CASE STUDY

Construction

ENVELOPE SOLUTIONS

Location

Italy

System boundary

production of building products (A1-A3)
transport to construction (A4)
replacement (B4)
end of life (C1-C4)

Origin of data

Constructions: OneClickLca fdatabase
Background data: OneClickLCA database, selection of the most representative datapoints for Italy,

ENVELOPE SOLTIONS

Functional unit

1 m2 of finished external wall

U-value of 0,23 W/m^{2}K.

50 yr building life time

Introduction:

The present case study deal with the carbon footprint assessment of technological solution for the envelope of buildings in Italy with the following major objectives:

- To illustrate 3 typical envelope solutions suitable for a Mediterranean context, like Italy is
- To illustrate how to build up the comparison of different solutions
- To illustrate the (screening) analysis of high-performance envelope solutions and provide examples/guid on how to interpret life cycle assessment results.

Solutions:

The solutions here analysed are massive solutions referred to the Italian context. Namely, they are designed to ensure a good insulation level for the winter period. At the same time, they also guarantee a high comfort level in the summer period.
The analysed solution are represented in the following figures (fig 1 to 3).

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Figure 1 – Representation of envelope solution A1

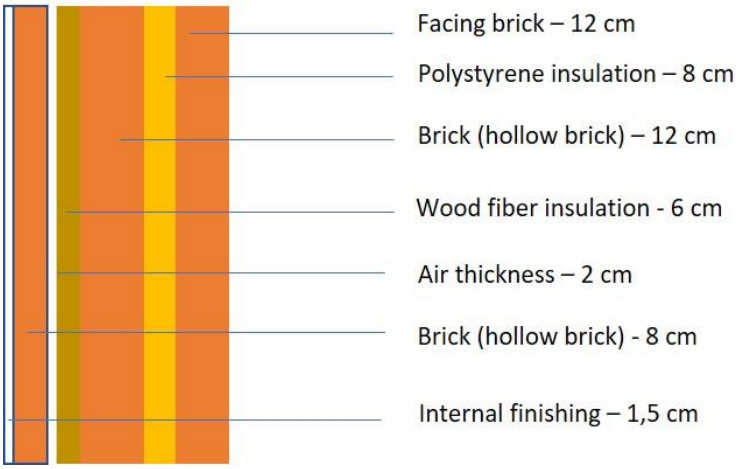

Figure 2 – Representation of envelope solution A2

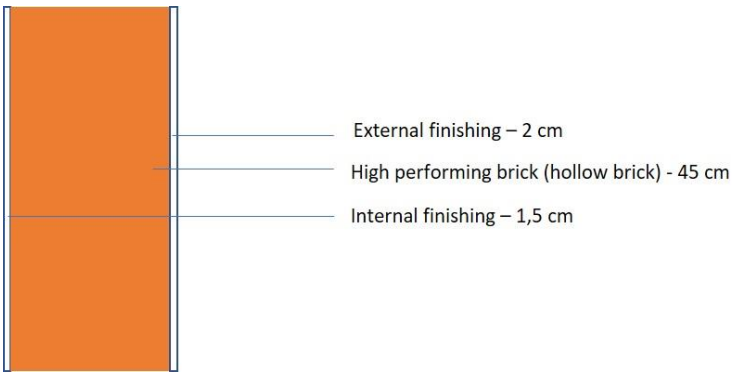

Figure 3 – Representation of envelope solution B3

All the analysed solutions have the same U-value, a high value of surface mass (Ma) and a very low periodic thermal transmittance (Yi,e), as represented in the table below (table 1).

Table 1 – Thermal performances of the analysed solutions

	Uvalue (W/m2K)	**M (kg/m2)**	**Yi,e (W/m2K)**
Solution A1	0,23	269	0,013
Solution A2	0,23	420	0,007
Solution B3	0,23	422	0,004

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Setting the comparison:

Solutions are compared on the basis of the same function. It means that the selected solutions perform the same function at the same level.
The functional unit is 1 square meter of finished external wall with a U-value of 0,23 W/m^{2}K.
The system boundaries include the production of the construction materials used for the envelope solutions, the transport to construction site based on what declared by the respective manufacturer and the end-of-life of the construction materials. No energy and material consumption at the construction site have been included. According to the reference LCA standard for EPD in the construction sector (EN 15804) the modules that have been accounted for are upstream modules (A1-A3), transport to the site (A4), replacement (B4) and the end- of -life (C1-C4).

Impact assessment

Global Warming Potential (GWP)

The table 2 reports the results expressed as kg of $CO_{2\ eq}$ for the analysed solutions subdivided for the analysed modules.

Table 2 – results expressed as CO2 eq of the envelope solutions

	Solution A1 (kg CO2 eq)	Solution A2(kg CO2 eq)	Solution B3 (kg CO2 eq)
A1-A3 Materials	68,29	112,19	117,79
A4 Transportation	0,68	1,07	0,80
B4 Replacement	10,74	4,60	10,74
C1-C4 End of life	2,47	2,29	1,31
Tot	**82,18**	**120,15**	**130,68**

As shown in table 2, the solution with lowest impacts in terms of GHG emissions is the solution A1, followed by solution A2 with an increased overall impact of 38%. For all the analysed solutions, the major contribution is related to the manufacturing of the construction materials (as shown in figure 4, 5 and 6).

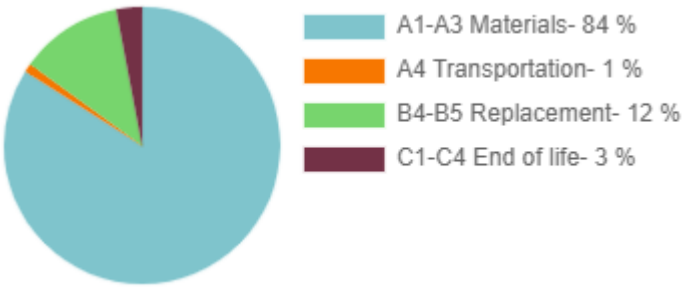

Figure 4 – Contribution of the different modules to the overall profile of solution A1

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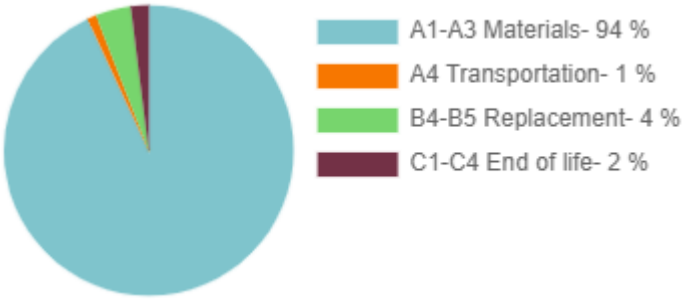

Figure 5 – Contribution of the different modules to the overall profile of solution A2

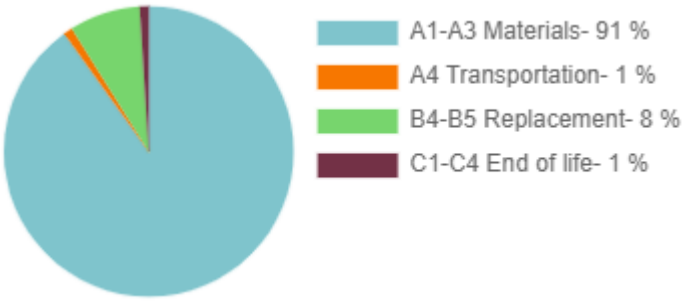

Figure 6– Contribution of the different modules to the overall profile of solution B3

Looking at the results in terms of contribution of building elements to the environmental profile of the envelope solution, the hot spots for all the analysed solutions are related to bricks, which represent the major component of the envelope solutions (as illustrated in the following figures), followed by the contribution of insulation and finishing elements.

Data points maggiormente contribuenti

Risorsa	Quota
Hollow bricks	38.99 %
Hollow bricks	27.73 %
Protective plasters, for indoor and outdoor application	15.04 %
Wood fibre insulation boards	10.93 %
Rock wool insulation panels, unfaced, generic	7.31 %

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Figure 7– Contribution of the different building elements to the overall profile of solution A1

Data points maggiormente contribuenti

Risorsa	Quota
Facing brick	47.54 %
Hollow bricks	24.11 %
Hollow bricks	17.14 %
Wood fibre insulation boards	6.76 %
Protective plasters, for indoor and outdoor application	3.98 %
Altri oggetti	0.47 %

Figure 8 – Contribution of the different building elements to the overall profile of solution A2

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Data points maggiormente contribuenti

Risorsa	Quota
Hollow bricks, for walls	91.04 %
Protective plasters, for indoor and outdoor application	8.96 %
dummy	%
EPS insulation	%
Wood fibre insulation boards	%
Altri oggetti	0.0 %

Figure 9 – Contribution of the different building elements to the overall profile of solution B3

Conclusions and considerations:

The case study analyses the impact in terms of GHG emissions of three typical high-performance envelope solutions of the Mediterranean context.
When comparing different solutions is important to consider whether they fulfil the same function or not in order to make a fair comparison.
In this practical case the envelope solutions have the same performance in terms of U-value, therefore they can be directly compared.
In terms of GHG emissions, the solution with lower profile is represented by A1, whereas the one with higher profile is represented by B3. The overall profile for all the solutions is driven by the manufacturing of construction materials, mainly the bricks.
However, it should be point out that these results came from average environmental profiles of construction products, therefore they shall be considered as a preliminary indication of the environmental performance of the analysed envelope solutions and they need to be furtherly checked with specific information provided by the manufacturers.

Reference:

Reale F, Gargari C, Fantozzi F, Edifici a energia quasi zero in clima mediterraneo. Costruire in Laterizio, n.147/2012, Tecniche Nuove, pag. 50-55 (ISSN 0394 -1590)

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