

Research Fund
for Coal & Steel



Teraskonstruksioonide jätkusuutlikkuse analüüs

MAKROKOMPONENDID NING *IPHONE* JA *IPAD* RAKENDUSED



Sisu

1) Makrokomponentide meetod

- LCA algoritm makrokomponente kasutades

2) iPad ja iPhone rakendused

- Tarkvara kirjeldus

3) Kokkuvõte



1) Makrokomponentide meetod

Meetod töötati välja RFCS projektis



SB STEEL

SB_Steel (2014), Terasest jätkusuutliku hoone projekt RFSR-CT-2010-00027

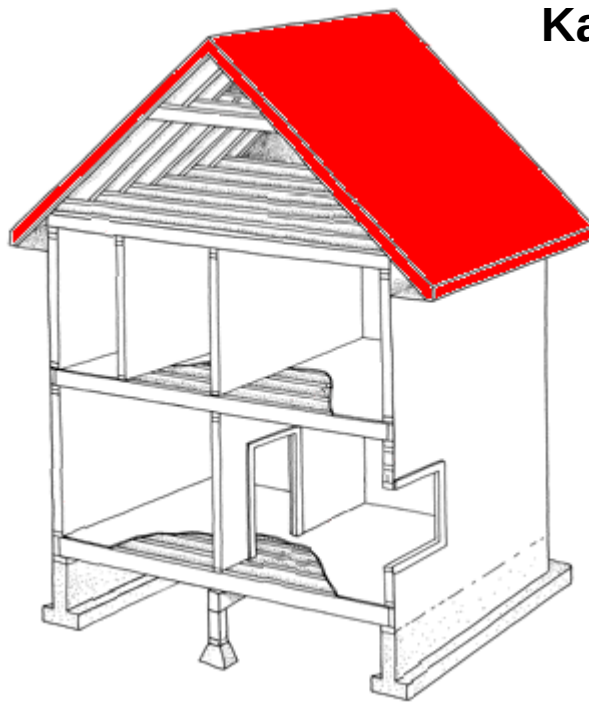
REFERENCES: Gervásio, H., Martins, R., Santos, P., Simões da Silva, L., “A macro-component approach for the assessment of building sustainability in early stages of design”, Building and Environment 73 (2014), pp. 256-270, DOI information: 10.1016/j.buildenv.2013.12.015.

Teraskarkassiga hoonete tüübid

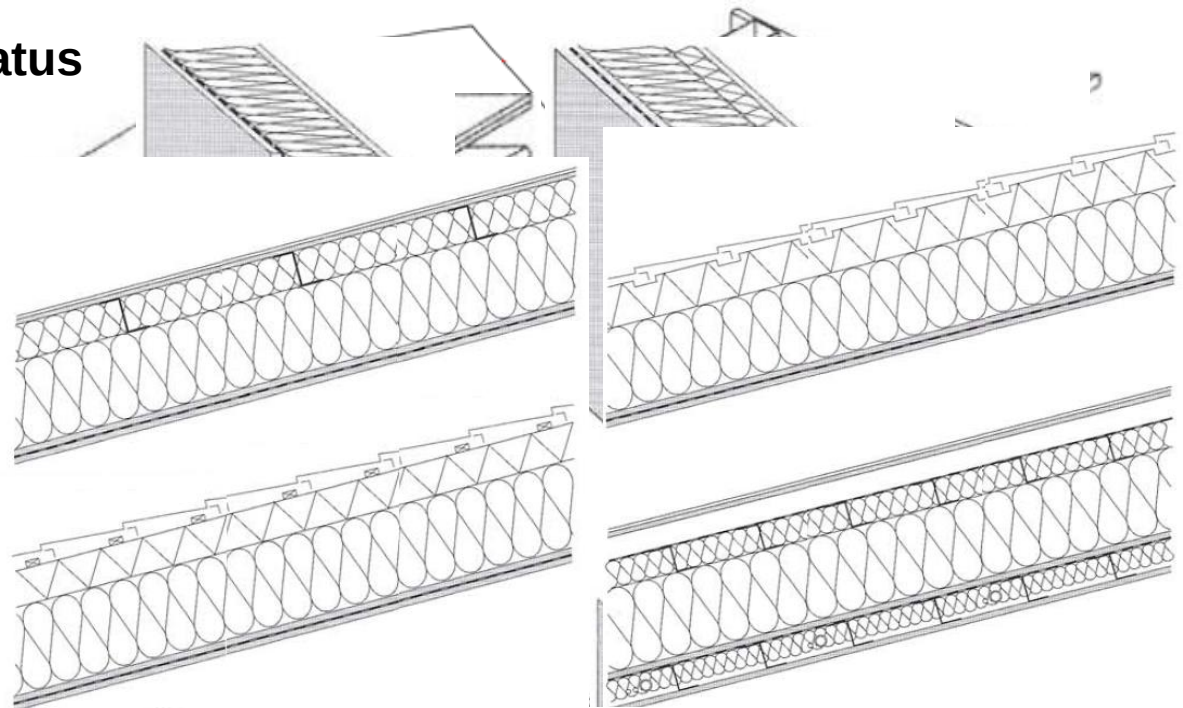
	Category 1	Category 2	Category 3
Single & multi-family building			
Apartment blocks			
Office buildings			
Commercial/Industrial buildings			

Ühepereelamu
Tüüp 1

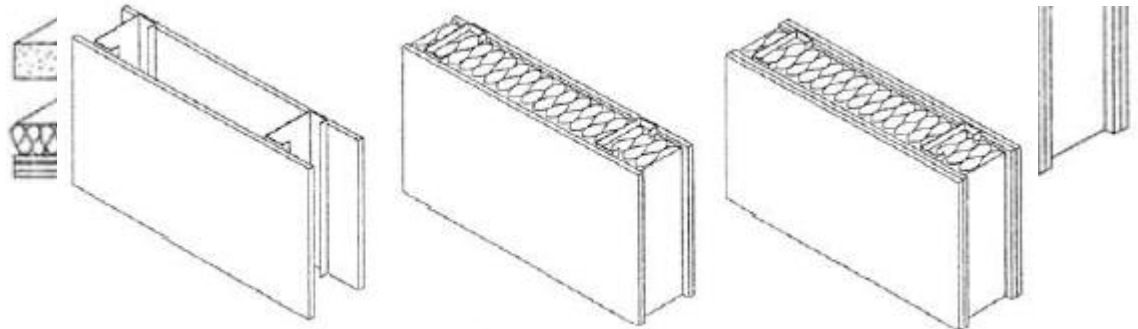
MAKROKOMPONENTIDE MEETOD



Katus



**Kandvad välisseinad
Vahelaed**



Mittekandvad siseseinad

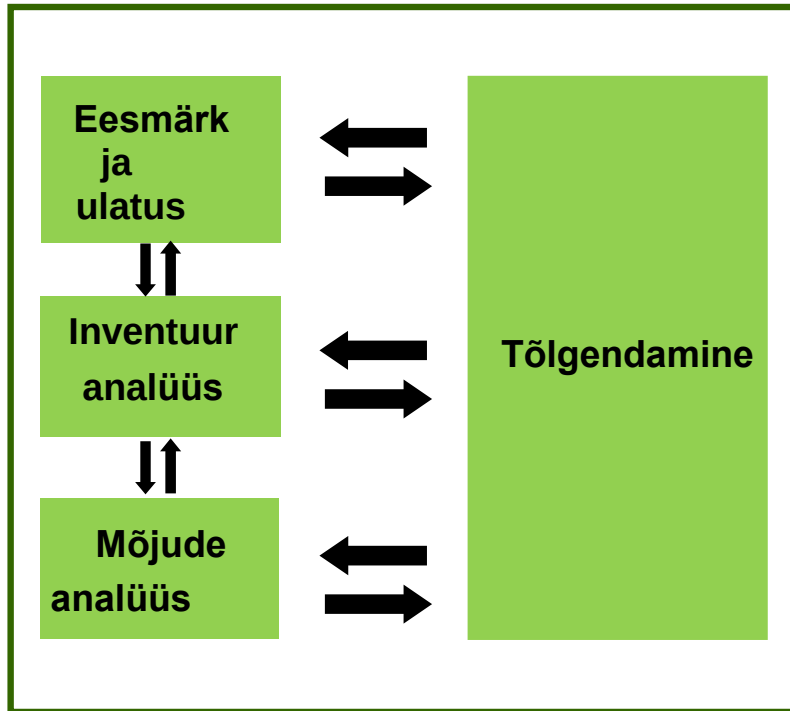


TERASKONSTRUKTSIOONIDE JÄTKUSUUTKLIKKUSE ANALÜÜS



MAKROKOMPONENTIDE ARVUTUS

ISO STANDARDID 14040/14044



Eesmärk ja ulatus

Kaks tasandit: LCA (i) komponendi tasand;

(ii) Hoone tasand.

Süsteemi piirid

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	

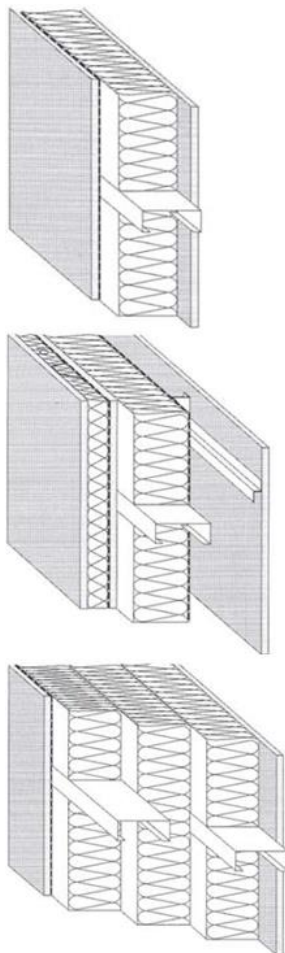
Muud asjakohased standardid EN TC350 – Sustainability of construction works - EN 15643-2:2011

INVENTUUR

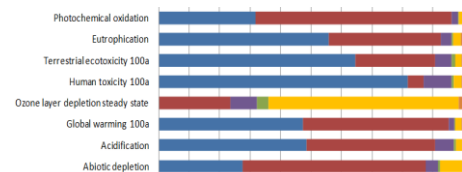
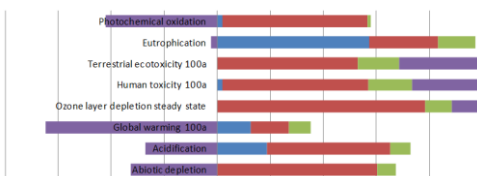
	Time coverage		Geographical coverage	Technology coverage	Completeness
Steel section	2007,	annual average	Europe	European producers	> 99% of mass and energy
Steel rebar	2007,	annual average	World	World producers	> 99% of mass and energy
Steel coil	2007,	annual average	Europe	European producers	> 99% of mass and energy
Concrete C20/25	2011,	annual average	Germany	German producers	> 95% of mass and energy
Oriented strand board OSB	2008,	annual average	Germany	German producers	> 99% of mass and energy
Gypsum 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 XPS	2011,	annual average	Germany	German producers	> 95% of mass and energy
Polyurethane rigid foam PUR	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

MAKROKOMPONENDID

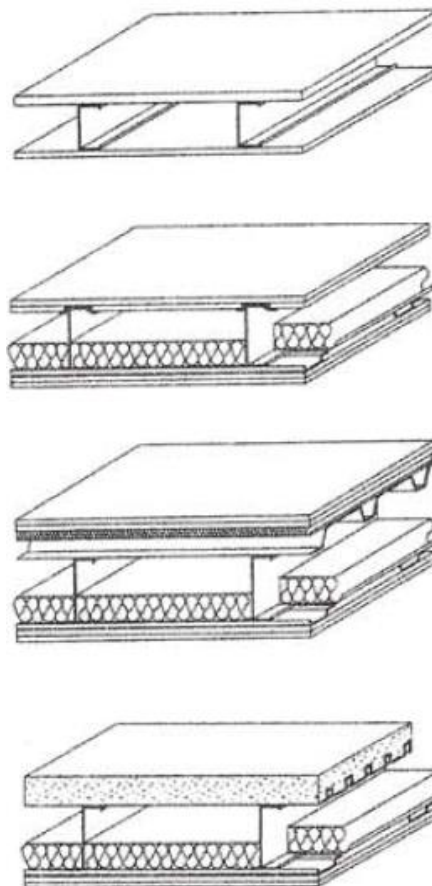
Välisseina tüüp



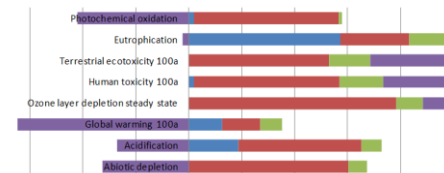
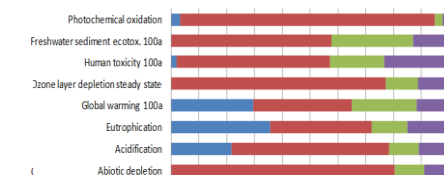
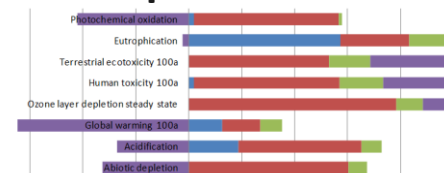
Keskkonnamõjude profiil



Vahelae tüüp



Keskkonnamõjude profiil





TERASKONSTRUKTSIOONIDE JÄTKUSUUTKLIKKUSE ANALÜÜS



MAKROKOMPONENTIDE LIIGITUS

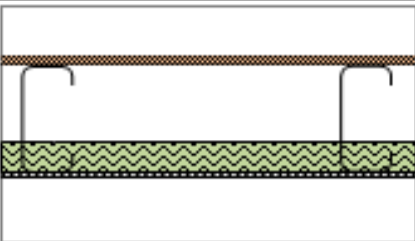
(A) Substructure	(A40) Slabs-on-grade	(A4010) Standard slabs-on-grade	
(B) Shell	(B10) Superstructure	(B1010) Floor construction	(B1010.10) Floor structural frame
			(B1010.20) Floor decks, slabs and toppings
		(B1020) Roof construction	(B1020.10) Roof structural frame
			(B1020.20) Roof decks, slabs and sheathing
	(B20) Exterior vertical enclosures	(B2010) Exterior walls	(B2010.10) Ext. wall veneer
			(B2010.20) Ext. wall construction
		(B2020) Exterior windows	
		(B2050) Exterior doors	
	(B30) Exterior horizontal enclosures	(B3010) Roofing	
		(B3060) Horizontal openings	
(C) Interiors	(C10) Interior construction	(C1010) Interior partitions	
	(C20) Interior finishes	(C2010) Wall finishes	
		(C2030) Flooring	
		(C2050) Ceiling finishes	



MAKROKOMPONENTIDE ANDMEBAAS

EXAMPLE:

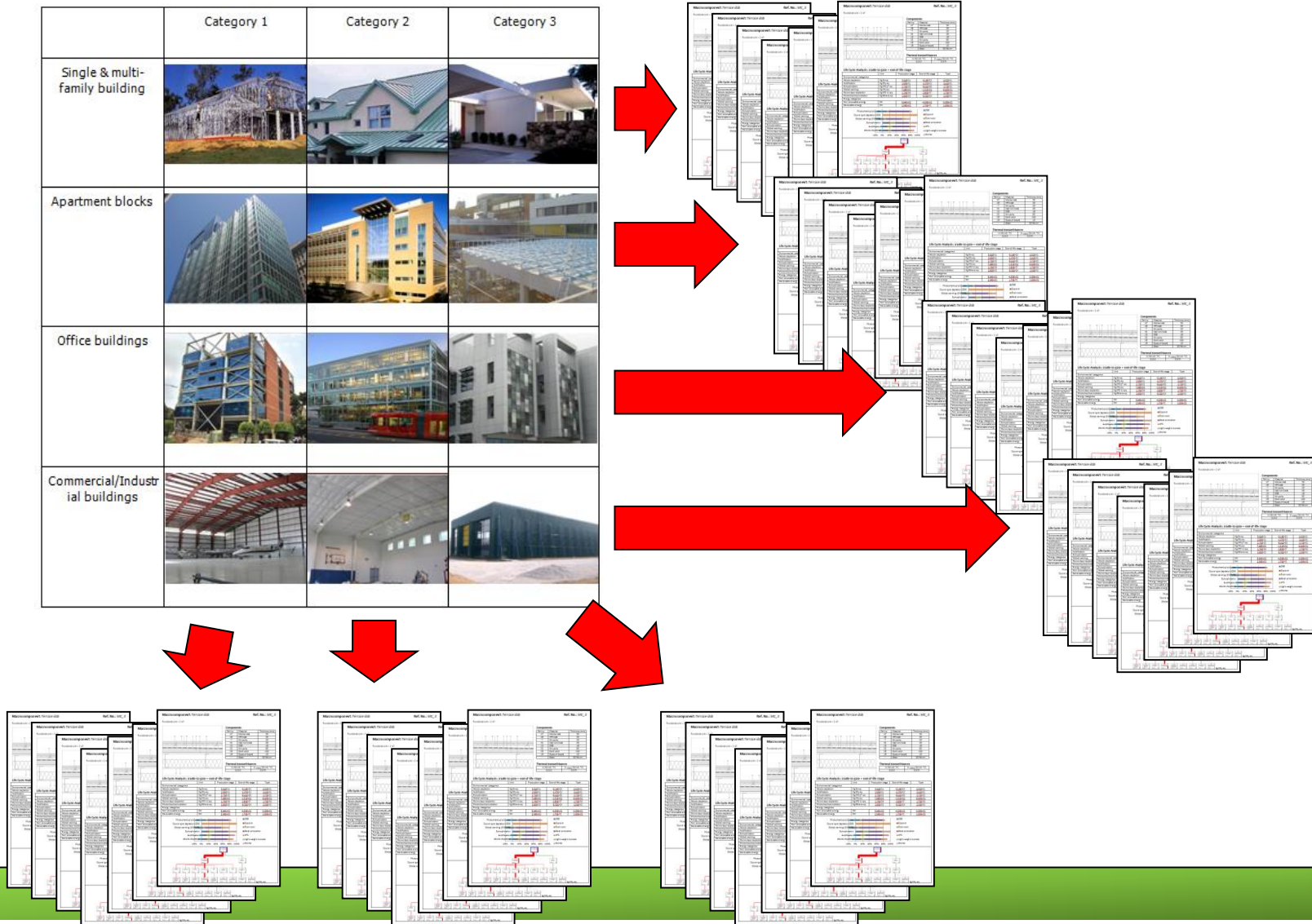
B1010.10 Floor structural frame

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

MAKROKOMPONENTIDE ANDMEBAAS





2) iPad ja iPhone rakendused

Menu

Teras_LCA

Kataloog

Juhend

Tulemused

Seaded



Menüü

Teras_LCA

Kataloog

Juhend

Tulemused

Seaded



Menüü >> Teras_LCA

Kaks tasandit:

Materjali tasand



EN 15804:2012

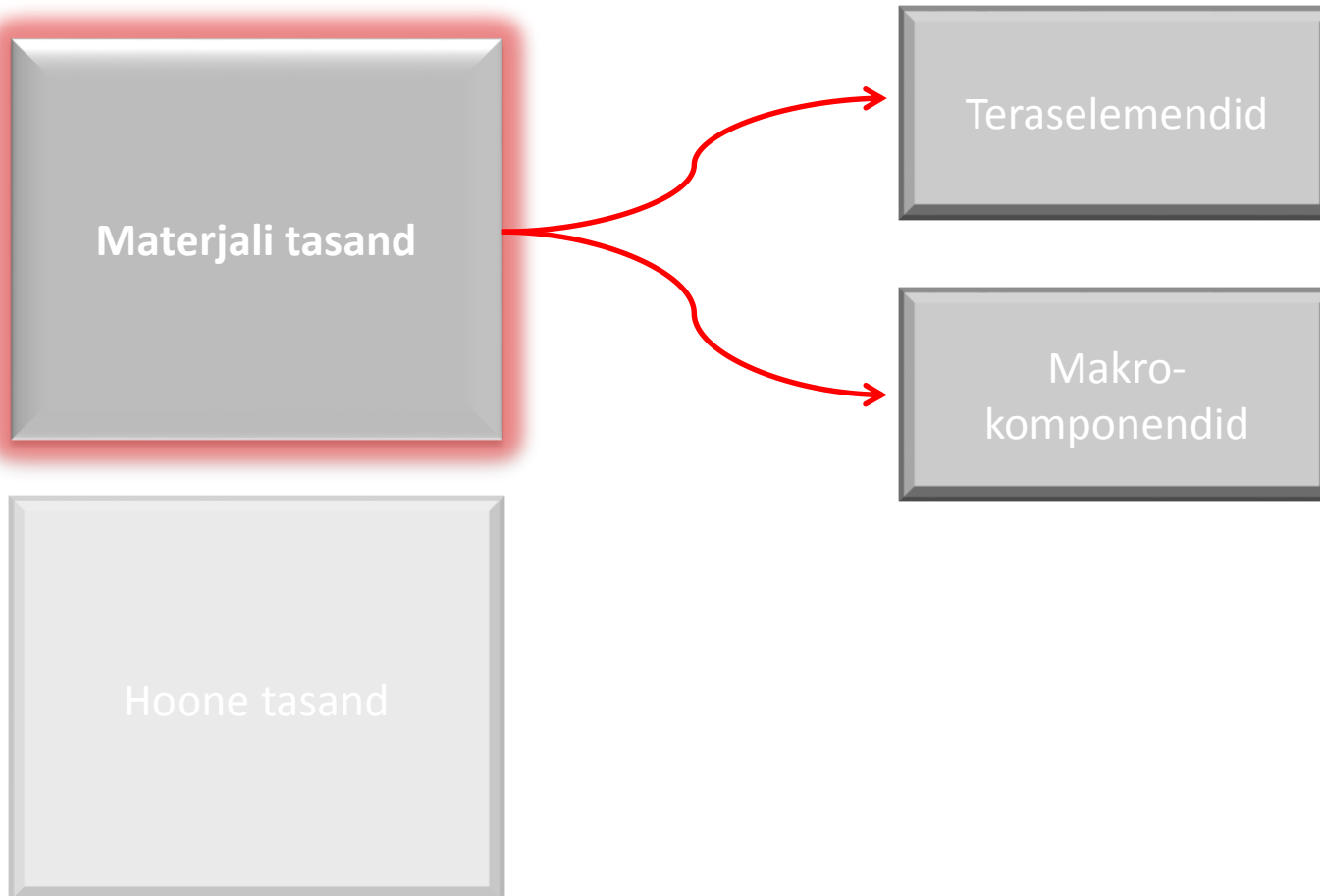
Hoone tasand



EN 15978:2011

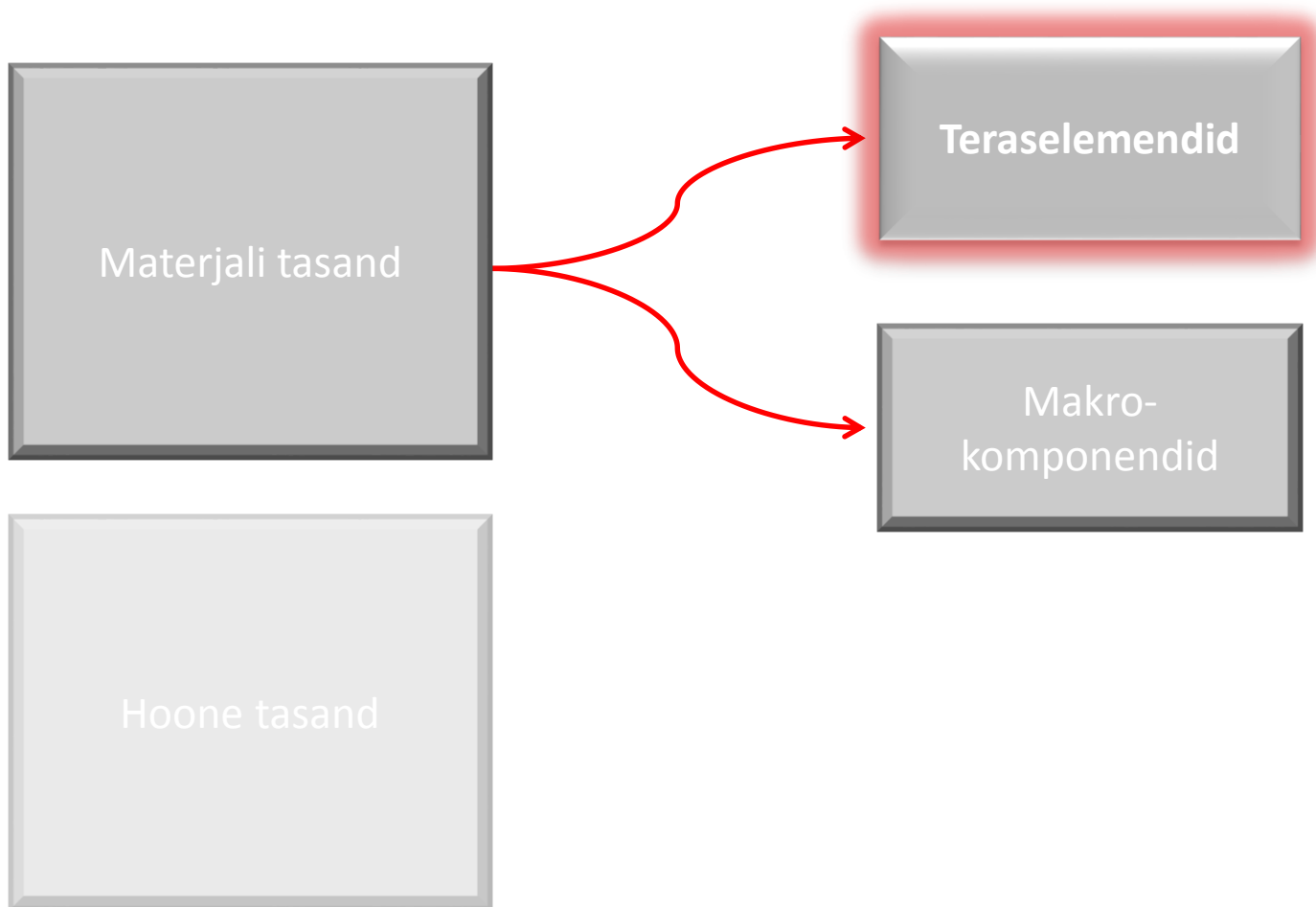


Menüü >> Teras_LCA >> Materjali tasand





Menüü >> Teras_LCA >> Materjali tasand





Menüü >> Teras_LCA >> Materjali tasand

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

MAP

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

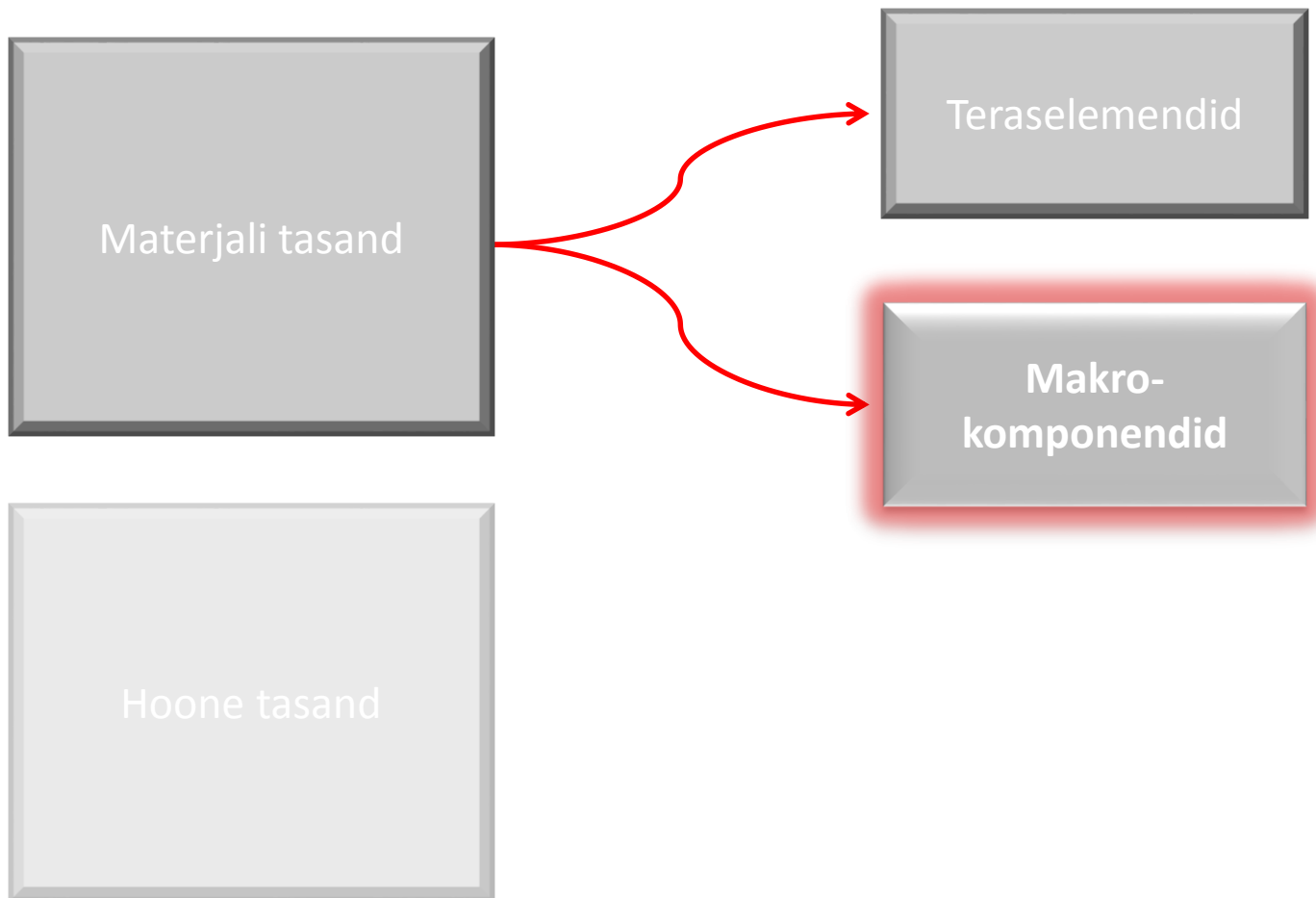
✓

End-of-life recycling

✓

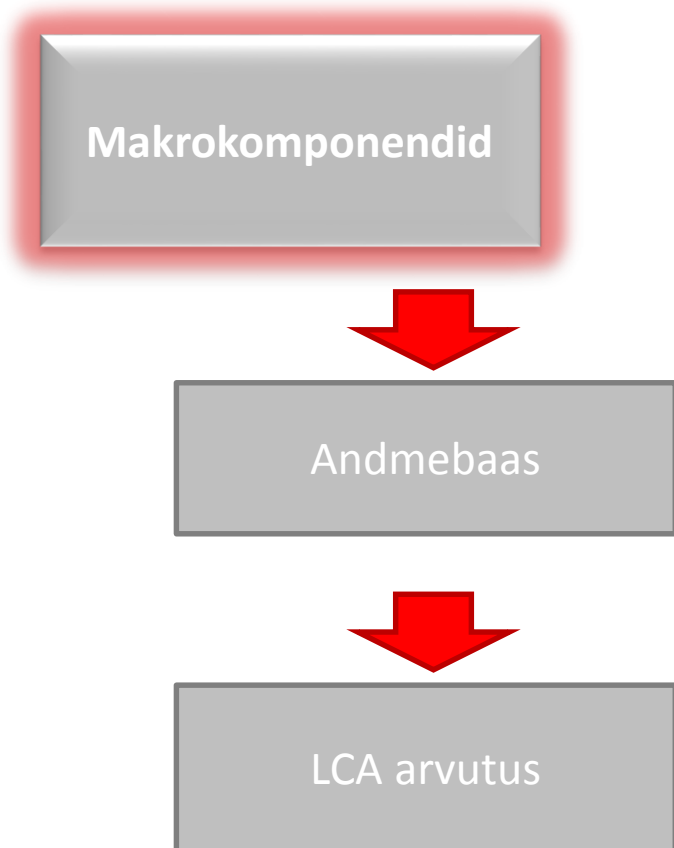


Menüü >> Teras_LCA >> Materjali tasand





Menüü >> Teras_LCA >> Materjali tasand >>
Makrokomponendid





Menüü >> Teras_LCA >> Materjali tasand >> Makrokomponendid

Makrokomponendid



Andmebaas



LCA arvutus

Makrokomponentide valik



(A) Substructure	(A40) Slabs-on-grade	(A4010) Standard slabs-on-grade	
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Menüü >> Teras_LCA >> Materjali tasand >> Makrokomponendid

Makrokomponendid



Andmebaas



LCA arvutus

VO DIM 11:02 100%

< (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

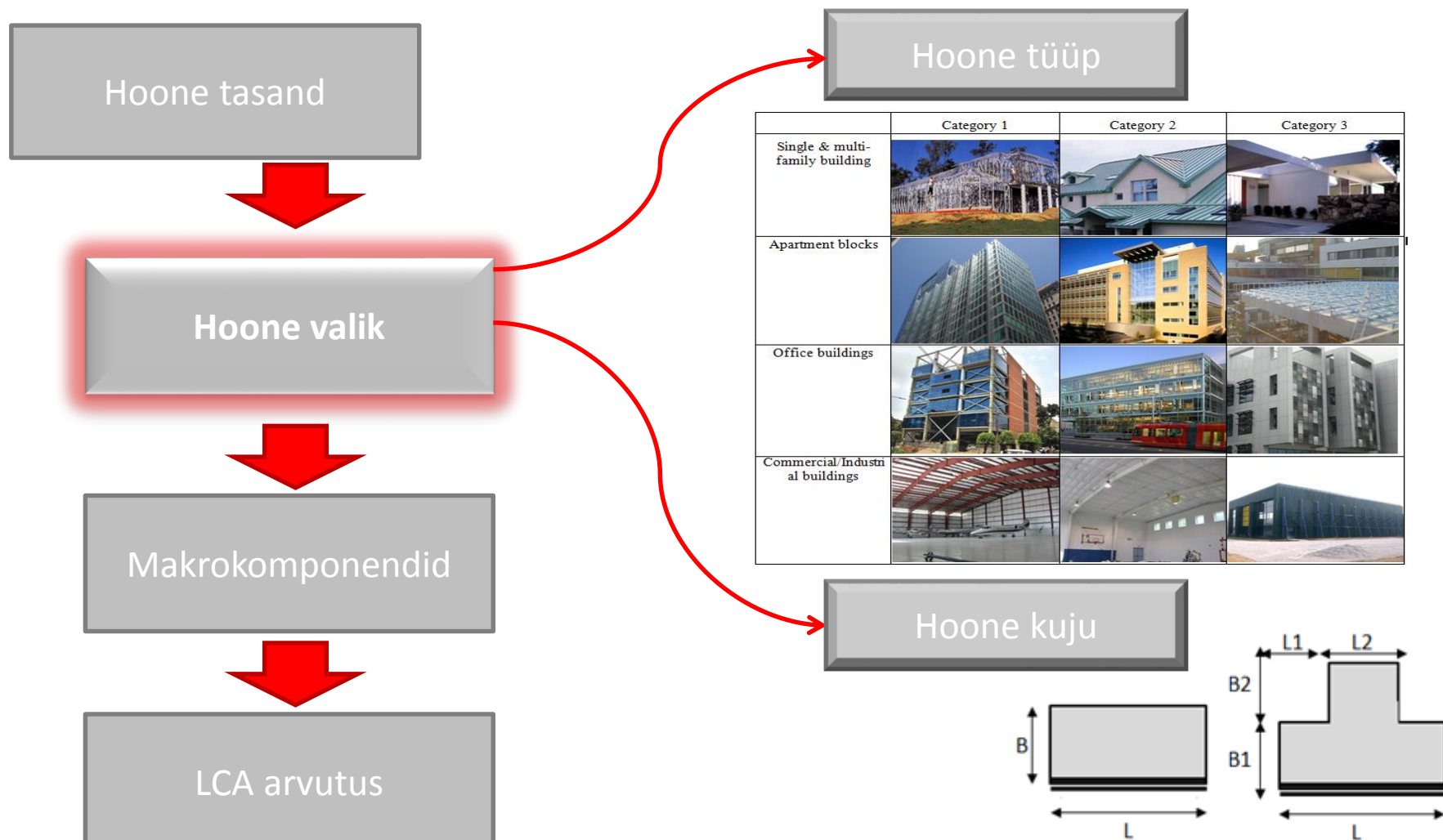


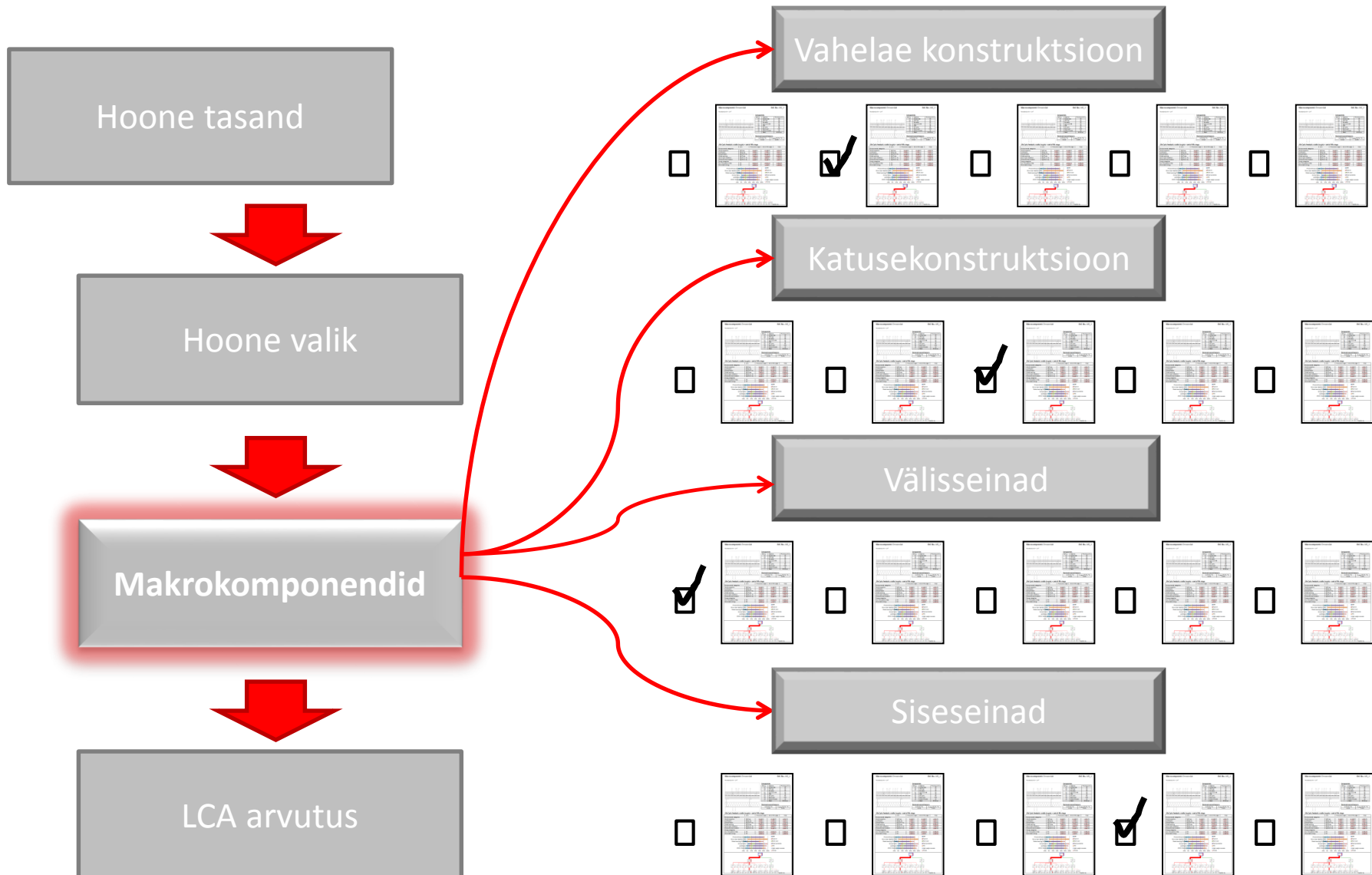
Menüü >> Teras_LCA >> Hoone tasand

Materjali tasand

Hoone tasand

Menüü >> Teras_LCA >> Hoone tasand >> Hoone valik







Menüü >> Teras_LCA >> Hoone tasand >> LCA arvutus

Hoone tasand

Hoone valik

Makrokomponendid

LCA arvutus &
tulemused

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 enviromental 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	7.95e-11	1.78e-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) Kokkuvõte

- Lihtsustatud LCA arvutus on võimalik teha ilma eksperte kaasamata ja suuri kulutusi tarkvarale tegemata.
- Lihtsustatud meetodi on kontrollitud kommertstarkvaraga GaBi 6.
- Tulemuste võrdlus annab kinnituse, et lihtsustatud meetod on piisavalt täpne.