



Budapest University of Technology and Economics (BME),  
Faculty of Architecture  
Department of Building Constructions

**Erzsébet Lányi**  
architect

**ENVIRONMENTALLY CONSCIOUS BUILT ENVIRONMENT:  
PRINCIPLES AND ARCHITECTURAL MEANS OF MODEL CHANGE**

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## ANTECEDENTS

This is the thesis booklet of an unusual PhD dissertation. Initially, this topic was dealt with by our colleague Dr. László Nagy who also gave lectures about the results he had achieved, within the framework of a facultative subject. My field of research included the structures and options of reconstruction concerning vernacular architecture (since that time I have recognized that the topic I used to work on at that time and this topic are not so far away from each other). After the death of our colleague in 1995, I have continued lecturing this subject. Soon I had to realize that at the consultations my students were interested rather in the "why" than the "how". This fact and my conversations with invited lecturers and other colleagues dealing with this topic but sometimes being qualified in other fields (IT expert, physicist, biologist, geologist, chemist, physician, etc) have inspired me to look for more and more connections by permanently collecting and processing relevant literature so that I can give answers to questions arising.

Although this topic has an extensive literature, in most cases it concentrates on a sub-area only, and I have not found any reference covering the topic as a whole and giving an answer to most of the questions posed by the students and by an increasing number of "non-professionals" who show interest in this topic. That is why I have decided to write such a synthesising book. This challenge considered as a "nearly impossible task" (as formulated by Professor András Zöld) has been accepted by the Board of Doctors as theme for a PhD dissertation and the book has been completed.

A book also suitable for education purposes would be very large as a PhD dissertation, therefore the chapters containing new scientific results have been marked in the Table of Contents. Finding them is facilitated by printing these parts of the texts onto recycled paper that has a different colour.

### 1. TOPIC OF RESEARCH, REASONS FOR THE SELECTION

#### 1.1. DESCRIPTION OF TOPIC OF RESEARCH

The current content and attitude of knowledge of an architect needs to be supplemented, and the role of an architect in the process of designing and implementing needs to be changed. Problems associated with natural, man-made and social environments can be generally formulated in the boundary zone of fields of science. To interpret them, small and large scale observations are required simultaneously, that is, in-depth examinations but with a limited range, and an integration between different special fields. That is what makes it possible to ensure that approaching the phenomenon should have sufficient concrete content in order to ensure that shallow superficiality is avoided but it should contain a broad spectrum of relationships so that realistic problems can be tackled.

The work of interdisciplinary research teams is required to ensure that each question arising can be formulated precisely and the answers to them can be worked out. This dissertation focuses - on the basis of currently available questions in mind, results from research and implemented examples - on the research and presentation and social and economic relationships, and on the collection and presentation and/or formulation of basic principles of architecture supposed to be part of the natural environment.

#### 1.2. REASONS FOR THE SELECTION OF THIS TOPIC

In 1996, in the initial period of my research, the world was over several oil crises, and a number of economists had recognized limits of growth for well-fare societies. After the first shock, in the 70's, research for the use of alternative energy sources has started. In America, and later in the western territory in Europe, a number of "solar buildings" were built, and in connection therewith the building project owners also recognized an opportunity to become politically independent. After the crisis was over, fossil fuels became cheaper again and the members belonging to the middle class could resume their comfortable way of life they had been used to, and politicians could heave a sigh of relief. The world has become unipolar and capitalism that had undergone a new metamorphosis also appeared in the East-European countries. In addition to information, cash, manpower and

"environmental pollution" have also started to flow freely, and we started to recognize the disadvantages of changes as well. Due to the threats of a climatic change and to the slow demolition of welfare measures, the future formerly believed to be promising has become threatening even in the richer countries as well.

Many of us think that we went astray somewhere. It is the "size", the cosmic order and the entirety what we have lost or discarded wilfully for the sake of the "part" and "money".

More and more of us are convinced that we would have to do something else, and so would, among others, the architects. But what? What and how should we build because according to our current attitude, the task of an architect is to display demands of society in space but they should not specify such demands. Architects, due to their multifarious skills, can have an overview on the creation and maintenance of a built environment as a whole. However, it requires that the knowledge of architects should be supplemented with some knowledge of relationships between natural, built and social environments surrounding construction and use. It is necessary to upgrade the role of an architect as designer which is devoted to coordinate the designing and implementing process of buildings and edifices and to formulate demands of a building project owner in every special field. It is of major importance to improve such ability, integrating capability, and holistic attitude. Without it, the representatives of different special fields cannot solve their sustainability-related tasks associated with construction. For this reason, it is necessary to write a synthesing book, which reveals and publishes relationships of a great number of available information and scientific results.

## **2. THE AIM OF THIS PHD DISSERTATION**

As justified by results from various surveys and by our own observations, urban people spend some 90 to 95% of their lives in some kind of a building or edifice. Urban people, therefore, stay out of the natural environment, and stay in dimensions made by themselves. They have also altered the world beyond the walls, and have created a man-made environment. The way of thinking of a builder / building project owner being different by ages and by cultures is typical of how he controls relation between interior and exterior, and whether he builds buildings communicating with nature or staying away from it. Buildings deemed to be brand new and environmentally conscious have existed since the Ancient Times and are simply buildings made on the basis of traditions preserved by generations (in many cases, cosmic knowledge), using a professional skill which developed organically during the centuries, sorting out improper solutions. When implementing it, options provided by terrain conditions, wind, solar radiation, vegetation, local air flows, water surface and natural light were consciously or unconsciously utilized, that is, the building had an integral connection with the natural environment, taking into account culture related considerations. Natural materials known for a long time were used which were built together based upon experience. A common feature of buildings of historical ages is that the energy required for their construction and maintenance was available as human and animal power of muscles, possibly small scale water, wind or mechanical energy, and the use of low cost fossil fuels was still not known.

The main aim of the dissertation is to emphasize the efforts to restore harmony between natural and man-made environments, and to support concepts of those "who have come home" after unsustainable detours. This aim does not mean sinking into the past but it specifies a new direction for development, using the knowledge obtained recently, for a change without growth. So, the aim is:

1. To systematize, on the basis of existing knowledge and results from research carried out in various special fields and my own recognitions, concepts associated with sustainable architecture and to group various tendencies of that special field.
2. To find and publish relationship between knowledge covering the entire sphere of issues and the built environment (architecture).
3. To give a theoretical description of architectural/technical means, urban and building planning strategies and methods required for the implementation of sustainable buildings.

This dissertation will make an attempt to add historical, economic, ideological, philosophical, sociological background knowledge which are changing in regard to their attitudes to the relevant set of knowledge because a really new architecture can be established only if one is aware of the changes of the civilization model.

### 3. RESEARCH/PUBLICATION METHODS

#### 3.1. THE RESEARCH METHOD

1. Detailed study and processing of domestic and international references related to the topic and the background knowledge.
2. Analysis, design, tracking the use for ecological buildings implemented, renewed in Hungary, published in journals and electronic press, including processing relevant experience
3. Organizing earth-building camps, getting to know different alternative construction techniques, participation in domestic and international research projects, in the work carried out by the Independent Ecological Center and Hungarian Association of Passive Buildings. Consultation with those dealing with this topic and with representatives of co-sciences.
4. Giving an answer to questions that have arisen during the 14 years spend with lecturing, and giving a summary and synthesis of information in a depth it requires.

#### 3.2. METHOD OF PUBLISHING RESEARCH RESULTS

1. I have put together the topics for two compulsory subjects (Building structures 7, "Structure in sustainable architecture", for architect students. "Ecological architecture" for environmental engineer students), and a two-semester facultative subject ("Structures for environmentally friendly construction") has been elaborated. For the major part of the above lecture courses, I have been the lecturer, including practical lessons and consultations.
2. I have performed an active publication activity in connection with this topic.
3. In regard to the size of the topic and to the fact that partial results from international background research and calculation methods are available (in databases, software items, references), only the theoretical solutions are summarized in this book. The currently used and environment-saving / sustainable architectural / technical solutions have been compared which facilitates the selection of those conforming to a specific aim.

I intend that this book should be devoted not only to the education and upgrading of architects and environmental engineers but to those involved in other special fields and to non-professional building project owners who show an interest in sustainable architecture, therefore, I have tried to use a language and way of lecturing to ensure that it should be easy-to-understand even for the public.

### 4. A SUMMARY OF NEW SCIENTIFIC RESULTS OF THE DISSERTATION - THESES

The novelty of this paper is represented by its complex attitude, collecting results belonging to the topic from various sciences and special fields, systematizing it to the building engineering process and to the integrating role of architects, and designating directions of research required for the improvement of environment-saving technical, in particular, building structural solutions, while the paper also contains independent scientific statements.

Due to the diversity of topic, the scientific results are found in the boundary zone of a number of other sciences.

**THESIS 1: By analysing the environmental crisis phenomena related to architecture/construction industry and the reasons that have caused them, it has been stated that, in fact, only one crisis exists: the crisis of our civilization model, and all the rest is a consequence thereof only. The crisis is primarily a global civilization phenomenon and only secondly an environmental phenomenon, so environmental problems are only consequences. The two issues can and must be dealt with together only.**

The feeling of crisis has been caused by the depletion of fossil fuels and raw material resources, climatic change attributed to the greenhouse effect caused by carbon dioxide produced by the combustion of fossils, and the fear caused by the devastation of the biosphere of the Earth [1]. During history, the development of production methods took place on an experience basis and was subordinate to interest of community and to the governing's mentality. So, it only locally meant a load for nature. During the industrial revolution the extent and range of human intervention increased abruptly. Our current model is based upon low cost fossil energy, technics, individual material profit and selfishness which has been inspired by the progress and the ideas of linear (material) development and could be realized using an enormous technical set of tools produced. [2, 3]. Phenomena associated with climatic change, and pollution and jeopardization of our habitat are the most striking. That is why research has started from here and has become, by now, in the focus of almost every science and special field including architecture and civil engineering. [24]

**Sub-thesis 1.1: It has been stated that although ecology, in particular, system ecology, as "science of system of relations between living beings and their environment" is suitable for discussing natural environment and man-made / built environment, economic and social relationships but in itself it is not suitable for handling systems of ideas typical of human being in a reassuring way, therefore, research has to cover examination of major systems of ideas and ways of thinking as well.**

The unified theory of ecology is system ecology which researches the way how ecological systems are structured and function. An ecological system is a functional unit containing interactions between environmental factors and living beings of a specific area, which comprises all dead (abiotic) and live (biotic) components through which the nutrient circulation and energy flow are realized. Such processes do not function properly unless properly structured interactions exist between, on the one hand, the soil, water and nutrients and, on the other hand, the producing, consuming, clearing and decomposing organisms. Environmental conditions and the amount of energy that can be fixed are finite. When a population attains that limit, its number will stabilize or if it cannot, then abnormal behaviour and biological reactions will occur. It can be seen that all this can be related to the anthropobiosphere dividable into anthropogenic ecological systems because they can be defined as a functional system of "beings", dead environmental factors and technical elements having a connection in the form of energy, material and information exchange. According to the literature, agrarian, forestry, aquatic and techno-ecological systems can be distinguished, the latter are called urban and industrial ecological systems [4; 22; 27]

Capitalism is the age of the utilization of hidden (subsoil) resources, which considered, for a long period, nature as a source of raw materials and a landfill area only. Its global success has been based upon theoretical bases from the past of about 300 years of the European thinking which are also realized in the field of architecture through exercising the profession. They include rationalism, materialism, cartesianism, relativism, positivism, sciences and desacralization. Exact sciences reduce problems occurring in nature to quantitative determination through numerical operations. A summary of systems of ideas has been performed using works by authors from the field of philosophy and essays, and integrated into my book [5; 6; 7; 8].

**Sub-thesis 1.2: It has been recognized that the essence of the "faulty way" is represented by the principle of the epoch of productivity, also determining its architecture, namely making life as a whole subordinate to economy. The actual task is, as a basic thought of sustainability-resumability, to put back economy under social control, to restore the integration of nature, society and economy. The built frameworks of new formation will absolutely differ from those of the existing one.**

Without performing the task, there is only little chance for us to renew life and its frameworks. Political fault-lines are globally found between believers of productivity and

anti-productivity which may mean a gradual transition into a "civil" society or lead to a social explosion. [3; 7; 12]

The process which began in the 17th century with the appearance of scientific thinking, and turned into consumer society, then into a neoliberal selfishness is now declining.. The world seems to rise against its goals it has had so far, namely material interests, the idea of progressive optimism, trust in continuous progress and unbroken linear development. [11]

It frequently happens that various resources are found not in the territory of a country that uses them. The war intended for acquiring them is fought sometimes by using weapons and sometimes through more and more abstract cash and credit transactions. It is of strategic importance to acquire control over and possess large supply systems, food and drinking water. [12]. The goal and means have been exchanged, capital has become self-propelled and now the development of technical means dictates setting-out of goals (see "urban planning by investors").

**THESIS 2: It has been recognized that two marked solutions are outlined for crisis management which also have different architectural projections. One of them deems that the solution to these problems is possible by sustaining the civilization model, yet changing to an environment-saving product system but with an unchanged social structure and mechanical-technical attitude. In my opinion, this is only teating the symptoms but not the illness. The other one reckons with a slow transformation of the model, supplementing the mechanical world image, strengthening the autonomy of localities, and creating hierarchically structured small communities, sustainable action programs supervised by strong states.**

**Sub-thesis 2.1: When designing buildings, in the first case, mainly the reduction of power consumption to a minimum is focused on, and the other requirements for sustainability (reduction of demand and loads, preservation of value, recycling) are considered to be secondary. For architectural solutions of the second version, the small scale, in-situ natural materials and environmental resources and energy, lower technical level and involvement of local manpower are dominant.**

As stated by Mies Van der Rohe, namely that "a built environment is a spatial expression of the will of society" is evident. Considering that in the second program a slow change in the current civilization model (which is power-requiring, innovative, consumption-centered, striving for a maximum profit on the short term) is concerned, its architectural frameworks must follow the "will of society". Basic conceptions and strategic elements of a sustainable life include - in addition to or as a precondition for environmental sustainability - social and economic decentralization, an integrated way of life and lifestyle and autonomy. Therefore, in order to ensure that our built environment can operate in a sustainable way, it is only one of the preconditions that it should not load its natural environment (supply area) to such an extent which would upset the ecological equilibrium. [13; 29]

Architectural designing cannot be separated from the "sustainable development" of natural and built environment - society - economy and from a culture based upon traditions, connecting a smaller or larger community either.

"Energy and climate design" are fashionable streamlines in architecture which consider that out of the six connection points (see later) - featuring an ecological attitude - of building, its user and environment [see later] the issues related to energy and material flows are dominant. They utilize environmental resources but in their technical means and in the use of techniques applied they do not consider or consider to a limited extent only the construction ecological and construction biological requirements (construction ecology is a field of science examining the relationship between building and nature, whereas construction biology examines relationship between building and man. [14]

Local, autonomous cooperating small communities reckon with human-scale buildings and consider it to be of importance to take into account "a package of requirements" formulated by

both fields of science described above. They propose local, non-toxic materials and building structures which are also able, for the most part of the year, to replace the role of building installation by enhancing and involving local renewable resources. However, they do not omit the role of intermediate techniques, human resources, and recycling either [16; 27].

**THESIS 3: It has been recognized that the recently popular definition of sustainable architecture is outdated in some aspects, and needs to be supplemented and modified. The definition of sustainable architecture has been re-formulated and supplemented as follows: "Sustainable architecture means a new attitude: it enforces the principles of sustainability in construction by using research results and definitions of construction ecology, construction biology and human ecology."**

At the first international conference of CIB (International Council of Research on Building) on sustainable building held in 1994 in Tampa, Florida, the definition of architect Charles Kibert formulated as a working hypothesis was accepted which is appropriate in many aspects but in my opinion, it needs to be re-interpreted according to the experience that have accumulated since that time. As formulated 16 years ago, sustainable architecture is as follows: "Creating and responsibly sustaining a healthy built environment through an efficient utilization of resources according to ecological principles".

The events taking place in the past 16 years have proven that due to an efficient use of resources, their use has increased in total (for means operating at lower cost, more are used and more times). Assuming responsibility - although it would be very much needed - is avoided by most people and construction biological research has not been able to clarify a definition of healthy environment yet. [21]

Aspects of the principles of sustainability in construction (R.C.R.) [15] can be linked with the Reduction of burden exerted on nature and demands of society for the use of construction site, material, water and energy, solid waste and sewage production, with the Conservation of the diversity of living beings, human cultures and built environments, and with Recycling for the construction materials and use of buildings.

Until World War One, "ecological building" was used extensively. They were built using a skill based upon traditions and experience of a diverse culture; natural and durable materials known for a long time were used, and local environmental impacts (solar, wind, precipitation, air flows, vegetation, climes, water surfaces, etc) were taken into account. The traditional popular architecture of every geographic site represents an excellent example of sustainability.

**THESIS 4: It has been recognized that the tools necessary for the creation of sustainable buildings as well as the „building – its user- environment” connection points need completion. Most part of the literature dealing with sustainable building reckon with human building usage only. Due to the tasks of the integrated lifestyle, upon realization of buildings the designer has to consider also the non-human needs following the function and the internal and external constraints suddenly and simultaneously.**

According to most part of the literature the house-man-environment connection points are the following: architectural formation, location, materials, construction techniques, energy and material flows. These require addendum, both each of them and their number. [17]

The styling related with the architectural function must be supplemented with social expectations, materials with building elements, construction techniques with usage techniques and site resources with the related constraints. In my opinion, beside energy and material flows, the needs, resources and constraints of the interior have to be taken into consideration. (Integrated lifestyle considers conduct of life and functions at neighboring, sometimes at the same places as feasible. Food-processing, storage, livestock-farming and the necessary workshops, but even the public institutions: sport, health care and cultural institutions are not connected to definite districts; all of them are situated near the dwelling areas.) [18] The

harmony of the establishment of buildings which are the frameworks of sustainable life cannot furnish either component of the outlined six “connection points”. It cannot be restricted either to artistic self-expression or to raw functionality or exclusive consideration of technical issues, but even satisfaction of conventional convenience and comfort with renewable energies and modern (passive or active) techniques cannot be the exclusive goal, and no harmonized building can be created unless they are jointly taken into consideration. [27].

**Sub-thesis 4.1: I have found that the structures of sustainable architecture have not been defined. My own definition runs as follows: The building structures of sustainable architecture are made according to theoretical exigences of sustainability and support the construction-ecological and construction biological-operation during its whole life cycle.**

Building structures can be fitted to the built framework of sustainable life if:

- they are made of in-situ, renewable, recyclable, non-toxic materials
- they require "closed" production technologies built upon circular processes, and "gentle" implementation and maintenance techniques also involving human resources
- they can "manage" with energy use and air moisture content
- they are able to enhance and utilize environmental resources.

[24; 25; 30]

**THESIS 5: It has been recognized that if we keep track of the strategy of model change concept in the process of building designing, we must reckon with three well isolatable architectural tasks:**

- **to the new agricultural working places and residential buildings which can be related to rural development (livestock-farmer, storage etc.),**
- **to the new, brownfield investments assignable to the division of the town into smaller units, and**
- **with a large number of design-construction works concerning rehabilitation and extension and renovation works in both cases.**

According to the (hopefully) slowly changing social expectations the altering building functions and architectural formation will be a task essentially different from the routine.

In an old/new society the built environment will not be “unappreciable from architectural point of view” just different. Today, architectural formation does not differ yet from the mainstream trends of the “society of productivity” which can be rarely harmonized with the social and natural expectations changing to the desirable direction. Brilliant creators are needed desperately who are able to practice the “art of co-seeing”.

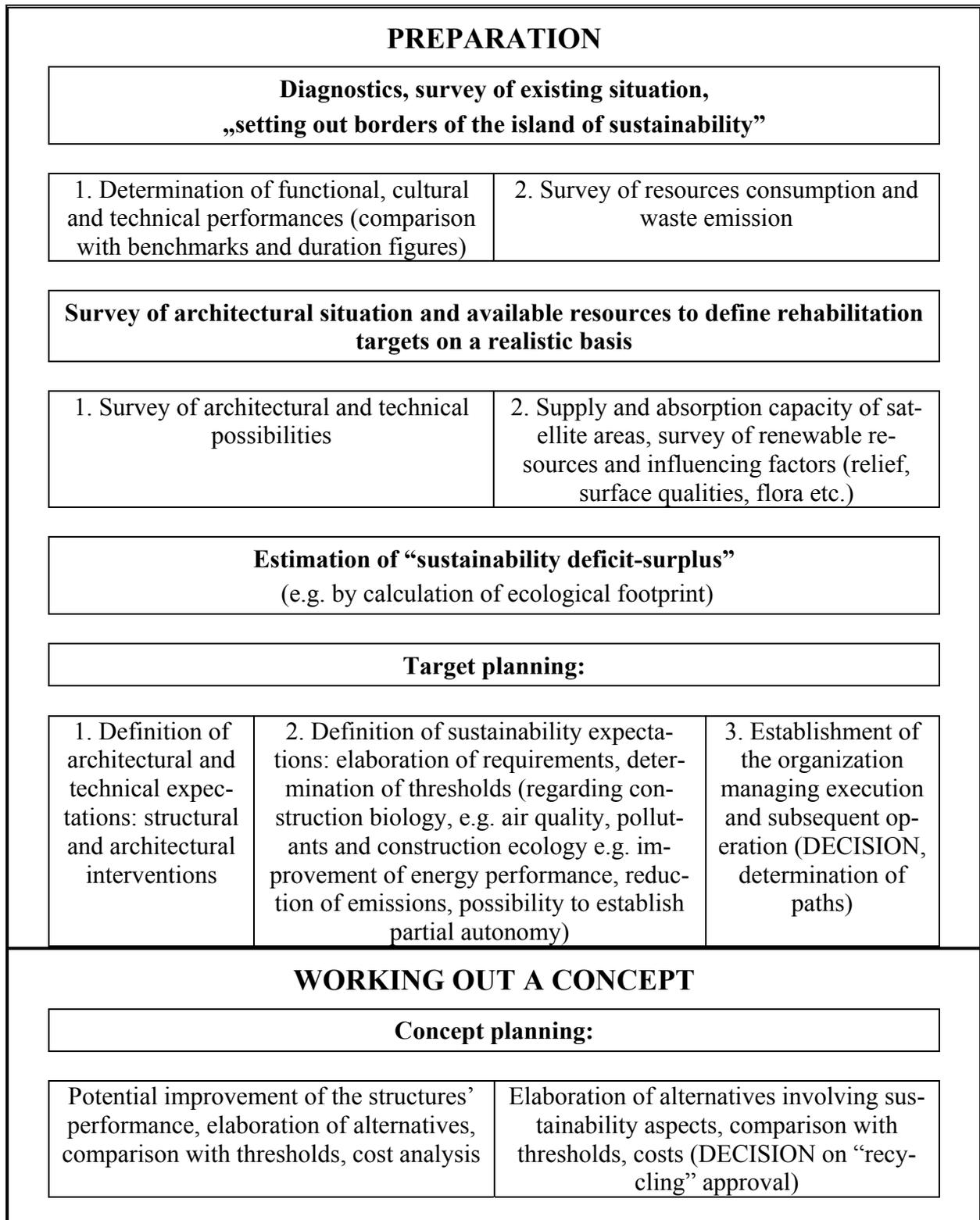
**THESIS 6: As recognized, sustainability aspects within renovation practices appear only with the aim to reduce energy consumption and often with essentially faulty technical solutions. The completeness of technical and sustainability-related expectations can be considered only together during the performance of rehabilitation works. Upon “easy rehabilitation” of buildings, technical solutions shall apply which are close to the original structural solutions and construction techniques, require as little demolition works as possible and allow the application of construction biology, construction and human ecological aspects. [14]**

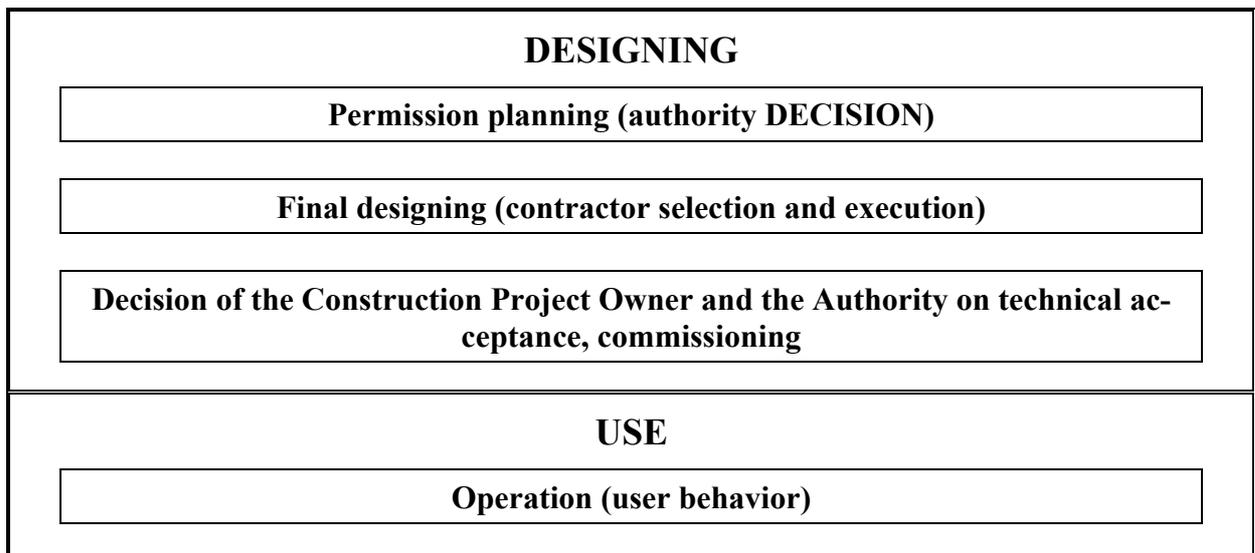
One of the key areas within sustainable architecture consists of sustainable adaptation of existing buildings, observation and protection of the architectural environment. However, sustainability aspects of rehabilitation tasks alone may prove to be insufficient if architectural/technical factors are neglected. The considerations mentioned above are only together justifiable allowing to reach the aim.

Renovations meeting the expectations of today cannot be performed without proper knowledge of architectural, static and structural design as well as technical, construction biological and ecological condition of the existing building, function and performance of the

structures as well as consumption habits of the users. The elimination of causes of adverse changes as well as their correction are essential; otherwise, disadvantages exceed advantages; building lifetime will be shortened rather than extended. (The issue is challenging; structures under load must be worked on while the buildings are often in use.) [26; 28]

**THESIS 7: An algorithm based on the concept of performance has been created which can be used to design sustainable rehabilitation and, with minor alterations, also in the case of new buildings. Upon application of a design strategy “keeping the entire sustainability spectrum in mind”, the rehabilitation design process consists of following elements:**





[17; 18; 19; 20; 23; 24; 25; 26; 28]

“Environmentally conscious” reconstruction / rehabilitation involves much more than “conventional” one. Conventional rehabilitation methods of buildings may also serve as a basis of environmentally conscious rehabilitation. However, this cannot be interpreted for one single building. The survey of the property’s features must be extended to the natural region supplying the location. The inspection covering functional and technical condition of the building(s) shall be also extended covering not only supply systems and the social and economic sphere but also construction biological issues. In addition to technical and energy solutions, sustainability-related and ecological issues must be considered and the finished situation financially and organizationally funded. “Ecological deficit or surplus” can be calculated/estimated upon survey of the current situation/load and being aware of locally available resources. Problems regarding intended functional recycling, technical, energy-related or pollutant-related issues may be decided in knowledge of this analysis. At least a partial autonomy must be targeted.

The design process is based on the presented system of flows, the performance conception and the method of effect-requirement-performance analysis also integrally comprising an analysis of “environmental” requirements and performances.

The data required to go through with the design process are contained in technical and authority regulations, research reports on environmental performances and thresholds as well as international databanks (e.g. ECOINVEST, Bau Bio Data Base, calculation support software products available via Internet etc).

## **5. POSSIBLE USE OF SCIENTIFIC RESULTS DESCRIBED IN THE DISSERTATION AND THE BOOK IN PRACTICE**

A gradual demolition of the concentration of enormous resources, money and power might be *a way leading out of the economic - financial - social crisis* that has hit the major part of the world. Unlike the few winners of productivism, the (small) community lifestyle arranged for self-supply *gives a job* for the enormous amount of uneducated "losers" frequently living in misery, and the cooperation replacing competition creates more humane conditions, and would hopefully *allow us to avoid a new migration and social explosion*.

*Populating the abandoned countryside and disintegrating the giant cities will allow creating more sustainable conditions.* This practice has already worked successfully in many parts of the world. *Establishing a built framework for these all and renewing the deteriorated urban buildings requires real ar-*

chitectural and technical creativity and gives jobs to many people. Translating the proposed technical solutions into practice, at a lower technical level, would be useful both for the people and for nature.

This dissertation/book, in its improved version, can be utilized:

- in the education of architects and environmental engineers
- in the designing and implementation of buildings and building structures
- in contributing to a change in the attitude of customers.

However, servile copying of any method cannot prove to be successful because the situation and culture are different for every country and people. So is climate, urban structure, architectural traditions, etc. In our country, in Hungary, for instance, relying upon our excellent fertile land conditions, we could give a priority to *organic family based management*, by utilizing existing structures of farms, abandoned small settlements, confined gardens, abandoned holiday resort zones.

## 6. FURTHER RESEARCH TASKS PROPOSED AND FORESEEN

1. After the completion of the PhD procedure and the publication of this book, the body of knowledge in it can be permanently updated later on, and a new version of cooperation between different fields of sciences and special fields may appear which sets as a goal to justify hypotheses. It will allow to reveal new relationships and to give answers to questions which are nowadays still unanswered.
2. A change in lifestyle also requires political intention. To change the way of thinking, and translate theoreticla solutions into practice, it is necessary to carry out social and economic research, publish the results, and inform the decisionmakers of politics.
3. I do not deem that ecological attitude has, at the moment, a matured culture and unified mentality. My book aims at a synthesis among diverse sources that often contradict each other, and may, therefore, serve as an initial basis for further research to be carried out in this field and providing a scientific background for mentality.
4. In the field of architectural designing, a series architecture-scientific research is needed (art of co-seeing) because new ideas in an old architectural guise would result in conflicting solutions.
5. In addition to the already known architecture using adobe and straw, one has to reveal again the in-situ construction materials, supporting and building structure solutions applied in our existing buildings, including the techniques that were used to construct them, which - when reformulated - could be used properly both for the creation of new buildings and in the renewal and reconstruction of old ones in a way that upholds the principles of sustainability.

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