ISES

Intelligent Services for Energy-Efficient Design and Life Cycle Simulation

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ISES VEL

Enabling open energy-efficient building design and simulation

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Cracow, Poland, Oct 24-26 2016
CGW Workshop 2016

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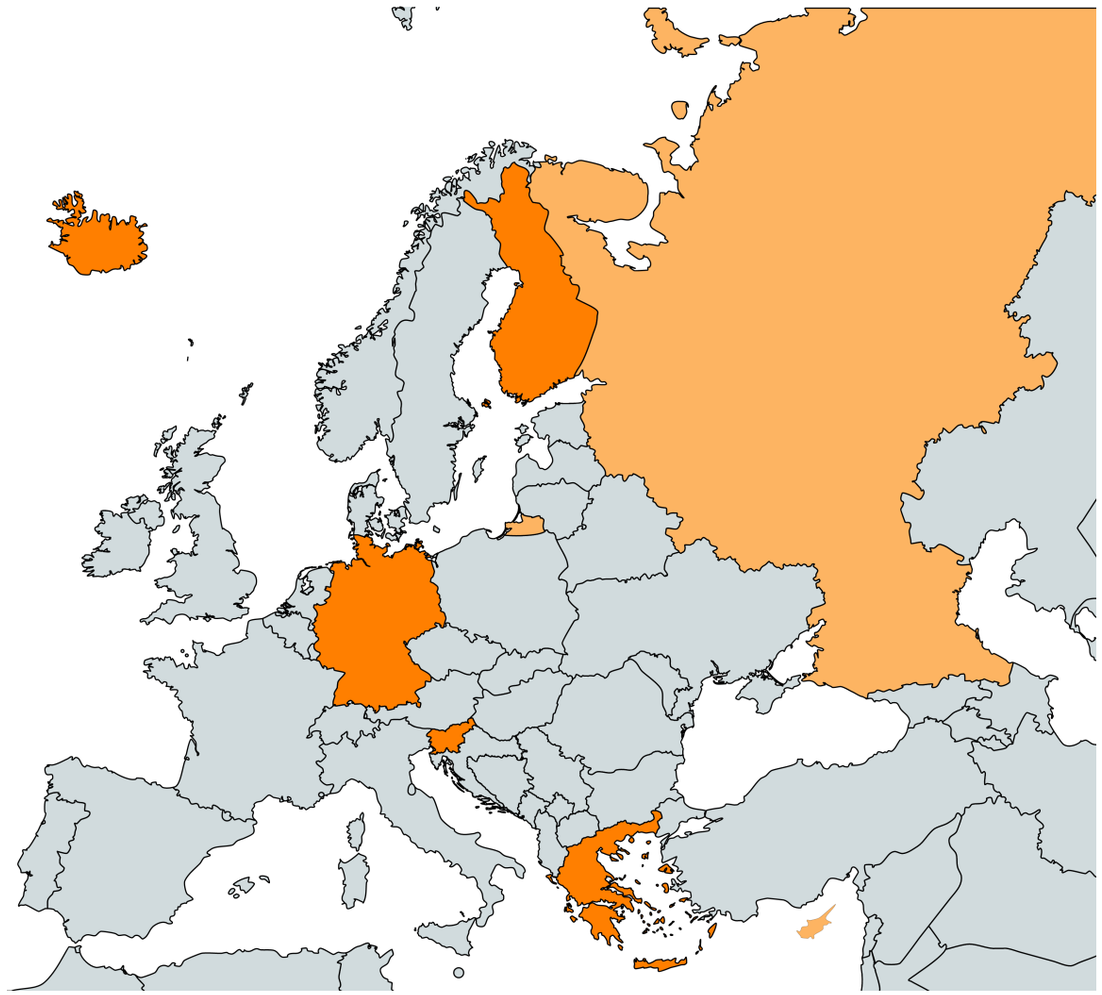
ISES in numbers



- Funded: 7th Framework Programme
- Area: ICT Systems for Energy Efficiency (ICT-2011.6.2)
- Duration: 36 months (12/2011 - 11/2014)
- Cost: 4.41 M EUR (EU contribution 2.96 M EUR)
- Partners: 8 + 2
  - 3 Industry organisations
  - 1 Software vendor
  - 2 + 1 Research organisations
  - 2 + 1 Universities

Leonhardt, Andrä und Partner, Germany Granlund Oy, Finland Technische Universität Dresden, Germany

SOFiSTiK Hellas S.A., Greece Nyskopunarmidstod Islands, Iceland University of Ljubljana, Slovenia University of Cyprus, Cyprus

Trimo d.d., Slovenia National Observatory of Athens, Group Energy Conversation, Greece Russian Academy of Sciences, Russia

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What is ISES

ISES is not a new energy tool

It is about **a new way** of **energy-aware design** work **using BIM**

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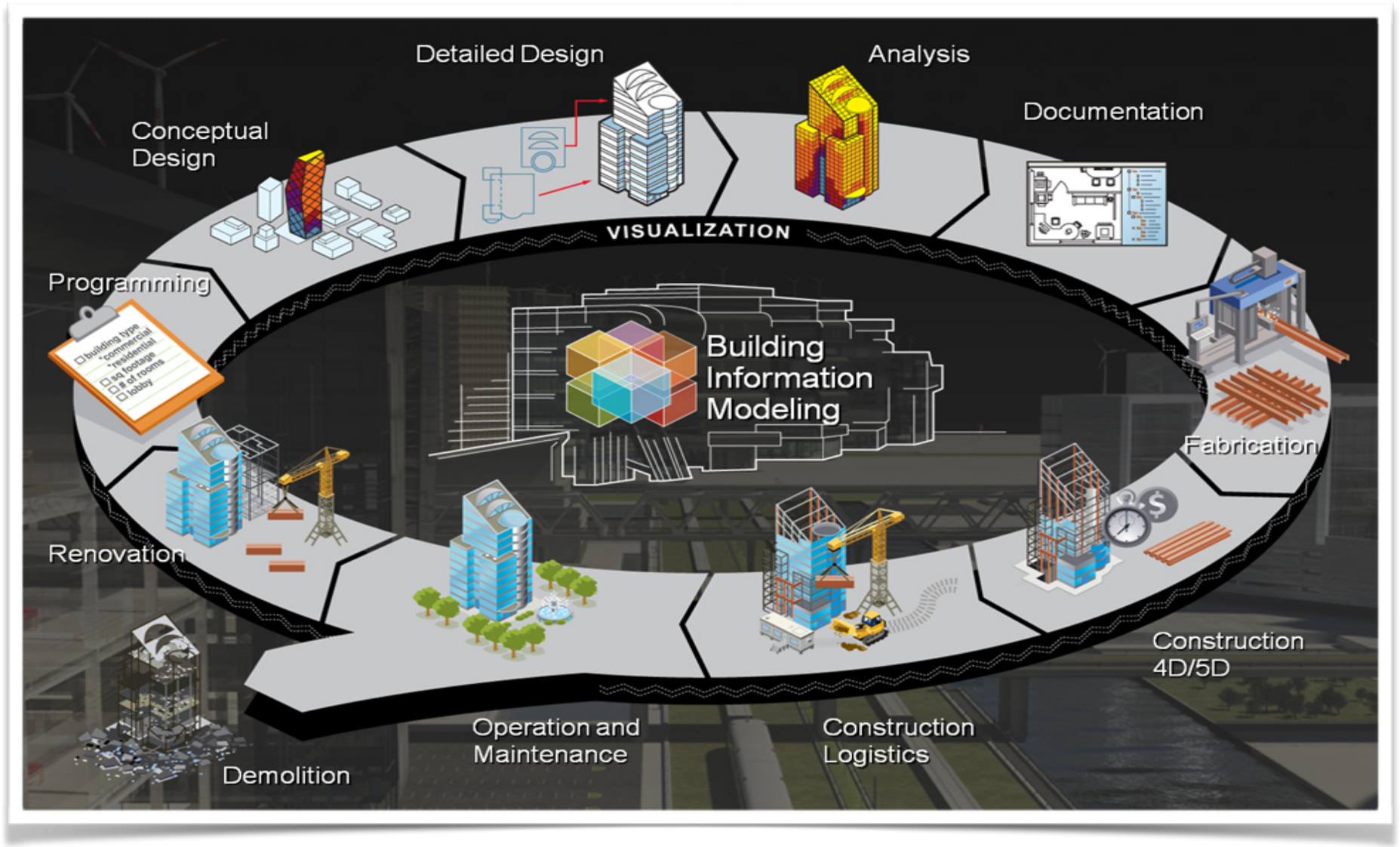
BIM based integration



- Vision of Interoperability in AEC/FM based on BIM

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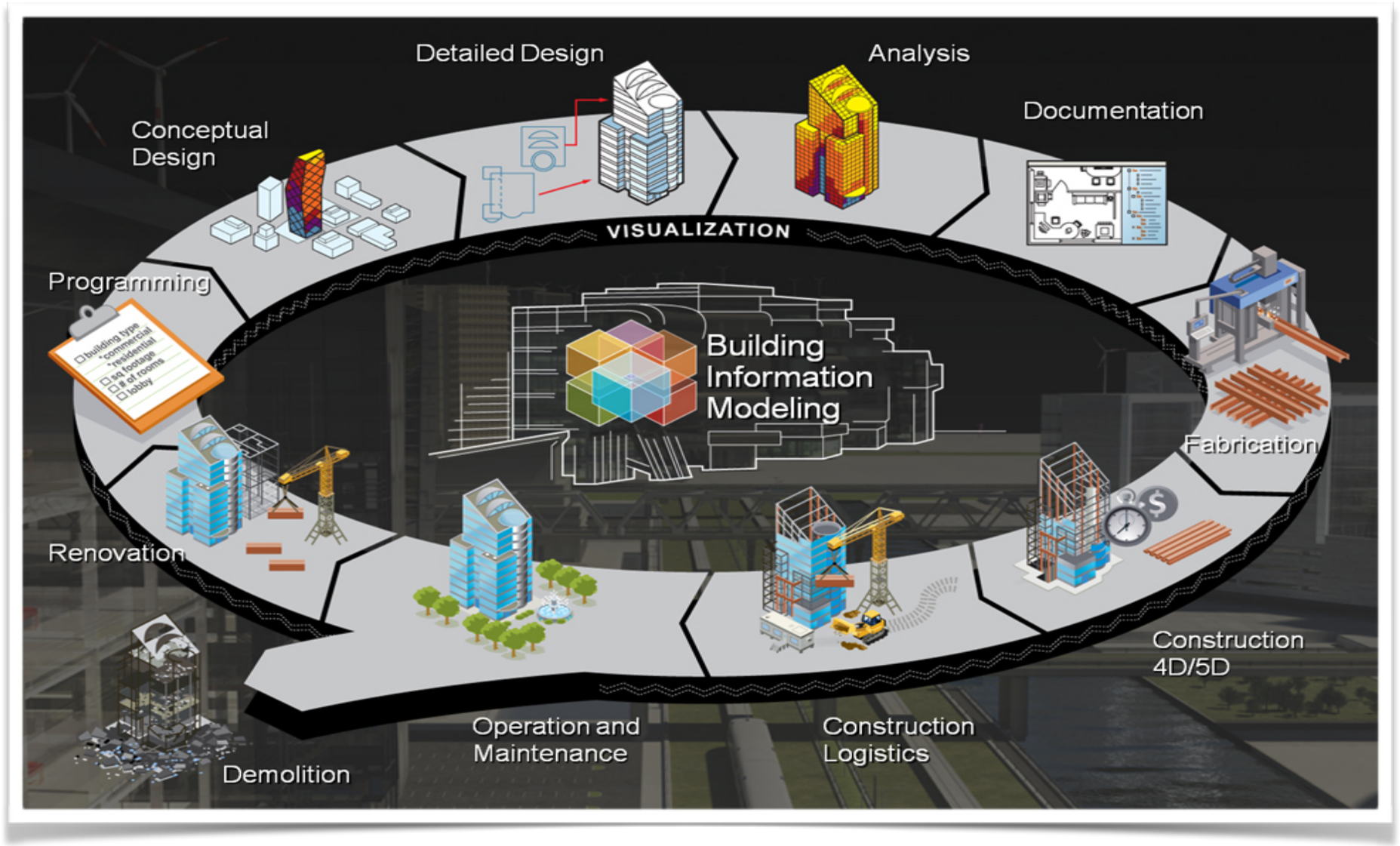
BIM based integration



- Challenge: Application interoperability within a domain

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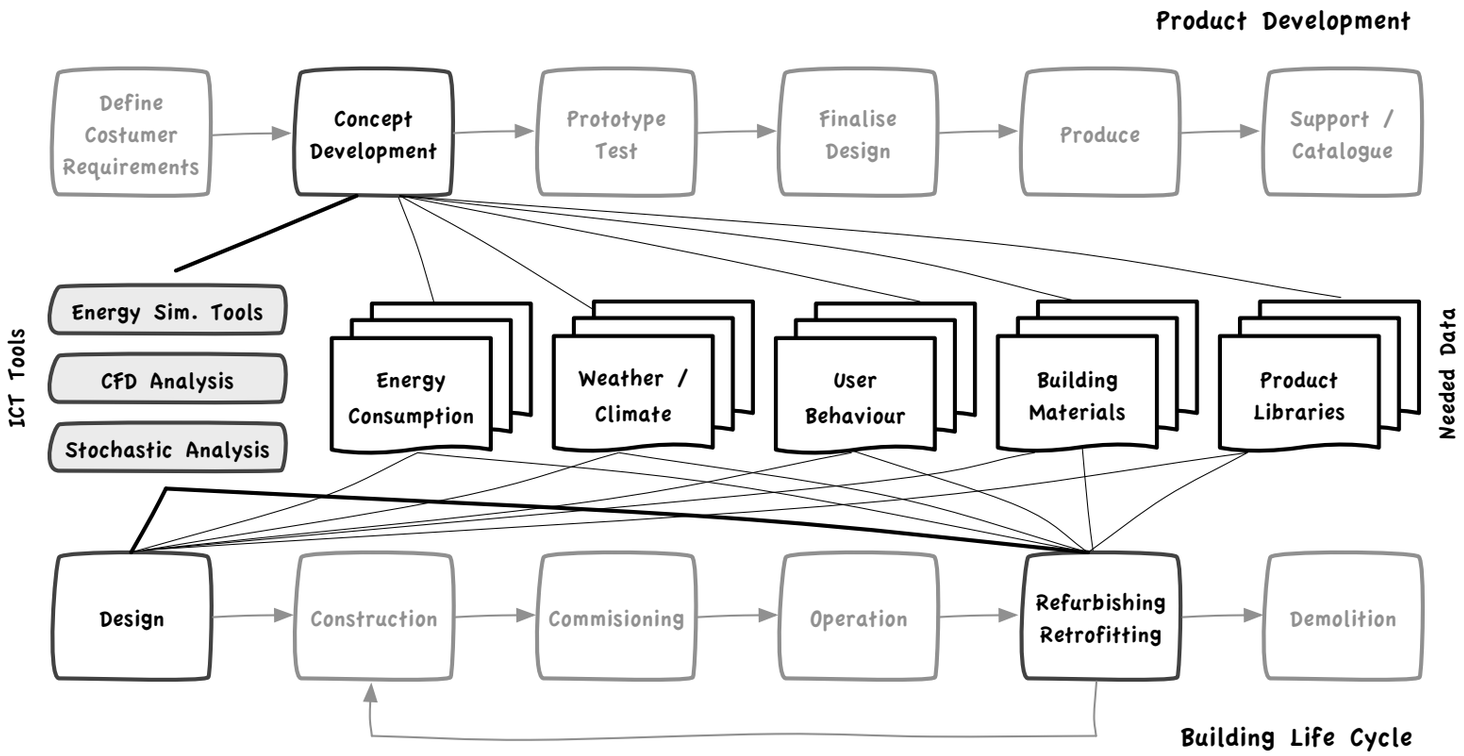
Drill down into the design process

- Three focused scenarios:
  - Early and detailed design of new buildings, incl. stochastic considerations
  - Refurbishment / retrofitting of existing facilities
  - Conceptual product development



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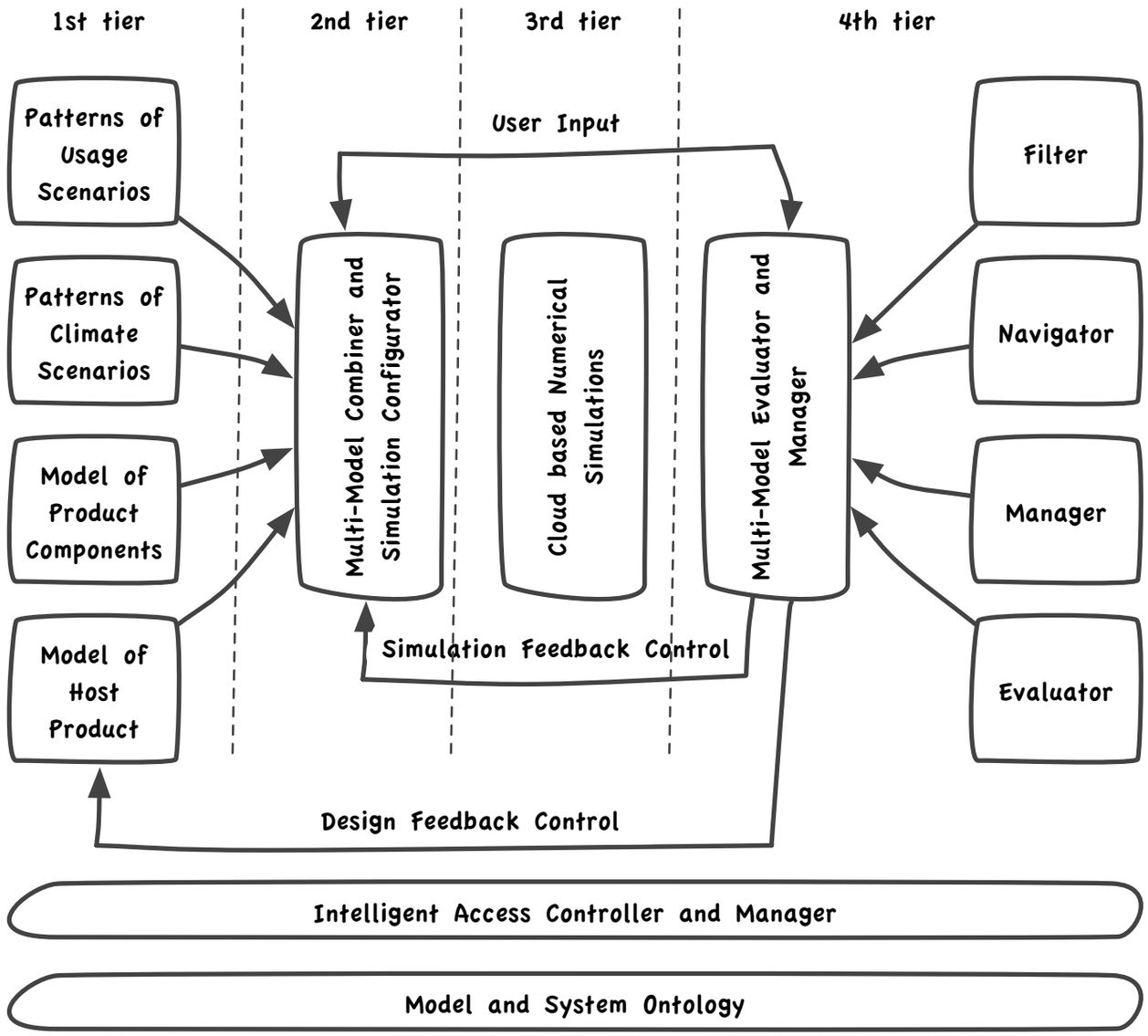
ISES VEL functionality



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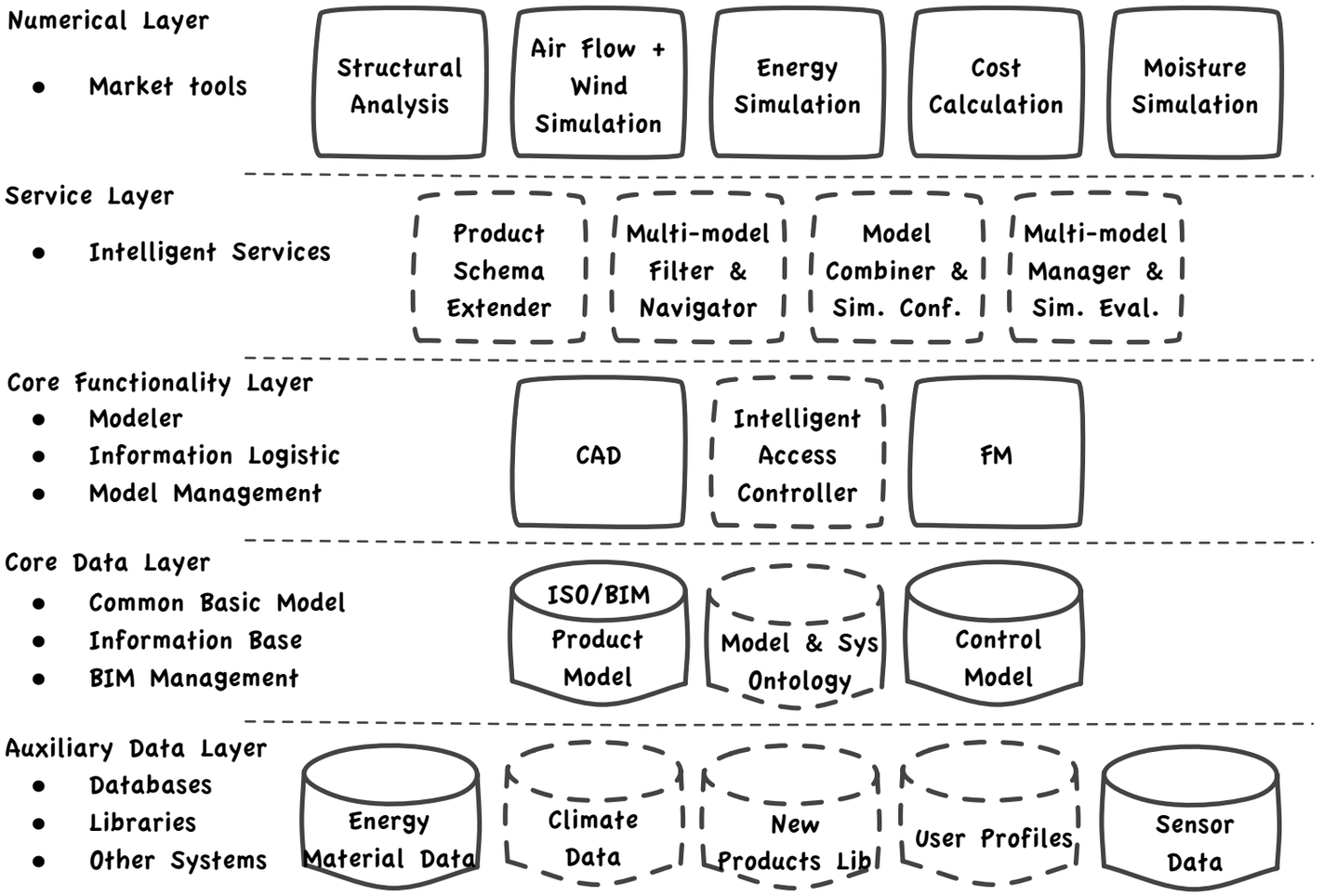
ISES VEL architecture



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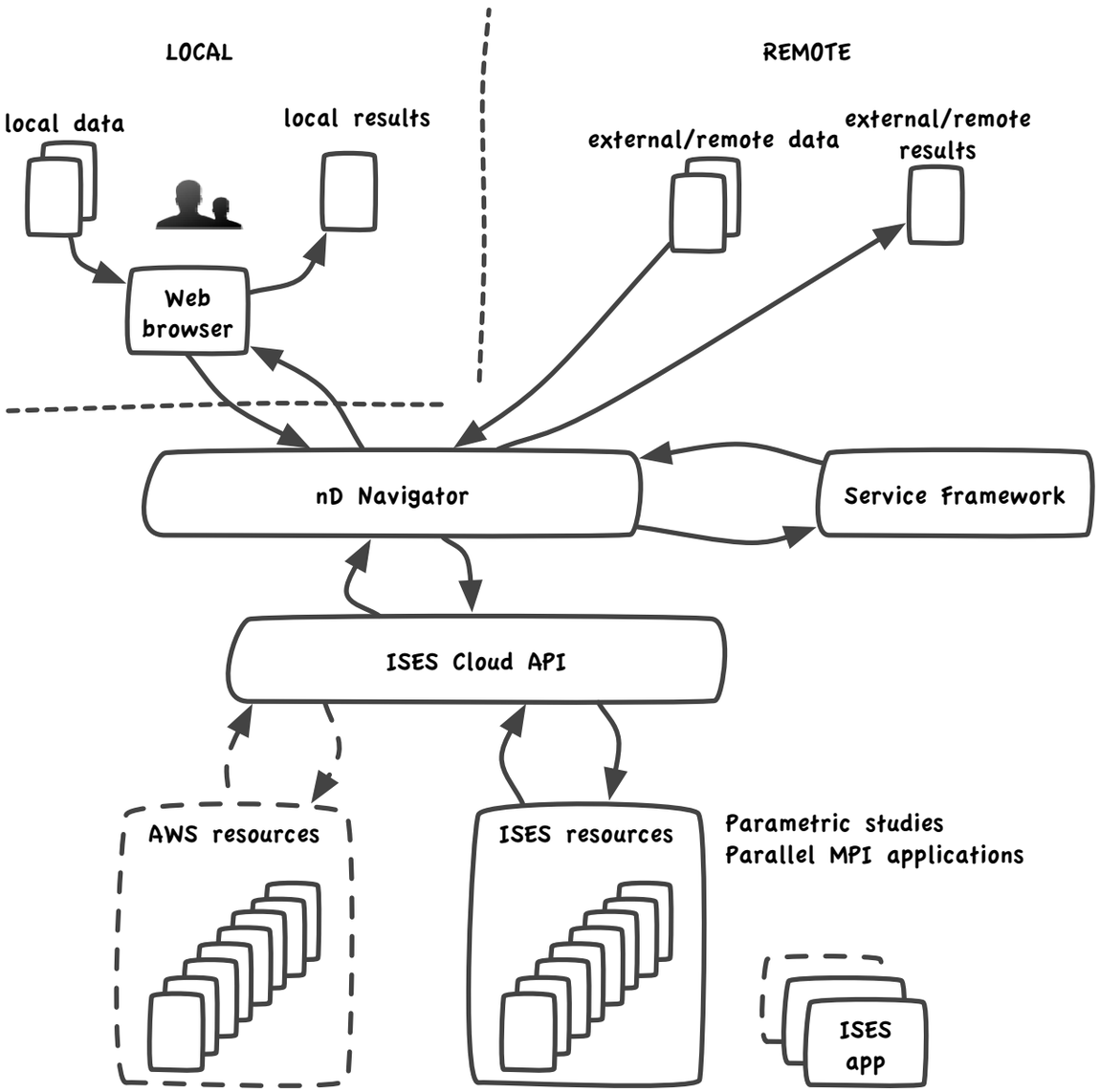
ISES VEL cloud architecture and testbed



Hardware specs

- IntelR XeonR Processor (2.26 GHz), 8/16 GB RAM
- 152 CPU cores
- Fiber-Channel disk array – 5 TB

Software

- Ubuntu Server 14.04 LTS
- OpenStack cloud infrastructure, HTCondor, MPI enabled
- General purpose software: MATLAB, BLAS, LINPACK, …
- ISES specific applications

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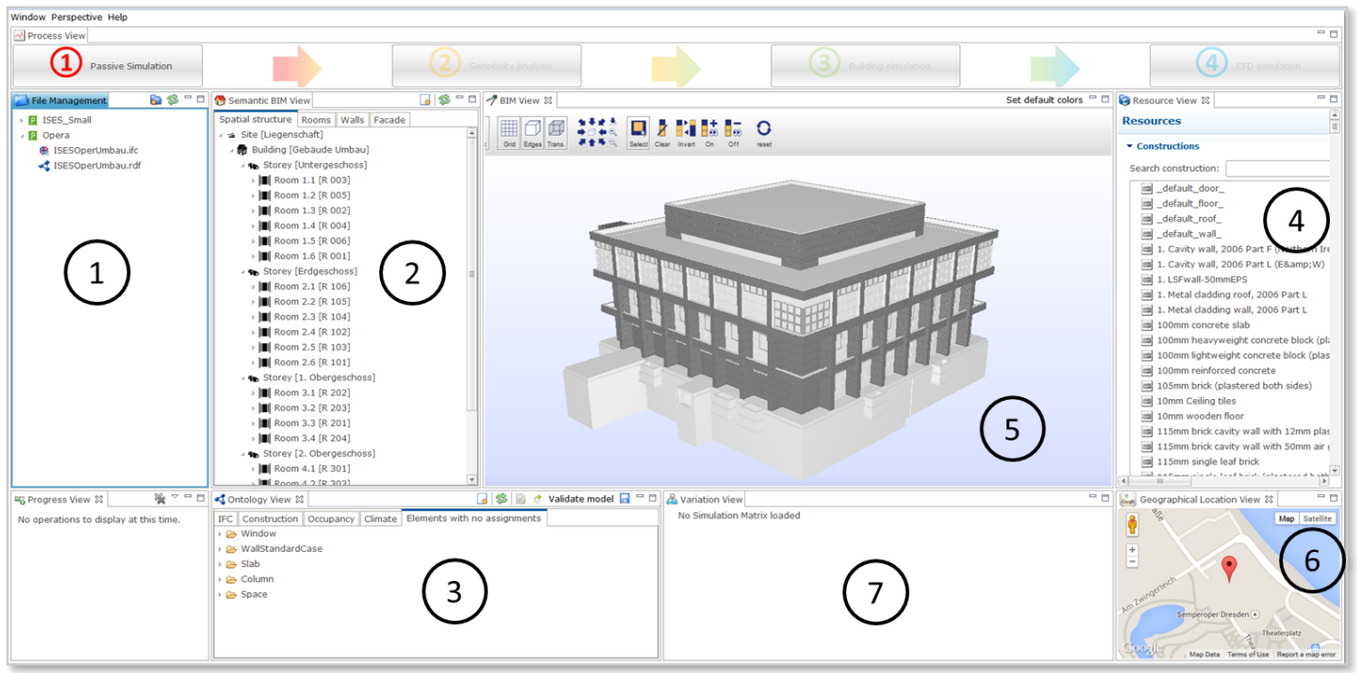
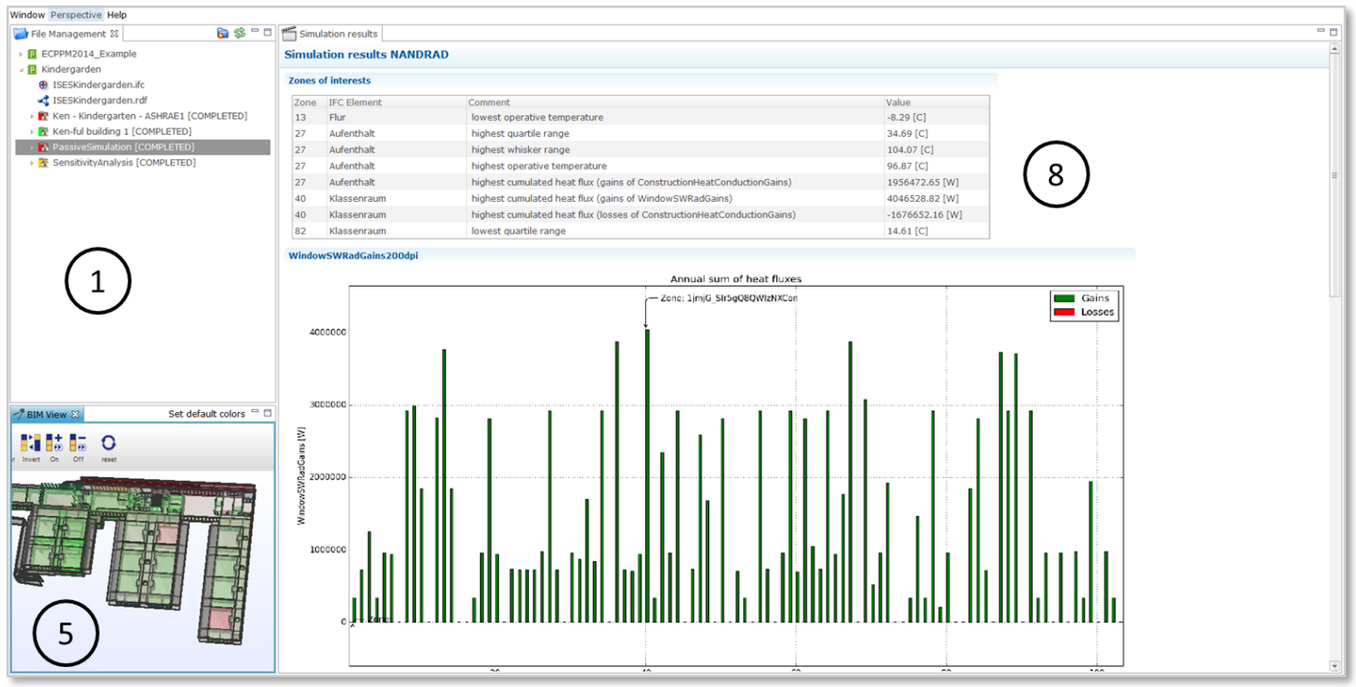
nD Navigator





1. project tree to create, download and manage VEL BIM and simulation projects
2. semantic query and model explorer to show the building spatial structure, the used product components, such as pre-fabricated facade elements, etc.
3. ontology view to show and validate current resource assignments
4. resource view to show linked external resources like pre-defined element constructions, occupancy schedules or climate reference years
5. 3D viewer to visualise the building and provide user interaction functions like selects, filters and results of simulations, e.g. for identified critical rooms and elements
6. geographical maps to show the building location
7. variation view for sensitivity analysis tasks
8. decision support tool

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Demo projects

New building	
Type of building	Kindergarten
Location	Trebnje, Slovenia
Construction period	2010 - 2011
Gross floor area	3,050m²
Gross volume	12,200 m³
Rooms	103
Typical usage	Playrooms, administration offices
Facade	Curtain wall, insulation panels
HVAC	Biomass heating; compressor cooling; mechanical ventilation with heat recovery

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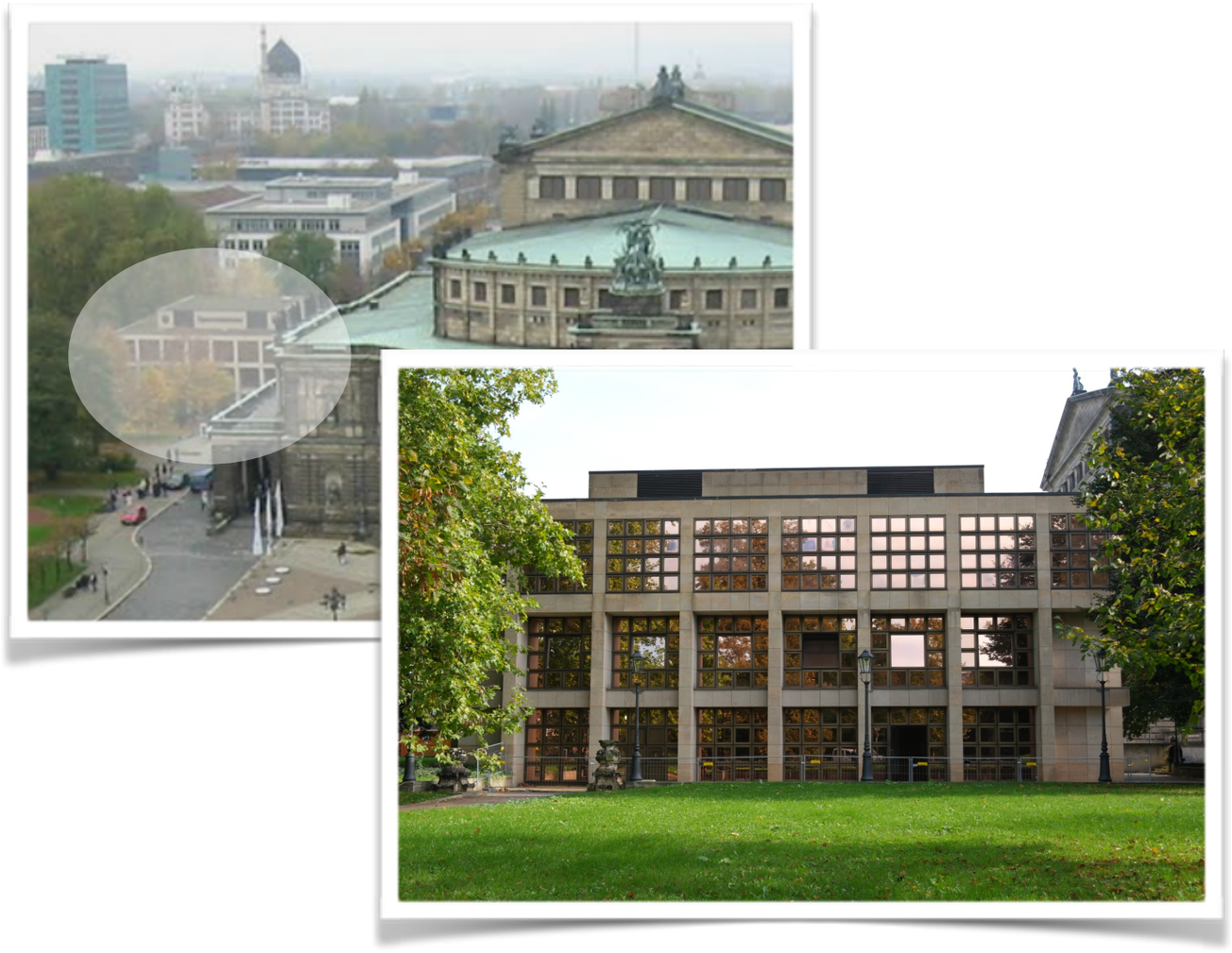
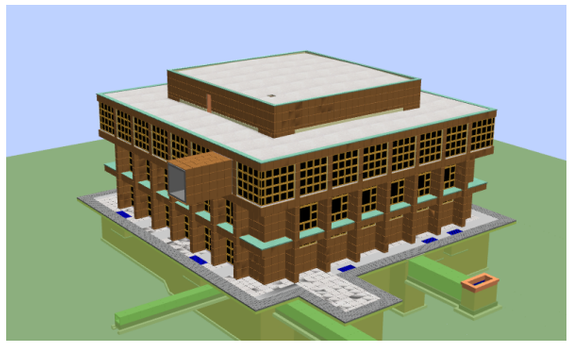
Demo projects

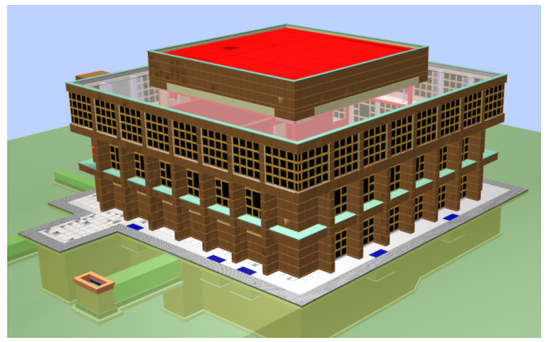
	before refubishment	after refurbishment
Type of building	Auxiliary building of an opera house	Theatre
Location	Dresden, Germany	Dresden, Germany
Construction period	1983-1985	2014-2015
Gross floor area	2,660m²	2,480m²
Gross volume	9,700m³	9,700m³
Rooms	80	22
Typical usage	Cantina / offices / workshops	Theatre / restaurant
Facade	Curtain wall	Curtain wall
HVAC	District heating, no cooling	District heating, forced-air cooling and ventilation

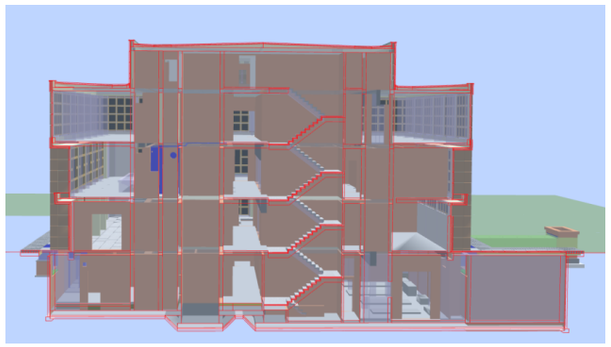


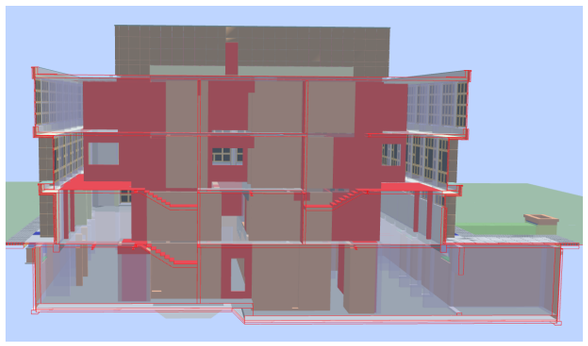
The “Young Opera” is an auxiliary building of the Semperoper, Dresden. It was built in the early 80s and will be refurbished in the next years.

The usage of the building will change from a Cantina with some offices to a theatre for young performers and rehearsals and a restaurant in the ground floor









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ISES analyses

- Stochastic analysis
  - Generating large parametric studies
  - Parametric studies execute one application many times with different sets of input parameters
  - High-throughput computing (HTC) environment
- CFD analysis
  - Computational fluid dynamics
  - Time consuming
  - Parallel applications, high-performance computing (HPC) environment

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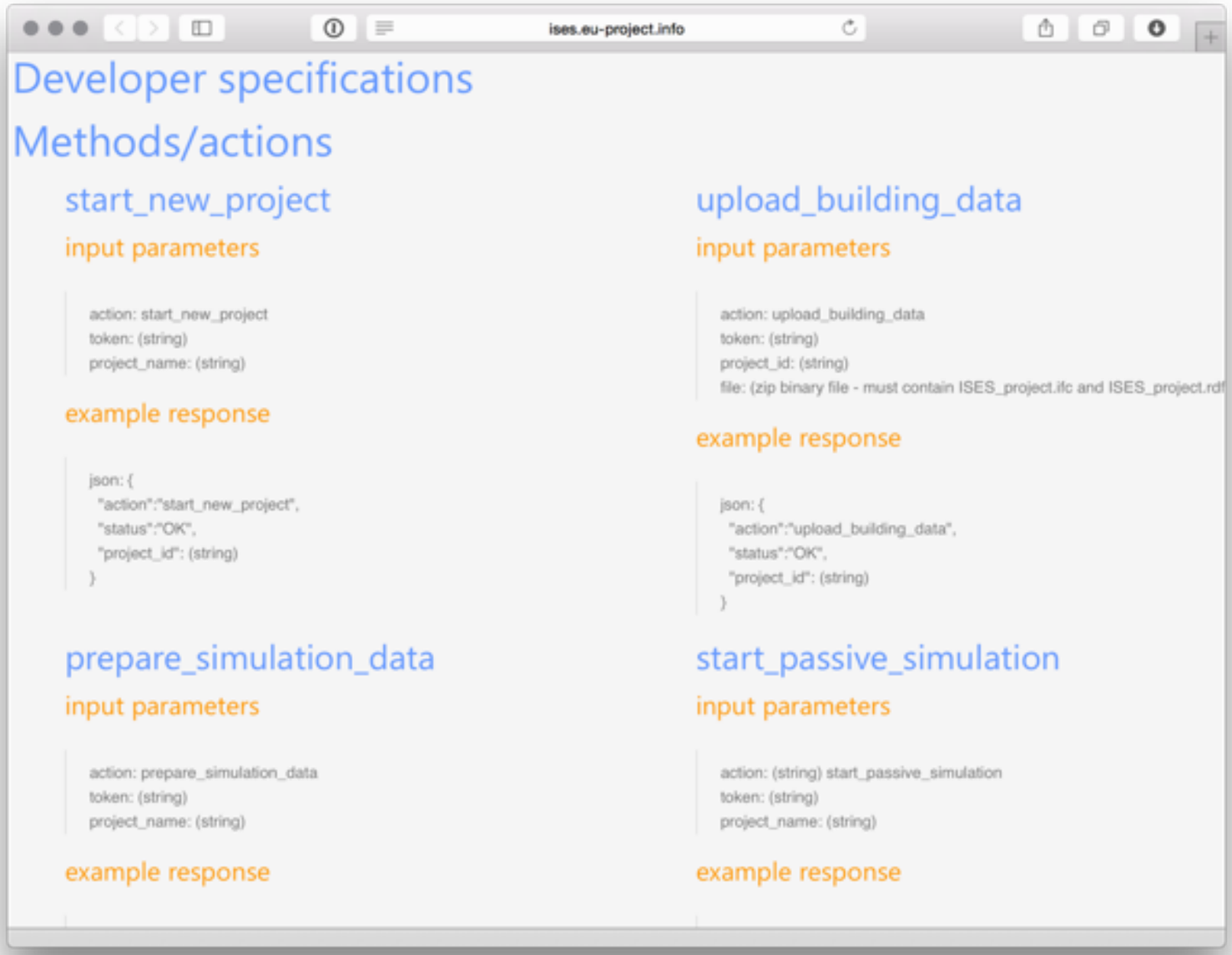
ISES cloud API

- Requirements
  - Use-cases
  - Workflow
- API
  - RESTful
  - Security issues
  - General usage instructions



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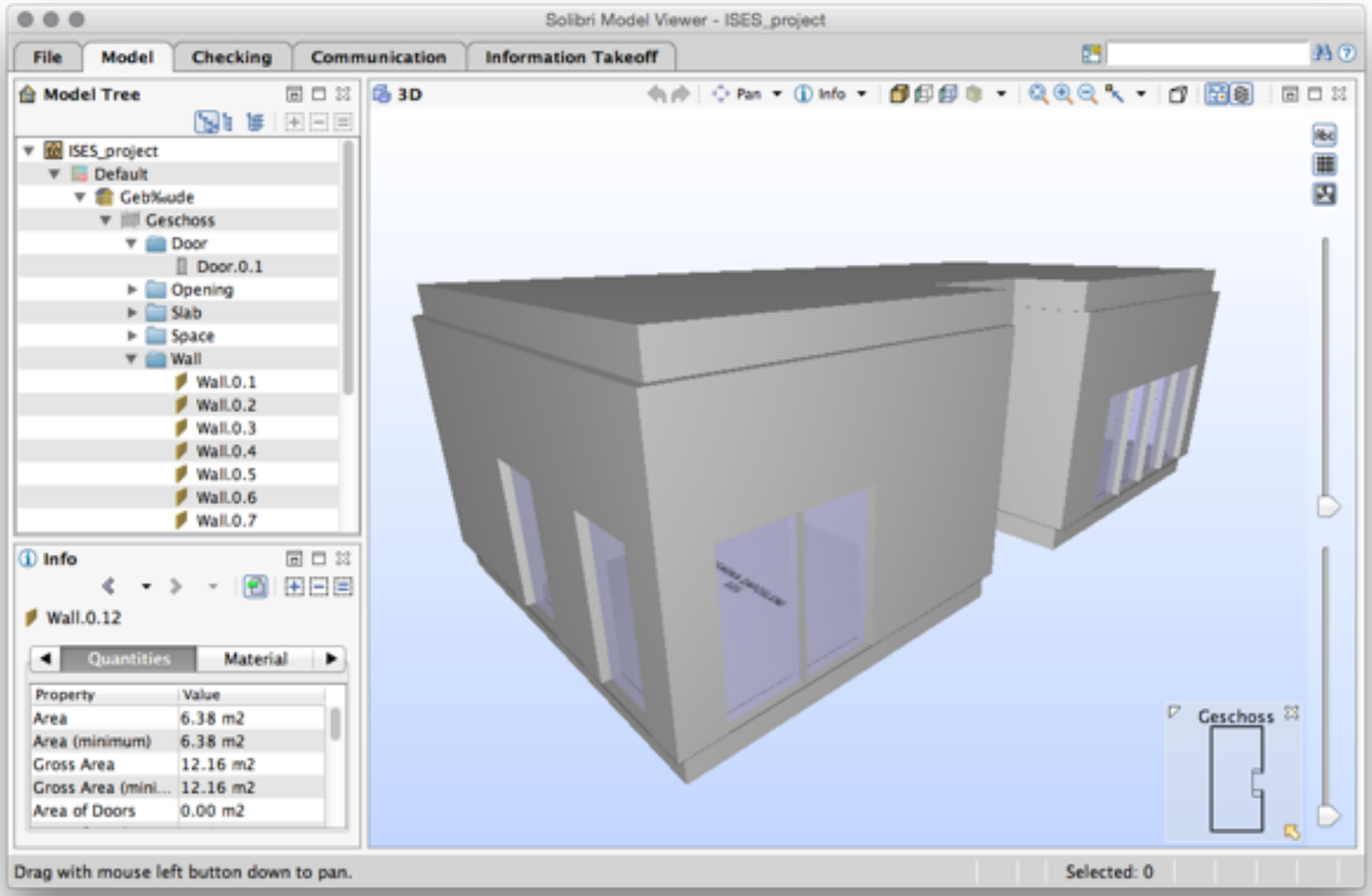
Benchmarking method

- The “Mavrica” Kindergarten BIM model
- Average of three simulation runs
- Test-bed hardware used for local and distributed simulations
- Wine 1.6 used for executing Windows based applications



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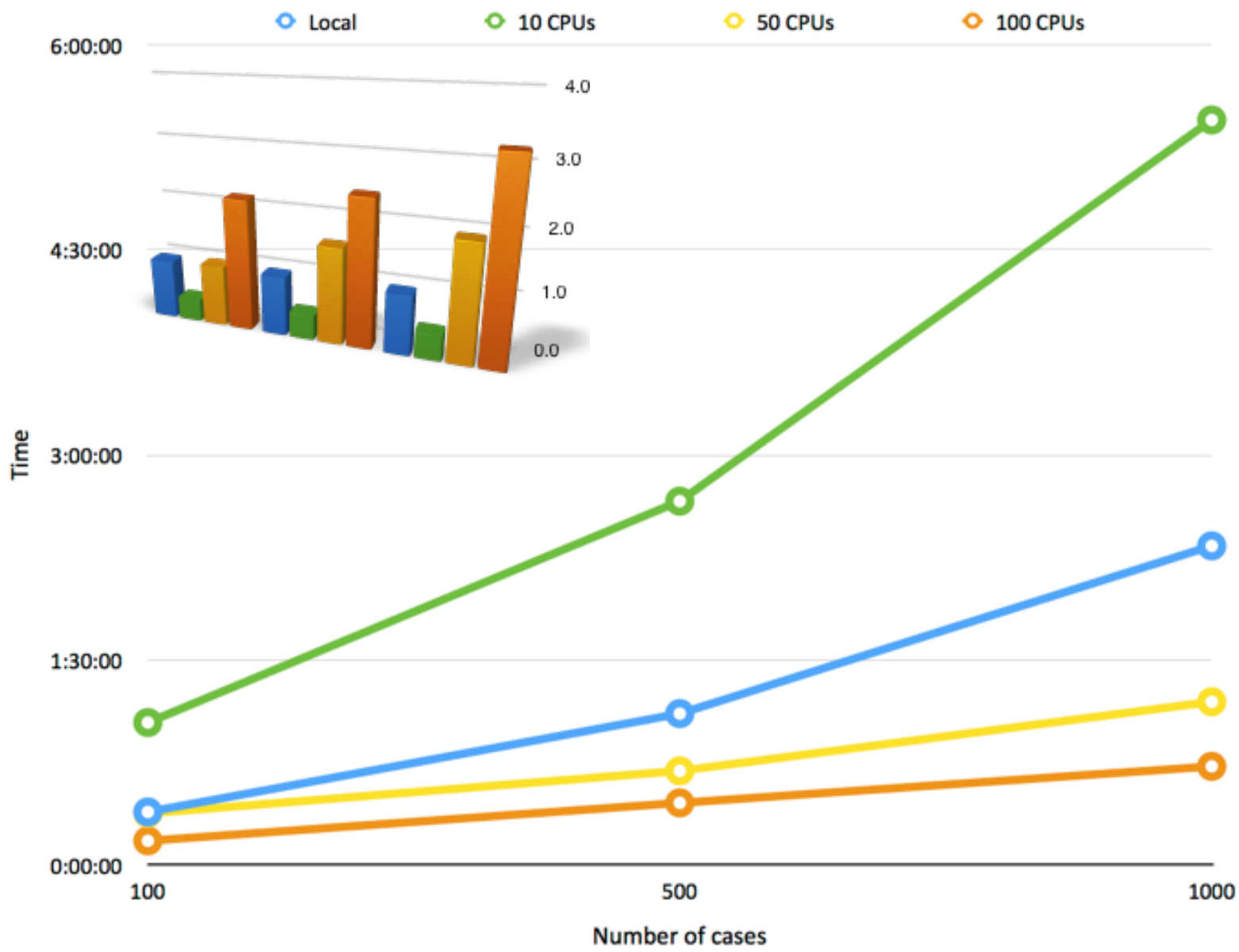
Sensitivity analysis



Application: Grandlund Riuska
Notes: Executed in Wine 1.6 environment

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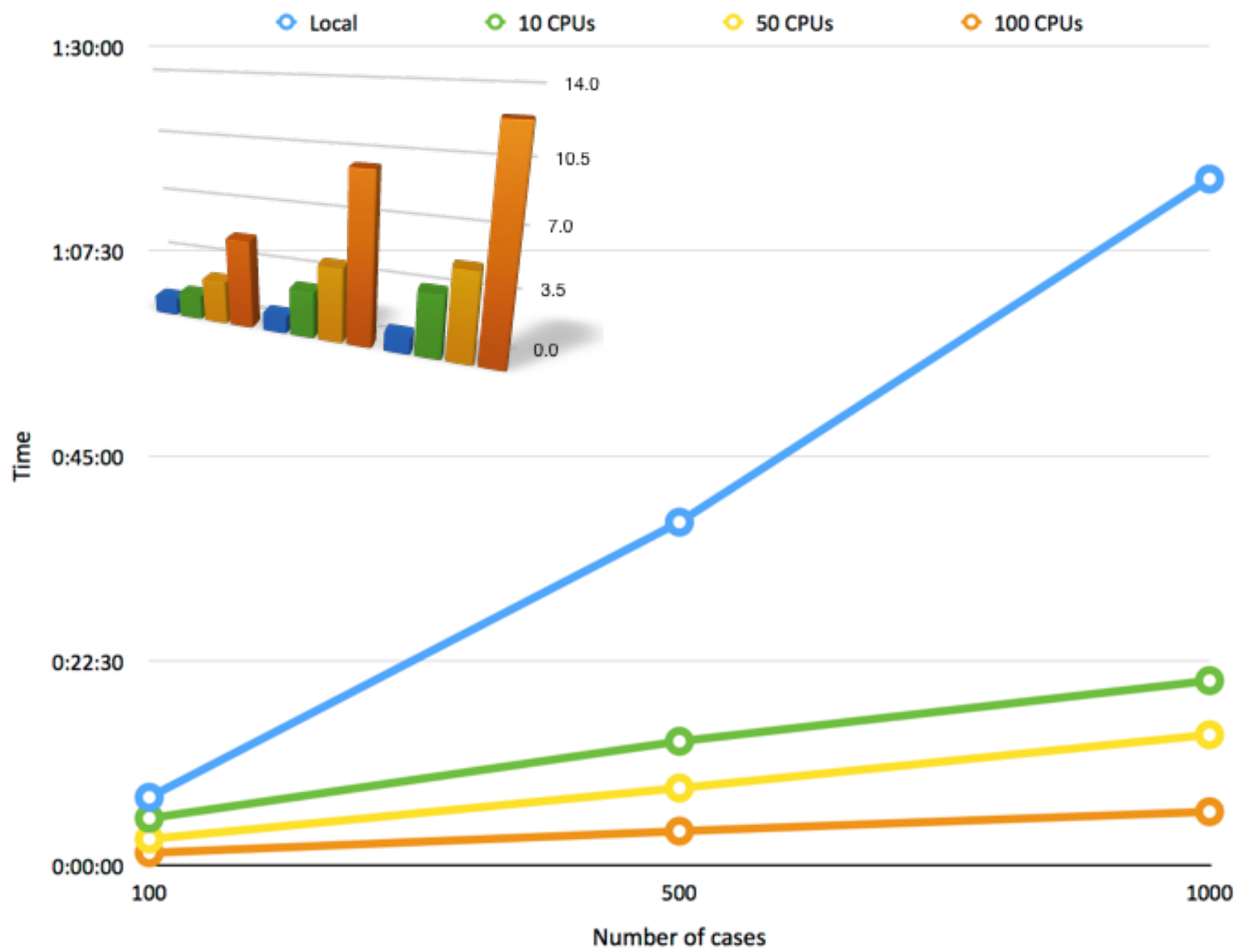
Sensitivity analysis



Application: Therakles, TUD-IBK
Notes: Native Linux application

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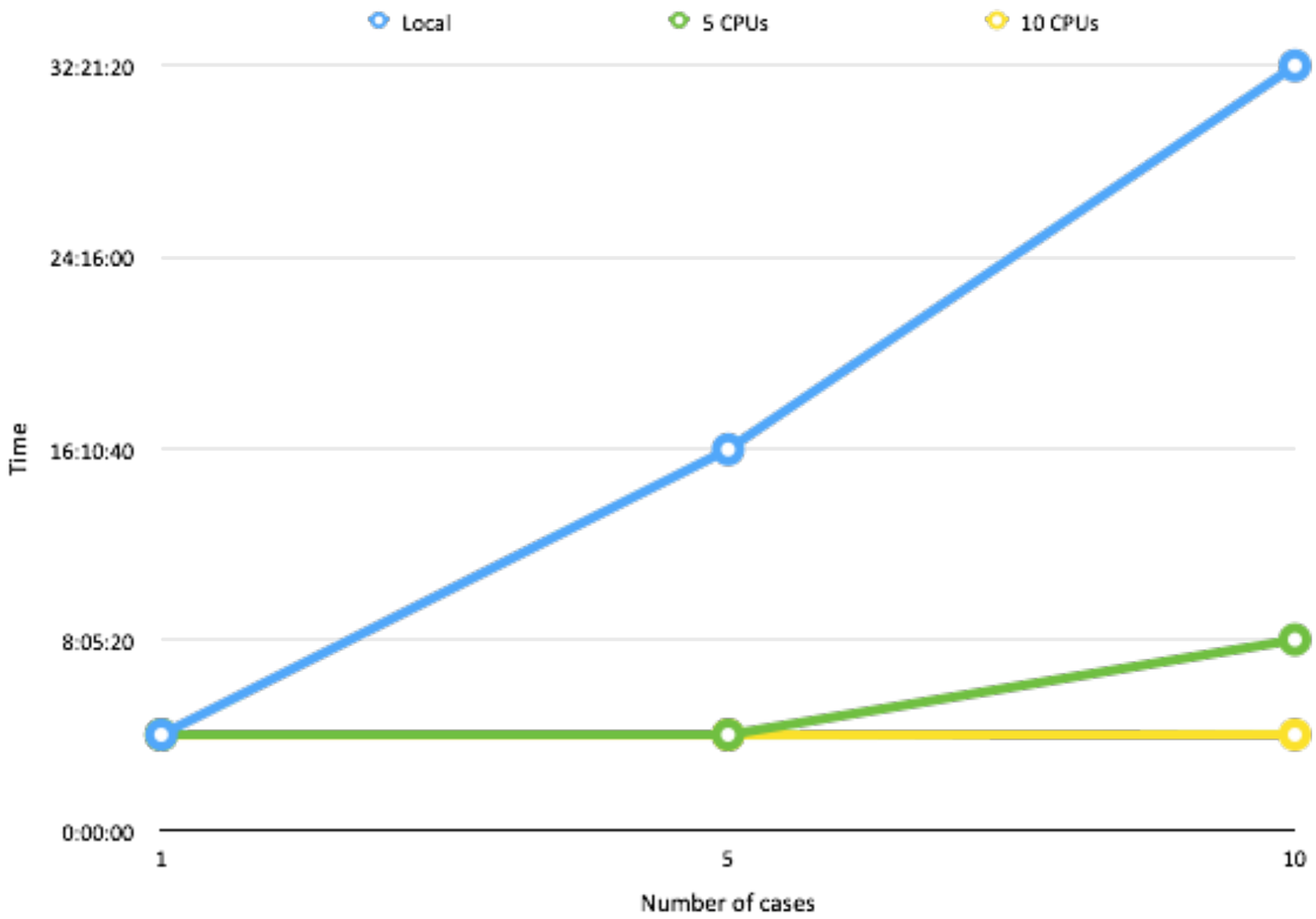
Detailed analysis



Application: Nandrad, TUD-IBK
Notes: Native Linux application

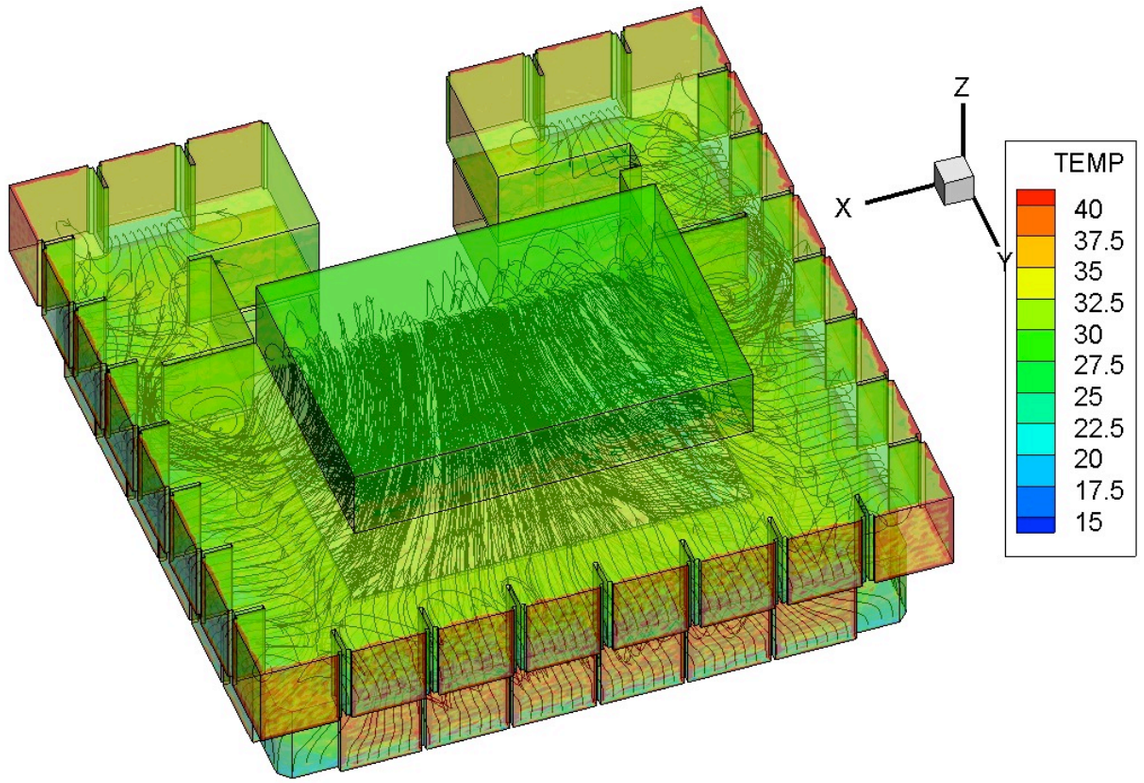
Detailed CFD analysis

Sofistik CFD

- Parallel CFD analysis tool for 3D unsteady, incompressible, turbulent, buoyancy-driven flows.
- Complementary tools (geometrical modeller, mesh generation tools, post-processing tools, etc.)

Parallel processing of CFD solver

- MPI protocol (MPICH2, OpenMPI)
- 64-bit Linux
- Synchronization - restricted parallelization
- Small number of large messages



16 CPUs	96 CPUs
~1 week	less then 1 day

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Lessons learned

- BIM-based integration
- Consideration of parameter variations incl. stochastic input
- Extensible solution based on an software virtual lab kernel
- Powerful pre- and post-processing tools
- Cloud-enabled analysis capabilities
- 5 “S” requirements still relevant

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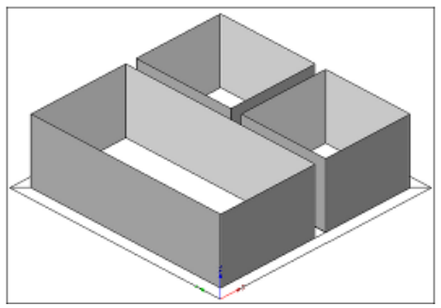
A taste of BIM challenges

1st level

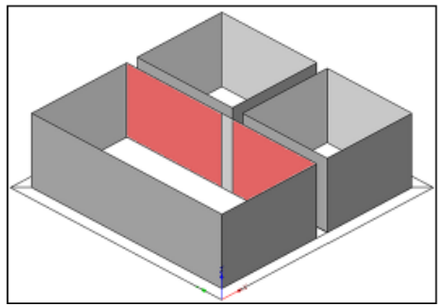
Space boundary without inner boundaries



2nd level

Space boundary with inner boundaries

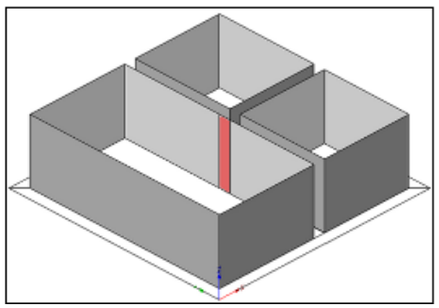
(in IFC: Type 2a)

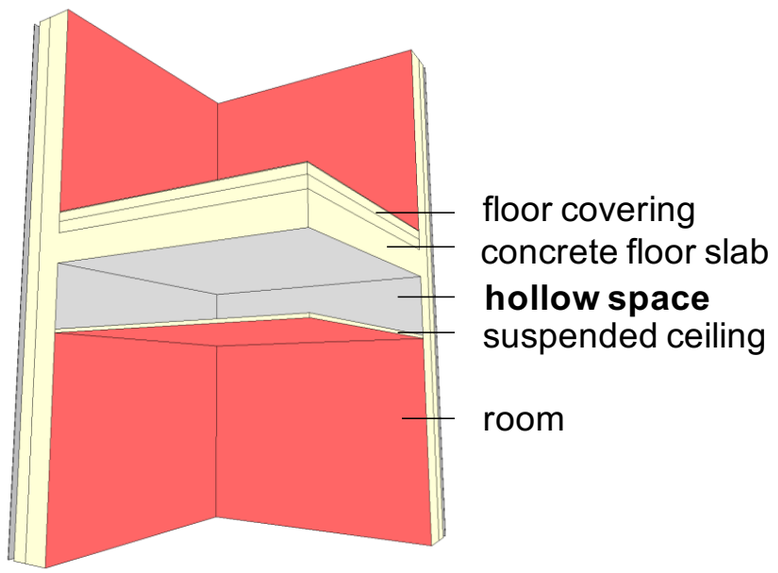


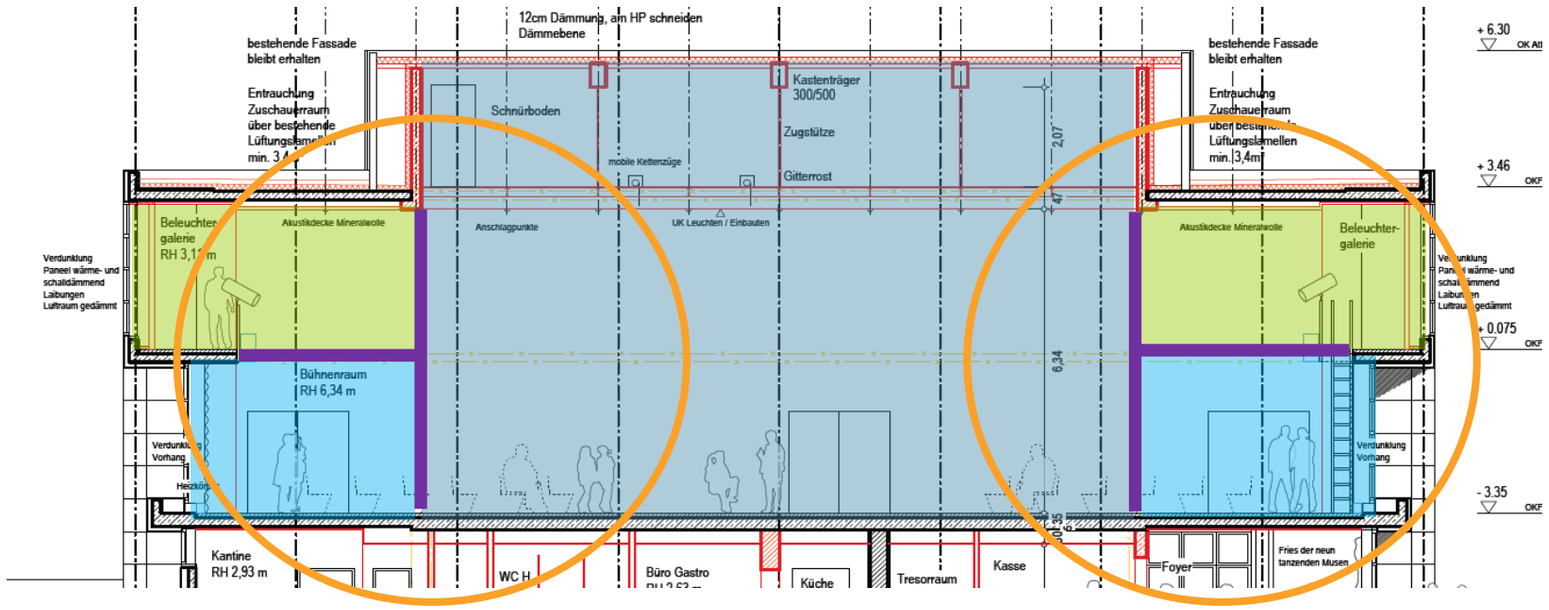
3rd level

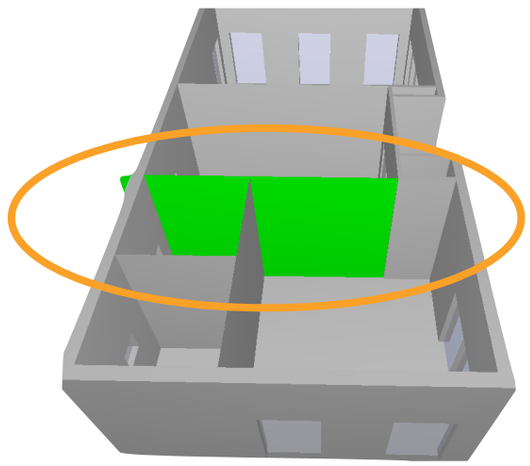
Adding 3rd level space boundaries means to close the gaps between the 2nd level virtual space boundaries

(in IFC: Type 2b)









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