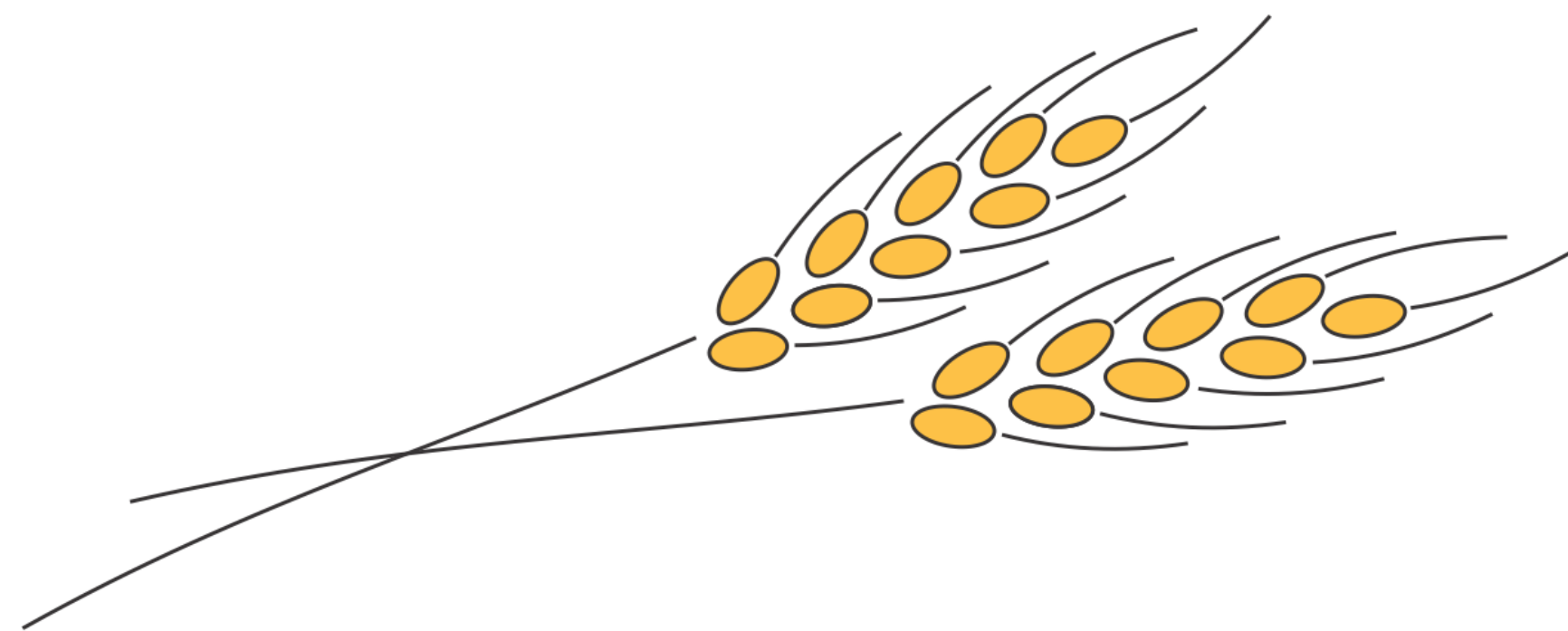


Straw bale building performance and design diversity



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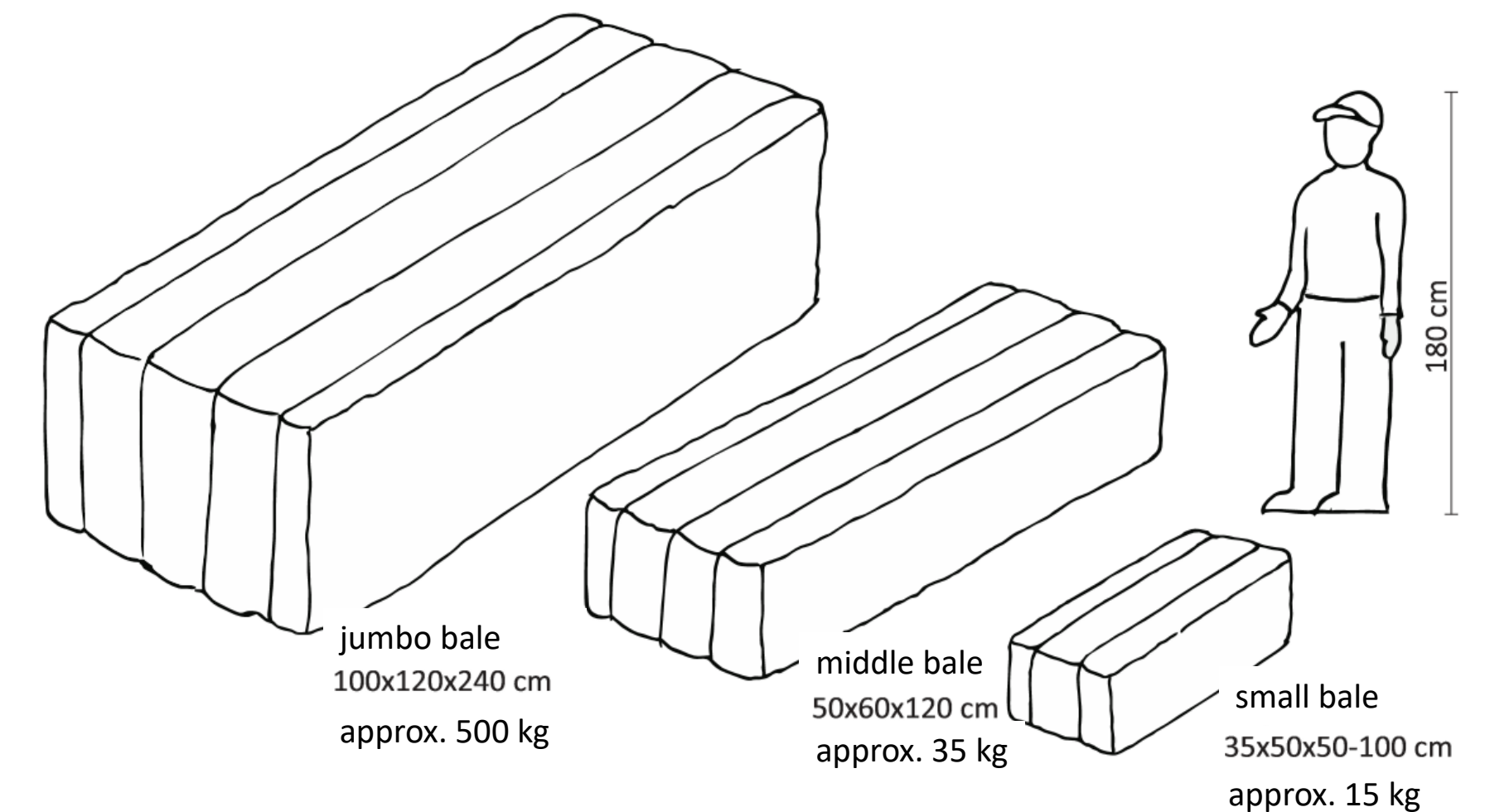
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General performance properties

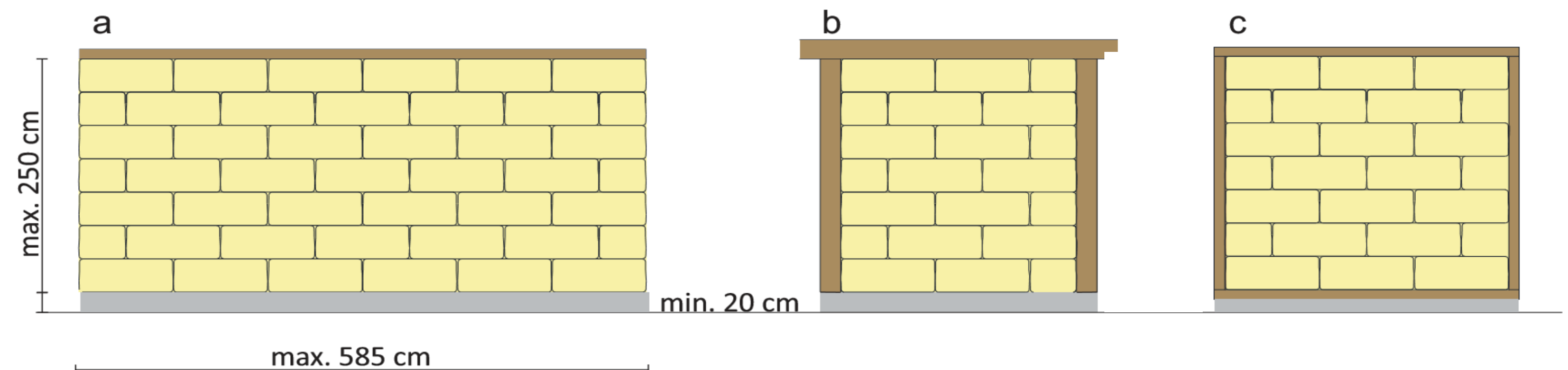
Straw bale properties:

- rectangular shape, various sizes,
- bale density must be above 85 kg/m^3
(and more than 105 kg/m^3 when used for load bearing),
- dry, moisture content less than 15 % (wet weight basis).



Stacking straw bales in one of the system:

- load bearing structure (a),
- as an infill in a timber frame structure (b),
- prefabricated panels (c).



Benefits

- **Environmental benefit**
- Insulation properties
- Sustainability

Comparisson of 1m² of straw bale wall and brick wall composites:

Acidification potential

AI - straw bale wall 0,052275 kgSO₂eq

AI - brick wall 0,216688 kgSO₂eq

Primary Energy Content

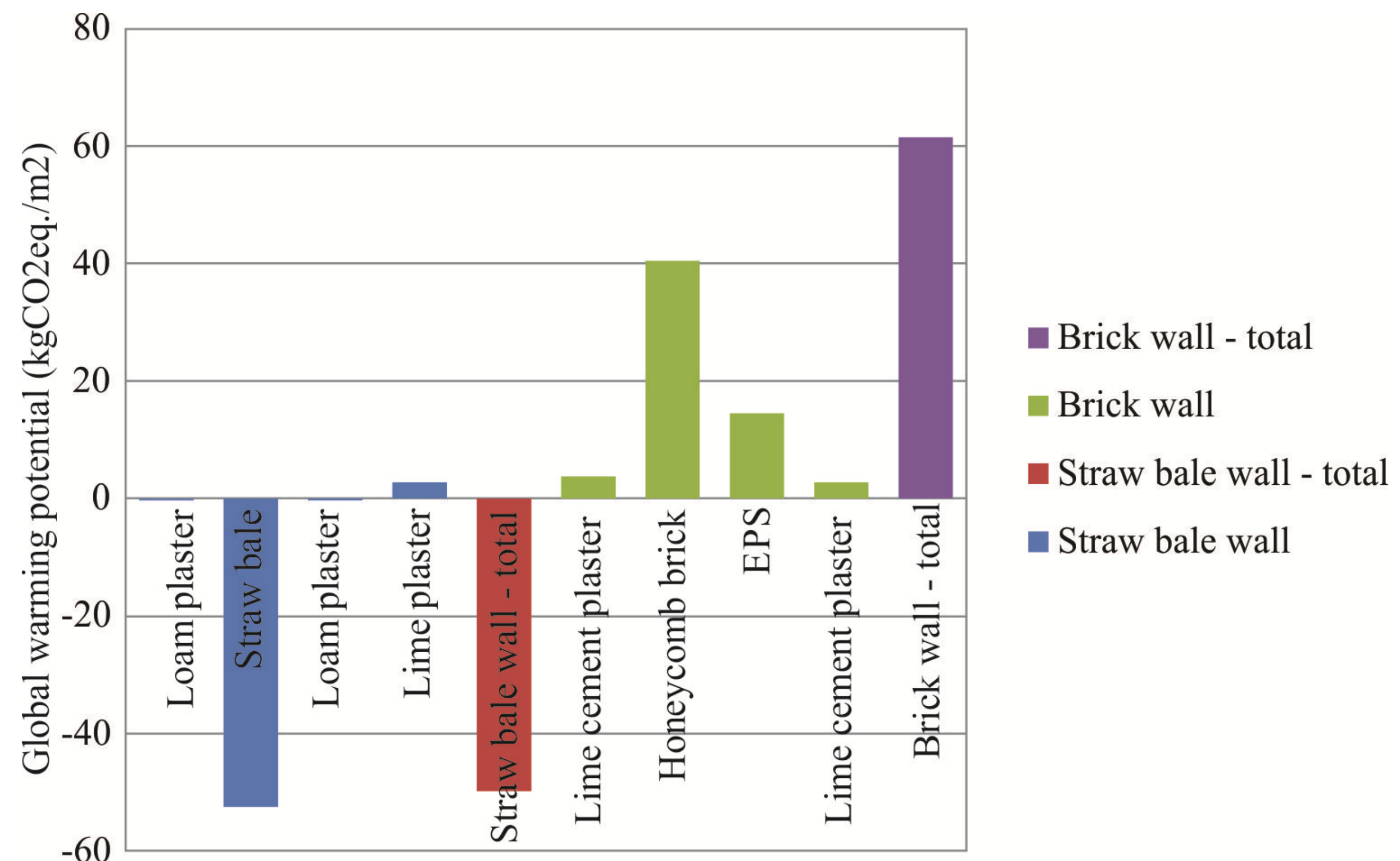
PEI - straw bale wall 104,83 MJ

PEI - brick 985,65 MJ

Global Warming Potential

GWP - straw bale wall -50,037 kgCO₂eq

GWP - brick wall 61,548 kgCO₂eq



Benefits

- Environmental benefits
- **Insulation properties**
- Sustainability

Research study – survey; subjective evaluation based on dweller experiences:

"Easy to heat. Consistent heat. Quiet. Warm. Cozy feel. The house is very warm in the winter. Great insulation."

Straw bale wall		Thickness D (m)	Thermal conductivity λ (W/mK)	R = D / λ (m ² K/W)
Heat transfer interior		/	/	0,130
Loam plaster	RÖFIX	0,035	0,80	0,044
Straw bale	Waldland	0,40	0,05	8,0
Loam plaster	RÖFIX	0,020	0,80	0,025
Lime plaster	Baumit Sanova Einlagen Trassputz	0,015	0,40	0,038
Heat transfer exterior		/	/	0,040
Total		0,470	/	8,277
$U = 1 / 8,277 = 0,12082$				

Brick wall		Thickness D (m)	Thermal conductivity λ (W/mK)	R = D / λ (m ² K/W)
Heat transfer interior		/	/	0,130
Lime cement plaster	Baumit MPI 25	0,020	1,0	0,020
Honeycomb brick	Wienerberger Porotherm N+F (natureplus)	0,250	0,259	0,965
EPS	Austrotherm F	0,280	0,040	7,0
Lime cement plaster	Baumit MPI 25	0,015	1,0	0,015
Heat transfer exterior		/	/	0,040
Total		0,565	/	8,170
$U = 1 / 8,70 = 0,12240$				

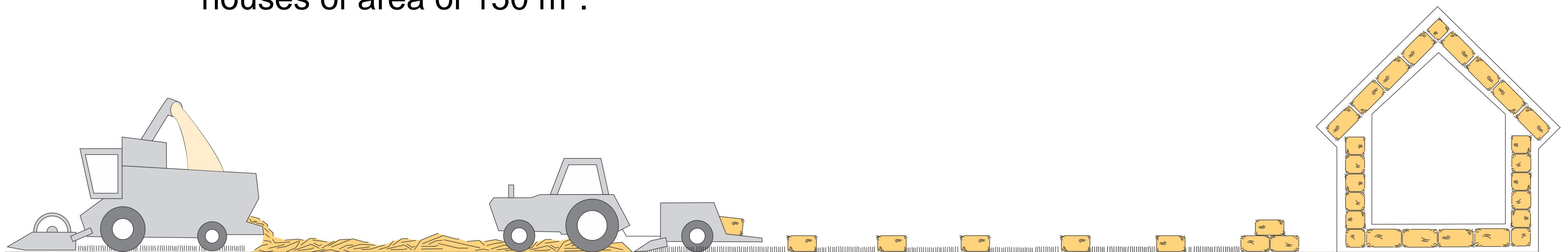
Benefits

- Environmental benefits
- Insulation properties
- **Sustainability**

Straw bales for a building purpose are easily produced, mostly in the field during the harvest process. With an annually produced straw could be build:

- 450 000 in UK (Jones, 2009),
- 350 000 in Germany (Minke, 2006)

houses of area of 150 m².



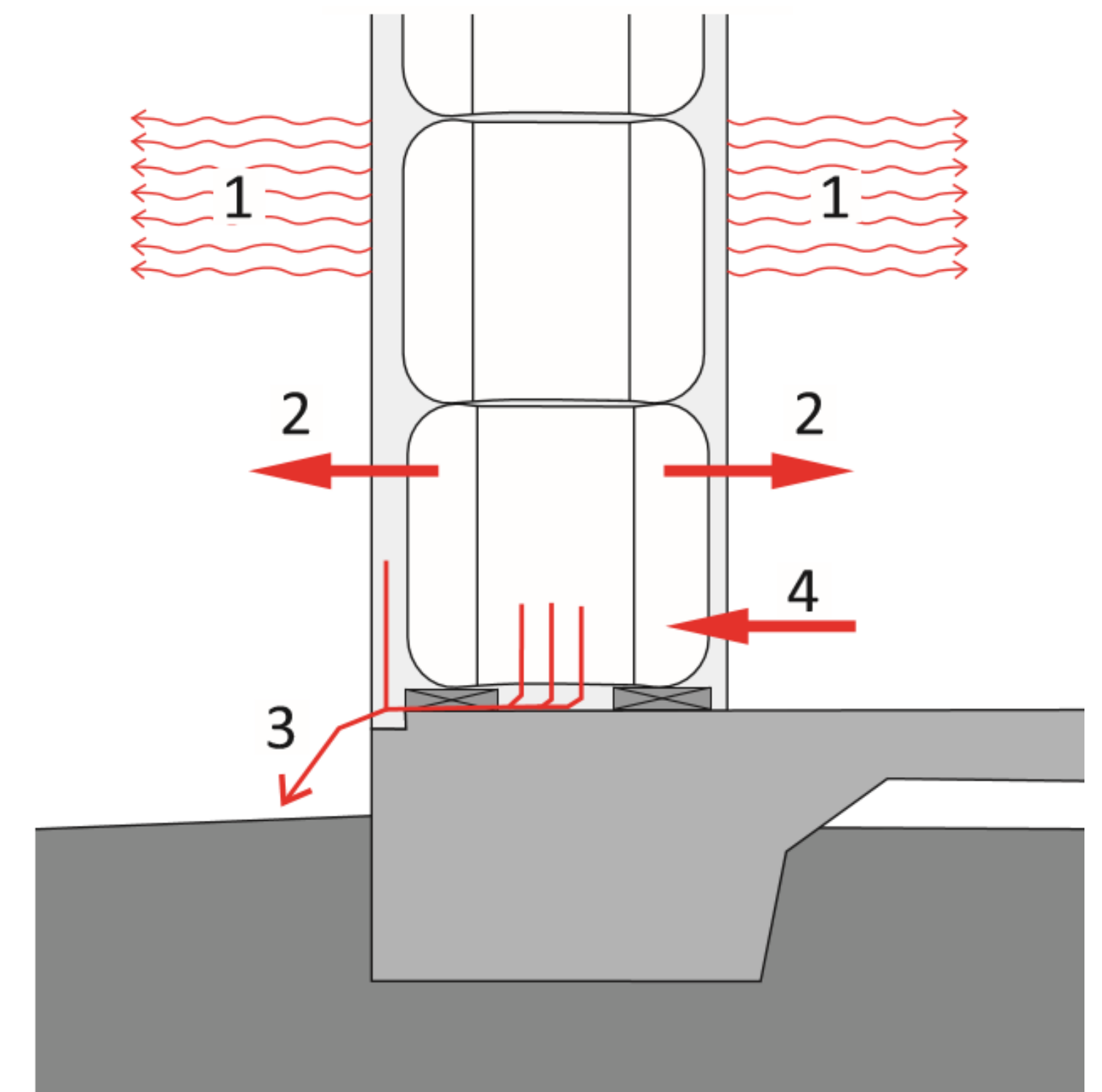
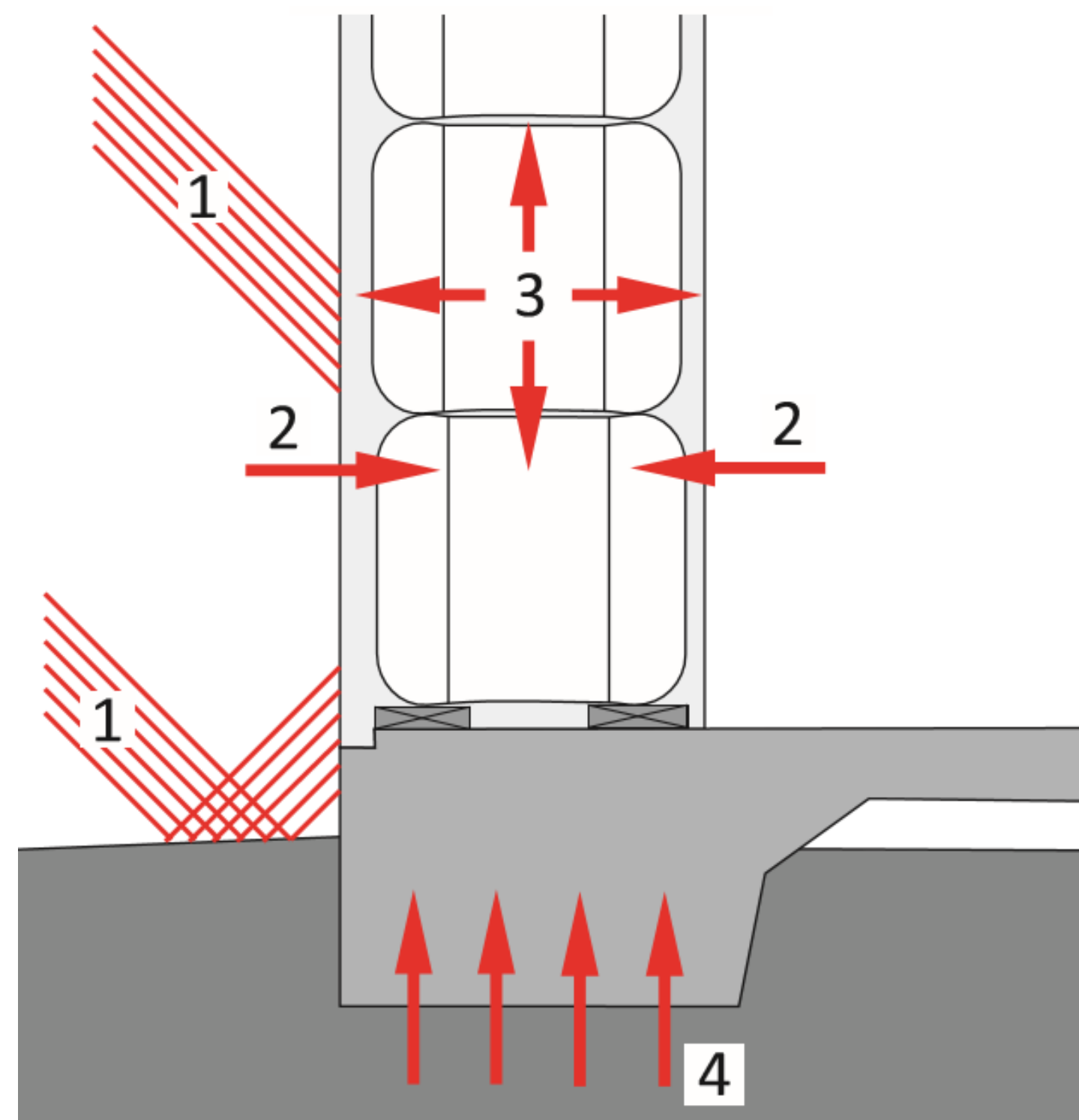
Drawbacks

- Fire safety
- Structural stability
- Moisture problems

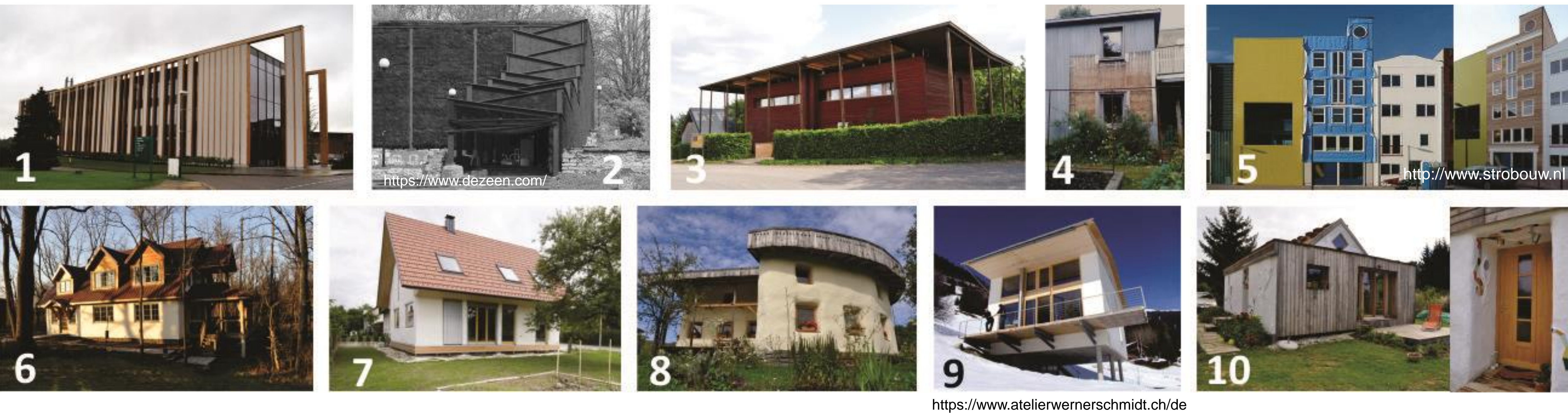
Fire safety certificate F90

Building codes for straw bale building

Protecting straw with layer of plaster and dilatation



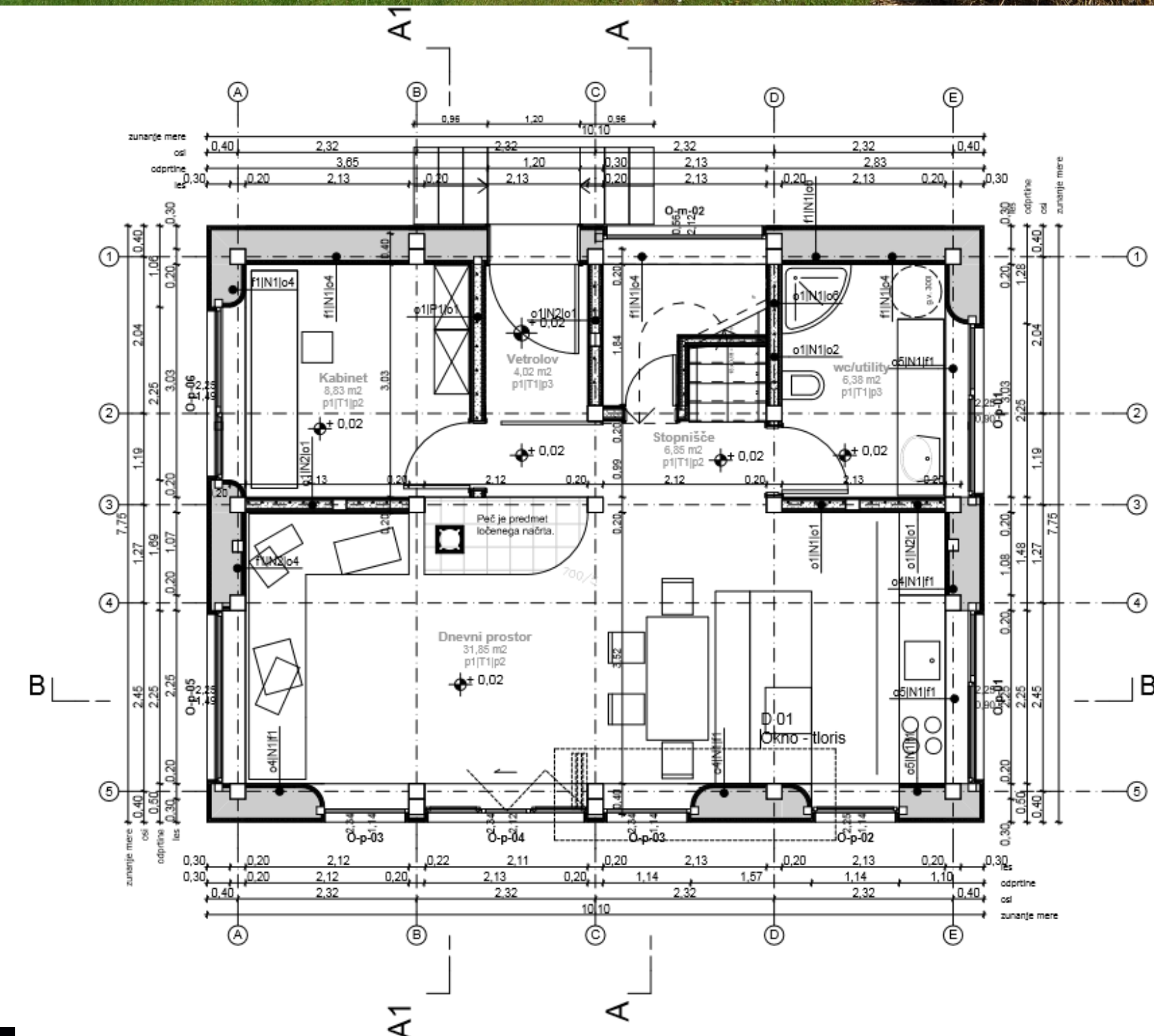
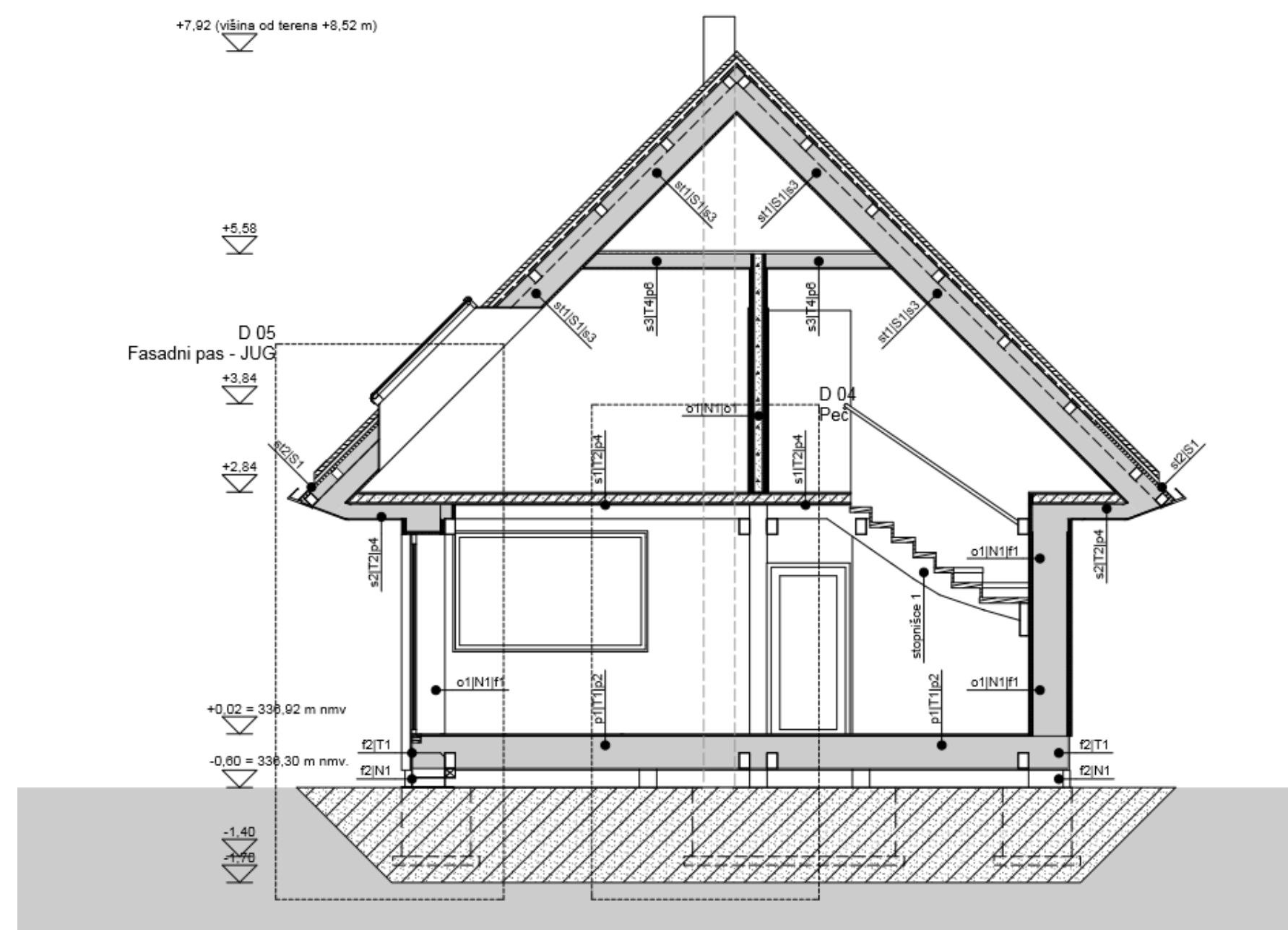
Design approach



- **size** from 50 m² (10) to 3100 m² (1),
- **construction system** timber frame (2, 3, 4, 6, 7, 8, 10), load bearing (9), prefab. panel (1, 5)
- **exterior layer** cement/plastic board (1,4), no layer (2), wooden panels (3, 5, 10), lime/earth plaster (6, 7, 8, 9, 10)
- **location/climate zone** temperate maritime (1, 2, 4, 5), humid continental (6), sub-alpine continental (3, 7, 8, 10), alpine (9)

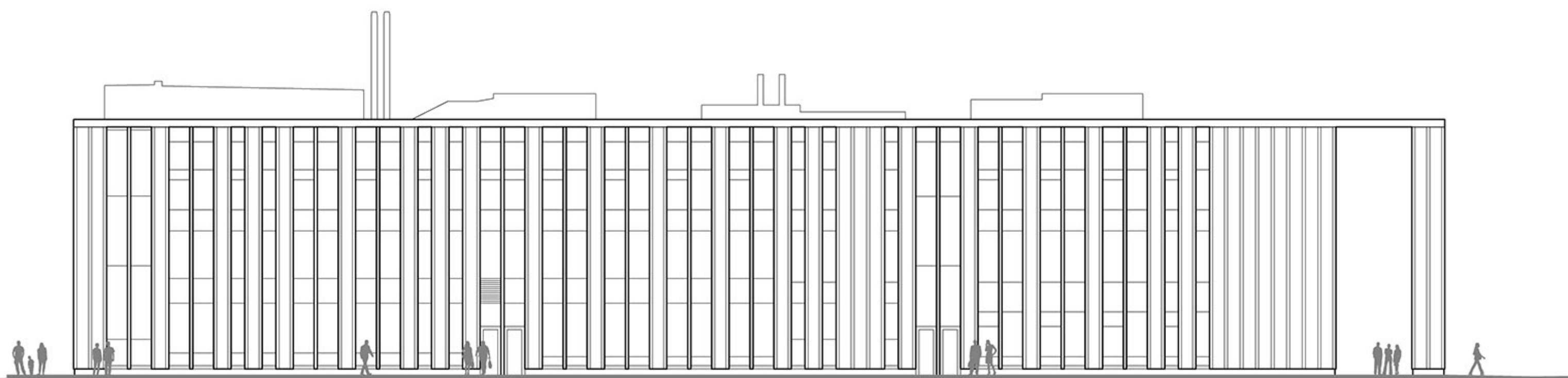
Study case 1

Single family house in Radomlje, Slovenia

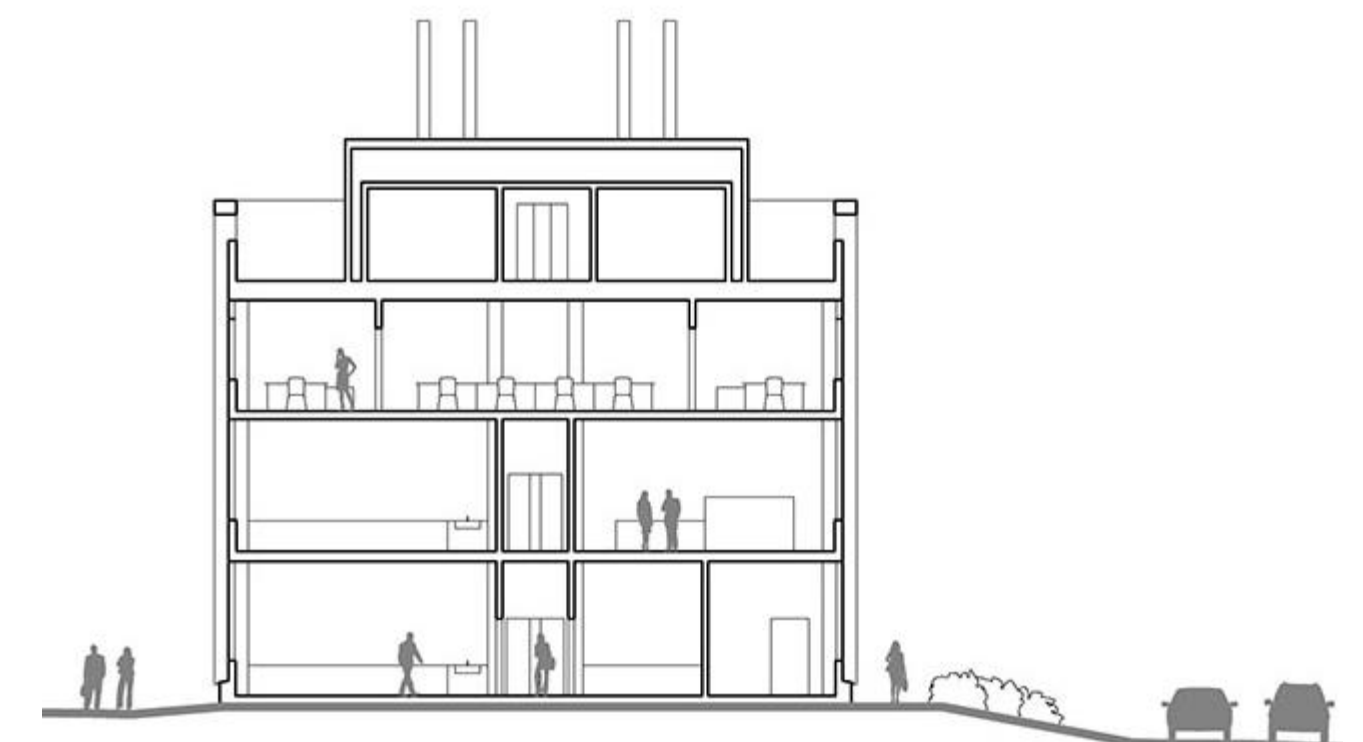


Study case 2

Gateway Building – Nottingham, UK



<https://www.dezeen.com/>



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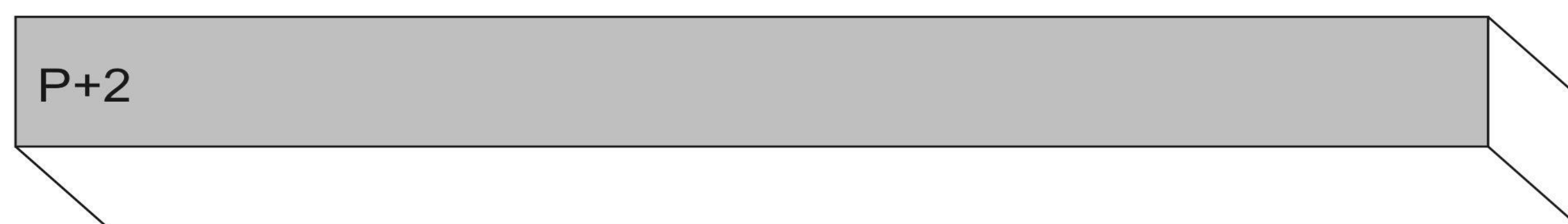
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Comparison

	house in Radomlje	Gateway Building
floor area (m ²)	120	3100
number of floors	2	4
foundation	concrete pier foundation	concrete slab
structure type	timber frame	timber panel
external layer	clay, lime render	cement board
function	dwelling	classroom, office
design	Blaz Babnik	Make architects
location	Radomlje, Slovenia	Nottingham, UK



Conclusions and further research directions

1. Straw bale building has progressed drastically in the past decade in regards to building design, building location (climate zone), and building techniques etc.
2. Straw bales were firstly used by self-build enthusiasts, nowadays can be applied even to more sophisticated architectural projects.
3. Straw bale building design needs to be thought-out well to achieve optimum functionality but at the same time, creativity is almost limitless. It can meet the criteria of modern design and it also illustrates the comprehension of an individual.
4. To introduce the straw bale building potential to the wider audience who is directly involved in building and to the one who is tending to design and build environment-friendly.
5. The current flaws can be addressed more as future research opportunities to improve existing models and systems of straw bale use. There are still open questions demanding new scientific proves and conclusions to support use of straw in the future.



Thank you for your attention!



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