

PRECONDITIONS OF PUBLIC BUILDINGS AND STRUCTURES FORMING ON THE TERRITORY OF KRYVYI RIH QUARRIES

In that article the analysis of quarries of Kryvyi Rih area was conducted. Analysis was conducted on the following criteria: quarry area, structure, shape in plan, closed-open plan type, water cutting and location. Based on the analysis the sequence of construction and reclamation of disturbed areas were determined. There were allocated three stages of quarries reclamation and the civilian buildings in the quarries forming. It was found that for public buildings, formed in artificial terrain in the center of the city it is advisable to choose a commercially viable option. In the periphery it is advisable to have research centers, agro-technological parks. Within sanctuaries and nature reserves it is useful to locate museums of nature and information centers. In recreational areas it is advisable to place entertainment objects and hotels. It was established the influence of the quarry geometry, its location relative to the morphological structures, isolation, produced raw materials, composition of the soil to the form of the buildings and structure formed in the quarry. Features of the quarry structure dictate also features of engineering territory preparation.

Keywords: *building reclamation, mining landscapes, quarry, damages areas.*

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ПЕРЕДУМОВИ ФОРМУВАННЯ ГРОМАДСЬКИХ БУДИНКІВ ТА СПОРУД НА ТЕРИТОРІЇ КАР'ЄРІВ У М. КРИВИЙ РІГ

Однією з найзначніших проблем, які несуть за собою антропогенні зміни ландшафту, є подальша його непридатність, без належних заходів рекультивациі та відновлення, до господарської діяльності людини. Для розв'язання цієї проблеми був проведений аналіз кар'єрів Кривбасу за такими критеріями: площа кар'єру, структура, форма в плані, замкненість, обводненість і місце розташування відносно зон міста. З урахуванням значної кількості кар'єрів, що потребують відновлення, доцільним є визначення черговості забудови та рекультивациі таких порушених територій. На основі аналізу визначено черговість забудови і рекультивациі порушених територій, виділено три черги рекультивациі кар'єрів з подальшим проектуванням на їх території громадських будівель і споруд. Установлено, що для громадських будівель і споруд, сформованих в умовах складного штучного рельєфу в центрі міста, основною доцільно вибирати комерційно-виправдану функцію. На периферії доцільно розташовувати дослідні центри, агро-, технопарки, в межах заказників і заповідників – музеї природи й інфоцентри, а в рекреаційних зонах – розважальні заклади та готелі. Виявлено вплив на форму будівлі будови і складності форми кар'єру, його глибини, форми в плані, розташування щодо морфоструктур, замкнутості, видобувної сировини, складу ґрунту. З'ясовано, що структура кар'єру диктує також особливості обраних напрямів інженерної підготовки територій.

Ключові слова: *будівельна рекультивация, гірничопромисловий ландшафт, кар'єр, порушені території.*

Introduction. Using of territorial resources is a quite acute problem of Kryvyi Rih. Anthropogenic landscapes are the only type of modern natural–territorial complexes in Kryvyi Rih. Kryvyi Rih territorial resources level definitely doesn't correspond to the current level of urban development. Since 1881 steppe landscapes transformation taking place constantly. As a result, leading geotechnical systems that change the landscapes are mostly industrial (mining, metallurgical, construction and others) on a comparatively small area of Kryvbas (4,1 thousand km²). This allows considering Kryvbas as a perspective ground for the study of the ways of architectural planning public buildings and structures in abandoned mining landscapes. There is an opportunity for development of networks based on newly formed man–made formations.

The problems of the industrial region are the synthesis of various character–functional and planning, architectural and spatial, ecological, landscape and aesthetic, economic aspects. Over the past decades the extensive type of urban development led to chaotic processes of city urban structure on the Kryvyi Rih territory. Networks of cultural, community and transport services at this time don't conform to modern cities subsystem tasks and progressive functional zoning of urban development entirely.

At the time of justifying expediency and planning the design of civil buildings in the quarries in contemporary city it should be considered the most important factors of urban development. At the same time, it needs to strive to implement the contributed project to the sustainable development of urban planning system.

A detailed study of Kryvyi Rih quarries allows determining the necessity and the possibility of building reclamation for every quarry. Thus it is possible to formulate recommendations for queues of building quarries reclamation. The queue will depend on the parameters of the quarry, its position in the city, etc.

Review of last sources and publication. In the field of scientific studies of the Kryvyi Rih quarries the next scientists investigated: V.L. Kazakov, Y.G. Tyutyunnik, I.M.Malakhov, S.V. Yarkova, M.G. Smetana.

Features of landscape architecture formed on the territory of reclaimed industrial areas are studied by N.C. Garmash, N.T. Zhdahina, G.A. Zaitsev, L.G. Zubov, I.V. Lazarev, L.V.sMotorin, V.A. Ovchinnikov, T.V. Tabolina, A.V. Chemakina, A.V. Tishchenko, V.I.sEfimenko, V.V. Efimenko.

A significant contribution to the general issues of architecture and urban planning study development were studied by Y.M. Belokon, I.P. Hnes, V.I. Kravets, N.Y. Kryzhanovskij, A.P. Osytnyanka, P.A. Solobay, V.A. Timokhin, A.A. Fomenko, M.V. Sholuk etc.

The theory of ecology and landscape were studied by A.P.Verhunov, A.G. Isachenko, B.B. Rodoman, L.I. Rubtsov, D. Symonds, A.G. Topchyev, A.H. Titior etc.

Previously unsolved aspects of the problem. Previously, there were no defined perspective directions in the building restoration of damaged areas (quarries) for the city of Kryvyi Rih.

Statement of the problem. The author aims to conduct the analysis of quarries of Kryvyi Rih area on the following criteria: quarry area, structure, shape in plan, closed–open plan type, water cutting and location. Also the author determined the quarries with the most appropriate conditions for building of reclamation. It enabled to determine the sequence of quarries reclamation and to identify functions that are optimal for objects in the quarries.

Basic material and results. Open extraction of natural resources is one of the main factors affecting the landscape. The areas that disturbed by quarrying usually characterize by soil cover changes, disturbed hydrological regime and incorrect ecological balance generally. This situation leads to disastrous for historically biocenosis consequences. To be more precise natural communities that inhabited the land changed, destroyed, and wasn't fully restored.

Large part of Kryvyi Rih territory is changed by technogenesis. Mostly it conditioned with the development of iron ore. Technogenesis process covers not only the individual components of the landscape, but the landscape as a whole. New man-made landscapes, which are not typical for this area and the natural steppe zone, are created [3]. The main types of these landscapes are industrial (mining – dumps, dips, quarries and factory), transport (road landscapes), recreational, residential (residential and commercial), agricultural, forestry, hydroeconomic, military (training ground), serving, wasteland (territory of landfills, industrial waste, abandoned and demolished areas) [7]. Today landscapes created by the industrial activities have become an integral feature of Kryvyi Rih.

An open method of mining in the mining regions is one of the most significant impact factors that affect the worse the state of urban structure and environment condition. As a result of the movement of large rock mass volumes the mode of soil and groundwater are degraded. Thus the surface drain and structure of soil are changed, erosion work of water and wind. Consequently, in some cases it can cause even climate change in the area of mining [2].

Taking into account the development features, the landscape structure and the environmental impact, it is expedient to separate the industrial landscape on directly industrial and mining.

Directly industrial landscapes are form around large industrial structures or areas. Mining Landscapes are form by the action of the mining and ore processing equipment. These landscapes have more influence on the material composition, structure and development of natural and anthropogenic landscapes then other industrial landscapes. In the cities with developed mining industry there are radically changed all components of the environment[6]. In these conditions the specific, impoverished and less stable in comparison with natural mining landscapes are forming. They have more differentiated, contrast and dynamic structure. Technogenesis process as a part of anthropogenesis is an integral part of the development of the mining industry. Anthropogenic landscapes (dumps, quarries, sludge storage, industrial territories, etc.) [5]. They formed untypical for Kryvyi Rih local landscapes of anthropogenic systems. These landscapes occupy an area of 40 000 hectares. It stretches from north to south over 100 km.

To date, the total area of Kryvyi Rih mining landscapes is 17,100 hectares (this area compared to the area of the city with a population of 300-500 thousand people. For example Mariupol area is 16,600 hectares). Kryvyi Rih quarries area is more than 4,200 hectares (these data are permanently changing because of the continuation and proliferation of mining operations). To date the longest quarries are Anovskyy (4,32 km) and № 1 CGOK (4,03 km); the deepest are Yuhokivskyy (381 m) and Pervomajskiy (365 m); the broadest are Yuhokivskyy (3 km) and Pervomayskiy (2,47 km) [1].

It is important to choose a rational function that is planned to be given to the area. This includes selecting of the type of remediation, agricultural, recreational, environmental or building typology direction and choice of public buildings and structures function that are planned in the territory of reclaimed quarry.

It was analyzed 41 ore, 4 granite, 6 sand, 1 limestone and 3 clay quarries. The analysis was conducted based on the following factors: quarry area, structure, shape in plan, closed-open plan type, water cutting and location. Based on this information it can be concluded about the necessity and priority of quarries building reclamation. It should be mentioned that 17 quarries (11 iron quarries, 2 granite quarries, 2 sand quarries, 1 limestone quarry and 1 clay quarry) are currently operating. The exact parameters of their pits after excavation cannot be determined. That is way their current reclamation cannot be planned. The time period to the end of their working cannot be precisely determined. Besides, reclamation technology can be changed by then. Also, 3 iron and 1 sand pits are already reclaimed: they were filled up. So, they do not require further renovation.

From the analysis of the aforementioned items it can be concluded that 36 quarries are require reclamation. Also 22 of them are suitable for building reclamation (Fig. 1).

Quarry name	Area, m ²	Structure	Plan form	Closed-open plan type	Water cutting	Location	Need reclamation	Need building reclamation
Iron								
1 Hannivskyy quarry						P		
2 Pershotravnevyy quarry						P		
3 The quarry in the North Red ravine	28	simple	elongated		●	N	●	●
4 Quarry №1, former Lenin mine						P		
5 Quarry №2, CGOK ltd.	78	complicated	elongated	●		C	●	●
6 Hleyuvatskyy (№1) quarry						C		
7 Karl Liebknecht quarry	21	complicated	elongated			P	●	●
8 North Mine quarry	1,9	simple	irregular			P	●	●
9 The basin of 3 Kalinin and Dzerzhinsky mine quarries						C		
10 Kalinin Mine quarry	1,8	simple	elongated	●	●	C	●	●
11 Perry and Brailovskoho Mine quarries №1 i №5	4,1	simple	elongated	●	●	C	●	●
12 The basin of Kopylova №2, Pastukhov and Laptev quarries	5,4	simple	elongated		●	N	●	●
13 Quarry of B.K.D. №2 mine	0,6	simple	oval	●	●	R	●	●
14 Quarry of B.K.D. №1 mine						R		
15 The basin STKZR, Constantine MT quarries	3	simple	elongated			C	●	●
16 Quarry of Vilchur mine	0,4	simple	elongated	●		P	●	●
17 Soviet quarry	1	complicated	elongated	●	●	P	●	●
18 NKHZK Arcelormittal ltd. №1 quarry	37,8	simple	triangular	●	●	P	●	●
19 NKHZK Arcelormittal ltd. №2 quarry						P		
20 Southern Mining ltd. quarry						P		
21 NKHZK Arcelormittal ltd. №3 quarry						P		
22 Quarry of mine Osychny	0,3	simple	elongated	●	●	R	●	●
23 Quarry of Southern industrial company mine						P		
24 Котловина кар'єру рудників АТКЗР і Алмазного товар						P		
25 Quarry of Rahmanivskyy mine	0,2	simple	elongated	●	●	P	●	●
26 Quarry №1 of Hervardt mine	0,2	simple	oval		●	P	●	●
27 Quarry №2 of Kramatorsk association mine	1,3	simple	elongated	●		P	●	●
28 Quarry of Starodobrovolskyy ATKZR North mine	0,5	simple	elongated	●	●	O	●	●
29 Quarry of Ingulets ATKZR mine	1,1	simple	round	●		O	●	●
30 Quarry of Chumachenko mine	1,8	simple	elongated	●		O	●	●
31 The basin of 3 Starodobrovolskyy ATKZR mines quarries	1,9	simple	elongated	●	●	O	●	●
32 Brown iron quarry №1 located on Green ravine of Ingulets mine	0,9	simple	elongated		●	O	●	●
33 Brown iron quarry №2 located on Green ravine of Ingulets mine	3,4	simple	oval		●	O	●	●
34 Brown iron quarry №1 located on Vizirka area of Ingulets mine	1,4	simple	oval	●	●	N	●	●
35 Brown iron quarry №2 located on Vizirka area of Ingulets mine	1,6	simple	oval	●	●	N	●	●
36 Brown iron quarry №3 located on Vizirka area of Ingulets mine	1,3	simple	elongated			N	●	●
37 Northern brown iron quarry of former Ingulets mine	0,9	simple	elongated			P	●	●
38 Quarry of Ingulets GZK ltd. mine						O		
39 Quarry of Kochubey mine	8	simple	elongated			O	●	●
40 Petrovskyy quarry of CGOK ltd.						O		
41 Artemivskyy quarry of CGOK ltd.						O		
Granite								
1 Kolomoisky quarry of Blasko ltd.						O		
2 October quarry	19	complicated	triangular	●	●	C	●	●
3 Central Karachunivskyy quarry						O		
4 Old Karachunivskyy quarry	0,8	complicated	ovate	●	●	N	●	●
Sand								
1 Ionivskyy quarry						P		
2 The quarry in the Timashev ravine	0,2	simple	irregular			P	●	
3 Obolonivskyy quarry						N		
4 The quarry in the Abrupt ravine	1	simple	elongated	●		O	●	●
5 The quarry in the Northern Red ravine	0,9	simple	elongated			N	●	●
6 Mudronivskyy quarry						P		
Limestone								
1 Rahmanivskyy quarry	1	simple	rectangular			C	●	●
Clay								
1 The quarry in the Kopanev ravine	2	simple	elongated	●		O	●	●
2 Quarry in mining allotment of former Karl Liebknecht mine	1,8	simple	rectangular			O	●	●
3 Obolonivskyy quarry						O	●	●

Legend		C - center or sub-center;
■ iron	▨ limestone	P - periphery;
▨ sand	□ clay	R - recreation area;
■ granite		O - outside the city;
		N - nature protection area
		work quarries
		reclamated quarries
		● - needed
		● - drowned
		● - closed

Figure 1 – The analysis of Kryvbas quarries

Taking into account the significant number of quarries that require restoration it is appropriate to determine the sequence of construction and reclamation of disturbed areas. For the first stage building restoration quarries it can be selected quarries that located near the city center of sub-centers of the city. These quarries are selected to improve the efficiency of functional use of damaged areas and restoring the transport connections within the city. For the second stage building restoration quarries it can be selected quarries that located within the city recreation areas in the territory of reserved areas. For the third stage it were assigned territories that located at the periphery of the city. Such territories can have complicated communication connections with urban infrastructure networks or require the formation of new networks.

There are 20 quarries intended for building reclamation. These include 14 iron quarries 2 granite quarries 2 sand quarries and 2 clay quarries. Most of the quarries (39%) are located at the city periphery. In such areas research centers, agricultural complexes can be located. Also on the periphery it can be placed cultural institutions of concert venues for festivals that provide significant public meetings to avoid the noise in residential development. However, at the same time 19% of quarries are located within the city center and sub-centers. It is quite logical to place commercial, entertainment and sports facilities in the central or sub central areas of settlements. At the same time 9% of quarries are located near the recreational areas, and 18% quarries are located within the sanctuaries and reserves. For quarries located on reserve territory it is useful to choose the function of Museum of Nature, info center, etc. For quarries located near the recreation areas it is obvious to choose the function of entertainment and hotels. The last 15% of quarries are located outside the city. Such quarries should be used for agricultural purposes.

Some quarries that require reclamation in the region are frequently pre-revolutionary. Mining in these quarries stopped a hundred or more years ago. Boards of such quarries are aligned under the influence of erosion. In case of their water cutting the lakes in the quarries turns area into swampy terrain. If these kind of quarries are not located in areas of public activity (within the city center, sub-centers or recreation areas), their reclamation construction is not justified. It is better to use biological methods of reclamation for that type of quarries and turn them into woodland and so forth. According to the analysis, there are 13 iron and 1 sand quarries that relate to such quarries in Kryvyi Rih area.

Depending to the typology of the object as well as geometry parameters of the quarry, its location relative to the city center, recreational areas, etc., the scheme of building space can be selected. The building or structure can be formed as a terraced composition, full or partial covering quarry dome, full or partial filling the quarry amphitheater, contiguity to the slope, a separate location on the bottom or top of the quarry, filling the quarry with one building, system of structures and open areas.

Certainly, architectural and planning building solutions has a reaction to the topographic and geological factors and involves the formation of architectural-planning organization of public buildings and structures in accordance with the depth, slope angle, terms of form of the quarry, the complexity of the quarry structure, and so on. The visual object interaction with the landscape, nuance or contrast solution is also important. In some cases quarry form can be a major factor in determining the functional filling of the quarry, in particular, the quarry geometrical parameters career may be convenient location for forming a water park, mountain skiing complex, sports facilities, etc. The dimension of the quarry also creates conditions for the locating one building or group of buildings locating. Particularities of the quarry structure are also affecting the features of engineering areas preparation: the relief organization, the regulation of surface runoff, underground runoff regulation, regulation of state and possession of subsurface rock. However, taking into account the anthropogenic relief origin, we can conclude that some of these measures were made during the quarry designing.

Conclusion. On the Kryvyi Rih area there were formed a variety of mining landscapes and it is necessary to include the disturbed land to the city system. The result of this process should improve functional and planning structure of the city. The significant number of quarries that require restoration it is appropriate to determine the sequence of construction and reclamation of disturbed areas. In determining the sequence of quarry reclamation it should be considered the quarry location towards the city areas, the place designed building or structure in the functional network of public buildings and structures, the condition of access roads, type of surrounding buildings, the length of roads and engineering communications to the area under design, quarry geometrical parameters. There are 20 quarries intended for building reclamation in Kriviy Rih. About 19% of quarries are located within the city center and sub-centers. There can be placed commercial, entertainment and sports facilities. At the same time 9% of quarries are located near the recreational areas, and 18% quarries are located within the reserves. For quarries located on reserve territory it is useful to choose the Museum of Nature, info center function. In the quarries located near the recreation areas it can be choose the function of entertainment and hotels. Most of the quarries (39%) are located at the city periphery. There can be placed research centers, agricultural complexes, cultural institutions of concert venues for festivals that provide significant public meetings to avoid the noise in residential development. The last 15% quarries are located outside the city and should be used for agricultural purposes.

Architectural and planning decisions of buildings and structures are largely dependent on the depth, size, complexity, structure and form of the quarry, the presence of passways, and structural features of rocks.

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