Olga ANDROPOVA
Kyiv National University of Construction and Architecture, Ukraine

PLOTTING THE NEW BUILDING PROJECT SPACE IN THE EXISTING DEVELOPMENT AT THE DESIGNING STAGE WHILE FOLLOWING THE INSOLATION STANDARDS

It is very important to take into consideration the problems connected with insolation while designing energy efficient buildings. The article covers the outline of plotting a project space using the algorithm of estimated elapsed time measurement of insolation in critical premises and critical points in the adjoining areas, where the insolation standards are to be met.

Keywords: project space, estimated time of insolation, maximum shadow mask, energy efficient buildings

INTRODUCTION

The estimation of insolation duration is obligatory in plotting a new building to provide for the hygienic norms in standardized premises and to preserve the existing insolation conditions in the existing structure. The preliminary complex analysis of surrounding buildings and the earthwork size and section estimation gives an opportunity to determine the maximum project space, which limits the new building proportion at the initial plotting stage. Of particular importance is the solution to this problem in the light of estimating the insolation and sealing the existing development.

1. THE NEW BUILDING PROJECT SPACE

The estimation of a possible height of a development by the means of plotting the system of solar horizontals was resolved in [1]. The usage of solar maps enables the analysis of the insolation conditions in premises during a year [2]. There is an estimation method of the maximum shadow mask of the project space (MSM-PS) that corresponds with maximum possible marks of orographic surface points, which allows the insolation conditions of a project point (PP) in premises of the existing building or in adjoining areas to meet the requirements or not to deteriorate during the standardized insolation period [3]. However, this method is very labor-intensive and requires clear layout compiling of a project space plotting. The project points

(PP) are determined, based on project planning solutions, cardinal direction orientation, standardized insolation requirements and limiting conditions. Afterwards, the estimation is conducted in two directions: upon availability of design drawings for the new building (a construction layout on land with sections varying in height pointed out) [4] and upon unavailability of preliminary designs. The project space plotting algorithm is stated in [5]. Upon availability of preliminary designs the plotting of possible shadow masks for every (PP) is conducted along with the estimation of maximum possible heights of sections for the new building. Otherwise, only the plotting of possible shadow masks for every (PP) is to be made.

2. UPON AVAILABILITY OF THE DESIGN DRAWINGS FOR THE NEW BUILDING

The new building, planned buildings or buildings in construction outlines and the area near the structures that serve as a standard for continuation of insolation are marked on a topographic map for estimation [6]. Afterwards, the position of the project points is determined PPi (i = 1,2,…,I). Then the maximum shadow masks MSM are plotted for every PPi, which creates different options for MSMi,j (j = 1,2,...,Ji) (Fig. 1).

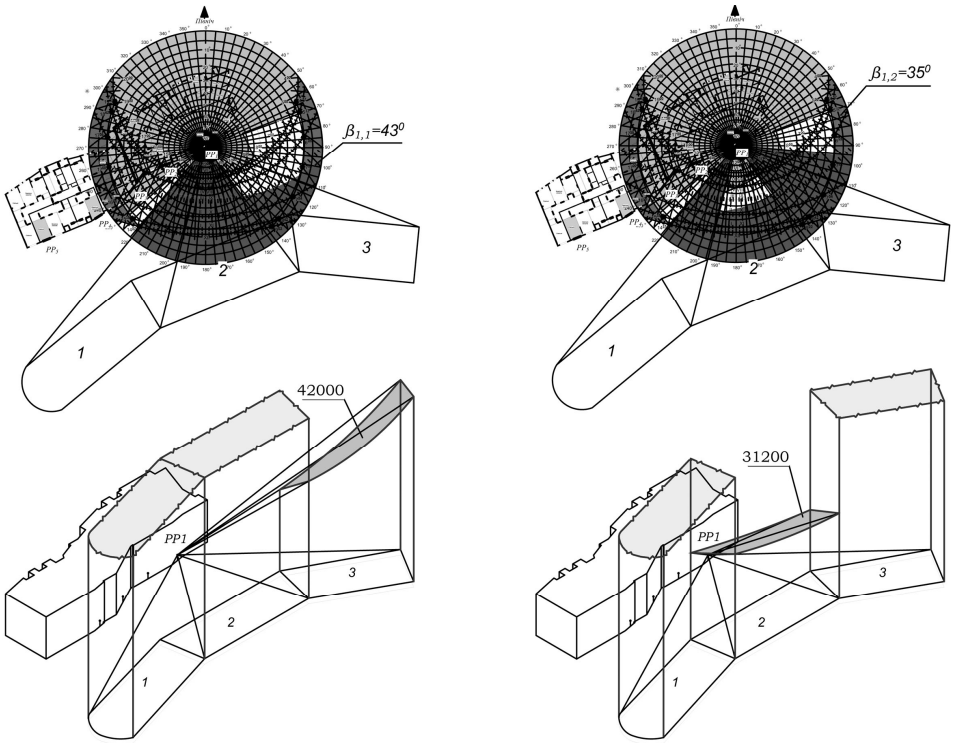

Fig. 1. The estimation of sections heights maximum value for (PP1) in the group (G0)

The maximum value of every section height H*i*,*j*,*k* is determined for every MSM*i*,*j* option. All the options of sections heights combinations create the zero-level group (G0) (Tab. 1). The maximum value of every section height $Hi,k = \max(Hi,1,k,Hi,2,k, ...,Hi,ji,k)$ is determined in the zero-level group (G0) (Fig. 2) and then the maximum possible value of heights $Hk = \max(H1,k,H2,k,...,HI,k)$ of sections (Fig. 3) is determined as well, which will meet the insolation standards in all PP*i*. All the values of heights H*i*,*j*,*k* in (G0) that are larger than corresponding *Hk* are substituted for *Hk* (Tab. 2). After excluding the iterative options in (G0), (G1) is created.

Table 1. **The creation of zero-level group (G0) and estimation of the maximum values of sections heights**

PP	Option	The marks of ledge levels in the new building [mm]		
		Section 1	Section 2	Section 3
1	1	unlimited	unlimited	42 000
	2	unlimited	31 200	unlimited
2	1	unlimited	unlimited	47 200
	2	unlimited	32 900	unlimited
3	1	unlimited	23 400	unlimited
	2	37 800	31 700	unlimited
4	1	unlimited	21 100	unlimited
	2	42 200	unlimited	unlimited

Table 2. **The substitution of maximum values of sections heights for maximum possible under the conditions of sections height insolation in (G0)**

PP	Option	The marks of ledge levels in the new building [mm]		
		Section 1	Section 2	Section 3
1	1	unlimited	31 700	42 000
	2	unlimited	31 200	unlimited
2	1	unlimited	31 700	unlimited
	2	unlimited	31 700	unlimited
3	1	unlimited	23 400	unlimited
	2	37 800	31 700	unlimited
4	1	unlimited	21 100	unlimited
	2	42 200	31 700	unlimited

Table 3. **The options of combining the maximum possible sections heights**

Option	Group	The marks of ledge levels in the new building [mm]		
		Section 1	Section 2	Section 3
1	1.1	unlimited	21 100	unlimited
2	1.2.1	37 800	31 700	42 000
3	1.2.2	37 800	31 200	unlimited
4	1.3.1	42 200	23 400	unlimited

This process continues till all the values of $Hi,j,1$ become the same. $N1$ first-level groups are created. By the means of a similar algorithm the second-level groups $(Gi,),1$, $(Gi,),2$, …, $(Gi),N2i$, are created, which have values of sections heights.

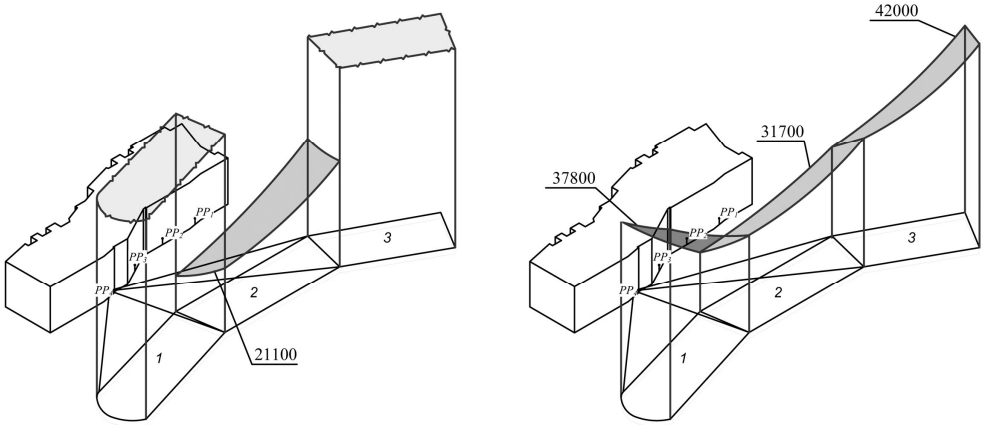

Fig. 2. The options of combining the maximum possible heights for (G1.1) and (G1.2.1)

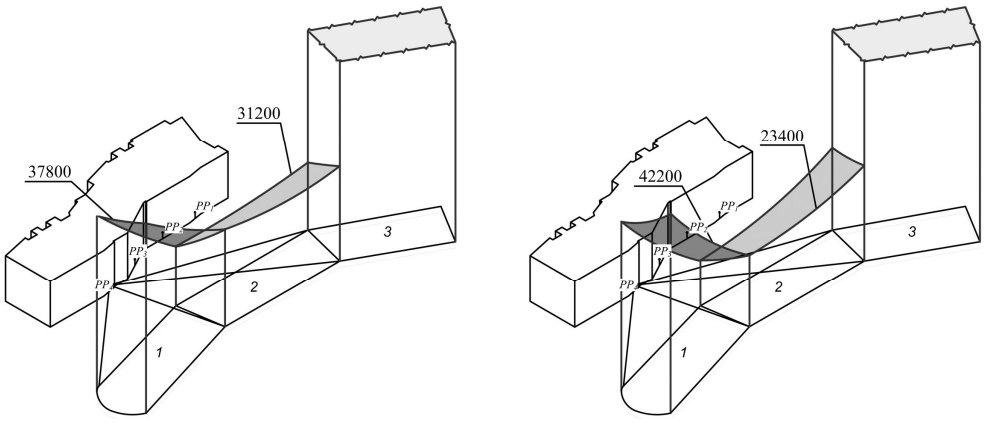

Fig. 3. The options of combining the maximum possible heights for (G1.2.2) and (G1.3.1)

The groups of third, fourth and subsequent levels are created in a similar way. The amount of levels equals the number of sections. Every group of a last level has only one option of combining the sections heights. The most suitable option for the architectural concept of the new building is chosen from among the received options.

3. UPON UNAVAILABILITY OF THE DESIGN DRAWINGS FOR THE NEW BUILDING

A new development land outline, buildings in planning or construction outlines and the areas where the insolation is normalized are marked on a topographic map. Then the position of project points PP*i* ($i = 1,2,\ldots,I$) is determined in the existing development and existing areas. A regular grid is marked on the land of a new development ($k = 1,2,\ldots,K$). Afterwards, a combined shadow mask is plotted for PP*i* without taking into account new construction process (Fig. 4). There is a maximum possible shadow mask of project space on the combined shadow mask in the range of horizontal shading angle of a development land.

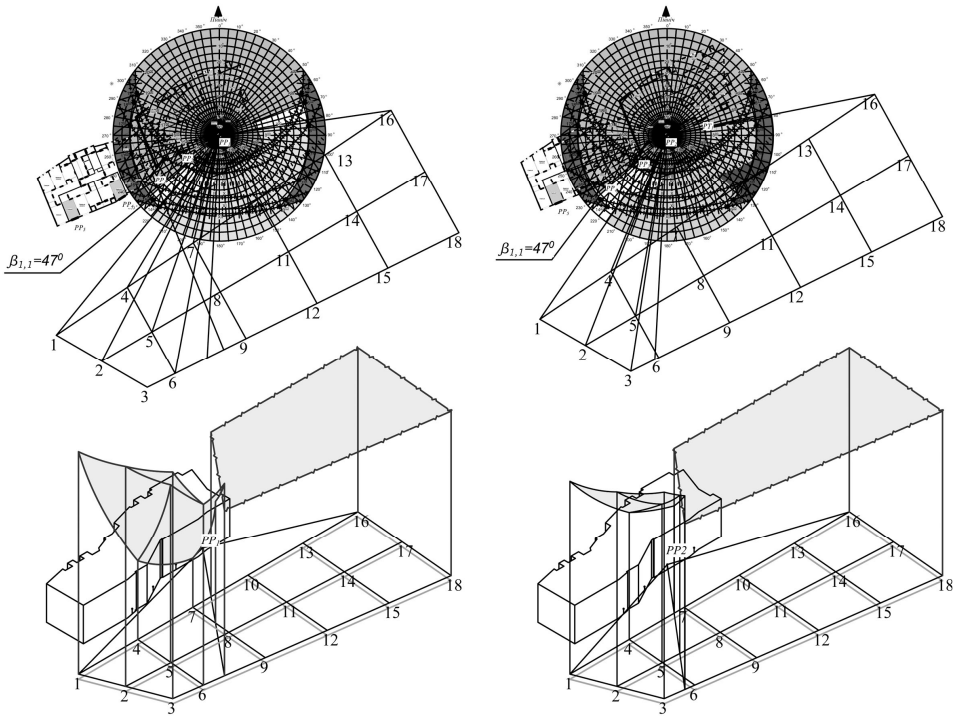

Fig. 4. Plotting of a maximum possible MSM for project point (PP1) and (PP2)

MSM*i* in every PP*i* determines a conical surface with the apex of PP*i*, which limits the height of the development (Tab. 4).

The maximum marks of possible development in grid nodes belonging to the area are determined by the crossing of a conical surface with corresponding vertical

lines for PP*i*. The surface limiting the height of a new development under the conditions of following the insolation regulatory requirements in existing buildings and adjoining areas, where the insolation is standardized (Tab. 5), is plotted by a point frame approximation that is situated over the grid nodes. The marks of points *Hi* are the minimal values of heights of the corresponding points from a range of marks obtained for all the points: $H_k = \min(H_{1,k}, H_{2,k}, \ldots, H_{l,k})$ (Fig. 5).

Table 4. **The estimation of the maximum values of sections heights for every PP*i* in grid nodes and the creation of (G0)**

PP	The marks of ledge levels in the new building [mm]						
	1	2	3	4	5	6	7
1	87 300	86 300	88 900	30 700	69 700	70 900	19 200
2	75 700	76 300	81 000	49 900	62 100	unlimited	unlimited
3	46 200	47 900	52 700	28 600	39 000	49 600	unlimited
4	49 600	53 700	unlimited	unlimited	unlimited	unlimited	unlimited

Table 5. **The substitution of the maximum values of sections heights for the maximum possible ones under the conditions of sections height insolation in (G0) and the creation of (G1)**

PP	The marks of ledge levels in the new building [mm]						
	1	2	3	4	5	6	7
1	46 200	47 900	52 700	28 600	39 000	49 600	19 200
2	46 200	47 900	52 700	28 600	39 000	49 600	19 200
3	46 200	47 900	52 700	28 600	39 000	49 600	19 200
4	46 200	47 900	52 700	28 600	39 000	49 600	19 200

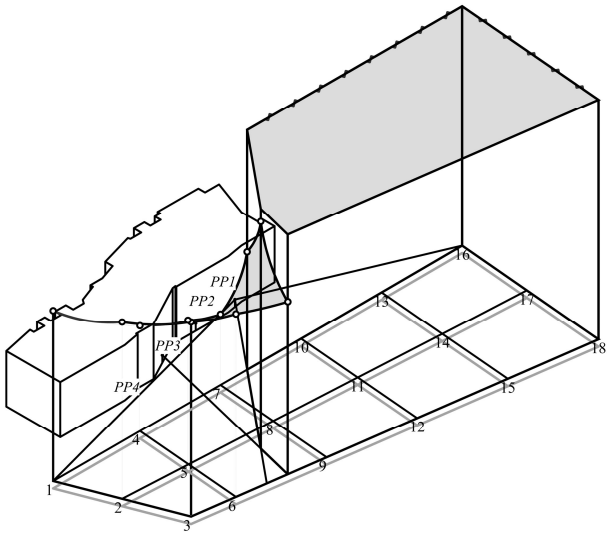

Fig. 5. The estimation of a possible project space for the new building

CONCLUSION

The proposed outline of plotting the project space for the new building in the existing development at the designing stage, while taking into account the standardized insolation time, is important for creating comfortable living environment.

REFERENCES

[1] Тваровский М., Солнце в архитектуре, Пер. с польск., Стройиздат, М.: 1977, 288 с.

[2] Підгорний О.Л., Світлопрозорі огородження будинків : навч. посібник для студ вищ. навч. закл., О.Л. Підгорний, І.М. Щепетова, О.В. Сергейчук, О.М. та ін.; під ред. О.Л. Підгорного, О.А. Домашевська, К.: 2005, 282 с.

[3] Сергейчук О.В., Вплив вимоги збереження інсоляційних норм в існуючих будинках на форму нового будинку, О.В. Сергейчук, О.В. Андропова, Прикл. геометрія та інж. графіка: між від. наук.-техн. зб., КНУБА, К.: 2008, Вип. 80, 279-284.

[4] Андропова О.В., Визначення обмежуючих умов для побудови схеми розрахунку інсоляції при пошуку форми нового будинку в існуючій забудові, Прикл. Геометрія та інж. графіка: між від. Наук.-техн. зб., КНУБА, К.: 2009, Вип. 81 (issue 81).

[5] Андропова О.В., Алгоритм визначення проектного простору нового будинку в існуючій забудові з умов дотримання інсоляційних норм, Технічна естетика і дизайн : між від. Наук.-техн. зб., КНУБА, К.: 2010, Вип. 7, 231-237 (issue 7).

[6] Державні санітарні правила планування та забудови населених пунктів: ДСП 173. [Затверджені наказом МОН України від 19 червня 1996 р.], МОН України, МОН України, К.: 1996, 66 с. (Державні санітарні норми України).

KSZTAŁTOWANIE OTOCZENIA NOWYCH BUDYNKÓW SYTUOWANYCH W ISTNIEJĄCEJ ZABUDOWIE W STADIUM PROJEKTOWANIA PRZY SPEŁNIENIU NORM DOTYCZĄCYCH NASŁONECZNIENIA

Przy projektowaniu energoefektywnych budynków ważnym zagadnieniem jest uwzględnianie problemu nasłonecznienia. W artykule przedstawiono schemat kształtowania przestrzeni projektowej przy użyciu algorytmu do określenia obliczeniowej długości czasu nasłonecznienia w najbardziej niekorzystnie położonych pomieszczeniach oraz w niekorzystnie usytuowanych punktach na przylegającej do nich powierzchni, w których powinny być zachowane normatywy nasłonecznienia.

Słowa kluczowe: przestrzeń projektowa, szacowany czas nasłonecznienia, maksymalne zacienienie, budynki efektywne energetycznie