The choice of aversion of the project proposal on restoration of the cultural heritage property on the basis of multicriteria comparative analysis

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Abstract. With time a problem of preserving architectural heritage sites becomes more acute, since many unique listed buildings are in an emergency state and require the restoration measures that take into account the specifics of the historical environment, an analysis of the technical condition, evaluation of the monuments’ value, the possibility of their functional adaptation to modern needs. The search for solution to preserve such objects is often complicated by the development of a modern urban renovation area around them and by the difficulties of maintaining a complete historical appearance of cities when adapting listed buildings to the functions demanded in modern society. The article proposes an approach to choose the best version of the project proposal for the restoration of a cultural heritage property of regional significance. The building is designed in an eclectic style in the city of Tambov. 11 versions of the author's project proposals for the restoration transformations are considered, which preserve the historical appearance of the building and various transformations of the internal volume and development options of the adjacent territory. 14 criteria are proposed to evaluate the qualities of versions. To select the best restoration version a scientific method of a multicriteria comparative analysis was used, which made it easy to compact a large amount of information about the object to a single quality parameter in the form of a synthetic indicator for each version. Simultaneously the weight factors of the criteria were established on the basis of expert evaluation obtained from the professional groups of various profiles: architects, representatives of the contractor, state supervisory authorities, the owner of the object, the tenant of the object.

1. Introduction

In seeking to resolve development problems, the historical town image is sometimes distorted due to the implementation of programs for a new construction and restoration of the architectural heritage without taking into account the specifics of the historical environment, an analysis of the technical condition, evaluation of the monuments’ value, the possibility of their functional adaptation to modern needs [1,2]. The problem of restoration is particularly acute for the listed buildings that have architectural and historical merits but which are in an emergency state and could be demolished during comprehensive development. A mansion, a house number 37 Komsomolskaya street in the city of Tambov is in an ultimate limit state now, it is a cultural heritage property (CHP) of a regional

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significance "The house in which the writer S.N. Sergeev-Tsensky lived during his studies at the Tambov gymnasium in 1887-1892" (Resolution of the Tambov Region Administration of 08/10/1993, No. 280).

The mansion of the middle of the XIX century belonged to the state councilor Ivan Skvortsov. He was a doctor, served as a director in a hospital for mentally defective patients, participated in the work of the city medical and sanitary commission, and he opened a hydropathic in a neighboring house. Skvortsov also let apartments for rent in his house. This house is also associated with a famous writer of the first half of the twentieth century, Sergey Nikolaevich Sergeyev. There was a river Tsne there, and later he added the pseudonym Tsensky to his last name. The future writer lived in this house in 1887-92, when he studied at the Tambov gymnasium. So, this house seems to be a part of the cultural treasure of Tambov and it forms the architectural space of the district [3 - 5].

The two-story building with a rustication of corners and symmetrically arranged windows framed with decorative elements in appearance runs to the architectural stylizations of the turn of the century (large windows, motifs of neoclassicism and oriental ornamentation of facades, etc.). An eclectic architecture of the facade of the building facing the Komsomolskaya street is not typical for the housing development of Tambov of that period. Currently, this building is in an ultimate limit state and needs an urgent conservation and a restoration work (figure 1). The historical territory of the monument (figure 2) is not identified and completely violated, despite the fact that there is an established protection zone and a development control and economic activity zone [6]. According to the approved subject of protection, when planning restoration work on a listed building, the parameters of cultural heritage property are not subject to change that is recorded in the subject of protection (Federal Law N 73 "On cultural heritage property (historical and cultural monuments) of the peoples of the Russian Federation" of June 25, 2002): location and spatial compositional construction of the building; the plane of the southern facade with all the architectural elements located on it (Directive of the culture and archiving department of the Tambov Region No. 260 of 10/15/2012). The restoration of the building with its adaptation to modern use (valorization) involves the consideration of several options to transform the object with possible additions of new volumes to it and options to develop the adjacent territory in accordance with modern approaches to the adaptation of monuments [7 - 9].

Many authors associate a quality assessment of cultural heritage property with categories of authenticity [10], value [11,12], social and semantic role [3, 13], and for the objects used for the practical purposes, safety requirements must be taken into account, [14]. There are methods of numerical evaluation of the significance of the objects, taking into account a number of value characteristics of the monument (historical, architectural, artistic, city planning, construction and technological, etc.) [4,15,16]. In addition to historical and cultural value, vital importance when estimating CHP is given to the cost indicators of the object [17, 18]. The value of the object can be expressed by a balance cost, an estimated value and a value, taking into account the restoration of the objects of protection; the methods to determine are based on the cost, income and comparative (market) approaches [19, 20]. The listed methods for determining the CHP quality indicators relate primarily to existing buildings and they are based on separate accounting of groups of nonmaterial indicators (authenticity, integrity, environmental perception, etc.), or technical (percentage of loss, physical deterioration, burdens, etc.) or cost; they do not imply the price adjustment during an object restoration with an adaptation for modern use. In this regard, to assess the quality of versions of the project proposals for the restoration of a listed building, we need a method considering a set of criteria for assessing the object and making it possible to take up the reasonable choice of the best option for a comprehensive indicator.

The purpose of this study is to develop the versions of the project proposals for a restoration of a mansion of the late XIX century in Tambov, which imply preserving the historical facade and transforming the building and the surrounding area, as well as evaluating the options according to the selected criteria and choosing the best option for the project proposal based on the use of the scientific method of multicriteria comparative analysis.
Figure 1. General view (current state) Cultural heritage site "The writer Sergeyev-Tsensky lived in this house while studying at the Tambov gymnasium. 1887-1892", Address: Tambov, Komsomolskaya street 37.

Figure 2. Protection zones scheme Cultural heritage site "The writer Sergeyev-Tsensky lived in this house while studying at the Tambov gymnasium. 1887-1892 Address: Tambov, Komsomolskaya street 37.

2. The choice and justification of a mathematical method of multicriteria comparative analysis

Many factors should be considered when assessing the quality of versions of the project proposals for the restoration of CHP [21,22]. These factors eventually determine the quality of the architectural environment [23-25]. Thus, the consideration of all factors when choosing the final version is very problematic, since a large number of criteria makes it harder to assess them objectively. Problem solving can be facilitated by using computational algorithms and tools that objectively characterize the quality of versions taking into account the preferences included in the project creation stage.
Various methods of multivariate and multicriteria comparative analysis can be used as the basis of a computing tool for assessing the quality of versions of project proposals for the restoration of CHP [26-28].

The authors have decided in favor of the multicriteria comparative analysis, which serves as a computational tool to determine the most suitable options among the many proposed, based on the totality of their characteristics or criteria. This method is based on the construction of a scalar of a synthetic indicator that considers the numerical values of the criterion evaluations and their weight numbers (factors) [28]. We used the adjusted summing indicator \(J_i\) as a synthetic indicator, [11], which was calculated using the formula:

\[
J_i = \sum_{j=1}^{m} (z_{ij} \cdot v_j)
\]

(1)

where: \(z_{ij}\) is the encoded measure of the \(j\)-th criterion for the \(i\)-th option; \(v_j\) is the weight number of the \(j\)-th criterion; \(m\) is the number of criteria.

Beforehand when performing an analysis all options must be evaluated in accordance with the selected criteria. The criteria can be quantitative, expressed by numbers, and qualitative, which require the creation of a rating scale and in accordance with the established scale it should be given digital values.

Then, for performing an analysis, the non-dimensional values are assigned to the values of the criterion evaluations expressed in units of measurement. For this purpose, the encoding of the values of the criterion evaluations is performed. In this work, the Neumann-Morgenstern method [28] is used, according to which the encoding for stimulants (criteria when increasing rise the assessment of the quality of the version) is performed using the formula:

\[
z_{ij} = \frac{(x_{ij} - x_{j\min})}{(x_{j\max} - x_{j\min})}
\]

(2)

as for destimulants (criteria when increasing hold down the assessment of the quality of the version) is performed using the formula:

\[
z_{ij} = \frac{(x_{j\max} - x_{ij})}{(x_{j\max} - x_{j\min})}
\]

(3)

where: \(z_{ij}\) is the encoded evaluation value of the \(i\)-th option according to the \(j\)-th criterion; \(x_{ij}\) are the natural values of the evaluations; \(x_{j\max}, x_{j\min}\) - the maximum and minimum value among the evaluations upon the \(j\)-th criterion.

In the case of applying methods that consider the criterion weights, the next step should be to determine the values of the weight numbers of the corresponding criteria, taking into account the fact that their sum should be equal to 100%. After establishing all the data, the values of the selected synthetic indicator are calculated for all versions.

3. Characteristics of the versions of the author’s project proposals for comparative analysis

Eleven versions of the author's project proposals for the restoration of the building were developed based on the results of the field studies of the selected cultural heritage property and analysis of the city adjacent area. These versions contained proposals for preserving the historical facade of the restoring building and for transforming the building and the surrounding area (table 1). Each version was also considered from the point of view of the potential users of the object.

Each version is interesting and unique in its own way. In order to assess fully the strengths and weaknesses of each of the versions, a special scientific analysis was carried out evaluating each version upon 14 criteria.
| № of version | Suggestions for preserving the historical facade and filling the plot up | Description |
|--------------|-------------------------------------------------|--------------|
| 1            | Complete restoration of facades and the building within the old walls. The material of the walls is selected according to the condition of the existing walls. Reconstruction of the historical layout. |
| 2            | Restoration of the building and the facade, an additional storey of the third floor. Window openings of the additional storey imitate elements of historical window openings. The roof is flat. |
| 3            | Restoration of the building and the facade, an additional storey of the second floor. Window openings of the additional storey imitate elements of historical window openings, the whole pediment located above the first floor is dismantled and is installed above the additional storey. The gable roof is hidden behind the pediment on the main facade. |
| 4            | Restoration of the historical facade, adding a new part that goes beyond the boundaries of the historical walls of the building. Number of floors - three floors. The roof is flat. |
| 5            | Partial restoration of the historical facade, dismantling of the facing part, adding a new part of the building with a bionic form, which goes beyond the boundaries of the historical walls. The adding floor has a complex roof. |
Continuation of table 1

| 1 | 2 | 3 |
|---|---|---|
| 6 | ![Image](image.png) | Restoration of the historical facade and the old walls around the perimeter. Dismantling of a part of the main facade and replacement of old parts with identical ones, which are made of modern materials (glass, metal, porcelain tiles), an adding within the old walls and going beyond them on one side, the adding storey is 1 floor higher than the main building. The roof is flat. |
| 7 | ![Image](image.png) | Restoration of the historical facade, partial restoration of the old walls, cutout of a part of the old facade and its use in the new facade of the addition. An identical part of the facade from modern materials (metal, glass, porcelain tile) is reconstructed at the cutout place to emphasize the time frame of the recreation. The additional building extends beyond the boundaries of the old contour of the building. The number of floors of the addition is the same as that of the main facade, additionally there is an attic floor. |
| 8 | ![Image](image.png) | Restoration of the historical facade, partial restoration of the old walls, a building is being erected within the boundaries of these walls, its height is like the historical facade and having an asymmetric attic floor. A passage is built from the new building at the second floor level, leading to a building erected 5 meters from the main building and at the back of the plot. The neighboring building has 2 levels and contrasts with the main historical facade. |
| 9 | ![Image](image.png) | Restoration of the historical facade, partial restoration of the old building, adding to it a new one, with increased number of floors and a different facade. |
| 10 | ![Image](image.png) | Restoration of the historical facade, extension of a new building to it within the boundaries of the old walls. The new building has two parts connected by a passage. The first part is equal in height to the historical facade, it has an offset (jog) on the left (there, presumably, was the entrance to the old building). The second part has uneven facades and surpasses the first part in height by one floor. |
Continuation of table 1

|   |   |   |
|---|---|---|
| 11 | Restoration of the historical facade, the construction of a new building within the boundaries of the old building with the dismantling of the old walls. The new building surpasses the old one in height and has a glazed attic. |

4. The choice of quality criteria of versions of project proposals

In order to assess the quality of the versions of the project proposal for the restoration of the monument under consideration, the criteria were selected that reflect various aspects - architectural, construction, social, household, etc. The composition of the criteria was formed taking into account the proposals of the professional groups participating in the discussion. At the same time, the regulations and requirements of design standards for buildings, the planning and development of the city areas, and, first of all, the nature of the architectural composition of the territory adjacent to the monument were taken into account. The selected evaluation criteria were adopted for the restoration of a specific architectural monument, taking into account its adaptation to modern use as an office building (business center). A special condition for choosing options and criteria for their evaluation was the success of the building being restored as a financial product, its investment attractiveness, which is achieved due to the architectural and historical significance of the monument, as well as its location in the central part of the city. Depending on the type of building, the features of its adaptation, the degree of preservation of genuine fragments, restrictions on the use of adjacent territories, etc. assessment criteria are able to change.

The authors do not claim to offer the only correct set of criteria, but as a result of painstaking analytical work for the considered monument, 14 criteria were selected. For each of them the content is formulated, the units of measurement are given, the nature of the contribution to the quality indicator, namely, stimulant (St) or destimulant (Ds), is specified, and for qualitative criteria the rating scales from the possible minimum to the maximum value are developed. The following evaluation criteria have been adopted:

- \( C_1 \) - the percentage of historical safety of the building. A full restoration is 100%, 0% is the demolition of the building, that is, the loss of all historical elements (stimulant criterion);
- \( C_2 \) - filling the plot under the historic building. The building in its historical dimensions - 1 (stimulant criterion);
- \( C_3 \) - architectural volume, m\(^3\) (stimulant criterion);
- \( C_4 \) - the versatility of the building. An absolutely universal building is taken per 1, which can have more than 6 functions without any changes inside the building, 0.5 - 3 functions, etc. (stimulant criterion);
- \( C_5 \) - building perspectives. 0 - demolition, 0.3 - preservation without changes in the existing form, 0.4 - conservation, 0.5 - reconstruction and restoration of individual elements, 0.6 - reconstruction of the entire building for operation, 0.7 - reconstruction of the building with partial ruination , 0.8 - reconstruction of the building with the preservation of some historical elements, 0.9 – addition of new volumes to the existing building with partial preservation of historical elements, 1 - reconstruction and addition with the loss of historical details (destimulant criterion);
- \( C_6 \) - the height of the building. 1 per a height of 10m., 0.9 - 9m, etc. (destimulant criterion);
- \( C_7 \) - an aesthetic view in the front of the street. 0.1 – a full identity with historical buildings, 0.3 – a reconstruction using modern materials, 0.5 – a partially preserved historical appearance, but using modern elements, 0.8 – a partially preserved historical appearance, but using many modern elements, 1 – a full contrast with historical buildings (destimulant criterion);
C8 – an evaluation of innovative solutions while transforming the building. 1 - innovative technologies that have no analogues are applied, 0.8 - a large number of new proposals, 0.5 - the use of new but already applied methods and proposals, 0.3 - a small introduction of innovations into the building reconstruction process, 0 - not used (stimulant criterion);

C9 - the color index of the external finish: 0- 0.4 - monochrome colors of one scale, 0.5 ... 0.7 - 2 colors with shades, 0.8-1 - more than 3 colors with shades (destimulant criterion);

C10 - the ratio of new and historical volumes. A relation between the old part of the building and the new volume is determined graphically (destimulant criterion);

C11 - the possibility of modernizing the internal space. 0 - impossible; 0.3 - difficult to redevelop; 0.5 - possible partial redevelopment; 0.7 - a large number of changes, 1 - any changes are possible (stimulant criterion);

C12 - the ability to place advertising signboards. 0 - it is impossible to place a signboard, it is possible to place a signboard, but with certain requirements, 1 - it is possible to place any signboard (stimulant criterion);

C13 - per square meter price, thousand rubles. It is determined upon aggregated indicators, taking into account the volume of the building, the average market value (destimulant criterion);

C14 - per cubic meter price, thousand rubles (destimulant criterion).

Taking into account the selected criteria in the appropriate measurement units and in accordance with the accepted scales for the quality criteria, all 11 versions of project proposals were evaluated.

5. The choice of weight numbers of the criteria

Weight factors of $v_j$ criteria were established on the basis of an expert evaluation obtained from the professional groups of different profiles: architects; representatives of the contractor involved into the restoration; administrative authorities supervising the monuments; owner of the building; tenant of the building. In this respect, six scales of preference were developed. Scale 1 is adopted with the same priorities and equal weight factors for all 14 criteria. Further, the scales of weight factors, corresponding to the priority criteria assigned by specialists, are adopted as follows: scale 2 - priorities of architects; scale 3 - priorities of representatives of the contractor; scale 4 - priorities of representatives of the administration; scale 5 - priorities of the owner of the object; scale 6 - priorities of the tenant of the object (table 2).

**Table 2. Weight factors $v_j$ for the selected criteria**

| Criterion | Scale 1 ($J_1$) | Scale 2 ($J_2$) | Scale 3 ($J_3$) | Scale 4 ($J_4$) | Scale 5 ($J_5$) | Scale 6 ($J_6$) |
|-----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| C1        | 0.071           | 0.10            | 0.05            | 0.30            | 0.03            | 0.02            |
| C2        | 0.071           | 0.08            | 0.03            | 0.01            | 0.02            | 0.01            |
| C3        | 0.071           | 0.08            | 0.15            | 0.01            | 0.03            | 0.01            |
| C4        | 0.071           | 0.08            | 0.06            | 0.03            | 0.02            | 0.08            |
| C5        | 0.071           | 0.05            | 0.02            | 0.10            | 0.10            | 0.01            |
| C6        | 0.071           | 0.06            | 0.15            | 0.10            | 0.15            | 0.15            |
| C7        | 0.071           | 0.08            | 0.01            | 0.08            | 0.04            | 0.15            |
| C8        | 0.071           | 0.08            | 0.05            | 0.10            | 0.01            | 0.02            |
| C9        | 0.072           | 0.05            | 0.05            | 0.15            | 0.02            | 0.01            |
| C10       | 0.072           | 0.08            | 0.15            | 0.01            | 0.10            | 0.11            |
| C11       | 0.072           | 0.05            | 0.05            | 0.02            | 0.10            | 0.10            |
| C12       | 0.072           | 0.05            | 0.03            | 0.03            | 0.08            | 0.08            |
| C13       | 0.072           | 0.08            | 0.05            | 0.03            | 0.15            | 0.20            |
| C14       | 0.072           | 0.08            | 0.15            | 0.03            | 0.15            | 0.05            |
| $\Sigma$  | 1.00            | 1.00            | 1.00            | 1.00            | 1.00            | 1.00            |
The established weight factors $v_j$ were further used when calculating the synthetic quality indicators of versions of the project proposals according to the accepted criteria.

6. The procedure of performing calculations
The first step involved assessment of the versions. The assessed values for individual criteria for each option are given in table 3. These values for qualitative and quantitative criteria were established according to the methods given in the description of each criterion.

Table 3. Assessment of $x_{ij}$ versions according to accepted criteria

| Criterion | № of version | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | $C_8$ | $C_9$ | $C_{10}$ | $C_{11}$ | $C_{12}$ | $C_{13}$ | $C_{14}$ |
|-----------|--------------|------|------|------|------|------|------|------|------|------|--------|--------|--------|--------|--------|
|           |              | St   | St   | St   | St   | Ds   | Ds   | St   | Ds   | St   | Ds     | St     | Ds     | Ds     | Ds     |
| $V_1$     | 100          | 1    | 1400 | 0.7  | 0.3  | 0.5  | 0.1  | 0    | 0.5  | 0    | 0.5    | 0.2    | 30     | 5.0    |         |
| $V_2$     | 20           | 1    | 2200 | 0.7  | 0.6  | 0.6  | 0.3  | 0.3  | 0.5  | 3.11 | 0.5    | 0.5    | 40     | 8.3    |         |
| $V_3$     | 20           | 1    | 2200 | 0.7  | 0.5  | 0.6  | 0.3  | 0.3  | 0.5  | 3.65 | 0.5    | 0.5    | 40     | 8.3    |         |
| $V_4$     | 16.6         | 0.8  | 3120 | 0.8  | 0.5  | 0.55 | 0.5  | 0.3  | 0.5  | 1.99 | 0.5    | 0.5    | 45     | 7.2    |         |
| $V_5$     | 13           | 0.8  | 2800 | 0.4  | 0.8  | 0.7  | 0.8  | 0.8  | 0.5  | 2.18 | 1.0    | 0.5    | 65     | 10.5   |         |
| $V_6$     | 40           | 1.2  | 2000 | 0.5  | 0.8  | 0.6  | 0.5  | 0.3  | 0.5  | 1.64 | 0.5    | 0.5    | 45     | 10.1   |         |
| $V_7$     | 30           | 1.2  | 900  | 0.5  | 0.9  | 0.6  | 0.5  | 0.3  | 0.7  | 1.40 | 0.5    | 0.5    | 55     | 11.6   |         |
| $V_8$     | 43           | 0.7  | 1300 | 0.4  | 0.8  | 0.65 | 0.5  | 0.3  | 0.7  | 1.30 | 0.5    | 0.5    | 45     | 12.0   |         |
| $V_9$     | 54           | 0.7  | 1800 | 0.7  | 0.8  | 0.85 | 0.5  | 0.3  | 0.7  | 2.20 | 0.5    | 0.5    | 40     | 13.2   |         |
| $V_{10}$  | 16.6         | 0.8  | 1400 | 0.5  | 0.8  | 0.7  | 0.3  | 0.5  | 1.50 | 0.5  | 0.5    | 38     | 11.5   |         |         |
| $V_{11}$  | 16.6         | 1    | 1700 | 0.6  | 0.5  | 0.6  | 0.3  | 0.3  | 0.5  | 1.56 | 0.5    | 0.2    | 40     | 8.3    |         |

The second stage of the study was the encoding of the assessment values from table 3, that is the assessment values of criteria expressed in units of measurement are given non-dimensional values. The encoding was performed separately for stimulant (St) and destimulant (Ds) in accordance with formulas (2) and (3).

After calculating the coded values of the partial estimates of the particular criteria, they were adjusted taking into account the weight factors of each group of experts. The final stage of the calculation was the summation of the partial correct coded estimates into a synthetic quality indicator $J_i$ for each $i$-th version. The calculation of the indicator $J_i$ for each version was carried out six times taking into account the scales of the weight factors of the criteria.

7. The results of the study and their explication
The results of multi criteria comparative analysis, by a hierarchization of versions of project proposals for the restoration of the considered monument in the are presented in table 4 from the highest quality to the lowest.

The distinctions in the obtained values of the synthetic indicator $J_i$ for six scales point to the importance of the correct selection of the weight factors of the criteria, since all the initial data for the calculations, except for the scales of the weight factors developed by the experts, were the same. However these distinctions were small. As the best version for project proposals, all groups of experts have chosen the version №1. The second position, according to architects, the contractor and the administration, was the version № 4. The owner and tenant have chosen № 3 and 2 respectively. The third position according to the architects, the contractor and the administration can be the version № 3. The owner and the tenant have settled upon the version № 4.
Pretty close unanimity was also observed in evaluating the worst versions. The most times all groups of experts selected the versions №7, 8, 9 among the three project proposals of the lowest quality. Significantly less often among the weak project proposals the versions № 6, 10 and 11 are identified.

**Table 4.** The results of multicriteria comparative analysis arranging the versions in the order from the highest quality to the lowest.

| Scale 1 | Scale 2 | Scale 3 | Scale 4 | Scale 5 | Scale 6 |
|---------|---------|---------|---------|---------|---------|
| J₁ Ver. | J₂ Ver. | J₃ Ver. | J₄ Ver. | J₅ Ver. | J₆ Ver. |
| 0.686   | 1       | 0.696   | 1       | 0.701   | 1       | 0.674   | 1       | 0.658   | 1       |
| 0.595   | 4       | 0.557   | 4       | 0.578   | 4       | 0.444   | 4       | 0.539   | 3       | 0.608   | 2       |
| 0.575   | 3       | 0.575   | 3       | 0.529   | 3       | 0.441   | 3       | 0.531   | 4       | 0.603   | 4       |
| 0.556   | 2       | 0.586   | 2       | 0.520   | 2       | 0.413   | 5       | 0.524   | 2       | 0.601   | 3       |
| 0.491   | 11      | 0.406   | 11      | 0.480   | 11      | 0.406   | 6       | 0.512   | 5       | 0.545   | 10      |
| 0.455   | 5       | 0.456   | 6       | 0.456   | 5       | 0.404   | 2       | 0.507   | 11      | 0.477   | 5       |
| 0.446   | 6       | 0.358   | 5       | 0.362   | 6       | 0.395   | 8       | 0.442   | 10      | 0.472   | 11      |
| 0.407   | 10      | 0.326   | 10      | 0.306   | 10      | 0.340   | 9       | 0.372   | 6       | 0.452   | 9       |
| 0.362   | 7       | 0.363   | 9       | 0.267   | 9       | 0.338   | 7       | 0.333   | 8       | 0.430   | 6       |
| 0.336   | 9       | 0.384   | 7       | 0.238   | 8       | 0.332   | 11      | 0.302   | 9       | 0.394   | 8       |
| 0.334   | 8       | 0.469   | 8       | 0.234   | 7       | 0.294   | 10      | 0.287   | 7       | 0.358   | 7       |

Thus the version № 1 was chosen from the author developed versions of project proposals for the restoration of the monument based on the applied mathematical method of comparative analysis and having into consideration the opinions of different expert groups. This version implies a complete restoration of the facades and buildings within the old walls with the selection of wall material based on the condition of existing walls as well as the restoration of the historical layout on the territory adjacent to the object. Six preference scales with different priorities of weight factors have been developed to evaluate specialists’ estimates. As a result, among the developed author’s versions of the project proposals for the restoration of the monument on the basis of the mathematical method of comparative analysis and having into consideration the opinions of different expert groups. The best version is the one that assumes complete restoration of the facades and the building within the old walls with the selection of the wall material based on the condition of the existing walls as well as a restoration of the historical layout on the territory adjacent to the object.

8. Conclusions

- Using multicriteria comparative analysis for assessing the quality of the project proposals for the restoration of cultural heritage property proved to be very effective. Once this made it possible to compact easily a large amount of information about the object up to a single quality parameter in the form of a synthetic indicator $J_j$ for each $i$-th version of the project proposal.

- The best version of the project proposals for the restoration of the monument by all expert groups was chosen number 1. Versions 4, 3, 2 can be considered as the alternative. similar ones in quality to the version 1.

- Most commonly the experts chose numbers 7, 8, 9 among the lowest quality project proposals for the restoration of the monument. Numbers 6, 10, 11 are identified less often among the weak project proposals.
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