

Glass as means of indoor/outdoor communication in architecture

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Abstract. Tendency to merge indoor and outdoor space, due to the wide application of glass panels in architecture, today shows a pressing need to restore integrity, wholeness and harmony of environment. Currently the process mainly shows to be of coincidental character which creates a need for scientifically proved mechanism to regulate these processes in line with artistic and harmonious spatial structure planning tasks. Development of new well-grounded principles for a harmonious linking of indoor and outdoor space, taking into account recent trends in this area, has become a central task and an issue for research. Objective of this particular research and article is to look at glass as the main means of communication, its impact on harmony between outdoors/indoors depending on the type of application. This article includes a part of more extensive research of indoor/outdoor harmony. Theoretical and empirical methods were employed during the study of glass history and its application in architecture, the main method in a particular stage - theoretically comparative, which manifests as informative and archive-making. In analytical generalisation phase the priority factors of outdoor/indoor harmony were determined by virtue of inductive cognitive method. When collecting the most significant facts from the metal/glass history, its impact on architecture and environment in relation to the time period, it was concluded that one can observe a steeply rising curve at a global scale. Along with the growing importance of glass panel application in Latvian architecture, one can expect upgrade of dialectics of outdoor/indoor dialogue more in terms of quality rather than quantity, searching for the key of harmony in front of doors of the new challenges. During the analysis of impact of glass application on environment quality one has to conclude that selection of appropriate means for outdoor/indoor communication plays a major role in achieving secondary goals - in more suitable time the most efficient application of glass in architecture in each particular object promotes harmonious outdoor/indoor communication. Subordination of values sets a decisive course in attaining harmony in art of environment design - to subordinate smaller goals of spiritual and material character to the supreme task in a proper order. At the same time, by putting forward tasks and goals of designing, one must still hold on the well started work of designers and administrative structures - by involving multifaceted public opinion more efficiently and paying a due respect to it. Outdoor/indoor harmony can be perfected through one of main milestones of harmonious environment design, namely by improving public's communication with designers and administrative structure employees. In order to foster a quality of harmonious and high-value environment, one must invest resources in educational field; it will become a reflection of inner conflicts of a new concept of space, continue historic process of architectural development and introduce diverse approaches to harmonise indoor/outdoor space.

Keywords: indoor/outdoor harmony, landscape architecture, architecture, interior, glass systems.

Introduction

Glass contrasts are grand - free and shapeless it flows melted in the heat, then it stiffens solid as crystal, containing so much power and expression in its structure — this special material is described so by the worldwide known light virtuoso and architect G. Birkerts in his poem written in the previous century [7]. The possibilities it creates aim towards spatial freedom, look for a new balance, based on the metaphysical order of things. Tendency to merge indoor and outdoor space, due to the wide application of glass panels in architecture, today shows a pressing need to restore integrity, wholeness and harmony of environment [23]. Currently the process mainly shows to be of coincidental character which creates a need for scientifically proved mechanism to regulate these processes in line with artistic and harmonious spatial structure planning tasks. Development of new well-grounded principles for a harmonious linking of indoor and outdoor space, taking into account recent topical trends in this area, has become a central task and an issue for

research [34]. High-standard living environment in attractive surroundings is one of the main conditions for city development and labour force attraction. Municipalities want to offer attractive residential territories thus securing their main municipal budget resource, i.e. income tax [29]. Harmonious environment demands a balanced set of material and high standard spiritual aspects which at the same time take care not only of economical, energy-efficient, ecological issues, but also security of physical and emotional health and welfare of residents. A harmonious environment consists of interaction between harmonies and disharmonies [37], its wide spectre encompasses parallels of material and spiritual aspects [19; 20; 21]. The issues, addressed by the present study, comprise a limitless amount of subjective and objective factors. Previous level of study on architectural conditions, criteria and aspects of indoor/outdoor harmony does not provide sufficient knowledge of the subject; this problem has previously not been

a primary focus. Studies conducted on the impact environment quality focus mainly on detailed analysis of energy-efficient and ecological outdoors/indoors aspects. Functional, aesthetic and ethical aspects of architecture, interior and landscape architecture communication and their mutual harmony has been studied in a fragmentary way, and the studies lack a unifying core in the meaning and scope of real situation in life and architecture where intensive application of glass systems may be observed. Theoretical basis of individual aspects of environmental design consists of generous range of studies, for instance:

- systems of universal proportions – inspiration of natural harmony in bionics and possibilities it offers for creating harmonious spaces [22; 23; 24; 37];
- application of colour harmony and principles in environmental design [13; 14; 23];
- harmony in synthesis of architecture and art [1; 26; 28; 37; 44];
- harmony in space [24; 27];
- Techniques of harmony in architecture [19; 20; 21; 24; 32; 37];
- aspects of harmony in urban landscape [4; 5; 6; 18; 30; 31; 33; 37].

Indoor/outdoor harmony and its future development possibilities anticipate an analysis of endless matrixes made of multiple components to obtain results with maximum precision, taking into account the factor of infinity and specifics of outdoors nowadays accumulated by indoors, both spaces freely interflowing into each other; multifariousness of public opinion, inconstancy and instability against time spans as well as dynamic importance of public space [12]. In order to comprehend and analyse the multifaceted factors influencing environment harmony more deeply by determining their mutual regularities, which is the main objective of this research, glass, its history, physical, aesthetic and ethical aspects in outdoor/indoor communication and its application in Latvian architecture during the last 25 years in publicly sensitive objects and their groups are analysed in this particular publication. Following tasks are put forward to the objective analysing glass and its application:

- study of evolution of indoor/outdoor dialogue in context of glass and metal technology history, chronological collection of main facts, supplemented by conclusions about current situation and its trend at global scale;
- application of glass and its impact on outdoor/indoor harmony in the inspected objects, summary of obtained conclusions;
- elaboration of conclusions and recommendations for glass application in architecture aimed at

of glass panels widely used in architecture on promoting outdoors/indoors harmony in today's Latvia.

In order to make the fulfilment of this task more realistic, limits in time and space have been set. These limits are the last 25 years in the territory of present-day Latvia. From 2013 to 2014 one inspected publicly most sensitive environmental objects and functionally different object groups in the territory of Latvia, and results were published in reviewed scientific publications and entered in the following internationally indexed scientific data bases [3; 15; 16; 17]. The aim of study intends, after summarising conclusions from theoretical and empirical research, to come as close as possible to conditions of harmonious indoors/outdoors serving as a basis for take-off in developing scientifically grounded methods for the advancement of indoor/outdoor harmony in the future. Objective of this article is to look at glass as the main means of dialogue, its impact on harmony between outdoors/indoors depending on the type of application. Research included in this article is a part from more extensive study on environmental harmony and is integrated in it.

Materials and Methods

The heavenly dimension of art is embodied in material expressions, especially architecture. One might say that architecture lies between heavens and the earth. The material, which the study focuses on, is glass and glass panels as construction material which uniquely includes both material and immaterial aspects due to its solid structure and transparency. Theoretical and empirical methods were employed during the study of glass history and its application in architecture, the main method in a particular stage - theoretically comparative which manifests as informative and archive-making. In previous stages of study, the results of which comprise the basis of the present study, one applied theoretical and empirical methods: photoanalysis, inspection of objects in nature in various seasons and various times of the day, and sociological surveys. Material chosen for study was publicly sensitive buildings and their groups built in the territory of Latvia from 1991 till 2014; one analysed the dialogue of building design, landscape and interiors (composition, coloristic, proportions – massiveness, level of filigree, glass panel areas, level of emotionality), harmony in mutual interaction of architecture and interiors.

Application of comparative method in summarising information for the study

1. Principles of glass system application in architecture:

- composition of glass panel areas in space and their proportion – massiveness in relation to parts without glass;
 - compositional application of colours and chiaroscuro under insolation impact;
 - research of visual accents created by chiaroscuro play;
 - assessment of semantic correspondence of indoors/outdoors and level of emotionality according to functional programme of respective space.
2. Summary of studies on the impact of mutual compositional build of indoors/outdoors:
- architectural shape-building, glass systems and landscape around objects as main criteria in the search for harmony between indoors and outdoors, compliance with a supreme spiritual task following the function of spaces.
 - assessment of indoor/outdoor harmony – summary of opinions by experts and other respondents on correspondence of indoor/outdoor dialogue to the supreme task of an object under consideration.

In analytical generalisation phase the priority factors of outdoors/indoors harmony were determined by virtue of inductive cognitive method.

Results and Discussion

Evolution of indoors/outdoors dialogue influenced by glass/metal technologies

Glass and metal were materials known already in ancient Egypt and they were used to create tableware and jewellery. First metal tools considerably influenced the pace of human evolution thus starting a new period in human history - the Iron Age. However, it took quite a while until they were utilized as construction materials. Up to the end of the 18th century metal was used in building for producing small decorative elements (bars, dividing elements, fastening details like nails and ties). After inventing coke-melting oven in England metal's quality improved; it became cheaper and opened new possibilities for its use in building. Metal as constructive material in building industry took rise only after cast-iron bridge structures were invented. In 1779, England, metal was used for the first time as constructive material in arch structures of cast-iron bridge across the river with 30 meter long spans, followed by many more. Glass production technologies evolved in parallel, making glass and its produce cheaper. Glass/metal constructions in house building was started when Englishman J. Paxton made the famous Crystal Palace in London's Hyde Park and deeply moved the world of architects. According to his words, J. Paxton borrowed the beautiful idea for the building from tropical plants. Walls and overhead cover were made of tiny modular metal structure

filled with glass panes. Composition of the building featured central symmetry and resembled a gallery in which metal columns instead of former masonry walls pulsated in a rhythm and supported the airy ceiling part built from cylindrical barrel-vaulted transparent overhead cover. Light filled the indoor space in an unprecedented manner and served for functional needs of exhibitions, market pavilions and winter gardens. Already in the second half of the 19th century glass and metal constructions and glass cupolas as roofs had become very common, especially in England, and became an integral part of Victorian era. It was the time when the first railway station pergolas built in glass and metal appeared winning people's hearts and minds. As a result, such pergolas were built in vast amounts. Exhibition and market pavilions built in glass and metal and easy to mount and demount turned out to be excellent companions of the general trend. This era is well characterised by the controversial Eiffel Tower in Paris built in honour of Exposition Universelle of 1889. It was the time when one of the first suspended facades was made for the Fagus Shoe Factory designed by W. Gropius and built in Alfeld on the Leine (Germany) in 1941. Suspended glass façade panels considered as an early prototype of modern façade panels started a new trend called constructivism. In America Mies van der Rohe led the work of finding new ways for applying glass for administrative needs in skyscraper construction. The optimal skyscraper construction system intended to have carcass structure where, instead of bearing walls, one inserted compression columns supported by a reinforced concrete core penetrating the whole building's height. Bearing brick walls in buildings of such construction lost sense. 19th century architects and designers tried to use the new opportunities to the maximum: compression members (supports, columns, arches) were made of cast iron, i.e. ferrous alloys and widely employed. Comparing to metal which contained very little carbon, cast iron is more durable in terms of compressive stress. On the other hand, metal works better in cases of tensile and flexural stress thus making a good material for beams and ties. However, the new combination of metal and glass revealed serious drawbacks: metal's high thermal conductivity cooled interior space in winter while in summer it got overheated due to the transparency of glass. The only method to tackle the problem was airing of rooms. The spirit of the age found a necessity to rehabilitate itself in the nature, and modern achievements offered an excellent opportunity to satisfy this need. Nature, due to glass panels in walls, became a part of interior, i.e. outdoors entered indoors. This concept was most skilfully embodied in the

artwork of L. Mies van der Rohe and F. L. Wright, Le Corbusier and O. Niemeyer [43].

20th century brought radical change and new accents in indoor/outdoor communication: a new era in environment design started linking indoors and outdoors into a single whole. Classical three dimensional system introduced by Newton started to lose its splendour in architecture and was considered primitive and trivial. Discovery of the fourth dimension (time) liberated space from the reference point.

In the 60s of the 19th century glass and metal are approved as the leading construction materials. It is witnessed by artworks of N. Foster (Great Britain), J. Nouvel (France), W. Rodgers (Great Britain) and F. O. Geri (USA) who incarnated the idea of monolith glass facades. Facade structures underwent rapid evolution and now offer increasingly qualitative solutions. At first metal profiles were replaced by lighter ones, i.e. made from aluminium; air-cored and polymer-insert profiles were invented which improved the necessary indoor comfort and reduced thermal conductivity of structures. Polymer alloys opened new horizons - aluminium window block became usable in residential premises. New constructions acquired advanced aesthetics suitable for the era; they were painted with specially improved formula chemical paints, glued over with polymer films, which opened endless design variations and made constructions ever-lasting and protected from corrosion.

In 1959 a way was found in England to considerably reduce prime cost of glass and improve its quality close to ideal. Basically 3.3 long glass strip was melted in oven, then placed in tin baths thus leading to perfect surface. In 1967 a new level of mastery led to production of glass without bronze hue, followed by invention of glass which reflects the surroundings more intensively and eventually a plate glass which made it possible to visually protect indoors from outdoors. Laminated, hardened and armed glass was created as the mechanical features and endurance of this material were sought to improve. Glass breaks because upon bending the external layers stretch and bend more than the inner ones resulting in tearing apart molecule ties and fragmentation of glass. In order to mitigate this characteristic, the glass is being hardened by repeated cyclical heating and immediate cooling. As a result the external ties cool faster than the internal manage to stretch. Load applied to glass treated in such way must at first overcome the tensile strength of external layers before it breaks. Lamination principle sees that a polymer layer (vinyl plastics) is placed between two glass plates. If the glass breaks, it does not fall apart due to the film thus protecting people from

injuries. Armed glass is produced according to the analogy of armed reinforced concrete - in this case subtle thread are inserted in sheet mass which resist extraordinary border bends. Next step for glass and metal tandem evolution was invention and mass production of insulated glass panels which made it possible to use large pieces of glass also in northern regions, significantly reduced noise level from outdoors to indoors as well as heat losses. Consequently insulated glass panel wall became a serious rival to masonry walls. When constructing glazed buildings or extensions to dwelling houses it is still advisable to leave 20-30 % of glass surface for airing, and building some part of it in masonry to ensure higher level of comfort during the hot season. If it is crucial to make the building completely out of glass, one must include forced ventilation with a conditioner. UV-impenetrable glass would be recommended in such case, regardless high costs, if compared to regular glass. In order to reduce indoor heat loss the glazed facade panels can be suspended slightly apart from a dark inner wall. Sun rays heat up the inner wall, reflect the heat which penetrates inside through special air channels and ensures energy savings [43]. Enduring and light-weight polymer-based composite constructions have become a serious rival to metal structures nowadays. Armed with fiberglass threads or fabric, in terms of endurance, it resembles metal structures, yet outplays it in terms of weight being 4 - 5 times lighter. Bearing facade frames and panels are made of polymer-based composite materials. Vast colour palette, also based on durable polymers creates endless aesthetic variations [38].

When collecting the most significant facts from the metal/glass history, its impact on architecture and environment in relation to the time period, it was concluded that one can observe a steeply rising curve at a global scale. In presence of geometrically increasing importance and application of glass panels in architecture due to constant development of science and technologies, one can expect rapid upgrade of dialectics of outdoor/indoor dialogue more in terms of quality rather than quantity, searching for the key of harmony in front of doors of the new challenges.

Summary of conclusions on indoor/outdoor harmony in objects inspected in nature

Results obtained in researching education institution architecture confirmed a previous hypothesis that the development of indoor/outdoor harmony in the context of 20th-21st century technologies creates a new architectural scenery. Latvian architecture presents excellent examples of an environment serving for the needs of unprotected members of society such as children, e.g. linking of nature and interior space in recreational areas,



Fig. 1. Facades of Jelgava Secondary School No. 4
[Source: photo by author private archive, 2013]



Fig. 2. View on the Brukna Manor from the garden
[Source: photo by author private archive, 13.04.2014]

for instance, the new extension of Jelgava Secondary School No. 4 d with facade made of glass panels and curved towards outdoors thus integrating nature into interior space in an intensive and propitious way (Fig. 1). In the new Latvian Academy of Arts' extension designed by A. Sīlis (SZK&Partners), an obvious contrast to the historic volume, the linkage with outdoors, or the sky, through proportions of glass areas in windows in relation to parts with no glass, has obtained a value of a finished, framed artwork. A widely popular and favourite technique is an entrance motif designed in voluminous glass panels: it emotionally softens borders, creates gradualness and overcomes interspatial borders. This principle has materialised in many new education institutions, e.g. International School in Piņķi designed by architect D. Zalāne [15]. This approach is preferred among architects and society circles, it can be seen in many shopping and sports centres and administrative buildings. Glass section in toned plate glass, e.g. Jelgava Ice Hall, designed by architect A. Račinskis, reduces indoors communication with outdoors and emphasizes surrounding landscape which reflects in the plate glass surface. Also, in healthcare institutions the linking of nature and specially designed rehabilitation gardens with interiors has become a key to indoor/outdoor harmony accepted on international level; this niche holds an important potential for development in Latvia [2].

A successful example of a harmonious linking of indoors and outdoors for rehabilitation needs is Brukna Manor complex which, after a 21st century transformation of buildings and landscape, has regained its original aesthetic and architectural quality and harmoniously states its identity through spiritual dimensions, mental feelings and attitudes (Fig. 2). Brukna Manor complex is a harmonious environment for a rehabilitation centre combining values of both material and spiritual harmony. Brukna Manor house, in spite a changed function, has been renovated according to the values of classicism and may be considered a standard of harmony. Building's new interiors form a unique synthesis of antique heritage and modern art. Environment there exists in a state of continuous transformation like a live organism and



Fig. 3. The Holy Trinity Roman Catholic Church
on A. Deglava Street in Riga
[Source: photo by author private archive, 2013]

is created for living, not for the strict needs of museum. Manor's classic building and interiors are finely supplemented by a garden designed in Italian renaissance; buildings of the 21st century render it stylistically diverse. However, core of the complex, i.e. manor house, interiors and garden, has a strong uniting factor, i.e. central symmetry axes of material and spiritual character that helped preserve harmony in spite of challenges that were posed by functional transformation. The spiritual vertical symmetry axis is expressed through a human one: since the very start of Brukna Manor restoration all works were successfully conducted by dean A. Mediņš. The vertical, as a central symmetry axis for spiritual dimension, is an irreplaceable frame of reference in creating a harmonious environment [3]. By keeping the historical values in architecture through



Fig. 4. View of the Purvciems residential blocks from the inside of the Holy Trinity Roman Catholic Church
[Source: photo by author private archive, 2013]



Fig. 5. Dobele Holy Trinity Roman Catholic Church,
Baznīcas Street 10a

[Source: photo by author private archive, 2013]

authentic window frames and use of glass filling instead of intensively pursuing the opportunities offered by modern technologies, outdoor/indoor harmony, which has stood the test of time and is still recognized as good among both experts and society circles, has been preserved.

Most recent heritage of sacral architecture in Latvia is widely represented in the form of new modern Catholic churches where in a harmonious indoor/outdoor dialogue the main importance should



Fig. 6. Interior of Dobele Holy Trinity Roman Catholic Church

[Source: photo by author private archive, 2013]

be attached to integration of the idea of transcendence. Compositional application of colours and chiaroscuro under the impact of insolation as well as visual accents created by chiaroscuro play have to underline altarpiece in a space by establishing necessary balance and arranging priorities in the right order. Aesthetic harmony or a picturesque landscape perceived through a glass panel only has a subordinate meaning. E.g. in Holy Trinity Roman Catholic Church in Riga (Fig. 4)

designed by architect U. Šēnbergs, light falls in through asymmetric windows arranged high in walls and accentuated altarpiece which not only organises space opening the view to the sky, but also, in balanced portions, opens interior sacral space for communication with urban outdoors (Fig. 5). There are a lot of examples of harmonious indoor/outdoor communication: Dobele Roman Catholic Holy Trinity Church, architects J. Kukša and I. Kārklīņš; Saldus Roman Catholic Church, architect A. Andersons; St. Dominique Roman Catholic Church in Liepāja old town and others. Māra Church in Liepāja, architect A. Skujiņa, St. Meinard's Church and catholic parish centre in Liepāja, architects A. Hupfauf (Germany) (central raised volume) and AKA bureau with A. Kokins and A. Kokina (radial enclosing external part), with their ideological contribution to harmonious indoor/outdoor communication, hold a potential for technical improvements in the future. Analysing a number of sacral buildings within the present study it was concluded that for the primary goal which manifests as emphasis on altarpiece and bears the idea of transcendence and to which other secondary aims and tasks are subordinated, include a proper use of glass in architecture both from the perspective of composition and type of the most suitable glass for all glazed parts of the building. Therefore advanced knowledge in creating indoor/outdoor harmony would not only raise the quality of architectural environment, but also help reaching a higher level of environment design in a more economic and purposeful way.

The new building of Latvian National Library (LNB) designed by architect Gunnar Birkerts can be considered as a bright and refined sample of indoor/outdoor harmony in architecture, a successful result of interdisciplinary cooperation of environment makers. Such opinion is confirmed in viewpoints expressed by Latvian elite architects - A. Kronbergs, A. Sīlis, U. Lukševics, J. Dripe, J. Lejnīeks and other experts. The building presents an encounter of noble aims defined twenty five years and respective results of the present day; they have stood the test of time and must be recognised as timeless. Regardless the cubic capacity and silhouette of the building, it still leaves a slightly phantasmal general impression due to opaque, frosted, four-layer glass in grey tone used in facade finish which rhythmically interplays with vertical transparent glass window openings totalling in 13,900 m². Meanwhile horizontal transparent glass inserts in slope panels or lateral facades of the building which alternates with mat belts provide intensive skylight to reading room interiors located in both ends of the building thus upkeeping the main function of library in a perfect way. Presence of



Fig. 7. A view of the NLL building from the side of the Daugava River
[Source: photo by author private archive, 16.10.2014]

urban housing view on both ends of building's layout is replaced by always-changing skies and they encourage necessary focusing on the intellectual work. Even more intense source of light falling indoors opens from the very spire of structure. Coronal finishing of transparent glass in the ridge of building invites intense daylight through inner atrium thus making indoor space closer to natural environment, namely outdoors, by means of light. Its author, G. Birkerts have always emphasized that this library serves a specially important function in a serious tonality [8]. It resonates indoors and from indoors to outdoors creating a mutual harmony, soft transitions in outdoor/indoor communication are merged, it has occasionally volatile borders where glass as construction material is used in a brilliant way to incarnate architectural ideas in life. "Critics have recognized my attempt to make light a material for architecture. But my consequent modernist approach, in which I create organic architecture in a series of works, is described as expressionist modernism or metaphorical modernism," G. Bikerts tells [9]. It was concluded previously that in order to come as close as possible to indoor/outdoor harmony in environment design, one must look utmost precisely in a more distant future, while being in stage of designing, and to define a primary goal - supreme task and tasks which lead to it and to which the secondary aims derived from available means and demand are subordinated. Subordination has the deciding role in reaching harmony [16].

During the analysis of impact of glass application on environment quality one has to conclude that selection of appropriate means for outdoor/indoor communication plays a major role in achieving secondary goals - in more suitable time the most efficient application of glass in architecture in each particular object ensures harmonious outdoor/indoor communication.

Application of glass in nowadays aimed at promotion of outdoor/indoor harmony

Step by step technologies offered solutions to material shortcomings regarding use of glass systems, while problems brought about by emotional and spiritual aspects still remained. For instance disproportionate use of glass systems in construction of private villa Farnsworth House (USA) designed by Mies van der Rohe led to the case in a court and he was accused of depriving the owner of private life space, following own eccentric moods, constructing a glass "aquarium" instead of a private house. But users of Latvian public buildings most probably would not fight like this for their rights. And it would not be a solution anyway. Situation is already burdened with short financing and improper practical performance and consequently balance between aims and results is lost (Fig. 8). What are solutions for creating psychologically cosy indoor and creation of outdoors under intensive interspatial communication conditions, considering the regional and ethnic peculiarities of Latvia.

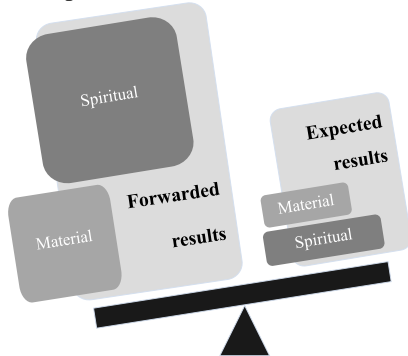


Fig. 8. Basis of artificially created environmental harmony is compliance of expected results with forwarded aims which are brought as close as possible to the objective ones [Source: scheme by author, 2015]

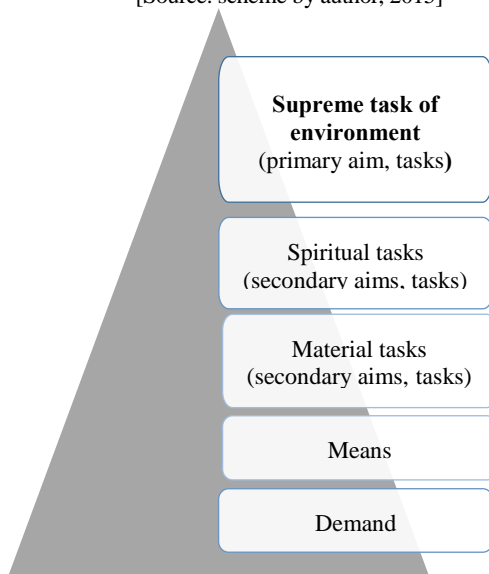


Fig. 9. Subordination of indoor/outdoor aspects as the main condition for creating a harmonious environment [Source: scheme created by author, 2015]

Summarising conclusions on environmental harmony in functionally different objects and their groups in Latvia, in all successful examples one may notice the same principle: the decisive role of value subordination in reaching harmony in environment design, balance between the spiritual and the material (Fig. 9). It is crucial not to lose the initial supreme task during the complicated and time-consuming designing and implementation process, subordinating secondary tasks of a spiritual and material nature in a proper order. Correctly used means serving to achieve goals, without mixing them up, ensure necessary harmony in environment design in Latvia today. At the same time by putting forward tasks and objectives of designing, one must still hold on the well started work of designer and administrative structures - by involving multifaceted public opinion more efficiently and paying a due respect to it. Thanks to the successful foreign experience and possibilities to integrate its instruments in Latvian situation, which is reflected, for instance, by newly finished study of I. Paklone about visual depiction in spatial planning in Latvia, the quality of communication for our country might see considerable improvements. Research also provides ground for improvements in current education system by introducing respective subjects in programs for new specialists [25]. If public communication, being a milestone of harmonious environment design, improves, one can expect proportionally better outdoor/indoor harmony.

Conclusions

When collecting the most significant facts from the metal/glass history, its impact on architecture and environment in relation to the time period, it was concluded that one can observe a steeply rising curve at a global scale. In presence of geometrically increasing importance and application of glass panels in architecture due to constant development of science and technologies, one can expect rapid upgrade of dialectics of outdoor/indoor dialogue more in terms of quality rather than quantity, searching for the key of harmony in front of doors of new challenges.

During the analysis of impact of glass application on environment quality in present-day Latvia one has to conclude that selection of appropriate means for outdoor/indoor communication plays a major role in achieving secondary objectives - in more suitable time the most efficient application of glass in architecture in each particular object promotes harmonious outdoor/indoor communication.

Gathering previously drawn conclusions about environmental harmony in objects and their groups

with diverse functionality, it was established that value subordination play a decisive role in achieving harmony in environmental design - secondary tasks of spiritual and material character are subordinated to the supreme task in a proper order. At the same time by putting forward tasks and objectives of designing, one must still hold on the well started work of designer and administrative structures - by involving multifaceted public opinion more efficiently and paying a due respect to it. If communication of public with designers

and administrative structure employees, being a milestone of harmonious environmental design, improved, outdoor/indoor harmony would proportionally become better. In order to foster quality of harmonious and high-value environment one must invest resources also in educational field; it will become a reflection of inner conflicts of a new concept of space, continue historic process of architectural development and introduce diverse approaches to harmonise indoor/outdoor space.

References

1. **Alle, E.** *Mūsdienu māksla Latvijas kultūrainavā* [online 19.08.2013]. Promocijas darbs Arhitektūras doktora (Dr.arch.) zinātniskā grāda iegūšanai ainavu arhitektūras apakšnozarē. http://lufb.llu.lv/promoc_darbi.html?i=promoc_darbi_freims.html&c=Alle
2. **Balode, L.** Rehabilitative landscape in the urban environment. *Landscape Architecture and Art*. Jelgava: Scientific Journal of the Latvia University of Agriculture, 2014. V 5, p. 75-87.
3. **Balode, L., Grietēna, A.** Harmony of Rehabilitation Garden, Architecture and Interiors in the Brukna Manor Complex after the Funktional Transformation in the 21st Century. *Landscape Architecture and Art*, Jelgava: Scientific Journal of the Latvia University of Agriculture, 2014. V 4, p. 17-31.
4. **Briņķis, J., Buka O.** *Pilsētu un lauku apdzīvotu vietu kompleksu arhitektoniski telpiskā plānošana*. Rīga: RTU, 2006. 166-194. lpp.
5. **Briņķis, J., Buka O.** *Reģionālā attīstība un prognostika pilsētplānošanas kontekstā*. Rīga: RTU, 2008. 108.-123. lpp.
6. **Briņķis, J.** Reģionālās attīstības arhitektoniski telpiskie aspekti. *Arhitektūra un pilsētplānošana*. Rīga, RTU, 2007/10-1. 101-109. lpp.
7. **Čaklais, M.** *Gaismas kungs jeb sāga par Gunaru Birkertu*. Rīga: Pētergailis, 2002. 258 lpp.
8. **Dripe, J.** Aiz kalniem un pilīm ir arhitektūra. *Latvijas arhitektūra*, 2014. Burtnīca nr.115, 14-32. lpp.
9. **Dripe, J.** Gunārs Birkerts. *Latvijas arhitektūra*, 2014. Burtnīca nr.115, 12-13. lpp.
10. **Dripe, J.** *Latvijas arhitektūra 1991-2011*. Rīga: Jumava, 2012. 317 lpp.
11. **Dripe, J.** Tonālā disciplīna un elegantā vienkāršība. *Latvijas arhitektūra*, 2012/2013. Burtnīca nr. 104, 8-9. lpp.
12. **Geldofs, M. J. P. G.** Publiskās telpas mainīgā nozīme vēstures gaitā. *Latvijas arhitektūra*, 2009. Burtnīca nr. 83, 12-16. lpp.
13. **Godjevac, I.** Die Farbe im Bauen - einige kultur - und architekturhistorische Anmerkungen. Dissertation, 2010. Wien: Technische Universität Wien, S. 10-236.
14. **Goethe, J.** Theory of Colours. 1810, paragraph #50
15. **Grietēna, A.** Harmony in Indoor / Outdoor Context in the Architecture of 21st Century Schools. *Landscape Architecture and Art*, 2013. V 3, p. 52-61.
16. **Grietēna, A.** Study of Harmony in the Indoor / Outdoor Context of Architecture from G. Birkerts at the new building National Library of Latvia. *Landscape Architecture and Art*, 2014. V 5, p. 48-57.
17. **Grietēna, A.** Study of harmony in the indoor/outdoor context of architecture of the 21st century of Catholic church in Latvia. *Science – Future of Lithuania*, 2014. 6(3), p. 234-244.
18. **Īle, U.** *Dzīvojamo rajonu iekškvartālu ainaviskā kvalitāte Latvijas pilsētās* [online 10.06.2013]. Promocijas darba kopsavilkums, 2011. Jelgava: LLU, http://lufb.llu.lv/dissertation-summary/landscape-architecture/Una_Ile_promocijas_d_kopsavilkums_2011_LLU_LIF.pdf
19. **Jencks, C.** Architecture becomes music [online 7.12.2013]. *Architectural Review*, May 2013. Vol. 233, p. 91-108. <http://web.ebscohost.com.ezproxy.llu.lv/ehost/detail?vid=5&sid=e7587d84-8bc1-4686-9701-39967f6f6bea5%40sessionmgr114&hid=4212&bdata=JnNpdGU9ZWwhvc3QtbGl2ZQ%3d%3d#db=asu&AN=87467917>
20. **Jencks, C.** God, the Architect of the Universe - Universe, the Architect of God [online 4.12.2013]. *Center: Architecture & Design in America*, 2010. 19 p. <http://web.ebscohost.com.ezproxy.llu.lv/ehost/detail?vid=8&sid=e7587d84-8bc1-4686-970139967f6f6bea5%40sessionmgr114&hid=121&bdata=JnNpdGU9ZWwhvc3QtbGl2ZQ%3d%3d#db=asu&AN=82876453>
21. **Jencks, C.** The New Paradigm in Architecture [online 6.12.2013]. *Architectural Review*, February 2003. Vol. 213, p. 72-77. <http://web.ebscohost.com.ezproxy.llu.lv/ehost/detail?vid=7&sid=e7587d84-8bc1-4686-9701-39967f6f6bea5%40sessionmgr114&hid=121&bdata=JnNpdGU9ZWwhvc3QtbGl2ZQ%3d%3d#db=asu&AN=505047624>
22. **Kimberly, E.** *Geometry of Design. Studies in Proportion and Composition*. Princeton Architectural Press, New York, 2001. 107 p.
23. **Kundziņš, M.** *Dabas formu estētika. Bionika un māksla*. Rīga: Madris, 2008. 168 lpp.
24. **Neufert, A.** *Architects` Data*. Hemden, Connecticut, Arcon books, Printed in Great Britain, 1970. 354 p.
25. **Paklone, I.** *Vizuālais attēlojums Latvijas telpiskajā plānošanā* [online 20.03.2015]. Promocijas darba kopsavilkums. Rīgas Tehniskā Univesitāte, 2015. 110 lpp. http://www.rtu.lv/component?option=com_docman/task/doc_download/gid,12095/ilzes-paklones-darba-kopsavilkums.pdf
26. **Spārītis, O.** Sculpture and environmental design in the cultural landscape of the European countries and Latvia. *Landscape Architecture and Art*. Jelgava: Scientific Journal of the Latvia University of Agriculture, 2013. V 2, p. 30-40.
27. **Strautmanis, I.** *Dialogs ar telpu*. Rīga: Liesma, 1977. 136 lpp.
28. **Strautmanis, I.** *Māksla arhitektūrā*. Rīga: Liesma, 1982. 103 lpp.

29. Treija, S. *Dzīvojamās vides attīstība Rīgā*. Rīga: RTU Izdevniecība, 2006. 22 lpp.
30. Ziemeļniece, A. Context seeking of cultural heritage and green structure in urban environment. *Landscape Architecture and Art*. Jelgava: Scientific Journal of the Latvia University of Agriculture, 2012. V 1, p. 67-73.
31. Ziemeļniece, A. Transformation of the landscape space in the post-war years Jelgava example. *Landscape Architecture and Art*. Jelgava: Scientific Journal of the Latvia University of Agriculture, 2014. V 4, p. 67-75.
32. Zigmunde, D. *Estētiskās kvalitātes kritēriji urbanizētas ainavas izpētē*. Jelgava: LLU Raksti, 2010. 25 (320), 1-12. lpp.
33. Zigmunde, D. *Latvijas urbānās un lauku ainavas estētiskā un ekoloģiskā mijiedarbe*. Promocijas darba kopsavilkums. Jelgava: LLU, 2010. 84 lpp.
34. Большакова, И. Современные проблемы объединения внешних и внутренних пространств [online 10.02.2015]. «Архитектон: известия вузов», сентябрь 2013. № 42-приложение, http://archvuz.ru/2013_22/70
35. Вавилина, Н. Возрождение: вперед в прошлое. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 23. стр.
36. Власов, В. Дизайн - архитектура и 21. Век [online 10.02.2015]. «Архитектон: известия вузов» № 41 март 2013. http://archvuz.ru/2013_1/1
37. Гликин, Я.Д. *Методы архитектурой гармонии*. Стройиздат, Ленинградское отд., 1979. 95 стр.
38. Сатин, М. Пластиковые купола. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 102. стр.
39. Джуха, М. Уроки древней Еллады. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 18-21. стр.
40. Курбатов, А. Эволюция жилища. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 14-16. стр.
41. Лихачева, Л. 777 Чудес света или архитектурный карнавал. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 90-97. стр.
42. Луцк, К. В единении с природой. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 72-75. стр.
43. Новиков, А. Стекло-металлический закат тысячелетия. *Частная архитектура*. Москва: ООО «Фирма «ЛАНС», 1(31)2000. 98-101. стр.
44. ООО «Фирма «ЛАНС», 1(31)2000. 98-101. стр.
45. Швидковский, О.А. Гармония взаимодействия. Стройиздат, 1984. 279 стр.

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Kopsavilkums. Ārtelpas/iekštelpas dialoga intensitāte un apvienošanas tendence arhitektūras vēstures kontekstā strauji evolucionējusi, pateicoties tehnoloģiju sasniegumiem – stikloto plakņu plašajam pielietojumam arhitektūrā, bet vides kvalitāte, kas izpaužas kā harmonija, uzrāda spontānu gadījuma raksturu. Realitāte atklāj nobriedušu vajadzību – atjaunot vides viengabalainību, veselumu un harmoniju, meklējot līdzsvaru starptelpu dialogā un ceļu uz harmoniju šajā komplicētajā sistēmā. Tas rada vajadzību pēc zinātniski pamatotu mehānismu radīšanas, lai varētu regulēt šos procesus kompleksā ar mākslinieciskiem un harmonisku telpisku struktūru plānošanas uzdevumiem.

Pētījuma mērķis ir analizēt stiklu kā vadošo komunikācijas līdzekli, tā ietekmi uz ārtelpas/iekštelpas harmoniju atkarībā no tā pielietojuma veida. Šajā rakstā ietvertais pētījums ir integrēts plašākā pētījumā par vides harmoniju kā daļu no tā. Stikla pielietojumam arhitektūras vēsturē izpētei tika lietotas empīriskās un teorētiskās metodes. Galvenā metode konkrētajā etapā - teorētiskā salīdzinošā, kas izpaužas kā informatīvā un arhivārā. Analītiskajā vispārinājuma fāzē ar induktīvās izziņas metodi noteikti prioritārie faktori ārtelpas/iekštelpas harmonijai. Apkopojot nozīmīgākos faktus metāla/stikla tehnoloģiju vēsturē un tās ietekmi uz arhitektūru un vidi attiecībā pret laika nogriezni, secināts, ka novērojama strauji augšupkāpjoša līkne globālā mērogā. Strauji pieaugot stiklotu plakņu pielietojumam un nozīmei arhitektūrā, ārtelpas/iekštelpas dialoga dialektikā turpmāk sagaidāms straujš kāpums ne vairs kvantitātes, bet kvalitātes ziņā, kas meklē harmonijas atslēgas jauno izaicinājumu durvju priekšā.

Analizējot stikla pielietojuma ietekmi uz vides kvalitāti mūsdienu Latvijas apstākļos, secināts, ka attiecīgu līdzekļu izvēlei ārtelpas/iekštelpas komunikācijā ir noteicošā loma sekundāro mērķu sasniegšanā – ne tikai funkcionāli ētiskie (sabiedriskais viedoklis) un estētiskie (stiklojuma kompozīcija, proporcijas) apsvērumi, bet arī piemērotākā stiklojuma efektīvākais pielietojums arhitektūrā katrā konkrētā objektā veicina harmonisku ārtelpas/iekštelpas komunikāciju. Analizējot līdzšinējos veiksmes un neveiksmes piemērus atjaunotās Latvijas sabiedriski jūtīgāko objektu arhitektūrā, iegūta arhitektūras teorijā un praksē pielietojama vadlīniju subordinācijas piramīda, kas sniedz atbalstu harmoniskas arhitektoniskas vides veidošanā. Secināts, ka tieši vērtību subordinācijai ir izšķirošā nozīme harmonijas sasniegšanai vides veidošanas mākslā - augstākajam virszudējumam pakārtojot garīga un materiāla rakstura apakšzudējumus attiecīgā secībā. Savukārt izvirzot projektēšanas mērķus un uzdevumus, jāturpina labi iesāktais projektētāju un pārvalžu struktūru darbs vides veidošanā intensīvāk iesaistot un respektējot sabiedrības daudzšķautņaino viedokli. Ja uzlabosies sabiedrības komunikācija ar projektētājiem un pārvalžu struktūru darbiniekiem, kas ir viens no harmoniskas vides veidošanas stūrakmeņiem, proporcionāli uzlabosies arī ārtelpas/iekštelpas harmonija.