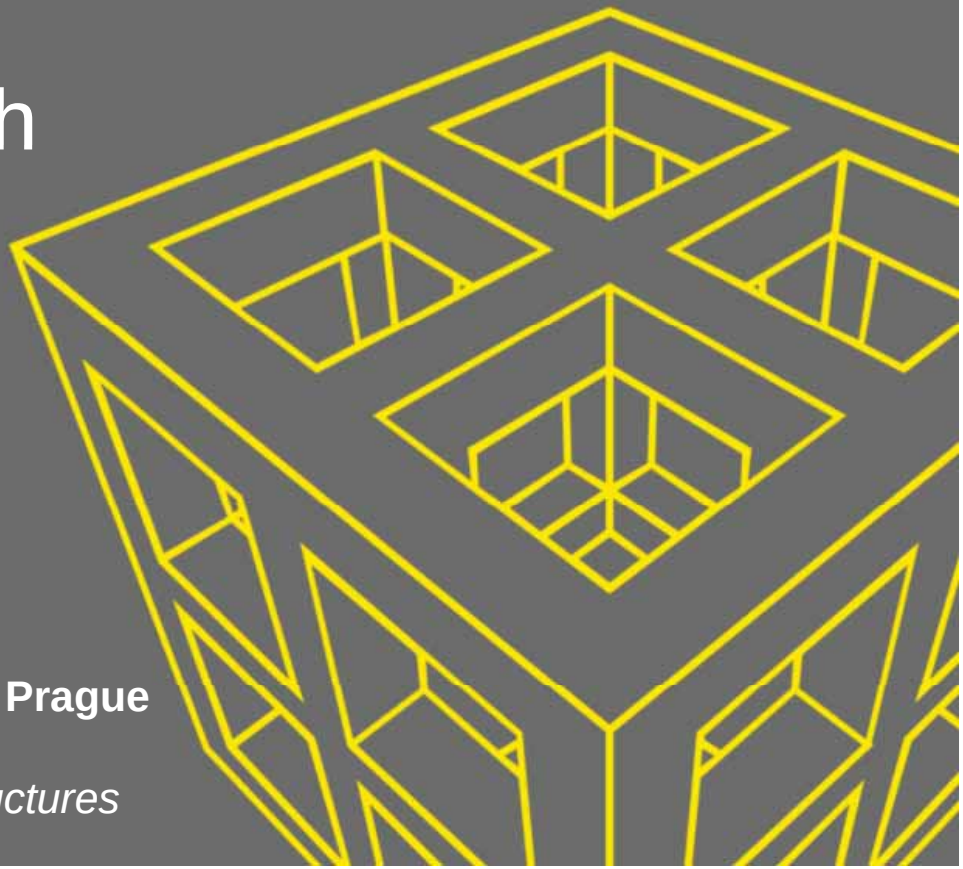
THE GROWING STEEL HOUSE

family rules

Sustainable approach



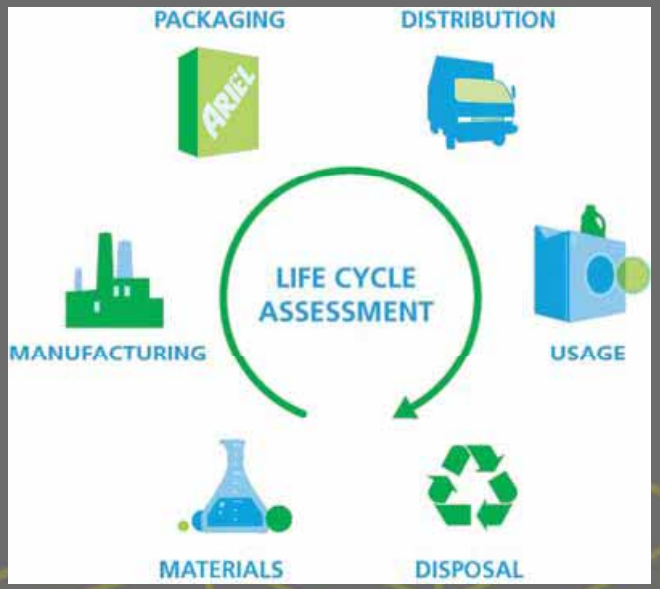
The Czech Technical University in Prague
Faculty of Civil Engineering
Department of Steel and Timber Structures

Layout

- Introduction
  - Assessment of sustainable development
- Methodologies in the Czech Republic
- SBToolCZ
- Growing steel house assessement
  - Description of the Growing Steel house
  - Assessment on sustainable development
- Summary

Assessment of Sustainable development

- LCA – life cycle assessment
- Multi-criterion analysis
- Several points of view



- LEED
- BREEAM
- SBTool

Methodologies – Czech Republic

- LEED
  - US methodology
- BREEAM
  - British methodology
  - originally based on EcoHomes
- based on fixed credits for criterions
- summary gives the rating
- simplicity
- hard to adapt to different regions

Methodologies – Czech Republic

- SBTool (iiSBE)
  - international assessment framework
  - rating system can be adapted to local conditions
  - SBToolCZ
- SBToolCZ
  - developed by the CTU
  - specific regional conditions of Czech Republic
  - assessment method for design phase

SBToolCZ

- can work also as a guideline
- list of criterions
- environmental, socio-cultural, economics, locality
- 33 criterions

Group	Criterion
Criterion for the area of environmental impact	
Climate change	Operational CO_2 emissions Embodied CO_2 emissions
Air quality	Operational SO_2 emissions Operational NO_x emissions
Biodiversity	Use of greenery on the land Use of greenery on the facade and roof Ecological value of the place
Use of resources	Consumption of primary energy for operation of the building Embodied energy Use of structural material during construction Construction waste during construction and demolition Use of rainwater Reuse of land
Environmental risks	Ration of rainwater kept on the land

SBToolCZ

Criterion for the Socio - cultural area	
Quality of indoors environment	Eyesight comfort Acoustic comfort Thermal comfort Air quality in the building
Availability	Access to public places for relaxation Availability of services Availability of public transport Promotion of cycling Access for disabled people
Safety	Safety in the building and its surroundings Security of the building
Functionality	Adaptability

Criterion for the area of economy	
LCC	Analysis of operating costs
Support of the local economy	Use locally produced products
Externalities	Innovative approach Provision of operational and detailed documentation
Risks	Minimisation of regional climatological risks Autonomy of operation

SBToolCZ

properties → evaluation of criterion
→ given benchmarks (points)
→ weight for each criterion
→ final given benchmark

↓

Summary of points from all criterions

Final scale: 0 – 10 points

0 – 3,99 | 4 – 5,99 | 6 – 7,99 | 8 – 10


CERTIFIKÁT KVALITY BUDOVY
X-LOFT
U Libeňského pivovaru
Praha 8
Zadavatel
CELKOVÉ SKÓRE
6,3
SBToolCZ
stromový certifikát
Zelená střecha
Nízkoenergetický dům
Zastavěný pozemek
Výborná dostupnost veřejné dopravy

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Description of the Growing Steel house

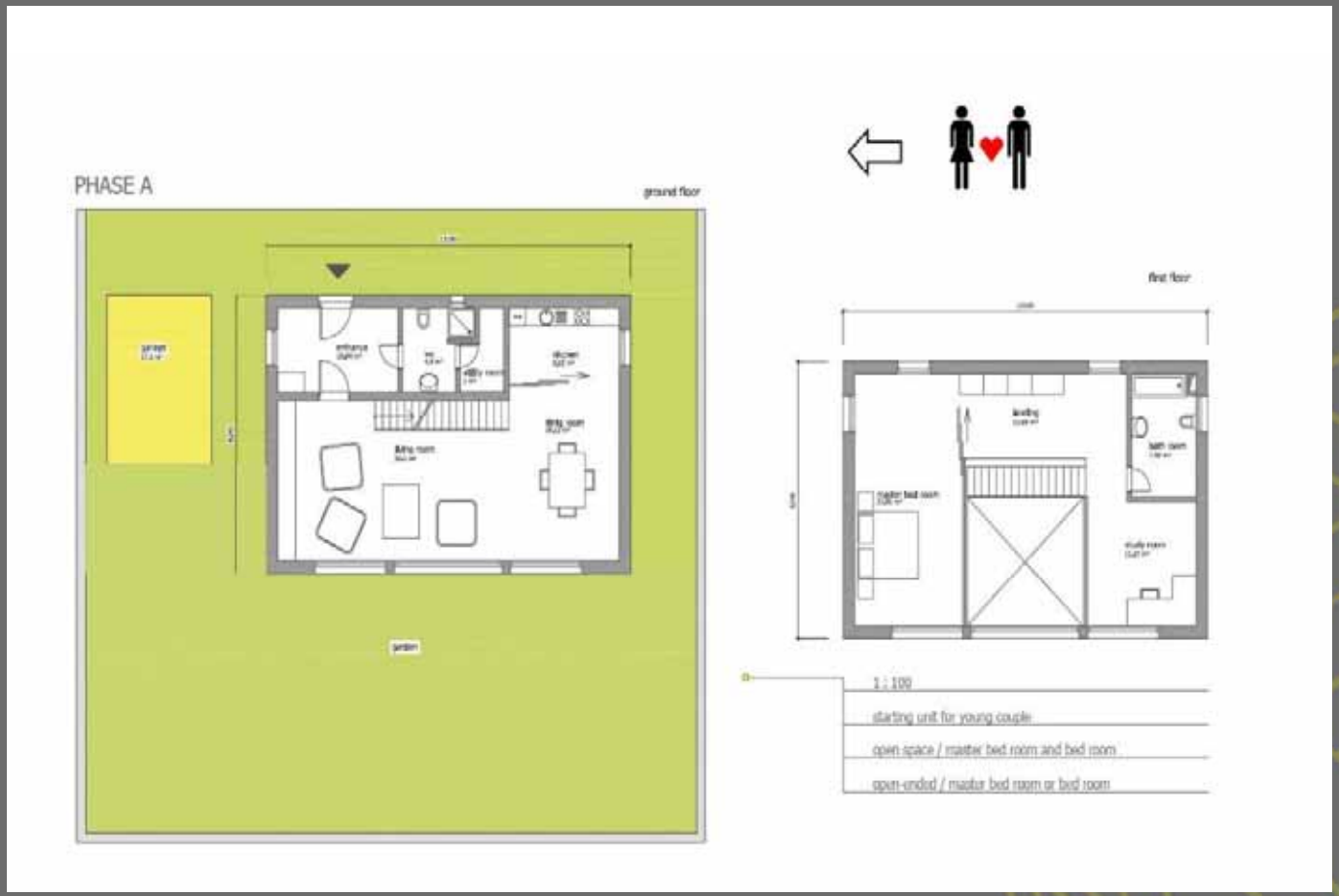
PROJECT IS BASED ON SEVERAL IMPORTANT POINTS

- to design a house for the widest possible sort of population
- to be adaptable both from outside and especially inside,
- dynamical reflex to the needs of family (Every family is changing, growing, reassessing their needs and necessity)

Description of the Growing Steel house

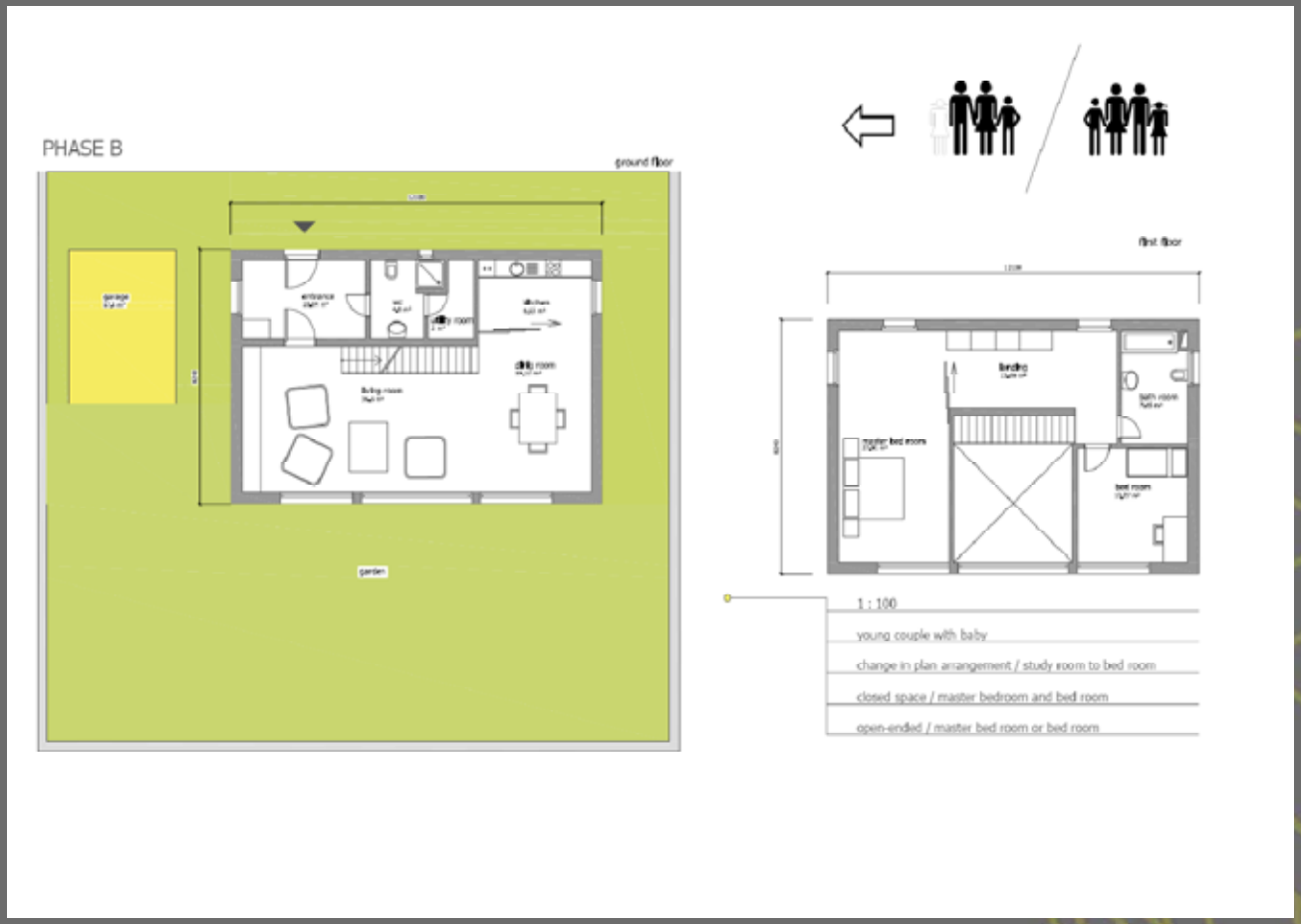
- accent on the importance on the linkage of the building with the landscape
- Windows located on the south facade (to aerate and illuminate the interior of the house, to allow the solar gains during winter period)
- The ground plan of our house (its usable area 130 m^2) is based on the surveys of the Bureau of Statistics, trends and average needs for the square meters
- Low energy standard with low operational emissions

The Growing steel house



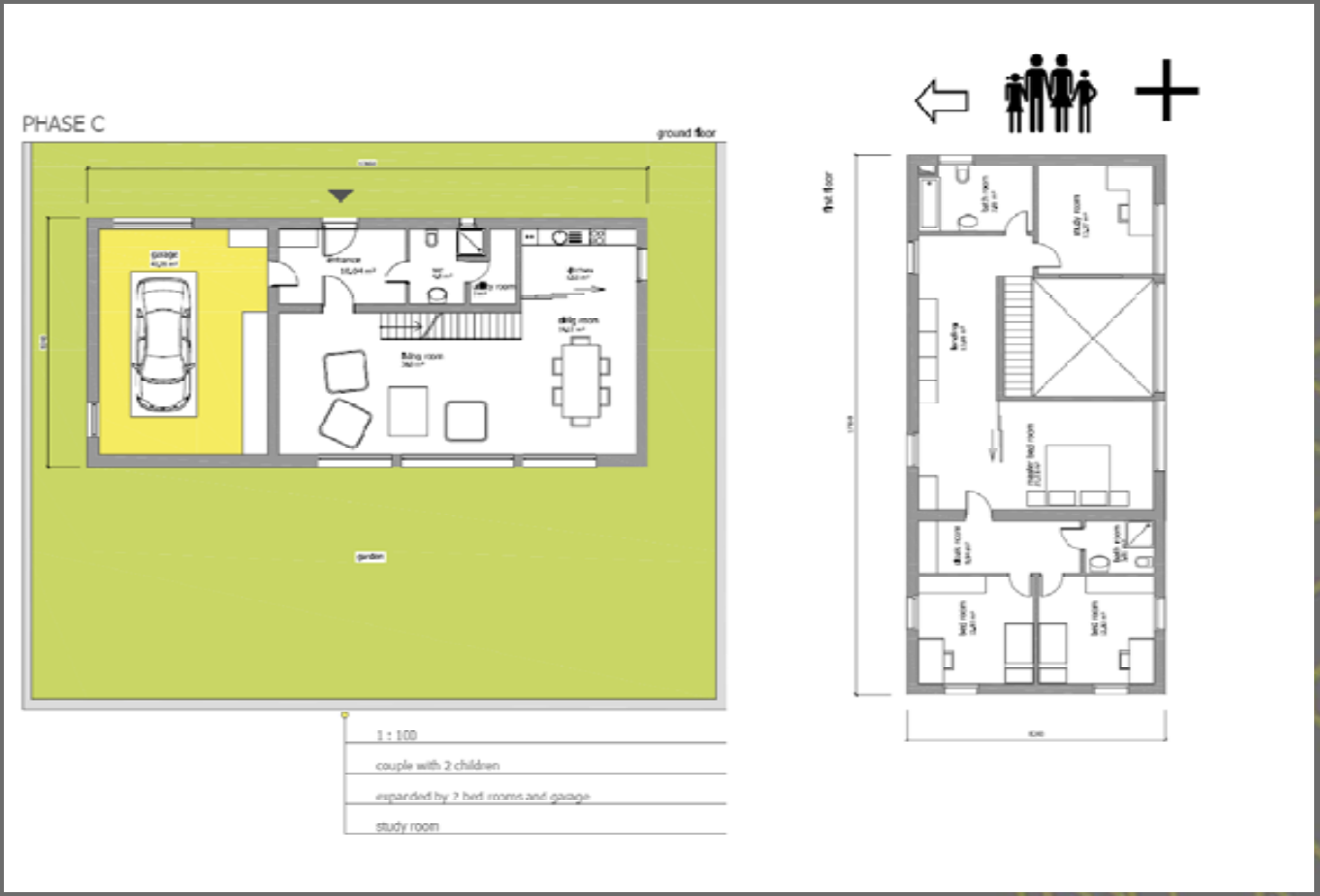
Starting unit for a young couple without children

The Growing steel house



Young couple with baby

The Growing steel house



Couple with two children + garage

The Growing steel house

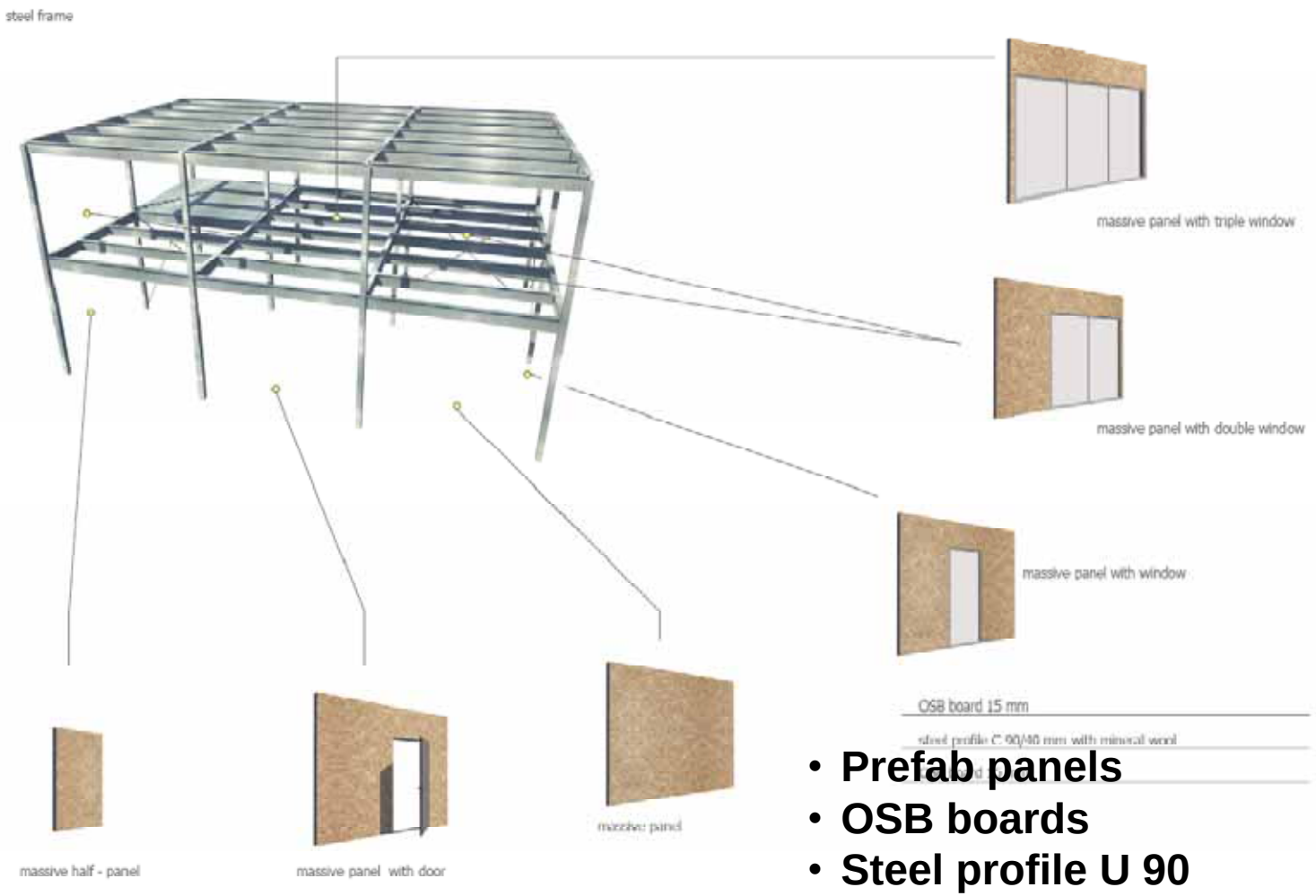
Construction part

Elements

- Purlins IPE160
- Beams IPE270
- Columns tube 120x120x5
- Bracing tube 38x4

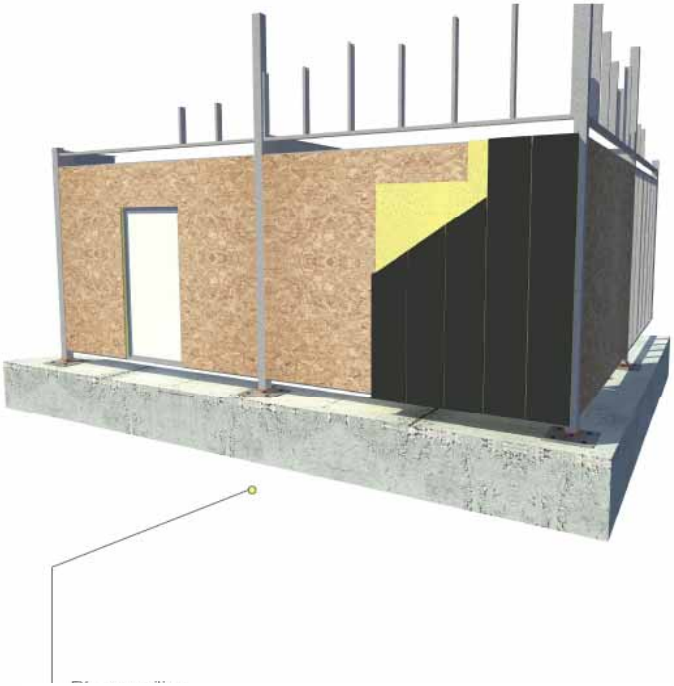
Steel hot rolled frame

External walls



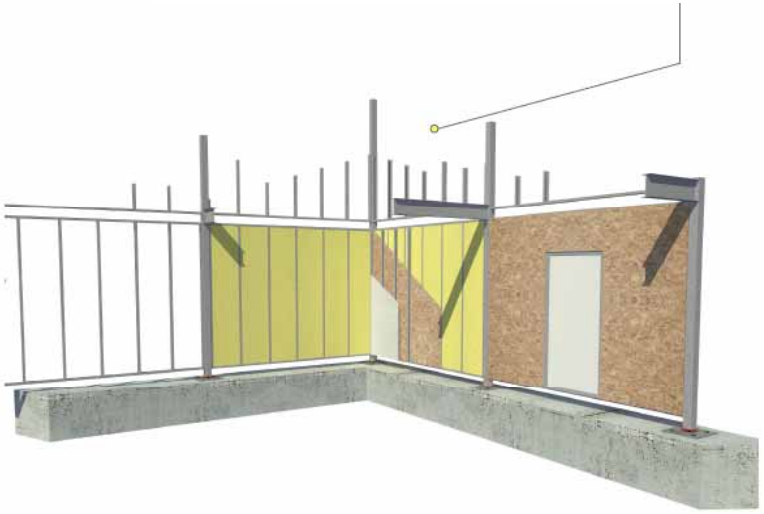
- **Prefab panels**
- **OSB boards**
- **Steel profile U 90**
- **Thermal insulation**

Wall composition



INTERIOR

- **Steel shape**
- **OSB boards**
- **Mineral insulation**
- **Air space**
- **Plaster board**

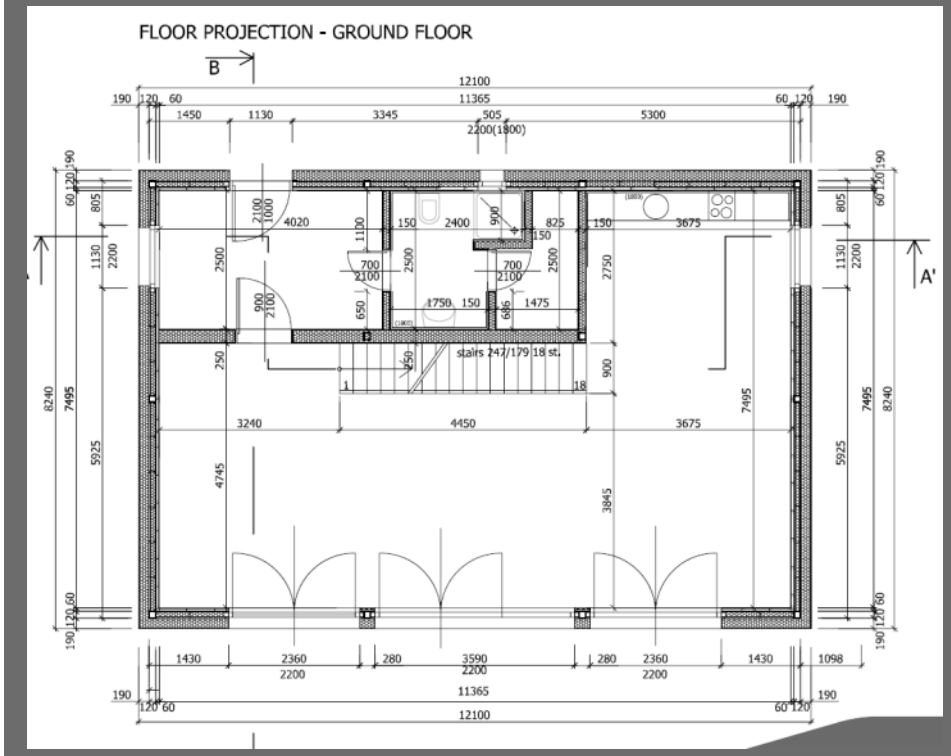


EXTERIOR

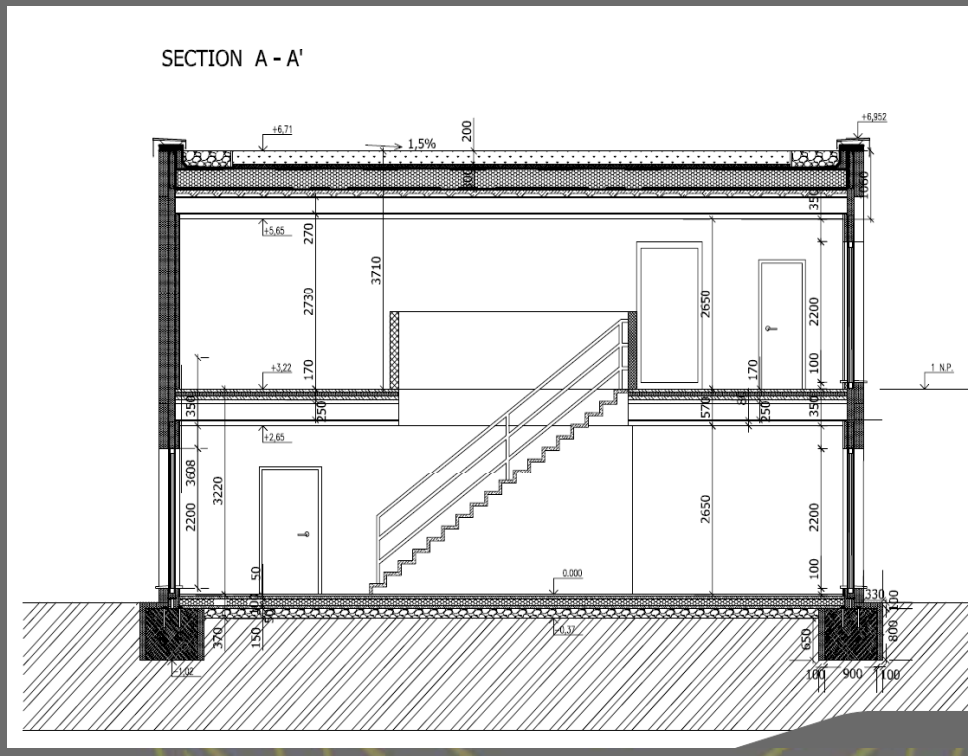
- **OSB boards**
- **Mineral insulation**
- **Air space**
- **External plaster**

Structural design

Plan view

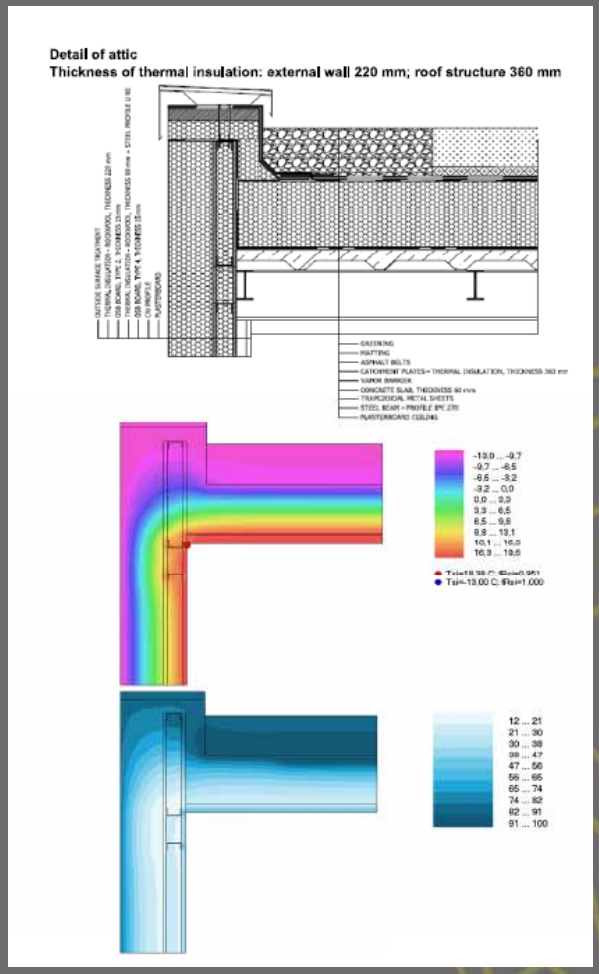


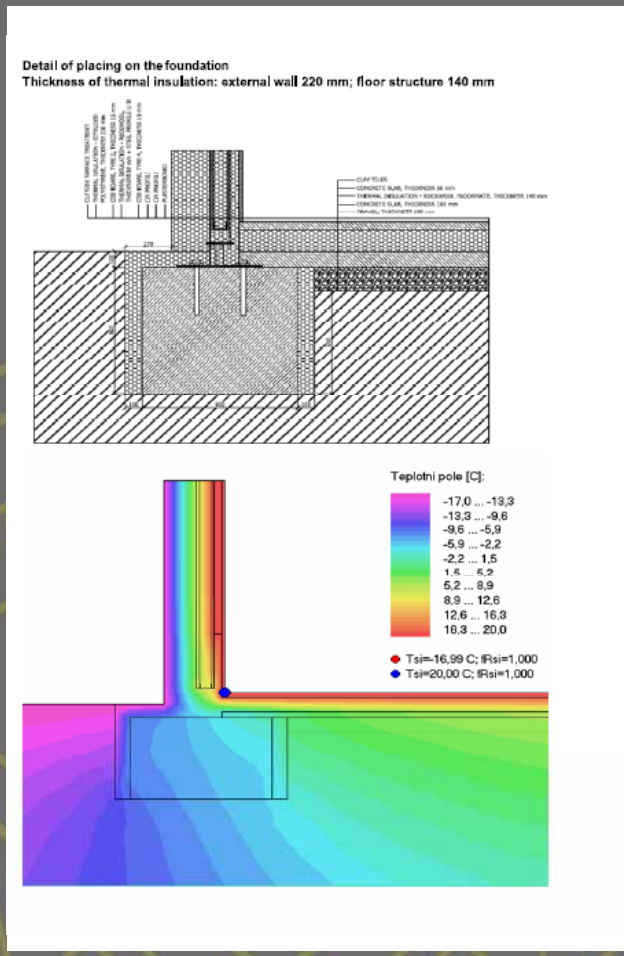
Section



Building Physics

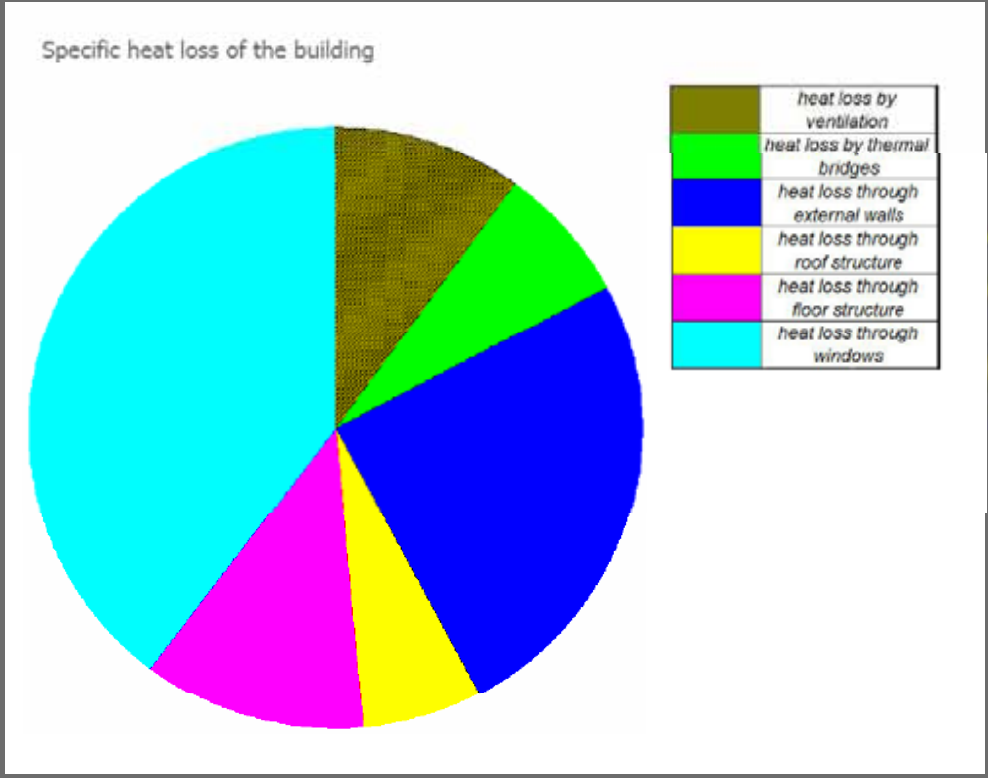
- Roof
- Attic
- Foundation
- Panels
- Window
- Wall corners

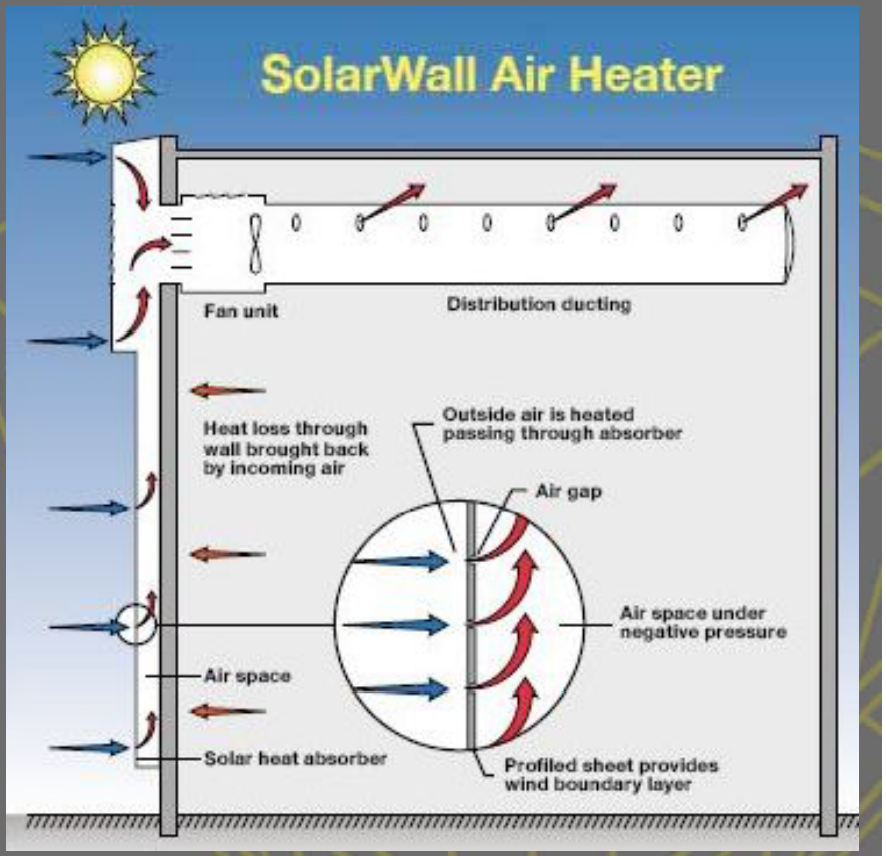




Building physics

- South - orientation
- Less then 20 kWh/m^2 per year
- For winter heating





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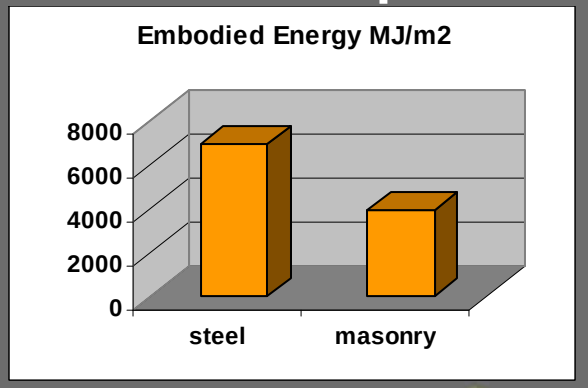
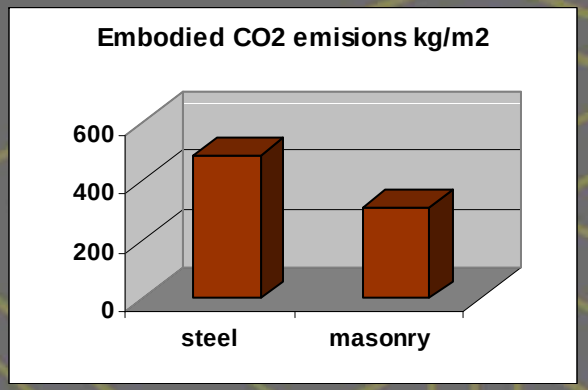
Assessment of sustainable development

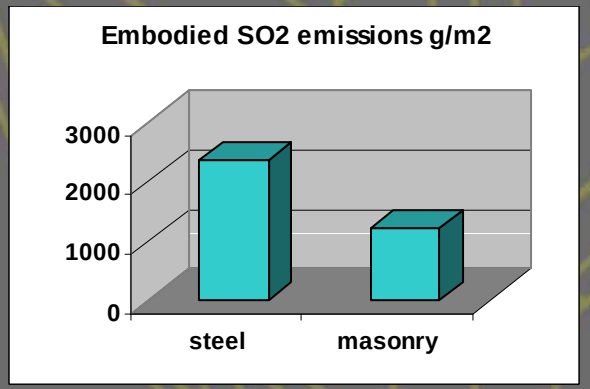
Environment		project	steel		masonry	
Climate change			Marks	Summary of marks	Marks	Summary of marks
	Operating emissions $CO_{2,ekv.}$	12,5%	3,73	0,466	3,74	0,467
	Embodied emissions CO2,ekv.	3,5%	-1,00	-0,035	-1,00	-0,035
Air Quality						
	Operating emissions $SO_{2,ekv.}$	4,6%	4,81	0,219	4,82	0,219
	Operating emissions NO_x	4,6%	4,31	0,196	4,31	0,196
Biodiversity						
	Proportion of area with the original nature character	3,6%	3,08	0,111	3,08	0,111
Usage of resources and waste						
	Annualized non- renewable primary energy used for facility operations	7,7%	3,79	0,291	3,79	0,291
	Annualized non- renewable primary energy embodied in construction materials	3,8%	-1,00	-0,038	-1,00	-0,038
	Usage of renewable and recycled materials in the construction	6,2%	4,00	0,248	3,00	0,186
	Construction waste- during the construction and demolition	3,6%	-1,00	-0,036	-1,00	-0,036
		50,0%		**1,421**		**1,361**
Social aspects						
Health and quality of indoor environment						
	Day lighting	5,2%	5,00	0,260	5,00	0,260
	Acoustic comfort	6,5%	3,00	0,195	3,00	0,195
	Thermal comfort	6,8%	5,00	0,340	5,00	0,340
	Indoor air quality	5,4%	3,00	0,162	3,00	0,162
Availability						
	Access for disabled people	3,3%	3,00	0,099	3,00	0,099
Security						
	Security of building	4,4%	1,00	0,044	1,00	0,044
Adaptability and flexibility						
	Adaptability	3,4%	5,00	0,170	-1,00	-0,034
		35,0%		**1,270**		**1,066**
Economy						
LCC						
	Life cycle cost	5,3%	3,00	0,158	3,00	0,158
Support of local economy						
	Usage of local products	3,6%	0,00	0,000	0,00	0,000
Externalities						
	Innovative approach	2,5%	3,00	0,074	3,00	0,074
	Availability of detailed and operating documentation	1,8%	3,00	0,053	3,00	0,053
Rizika						
	Autonomy of operation	2,0%	0,00	0,000	0,00	0,000
		15,0%		**0,284**		**0,284**
				3,00		**2,70**

Marks

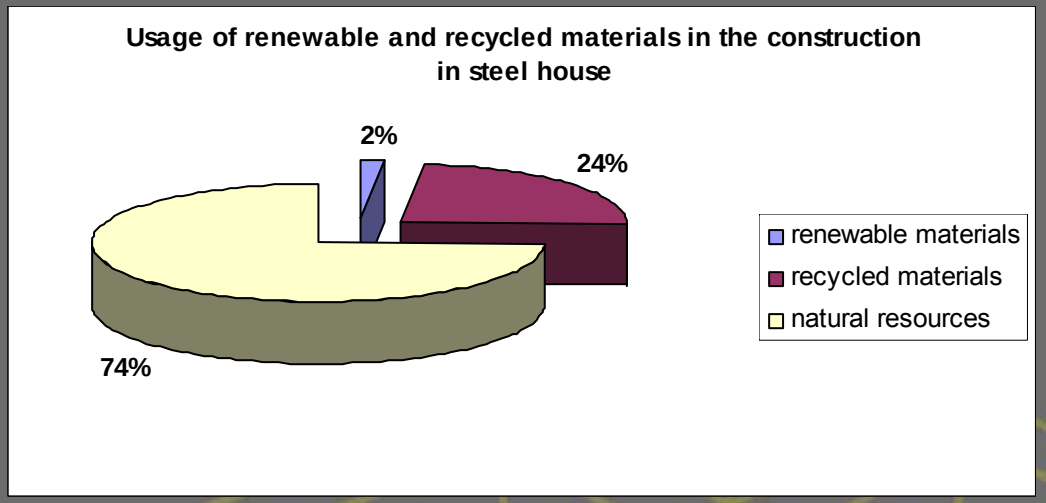
-1	...Inappropriate solutions
0	...Admissible solutions
3	...Good solutions

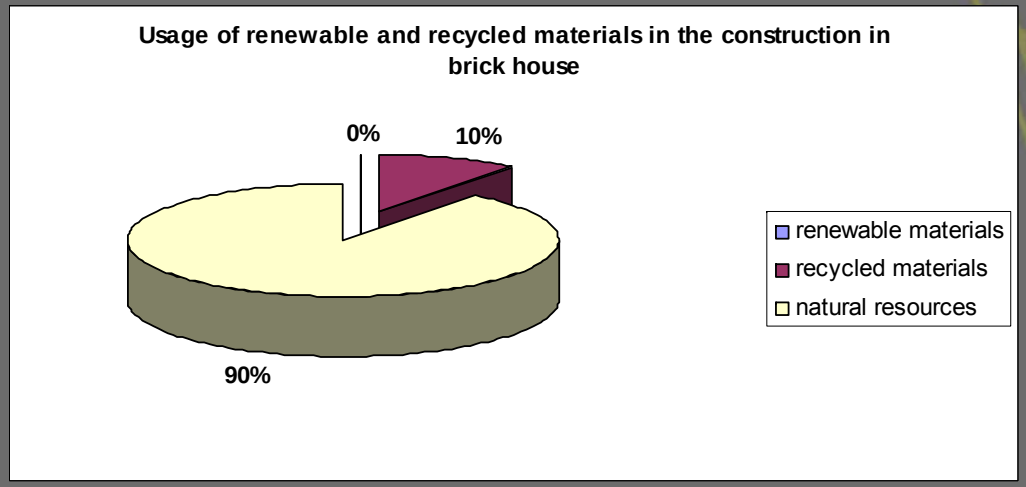






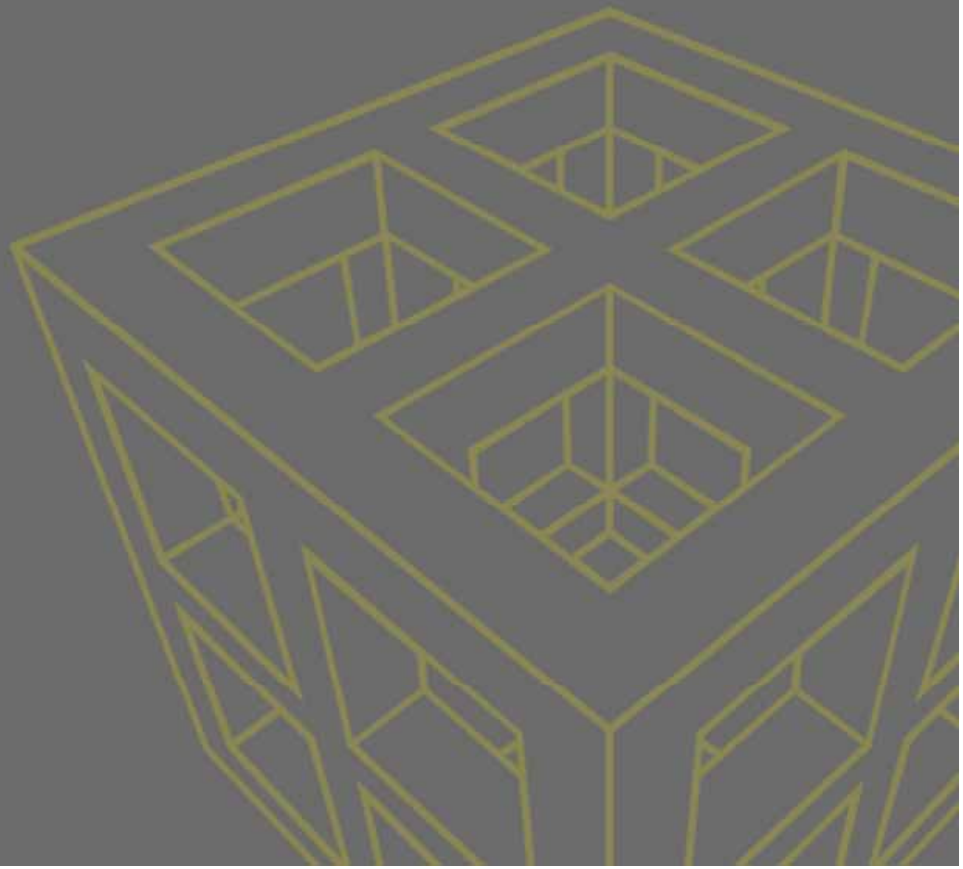
Assessment on sustainable development





Summary

- Growing steel house 3,00 pts. – very good solution
- Steel vs. brick house
  - Embodied emissions and energy
  - Usage of materials
  - Adaptability



THANK YOU
FOR YOUR ATTENTION

fire.fsv.cvut.cz/affordable_houses

Students / design: tereza pavlů - structural design; petr schorsch - structural design; lukáš turek - architectural concept and solution;

Students /collaboration on the text part : tomáš horálek - socio-economical evaluation; jakub holeček - socio-economical evaluation; pavel jenýš - traditional housing concept; rostislav mazáč - socio-economical evaluation; zdeňka staňková - traditional housing concept; oldřich švec - socio-economical evaluation; kristina trnková - traditional housing concept; zuzana šulcová - web Page

Teachers / concultations: františek wald - head; karel mikeš – manager; petr hájek - sustainability building concept; jan tywoniak - building energy concept