

An Ecologic Approach Applied to Restoration and Rehabilitation of Buildings

Keywords: adaptable building, industrial patrimony, potential of regeneration, suitable function, sustainability

0. Description of the Paper. Short Summary

The paper aims to bring the component of an ecological reasoning into the field of restoration and rehabilitation of buildings. The re-use of abandoned buildings is an ecologic act in itself, consisting in fact in the recycling of existing material at a large scale. The paper also formulates the concept entitled **potential of regeneration** with respect to the capacity of transformation of an existing building into an ensemble which may become sustainable during the contemporary period. As a special issue, the case of industrial patrimony is presented, with the analysis of a list of possibilities and examples for the functional conversion of factories and the observation that nowadays industry mainly survives through its transformation into culture. The presentation on architectural conversion of industrial spaces ends with the formulation and detailed presentation of *10 points* for the sustainable conversion of an industrial building.

Considering from the beginning of the design process the improving of the relation of the transformed building with the natural and social environment is also important. In this sense, a study case for a restoration project in the historical centre of Bucharest is presented – the project has an ecological approach starting with the first sketch of architectural concept and this fact is explained in detail. This study case is an exemplification of the theories presented above and leads us to a conclusion for the paper, making possible a further extraction of principles which are adaptable to architectural education.

The ideal for the future of architectural education in the conception of the present paper is to lead towards an ecology of urban spirit, to a safe reasonable manner of life transferred to an urban scale.

1. A Few Remarks on Rehabilitation and Conversion. Suitability and Sustainability of Architectural Function.

Rehabilitation of existing buildings is a natural approach, in the spirit of the idea of recuperation, of avoiding throwing away valuable things which are still useful. Form, function and structure are condemned to coexist from the moment dedicated by the architect to draw his first lines of the project on paper (1) but not always their life ends at the same moment, structure (*soliditas*) generally being the one that survives the other two components. Why throwing away structure if function already died? This question generated unexpected answers, materialized in spectacular architectural solutions.

Adaptation of old buildings to new functions is much older than may be considered at first sight (it is enough to think about the re-utilization of the amphitheatre in Arles as a fortification for a new town during the Middle Ages or about the transformation of the former palace of Diocletian from Split, Croatia, into a cathedral and dwellings, forming today the nucleus of the historical centre of the town). Actually only the industrial revolution brought the practice of demolition and replacement of buildings, which lead to avoid their re-use.

Today the fact that the conservation-rehabilitation of buildings approach functions correctly only accompanied by the urban development politics is an universally accepted truth. Rehabilitation began to convince investors, who discovered that people prefer old buildings, with better standards of space and architectural quality.

The ecologic component is fundamental in justifying rehabilitation interventions. If to build is by definition an act which supposes an energetic consume, to conserve means to save energy, for instance through the thick exterior skin traditionally made of solid brick walls, with little window openings, as Sherban Cantacuzino remarked (2). It is natural that such things are only realized in moments of economic crisis, as now, and as in the case of the 70's in countries with developed industries - when first functional conversions on abandoned industrial buildings appeared.

The industrial patrimony of many countries is impressive through its quantity, dimensions and, many times, architectural value. As a general characteristic, industrial spaces of the XIX-th and XX-th centuries are vast, opened spaces, separated into structural units by pillars and beams. The oldest buildings generally have great openings in comparison with the possibilities of materials which form them (brick or stone walls, forged iron pillars, wooden floors).

A general difficulty that interventions on such buildings have to face consists in their great dimensions, hardly covered by other functions, which generally need spaces of a different scale. That is why factories are generally suitable for multifunctional purposes and there is a series of functions highly appropriate for this type of spaces, as trade centers, exhibitions or malls. But when the new function is a museum, a music hall, collective dwellings, hotels etc., the difference of scale is a challenge, raising real difficulties to be solved.

It is interesting to observe that in many cases these conversions are supported by local authorities, being part of integrated programs for the territorial urban planning.

The education and training of architects in the field of rehabilitation and conversion of buildings is quite recent. As Sherban Cantacuzino observed (3), if 40 years ago just a few architects between the most internationally recognized names were trained for rehabilitations in general and for industrial conversions particularly, starting with the late '80s and '90s the field starred names as Rogers, Stirling, Martorell, Bohigas, Mackay and many others.

2. Adapting a Building to Climate Changes. Ecological Approaches in Architectural Design versus Restoration and Rehabilitation.

The first logic step to be considered by an architect who aims to face the challenges of climate change is the manner of conceiving an adaptable building, capable to evolve together with its surrounding environment. Technical works describe in detail the various manners of realizing this purpose; but here we lance the sketch of a theoretical approach, supported by some detailed examples. Architectural education is responsible to find methods in order to bring the principles of ecological design into the field of restoration and rehabilitation of buildings from the very moment of architectural conception, in the sense of a synthetic integrated reasoning.

Restoration is ecologic as far as it consists in the preservation or re-use of existing material (structure, construction elements etc.), which means in the same time both an economy of new material and the keeping of traditional construction systems and techniques and the keeping of the way of traditional reasoning in building, which is generally ecological in itself, cumulating the experience of various generations.

Rehabilitation is here considered to be a recycling of constructed fund, an ecologic action in itself, adaptable to urban scale strategies and leading to a general improvement of quality of urban life. The concept of restoration is different because it supposes a more delicate operation, mainly referring to the necessity of preserving the original substance of architecturally and historically valuable buildings, generally defined as *monuments*. We defend here the position for a regenerative restoration, which considers existing buildings to be living organisms whose life is necessary to be continued, our duty as architects being to search the best solutions for ensuring the continuity of this life.

The concept of rehabilitation includes the concept of appropriation of the restored building by a new suitable and sustainable function, which makes the building live and keep its physical, symbolic and social integrity. The re-use and transformation of existing buildings should be in itself an act dedicated to reduction of pollution and preservation of construction materials and techniques and, last but not least, of cultural values.

3. The Particular Case of the Industrial Patrimony. From Industry to Culture and Some Principles for Functioning in Harmony with the Environment.

The existence of an abandoned industrial patrimony, of considerable dimensions, is one of the important realities of the actual situation of European cities. Industrial buildings are outstanding because of their volume, because of their solid structure, which has been calculated for supporting heavy machines, because of the flexibility of their space, defined by generous openings and a good natural system of ventilation and illumination. These qualities, together with their great presence of their volumes reported to the constructed fund of urban settlements and together with their situation in territory, make the significance of historical industrial patrimony, which is constituted as a coherent texture, able to resolve or complete some of the failures of contemporary cities. The great industrial ensembles of the XIX-th century and of the beginning of the XX-th century, formerly situated outside the urban limits of cities but in their close neighborhood, are now part of the city centers, due to the growth of urban textures and to expansion of inhabited areas in territory. More than that, factories of the industrial era are representative for quality architecture, able to lead to the setting up of a new style. The subtlety of the composition of brick decorations on the facades and the elegance of well calculated and dimensioned structures make out of the industrial patrimony of the beginning of the XX-th century a valuable one from the historical and architectural point of view and out of its preservation an obligation for us. Transferring these observations to a systemic reasoning, we can wonder what will become the industrial buildings of our present in the near future. Extremely modulated and prefabricated, generally lacking of any architectural identity and beauty, but conserving the qualities of an extremely flexible space and of a great volume, possible to be filled with the most diverse functions, the factories of our times are no more located close to the city centers, so it is hard to imagine them integrated to centers, even in a distant future. But these ensembles can become urban centers in themselves, local communitarian centers dedicated to cultural and recreational purposes, parts of the endless texture of an extended *megalopolis* - as anticipated by the contemporary theories of urban planning.

As mentioned in the introduction, the purpose of this paper is the integration of ecology into urban spirit, in search of a way of life which demonstrates to be adaptable to ecologic needs and transferrable to an urban scale.

The challenges brought by the industrial revolution form the basis of the technological, social and professional changes in the architecture of the XX-th century. The industrial era developed until producing great implications on society, culture and architecture. Architecture dedicated to industrial purposes is special, mixing the innovation of technology applied both in the construction of the buildings and the production process with an amazing accuracy of styles and ornaments and an outstanding quality of space. Now the former industrial buildings are in great danger because of their abandoning and getting out of use and in the meantime because of the lack of responsible communities to appropriate them. The lucky industrial buildings (quite a few,

unhappily) survive only by a complete change of their function, being converted to centers which are generally in charge of local administrations.

The particular tendency of transforming industry into culture presented a remarkable growth in the last years, especially in occidental countries. A few years ago, in Spain, I formed part of a team that used the following enumeration as a *logo* for the project presented in the competition for the transformation of a factory situated in a small town on Costa Brava into a cultural centre: *industry - production - repetitive process - technique - industrial space - meeting of persons - ideas - values - culture. (4)*

In many cases conversions of industrial spaces to culture are financed by local authorities, being part of complex integrated programs or by private investments, guided by authorities, so that the image of valuable architectural ensembles may be preserved, the adopted function may be compatible with the building, the technological components of the industrial process may become integrated in the new proposal, and the space may be adopted by a new community. In this way, many times the former factories begin real sources of knowledge, constructing valuable information networks between them.

Here are some examples of industrial buildings - the ones transformed into culture have been selected in order to prove this outstanding phenomenon that began in the end of the '90s. Their new way of functioning is appropriate, integrating into the new entities both the architectural values of the buildings and the remaining elements of the technological process.

Selected examples:

3.1. Library for children in a former factory in Copenhagen (in a residential area)

The intervention is remarkable for the discrete, minimal, presence of new elements, which do nothing but support structurally the existing brick facades. The exterior shows the nude sincerity of the existing historical factory, on which the reversible consolidation system plays the role of thin detached scaffolding. The interior is however transformed according to the new functional needs of the building, some interior floors have probably been removed in order to get a better height and the interior walls and pillars have been painted in white.



3.2. The "Arsenale" in Venice, transformed in exhibition for the *Architecture Biennale (2006)*. Furniture interventions and creation of public spaces reduce the industrial scale, appropriating it to human nature. This example is also mentioned in the next chapter, while enumerating the *10 Points for a Sustainable Rehabilitation of Industrial Buildings*

3.3. Modern Art Museum and the Vitra Factory in Istanbul, Turkey (a superposition of a museum and an industrial space, image taken during the International Congress of the UIA – 2005)



3.4. The *El Águila* Brewery from Madrid transformed in the Leguina library and Regional Archive of the Community of Madrid. This outstanding intervention by the architects Mansilla and Tuñón has been elected as effect of an architectural competition that took place in the '90s. The project is sensitive and expressive, basing on the contrast between the massive volume of the existing brick factory (a well-known brewery, built in the first years of the XXth century) and a new extension, covered with a membrane of translucent boards. The cylindrical tanks used in the process of beer fabrication have been transformed into book storages.



3.5. Architecture studio organized in the former storage of a factory, in the centre of Barcelona. It was the initiative of several young architects to cooperate and install their professional headquarters in an industrial building of modest dimensions, but with an expressive architecture. A few interventions were necessary for obtaining a functional new studio.



4. 10 Points for a Sustainable Rehabilitation of Industrial Buildings

As a conclusion for the study of the various situations of functional transformations of industrial buildings presented above, as well as an alarm signal to the danger that valuable industrial heritage faces in general, we formulated *10 points for a sustainable rehabilitation of industrial buildings*, which try to become a guide for the architect facing the challenge of designing the conversion of an industrial building and are supposed to awake the responsibility of architects and students for the conscience of an ecologic design, with implications both in practice and education.

1st point. The complete documentation and information on the industrial objectives, the conscience of their value as industrial patrimony



The presentation for visitors of the historical crane from the Arsenale, in Venice (XIXth century)

It is quite an obvious fact that any preservation of a valuable patrimony should start with the consciousness of its value for the community in charge of it and for its possible visitors. Industrial objectives are in most cases a vivid part of the history of cities and places, pointing out important stages in their evolution and development. This kind of education should be completed with the presentation of ecological advantages on the environment and the city that the preservation of these buildings may bring. In order to correctly establish these advantages, a pertinent analysis of the **potential of regeneration** of the industrial buildings and equipments should be made, as well as drawing creative proposals for its conversion.

2nd point. The integration of the industrial building in a circuit of industrial patrimony objectives; connection with compatible objectives (from the neighborhood or not) through a functional network

The creation of communication networks between industrial objectives is always benefic, joining common objectives into a coherent system accessible to researches, fans of industrial archaeology, historians, or just visitors. This kind of networks could contain an integrated vision of the industries of a certain period in a certain regional area or join similar objectives, with a common specific, from various areas/countries (for instance railway museums, mines, textile museums etc.) *Example:* a network of the kind, extremely well organized and operative, was drawn around the Museum of Science and Technique of Catalonia, with its headquarters in the former XIX-th century textile factory from Terrassa, an industrial town located at about 40 kilometers from Barcelona. The institution of this museum is the main center of the network, which contains a few institutions more and is in charge to provide information about the important historical industries of Catalonia (among which the textile industry, developed as an effect of transcontinental trade with America in the XIX-th and XX-th century, is the most important one).

3rd point. The research of a compatible function, considering the necessities of the zone, the dimension of the building and its architectural importance

At the first point, the necessity to dispose of creative regeneration proposals was mentioned. These proposals should take the form of a sustainable strategy, expressing the possibilities of the industrial building to become a regeneration pole for its urban area and to satisfy as much as possible the necessities of the various categories of inhabitants of the area.

4th point. The integration of the technological process original elements in the new composition

Industrial archaeology is in charge of much more than simply architecture - industrial objectives generally suppose complex systems of communication, equipments and machines that used to form the technological process itself, whose development and functioning was ensured by the container (the building). It is enough to think, for instance, of how complex a railway system is, including the railways, the stations, the annexed buildings and even the trains themselves. A correct rehabilitation should consider keeping and integrating elements of the whole system, in order to re-compose a correct and complete image of the system.

5th point. The re-use of equipments and construction materials

If the technological process is a system in itself, this system is composed out of elements - mechanisms and machines - which are at least as valuable as the building of the factory itself. Methods of industrial technology represent a historic process in the human knowledge, allowing nowadays people to get in contact with basic principles of applied science and helping them to understand the technological progresses of their surrounding world. This form of technological education forms conscientious open-minded people, with increasing capacity to get solutions for the problems of our era.



Containers used for beer fabrication integrated in the space of the Leguina Brewery from Madrid

6th point. The separation of the intervention into phases and compatible additions where necessary

A good intervention strategy should consider both economical and technical reasons starting with the phase of design. As mentioned in the introduction, the problem of industrial spaces generally consists in their huge dimensions, hardly adaptable to the more used functions (cultural, residential etc.). That is why the gradual occupation of the building is sometimes a reasonable option (with considering all functional problems coming out of it, thermal and phonic insulation of the transformed space etc.). However, sometimes additions may prove to be necessary, as is the case of this event hall attached to a children's library functioning in a former factory close to the centre of Copenhagen. The separated volume appeared because the inner space of the factory didn't allow more occupied square meters, but also as an element of expression and architectural identity of the ensemble, marking the new phase of intervention.



Children's library in a former factory from the centre of Copenhagen - event hall in an additional building

7th point. Minimizing interventions

The option for a minimal intervention, with as much preservation of original material as possible, is the most economic and ecologic way to rehabilitate an existing building. The next picture is an example of simple low-cost consolidation, in which a wooden and metal structure, with no more complication than a scaffolding, sustains the brick walls of the factory from Copenhagen presented above (and also within the examples from the 3rd chapter). A few more interventions can be observed on the façade (an improved layer of glass windows at the exterior of the old ones and large wooden shop windows in the ground floor).



Children's library in a former factory from the centre of Copenhagen - façade

8th point. The reduction of scale using elements which are near to the human scale

For the same reasons mentioned within the discussion about functional change, the appropriation of industrial spaces for a human scale may result difficult, because of the fact that industrial spaces have originally been designed for the dimensions of machines and equipments. The picture below presents the furnishing of the space of the *Arsenale* and docks area in Venice with modulated armchairs, with an economic but pleasant design. This simple intervention (no more than furnishing) transformed the industrial area of the docks in a promenade and *loisir* area during the 2006 Architecture Biennale.



9th point. The creation of references which make space intelligible and easy to understand

The spatial composition of industrial ensembles was originally conceived according to the logic of the technological process, which is not always easy to understand because of its specificity in each case, and is even more difficultly expressible after having suffered a process of rehabilitation. That is why the existence of banners, logo-s etc. which structure the itinerary through industrial space is a simple and efficient way of making space understandable and easily recognizable. The picture presents the entrance of the Leguina Library and the National Archives of the Community of Madrid, functioning in the former *El Águila* brewery.



10th point. The appropriation of the transformed space by a new community

The abandoned industrial buildings are lacking of a coherent community of users until their functional transformation, which is in fact a cause of their decay. Architectural conversion is supposed to bring a new community of users whose needs are satisfied by the transformed building and that will responsibly take care of it and maintain it.



Architecture studio organized in the former storage of a factory, in the centre of Barcelona

5. Study Case – Restoration Project. *Cultural Centre in the Restored Gabroveni Inn - Bucharest, Romania* (5)

The project presented bellow was elaborated by a team of young architects (including the author of this paper) within an architecture competition finalized in December 2009. The competition referred to the transformation of an historical building from the centre of Bucharest into a cultural centre. This chapter is dedicated to explain the component of ecologic reasoning that lead to the design solution which was adopted. The project is presented as a practical example of designing conscientiously together with climate in restoration, from the first concepts and sketches.

The former *Gabroveni Inn*, a residence for merchants and merchandises of the XVIII-th and XIX-th century, the Romanian correspondent of the Venetian and Byzantine *fondacco* (6), was also asked to be extended by the addition of a new building on the free plot related to it. The inn is a long vaulted half-destroyed brick building, which is one storey and with an underground level, having a passage in the middle, for linking two of the important streets of the historical centre of Bucharest.

The proposal grew around this passage which was linked to the center of the new building, creating a *nucleus*, a green atrium covered by a moving glass roof whose role was to increase the thermal insulation performances of the building in winter and to ventilate it in summer, the inner court creating a specific micro-climate, on the traditional principle of Andalusia's patios.



The project developed around the following key concepts:

5.1. Identity. The main integration of the inn building in the axiological category of monument is a guarantee for its quality to be a cultural reference and for its importance within collective memory. The proposal was respectful for the original material of the monument, for the

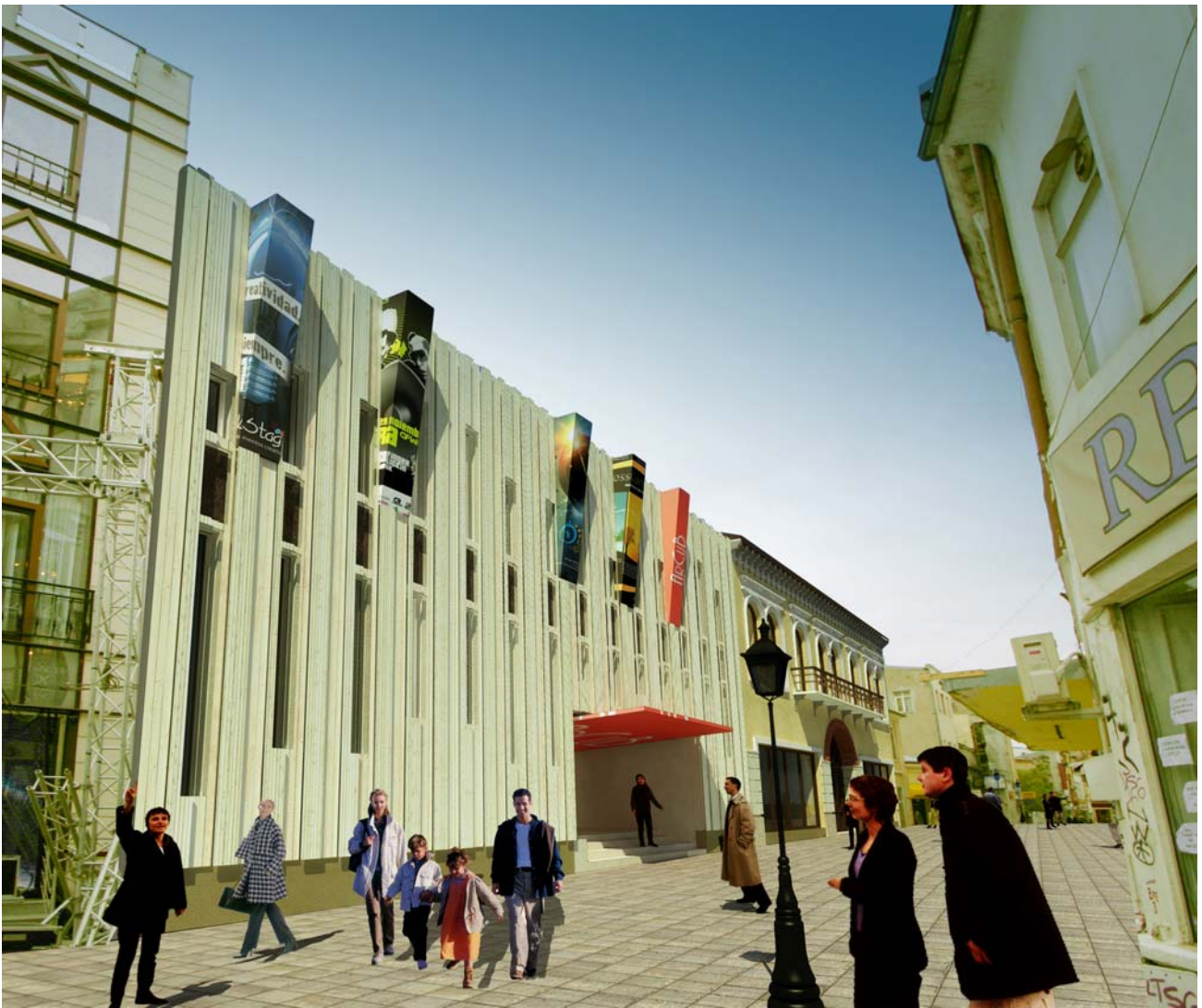
existing sources of documentation and for the image of the whole area, which is the historical centre of Bucharest itself.

5.2. Diversity but harmony. The discrete, subtle and expressive enlacement between **old** and **new** is one of the major difficulties the project faces and solves. The contrast between old and new is to be found both in the intervention of the existing inn, where destroyed elements are replaced with light structures (wood, metal, canvas) that re-compose spatially the lost image and in the image of the annexed new building, which imposes its own rules, without copying anything from the facades of the neighborhood (actually completely heterogeneous) and only respecting the dimensional norms imposed by urban regulations.

5.3. A link between old and new. The new interventions on the building of the inn are related by strictly following some volumes, forms and dimensions which re-invent a spatial image, which was lost a long time ago. But the problem of the spatial link between the building of the inn and the new extension is even more subtle. This link is created by the central nucleus, with a public function, covered by a transparent movable structure, a space with powerful architectural values, opened on various levels. More than that, this nucleus was conceived to be green, covered with vegetation – some kind of common lung through which the old and the new building breathe together, simultaneously representing the absolute centre of the composition, from the spatial, expressive and even social point of view. The coverings of interior space (the one constituted by the existing or re-created vaults and the optional glass covering of the passage) are conceived to create a discrete protection of spaces, which gives security and leaves a possibility of complete natural ventilation in summer. In this sense, the general covering of space is movable, allowing the house to transform according to climate and to the sequence of seasons.

5.4. The image of the new building: from music to architecture, through rhythm. New facades consist of a warm wooden texture, composed on a generous surface of glass, some parts of which it temporary covers. The vertical composition reminds of the keyboard of a huge piano which aims to transform musical rhythm into architectural rhythm, through the scenario of a mathematical-musical synthesis.

5.5. Permeable introversion. The inns of Bucharest have always been introverted volumes, and the Gabroveni building makes no exception to it. Oriental tradition states that the centre, the richness of the building open only after having entered its gates. The intervention proposed by our project kept and transformed this principle, proposing an image of architectural contemporary richness. In the same time, both the new and the old building can be crossed fluently, through a direct link that unifies the Lips cani and Gabroveni streets: the central pedestrian passage for the inn and the opened way through the main hall of the theatre contained in the new building.



ECOLOGICAL BASIS OF THE PROJECT CONCEPTION

Respecting and also completing the requests of the theme of the competition, our team created an ecologic construction, which includes passive principles of capturing and utilization of solar energy, in order to increase the comfort of users and to reduce the costs supposed by the exploitation of the building. The materials employed for the restoration and the construction of the new building are ecological, recyclable and have a reduced carbon emission.

Economy in architecture means the adoption of some solutions specific to sustainability, the intelligence of the exploitation of resources and the maintenance of the equilibrium between means and purposes. (7)

The transparent covering of the central nucleus has the role to create an inner space, with a controllable climate but without losing the vantages of an exterior space. In winter the covering acts by creating the effect of the heating of the interior space, as in a green house, reducing the quantity of necessary thermal energy. In summer, the covering opens, favoring natural ventilation and decreasing the necessary energy for the improving of the inner climate and ventilation.

More than that, by its volume and geometrical shape, the central nucleus maximizes the quantity of natural light during the whole day for all public functions of the cultural centre, decreasing the quantity of electric energy necessary for illumination. If necessary, the entrance of light may be completely or partially hidden, the central space becoming a place for artistic representations of any kind. The use of a thermal insulation compatible with standards for passive houses for the new building is also meant to reduce costs on the entire period of utilization of the cultural centre.



6. Instead of Conclusions

Conversion of industrial patrimony means saving existing spaces for multifunctional purposes, adaptable for the necessities of new communities, capable to use and maintain them. The great dimensions, spatial flexibility and advantageous situation of abandoned industrial buildings and infrastructures within the cities transform them into available elements in solving the urban actual necessities of those. The *10 Points for a Sustainable Rehabilitation of Industrial Buildings* proposed in this paper may form the beginning of an elaborated theory referring to the research of sustainable design methods generally applicable in the rehabilitation of industrial heritage.

The case study, referring to an historical building from the very center of an East European city, traditionally dedicated to trade and crafts, is an example of ecological approach within a restoration project. The building is much prior to the industrial era (end of the XVIII-th century), so the *10 points* formulated above are just partially applicable. But the proposed intervention is described in detail, having considered, from the very phase of conceptual design, the creation of a partially green building which is adaptable to environment and integrates the original substance of the XVIII-th century monument.

In the end of this discourse, we could wonder about the opportunity of applying the here presented principles into architectural education. If the necessity of an ecological approach in restoration and rehabilitation of buildings is now clear, what architectural education can do is offering the mechanism of analysis and evaluation of the **potential of regeneration** of a building. Documentation and analysis on an existing building are valuable as far as they constitute the first step in a further strategy, able to offer to it and to its users more years of safe life.

Let us not forget the main purpose of this paper which is to point out a manner of teaching ecological design in restoration and rehabilitation of buildings. This conception should lead to a form of bringing indirectly the ecological component and the responsible approach into various disciplines generally taught in European schools of architecture, among which: restoration of historical buildings, rehabilitation of built patrimony, industrial archaeology etc.

Restoration should be an integrated work, joining architects, historians, engineers, plastic artists etc., some kind of orchestra whose director is no one but the architect. But too often restoration decisions are the effect of the inertia of copying the surroundings of a building or a dead image of it, documented or just intuited in some past epoch. The approach should be a subtle one, considering the existing building (or ruins) like a living organism, possible to be protected and brought to a new life by having a correct relation with the natural environment and with the architectural, social and historical layers of the city (village, place) that shelters it.

Notes

1) *The Vitruvian definition, elaborated in Antiquity, is still the best and most complete way to define an architectural object.*

2) after Cantacuzino, Sherban – Re-Architecture, Thames&Hudson, 1989, also cited in *Bibliography*

3) same as **2)**

4) *The argumentation was appreciated by the jury and the project won the second prize.*

5) *Project elaborated for the competition for the creation of a Cultural Centre within the building of the Gabroveni Inn in the historical centre of Bucharest and on the free plot near it, by a team guided by the author of this paper. The competition ended on December, 22, 2009. This presentation was made especially for the EAAE Prize 2009-2010 and has not been published nowhere before.*

6) *In Venice and Constantinople the fondacco was an inn especially designed to shelter merchants and merchandises*

7) *Definition inspired by Metapolis Dictionary of Advanced Architecture: City, Technology and Society in the Information Age*

All images are property of the author. The condition to keep the paper anonymous makes impossible mentioning the names of the authors of the cited projects for the moment.

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