Costs of auxiliary structures are among the most expensive items in the facade work. In this context it should be understood optimization as a basic tool of cost reduction in the use of auxiliary structures, resulting in increased competitiveness building companies and ultimately reducing the price offer.

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IMPACT OF SHAPE OF BUILDINGS ON ENERGY CONSUMPTION

Наведено аналіз форми будівель (план фундаменту і вертикальний розподіл) і їх вплив на коефіцієнт форми / аеродинамічний коефіцієнт/ FT будівель. Для деяких будівель запроваджений параметричний аналіз, отриманий з вичерпного відтворення енергетичних потоків цілої будівлі. Параметричний аналіз стосується орієнтації будівлі і пропорційно процентності скління конкретної стіни.

Ключові слова: форма будівель. Коеффіцієнт форми (аеродинамічний коеффіцієнт), орієнтація, процентність скління.

This paper provides analysis of buildings shape (ground plan and vertical division) and their impact of shape factor – FT of buildings. For some shape is provide a parametric analysis obtained from a comprehensive whole building energy simulation. Parametric analysis regards orientation of buildings and ratio % glazing to the wall.

Key words: shape of buildings, shape factor, orientation, % of glazing.

Introduction. Designing a building requires the interplay of architecture and design parameters to create an artificial material environment. Each architectural and engineering design has a direct impact on the indoor climate environment and a key determinant of operational performance of buildings throughout the life of the building. One important component of the process of reducing the operating energy performance of buildings within a designated period of their exploitation as packaging design of buildings and their physical and technical characteristics, which are intended design concept and building material solutions.

In accordance with long-term strategic objectives of reducing emissions and improving energy efficiency, adoption of the European Parliament on May 18, 2010 and the adoption of 2010/31/EU raised the commitment by 2020 to reduce overall emissions of greenhouse gases by at least 20%. The Directive requires Member States to design all new buildings with nearly zero energy until December 31,the 2020th.

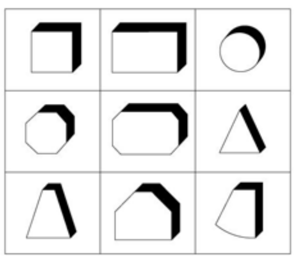
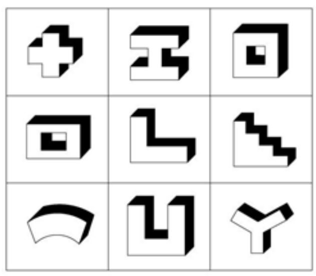
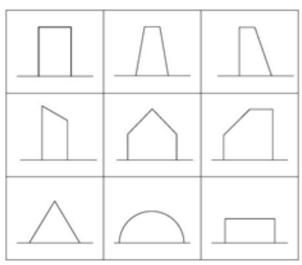
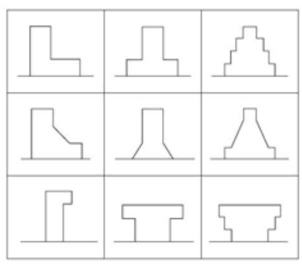
Aims of the Directive can be applied in conjunction excellent thermal parameters of packaging designs energy-efficient buildings and shape solutions. For optimal design EEB has a major impact outside the geometry, ie compact shape and surface topography. After construction of the EEB is possible to adjust the amount of packaging design parameters, but the shape that has been proposed in the early stage of architectural design usually remains unchanged throughout the life of the building. With emphasis on the need for domestic heating is the most compact design of the object, only a small degree of segmentation.

Building energetic design of the proposal buildings Building energetic concept of the proposed building would be a Framework processed in parallel with the primary architectonic study. By that concept is defined amount of energy required to ensure desired state of the indoor environment (heating, ventilation, cooling). The resulting energy performances of buildings are affected by the nature of a particular project.

Geometric concept of buildings Analysis of actual shapes mainly office buildings were created groups of eighteen potential ground plan structure of the building and eighteen groups of the vertical structure of the building. The most common plan and vertical structure of the building are shown in the figures in Table 1st. A good tool to optimize the shape of buildings in terms of minimizing heat loss packaging design is the creation of four groups with ground plan and vertically divided structure. Combinations shown in Figure 1, 2 resulting breakdown in shape, Figure 4 shows the difference between the max. and min. shape factor. Figure 3 shows the comparison of shapes of buildings of simple and complex ground plan breakdown in terms of form factor and their deviations against the ideal cube with the same volume.

Table 1

Morphology of buildings – ground plan and vertical division

Plans	
Simple	***Complex***
	
Elevations	
Simple	***Complex***
	

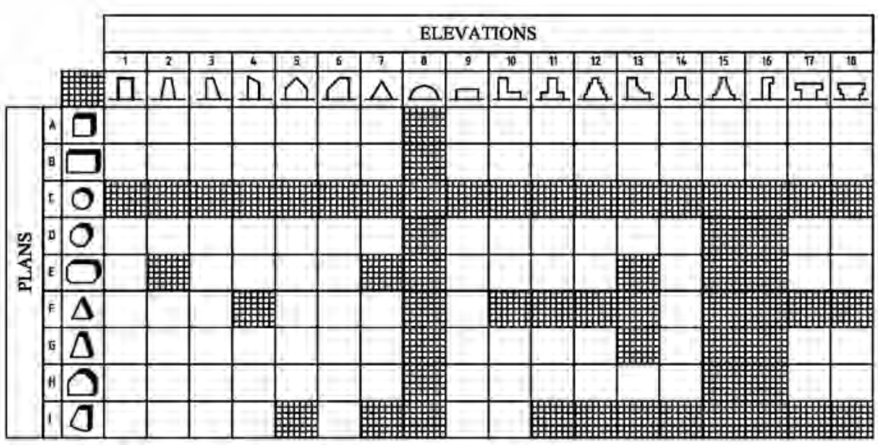


Figure 1. Created shapes of buildings – simple ground plan

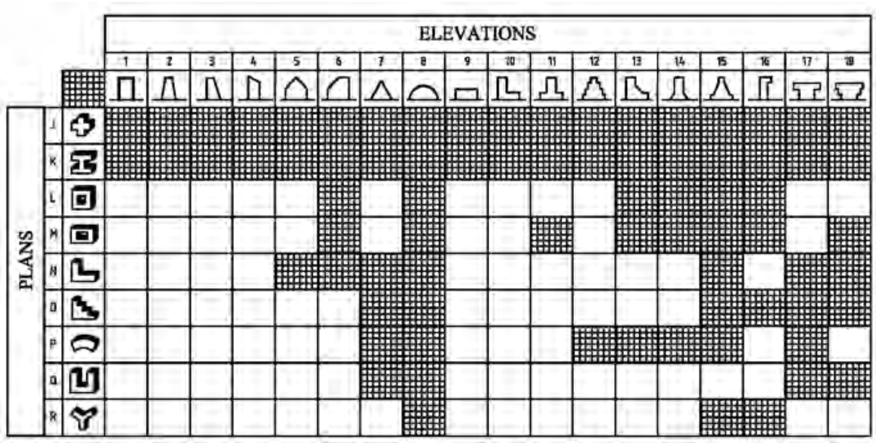


Figure 2. Created shapes of buildings – complex ground plan

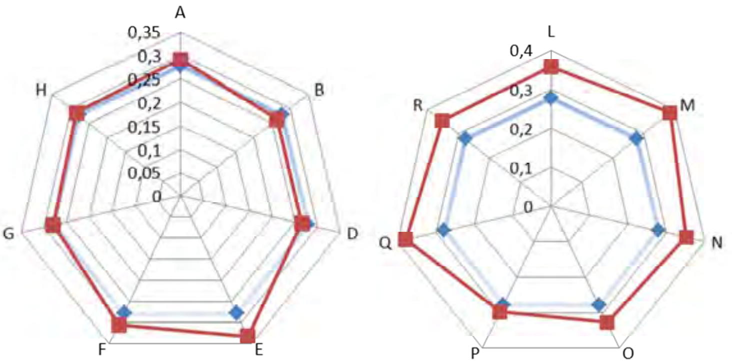


Figure 3. Shape factor: left - simple ground plan, right - complex ground plan

Figure 4. The difference between the maximum and minimum shape factor (FT) of the building

Impact of selected parameters on heat needs for heating. For comparison, the heat needed for heating was selected several types of frequently occurring forms of administrative buildings, which were simulated in a dynamic simulation program Design Builder. Computational core is formed by Energy Plus program [3]. All shapes are compared the same volume (V = 42875 m^3) and measuring the same area (S_{pdl} = 12250 m^2), an essential element in creating the planned shape is a cube with dimensions of 3,5 x3, 5x3, 5m. Examined the effect of orientation on the cardinal points, the percentage of glazing to the perimeter wall and the rectangular ground plan parties influence the ratio of the need to heat. On the Tab. 2nd analyzed shapes are displayed. Compared were the four basic shapes of buildings and a rectangle with varying aspect ratio (ratio influence on the shape factor can be seen on the chart - Figure 5).

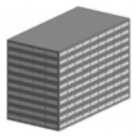
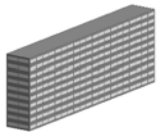
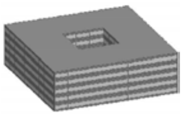
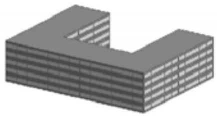
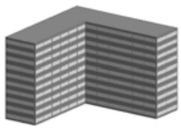
Boundary conditions. The individual shapes were simulated in day intervals parametrically for different orientations (Fig. 9) and for different ratio of glazing to external walls - from 0% to 100%. In packaging design envelope was considered a massive structure - better mass accumulation, the structure complies with all other requirements of a standard STN 73 0540 [4]. Thermal characteristics of packaging structures, which are used in calculations, are listed in Table 3.

Results of parametric simulation Fig. 5 shows an orientation to the world envisaged by the various forms analyzed, considered the possibilities with 8 orientations (from 1 - North, 8 - Northeast). Fig. 7, 8 for the intended shapes graphically illustrates the dependence of heat in% (100% represents a cube) orientation relative to the cardinal, and him-% ratio of glazing to the perimeter walls.

The graphs of Fig. 7, 8 shows that the thermal property of transparent and nontransparent building envelope constructions is most favorable to minimize heat loss of 60% glazing (the ratio of heat gain and loss is the most optimal).

Table 2

The main shapes of buildings, that were comparison of energy consumption

1	**1:2**	**1:8**
		
4	**3**	**2**
		

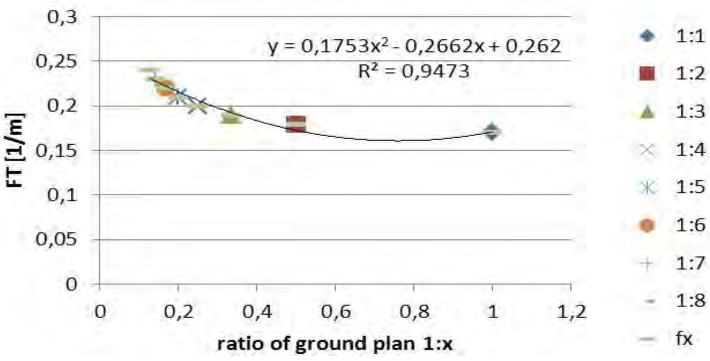


Figure 5. Effect of the ratio ground plan on shape factor on the same ground-plan area and same floor of buildings

Building envelope thermal properties

Buiding Component	Construction details (quantity of insulation)	U [W/m².K]
Ground floor	100mm XPS polystyrene	0,292
Floor	150mm concrete - heawyheight	
Wall	450mm brick, 60mm mineral fibre	0,300
Roof	200mm concrete and 200mm polystyrene	0,141
window	Doble (with 16mm argon, total solar transmission 0,43)	1,345

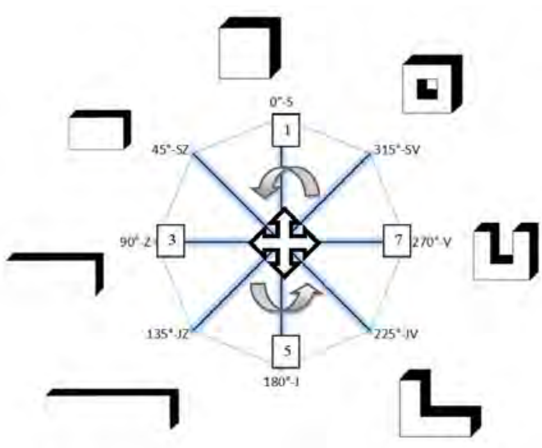
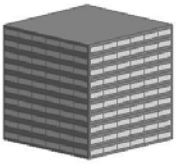
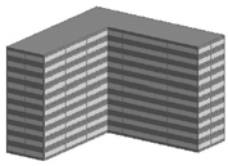


Figure 6. Initial orientation of buildings to the cardinal point



min.: 60%, 180°-J
max.: 0%, 225°-JV



min.: 40%, 0°-S
max.:100%, 135°-JZ

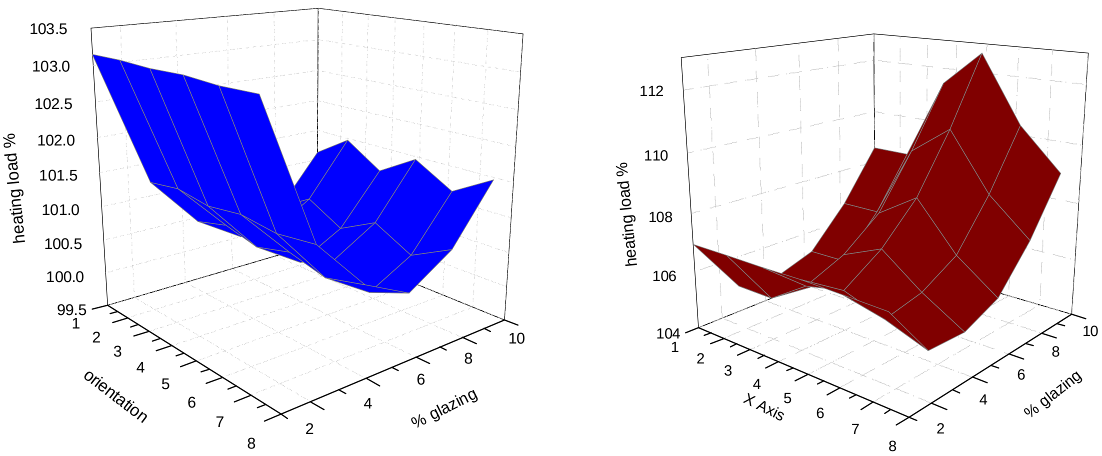


Figure 7. Heating load due to orientation and % of glazing to the external walls for shape 1and 2

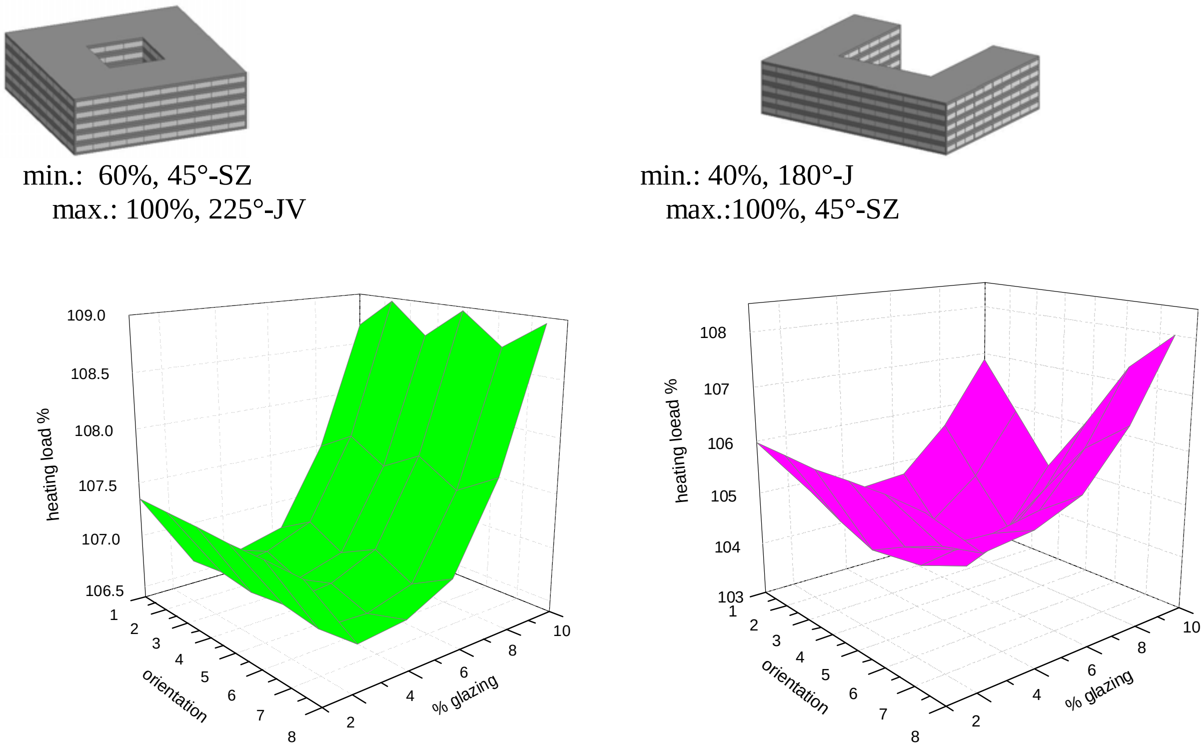


Figure 8. Heating load due to orientation and % f glazing to the external walls for shape 3 and 4

Fig.9 shows the impact of orientation to the cardinal points of the shapes when considering the ratio of 60% glazing to the external walls.

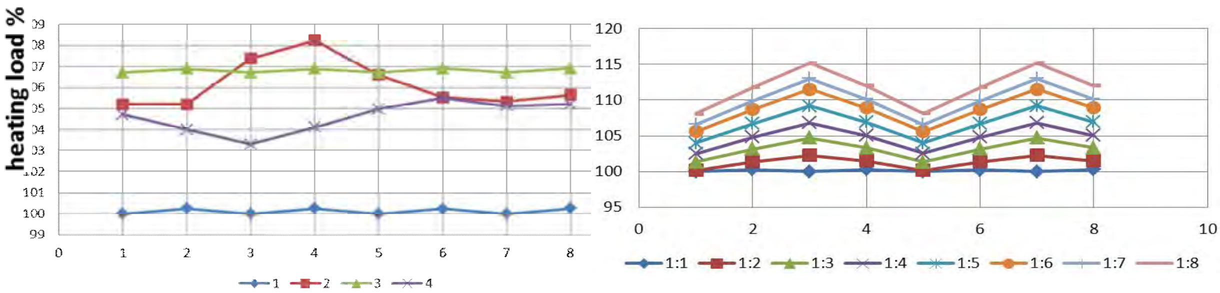


Figure 9. Impact of orientation on heating load for the shapes 1-4 (left) and 1:1-8(right)

Dependency of shapes of buildings on need for heat On Fig. 10 are for the shapes with an aspect ratio of 1:1 to 1:8 depending on the impact of regression indicated ratio and heating load. On Fig. 11 is for these shapes expressed a linear relationship of heat and proportionately 1/FT and E/E_{ref} (E_{ref} = cube of equal volume and specific surface).

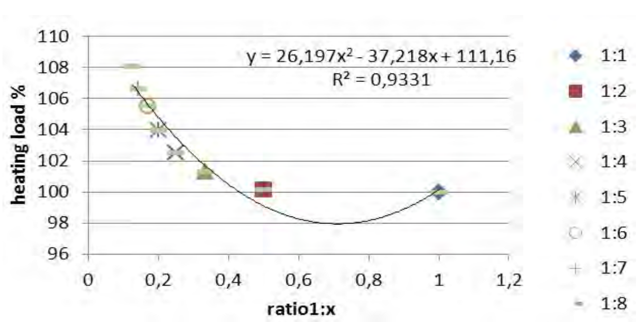


Figure 10. Regression dependency of the ratio of ground plan and heating load % (100% = cube – 1:1)

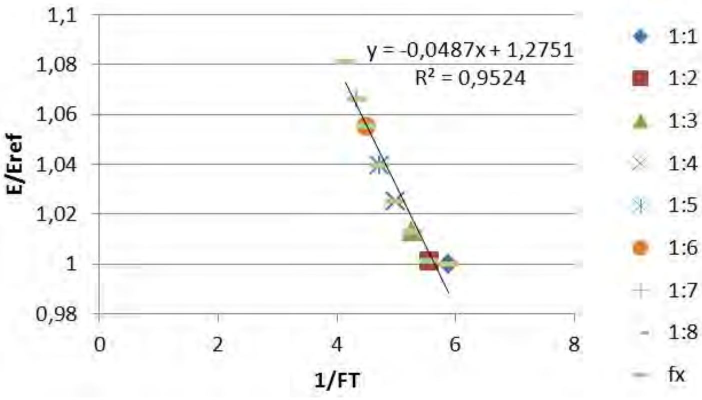


Figure 11. Linear dependence 1/FT of objects with a ratio 1:1-1-8 and heating load proportionally to the heating load of reference cube the same volume

Conclusion. In the initial design phase of buildings where the architect creates a building should be considered essential elements: shape, orientation, glazing ratio to the walls, the type of glazing, thermal mass in relation to storage capacity, thermal insulation and the cover. Appropriate architectural and structural design we save quite a considerable amount of energy. The ideal solution is equal to careful integration of these elements. In accordance with long - term strategic objectives of reducing emissions and improving energy efficiency.

In accordance with long-term strategic objectives of reducing emissions and improving energy efficiency 2010/31/EU Directive requires Member States to design all new buildings with nearly zero energy until December 31, the 2020th. Aims of the Directive can be applied in conjunction excellent thermal parameters of packaging designs energy-efficient buildings and shape solutions. For optimal design EEB has a major impact outside the geometry, ie compact shape and surface topography. After construction of the EEB is possible to adjust the amount of packaging design parameters, but the shape that has been proposed in the early stage of architectural design usually remains unchanged throughout the life of the building. With emphasis on the need for domestic heating is the most compact design of the object, only a small degree of segmentation.

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