

Building information models

GEO1004:
3D modelling of the built environment

<https://3d.bk.tudelft.nl/courses/geo1004>



3D geoinformation

Department of Urbanism
Faculty of Architecture and the Built Environment
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What is BIM?

- a methodology (not just 3D models)
- ...to create and use detailed 3D models (in both geometry and semantics)
- ...of buildings or infrastructure projects
- ...for design and construction (and more).

BIM

geo (3D city models)

origins

architecture, CAD

cartography, maps

scale

one construction site

large regions

made

manually as a design

processed sensed data

detail (geom/semantics)

very detailed

less detailed

models

volumetric built elements

visible semantic surfaces

up to date

as designed, maybe as built

based on input data

focus

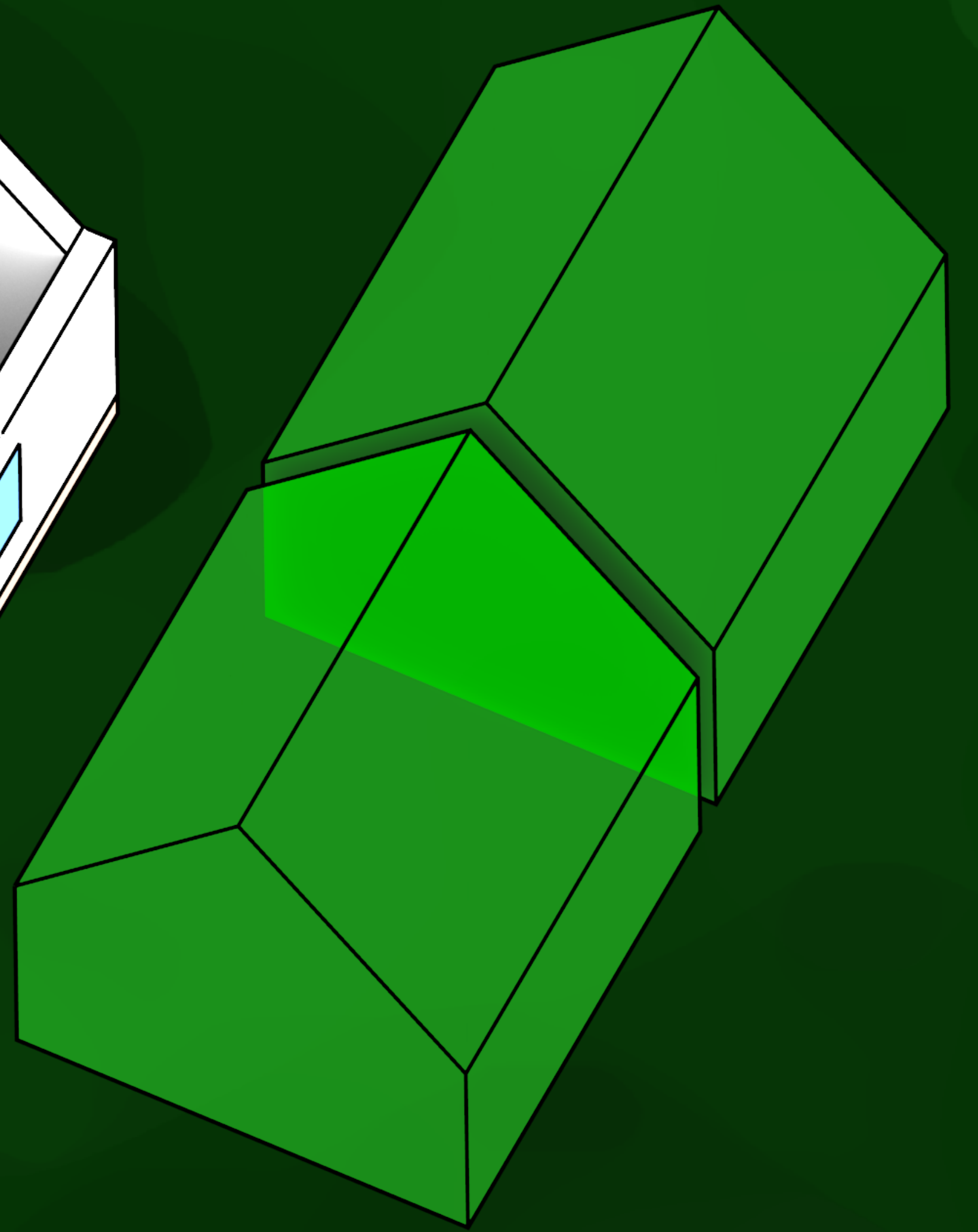
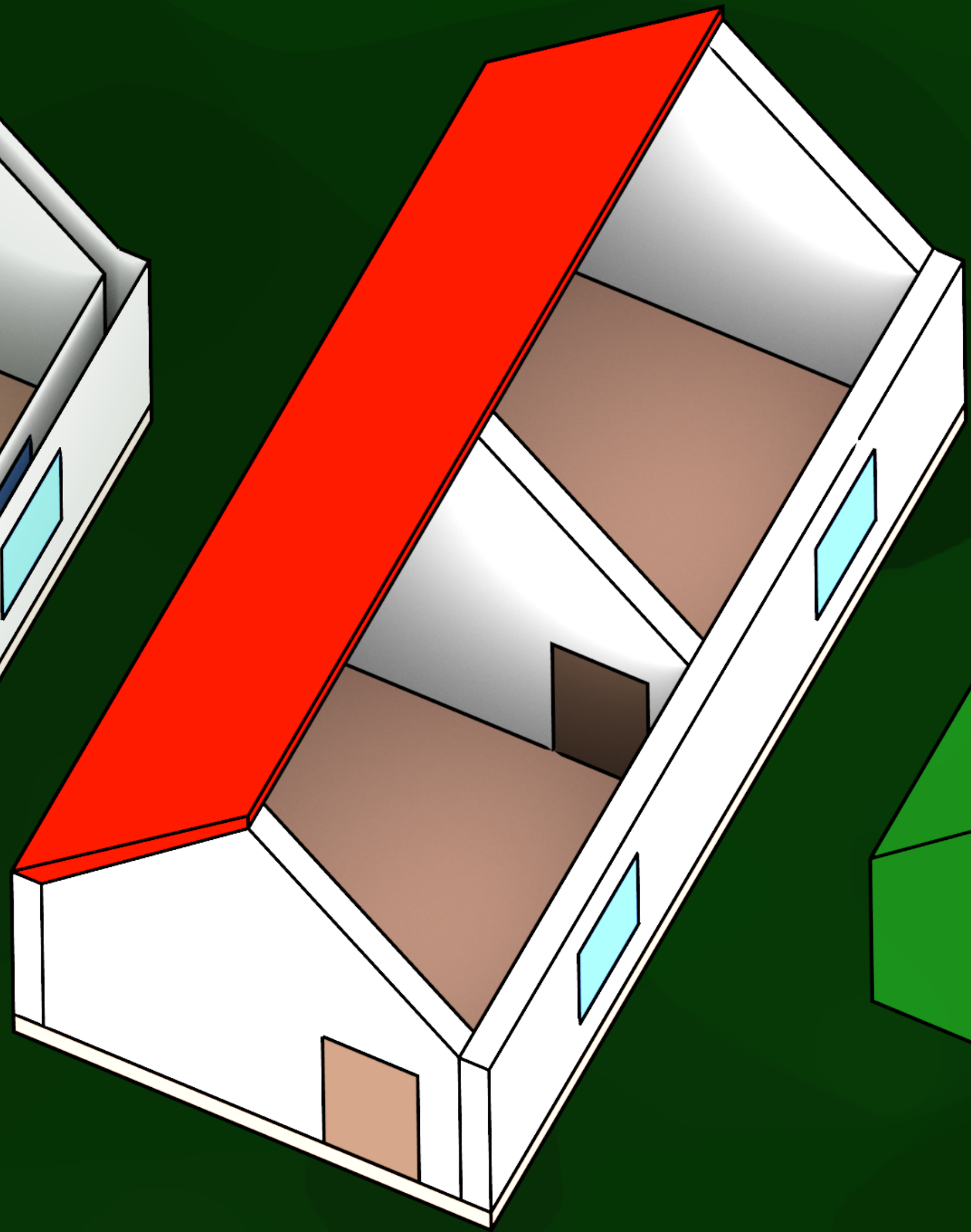
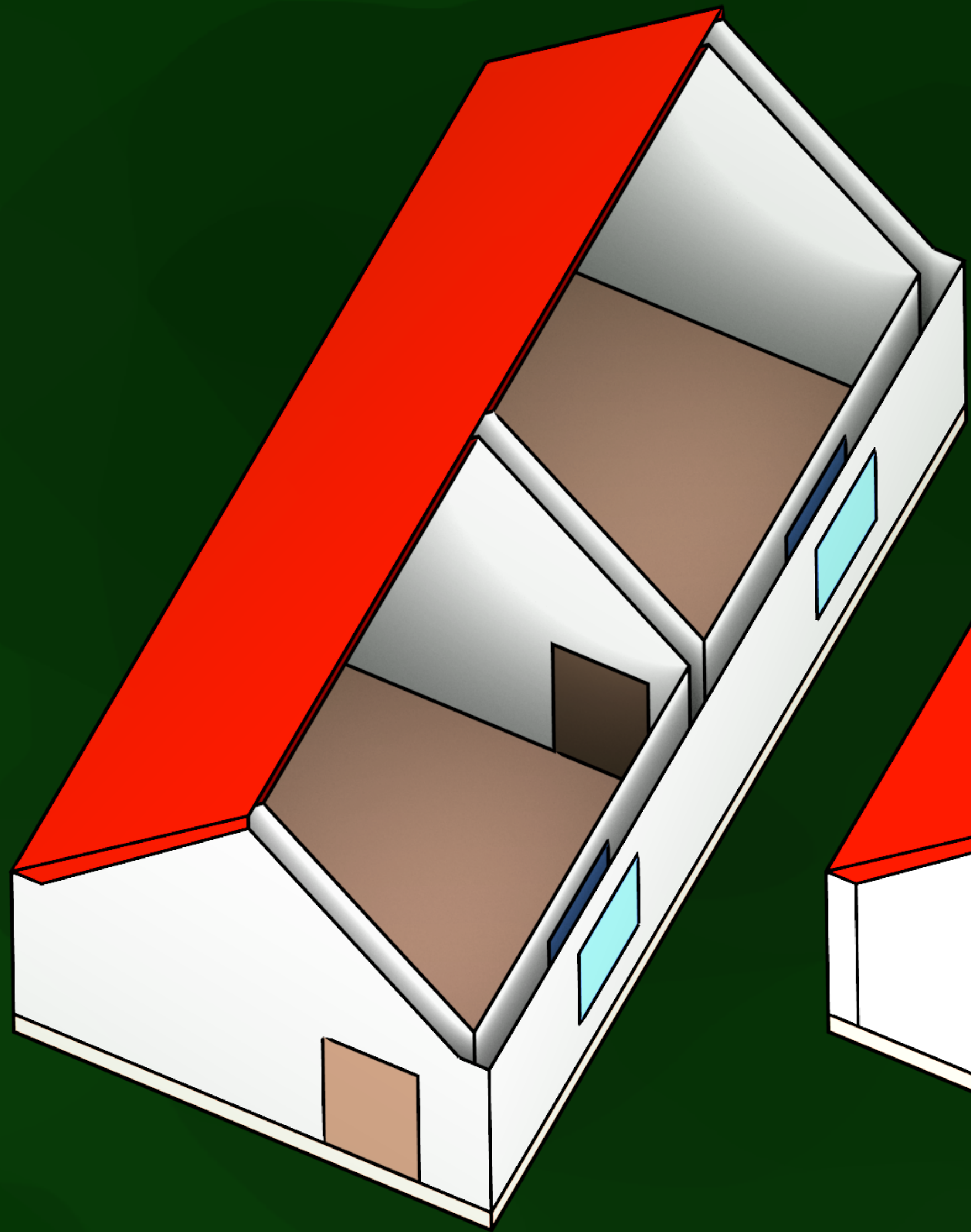
buildings and infrastructure

everything but mainly cities

strengths

design and construction

spatial analyses



BIM in practice

- Closed software + platforms: organisations using internally the same software/platform and its formats, e.g. Autodesk Revit, ArchiCAD, Trimble Connect, Allplan, etc.
- Open standards + software: different organisations exchanging IFC files, using BIMserver, processing with IfcOpenShell, etc.

IFC

- open standard by the buildingSMART Consortium
- large standard (130 defined types, 217 enumeration types, 60 select types, 816 entities, 47 functions, 2 rules, 415 property sets, 93 quantity sets and 1697 individual properties in IFC 4.2)
- defined using EXPRESS data modelling language
- two encodings: STEP (almost always) and XML (rarely)

IFC

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#367=IFCDIRECTION((0.,0.,1.));
#369=IFCCARTESIANPOINT((0.,0.,0.));
#371=IFCAXIS2PLACEMENT3D(#369,#367,#365);
#372=IFCDIRECTION((0.766044443119,0.642787609687));
#374=IFCGEOMETRICREPRESENTATIONCONTEXT($,'Plan',3,1.000000000000E-5,#371,#372);
#375=IFCGEOMETRICREPRESENTATIONSUBCONTEXT('Box','Plan',*,*,*,*,#374,$,.PLAN_VIEW.,$);
#377=IFCCARTESIANPOINT((-3.,-3.,-1.));
#379=IFCBOUNDINGBOX(#377,18.,16.,1.);
#380=IFCSHAPEREPRESENTATION(#375,'Box','BoundingBox',(#379));
#383=IFCPRODUCTDEFINITIONSHAPE($,$,(#355,#380));
#389=IFCSITE('0KMpiAlnb52RgQuM1CwVfd',#12,'Gelaende','Ebenes Gelaende','LandUse',...
#400=IFCRELAGGREGATES('1G086xgv8B470LzUwG9dnQ',#12,$,$,#66,(#389));
#406=IFCPROPERTYINGLEVALUE('BuildingHeightLimit',$,IFCPOSITIVELENGTHMEASURE(9.),$);
#407=IFCPROPERTYINGLEVALUE('GrossAreaPlanned',$,IFCAREAMEASURE(0.),$);
#408=IFCPROPERTYSET('1pzemvk20um3F9bx64I1e9',#12,'Pset_SiteCommon',$,(#406,#407));
#412=IFCRELDEFINESBYPROPERTIES('2w5hE3w6ce8Clm81uDvALx',#12,$,$,(#389),#408);
#416=IFCQUANTITYLENGTH('GrossPerimeter',$,$,0.,$);
#419=IFCQUANTITYAREA('GrossArea',$,$,0.,$);
```

IFC

- among others, models:
 - actors (people, organisations)
 - controls (specifications, regulations, schedules and other requirements)
 - processes (actions during construction)
 - products (physical building elements and other spatially defined objects)
 - project (where it is placed)
 - resources (cost, materials and equipment)

IFC

- geometry types:
 - primitive instancing, e.g. parametric 2D profiles
 - extrusions / sweeps
 - boundary representation
 - CSG with other types and half-spaces

details in the book...

BIM example

Homework 3

Next week

- Application lessons, not covered in exam
- Usual format: 1h lecture + 1h questions/help with assignments
- Monday: 3D representations in machine learning
- Wednesday: applications of 3D modelling through Geomatics theses
- Thursday: help session with Dimitris (also weeks 8 and 9)

About the final exam

- April 15 9:00-11:00
- Same format as midterm: open book, open computer, no phone, no communicating with others
- 12 open questions for Lessons 1.1 - 6.2
- Marking: evening of same day
- Questions? Come to my office (BG.West.550) or ask on Discord on April 16

What to do next?

1. Today:

- Continue with Homework 2 (generalisation of a 3D city model)
- Go to [geo1004](#) website and study today's lesson (3D book Chapter 11)
- Start with Homework 3 (BIM to Geo conversion using voxels)

2. Thursday: help session with me

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