

## INTERACTIVE ADAPTIVITY IN ARCHITECTURAL DESIGN

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### ABSTRACT

In architectural design, flexibility may be introduced at typology level aiming at providing adaptivity and interactivity according to the changing needs and activities of the users. In this framework, adaptive architecture derives from transformations of architectural elements in enabling separation, visual connections and unification of spaces. Adaptivity is provided at tectonic level through appropriate integration of modular units and architectural elements for enabling changeability and transformability. Interactivity refers primarily to the activities and experience of the users within the spaces, based on their visual and physical boundaries. The introduction of interactive adaptivity in architectural design is discussed based on three examples of architectural proposals made by the authors in the frame of respective European architectural competitions. The example of a university students hall traces adaptivity through the definition of an open atrium surrounded by the public and private spaces of the multistorey building complex. Interactivity derives from the visual and physical correlations of the spaces and their external circulation zones with the atrium. The example of an extension of a public primary school and a new kindergarten features an interactive adaptivity through the optical correlations of the classrooms with the open spaces and the possible unification of the interior spaces with the open playground. The

example of a multipurpose cultural center of a municipality, features adaptivity through the interconnection of the primary spaces over an open garden that acts as a connecting point of reference for all spaces of the building complex. The examples analysis demonstrates that interactive adaptivity of the spaces counteracts the traditional static nature of a building and influences the experience levels of the users while accommodating daily activity and change at different rates, scales and types that take place.

### KEYWORDS

Architectural design; adaptive architecture; interactive architecture

### 1. INTRODUCTION

Adaptive, changeable buildings and spaces have been present for Centuries in building traditions of different cultures internationally. Most representative examples constitute traditional Japanese and Korean dwellings that consist of interchangeable spaces in their function. This feature is primarily enabled through a high degree of flexibility on the size of the spaces, for example by using openings through sliding partitions that separate adjacent spaces, for the interconnection or separation of environments of different

nature and activities. In contemporary means, flexibility in the spatial organization of buildings was introduced through industrialization, mass-production and modularity of the architectural elements, while also aiming at providing adaptivity to the users. The building was envisioned to respond to the activities and needs of the users through manual or automated changes in the architectural layout (Moneo, 1978). Thus, adaptivity in the architectural design of a building referred to its ability to alter its physical properties (form, shape, divisions, porosity etc.) in a predefined/programmed/ designed way to adapt to changing user activities and needs, external and internal environmental stimuli (environmental related criteria of thermal comfort, wind, sound, solar radiation, etc.) and social contexts (Orhon, 2016). By extension, the integration of interactivity in architectural design offers the potential to enhance the experience of the building through development of different uses and activities within the interior and exterior environment, as well as the quality of the spaces according to the time-dependent changing requirements by the users (Phocas, 2017).

In the 1960s, experimental architecture referred to an architecture that was fluid, flexible and responsive. Principles of an industrialized planning were applied, whereas the building product was hierarchically organized with regard to the primary structure and the architectural elements that could be freely arranged in relation to the former. In particular, the space frames explored by Eckhard Schulze-Fielitz and Yona Friedman followed these architectural design principles. Central to the concept was the realization that architecture form is an evolving process, using a set of interchangeable, integrated components. Architectural elements could be added together in alternative combinations, interchanged and replaced by improved components. The latter allowed the introduction of new products through a

constantly evolving technology. Therefore, the building form could evolve as the functional requirements changed, and at the same time, new technological and design developments could be employed. Representative examples are the Raumstadt project by Eckhard Schulze-Fielitz in 1959, a space truss system that allowed different formations to be manually configured by the users through modular, assembled and changeable spaces (Banham, 2020), and the Fun Palace by Cedric Price proposed in 1964, that was based on interiors that could be reconfigured and redeployed based on the needs of the users in real time (Kolarevic and Parlac, 2015). Along these lines, the T.E.S.T. (Team for Experimental Systems and building Techniques) open system developed by Helmut C. Schulitz in 1974, was based on architectural elements already available in the market in support of the users in a choice and planning of the built-in elements.

Recent built examples featuring adaptivity in their architecture for the enhancement of interactivity by the users and different environments refer to an architectural element or even spaces scale (Kolarevic and Parlac, 2015). The Sliding House in Suffolk, UK, designed by dRMM in 2009, features an enclosure that can move along recessed tracks to cover or uncover different buildings along its linear path: the house, the garage, or the annex (Janowski, 2021). The Shed at new Hudson Yards in New York, USA, designed by Diller Scofidio and Renfro in 2019, houses in eight storeys, exhibition, educational and event spaces that are flexibly programmable using a kinetic building envelope (Akgün et al., 2022). A 35 m high building envelope can be freely extended and retracted, transforming the program of spaces from a multistorey art space to a public outdoor plaza. Furthermore, the building may respond to future requirements that may go beyond its actual purpose, even accommodating the changing requirements of the urban space. The Living room House in Gelnhausen in Frankfurt, Germany, designed

by Formalhaut in 2011, features a bedroom that can be shifted out of the main building volume and cantilever over the street below (Schnädelbach, 2010). The Sharifi-ha House in Tehran, Iran, designed by Nextoffice in 2013, features enclosed wood-clad room boxes that can be rotated independently of each other out of the facade by 90° to increase the amount of living space by up to 20 m<sup>2</sup> per box and to expose or protect the interior from the seasonal weather (Taghaboni, 2014).

Reflecting on possible forms of adaptivity in architectural design for the enhancement of interactivity in the users' activities and experience within the spaces, based on their visual and physical boundaries, three design examples of architectural proposals made by the authors in the frame of respective European architectural competitions will be displayed in the current paper. The examples refer to different building scales, spatial composition, functions and rates of connectivity. They advocate an architectural unfolding with features of adaptivity, transformation, mobility, expansion and interaction.

## 2. THE OPEN ATRIUM AS CONNECTIVITY SPACE

The design proposal for the student halls of Cyprus University of Technology refers to the duality of the communal and private life in the building complex. The complex houses in three multistorey building blocks, public, collective and private residence spaces (fig. 1). The student halls are perceived as a 'container of human life' that is formulated in an introverted arrangement of the interior spaces and an interconnecting atrium in conveying the feeling of community, family and belonging. Within this container, three main spatial functions are knitted: posture, movement and viewing. In this framework, circulation paths develop within the atrium that relates to a variety of spaces for meeting and socializing. Thus, the design traces adaptivity through the definition of the open atrium surrounded by the public and private spaces of the buildings. Interactivity derives from the visual and physical correlations of the spaces and their external circulation zones with the atrium.



Figure 1. Perspective view of Student Halls of Cyprus University of Technology. Source: (Authors 2020)

The complex is organized in three building-communities with spaces designed to accommodate every gradation of social life from all the tenants to the isolated private life. The three building blocks, despite the morphological distinction of the eastern one which functions as the main entrance, have a similar structure and volume with the main characteristic being the atrium and the organization of functions and residences around it. The ground floor has a more shared private and public function (fig. 2). The eastern building block also functions as a reception/main entrance to the complex, marked by a public square that brings together collective functions for all tenants. The atrium with greenery and monastic contemplation comprises the cell of each community, while the southern green zone acts as an open extension of the life of the atrium.

The main corridor running through the complex essentially connects the main to the secondary entrance, at the northern boundary of the complex. On the corridor are the entrances of the three building blocks and their main vertical movements. A series of secondary vertical movements served by stairs visible through the atrium intensifies the possibility for encounters and socializing. All vertical movements are connected by perimeter corridors of variable width to create

small standing areas for outdoor relaxation according to the scale of social gathering and intercourse favored. The large semi-open spaces/pilotis around the atrium are addressed to all the members of each building community, as are the roof gardens on the southern facades overlooking the horizon.

The rooms are organized in unities of mainly six to eight units with a shared kitchen, living room and semi-outdoor space. They consist of independent prefabricated structural units in timber that are supported on the primary structure of the building block acting as sub-support. They are mainly positioned on the floors, with a small number located on the ground floor of the southern facades, to maintain life and the human presence near the gardens and the large common areas. Internal movement in the room units succeeds in a way that ensures their privacy and autonomy. The widening of the corridors on the floors accommodates concourses on each level. The semi-outdoor spaces/terraces of the kitchens serve as private spaces for each unit of rooms. Therefore, the articulation between private and non-private communal spaces primarily succeeds through the definition of the in-between spaces to the atrium based on the autonomous room units, their envelope and the spatial organization of the atrium itself (fig. 3).



Figure 2. Ground floor plan of the building complex. Source: (Authors 2020)



Figure 3. Perspective views showing the spaces-atrium interactivity. Source: (Authors 2020)

### 3. THE OPEN PLAYGROUND AS EXTENSION SPACE

The design proposal for the extension of the new Eleneion public kindergarten in the center of Nicosia refers to the development of additional classrooms to an existing public primary school, a kindergarten and two courts for different sport activities of the students. The design approach is based on the spatial dimension of a stone-built, historical, preserved school building, integrated on the north side of the plot, and on the development of a unified environment for teaching and learning, education,

socialization and training through the required extension. This unified environment is provided through a rational arrangement of the functional spaces required, which favor corresponding visual, partly functional interconnection, interaction and coexistence (fig. 4). The unified configuration of the built and surrounding spaces is achieved primarily based on functional criteria and enables the independent and autonomous exercise of the various activities, responding to different nature and ages within the school complex. In all cases, it allows continuous expansion and visual connection with the historical preserved building.



Figure 4. Perspective view of the extension of the New Eleneion Public Kindergarten. Source: (Authors 2024)

The kindergarten and the primary school are housed within a single building volume of two levels west of the plot (fig. 5). The building sector of the kindergarten with a transparent façade of the classrooms facing the playground, is integrated on the ground floor, southwest of the building block, the primary school, on the 1st level of the building volume, on the western side of the block and a restaurant with two catering rooms for the students of the kindergarten and primary school respectively and shared food preparation area, on the ground floor on the northwest side of the block. The sports infrastructure of the school complex refers to a versatile basket/volley court and a futsal court, which are vertically integrated on two levels opposite the building block, east of the plot. In addition, a canteen and sanitary areas are housed in a morphologically and tectonically

autonomous building, placed on the ground floor on the north transverse side of the courts.

The outdoor activity area extends to the central zone of the plot, between the schools and the courts. It comprises an extension of the historical, preserved school building. The outdoor space serves the free activities of the primary school and kindergarten students, while at the same time it is a natural extension of the vertical transparent boundaries of the kindergarten classrooms and the restaurant. The outdoor space is divided into two parts by means of permanent fencing on either side of the horizontal level connecting the primary school with the futsal court on the 1st level. In this way the design features an interactive adaptivity through continuous optical correlations of the functional spaces with the open spaces and their actual unification on the ground floor (fig. 6).

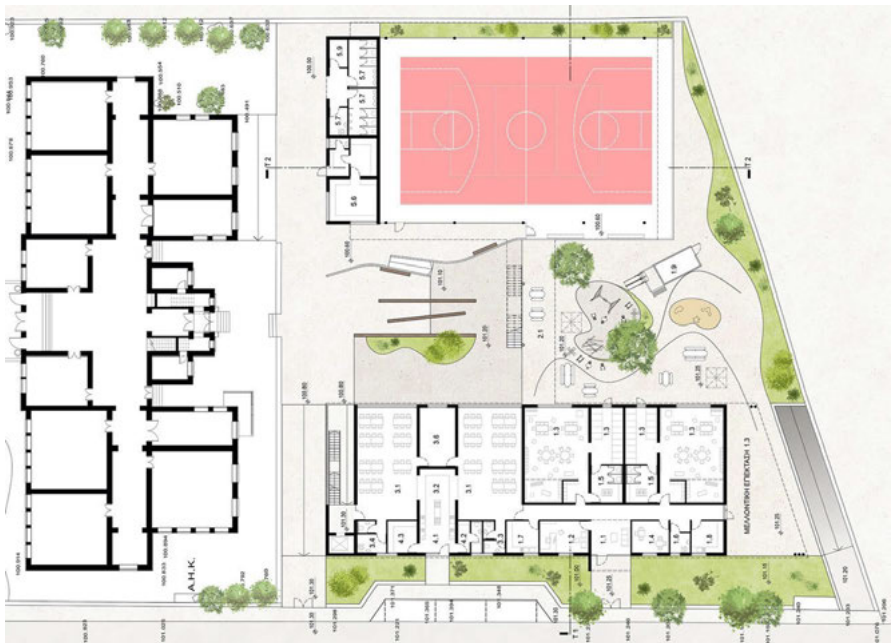


Figure 5. Ground floor plan of the primary school extension. Source: (Authors 2024)



Figure 6. Perspective view of the playground between the building block of the primary school, kindergarten and restaurant and the courts. Source: (Authors 2024)

#### 4. THE INNER GARDEN AS CORE SPACE

The multipurpose cultural center of Morphou municipality in Nicosia refers to a building complex that houses public spaces for a city that has been occupied on the north of the island since the Turkish invasion, fifty years ago (fig. 7). The built spaces, the garden with the orange trees and an open access corridor comprise the main elements of the design reviving the personal memory that keeps active within one, from individual images alternating focus and from individual experiences of an abstract framework of memory of the city and its specific environment. The users are confronted to the surrounding natural and built space through an abstractness and generalization of feelings that derive mainly from physical contacts with the people and the environment, which cultivate the anthropocentric dimension and perception of individual moments in the specific space. The design proposal aims at decoding these aspects of human memory.

Three distinct building volumes house all functional spaces of the cultural center, namely

the entrance, exhibition space, office spaces and event hall. These are arranged around the perimeter of an 'inner' garden. The building volumes provide the possibility, through their geometry and envelope, to connect and separate their internal autonomous functions from the surrounding garden. The tree-planted garden acts as a connecting functional element of the building volumes of the complex, for unifying, accessing the spaces and extending the urban boundaries of the public space. It acts as the core of the complex imparting a feeling of interpersonal and social coexistence to the users and visitors of the center. The path to the entrance of the cultural center is developed through a covered ramp, which is a free access element integrated between the garden and the public road network. It marks the entrance to the cultural center, at the same time uniting the two main compositional levels of the ground floor spaces, entrance-exhibition and event hall. The ramp and the garden regulate the cohesion of the urban fabric and the complex by offering a visitor experience of flow-movement-stop and access within and outside the public space.



Figure 7. Perspective view of the multipurpose cultural center of Morphou municipality. Source: (Authors 2012)

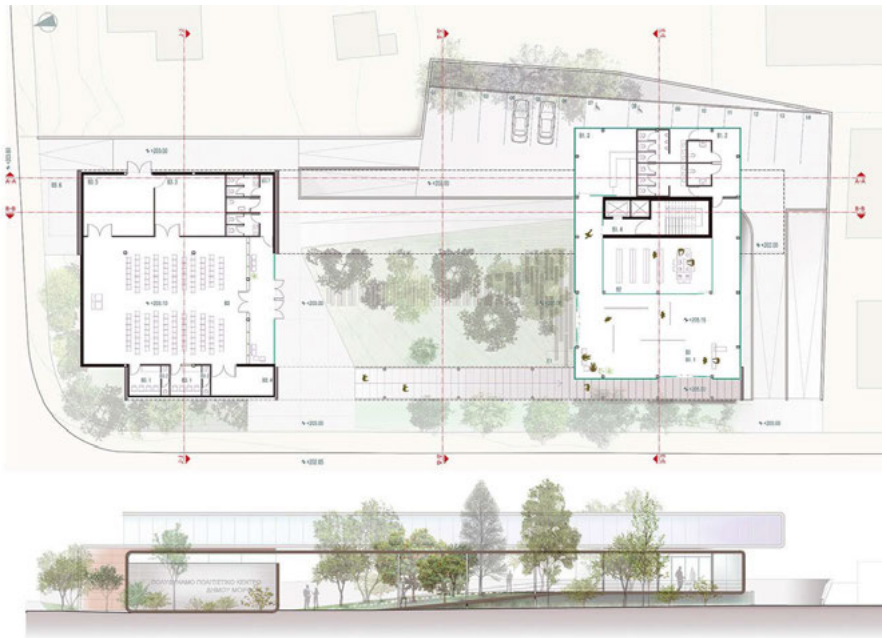


Figure 8. Ground floor plan and longitudinal section of the building complex. Source: (Authors 2012)



Figure 9. Perspective view of the inner garden. Source: (Authors 2012)

The proposed architecture creates, instead of a self-projection of the built in a manifest natural space, a platform for living a memory, promoting in a harmonious way the regeneration and use of the natural space together with the built. The legibility of the building volumes is achieved in an aesthetically unified and functionally flexible building complex. All functional areas are interconnected with and through the garden. The functional correlation and interaction of the inner and outer spaces favors time-regulated operating conditions of the interior spaces, together or separately.

## 5. CONCLUSION

Adaptivity in architectural design refers to the spatial organization of the building to

enable a certain degree of flexibility of the boundaries of individual spaces and/or their envelope, so that different activities and experiences by the users become possible. By extension, interactivity throughout the building operation gains significance. Three design examples presented in the current paper deal with aspects of interactive adaptivity in design, based on corresponding design principles and interrelations developed between the private and public spaces with the natural environment. The specific role given to the natural environment, i.e., as connectivity, extension and core space, enables the conception of the built product as a transformable living space according to the time-dependent usage of the building.

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