Research Fund for Coal & Steel

LVS 3

Large Valorisation on Sustainability of Steel Structures

MACRO-COMPONENTES: APLICAÇÕES PARA O *IPHONE* E *IPAD*

U C FCTUC FACULDADE DE CIÊNCIAS E TECNOLOGIA UNIVERSIDADE DE COIMBRA

Dezembro 2014

Agenda

1) Abordagem das Macro Componentes

- Algoritmo para análise do ciclo de vida baseado em macro componentes

2) Aplicação para iPad e iPhone

- Descrição do programa

3) Considerações Finais

1) Abordagem das Marco Componentes

Esta metodologia foi previamente desenvolvida no âmbito do projeto de investigação RFCS

SB STEEL

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

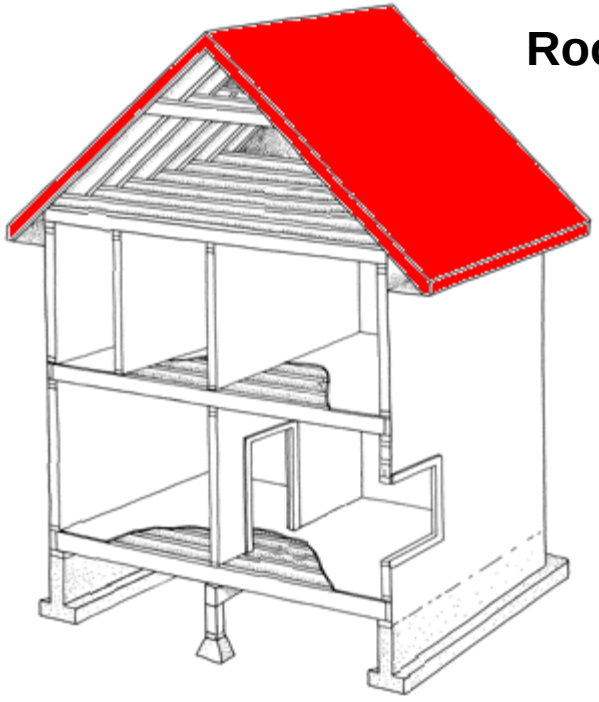
REFERÊNCIA: Gervásio, H., Martins, R., Santos, P., Simões da Silva, L., "A macro-component approach for the assessment of building sustainability in early stages of design", Building and Environment 73 (2014), pp. 256-270, DOI information: 10.1016/j.buildenv.2013.12.015.

Classificação de edifícios com estrutura de aço

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

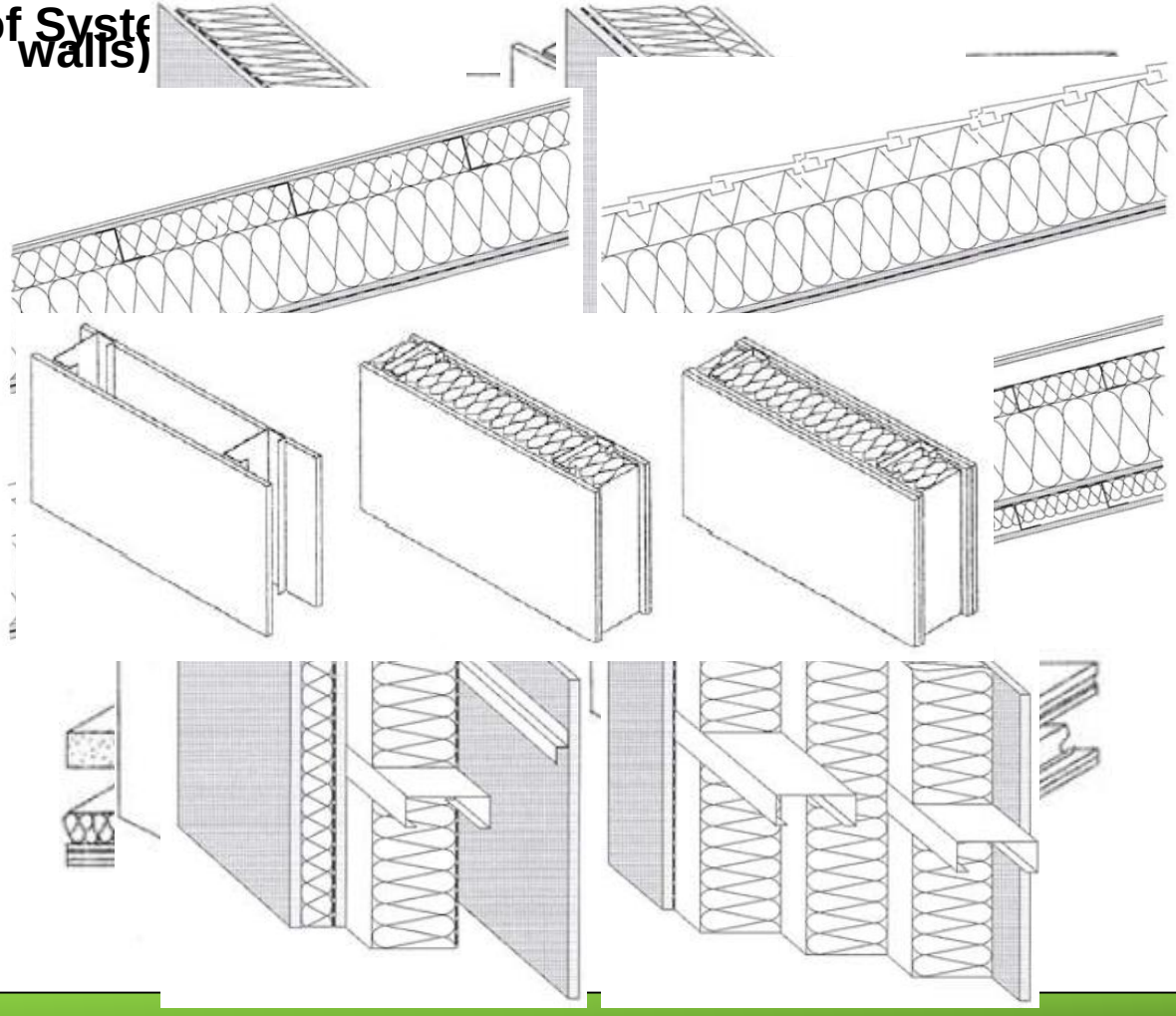
Residência familiar na <u>Categoria 1</u> (edifícios totalmente metálicos)

DEFINIÇÃO DE MACRO COMPONENTES



Roof Syste

Internal wall system (load-bearing walls)

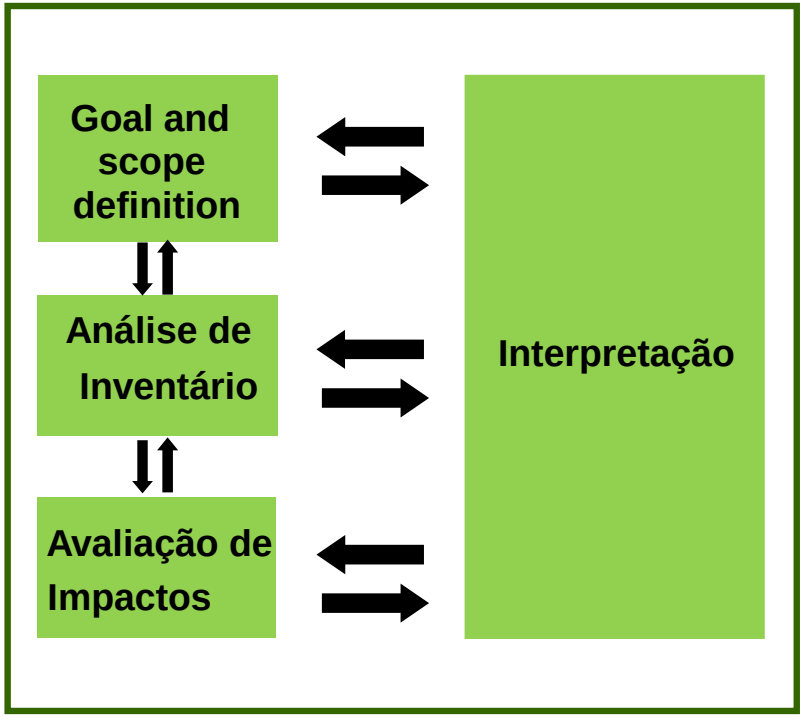


External wall system (load-bearing walls)

Floor system

CÁLCULO DAS MACRO COMPONENTES

ISO STANDARDS 14040/14044



Outras normas importantes EN TC350 - Sustainability of construction works - EN 15643-2:2011

Objetivo e âmbito

Dois níveis: ACV, (i) ao nível do componente; e

(ii) ao nível do edifício.

Fronteiras do Sistema

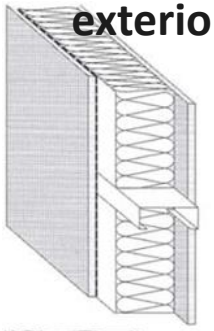
Product stage			Construc stage		Use stage							End-of-life stage				
Raw material supply	Transport	Manufacturing	Transport	Construction process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Demolition	Transport	Waste processing	Disposal	Reuse/Recycling
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

FASE DE INVENTÁRIO

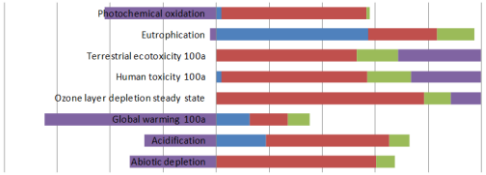
	Time coverage	Geographical coverage	Technology coverage	Completeness
Steel section	2007, annual average	Europe	European producers	> 99% of mass and energy
Steel rebar	2007, annual average	World	World producers	> 99% of mass and energy
Steel coil	2007, annual average	Europe	European producers	> 99% of 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
Gympsum 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

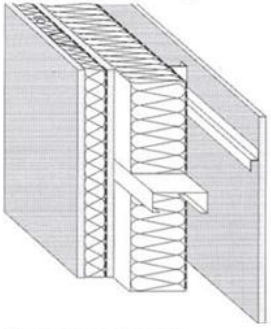
BASE DE DADOS DAS MACRO COMPONENTES

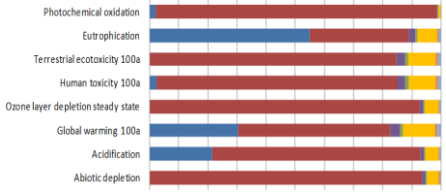
Tipo de parede exterior

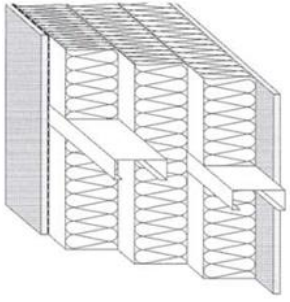


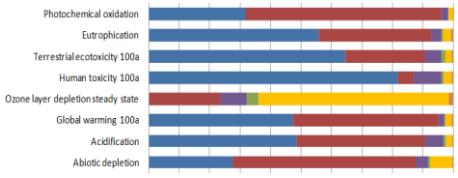
Perfil ambiental



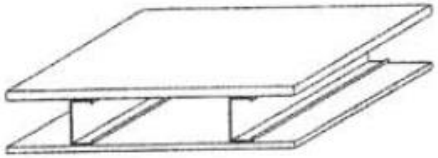


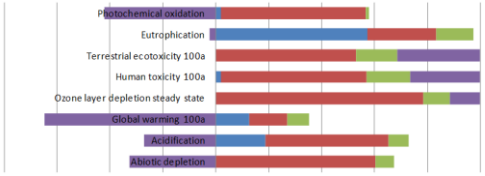


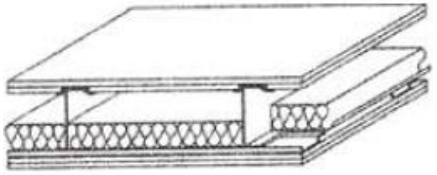


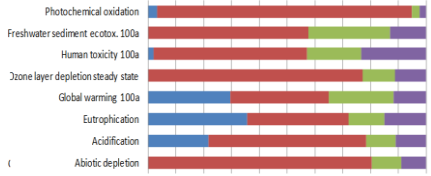


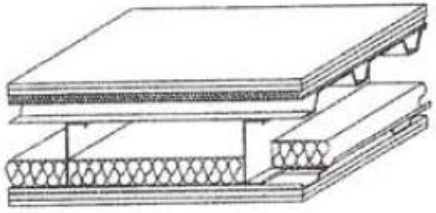
Tipo de sistema de pavimento

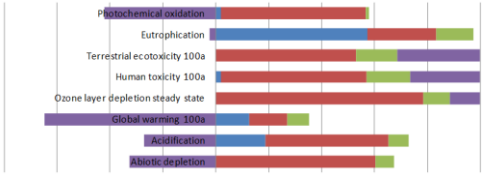


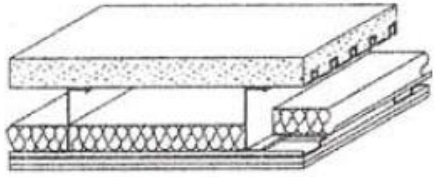


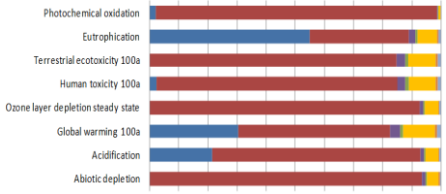












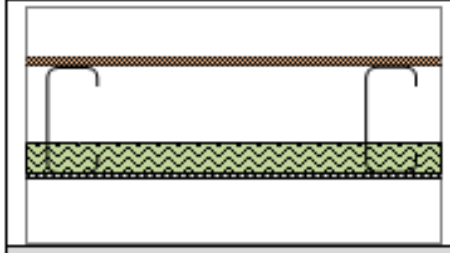
CLASSIFICAÇÃO DAS MACRO COMPONENTES

(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	

BASE DE DADOS DAS MACRO COMPONENTES

EXEMPLO:

B1010.10 Floor structural frame

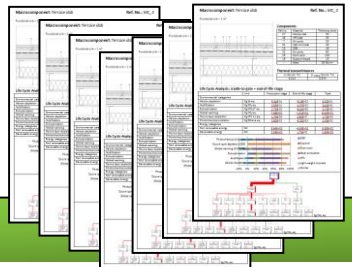
B1010.10.1a	Materials	Thickness/ density	End-of-life scenario	RR (%)
	OSB (mm)	18	Incineration	80
	Air cavity (mm)	160		
	Rock wool (mm)	40	Recycling	80
	Gypsum board (mm)	15	Recycling	80
	LWS (kg/m2)	14	Recycling	90

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

BASE DE DADOS DAS MACRO COMPONENTES

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



2) Aplicação para iPad e iPhone

Menu

Aço_ACV

Catálogo

Manual

Relatórios

Configurações

Menu

- **Aço_ACV**
- Catálogo
- Manual
- Relatórios
- Configurações

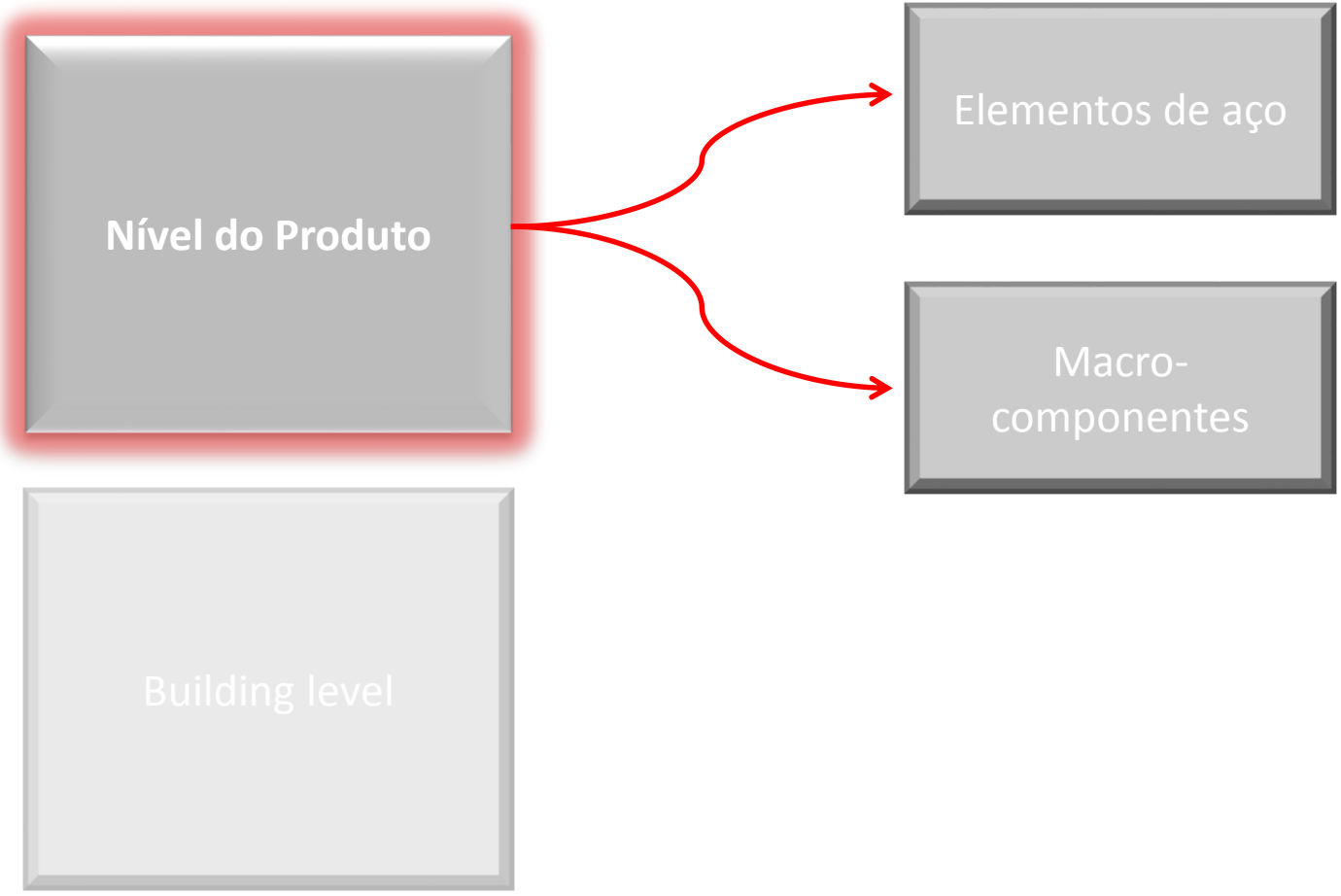
Menu >> AÇO_ACV

Dois níveis de cálculo:

Nível do Produto → EN 15804:2012

Nível do Edifício → EN 15978:2011

Menu >> Aço_ACV >> Nível do Material



Menu >> Aço_LCA >> Nível do Material

Nível do Produto

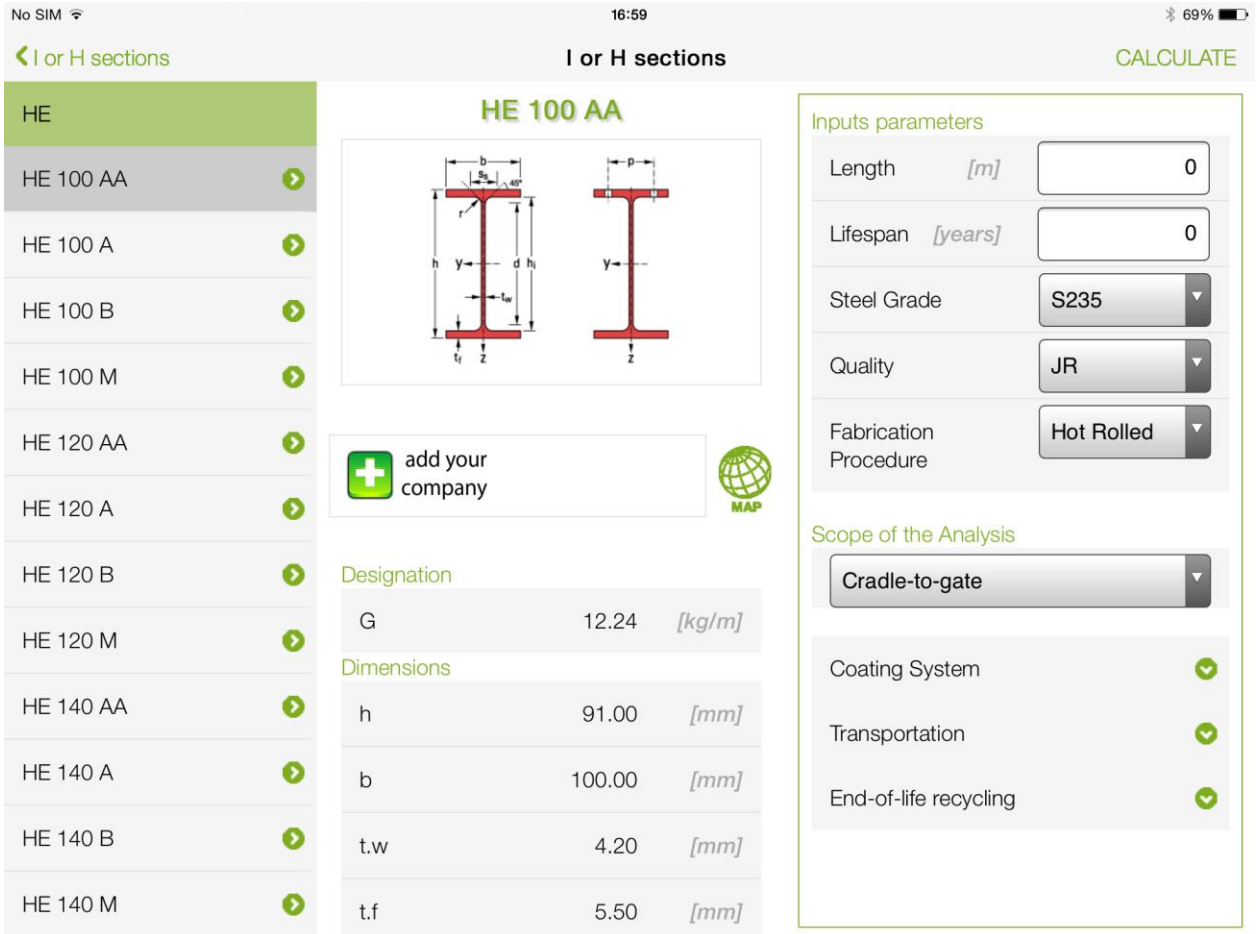
Elementos de aço

Macro-componentes

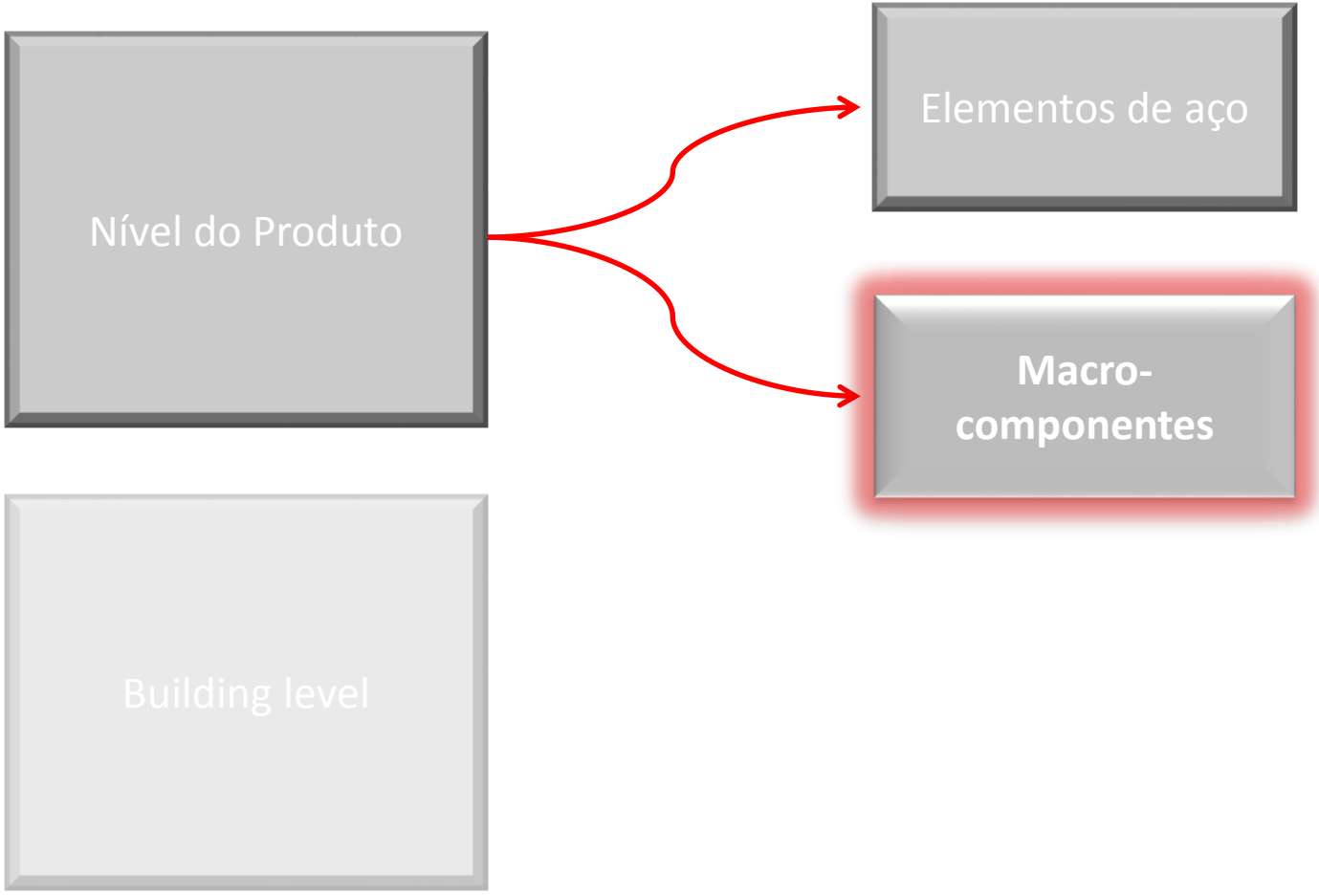
Nível do Edifício

Building Level

Menu >> Aço_ACV >> Nível do Produto



Menu >> Aço_ACV >> Nível do Produto



Menu >> Aço_ACV >> Nível do Produto>> Macro-componentes

Macro-componentes

↓

Base de dados

↓

Cálculo da ACV

Menu >> Aço_ACV >> Nível do Produto>> Macro-componentes

Macro-componentes

Base de dados

Cálculo da ACV

Seleção das macro componentes

(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
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		(B2020) Exterior windows	
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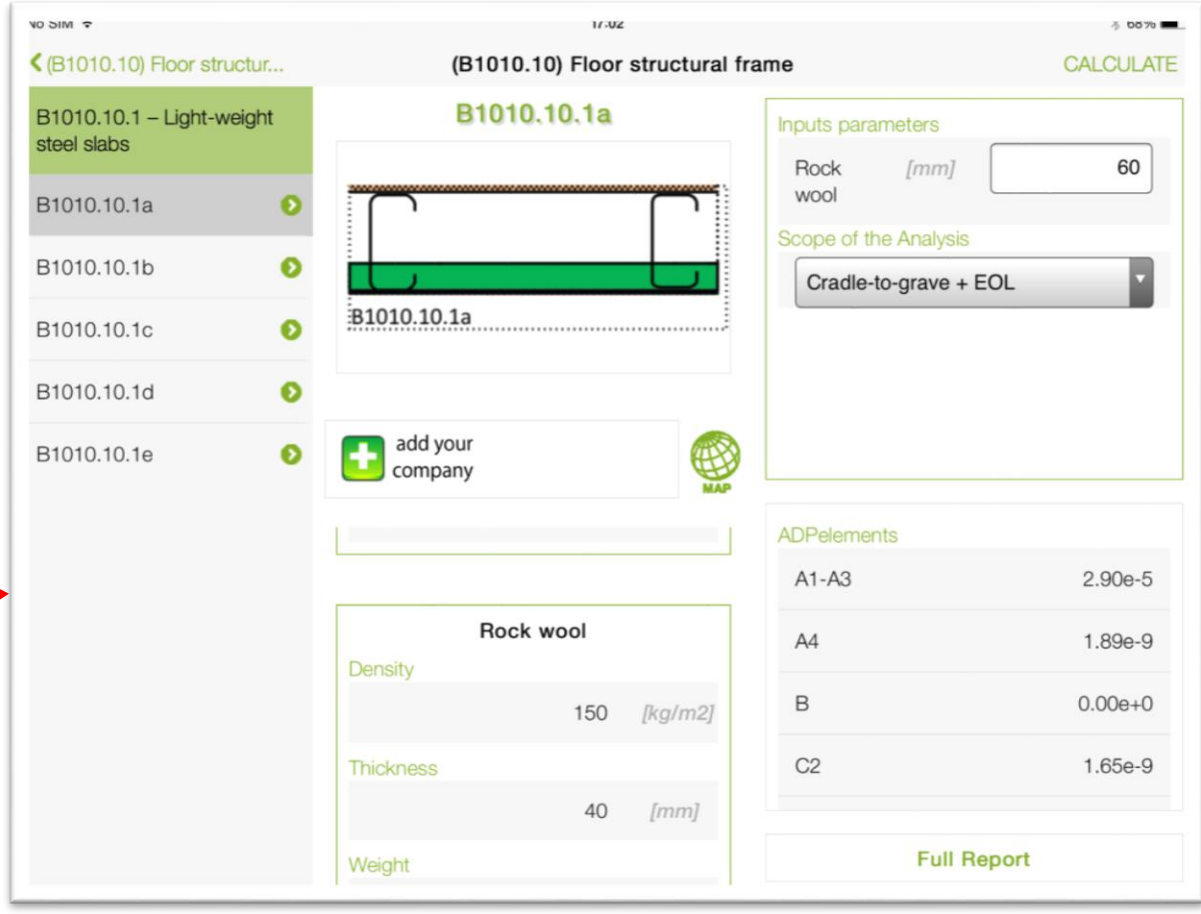
	(B30) Exterior horizontal enclosures	(B3010) Roofing	
		(B3060) Horizontal openings	
(C) Interiors	(C10) Interior construction	(C1010) Interior partitions	
	(C20) Interior finishes	(C2010) Wall finishes	
		(C2030) Flooring	
		(C2050) Ceiling finishes	

Menu >> Aço_ACV >> Nível do Produto >> Macro-componentes

Macro-componentes

Base de dados

Cálculo da ACV



Menu >> Aço_ACV >> Nível do Edifício

Nível do Produto

Nível do Edifício

Menu >> Aço_ACV >> Nível do Edifício>> Seleção do Edifício

Nível do Edifício

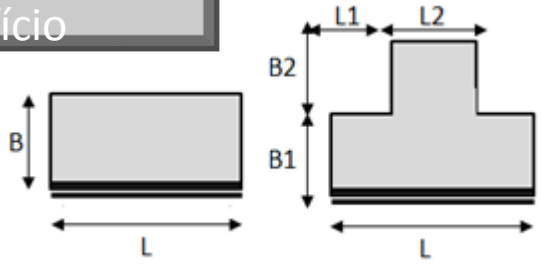
Seleção do edifício

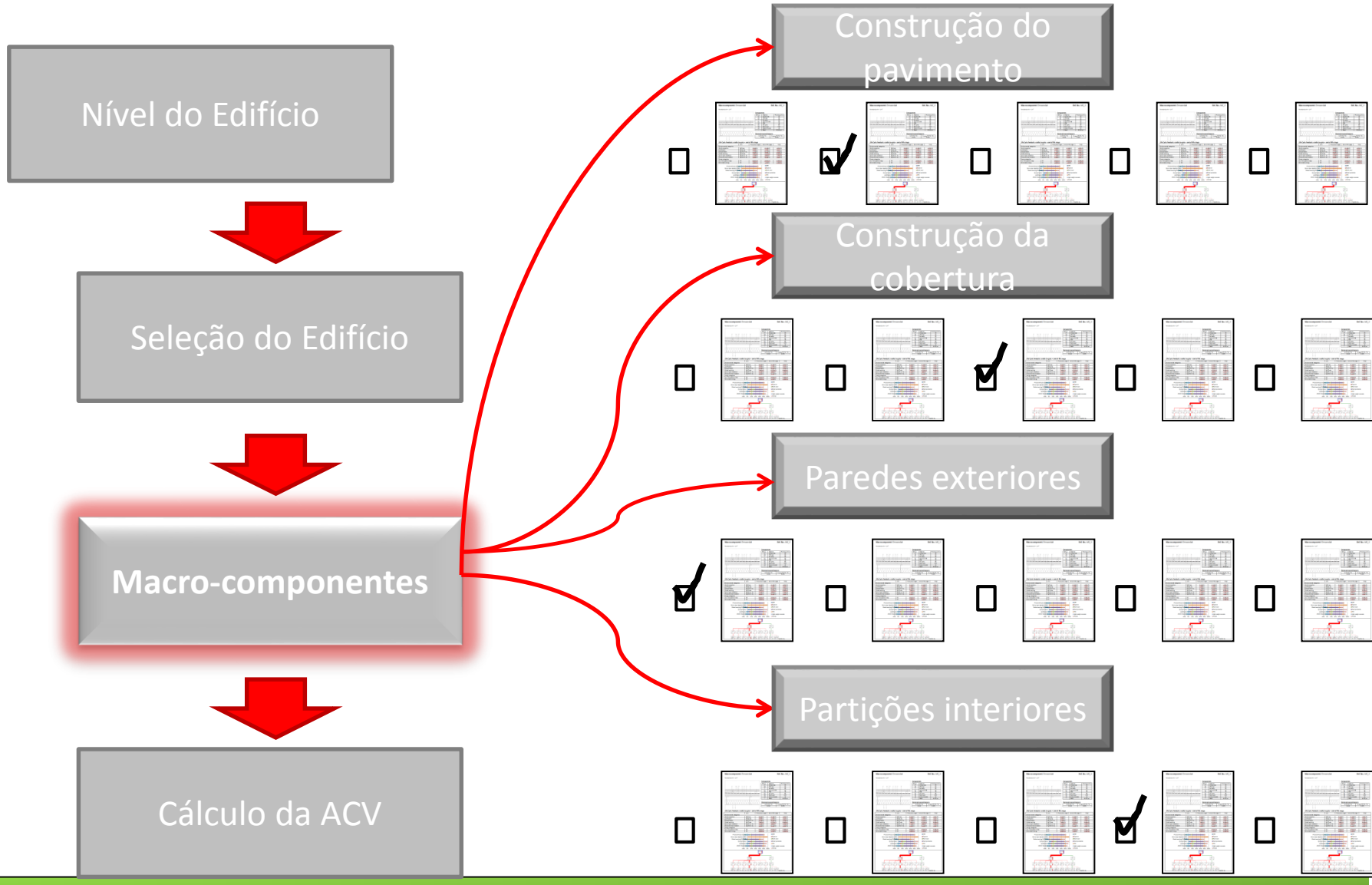
Macro-componentes

Cálculo da ACV

Tipo de Edifício

Geometria do Edifício




Nível do Edifício
Seleção do Edifício
Macro-componentes
Cálculo da ACV
Construção do pavimento
Construção da cobertura
Paredes exteriores
Partições interiores

Menu >> Aço_ACV >> Nível do Edifício>> Cálculo da ACV

Nível do Edifício

↓

Seleção do edifício

↓

Macro-componentes

↓

Cálculo da ACV & relatórios

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 pasterboard	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 SO2 Eq.]	1.93e-1	2.27e-4	0.00e+0	1.97e-4	6.25e-4	-4.45e-2	1.50e-1
EP	[kg PO4- Eq.]	1.66e-2	5.22e-5	0.00e+0	4.51e-5	9.59e-5	-1.01e-3	1.58e-2
GWP	[kg CO2 Eq.]	5.46e+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 C2H4 Eq.]	2.70e-2	-7.40e-5	0.00e+0	-6.38e-5	1.62e-4	-1.07e-2	1.63e-2

3) Considerações Finais

- A metodologia simplificada para ACV evita a utilização de ferramentas complexas e a utilização de profissionais da área e providência uma redução substancial de tempo usualmente requerido para realizar este tipo de análises

- A validação da abordagem baseou-se na comparação com análises avançadas realizadas com utilização do software comercial GaBi6.

- A comparação dos resultados permite concluir que a precisão da metodologia é bastante razoável