Radio tower of V. G. Shukhov in the energy supply system of the Russian capital

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Abstract. Today, when solving the problems of energy supply of buildings, it is important to turn to past experience, to evaluate the effectiveness of solutions that pertain to the period of the formation of an industrial Russian city of the XX century. In this regard, it is important to preserve those objects of industrial architecture that were intended, among other things, for solving problems of energy supply. Even now the architectural legacy of V.G. Shukhov, an outstanding Russian engineer and inventor, triggers discussions and debates. In particular, an impassionate debate arose over the best procedures for the preservation of his architectural works. In the meantime, while debaters lock their horns, the architectural works, designed by this phenomenal engineer and architect, keep decaying. The mission of this article is to assess the impact of the structures, designed by V.G. Shukhov, produced on the conceptual design of an industrial city, and to understand what particular losses the decay of his projects may involve.

Another mission, pursued by the author, is to demonstrate the scale of V.G. Shukhov’s work performed in the capacity of an engineer and an inventor. The subject of this research is limited to the study of the restoration effort applied to the Shukhov radio and television tower, also known as the Shabolovka tower.

1. Introduction

The focus of the article is one of the most well-known objects of energy supply, relating to the period of building the infrastructure of an industrial society in our country. In this article, the author assesses the current state of the outstanding creation of V.G. Shukhov, – the radio tower built on his project in Moscow on Shabolovskaya street. Indeed, the radio tower on Shabolovka was built as the part of implementation of GOELRO plan, aimed at energy re-equipment and improving the energy efficiency of industry in Soviet Russia, to turn the country from an agrarian into an industrial one. Thanks to such constructions as the Shukhov’s radio tower, the energy base of Russian industry and communications was formed in the XX century.

The works, designed by V.G. Shukhov, a prominent Russian engineer and architect, have proven the superficiality and biasness of the statement made by some architectural historians and art experts, who believe that architects and urban designers of the Art Nouveau, the period of the unprecedented evolution of industrial production and urban areas, “developed no advanced architectural shapes for new buildings and structures.” [1] Rather, the most advanced inventions made by Vladimir Shukhov, a prominent Russian engineer, inventor and architect, including his hyperboloid of rotation and grid structures, were eagerly developed by the avant-garde style, famous for its unprecedented engineering research and spiritual upheaval. The introduction of new construction materials, including glass, metals, ceramics,
and concrete, was an important factor. [2] They renewed traditional design principles and reworked conventional architectural forms.

Some avant-garde artists declared the liberation of humans from any dependencies, including natural, economic and socio-political factors. However the pathos of Shukhov’s designs was totally different. In some of his projects, the engineer anticipated the biosphere compatible architecture of the 21st century and identified the link between the anthropological environment and the outer space. [3] That’s why the architectural theorists insist that the structures, designed by V.G. Shukhov, are always naturally built into any environment, whether natural or man-made. In other words, his design projects are in harmony with any urban or rural environment. The author believes that the Shukhov’s engineering aesthetics, which is different from the straight lines of the classical avant-garde, may settle the dispute raised by the contemporary civilization. These disputes caused by the negative influence produced on the human conscience by the anthropological environment, in which each individual has to live, act and work.

Besides, V.G. Shukhov successfully captured the spirit of the century, or the pace of the urban evolution which developed engineering structures into the symbol of urban culture [4]. Buildings of railway stations, radio towers, airports, and industrial enterprises became spatial dominants at the time when the industrial society was nurtured; thus, new structures did away with the architectural supremacy of churches and city halls. The urban planning function of new architectural dominants survived their functionality.

And now we will draw your attention to the external factors which facilitated the implementation of V.G. Shukhov’s design projects in the past and which safeguard them in the present. The atmosphere of spiritual renewal and social experimentation, typical for the first decades of the 20th century, served as the best background for the implementation of Shukhov’s innovative projects. If not for WWI and the inflow of ambulance trains from the West, the platform jetty of the Bryansk railway station would have never been built. Transparent floor slabs, designed by V.G. Shukhov, turned out to be the optimal solution. The Shabolovka radio tower, known for its easy to build grid shell, was designed against the background of devastation caused by the civil war. This design represented the only feasible option, because each gram of rolled steel was worth a fortune.

It was Vladimir Georgievich Shukhov, who developed the “reliable and chip” building principle, which was later adopted by the builders all over the world [5]. And indeed, it took local builders mere two months to construct the Bryansk platform jetty in 1915, and the construction of each arch, which was 47 meters long and 27 meters high, took one working day. And now let’s get back to the famed Shabolovka radio tower. Some specialists are sure that it was the low quality of its steel (which contained too much phosphorus) that improved the corrosion resistance of the structure. [5,6]

2. Methods

Even now the creative legacy of V.G. Shukhov, an outstanding Russian engineer, architect, and inventor, arises debates in the research community and discussions between the admirers of his talent. The civil society is worried about the condition of the engineering monuments of the 20th century. The present-day condition of Shukhov’s works causes particular concerns. Shukhov’s creations, which are eternal in terms of intensity and depth of the underlying research, have turned out perishable. The platform jetty of the Bryansk (Kyiv) railway station, the Bakhmetyev garages, the frames of the open-hearth plant in Lysiev, the water tower in Yaroslavl are either gone or restructured to a substantial extent [7]. This list of losses goes on.

The research project pursues a dual goal: it is both theoretical and applied. Any changes, underway in our society, help to identify its information demands. Our society needs to know the opinion of versatile social groups in respect of the most important issues, including the preservation of architectural monuments. The project co-developers employed the following tools and techniques for the source information collection: questionnaires, qualitative content analysis of texts, published in mass media, popular science and academic literature, analysis of the research works covering the history of the Russian avant-garde.
The conclusions, drawn by the author, are based on the findings of the non-recurrent selective survey, conducted among the future urban developers, including engineers and architects. The sampling frame represented students taking bachelor and specialist level programmers at the Moscow State University of Civil Engineering (MSUCE). The poll was conducted in the form of a written questionnaire. The majority of the respondents included Muscovites, who are aware of the problems experienced by the capital.

Thus, the students of the civil engineering university were to express their attitude towards the demolition of architectural monuments in the megalopolis. At the preparatory stage of our poll, the project developers formulated the following hypothesis: the destruction of architectural monuments, including pieces of the Russian avant-garde, is possible due to the indifference of the civil society. The civil minority fights for the preservation of monuments, while the majority of urban residents fail to provide any support.

The poll findings are interpreted in the final section of our research. There, we identified the links between our assumptions and the poll findings; thus, our hypothesis was confirmed by the poll. One of the questions, asked of the respondents, read as follows:

*Are you familiar with the history of creation of the Russian avant-garde monuments?* 25% of the respondents answered that they were, and that they were interested in the issue; 55% responded that they knew a little about it; 20% of the respondents took no interest in the Russian avant-garde.

The answers given to the next question are a lot more worrying.

Only 31% of the respondents gave a positive answer to the question “do you agree that your comfort and the appearance of a city are interrelated?” (Figure 1)

![Figure 1. The answers given to the question](image)

The author did not limit themselves to polling techniques, and the most valuable data on the architectural monuments of the late 19th – early 20th century represented the opinions expressed by restoration artists, architectural historians, urban designers and specialists in architectonics, as well as the sources covering the history of the Russian avant-garde and its development both in the early 20th century and later.

Towards this end, the author analyzed the conclusions made by R. Graefe [8], V. Shukhov, A. Selivanova [9], F. Chernous’ko [10], Yu. Volchok and others. Our research is also backed by the media articles, covering the activities of such non-governmental organizations as “Arkhnadzor”, “Center for Russian Avant-garde”, “Association of Culture Managers” reporting to the Department of Cultural Legacy of the Moscow City Hall.
3. Results

The range of Shukhov’s research efforts is truly impressive. F.L. Chernous’ko, the researcher of V.G. Shukhov’s works, provides his assessment of the range of the inventor’s activities. According to the estimates, made by F.L. Chernous’ko, in 1878 – 1939, two thousand kilometers of pipelines, about ten thousand tubular boilers, about two hundred water, radio, railroad and watchtowers were built on the basis of the designs, developed by V.G. Shukhov according to the principle of the rotation hyperboloid. In Moscow alone, over sixty structures were designed by Shukhov. [11] Moreover, the researchers draw our attention to the value of the theoretical advances developed by the Russian engineer and inventor.

Today, the Shabolovka tower is a matter of disputes over the destiny of architectural monuments [12, 13]. It is noteworthy that the restoration efforts turn more intensive at the times of V.G. Shukhov’s jubilees. The year 2013 was the most successful one in this respect, as back then Shukhov’s 160th jubilee was celebrated, and the celebration accelerated the Shabolovka tower restoration. [14] In 2016, the first stage of the tower preservation programmer was completed. Wide pipes were placed into the structure to support its segments. In other words, these pipes serve as the frame supports. [15] However, no restoration was initiated before the spring of 2016. The press office of Department of Cultural Heritage acknowledged that the restoration dates were set in 2016. The restoration programmer will make it possible to identify the specific actions to be implemented. Nonetheless, preservationists express reasonable complaints in respect of the pre-restoration work. Some “monument preservation activists” have already distributed an electronic letter addressed to the head of the state, in which they request that any restoration works performed at the radio tower were sufficiently “transparent”. It is noteworthy that urban residents share the activists’ concerns over the condition of architectural monuments. According to the findings of the poll, conducted among the MSUCE students, including future architects and civil engineers, over fifty per cent of the respondents share the willingness of civil activists to have historic monuments preserved; however, no more than 14% of them are aware of the initiatives implemented by Arkhnadzor, Centre for Russian Avant-garde, and other similar non-governmental organizations. The condition of the radio tower is primarily monitored by the specialists, rather than civil activists. This poll finding confirms the hypothesis that the indifference of urban residents to the works of the Russian avant-garde contributes to their decay. Besides, a small percentage of the respondents (37%) would like to participate in the architectural planning of the city or its communities. They are willing to attend public hearings, make their contributions into the operation of non-governmental organizations and movements (Figure 2).

![Figure 2](image-url)

Would you like to participate in the architectural planning of the city or its communities?

|       | yes | no |
|-------|-----|----|
| 37%   |     |    |
| 63%   |     |    |

What do the specialists think about the preservation of the Shabolovka radio tower?

If we address the research works, we can find a description of the actions to be used to cocoon historic facilities. The executives in charge of the work performed to preserve the grid hyperboloid think that there is a need “to disintegrate the major problem into minor ones”. According to Yu. P. Volechok, “they assume that before the restoration of any historic monument is initiated, specialists must think of the way to prevent its destruction in the course of any preparatory work” [12].
Indeed, any discussions of restoration methods and means make no sense, if the monument disintegrates before the discussions are over. The project co-developer, professor of the MARKHI Institute, shares this viewpoint and states that “making sure that the condition of the tower does not deteriorate during the pre-restoration period and that the restoration can prevent any critical situation” [12]. Although he realizes that the cost of this method is high, he believes that this is the only way to extend the life of this architectural monument.

The so-called preservation case, or the cocoon, should serve as the core instrument of preservation efforts. Its principal mission is to prevent any environmental exposure. The cocoon will also serve as the scaffolding and the viewing platform. The cocoon will be composed of transparent and non-transparent sections. Transparent ones will be employed to restore the tower. Non-transparent sections will serve as billboards.

Indeed, civil activists draw attention to the fact that those experts who used to be involved in this project, now have no access to the tower. The Centre for Russian Avant-garde, a non-governmental organization, willing to preserve this work of architecture, organized the “Birthday of the Radio Tower” holiday on March 19, 2016, to draw the public attention to the tower and its problems. This action is going to turn into an annual event[16]. On this day guided tours of the tower started at Shabolovskaya subway station every thirty minutes; employees of the Centre for Russian Avant-garde served as guides. On the following day, the Centre specialists delivered lectures on the works of this “Russian Leonardo” and his achievements as an engineer and inventor. There is another matter of concern, that is, the preservation of the area surrounding the tower. Developers of this project think it necessary to extend the protective area surrounding the architectural monument. The protective area should include the zones adjacent to Shukhov and Shabolovskaya streets. Civil activists express concerns that hi-rise structures can be built in these zones, and the architectural planning environment of the monument will be destroyed. Now the Shabolovka tower, the dominant architectural focus of the local area, is not visible as a whole from every adjacent view point.

The point is that the condition of the tower is so poor that any remedial actions are neither able to save it, nor to produce any impact on its condition. A. Selivanova, Director, Centre for Russian Avant-garde, acknowledges that any emergency actions taken by the restorers are kind of simulative. [15] The tower sections and segments haven’t been painted; therefore, the hyperbolic grid is exposed to corrosion. If the hanging structure is not restored in the nearest future, its knots may be exposed to deformation. Civil activists assume that any further delays of the restoration will inevitably cause the demolition of the original tower, which will be replaced by its modern replica.

Indeed, the concerns expressed by the civil activists are not groundless. Presently, the relations between the monument and the urban environment, or, if we take a wider look at the problem, the relationship between the monument and the anthropogenic space, turns all the more relevant. Even today, in the 21st century, architectural monuments of ancient times, middle ages and the new era remain in their original environment. This statement remains true for a group of monuments in Giza, Notre Dame and Louvre in Paris, and the new era monument – the Eifel Tower in the same city. The destiny of the Russian avant-garde is kind of different. Both the famous home of Konstantin Melnikov and the grid hyperboloid in Shabolovka street are hardly visible against the background of newly built structures. Isn’t it the reason why the intensity of their aesthetic influence goes down? In some cases their aesthetic influence is reduced intentionally, and, as a result, the civil society no longer takes any interest in some particular buildings or structures, while the parties willing to have them demolished find it easier to attain their goals and to build simplified replicas instead of original monuments (let’s recall the debates over the reconstruction of the Children’s World store in Moscow and the restored platform jetty of the Kyiv railway station).

In this final paragraph we will make an attempt to assess the creative work performed by this outstanding architect and universal engineer. Absent of this assessment, we will never be able to understand why the preservation of each work of this inventor and architect is a must. In the first decades of the 20th century, architects, who had to develop audacious engineering solutions, were capable enough to meet this social challenge and to fully implement their original vision of space in their architectural
projects. V.G. Shukhov was among those capable architects. Original architectural ideas, implemented in the Shabolovka tower, absorbed European biotech, which represented industrial laconism stripped of its simplified geometry. The researchers, specializing in the study of the Shukhov’s legacy, believe that he managed to overcome the limitations of constructivism, and the Shabolovka tower demonstrates the traces of this architectural style which replaced the austere aesthetics of Art Nouveau. Shukhov was a virtuoso who coupled functionality (including user friendliness, technological advancement, and simplicity) with aesthetic strengths, including the harmony between the structure and the ambient landscape. Shukhov attains this balance by imitating natural elements and transferring them into the human space and into the realm of human activities. The tower’s structural features demonstrate the architect’s ability to employ the analogue method in his projects. This method is widely covered in the literature [17, 18].

4. Discussion section
What particular ways out of this situation does the civil society propose? Some of its leaders ask for the taxation and other benefits to be granted to businesses or individuals who contribute to the preservation and restoration of the architectural legacy. [19] Other civil activists insist on adding the specialists having alternative viewpoints to the lists of members of commissions in charge of the destiny of monuments. Some activists suggest that a cultural cluster should be developed on the basis of this monument [20]. Anyway, the general public must have access to public hearings covering the destiny of the Shabolovka tower. However even public hearings cannot serve as a universal solution. The findings of the opinion poll have confirmed this statement.

It is noteworthy that consistency and integrity are typical for Shukhov’s works. Their consistency means that the Russian architect solved aesthetic problems, on the one hand, and industrial, economic, ergonomic, technological, and social problems, on the other hand. The aesthetic component was not the main one in Shukhov’s works. Their core components included production expediency as a systemic requirement applied to the work performed by the urban planner. [21, 22]).

5. Conclusions
The author made the following conclusions in the course of the analysis and discussion of the events, involving the Shabolovka tower:
1) Residents of the capital have a vague idea of the “architectural” history of Moscow. Their ignorance is regarded as the reason for the civil society’s inactive behavior;
2) In their turn, representatives of the expert community recognize the complexities, arising in the course of the restoration of the Shukhov’s hyperboloid. Therefore, different reconstruction options are proposed for this monument which is in the process of decomposition;
3) Civil activists from such organizations as Arkhnadzor, Centre for Russian Avant-garde, etc., launch campaigns to draw attention of the civil society to this problem and to make an impact on the decision to be made by the authorities;
4) These actions are insufficiently effective and they cannot accelerate the works performed at the Shabolovka tower;
5) The preservation of the Russian avant-garde buildings requires both their restoration and the reconstruction of the authentic architectural planning environment around them.

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