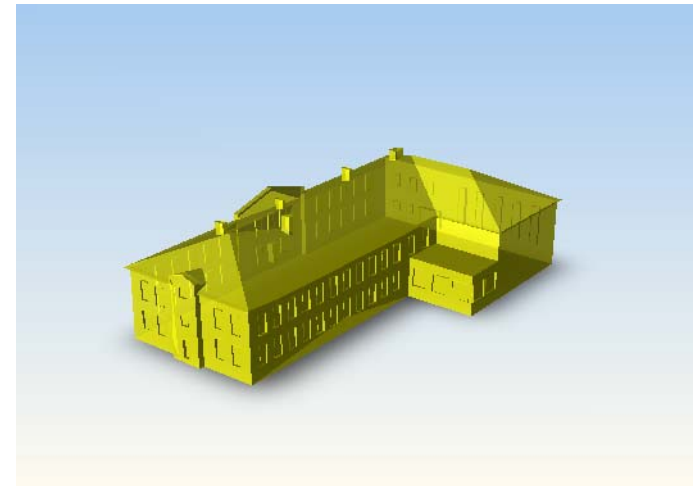
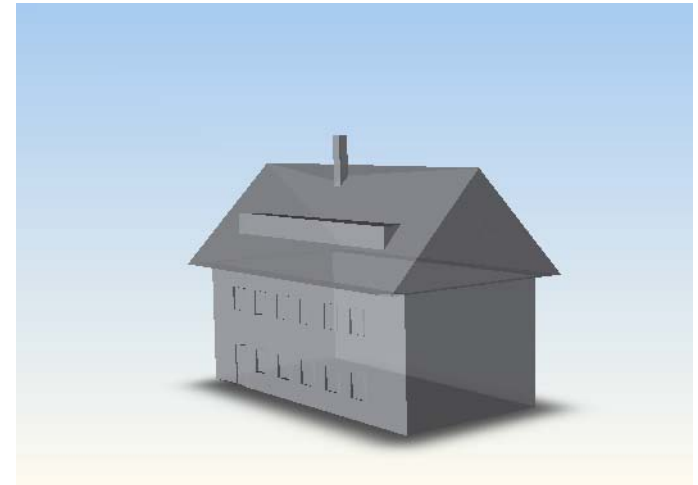


Interpretation of Building Parts from Boundary Representation

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Motivation

- ▶ Simple 3D building models
 - Only geometry
 - Without any explicit semantic information
- ▶ Extract implicit semantic information
 - Architectural elements: windows, doors, balconies, chimneys, dormers, bays ...
- ▶ Useful for
 - Automatic texturing
 - Automatic labelling
 - Automatic generalisation

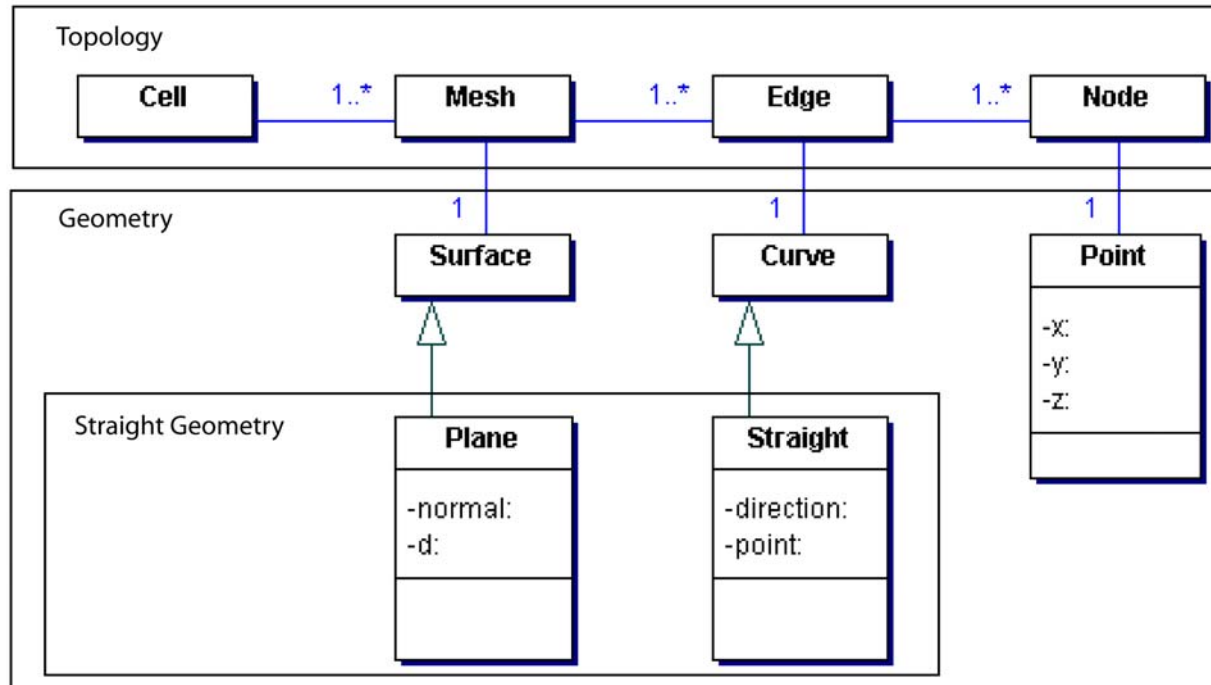


Overview

- ▶ Input Data
- ▶ Segmentation
- ▶ Interpretation
 - Building Parts
 - Attributes
 - Our Model
 - First Implementation
- ▶ Problems & Outlook

Input Data

► Buildings in Boundary Representation

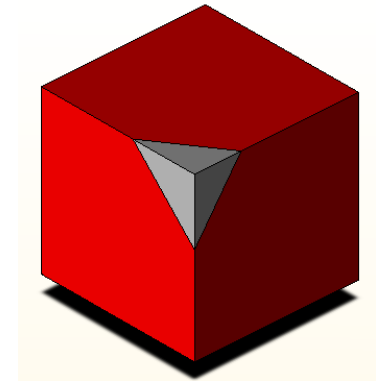
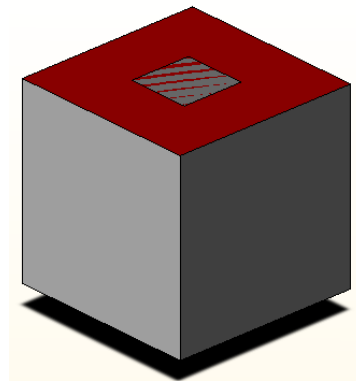
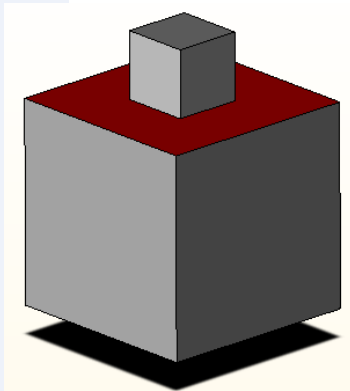
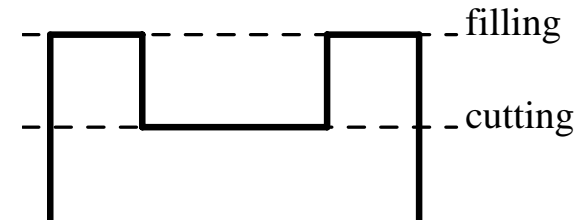


- Only straight or planar geometry
- Only “real edges” = adjacent faces are not co-planar
- Only “real vertices” = adjacent edges are not co-linear

Segmentation - Approach

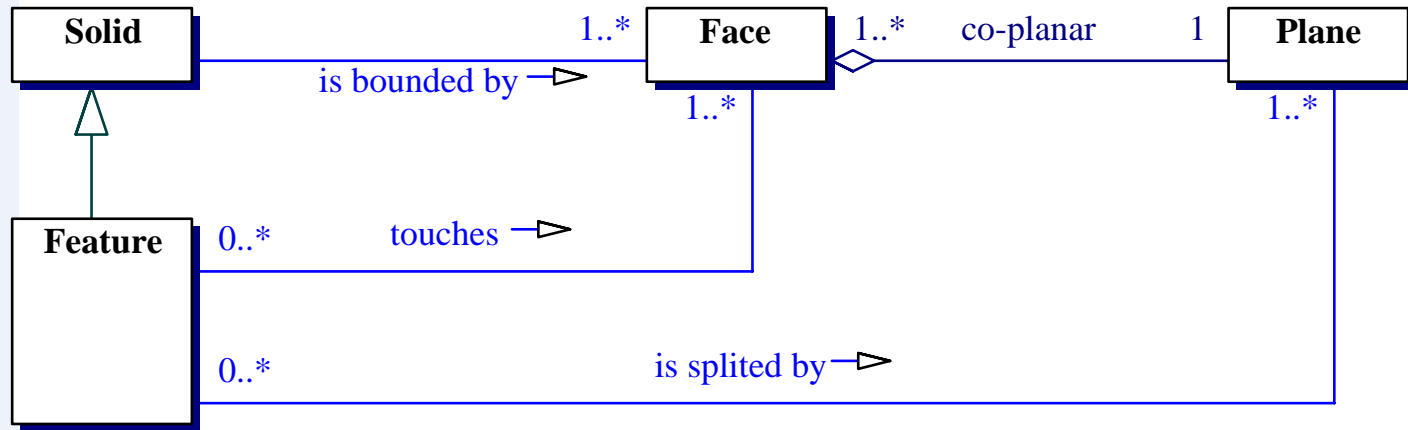
- ▶ “Finding and Removing Features from Polyhedra”
(Ribelles et al.)

- ▶ Features are parts that
 - Stick out
 - Form holes
 - Can be added to fill a cut edge



Segmentation

► Features:



► Result:

- A set of features in a CSG tree

Interpretation

- ▶ Need a model for the for interpretation
- ▶ Rule based → rules

Building parts / architectural elements

► Different features, with different styles



Interpretation - Attributes

- ▶ Useful attributes for classification
 - Material or colour
 - Size and form
 - Position (height, distance)
 - Direction (upwards, downwards, side-wards, horizontal, vertical, sloped)
 - Topologic relation (in front of, behind, inside, touches, outside)
 - Connectivity
 - Included parts
 - Manoeuvrability (can be opened)

Interpretation - Attributes

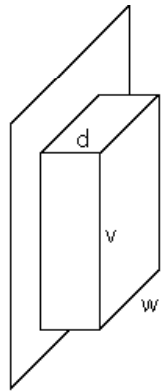
- ▶ Useful attributes for classification
 - Material or colour
 - Size and form
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 - Direction (upwards, downwards, side-wards, horizontal, vertical, sloped)
 - Topologic relation (in front of, behind, inside, touches, outside)
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Interpretation - Attributes

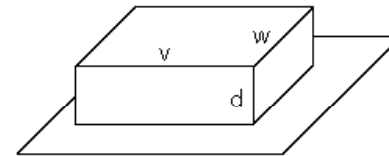
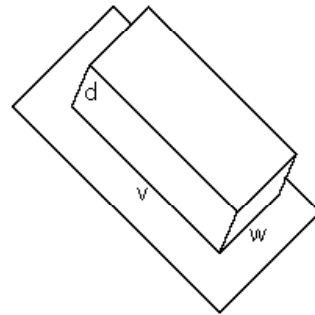
- ▶ Attributes, which can be easily calculated from input data
 - Inclination of faces
 - Behind or in front of the façade / roof
 - Height over ground
 - Parallel to the split plane or vertical
- ▶ Additional attributes
 - The area of a face or of all faces in a plane
 - The number of faces in the plane
 - The minimum enclosing rectangle of the face or of all faces in the plane

Interpretation - Plane Based Coordinate System

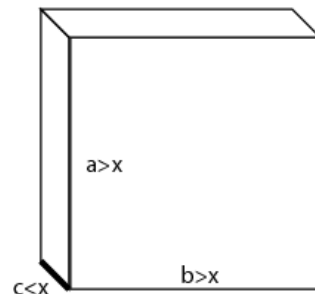
Special measures for easier describing



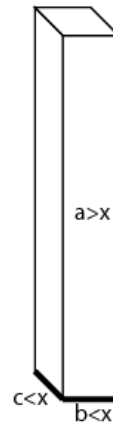
$dz = v$



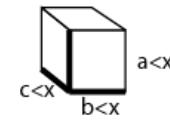
$dz = d$



quasi 2D



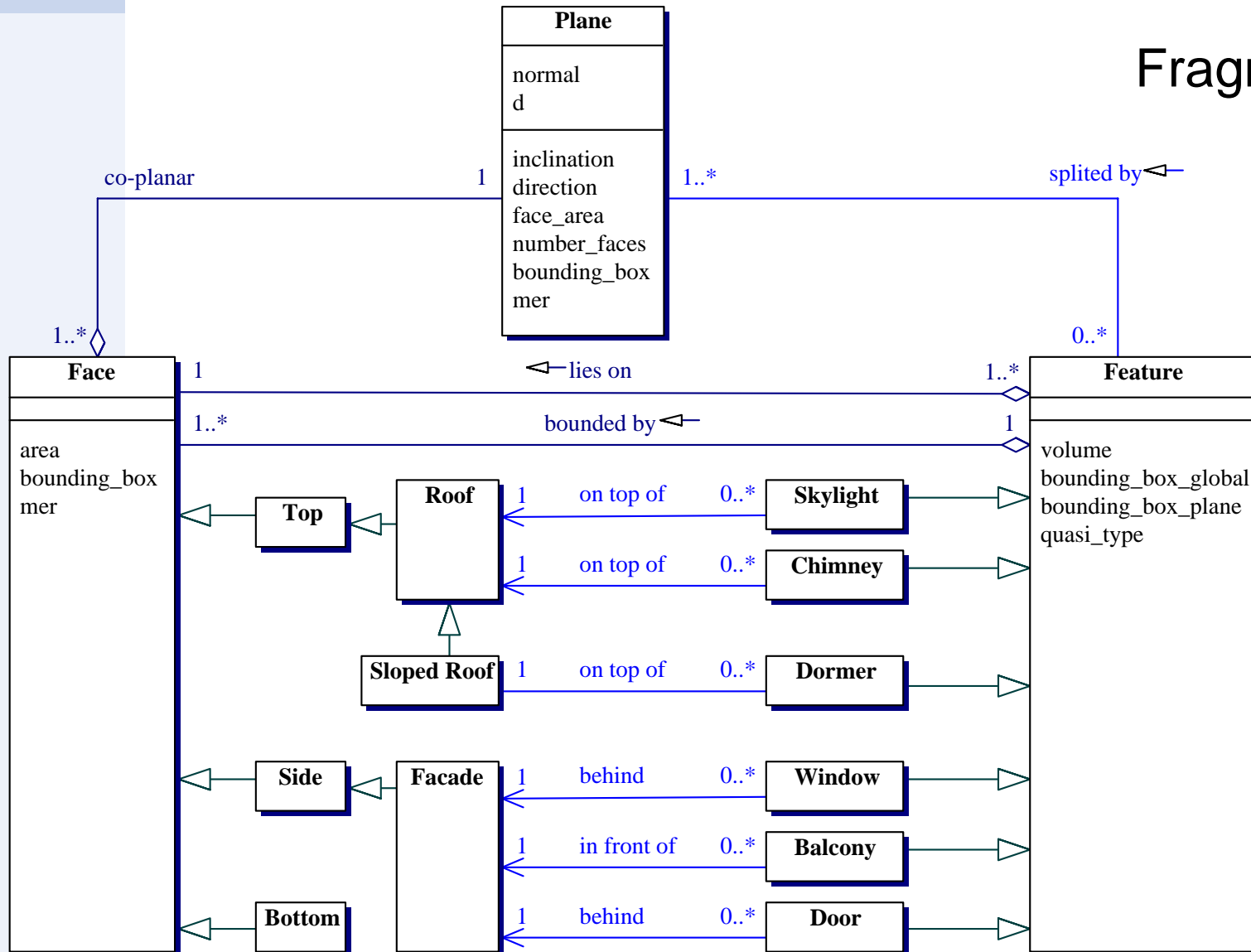
quasi 1D



quasi 0D

Interpretation - Our Model of a Building

Fragment!

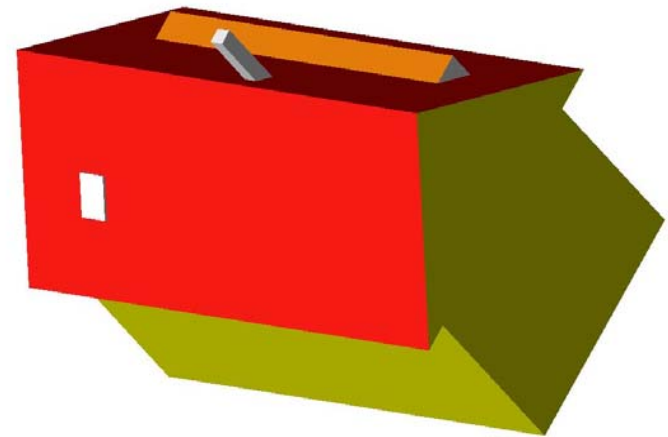
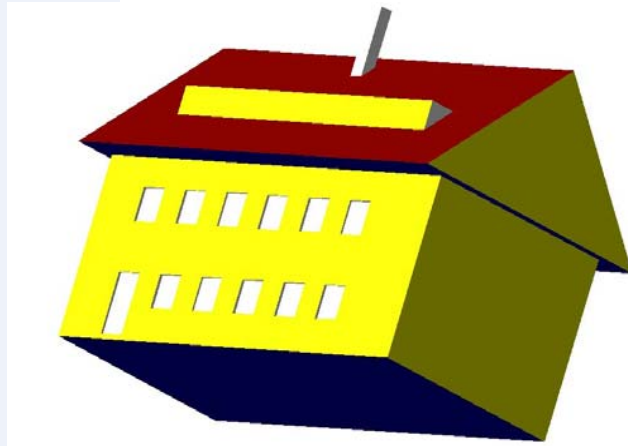


Interpretation - Rules

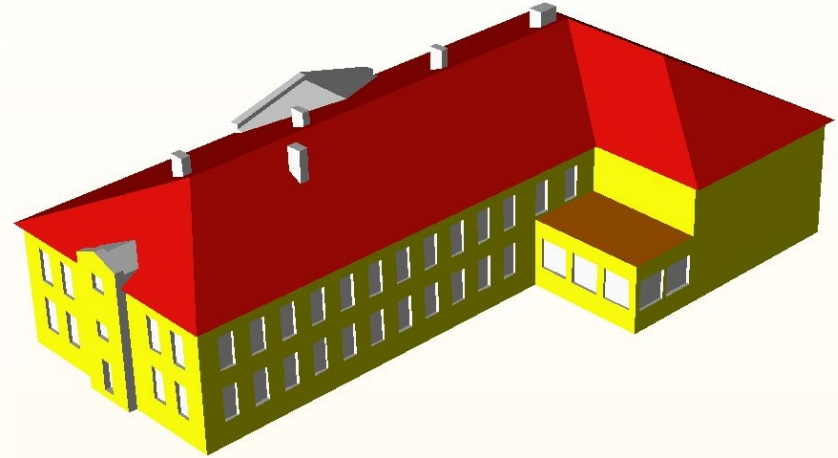
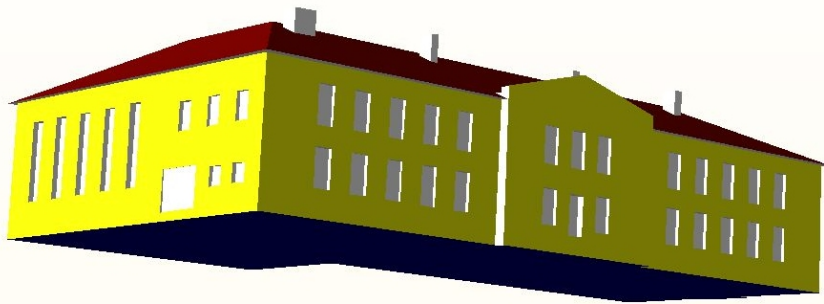
► Some Examples

Feature	Face	Face relation	Height relation	Size limits [m]	Features
dormer	roof	in front		$dz > 0.5$ $b > 1$	windows doors
skylight	roof	parallel in front		$d < 0.2$	none
chimney	roof	in front			none
window	façade	parallel behind	over ground	$d < 0.5$ $dz < dz_{\text{floor}}$	none

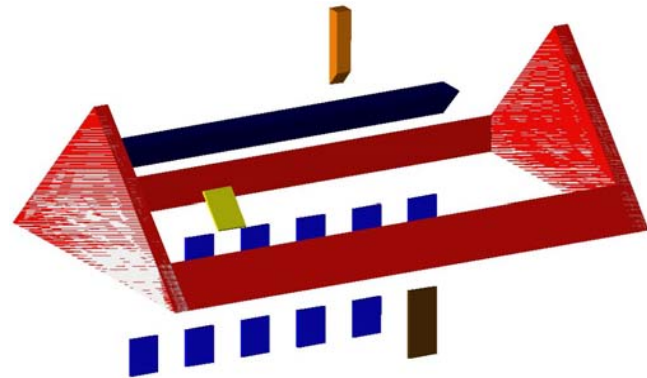
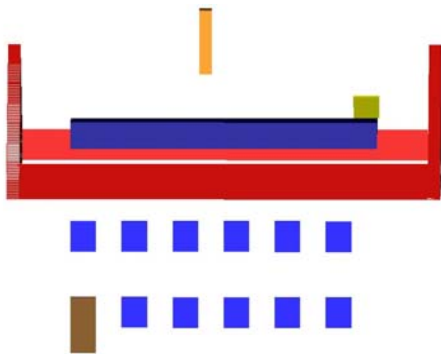
Results – Classification of faces I












Results – Classification of faces II

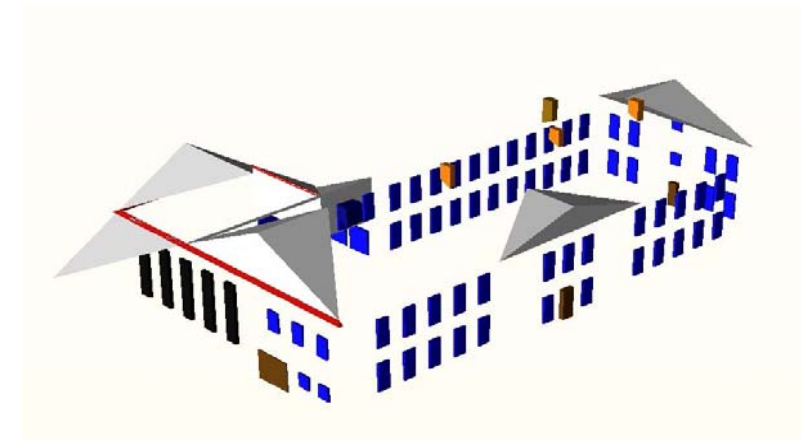
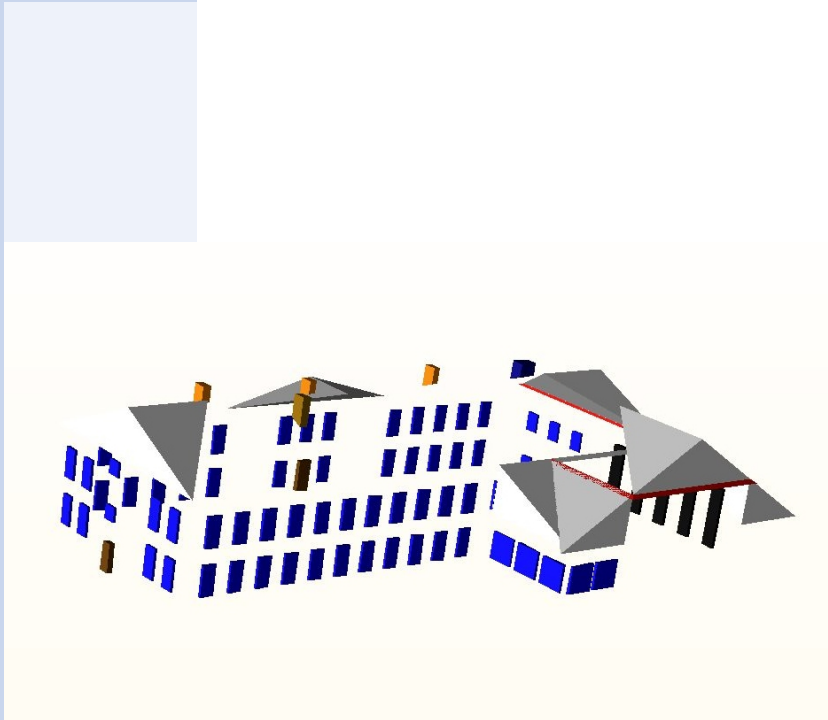











Results – Classification of features I



window		roof projection		chimney	
door		protrusion		skylight	
set-off		gap		dormer	

Results – Classification of features II



window		roof projection		chimney	
door		protrusion		skylight	
set-off		gap		dormer	

Discussion & Outlook

► Problems

■ Segmentation

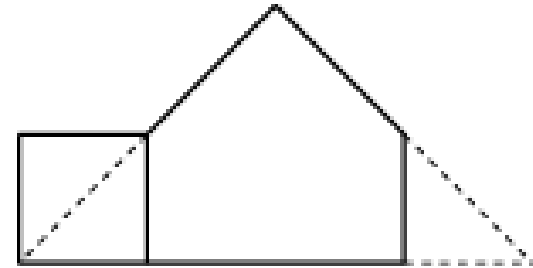
- High complexity
- Artefacts
- Wrong feature splits

■ Interpretation

- Need more and better rules
 - > interpret also edges, vertices
 - > extract facade height, room height

► Next Steps

- Improve the segmentation
- Integrate the segmentation and interpretation



END

- ▶ Thank you for your attention!