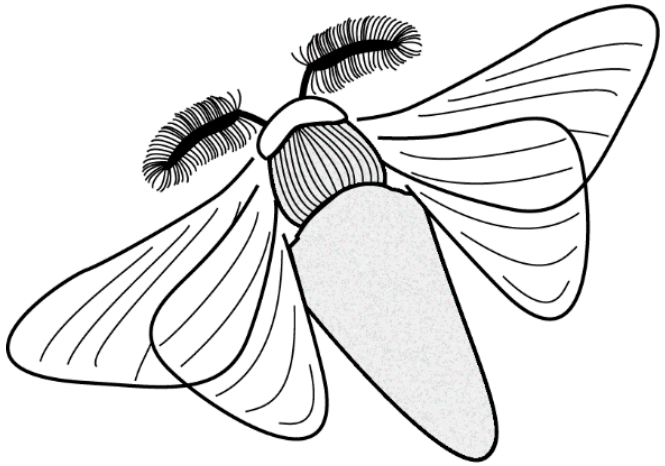
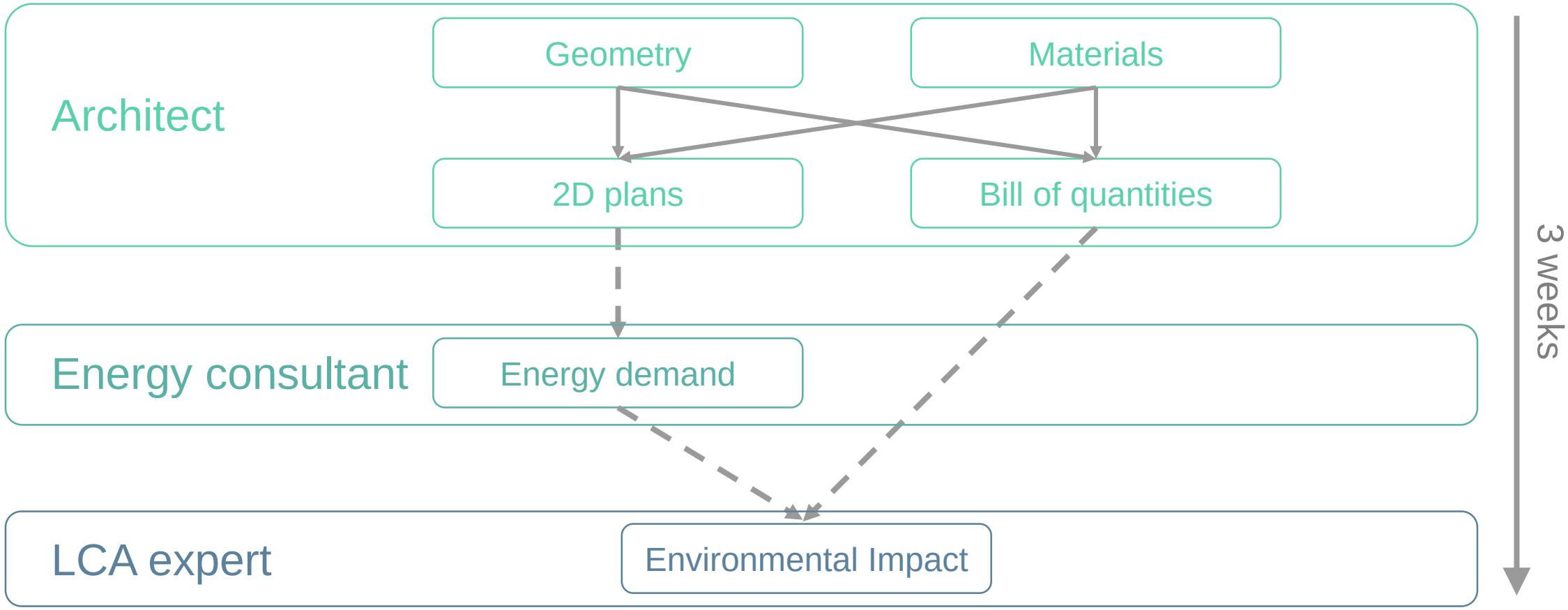
BOMBYX



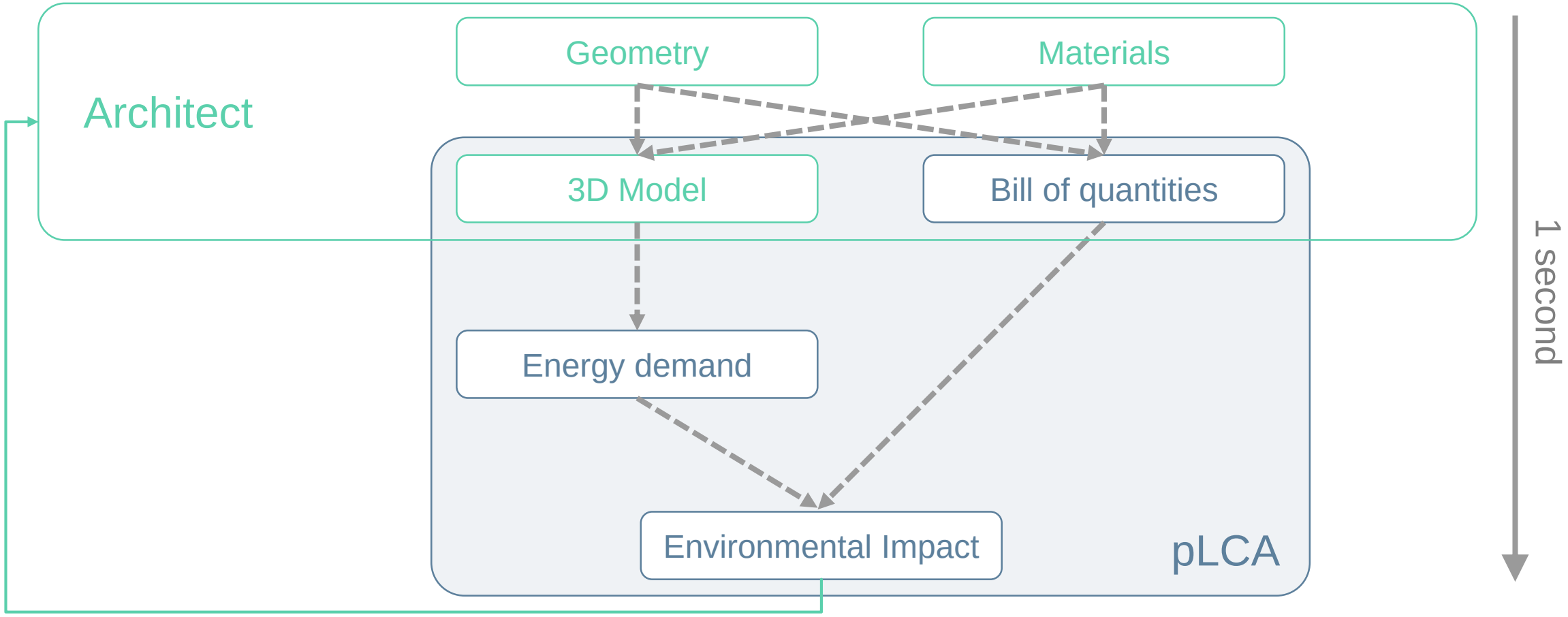
A design-integrated parametric Life Cycle Assessment

Alina Galimshina, PhD student
Chair of Sustainable Construction, ETH Zurich

Process of LCA in architectural practice today

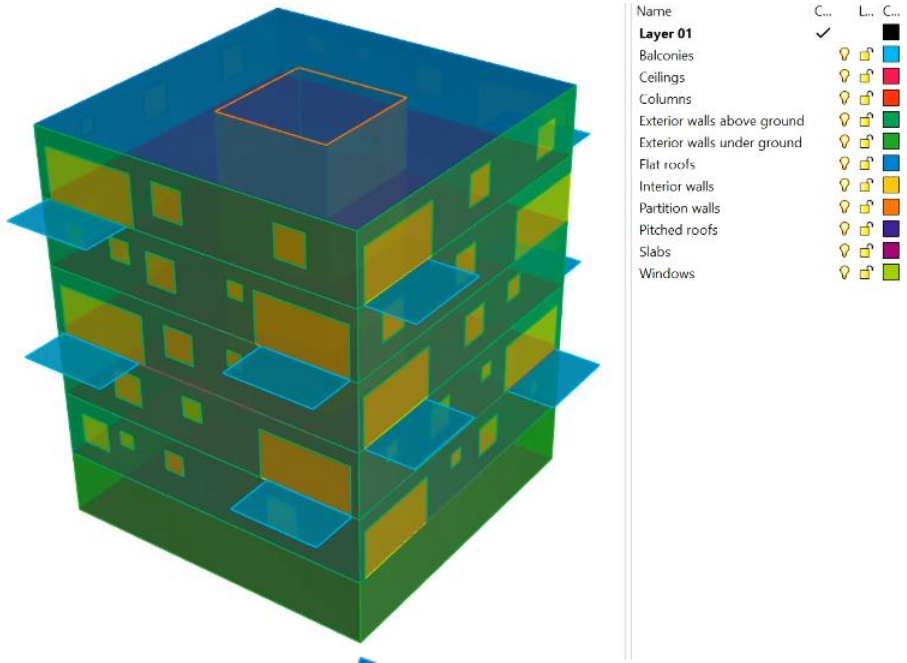


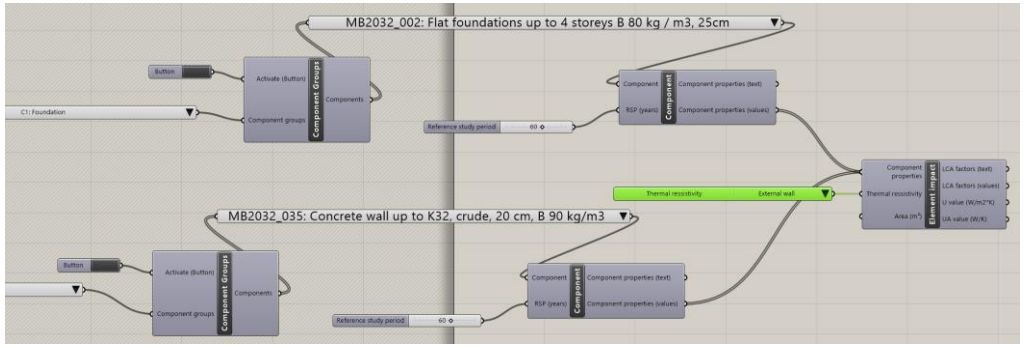
Parametric LCA



Bombyx…

- is a parametric LCA tool for application in early design stages
- incudes simplified LCA method
- is based on Rhino 3D modelling software and grasshopper
- can be applied in Revit





Tool Structure

Version 1 (2018-2019)

Bottom – up

Material – component – element – building

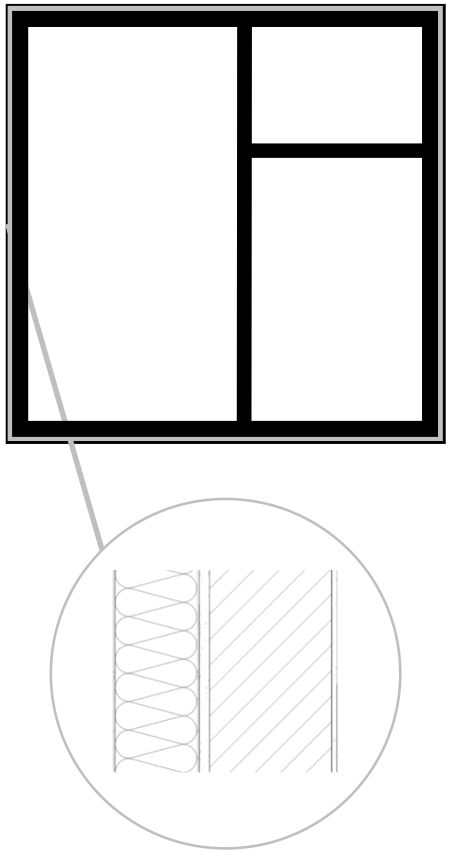
Version 2 (2020)

Top – down

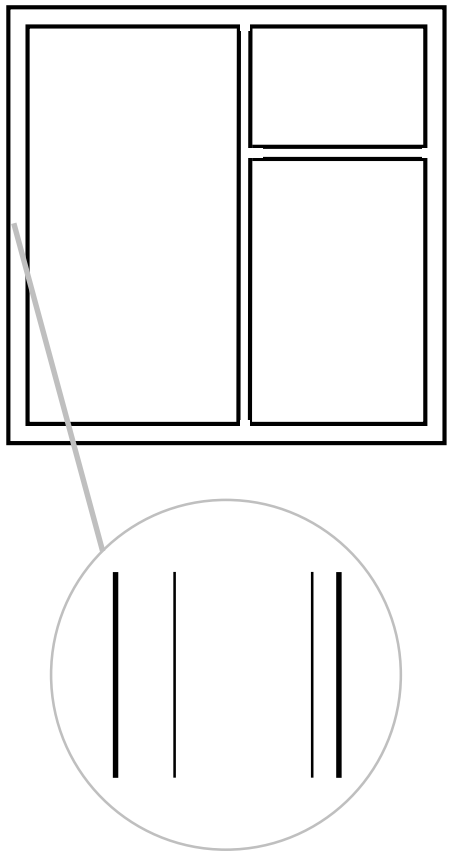
Building characteristics – average impact of the element – building impact

Structure of building elements

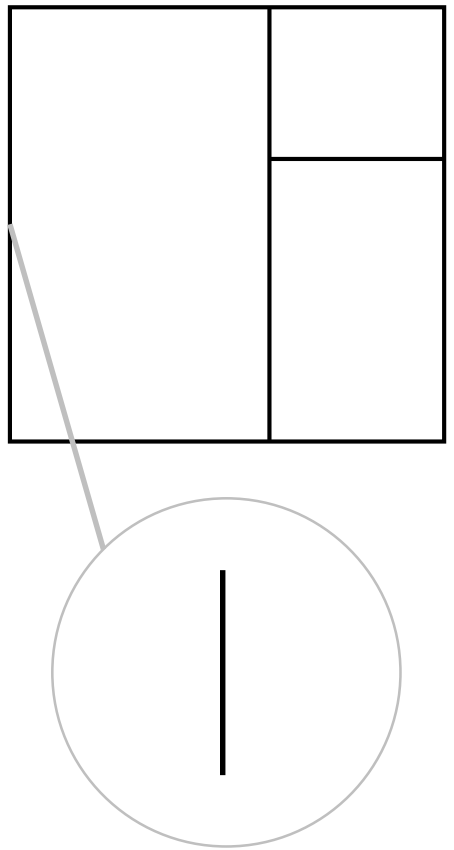
Material level



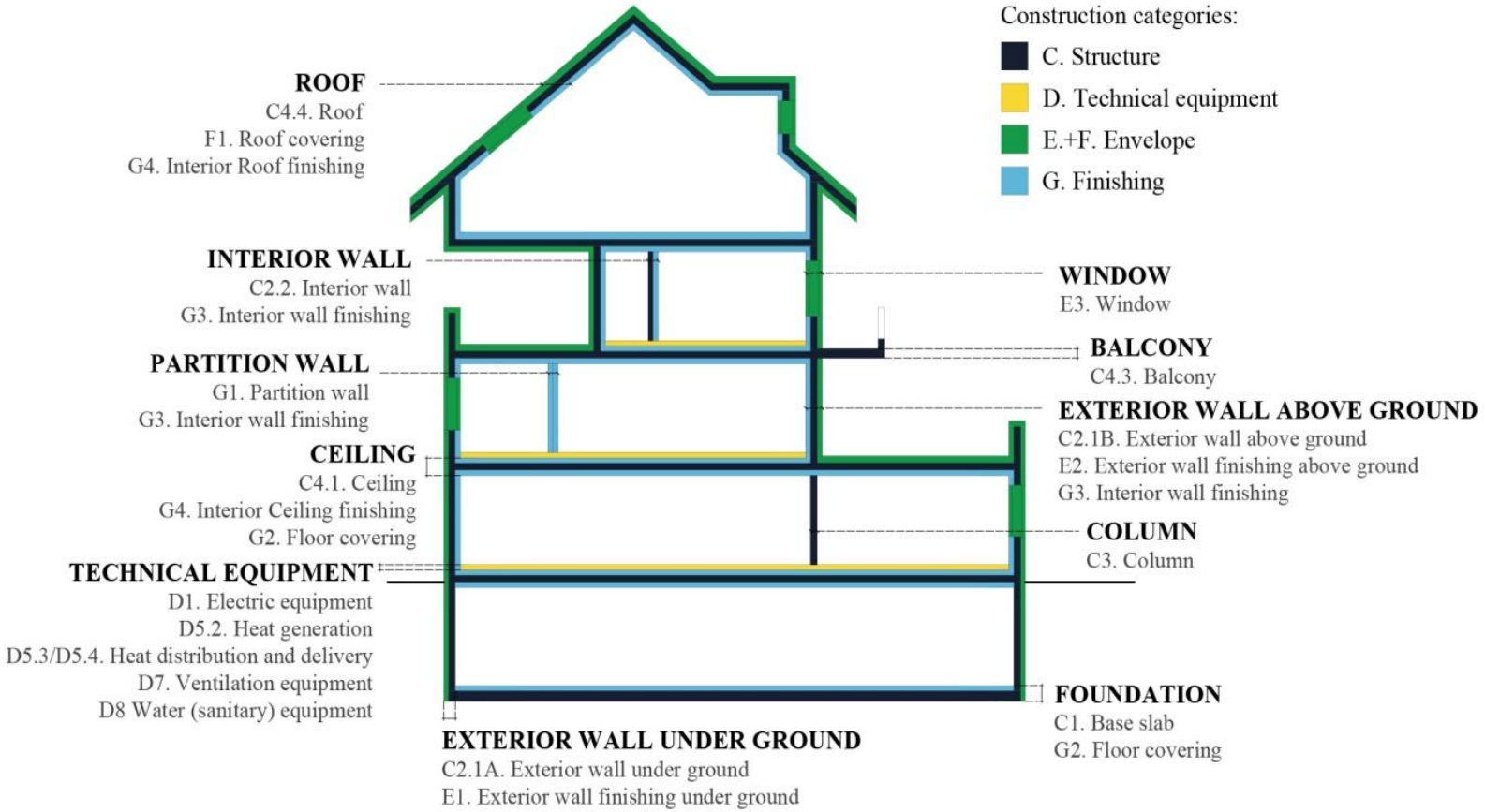
Component level



Element level

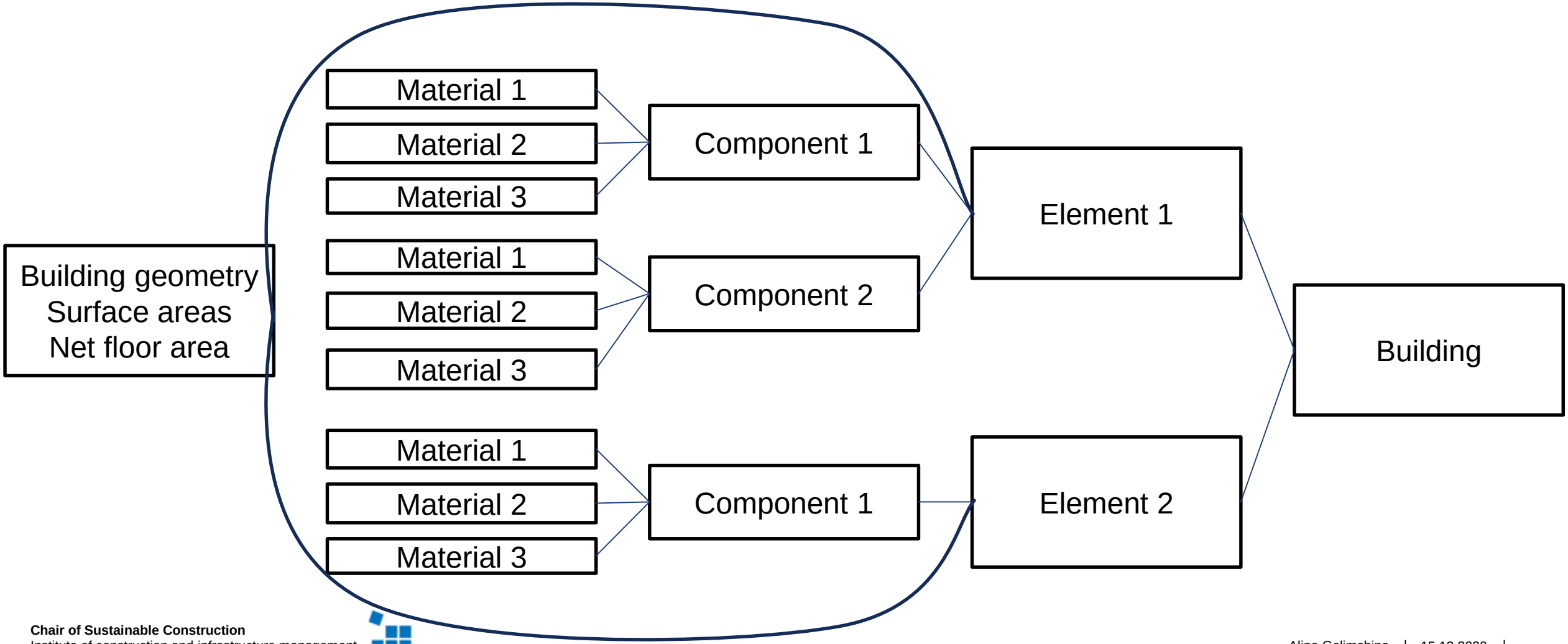


Structure of building elements

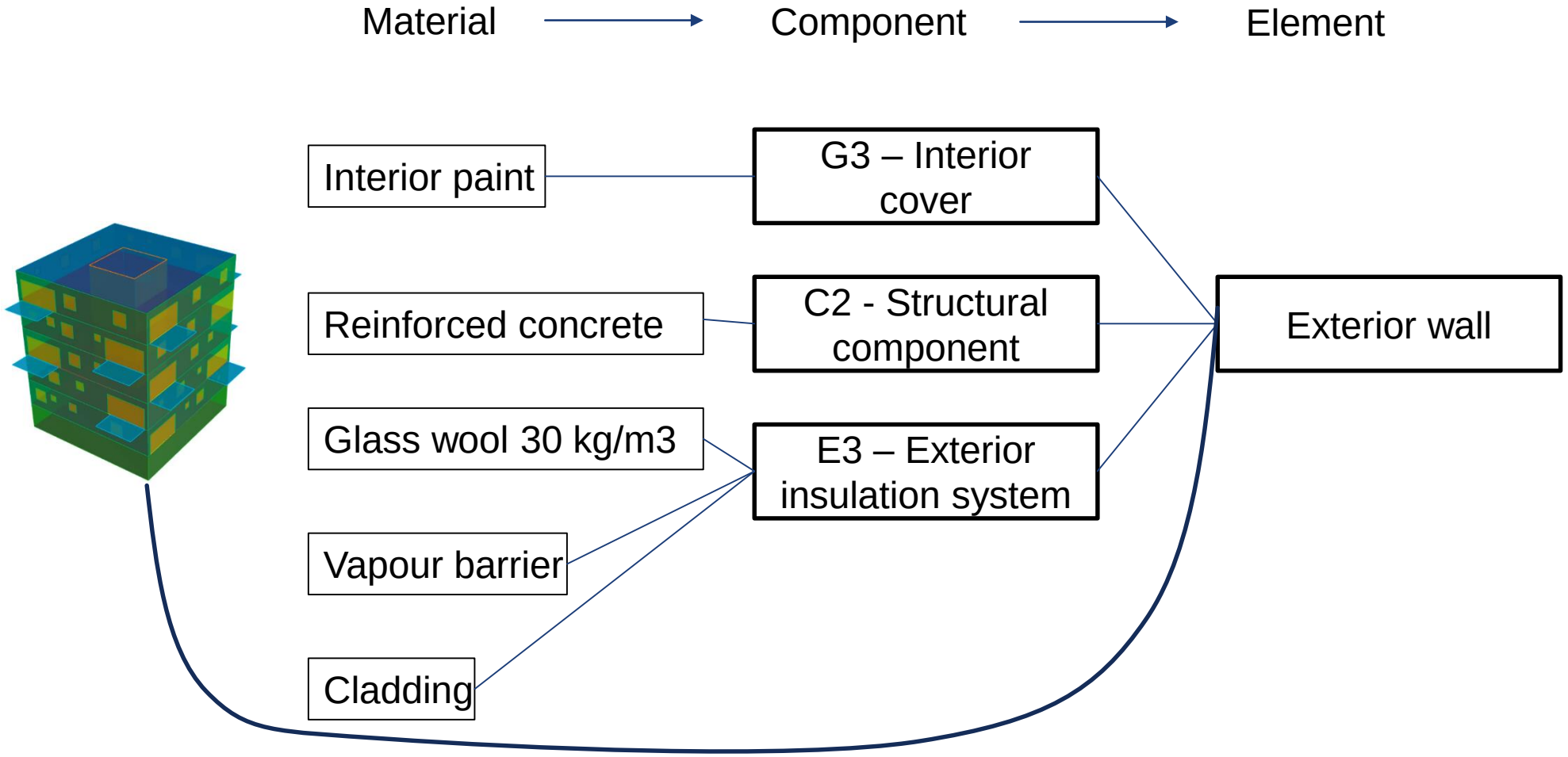


Architectural element	BKP-H Component
1. Foundation	C1 Base slab, foundation
	G2 Floor covering
2. Exterior wall under ground	C2.1A Exterior wall under ground
	E1 Exterior wall finishing under ground
3. Exterior wall above ground	C2.1B Exterior wall above ground
	E2 Exterior wall finishing above ground
	G3 Interior wall finishing
4. Window	E3 Window
5. Interior wall	C2.2 Interior wall
	G3 Interior wall finishing
6. Partition wall	G1 Partition wall
	G3 Interior wall finishing
7. Column	C3 Column
8. Ceiling	C4.1 Ceiling
	G2 Floor covering
	G4 Interior ceiling/roof finishing
9. Balcony	C4.3 Balcony
10. Roof	C4.4 Roof
	F1 Roof covering
	G4 Interior ceiling/roof finishing
11. Technical equipment	D1 Electric equipment D5.2 Heat generation D5.3 / D5.4 Heat distribution and delivery D7 Ventilation equipment D8 Water (sanitary) equipment

Steps

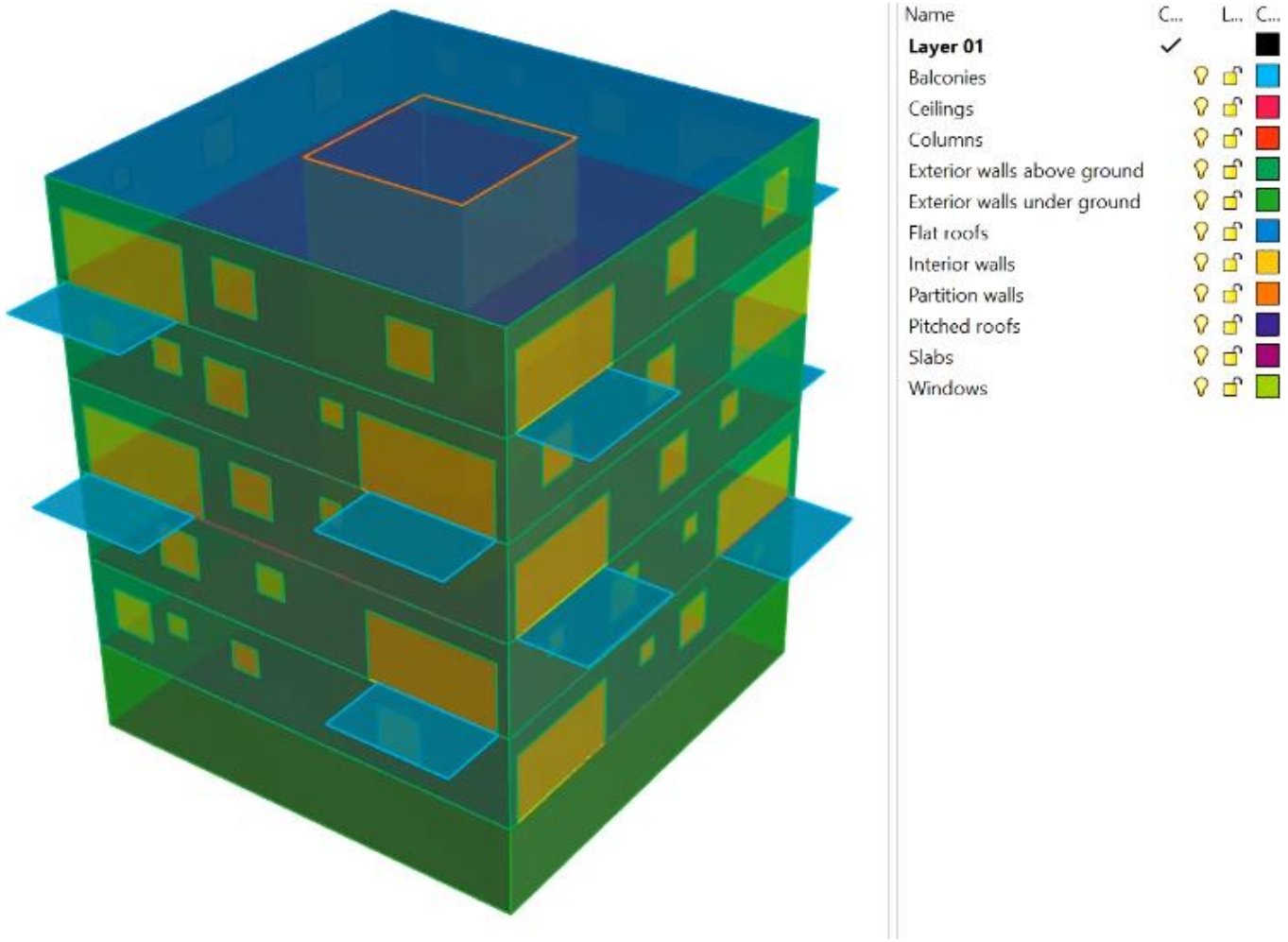

Building geometry
Surface areas
Net floor area
Material 1
Material 2
Material 3
Component 1
Material 1
Material 2
Material 3
Component 2
Material 1
Material 2
Material 3
Component 1
Element 1
Element 2
Building

Example exterior wall



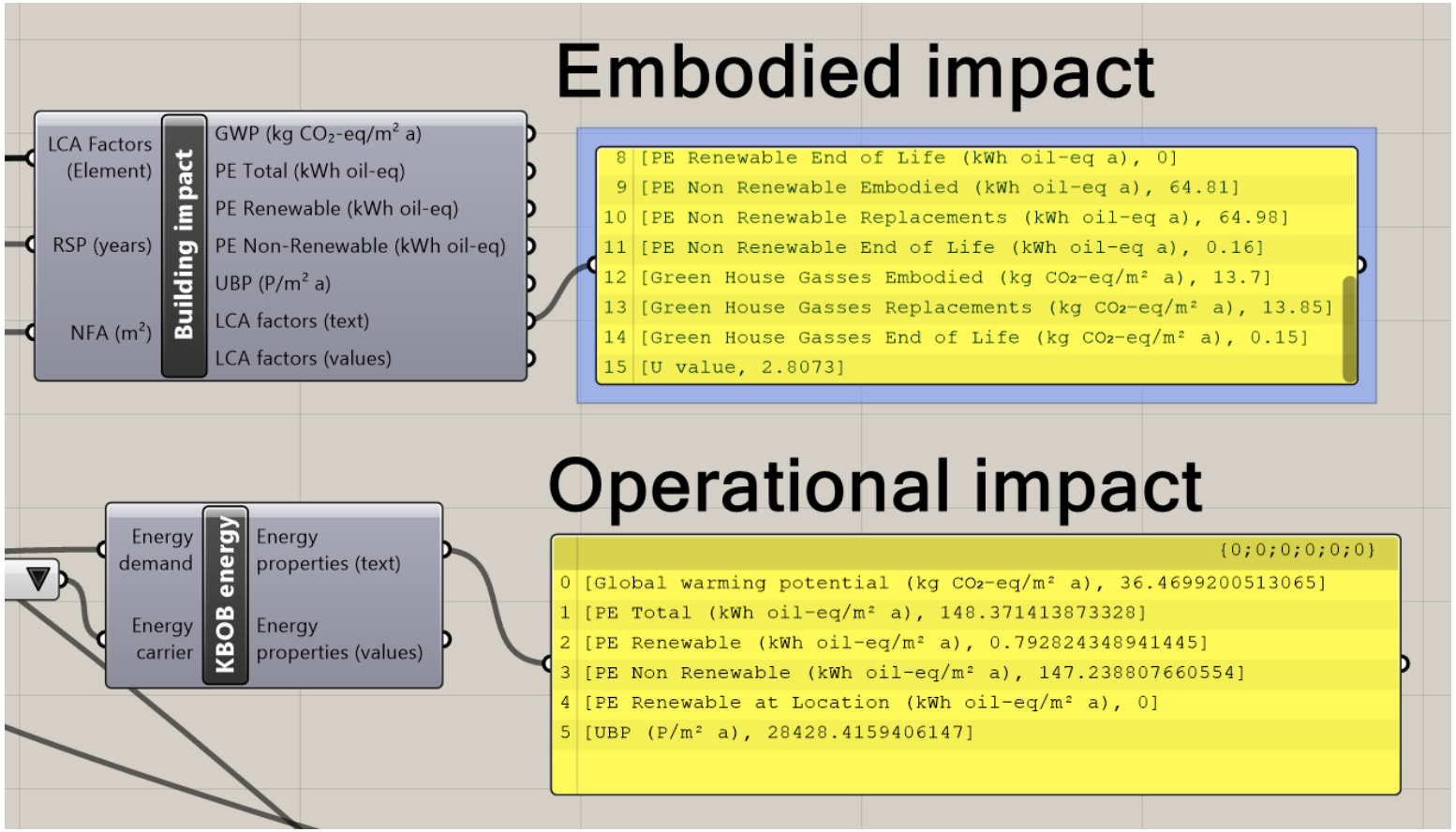
Geometry

- Geometry is created in Rhino or imported from CAD/BIM tool
- Each element is drawn on one layer
- Each layer is assigned a material combination



Embodied vs Operational

- SIA 380/1 quasi-static energy analysis



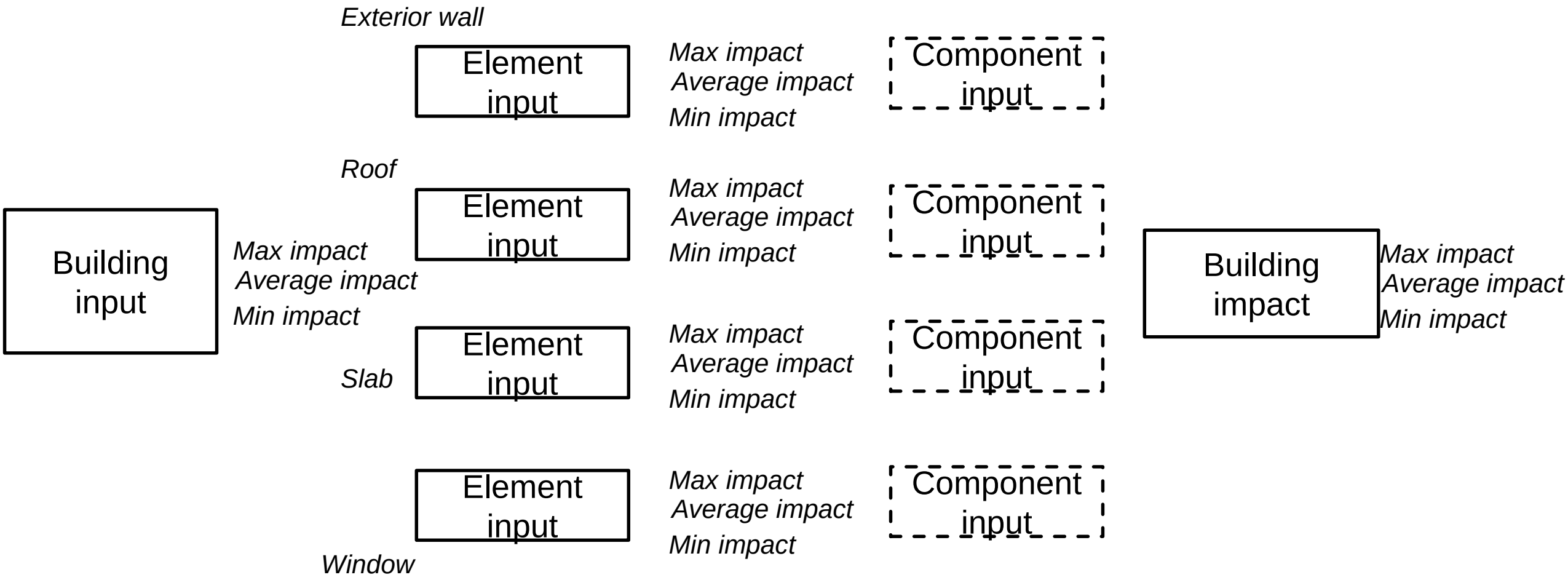
Advantages and disadvantages

- Full assessment
- Easy to use
- Swiss database with big selection of materials

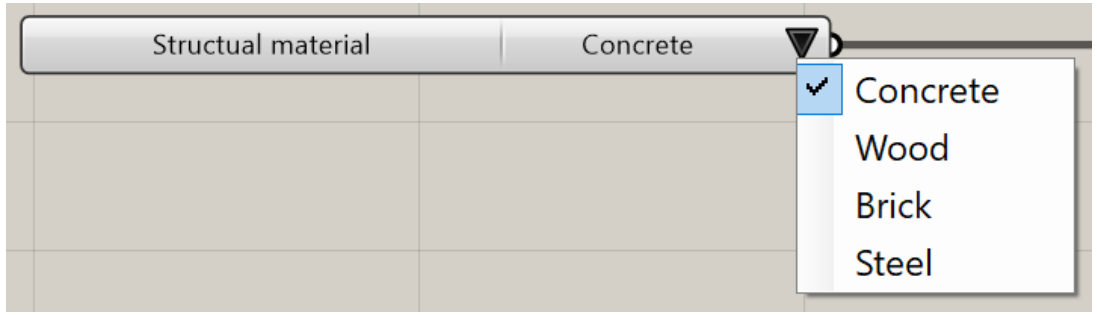
- Requires knowledge of all the materials or the components

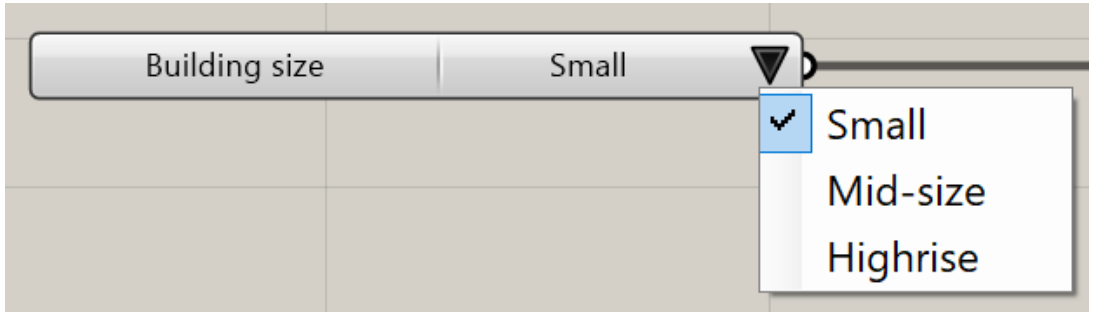
Version 2

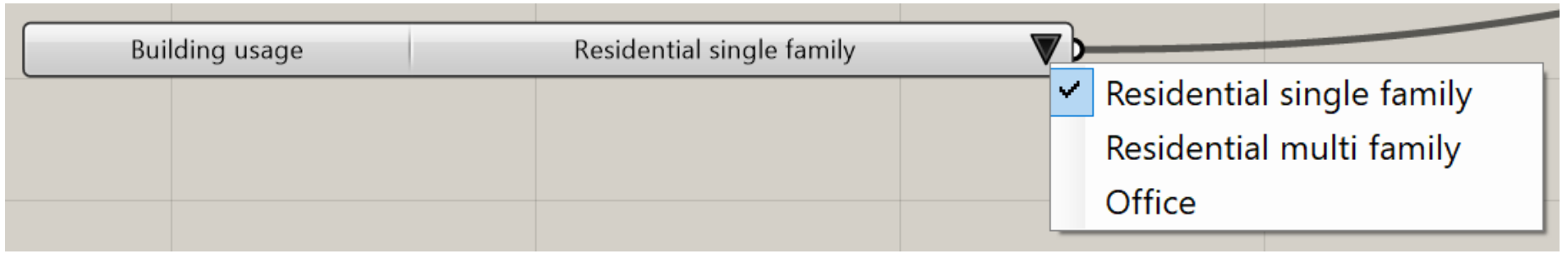
Version 2


Exterior wall
Element input
Max impact
Average impact
Min impact
Component input
Roof
Element input
Max impact
Average impact
Min impact
Component input
Building input
Max impact
Average impact
Min impact
Slab
Element input
Max impact
Average impact
Min impact
Component input
Element input
Max impact
Average impact
Min impact
Component input
Window
Building impact
Max impact
Average impact
Min impact

Version 2 – building input







Database

- Material level - KBOB
- Component level – Bauteilkatalog, EcoKomposit

Material level

Details for material: 10.004 - Polystyrene expands (EPS)(15 kg/m3)

English name:	Polystyrene expands (EPS)(15 kg/m3)
German name:	Polystyrol expandiert (EPS)(15 kg/m3)
French name:	Polystyrène expansé (EPS)(15 kg/m3)
KBOB ID:	10.004
Density:	15.00 kg/m^3
Reference unit:	kg
Disposal ID:	91.028
Disposal:	Entsorgung, Gebäude, EPS-Isolation flammgeschützt, in Beseitigung
UBP'13 embodied:	3610.00
UBP'13 EoL:	1570.00
Primary energy total embodied:	30.00 *kWh oil-eq*
Primary energy total EoL:	0.14 *kWh oil-eq*
Primary energy renewable embodied:	0.36 *kWh oil-eq*
Primary energy renewable EoL:	0.00 *kWh oil-eq*
Primary energy non renewable embodied:	29.70 *kWh oil-eq*
Primary energy non renewable EoL:	0.13 *kWh oil-eq*
Global warming potential embodied:	4.46 *kg CO_2-eq*
Global warming potential EoL:	3.19 *kg CO_2-eq*
Thermal conductivity:	0.04 *(W/m*K)*

Edit material | Back to List

Summary

- Simplified LCA calculation tool based on different LOD
- Swiss database of materials and predefined components
- Geometry is taken from 3D model

Lets practice!

Thank you!

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www.ethz.ch/en.html