

Restoration of historic buildings from a daylight perspective

Stefan Goras^{1*}, Dusan Katunsky¹, and Eva Kridlova Burdova²

¹Technical University of Kosice, Faculty of Civil Engineering, Institute of Architectural Engineering, Vysokoškolská 4, 040 01, Košice, Slovakia

²Technical University of Kosice, Faculty of Civil Engineering, Institute for Sustainable and Circular Construction, Vysokoškolská 4, 040 01, Košice, Slovakia

Abstract. Nowadays, civil engineering deals with many technologies of buildings. Oftentimes, we forget the basic necessary requirements of building, which are created for human. Well, a building shouldn't just be a construction object with lots of space. We have many requirements for building quality, daylight is forgotten. However, internal spaces are lighting artificial light or a few small windows. The topic of my work is daylight in historical buildings. This paper includes a several notable public historical restorations buildings in recent decades. Everyone restored building offers various public and private spaces for rent and services of varying importance. Everyone spaces have own terms of the daylight. Thanks to daylight, we have a lot of vitamins, a good mood, or at least normal brights of the room without the need for electricity costs also. We can bring a few good ideas, because of focusing on daylight in renovated buildings. These comparisons, I'll point out what is a correctly designed. It is necessary to preserve any historical building, and we also use finished buildings for other purposes. It is all the better if the buildings are designed correctly and can offer bright spaces. We should bring light to rooms by the passive elements.

1 Introduction

The aim of this paper is to compare the various building renovations that have already been completed in terms of daylighting and also observe and describe independent view of how natural daylight comes into buildings. The selection of the individual renovations was chosen, but of course conditioned by several parameters. The focus of the paper is daylight in historic buildings. So, historical buildings that have been restored have been selected. The spaces of some of the buildings were in use before the renovation began. In some renovations, the rescue of the building was achieved with the inclusion of life to the building. Different historic buildings are compared, but they have one point in common. All buildings have been successfully renovated. Their restoration or reconstruction has been so significant that they have come to the forefront of the presentation. Significant renovations have changed them in the right way for today's times.

* Corresponding author: stefan.goras@tuke.sk

The comparison is not to evaluate the architectural design of the building. That is not the aim either. It looks at successful restorations in historic buildings. These are the restorations that are significant and are often presented and the spaces are used for public purposes. Especially these public spaces should fulfil all the building requirements for the building. It is the public buildings that should be the exemplar.

One of the building requirements is daylighting. So, we are talking about natural light from the sun. We are talking about the light that comes into the building space. The light entering through the various opening structures, even without direct sunlight (diffuse light radiation).

The reconstruction of cultural monuments requires additional procedures compared to normal reconstruction. Some procedures are clearly defined by law [1].

1.1 Problems in renovations

It is necessary to highlight the work stimulated by conservation. We often come across many opinions that conservation is strict and slows down construction. There is pressure from the non-professional community for general criticism of unfounded suggestions. All of us who want our history preserved should protect the buildings, just as we protect our folklore.

It is right, that we have such conditional heritage protection. There should be properly educated employees in this office who are knowledgeable on the subject. Yes, many people understand if we are protecting 13th century buildings. But there is also historical value in smaller buildings from a much younger period. In the restoration of monuments, cooperation between the 'conservationists', the investor and the possibility of implementation is necessary. Compromise is necessary, and not only in restoration.

The problems start at the level of surveys and documentation of the reality the building. In the historical buildings it is even more complicated, sometimes even impossible to find out all the necessary information about the building and especially what is "under the surface". In the context of cultural monuments, these procedures are even more difficult. All surveys must be carried out in a careful method [1].

Increasingly, we are finding more and more interest in the restoration of public historic buildings. Humanity is increasingly aware of the unity of human values, considers them as a common heritage and recognises its shared responsibility to preserve them for future generations [2].

So is the public, who are gradually realising the value of the buildings, which together provide us with a preview of the nation's history. And equally, from the state side, there are more appeals for restoration. Yet the state is only in the position not of an implementer, but of a financial partner, offering funding for partial restoration. Because many historic buildings are owned by private individuals. Last year, was public issued a tender for historic buildings as well. The title of the call is: Plan for the restoration of public historic and listed buildings.

In recent years, the state has been increasingly involved in supporting the restoration not only of houses for living, but also of public historic and heritage buildings. These are often a source of major energy waste, as they do not have sufficient thermal insulation and their construction often has defects that significantly increase operating costs.

The main objective of the support is to improve the overall energy performance of the buildings, but at the same time prolong their lifetime and increase their use by the public.

These objectives can be achieved through a variety of measures, in particular the repair of the building façade or roof and get any installation of modern ventilation, cooling or heating systems.

A basic condition for support is that primary energy savings of at least 30 % are achieved.

Of course, it is important to preserve the heritage and historical value of the building when renovating. The renovation must therefore be carried out in accordance with STN EN 16883 Care for the conservation of cultural heritage: Guidance on improving the energy performance of historic buildings [3, 4].

2 Light penetration into buildings

Light penetrates buildings and all spaces. And that's without having to expend any energy. It is advisable to take advantage of this opportunity that is available to us. But too much energy also brings too much heat - this must be limited.

The correct thermal design of a building is also related to this issue. With the correct design we can achieve multiple requirements for the building. But we must remember that if we are talking about the renovation of a historic building. It cannot be looked at in the same way as a new building. Expressive architecture for the time must be preserved. Of course, at the expense of large heat losses, which bring financial dependence.

During renovations, it is usual to "insulate"/add thermal insulation to the facade of the building. In addition, replacement of windows and doors is envisaged. Replacement of windows and doors is one of the main needs in renovation. Heat escapes or arrives much faster through windows - by direct sunlight.

In the past, leaky windows have created an unregulated but regular air exchange. Today there is a requirement for absolute tightness of buildings, for less heat loss. Not many people realise that airtightness also means the need for regular air exchange. To function properly one needs to have enough oxygen in the room. Air exchange can be ensured by: 1. non-visible human opening of windows / 2. regular air conditioning unit. Air ventilation is expensive for the investor and many times does not get it installed.

And there is no space for technologies in historic buildings (depending on the building). It is a matter for debate if, in areas where there is no air conditioning and the building is not insulated with thermal insulation, it is advisable to absolutely seal window frames and put in tight windows. "The space has to breathe".

For window replacements, the designer or architect may propose only a routine window-for-window replacement. Obviously with a new window with improved window performance. For major building renovations, it is preferred to propose a more modern alternative. That is, the possibility of a window upgrade. We can take advantage of the large range of products today even with large-size windows.

Windows in past times were segmented for their maximum possible size that they could produce at the time. Of course, for each period this brought characteristic elements for a particular building.

The form of the windows is connected to the type of building and the use of the interior. In general, the conservation principles apply to all windows without distinction. The most important principles are the focus on protecting the historic original and respecting adequate form when replacing. The conservation care of each typological group of windows may differ in some specific issues. For a specific group, let us think of windows of industrial architecture, temple windows, or the glazed facade of modern architecture [5].

When restoring, it is important to choose a restoration goal. Restoration can replicate the historicizing status, and try to retain the original condition. But there can also be a completely different perspective in restoration. And that is one where the façade of the building is preserved as much as possible and create a new design with modern elements. This simpler way, however, cannot be applied to all historic buildings. It is possible to create it for historic buildings that in the past served as workshops, warehouses, barracks, etc.

2.1 Design of daylight

The lighting design of indoor and outdoor spaces is primarily based on their use. The object of lighting design is to create the appropriate lighting conditions for a given visual activity (for example: reading, writing, machining, medical procedures, etc.). Therefore, to determine what lighting conditions are sufficient for a particular visual activity, many professional and scientific studies and experiments have been carried out. On the basis of statistical results of their evaluations, values of light-technical parameters have been established for individual visual activities, which have become part of national and international norms [6].

Daylighting can usefully supplement or replace artificial lighting. Of course, not totally. Its aim is to create favourable visual conditions, in other words, to create visual comfort. We come across it in everyday life. It affects the private sphere, the social sphere, and the working sphere. It is used in transport, architecture, public life, technology, etc. All of this brings with it enormous costs for the operation and maintenance of luminaires [7].

Slovak Government Regulation No. 391/2006 Coll. on minimum safety and health requirements for the workplace - specifies that workplaces must, according to a special regulation (Decree No. 541/2007 on details of requirements for lighting at work) shall be illuminated as far as possible by daylight and equipped with artificial lighting appropriate to occupational safety and health. This is a transposition of Council Directive 89/654/EEC on minimum health and safety requirements at work [8].

3 Examples of renovation of historic buildings

In this part there are a few significant restorations. The selection of individual objects was random. The objects have been subjected to important restoration, which has been awarded by several experts. There are buildings of public interest in this area. The historic buildings that have survived are in important places with great spaces. Because of their important location, new public spaces are included in the historic buildings. These are mostly spaces that do not have difficult requirements such as: concert halls, studios, etc.

The more space needs, the more problems. In historic buildings we only have limited spaces/volume of building.

3.1 Restoration of the nursery in Moravě

One of the nice examples of renovated buildings is the nursery school in Polánka. The village is located in the Czech Republic. The building has been used and its use is very similar, but it is already an efficient and nicer place to live. The renovation of the building has achieved a visual cleanliness that immediately attracts the eye of the visitor. We can see this in the figure 1.

The kindergarten is one of the most important places of public life here, along with the church and the inn. It is in a previous school building, with the nursery's premises situated on the first floor. On the ground floor we would find the local grocery store and facilities for the Polanka Citizens' Association, which takes the cultural events of the village [9].

The facade was designed to be simple white on the entire building, divided only by a specific structure. The modification of the exterior and the uniform façade with repeating elements made the building more complete. The most useful design for better use of the spaces is the choice of large-size windows. By enlarging the opening structures, they brought an abundance of natural light into the interior. At the same time, they changed the architecture of the building for the better.



Fig. 1. Nursery in Polanka after reconstruction [9].

3.2 Restoration of the Slovak National Gallery

The overall restoration of the National Gallery has been really thorough. Many other articles also speak very positively about this renovation. From the point of light engineering, the basic requirements of the building have been achieved. Of course, this is also the restoration of a historic building.

The completion of this difficult project is a milestone for Slovak culture, the art scene, but also for the capital itself, which will get a completely new public space for spending free time on the shore of the Danube.

The reconstruction of the National Gallery of Art has taken a sustainable and at the same time monumentally intelligent approach to the architecture of the 1970s. We hope that the positive examples of possible uses of the original aesthetic and technical values will become an example worth following [10].

In all renovations, not just this one, all windows are replaced of course with better performance of the window itself. Already in the courtyard of the National Gallery you can see the modern idea in the restoration, it can be seen in the figure 2. Today we have a greater range of production possibilities for windows. We can make windows to large sizes. Thanks to this, they were also able to replace the original segmented windows with uniform windows for the full area of the opening.



Fig. 2. Courtyard of the restored SNG [10].

In the building, all openings are used to illuminate the rooms. Both exterior and interior spaces are finished with white reflective surfaces that increase the space, increase the lightness of the space, and add to the cleanliness, the above example is shown in the figure3. In addition to windows, they make use of a lot of skylights, glass doors. They even covered a little historic courtyard with a glass roof.



Fig. 3. View of the restored wall with new structures around it [10].

3.3 Conversion of the glass factory hall into a sports centre

Conversion of the glasswork's hall in Josefův Důl into a sports and cultural building with a sports and cultural use with a multi-purpose hall. The building is currently in the centre of the village; it forms a block with other important buildings. It keeps the maximum of the original construction, highlighting the original industrial character. Takes inspiration from historic postcard evidence. In the interior, it uses fragments of original glass production. Some walls are preserved without finishing. They are sandblasted, cleaned. The hall is provided with lighting and sound technology; it allows concerts to take place [11].



Fig. 4. Renovated glass factory into a multipurpose hall [11].

The renovation of a past glass factory is an inspiring form of possible renovation. In this renovation, they use all the historic structures which they use as the main elements of the structure. The floors, windows are modern, airy, and distinct from the historicizing elements. What is new is new; and what is historic is properly preserved. They have preserved a large space in the main production hall for the potential of an indoor playground or concert hall, it is visible in figure 4. They have also retained the original screening elements, the side tall windows and in the roof its roof glazed dormers. The original tall windows make the space feel adequately illuminated. But the skylights at the top of the roof, which bring diffused light into the space directly to the centre of the area, help in many ways.

Interesting is the full use of all spaces, even underground. In the underground spaces they created a wellness zone. On the ceiling structure admit historical small arches. In figure 5 it is possible to see the bathroom area, where they use glass fittings in the ceiling, which illuminate the space sufficiently - with diffuse (scattered) light.



Fig. 5. Underground space illumination through glass fittings in the ceiling [11].

3.4 Renovation of the old military barracks into a cultural centre

Barracks / Kulturpark is a new type of cultural institution that provides a space for the production and presentation of current culture and art. It is the revitalization of a large area, creating a new creative, educational and relaxing district of Košice, close to the historic city centre.

The new cultural centre Barracks/Kulturpark is located in the historic area of the barracks from the last decade of the 19th century. An especially important aspect of the whole project is the public space, its design and articulation. The planned area is divided into two basic parts. A public urban area opens to the surrounding urban structure and an enclosable interior area with a park.

The central object of the complex is the ALFA building - a central building containing hall spaces for cultural events with the appropriate technical facilities. These halls are complemented by exhibition spaces serving for the exhibition activities of individual residents and civic associations operating in the centre. The functional composition is complemented by smaller halls for artistic activities and workshops, as well as administrative spaces and facilities for performers.

The proposed architectural design is based on maximum respect for the qualities of the existing complex. Buildings of clear organization, geometry, proportion, and design bordering a park with century-old trees [12].



Fig. 6. Renovated Kulturpark in Košice [12].

In the complete renovation of the old barracks, the architects included the complete open space around the buildings. They transformed the environment into a modern one and involved the participant already from the outside, it can be seen in figure 6. The environment and the restored buildings keep the historical mass intact and easily visible throughout. The facade modification is so simple as to be ingenious. Anyone passing by will be impressed by a historic building with a two-tone combination that is fresh and modern.

In the historic building, they replaced the original complicated historic windows, with modern ones with a simple thin window frame. With fewer windows, more light enters the spaces.

The atmosphere in the interior is created by the play of light. More light in the interior gives a feeling of openness and freedom, supports creativity and at the same time communicates contact with the surrounding unique environment. The art in the interior is also connected to the outside world through the new VELUX skylights and light tubes, which were an automatic choice for the new roof and roof on the renovated Bravo building.

In the new pavilions, light infiltration into the interior is designed through a structural façade. They are unique in Slovakia in that they also have a carrying function and support the ceilings of the pavilions.

VELUX skylights in the multi-purpose attic spaces create a healthy indoor environment flooded with daylight [13].

4 Conclusion

The idea of the article is not to discuss in detail the selected buildings from the point of view of architecture or light-technology. The article is only to point out interesting renovations, realized in the nearby area around the Slovak Republic. The selected buildings point to possible improvements of the spaces. They use historical architectural elements but also modern constructions.

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