



Large Valorisation on Sustainability of Steel Structures

MAKROKOMPONENTER OCH APPLIKATIONER FÖR *IPHONE* AND *IPAD*



Agenda

1) Makrokomponentmetod

- Algoritm för livscykelanalys baserat på makrokomponenter

2) Applikation för iPad och iPhone

- Beskrivning av program

3) Slutliga kommentarer



1) MAKROKOMPONENTMETOD

Den här metoden har utvecklats tidigare i RFCS forskningsprojekt















SB_Steel (2014), Sustainable Building Project in Steel. RFSR-CT-2010-00027

REFERENS: Gervásio, H., Martins, R., Santos, P., Simões da Silva, L., “A macro-component approach for the assessment of building sustainability in early stages of design”, Building and Environment 73 (2014), pp. 256-270, DOI information: 10.1016/j.buildenv.2013.12.015.



Klassifikation för byggnader med stålram

	Category 1	Category 2	Category 3
Single & multi-family building			
Apartment blocks			
Office buildings			
Commercial/Industrial buildings			

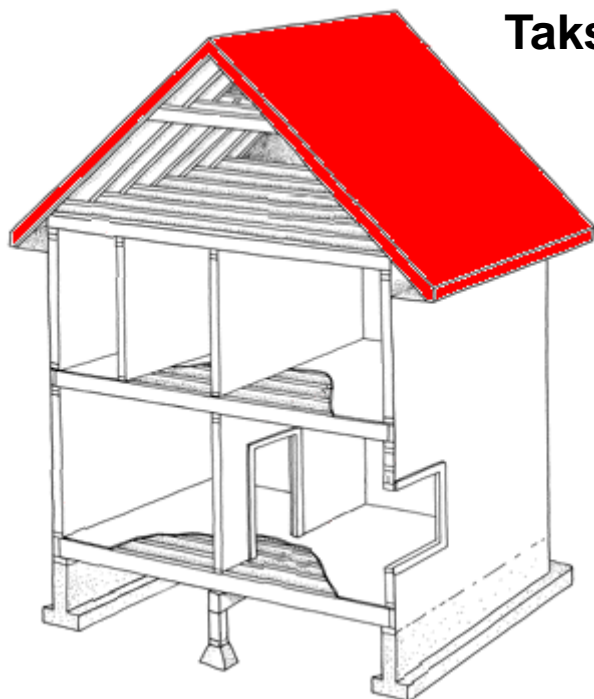
Enfamiljshus i
Kategori 1
(stålintensiv
byggnad)



DEFINITION AV MAKROKOMPONENT

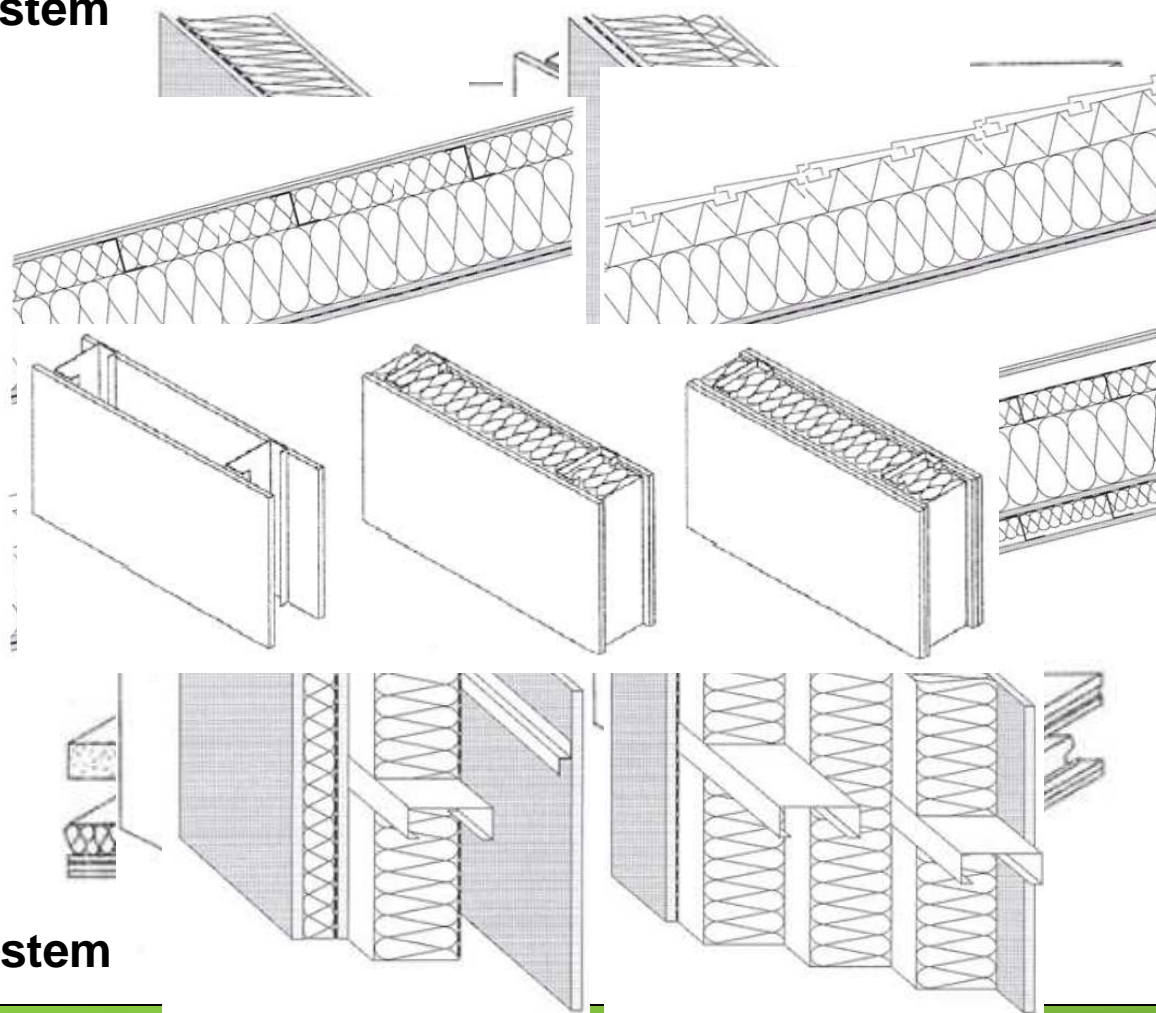
Internt väggssystem (lastbärande väggar)

Taksystem



Externa väggssystem
(lastbärande väggar)

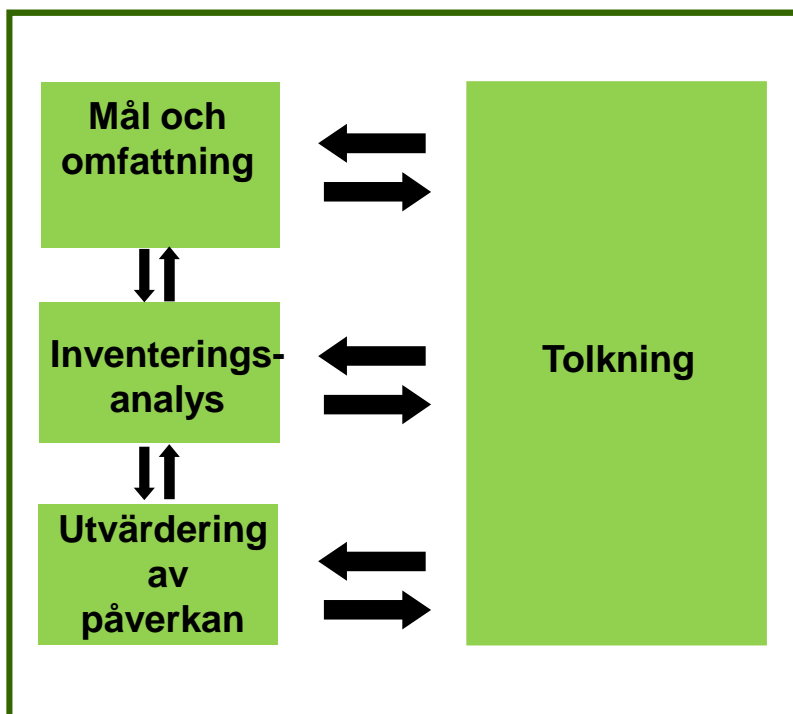
Golvsystem





BERÄKNING AV MAKROKOMPONENTER

ISO STANDARDS 14040/14044



Andra relevanta standarder EN TC350 - Sustainability of construction works - EN 15643-2:2011

Mål och omfattning

Två nivåer: LCA på (i) komponentnivå; och (ii) byggnadsnivå.

Systemgränser

Product stage		Construc stage		Use stage								End-of-life stage				
Raw material supply	Transport	Manufacturing	Transport	Construction process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Reuse/Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
x	x	x	x	-	-	x	x	x	x	-	-	x	x	x	x	x



LARGE VALORISATION ON SUSTAINABILITY OF STEEL STRUCTURES



INVENTERINGSFAS

	Time coverage		Geographical coverage	Technology coverage	Completeness
Steel section	2007,	annual average	Europe	European producers	> 99% of mass and energy
Steel rebar	2007,	annual average	World	World producers	> 99% of mass and energy
Steel coil	2007,	annual average	Europe	European producers	> 99% of mass and energy
Concrete <u>C20/25</u>	2011,	annual average	Germany	German producers	> 95% of mass and energy
Oriented strand board <u>OSB</u>	2008,	annual average	Germany	German producers	> 99% of mass and energy
<u>Gypsum</u> plasterboard	2008,	annual average	Europe	European producers	> 95% of mass and energy
Bricks	2011,	annual average	Germany	German producers	> 95% of mass and energy
Rock wool	2011,	annual average	Europe	European producers	> 95% of mass and energy
Expanded polystyrene EPS	2011,	no data	Europe	No data	No data
Extruded polystyrene <u>XPS</u>	2011,	annual average	Germany	German producers	> 95% of mass and energy
Polyurethane rigid foam <u>PUR</u>	2011,	annual average	Germany	German producers	> 95% of mass and energy
Expanded Cork	2011,	annual average	Germany	German producers	> 95% of mass and energy
Glass wool	2011,	annual average	Europe	European producers	> 95% of mass and energy
Polyethylene foam PE	2011,	annual average	Germany	German producers	> 95% of mass and energy

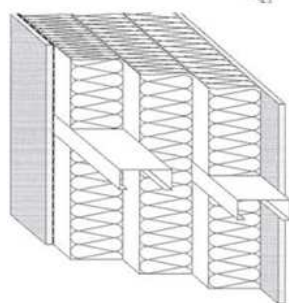
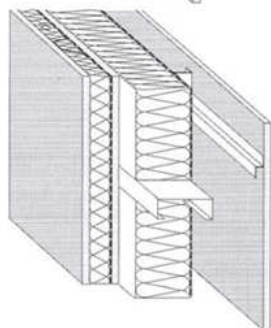
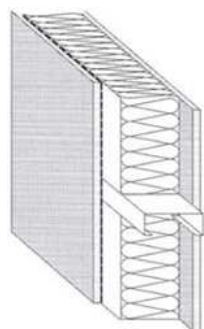


LARGE VALORISATION ON SUSTAINABILITY OF STEEL STRUCTURES

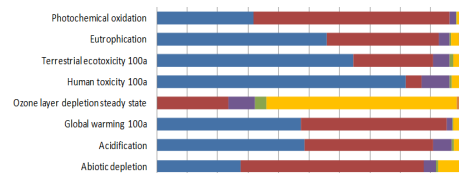
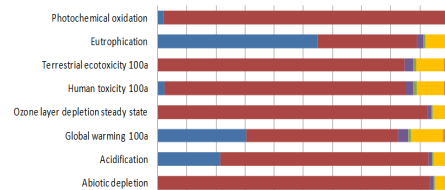
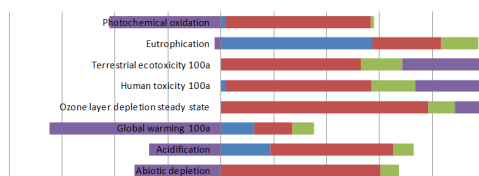


DATABAS FÖR MAKROKOMPONENTER

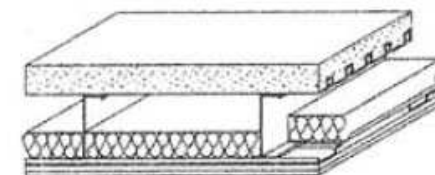
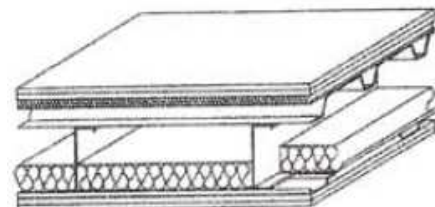
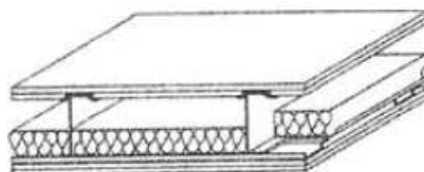
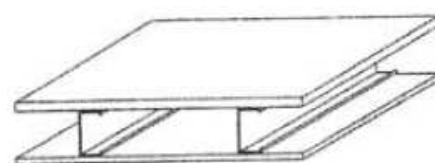
Extern väggtyp



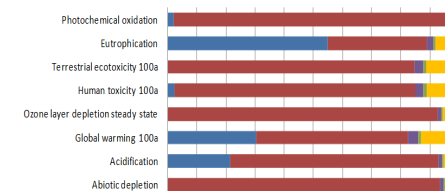
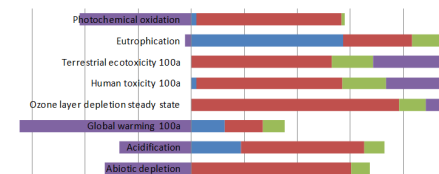
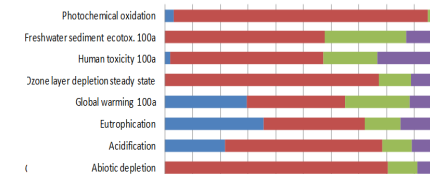
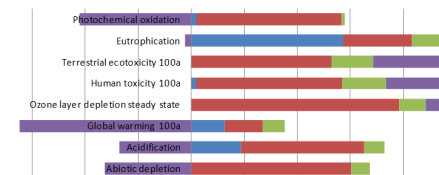
Miljöprofil



Typ av golvsystem



Miljöprofil





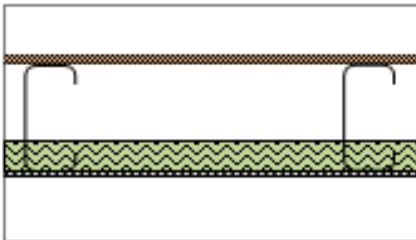
KLASSIFICERING AV MAKROKOMPONENTER

(A) Substruktur	(A40) Plattor på marken	(A4010) Plattor på marken, standard	
(B) Skäl	(B10) Superstruktur	(B1010) Golvkonstruktion	(B1010.10) Strukturell ram, golv
			(B1010.20) Deck, plattor och ytor på golv
		(B1020) Takkonstruktion	(B1020.10) Strukturell ram, tak
			(B1020.20) Deck, plattor och stålplåt på tak
	(B20) Yttre vertikala höljen	(B2010) Yttre väggar	(B2010.10) Yttre väggfanér
			(B2010.20) Yttre väggkonstruktion
		(B2020) Yttre fönster	
		(B2050) Yttre dörrar	
	(B30) Yttre horisontella höljen	(B3010) Takläggning	
		(B3060) Horisontella öppningar	
(C) Interiör	(C10) Inre konstruktion	(C1010) Inre partitioner	
	(C20) Inredning	(C2010) Väggar	
		(C2030) Golv	
		(C2050) Tak	



DATABAS FÖR MAKROKOMPONENTER

EXEMPEL:

B1010.10 Floor structural frame					
B1010.10.1a	Materials	Thickness/ density	End-of-life scenario	RR (%)	
	OSB (mm)	18	Incineration	80	
	Air cavity (mm)	160			
	Rock wool (mm)	40	Recycling	80	
	Gypsum board (mm)	15	Recycling	80	
	LWS (kg/m2)	14	Recycling	90	
B1010.10.1a - LCA					
	A1-A3	A4	C2	C4	D
ADP elements [kg Sb-Equiv.]	2,83E-05	1,76E-09	1,54E-09	3,37E-08	-1,96E-04
ADP fossil [MJ]	5,48E+02	6,54E-01	5,72E-01	1,31E+00	-3,35E+02
AP [kg SO2-Equiv.]	1,70E-01	2,11E-04	1,83E-04	5,74E-04	-4,45E-02
EP [kg Phosphate-Equiv.]	1,41E-02	4,86E-05	4,20E-05	8,79E-05	-1,01E-03
GWP [kg CO2-Equiv.]	5,12E+01	4,71E-02	4,12E-02	3,86E-01	-1,46E+01
ODP [kg R11-Equiv.]	7,65E-07	8,25E-13	7,21E-13	7,21E-11	1,76E-07
POCP [kg Ethene-Equiv.]	2,53E-02	-6,89E-05	-5,95E-05	1,49E-04	-1,07E-02

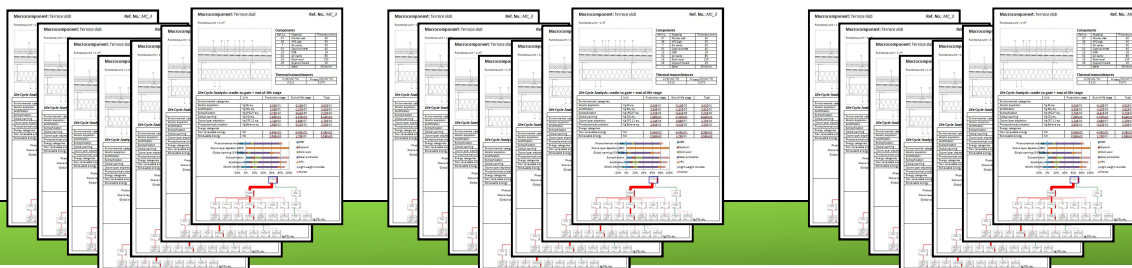
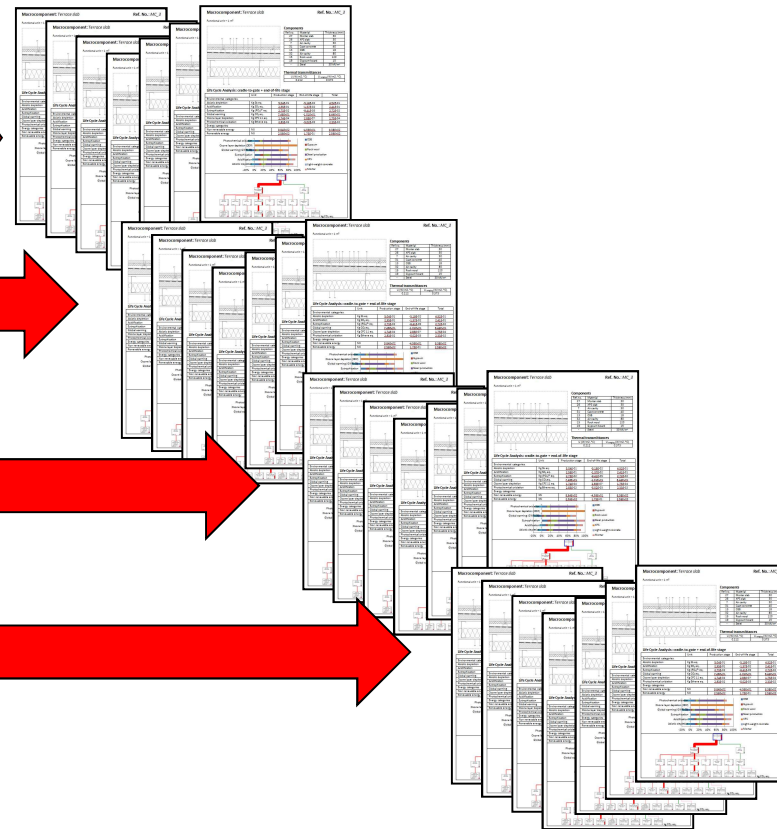
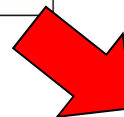
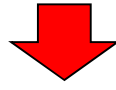
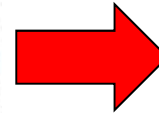


LARGE VALORISATION ON SUSTAINABILITY OF STEEL STRUCTURES



DATABAS FÖR MAKROKOMPONENTER

	Category 1	Category 2	Category 3
Single & multi-family building			
Apartment blocks			
Office buildings			
Commercial/Industrial buildings			





2) Applikation för iPad och iPhone

Meny

Steel_LCA

Catalogue

Manual

Reports

Settings



Meny

Steel_LCA

Catalogue

Manual

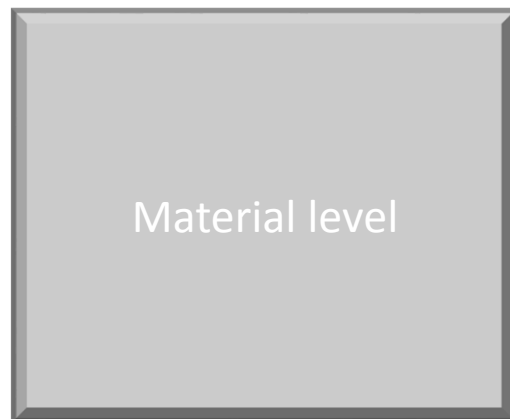
Reports

Settings

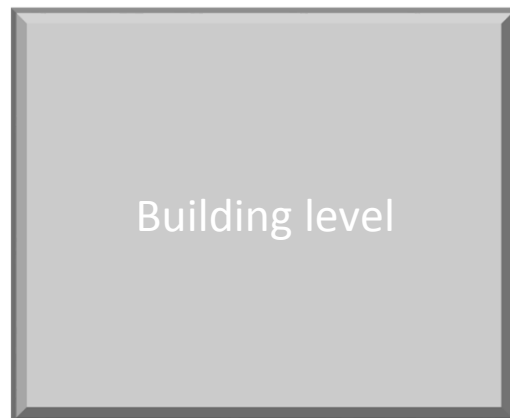


Meny >> Steel_LCA

Beräkningar i två nivåer:



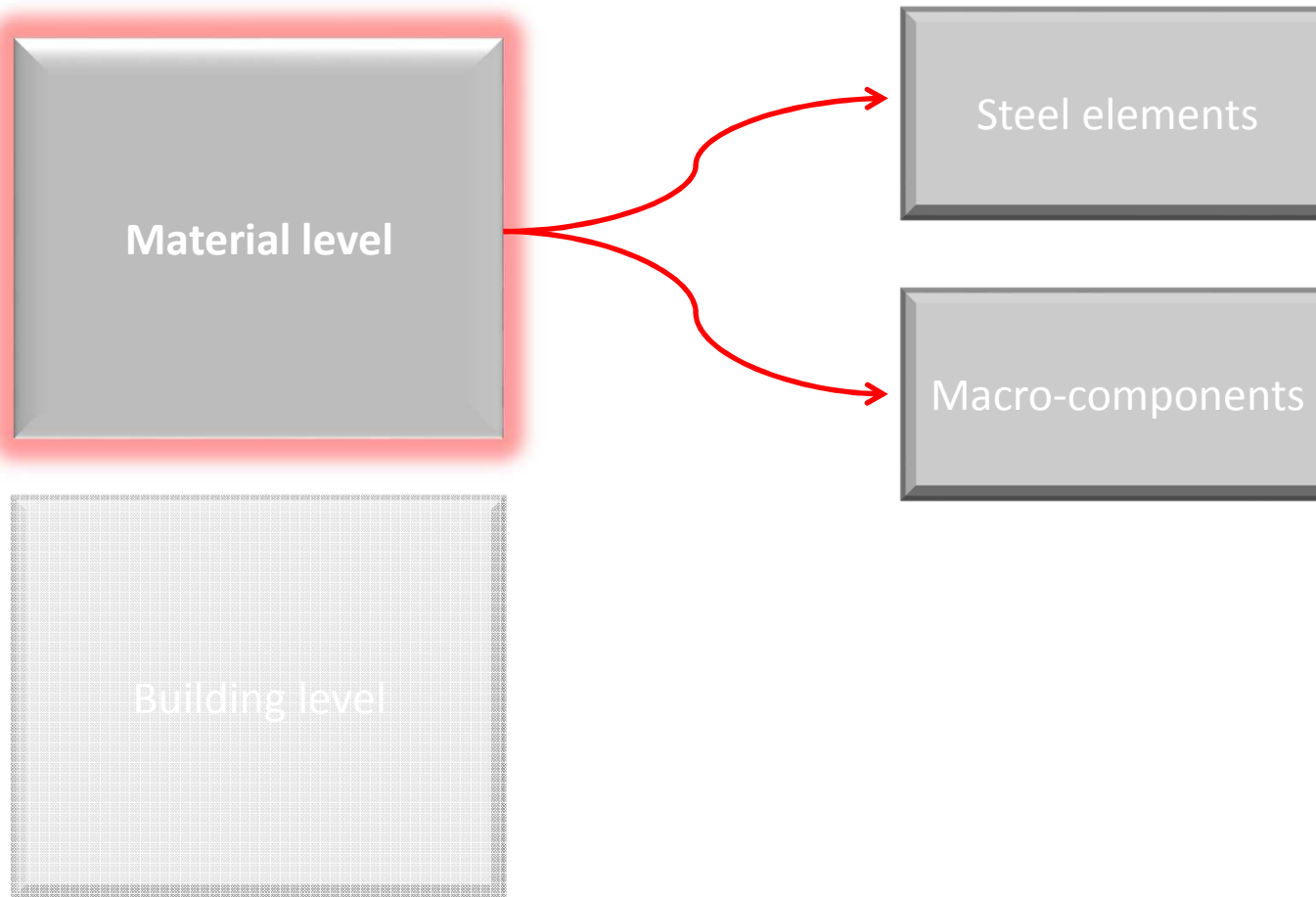
EN 15804:2012



EN 15978:2011

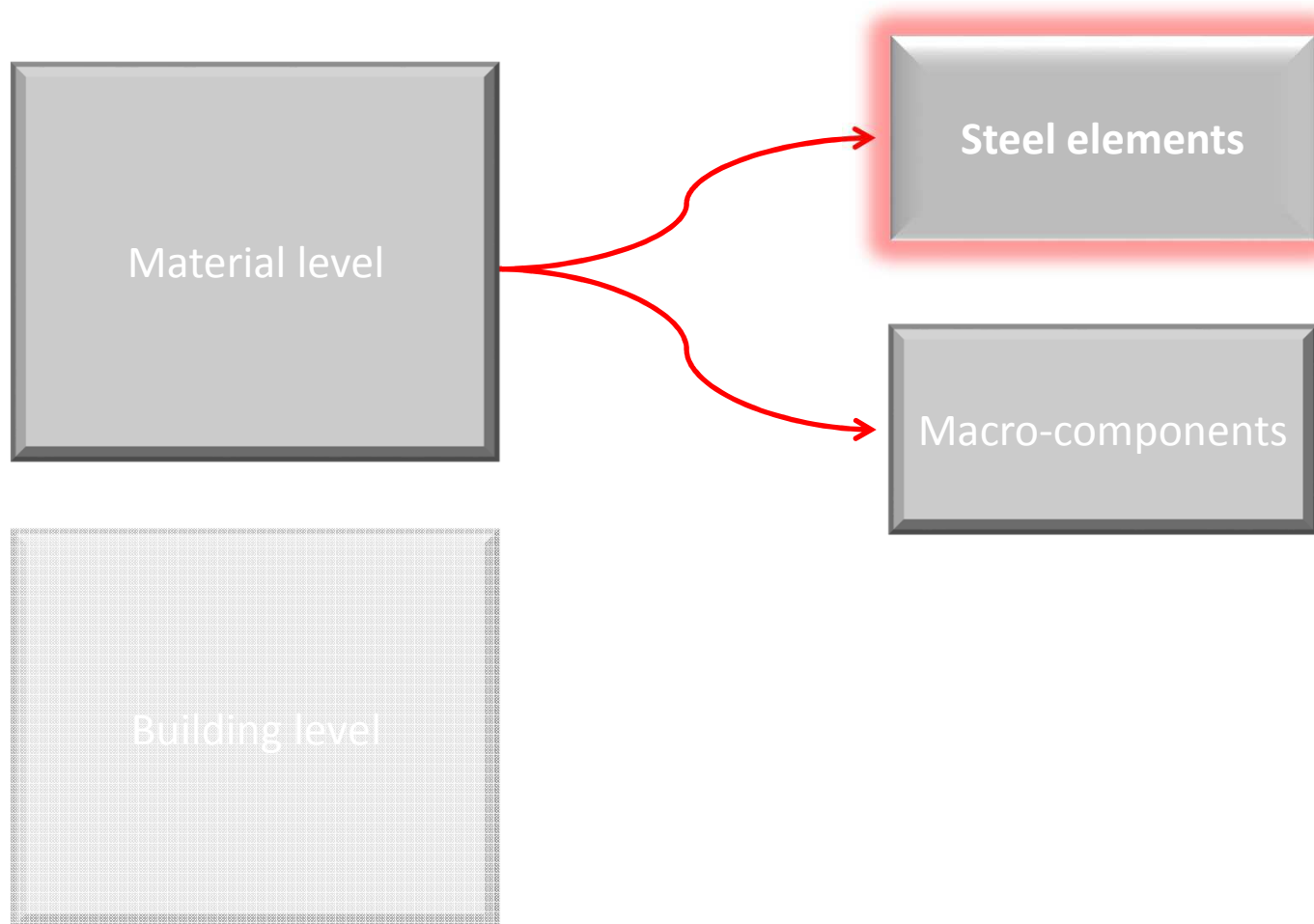


Menu >> Steel_LCA >> Material level





Menu >> Steel_LCA >> Material level





LARGE VALORISATION ON SUSTAINABILITY OF STEEL STRUCTURES



Menu >> Steel_LCA >> Material level

No SIM
16:59
69%

< I or H sections
I or H sections
CALCULATE

HE
HE 100 AA
HE 100 A
HE 100 B
HE 100 M
HE 120 AA
HE 120 A
HE 120 B
HE 120 M
HE 140 AA
HE 140 A
HE 140 B
HE 140 M

HE 100 AA

add your company

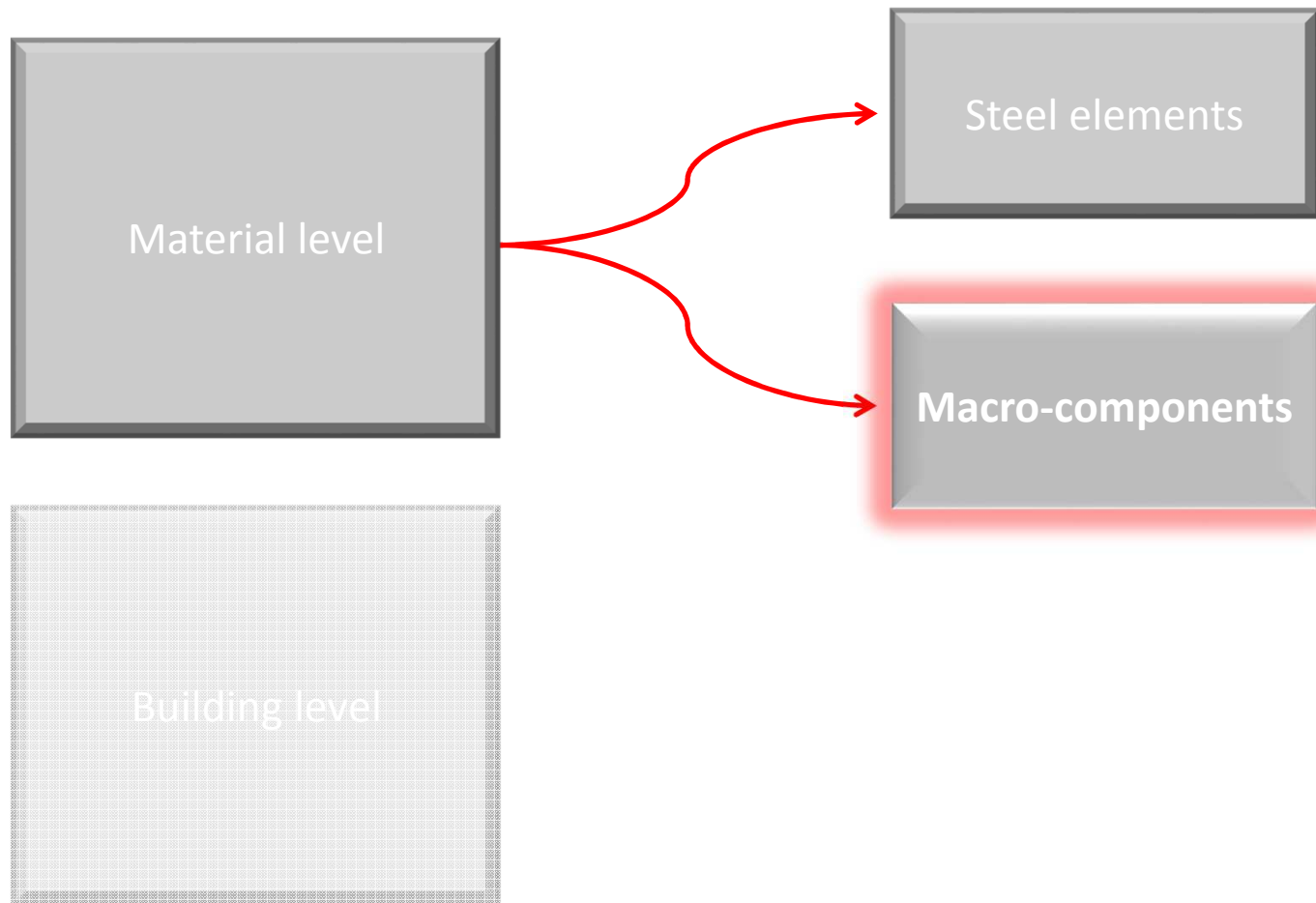
Designation		
G	12.24	[kg/m]
Dimensions		
h	91.00	[mm]
b	100.00	[mm]
t.w	4.20	[mm]
t.f	5.50	[mm]

Inputs parameters
Length [m] 0
Lifespan [years] 0
Steel Grade S235
Quality JR
Fabrication Procedure Hot Rolled

Scope of the Analysis
Cradle-to-gate
Coating System ✓
Transportation ✓
End-of-life recycling ✓



Menu >> Steel_LCA >> Material level





Menu >> Steel_LCA >> Material level >> Macro-components

Macro-components



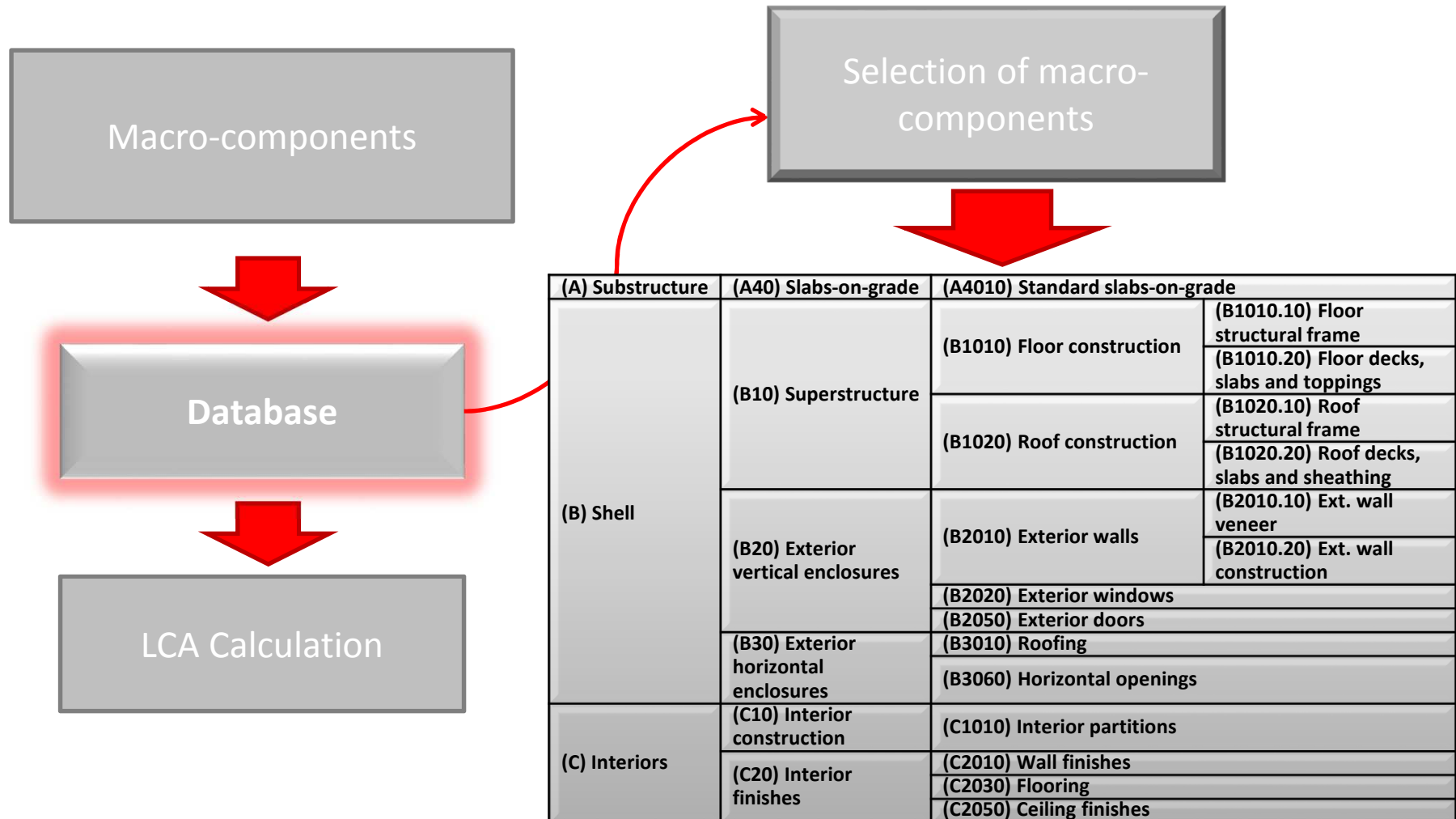
Database



LCA Calculation



Menu >> Steel_LCA >> Material level >> Macro-components





Menu >> Steel_LCA >> Material level >> Macro-components

Macro-components



Database



LCA Calculation

VO SIM 17-02 00:70

< (B1010.10) Floor structur... (B1010.10) Floor structural frame CALCULATE

B1010.10.1 – Light-weight steel slabs

- B1010.10.1a
- B1010.10.1b
- B1010.10.1c
- B1010.10.1d
- B1010.10.1e

B1010.10.1a

+ add your company MAP

Rock wool

Density 150 [kg/m²]

Thickness 40 [mm]

Weight

Inputs parameters

Rock wool [mm] 60

Scope of the Analysis

Cradle-to-grave + EOL

ADPelements

A1-A3	2.90e-5
A4	1.89e-9
B	0.00e+0
C2	1.65e-9

Full Report



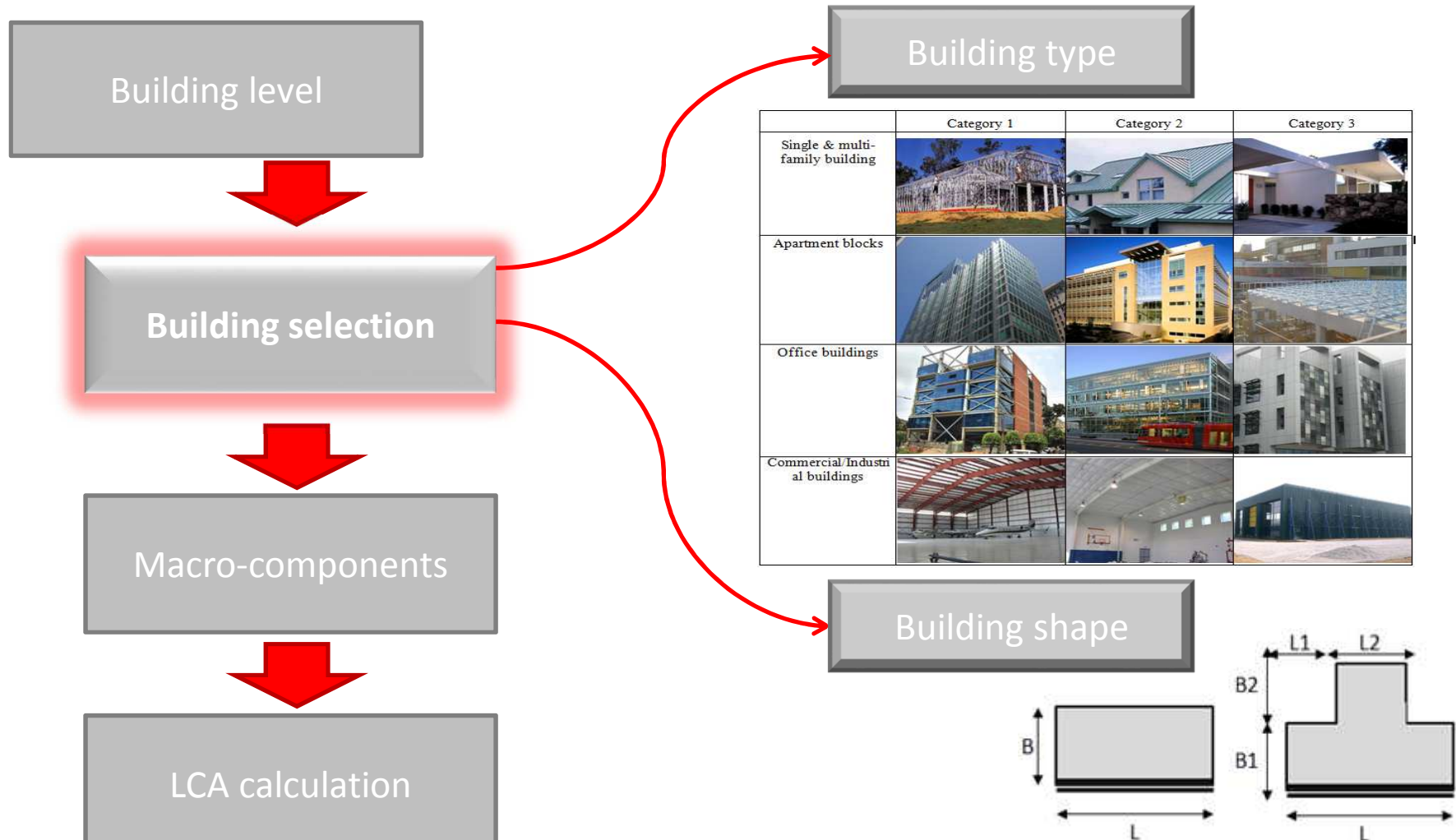
Menu >> Steel_LCA >> Building level

Material level

Building level

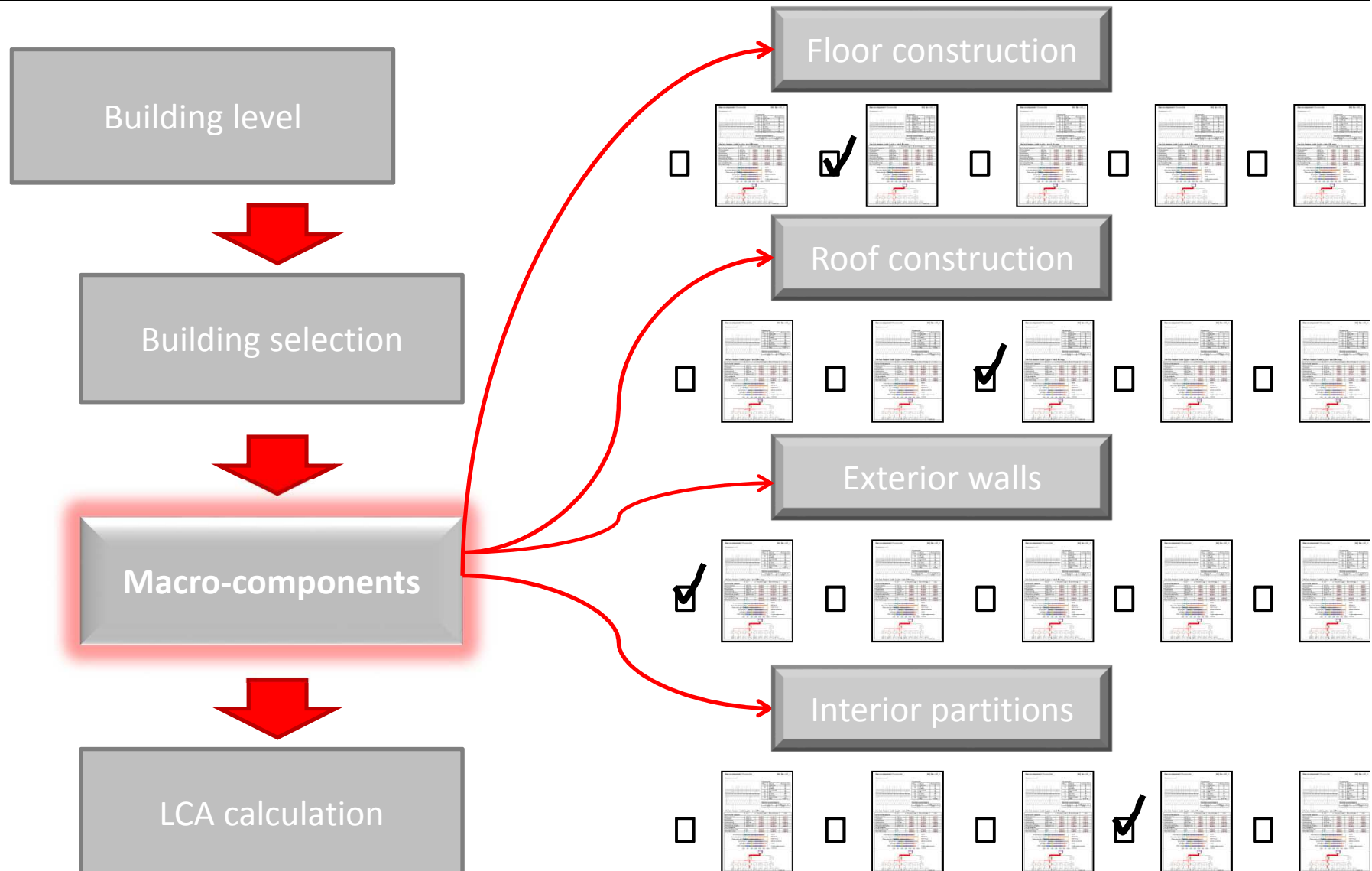


Menu >> Steel_LCA >> Building level >> Building selection





LARGE VALORISATION ON SUSTAINABILITY OF STEEL STRUCTURES





Menu >> Steel_LCA >> Building level >> LCA calculation

Building level



Building selection



Macro-components



LCA calculation & report

LCA REPORT FOR STEEL BUILDINGS

SUMMARY

Scope: Cradle-to-grave + EOL

Lifespan: 50 years

Environmental Impacts

LCA index: $-1.42E-11$

Global Warming Potential (GWP): 41 kg CO₂ eq

Primary Energy Demand

Total Primary Energy Demand: 679 MJ

DETAILED RESULTS

LCA Input Data

B1010.10 Floor structural frame

	Materials	Thickness (mm)	End-of-life scenario	RR (%)
	Light weight steel (LWS)		Recycling	90
	OSB	18	Incineration	80
	Gypsum plasterboard	15	Recycling	80
	Rock wool	40	Recycling	80

LCA Results

LCA of 1m² of a Roof macro-component

Parameters describing environmental impacts

Indicator	Unit	A1-A3	A4	B1-B5	C2	C4	D	TOTAL
ADP elements	[kg Sb Eq.]	2.90e-5	1.89e-9	0.00e+0	1.65e-9	3.67e-8	-1.97e-4	-1.68e-4
ADP fossil	[MJ]	5.88e+2	7.02e-1	0.00e+0	6.14e-1	1.43e+0	-3.36e+2	2.55e+2
AP	[kg SO ₂ Eq.]	1.93e-1	2.27e-4	0.00e+0	1.97e-4	6.25e-4	-4.45e-2	1.50e-1
EP	[kg PO ₄ - Eq.]	1.66e-2	5.22e-5	0.00e+0	4.51e-5	9.59e-5	-1.01e-3	1.58e-2
GWP	[kg CO ₂ Eq.]	5.48e+1	5.06e-2	0.00e+0	4.41e-2	4.20e-1	-1.46e+1	4.05e+1
ODP	[kg CFC-11 Eq.]	7.65e-7	8.86e-13	0.00e+0	7.73e-13	7.85e-11	1.76e-7	9.42e-7
POCP	[kg C ₂ H ₄ Eq.]	2.70e-2	-7.40e-5	0.00e+0	-6.38e-5	1.62e-4	-1.07e-2	1.63e-2



3) Slutliga kommenterar

- Den förenklade metoden för livscykelanalys undviker användning av komplexa verktyg och experter, och möjliggör en väsentlig reduktion av den tid som vanligtvis krävs för en sådan analys.
- Valideringen av metoden baserades på jämförelse med avancerade analyser utförda med den kommersiella programvaran GaBi 6.
- Jämförelsen av resultaten leder till slutsatsen att noggrannheten är tillfredsställande hos båda metoderna.