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# THE IMPACT OF THE SELECTION OF THE PERIMETER WALL OF A FAMILY HOUSE ON THE ASSESSMENT OF THE LIFE CYCLE AND ITS COSTS

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# Introduction

- Mortgage loans for own housing are currently most affordable in the era of independence of the Slovak Republic (NBS, 2017).
- Market share of timber constructions in Slovakia has increased from 2% to 10% in the last 15 years (Šuštiaková, 2016). It clearly shows the rising trend of interest in this type of construction.
- A potential investor asks how to secure their own housing. Alternative is a classic form of silicate construction or wood-based construction.



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# The Goal of Research

- ▶ **The paper is aimed at assessing the reference building of a family house with two types of perimeter walls: timber frame house and brick house.**
- ▶ **The reference building was designed according to the questionnaire survey and represents the ideas of potential customers of the construction of the family house (Debnár and Potkány, 2016).**
  - ▶ Application of LCA analysis to assess the ecology side of housing
  - ▶ Application of LCC analysis to assess the economic side of housing

# Materials and Methods

- ▶ Life Cycle Cost Analysis (LCC) can provide real information for the construction of family houses exclusively from an economic point of view throughout their life cycle. (Pelzeter, 2007)
- ▶ The total life cycle costs of a house comprise the costs of construction, use and end-of life waste management and are calculated as follows (Bull, 2015):

$$LCC = C_C + C_U + C_{EOL}$$

LCC – total life cycle costs of a house

$C_C$  – costs of house construction

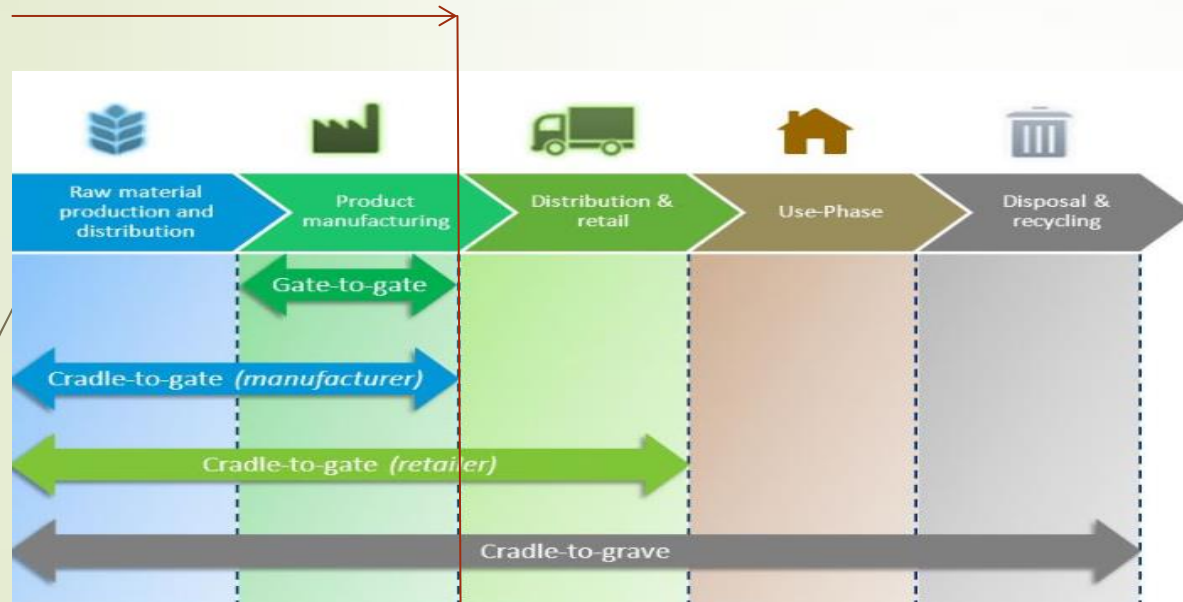
$C_U$  – costs in the use stage of the house

$C_{EOL}$  – costs of end-of-life of the house

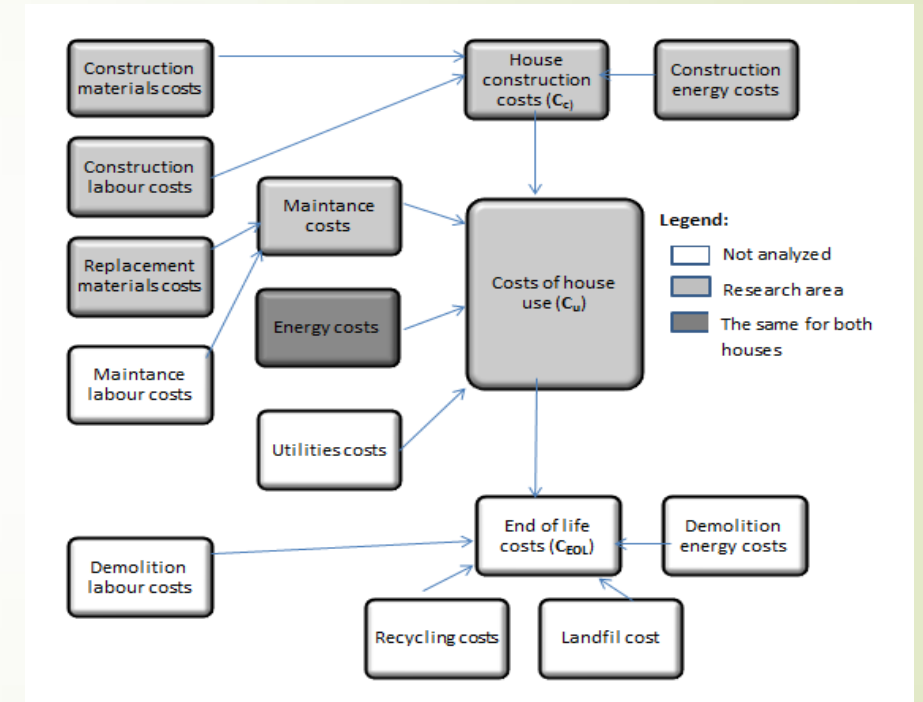
- ▶ The ecological side is also very important. The **ISO 14 040** and **14 044** standards describes in detail the methodological approach to use the Life Cycle Assessment (LCA) to assess the environmental impacts of the life cycle of family house.
- ▶ An important aspect of the life cycle assessment of a building is therefore the economic and environmental aspects that **need to be assessed in their synergies.**

# Materials and Methods

► Range of research and basic parameters



System boundaries of LCA, source: [lcaboundaries.com](http://lcaboundaries.com)



System boundaries and the costs in the life cycle of the houses (Bull, 2015)

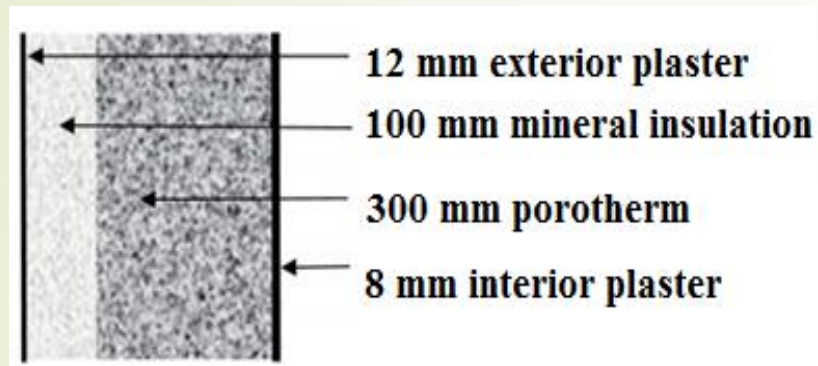
# General information on the houses



	Wooden house	Brick house	Source
<b>Base plate area (m<sup>2</sup>)</b>	92 (11.5 x 8)	92 (11.5 x 8)	Disposition of RB
<b>Usable floor area (m<sup>2</sup>)</b>	157	147	Questionnaire survey(QS)
<b>Household size (no. of people)</b>	4-5	4-5	QS
<b>Number of bedrooms</b>	4	4	Disposition of RB (QS)
<b>Number of floors</b>	2	2	Disposition of RB (QS)
<b>Construction type</b>	<b>Timber frame construction</b>	<b>Porotherm – clay bricks</b>	QS
<b>Type of roof</b>	saddle roof	saddle roof	Disposition of RB (QS)
<b>Heat transfer coefficient for external wall U[W/m<sup>2</sup>K]</b>	0.15	0.15	Fragment 5.0 software

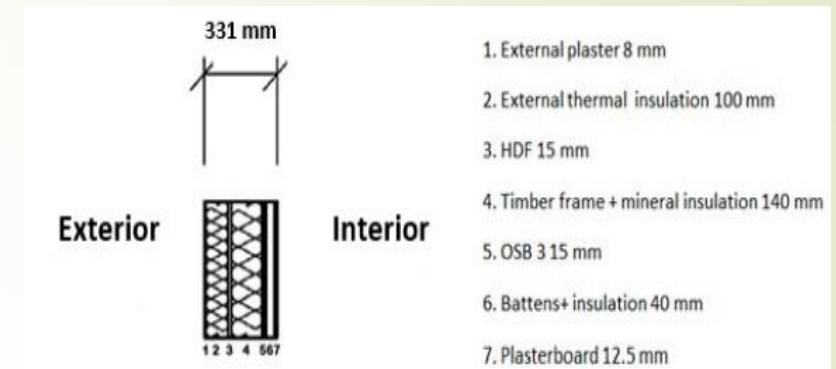
# Specification of walls

## A) Brick house



Material	Thermal conductivity [W/(m.K)]
Baunit Granopor plaster	0,7
Rockwool insulation	0,034
Brick Porotherm 30 Profi	0,155
Baunit interior plaster	0,7

## B) Timber frame house



Material	Thermal conductivity [W/(m.K)]
Plasterboard - gypsum 12,5 mm	0,21
Service cavity	-
Rockwool insulation	0,034
OSB3	0,13
Timber frame construction	-
Rockwool insulation in construction	0,034
HDF, 15 mm	0,1
Thermal insulation – ISOVER	0,034
Baunit acrylate plaster	0,7

Source: Fragment 5.0 software

# Results – ecological side

- The comparison of the impact of the perimeter walls of the family house

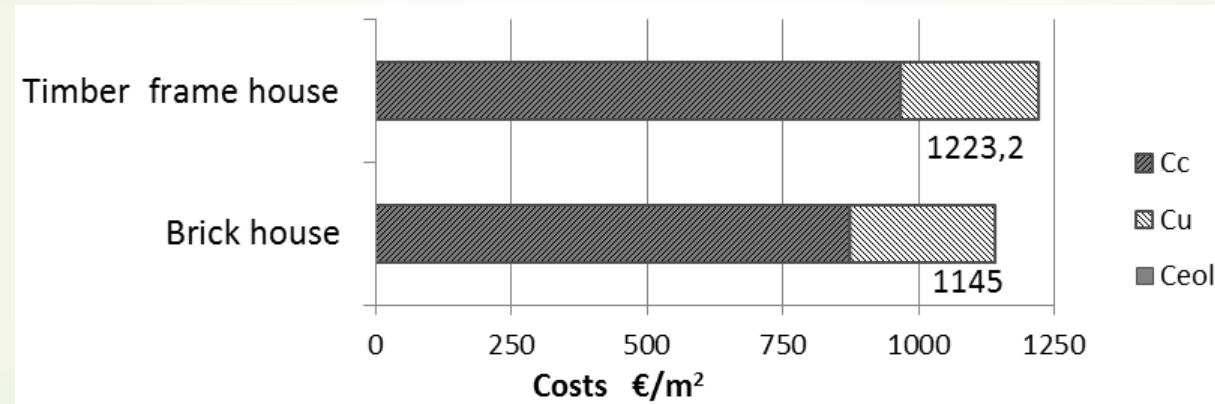
Criteria / Envimat	Outside Wall of Timber frame house	Outside Wall of Brick house	Unit
Primary energy input for production (PEI)	635.027	882.635	[MJ·m <sup>-2</sup> ]
Global Warming Potential (GWP)	37.52	78.6855	[kg CO <sub>2</sub> eq. m <sup>-2</sup> ]
Acidification Potential (AP)	142.06	194.682	[g SO <sub>2</sub> eq. m <sup>-2</sup> ]
Eutrophication Potential (EP)	53.266	54.868	[g (PO <sub>4</sub> ) <sup>3-</sup> eq. m <sup>-2</sup> ]
Ozone Depletion Potential (ODP)	0.00244738	0.00517956	[g R-11 eq. m <sup>-2</sup> ]
Photochemical Ozone Creation Potential (POCP)	13.7867	18.9339	[g C <sub>2</sub> H <sub>4</sub> eq. m <sup>-2</sup> ]
Density (p)	199.892	664.762	[kg·m <sup>-3</sup> ]
Basic weight	<b>64.06</b>	<b>279.20</b>	[kg·m <sup>-2</sup> ]

The environmental impact of the perimeter walls is expressed on m<sup>2</sup> of the perimeter wall area. We can conclude that in all the criteria being compared, the impact on the environment was lower of the wood-based perimeter wall.



# Results – economic side

- ▶ With the same thermal and technical properties, the wall thickness of the wooden house is 90 mm thinner, which increases the useful area of the house by almost **10 m<sup>2</sup>**.



# Conclusion

- ▶ The analysis was performed **partially** and does not show the overall impact of the construction from a lifecycle perspective. The results of the paper show that the life cycle costs are **7 % higher** for the wood-based construction, **but** the **environmental impact** of the perimeter walls **is lower**. This fact in favour of silicate construction could be mitigated in the future by a forthcoming legislation that would favour this type of construction by **subsidy**.
- 1. Wood is a renewable raw material and for Slovakia has a strategic importance.
- 2. Value added of wood is higher in wooden houses.
- 3. Slovak Government is considering subsidizing wooden houses and LCC analyses can help to determine.

**Thank you for your attention.**

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