

## Restoration characteristics of the internal healing environments: The specialty of visually extended space neighboring multi-story housing



Rawan Hasan Abdulrazaq\*, Ghada M. Younis

Department of Architecture, College of Engineering, University of Mosul, Mosul, Iraq

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### ABSTRACT

The concept of restoration is linked to the objectives achieved by the design characteristics of the internal space that support users' physical and mental health in recovery, improvement, vitality in performance, and stimulation of activity. The research addressed the design characteristics that give restoration features to the internal spaces as a design strategy to support the health of the individuals, that by adopting one of those characteristics which are the visually extended views neighboring, which is required for multi-story housing buildings through the views achieved by the permeability of the residential unit with the neighboring nature. The research, in its methodology, relied on getting a theoretical framework for the main items of the characteristics of the restoration spaces through the direct and indirect impact on the physical, mental and psychological health of the residents. The objectives of the research are concerned with discovering the impact of visual extended factors achieved by the external boundaries of the residential unit on its natural surroundings, a selected sample of 10 housing projects in Erbil/Iraq was measured. The research hypothesis was tested using Isovist-graph software for one of the comprehensive visual characteristics of the optical axes (Entropy), which determines the amount of comprehensive information about the internal spaces that can be known from the point of entry. The conclusion is the impact of the visual depth on the formation of axes of the visual extended that is held by a relationship of the external natural boundaries of the residential unit, and therefore the diversity in the visual characteristics of the spaces extending outside, which give the renewal and vitality to the spaces used.

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### 1. Introduction

The basic task of restoring the environment is its potential to support improvement and well-being in humans, as well as to reduce mental fatigue and improve individual productivity. Moreover, it reduces stress resulting from its interaction with the concrete or urban environment (Korpela, 1991). Other terms can be used, they describe the meaning of a renewal environment, such as hospitalization, care, integration, revitalization, and renewal, and they are very close to the process of de-stress (Ulrich et al., 1991). In addition, the restoring environment contributes to supporting the human self-potential for restoration and recovery of his/her physical,

psychological, and social capabilities (Hartig, 2004). Many natural environment patterns directly support and enhance the renovating process of those individuals' potential, and closed indoor environments can achieve the same goal if designed accurately, yet, the individual may often feel that the concrete environment stopped to pay attention and offer support. In addition, the renovated environments, in other words, seek to challenge finding compatibility of all the requirements and regulations of the concrete environment to reach a final product that is compatible with all, as the restoring qualities of the environment are often left without priority in the requirements of design and the result is that our environments can be more harmful to our health (Nousiainen et al., 2016). The human being distanced themselves from nature in recent decades due to technological and informational development and rapid population growth, as the individual spends most of their day in closed and neutral indoor environments that rarely support improvements, and many children spend

\* Corresponding Author.

Email Address: [rahawsan92@gmail.com](mailto:rahawsan92@gmail.com) (R. H. Abdulrazaq)

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Corresponding author's ORCID profile:

<https://orcid.org/0000-0001-9116-6636>

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less time outdoors than their parents did in their childhood (Kellert et al., 2011). The living environment with its characteristics and capabilities has a great impact on the overall mechanisms of improvement and well-being even for ordinary people, as individuals actually spend about 90% of their day indoors, and instead of adopting the feature of diversity and renewal in building designs, space design is usually directed to other factors such as performance, efficiency, and cost, so the design must take into account the use of space and his/her needs. What is often ignored is the extent to which the living environment affects mood, health, and behavior, as it can have a positive impact through assistance and support in adding improvement, recovery, and well-being factors. What's important here is understanding how can the environment negatively affect us? This may be illustrated through many side effects such as increased depression, the use of painkillers, and prolonged recovery time. Architects as designers of life environments bear a great responsibility in all options made in the designs of indoor environments, as materials, lighting, shapes, and colors affect individuals in forming their spatial practice (Nousiainen et al., 2016). It is clear from the previous studies that the concept of restoration depended on most of the design characteristics of the interior spaces, whether the formal, structural, or sensory elements, but they did not address the restoration resulting from the visual structure of internal space, that is, the visual axes and their relationship to the visual extension of outdoor and neighboring, it is one of the most important supporting factors, visual restoration resulting from the diversity in the possible visual views, and consequently the sensory and psychological renewal of the occupying individual.

## 2. Restoration

### 2.1. The definition of restoration

Hartig (2004) introduced a widely accepted definition of restoration concept as "the process of renovating, restoring or recreating the physical, psychological and social capabilities of the individual, which diminished in the continuous stress of interaction and to meet the requirements for adapting with the environment." This term is used to express a variety of processes through which individuals recover or renovate physiological, psychological, and social resources that serve as adaptive capabilities they use to meet the requirements of normal life. Physiological resources include the ability to concentrate physical energy for work that needs certain requirements, whether it is very difficult, such as when speeding up catching the bus, or perseverance and prolongation, as when working hard for a long time to meet the task deadline, whereas psychological resources include the ability to maintain the necessary focus for some daily tasks, even when noise or other distractions reduce that focus. Social resources include various

forms of assistance or support provided by family, friends, at home, co-workers, or anywhere else, because when an individual exhausts all those different resources in meeting daily demands, there emerges a need for restoration and recovery regularly. An individual must ensure sufficient possibilities for restoration or no risk in getting the capacity to meet these demands. As time passes, the lack of adequate restoration can be reflected in mental and physical health problems (Hartig, 2007).

To determine the specifications of the restored environment, it can be said that it must meet two basic requirements, the first one: is that the environment helps restoration by making the individual, during his/her presence in a certain environment, relatively free from the needs and requirements that demand self-restoration, and the second one: is that the environment encourages restoration, as some environments may contain certain features and provide activities and events that attract and draw attention and pull the individual's thoughts away from the needs and requirements that are formed when he is in that environment, and these features and activities can lead the person to a continuous restoring experience and prolong their impact. The presence of these positive features and the absence of negative features lies behind the definition of the "restoring environment" as an environment that promotes periodic restoration rather than merely allowing it (Lindal and Hartig, 2013).

The new conventional definition of restoration: the term restoration according to Cambridge Dictionary is defined as any act or process to restore the object to its previous good state or condition, is the act of restoration, revival, and reforming, which is the renovation of a building, a work of art, and etc. to its original state according to Oxford Dictionary. The term restoration in the Arabic language, is related to ideas or things, and restoration, as the term, is the human effectiveness whose source is the individual and society, and restoration means to the situation of inactivity, immobility, and stability, and seeking development, growth and intellectual and practical change, in addition to the use of all means available in various related areas of life. The related terms are recovery, revival renewal, reclamation, rehabilitation, renovation, rebuilding, refurbishment, and repair. The procedural definition of restoration: is the traits (features) of restoration achieved by the characteristics of the interior space design of the user in order to support his physical and mental health in well-being, improvement, and vitality in performance and stimulation of activity.

### 2.2. The theoretical frameworks of restoration

Both the Kaplan and Kaplan (1989) art and the physiological and psychological conceptual framework of stress reduction theory Ulrich et al. (1991) SRT dominate the prospects for restoration in environmental psychology. These theories differ in focusing on emotional and physiological factors

and attention to their specifications in both previous and restoration situations. In short, the conceptual framework for reducing stress assumes that the initial state of psychophysiological stress, which is defined as an emotional, physiological and behavioral response to a situation in which existence is threatened, may result in the consequences of this stress in the form of negative emotions and involuntary arousal. The process of restoration occurs when the visual confrontation with a scene or place which have certain characteristics, such as natural elements, moderate complexity, or the presence of a focal point, as the realization of these characteristics leads to a shift towards a more harmonious and positive emotional situations, as well as reduces activity in different physiological systems, provokes constant attention and prevents negative feelings and ideas (Korpela and Hartig, 1996). On the other hand, the theory of attention restoration assumes that the initial state of oriented-attention fatigue, which occurs with any prolonged mental effort that requires the continuous exercise of the inhibitory the mechanism necessary to make oriented attention possible, is among the negative natural consequences of oriented-attention fatigue are irritability, inability to plan, reduced sensitivity to self-signals, and increased possibility of performance errors.

Kaplan and Kaplan (1989) indicated in most of their research that spending time in nature can treat rational or mental fatigue quickly, as they have created an important distinction between concrete environments and natural environments and the requirements for sensational perception and concentration of each one of them. According to their theory, the urban city environment generates mental fatigue, because it requires the individual to continue to focus and recognize directly, and for a short period, the exhaustion happens to the ability to focus and pay attention (Bringslimark et al., 2009). This exhaustion can be due to exposure to traffic, advertising, over-seen information, and other life activities. Mental fatigue appears in the form of difficulties in concentration, stress, negative feelings, irritability, hesitation, impatience, self-inertia, and psychological harm. ART theory indicates that natural and restored environments can help us live away from this fatigue and provide comfort and relaxation because nature attracts our attention more accurately and seeing nature does not require any mental intersections or direct focus, they are at their best free of worries, comfortable and wonderful when we see the movements of nature, such as the rustle of leaves in the wind or the movement of the surface of the water, our minds calm down and settle down. Supporting nature is particularly important in healthy, developing, and educational environments, such as hospitals and schools, where individuals are often more responsive (Nousiainen et al., 2016).

Other differences between SRT stress reduction theory and ART attention-restoration theory are related to the duration of the restoration process, the

field, depth, and continuity of effects, as the approach to reduce physiological and psychological stress emphasizes the first moments of confrontation with the aesthetically exhilarating landscape (Ulrich et al., 1991) and the possible long-term effects of such confrontation (Parsons et al., 1998). In contrast, the theory of restored attention allows for a possibly long period in restored practice, so that a person can pass through successive levels (Kaplan and Kaplan, 1989). The first level involves "mind cleaning." The second is to restore the ability to pay oriented attention and the third requires facing the accumulated things in one's mind, the fourth one is to think about one's priorities, prospects, actions, and goals in life. Penetrating these successive levels requires an increase in the time and intensity of factors that are believed to be working in the restoration experiment. Thus, this theory describes a wide time scale through which the process of restoration and its effects can be seen (Korpela and Hartig, 1996).

### 2.3. Concept of health

The World Health Organization (WHO, 1948) defined health as "a state of complete physical, mental and social improvement, not just the absence of illness or disability." This widely spread definition seems utopian and unrealistic, but it refers to key aspects by taking into account the physical, mental and social situation of the person, as this definition confirms other dimensions of health as multidimensional and calls for thinking about how to obtain health from the interaction of multiple factors, through drawing attention to improvement or wellbeing. Subjective aspects of health must be seen, because improvement has an important personal aspect representing the individual's dealing with his/her surroundings, i.e. determining how psychological, social, and cultural factors can come to work on chronic ill health or how to maintain good health under extremely difficult and exhausting conditions. The definition of the World Health Organization emphasizes decreasing the importance of the idea that health includes the absence of pathological symptoms only and the importance of adopting preventive and curative measures accompanying the usual conditions of the individual. Healing design as a strategy of the design process could be achieved or based on three design strategies: 1) supporting strategies that use specific elements to reinforce physical health, vital life energy, and psychological well-being; 2) balancing strategies that are oriented toward harmonizing those elements; and 3) nourishing strategies that address emotions, spiritual life, and the soul (Younis, 2021).

### 3. Previous studies (hypothetical framework)

Many theoretical theses and studies of the concept of the restored environment and restoration were associated with the conceptual relationship

between biophilic design on one hand and Evidence-based Design on the other, and about sustainability, the concept is represented in living features of the internal environment and aspects of hospitalization and wellbeing, i.e. the restored design is the link between them. Some studies have taken the concept of restoration from the perspective of biophilic design (human relationship to nature), while other studies took the concept of restoration from the perspective of evidence-based design (environmental adaptation), and the following is a review of the most important of these studies: [Nousiainen et al. \(2016\)](#) referred to many characteristics of the restored environment that emerge from the will to improve the living environment, through perception and awareness of the details of the delicate environmental conditions, i.e. awareness of where we are. The restoration design is an important equation that combines the responsibility of nature in adding a spirit of restoration with the responsibility of the internal environment in supporting well-being, as the study considers that nature is very accurate and does not need cognitive challenges or concentration in dealing with it, and in its most complex cases, it supports relaxation, psychological comfort, and fascination.

The study also developed cognitive indicators of the restored environment based on two theories that inspired the majority of research on restored environments, one of which is the theory of attention restoration (ART), which is the first way to understand the restored environments and the effects of their stimulating nature, while the other theory is the stress reduction theory (SRT) based on research conducted by [Ulrich et al. \(1991\)](#) as the vision of nature positively affects humans, particularly in stressful situations to human beings. This theory focused primarily on hospital environments, which led significantly to the emergence of EBD evidence-based design, which is a design method for healthcare environments that support and promote improvement for patients. The study considers that the restored environment should support all human senses (vision, hearing, touching, and smelling). The visual environment should be clean, comfortable, harmonious, and enjoyable, and the audible environment should be soft, calm, and enjoyable, the texture of the material should be lovable, warm, and natural, and even the smell must express the cleanliness of the place. One of the most important features for the people who occupy the place is the natural light (daylight) which should be vibrant and naturally changing, creating different atmospheres, colors, and moods, outdoors or indoors. The healthy light is a result of the interaction between daylight and the dynamic artificial or interactive light which increases the pace of recovery of the patients in the hospitalization places ([Nousiainen et al., 2016](#)).

[Stage Linda and van der Berg's \(2012\)](#) study, which is considered one of the most important methodological books in the study of architecture

psychology, indicated that there is growing empirical evidence that contact with nature can provide recovery from stress and mental fatigue, by adopting theoretical concepts of the restoration effects of nature on the path of research of restored environments, i.e. both of (ART and SRT) theories. The study used experimental scales on a specific sample of people represented by both the scale of sensory effects and feelings, the scale of perception and attention and memory tasks, and finally physiological scales (heart rate, blood pressure, skin sensitivity, and cortisol level) as an important tool in determining the general perspective of the restoration effects of architecture as objective and quantitative scales. To further reveal the circumstances and mechanisms behind the practice of the restored environment, the study introduced three experimental curricula ([Stage Linda and van der Berg, 2012](#)):

- Perceptual fluency account.
- Connectedness to nature.
- Micro-restorative experiences and restorative effects.

The first approach (PFA) is based on the phenomenon of cognitive fluency ([Joye, 2007](#)) and aims to find integration for both previous theories, the basic hypothesis of PFA is that natural environments are treated more fluently than urban areas, and this difference in fluency leads to a difference in the restored potential, where it is believed that the extended treatment of nature of stimulants and scenes occurs because the visual part of the brain often controls the way visual information is organized in landscapes than in concrete environments. It is believed that due to so-called resembled or self-resembled patterns, landscapes contain more redundant information than urban scenes, making the former more fluent in processing than the latter. Nature's ability to reduce stress can be explained by increasing the sense of safety or familiarity which is commonly related to the systems of fluent stimulations rather than ineffective systems ([Song and Schwarz, 2009](#)) through the fact that free stimulations demand fewer requirements in cognitive resource than inappropriate ones, leaving more room for attention restoration. The second approach to restoration (association with nature) begins with the observation of people acquiring a goal and meaning in life by feeling that they belong to the natural world, and the feeling of emotional attachment to nature is expected to be an important mechanism behind the restorative effects of nature. The positive effects of direct exposure to nature on positive emotional feelings and the ability to think about the problems of life that have not been solved can be explained in part by increased connectedness to nature through increasing the ability to pay attention, but this cannot interpret the greater positive feelings of participants and their ability to think. The theoretical theses of this approach

provide some of the first empirical evidence of the assumption that an experimental sense of belonging to the natural world plays a role in the experiences of the restorative environment, as well as unconscious cognitive processes (Mayer et al., 2009). The third approach focused on micro-restorative practices resulting from short-term sensory contact with nature, such as through a window, in a book, on television, or in a picture (Kaplan, 2001). These micro-restorative practices accumulated over time may significantly improve people's sense of improvement and provide a barrier against the negative effects of stressful events. An investigative study of nature-based confrontation strategies for primary school teachers suggests that micro-restorative experiences are particularly useful when stress levels are low (Gulwadi, 2006), as teachers who suffered greatly from occupational stress (having to teach in crowded classrooms and under poor working conditions) prefer to go out and live in nature (such as walking in the forest), while those with low levels of occupational stress are found to be able to experience short-term sensory interactions with nearby nature, like listening to the sounds of sparrows. This shows that there is growing evidence that exposure to nature may not only have restorative effects but may also have complex effects on individuals who are not already stressed or exhausted (Hartig, 2007; Stage Linda and van der Berg, 2012).

A study by Lindal and Hartig (2013), which is an important contribution of environmental psychology for the sake of the intelligent pursuit of sustainability through recognizing that sustainability objectives have cultural, social, and psychological aspects as well as environmental aspects, as they reflect smart sustainability scales in the perception that technological solutions can fail if they neglect how individuals behave within the social and cultural context. From this point of view, the study identified two basic perspectives of the concepts associated with restoration:

- First, the perspective is based on human adaptation to the environment, as restoration occurs when the individual recovers the knowledge and social resources drained by adaptation to meet environmental requirements.
- Secondly, the perspective is based on the direct association of the individual's mental health with nature, as restoration occurs in direct association

with nature, which has advantages that enable him/her to recover the necessary resources easily, quickly, and in an integrated way.

Individual adaptation to environmental change has long been paid major attention by the research and theory in environmental psychology and has found this interest objectively reflected through three aspects of environmental survey that are linked respectively to stress, adaptation, and restoration processes, these aspects complete each other and are importantly relevant to the requirements of human adaptation to the environment. The study indicated that environmental stress happens when meeting the demands of the environment that challenge adaptation, as well as changes that occur in people when they confront those demands using the available resources (psychological, social, physical, and other resources that people use when trying to meet the demands imposed by the environment), in addition to the strategies they adopt to use the available resources, periodic restoration happens in confrontation through processes in which people recover knowledge and social resources that had been depleted in their efforts to meet environmental demands, and through the various components of environmental practices that support the recovery of depleted resources (Saegert and Winkel, 1990). The theoretical hypothesis of a stress perspective is that when a person constantly faces heavy demands, adaptation may fail, as reflected, for example, in poor physical or mental health. On the contrary, the theoretical hypothesis of a confrontational perspective is that a person can meet very heavy demands over long periods if he/she has sufficient physical, psychological, material, and social resources. Interventions can also help environmental treatments that make resources more easily available and help people make use of the resources already available for them to maintain adaptation. The concept of restoration here means that a person can enjoy adequate protection of environmental demands using the abundant resources available, yet, he/she still needs to restore periodically in the pursuit of goals and maintain social relationships, and do many activities that add meaning to life and not just survival. Theoretical theses on human adaptation to the environment can be summarized with the associated environmental design approaches (Table 1).

**Table 1:** The most important theses of human adaptation to the environment

	Stress Perspective	Coping Perspective	Restoration Perspective
Theoretical Premise	Heavy demands can undermine adaptation.	Readily available resources support adaptation.	Adaptation requires periodic restoration
Practical Premise	Interventions can eliminate or mitigate demands.	Interventions can enhance the availability of resources.	Interventions can enhance opportunities for restoration
Design Approach	Protective	Instorative	Restorative

(Bringslimark et al., 2009; Hartig, 2007)

As for restoration, it is an entry point to link the life practice of nature and health, interventions based on the trilogy of (tension, overcoming, and

restoration) throughout the long cognitive history and for many societies distinguished nature from the concrete or artificial environment (Hartig, 1993).

People in many places seek to distance themselves from the harsher conditions of the natural environment and the requirements of living outside cities by moving to homes and cities in search of safety, comfort, and jobs that are less vulnerable to the forces of volatile nature, this was a reason to reject the idea that communication with nature promotes health and is most likely a romantic idea, yet we should not ignore the possibility that being in relatively short periods with the most pleasant and not stressful places for the natural world can remain important to improve many people who enjoy the amenities of the urban lifestyle. The importance of contact with nature for cities dwellers comes at least from the support that nature can provide for the self-restoration of individuals, as there is hardly a city without green spaces and even indoor spaces that do not provide visual contact with the outdoors, individuals bring plants and other alternatives to nature as forms of compensation for natural manifestations (Bringslimark et al., 2009). In terms of the environmental requirements for restoration, it can be said that restoration has two basic requirements. The first is that the environment allows for restoration, and it happens while the individual is present in a particular environment in which he/she can be relatively free of the needs and demands that generate the need for self-restoration compared to the previous living space. The second is to encourage the environment to restore, some environments can contain features and provide activities that attract and draw attention, by driving the individual's ideas away from the needs and demands that form when he/she is in that environment, as these features and activities can lead the person to a restorative experience and prolong its impact. The presence of these positive features and the absence of negative ones lies behind the definition of a "restorative environment" as an environment that enhances restoration, not just allowing it (Lindal and Hartig, 2013).

Korpela's (1991) study referred to the mechanisms of merging the concept of the identity of the individual's preferred place with the theories of restorative environments, as the theory and research in the field of architecture, that deals with the identity of the place and the restorative environments continued cumulatively, seemed in the hypothesis that the emotional harmony and self-regularity of the individual are two basic processes to develop his/her sense of the identity of the place and that his favorite place is a model for the environments used in these organizing processes. The study went beyond the adoption of the initial observations of aspects of the restoration of preferred places to look at how individuals evaluate their favorite places using items developed by the theory of restorative environments. The study addressed these concepts with an experimental perspective through which it provided quantitative data for the items of self-regularity of individuals in their self-assessment of the preferred place, which indicates that teenagers use their favorite places to

establish feelings and self-regulation and that individuals often go to their favorite places to relax and calm down and filter their minds after threats, environmental harm or the emotional negative events, as well as enjoying the natural beauty, judgment and control, freedom of expression and to stay away from accumulated social pressures. The concept of preferred places was the one that shaped the experiences of interest in the research of restorative environments. The current study goes beyond these preliminary indicators to look at how individuals evaluate their preferred places using the terms set out in the theory of restorative environments. The process of restoration occurs in visual confrontation with a scene or place of certain characteristics, such as natural elements, moderate complexity, or the presence of a focal point, as the recognition of these characteristics leads to a shift toward more harmonious and positive emotional situations, as well as it reduces activity in different physiological systems, provokes constant attention and prevents negative feelings and thoughts (Korpela and Hartig, 1996). The initial state of guided-attention fatigue (continuous attention-drawing), which occurs with any prolonged mental effort, requires the continuous exercise of the inhibitory mechanism necessary to make guided attention possible, as one of the negative natural consequences of this is irritability, inability to plan, reduction of sensitivity to self-signals, and increased possibility of performance errors. The process of restoration is possible when four factors arise in the state of interaction between the individual and the environment, they are:

- Being away requires obtaining a psychological and possibly geographical distance from the usual context of the individual, including the usual work that one does and the pursuit of certain goals and purposes.
- Fascination, or smooth attention, that's when performance is supported by fascination, efforts can be mitigated to prevent jamming and restore the ability of guided attention, and fascination can turn to the natural elements of the environment such as water and greenery or by nature exploration and understanding.
- Extend, this indicates the possibility of indulgence in a coherent physical or conceptual environment of sufficient scope to maintain exploration and interpretation.
- Compatibility refers to the compatibility between individual tendencies and purposes, environmental support for the required activities, environmental determinants, and life actions.

The open question is about the varying importance of the four factors of environmental self-regulation, the study indicates that the term compatibility is the closest to the idea of the self, in that it draws on the individual's own goals and tendencies, and that high levels of compatibility are supposed to be necessary for the type of thinking

that is believed to contribute to deep restoration that may often involve one's sense of self. However, high compatibility cannot be found in situations that lack high degrees of distance, fascination, extension, or other factors of restoration. The feeling of moving away from a particular environment, being fascinated by what is in it, and discovering it to be having meanings for some cohesion and extension are all behaviors that are supposedly subject to processes that also work in self-development (Lindal and Hartig, 2013). Cleveland's (2014) study referred to the characterization of one of the themes of biophilic design that addresses issues of human correlation with the natural environment along with sustainable design under the name of "restorative environmental design," as the focal was developed in response to the rapid deterioration of natural systems such as green spaces and the dramatic spread of modern reconstruction that exhausted all forms of direct relationship between man and nature, as well as the effects of the sharp increase in human alienation from the natural world, the use of unsustainable energy, and the increased loss of biological diversity. This model of a comprehensive design of both biophilic design and sustainable design is an approach aimed at both the strategy of minimizing environmental impact and mitigating negative impacts on the natural environment and enhancing its positive environmental impact through a biophilic design approach that promotes the vital link between individuals and nature in modern buildings and outdoor spaces. This clarifies that the implementation of biophilic design is the missing element in the current sustainable models due to the attention it pays to human improvement and attachment to the place (sustainable, biophilic, and restorative design trilogy) (Cleveland, 2014). The study referred to the concept of health-restorative environments from the self-correcting mechanism to correct the critical situation of individuals from frustration, anxiety, or stress, which often tend to remove themselves from their psychological stress by "escaping from everything," especially for those working in highly stimulating environments such as urban areas, which is often considered as a need for change in environments, places or landscapes. Kaplan (2001) described it as the suffering from mental fatigue which is an exhausting condition that precedes a period of intense effort, anxiety, or stress, as mental fatigue and stress cannot be mixed, which often involves the feeling of threat or harm as a result of a particular event or action. Kaplan (2001) explained in his description of the experience and practice of nature that the desire to experience a sense of restoration can be achieved through two different means, comfort and escape and that the suitability of each depends on the act that makes the individual suffer from mental fatigue (Cleveland, 2014). The study indicated the items of the restored health environment as follows:

- **Escape:** The term escape refers to the ability to stay away from some of the usual tasks, such as the

urban environment, noise, congestion, chaos, and even the daily work routine, as well as an expressing the desire to take mental and/or physical break from pursuing a particular purpose or task.

- **The Concept of Connection and Extent:** The desire to escape comes with a sense of attachment to the environment in which it will occur, its scope and its extension, and the physical or cognitive extension, which is necessary to illustrate the feeling of immersion in the environment.
- **Fascination:** It is stimulated by the involuntary interest which is represented in attention and requires no effort at all, as something stimulating or interesting happens and then the individual looks forwards to finding out what is going on, and success in that task depends on supporting the extension and continuity.
- **Action and Compatibility:** Kaplan (2001) described that for the design to be successful, a restored environment is required to provide compatibility between the individual's tendencies and the procedures required by that environment during immersion in it, as the individual's decisions are shared with the constraints and demands of the environment, and the psychological activity that guides users' compatibility and activities is stimulated by the patterns provided by the environment (Cleveland, 2014).

Finally, Zou and Ergan (2019) indicated that the serious discussion of the impact of the concrete environment based on human restorative factors took up important space in the debate about the interchangeable relations between human neuroscience and the characteristics of the concrete environment and the degree to which that relationship contributes in increasing human restoration, which has not yet been fully understood. This study aims to find an organized understanding of architecture and its interactions with neuroscience within the designed spaces and to assess its impact on the human experience of architecture. The study emphasized the conclusion of the characteristics of this relationship by measuring the factors of human restoration within two virtual environments (restored, and not restored) using the characteristics of architectural designs related to human rehabilitation identified by previous literature. People were asked to perform moving and interacting tasks with these spaces while recording their physical responses with body area sensors (EEG, GSR, and eye-tracking). The result showed that human responses in the two different environments have a statistically significant difference (Zou and Ergan, 2019). The architectural design of the interior spaces is a necessity for achieving health, improvement, and self-development of individuals, as many different studies emphasized in the scope of their investigation in the impact of good architectural design on the human experience and confirmed multiple pieces of evidence, including that well-

designed services can lead to faster recovery in hospitals (up to 30%), better learning in schools (up to 25%), and higher productivity in offices (up to 25%) within multiple architectural design configurations and features (e.g., natural daylight, windows, and exposure to nature) (Goldhagen and Gallo, 2017).

On the other hand, poorly designed buildings can hurt the physical and psychological health of their residents, for example, "Sick Building Syndrome" SBS, where residents suffer from organic diseases and stress that appear to be linked to the time they spend in those buildings (Dravigne et al., 2008). In recent years, with the development of "Body Sensor Network" BSN technology and improved motion capture sensors, researchers began to consider the possibility of using the BSN and improving motion capture systems to objectively and quantitatively study human responses to changing designed features through testing individuals' physical responses (heart rate, facial expressions, skin connectivity), especially when interacting with actually designed spaces (Ergan et al., 2019). The results of this research showed that it is possible to observe statistically significant differences between clearly designed spaces, with stress and anxiety as a particular human experience, which are still inconclusive or confirmed, because the differences discovered in the data of body organ sensors cannot be proved to be directly caused by a change in design features (Bratman et al., 2012). There is also still a

need to identify the causes of variation in the human experience in specifically designed places, and eye-tracking technology may be used to meet the requirements of the study (eye-tracking devices), devices that measure the movements of the eye of users that can be used to reflect users' vision patterns and visual attention (Dzeng et al., 2016), as human eye movement and vision pattern was linked to human attention and perception, revealing the users' brains activities (e.g., understanding the scene and awareness of risks) (Hasanzadeh et al., 2016). The impact of architectural design features on human practice in buildings was studied through studying a sense of restoration in the architectural scope because it is closely linked to the functions of a variety of buildings, such as hospitals, schools, and office buildings (Rashid and Zimring, 2008). The sense of restoration and psychological recovery, which is an indicator of human improvement and satisfaction and thus recovery from stress or deliberate fatigue, the study identified through a group survey of 400 participants and architects as experts, a range of design characteristics associated with a sense of restoration. The restored concrete environment has architectural design characteristics that reduce fatigue and mental stress, they are (the presence of windows-the size of the windows-the presence of a landscape-the presence of natural light). The effect of design features is summarized based on a sense of restoration (Table 2) (Zou and Ergan, 2019).

**Table 2:** Internal architectural design that achieves human restoration

Design Features	Impact on Human Experience
Presence of windows	The presence of windows increases the speed of recovery from stress and attention fatigue.
Size of windows	Small windows prevent occupants from restoring from fatigue.
Presence of natural light	Natural light helps relax and ease the occupants' stress levels.
Presence of a nature view	Nature's view induces refreshing and restorative feelings.

(Zou and Ergan, 2019)

According to what was mentioned above, it is clear that the concepts associated with the designs of the restored environments originally stem from the concepts and principles of biophilic design, but from the perspective of sustainable design related to the sustainability of the life features of the internal environment like an improvement, comfort, and well-being (recovery), i.e. the restorative design is one of the axes of sustainable design within the principles of biophilic design. It is clear from the previous studies that the concept of restoration depended on most of the design characteristics of the interior spaces, whether the formal, structural, or sensory elements, but they did not address the restoration resulting from the visual structure of internal space, that is, the visual axes and their relationship to the visual extension of outdoor and neighboring, it is one of the most important supporting factors, visual restoration resulting from the diversity in the possible visual views, and consequently the sensory and psychological renewal of the occupying individual.

The design characteristics of restoration of the internal environments affect the occupying

individuals directly and indirectly factors: The direct impact is based on the physical characteristics of the environment at the level of formal and structural characteristics on the one hand and the level of the characteristics of sensory experience on the other, while the indirect impact represents the impressions, feelings, and perceptions resulting from the interaction of individuals with the internal environment (Table 3).

#### 4. Research methodology

In order to test the research hypotheses on the direct and indirect impact of the internal environment in adding features of restoration, the research adopted the methodology of interpretation and analysis of the impact of the extension of the visual landscape of the interior environment abroad and the impact of the natural elements and nearby buildings to improve the psychological state of residents of the housing unit in multi-storey housing buildings.

Because of its role in supporting and promoting the transitional and diverse visual experience, as



spatial extension is one of the effective structural characteristics which directly affect restoring the stereotype of the internal environment through changing and restoring visual relationship with the outside due to the diversity of the surrounding

natural variables which can be seen through the number and size of windows through which the effective visual extension can be achieved within the residential unit of multi-story housing buildings.

**Table 3:** The restoration features in the characteristics of the internal spaces

Keywords	Secondary words	Design characteristics
Restorative characteristics of the internal environment that support human health	Appearance characteristics	The presence of convenient windows creates a good state of connection with nature
		The presence of landscape as an active visual extension
		The presence of natural light gives a sense of diversity along the daylight timeline
		Provoking nature through forms and natural elements indoors
		Natural constructional materials that give a sense of warmth and life to the solids
	Structural characteristics	Direct immersion in the elements of nature
		The use of nature's colors and living elements
		Spatial extension
		Spatial direct connection with nature (moving space)
		Details of mini-practice connection with the internal environment (short-range sensory contact with nature)
Sensory characteristics (perception stimulation)	Smooth shift between internal and external spaces	
	The spatial structure that achieves isolation and temporary departure	
	Cognitive fluency (fluency feature in attention direct stimulation)	
	Bearing nature's meanings (clear, comfortable, harmonious, fun, and bright)	
	The ability to immerse in a solid material or cognitive environment of a sufficient range to keep exploring and interpreting	
Organic effects	Body and mental health	
	Feeling of being interesting, taken care of, and supported	
	Stimulating fascination (visual extension with connection to daylight)	
	Feeling of belongingness to nature	
	Reducing mental fatigue and stress	
Psychological effects	Enhancing positive mood	
	Compatibility	
	Behavioral effects	
	Adaptation	
	Solidarity	
The direct effect resulting from the material features of the internal environment	The indirect impact resulting from human interaction with the internal environment	The match between individual tendencies and required purposes
		Environmental support for the required activities
		Reducing disability and environmental neutrality of the required activities
		Ease of resources availability
		Psychological, social, and financial Resources enhancement
		Allowance of drained resources recovery
		On the extension of the transitional experience

What limits the diversity of the transitional visual experience of the possible view of the natural landscape scenes with the presence of a certain pattern of windows with specifications suitable for vertical housing patterns, is the level of complexity of the spatial depth of the spaces of the residential unit and the relationship of the optical axes formed from the moment of entry into the unit along with the outside walls of the unit as a whole and the visual correlation determined by the models of windows (standard) overlooking outside. The methodology for measuring this relationship is based on software scales Depthmap, among which is the Isovist-graph scale to measure visual depth, visual integration, visual space, and epicenters of control from the residential unit's access area. One of the most important variables to measure according to this software is Entropy, the complexity of the optical depth, which determines the level of comprehensive information provided by the spaces as a whole to the positional place at the point of entry, as any position of the structural form has its depth and the complexity of the space system works to reduce the visual dimension of spaces with each other and thus reduce the view of the residential unit on the outside area from the entry point. Therefore, the

methodology of analysis and interpretation of the relationship of the structural form of the housing unit will be adopted with the level of visual depth Entropy. Table 3 shows the most important keywords and possible values of the restoration features in the characteristics of the internal spaces.

**4.1. Extended space (visual horizon)**

Al Shahiry and Al Dabbagh's (2017) study of "Extended Space for Health Restoration" indicates that the extended landscape, the scene, or the point of view extending with no obstacles at a distance for observation and organization, this scene provides users with an appropriate state of surrounding visual scan of the environment around them (internal or external), and gives space that contains a state of the extended horizon a sense of openness and liberation with a sense of security and control. Among the recommended health benefits of this pattern include reducing stress, boredom, irritability, fatigue, and cognitive weakness, as well as improving the overall comfort level as a result of human aesthetic preferences in general and their preferences for natural scenes and particularly their preferences of landscapes in case they are open to

nature (Heerwagen and Orians, 1995). There are possibilities for endless combinations to apply the characteristics of the extended horizon, including the inner horizon, the short-depth horizon, and the large-depth horizon, which can appear simultaneously together.

For interiors or dense urban spaces, the horizon represents the ability to see from one space to another when there are clear differences between these spaces and opportunities to penetrate the vision through multiple spaces. The complexity of the diversity of the ways to achieve the term of the extended horizon is what makes it a powerful design element, and possible design considerations in achieving the visual extension feature towards the horizon within space are:

- Directing the building, windows, corridors, and room locations improves visual penetration toward extended indoor and outdoor scenes.
- A high location can enhance the extended landscape (internal and external) but it is not the primary condition for achieving the penetration experience of the scene.
- Locating stairs in the vicinity of the building with a glass front or using the inner glass walls of the stairs may form a double horizon.
- The possibility of providing physical extension within the relatively small area through roads and paths (such as curved roads) can be designed in such a way that small areas look larger than they are. Limited space is another way to provide a sense of a completely different world, although it is not widespread itself.
- Taking advantage of the natural elements within the natural site environment to enrich the horizon experience (e.g. bodies of water).
- Removing visual obstacles and the use of cuts or low elements within space to provide continuity and enhance the extended landscape, the height of which is determined by the status of the recipient "sitting/standing," adoption of glass separations, transparent materials, balconies, and platforms, open floor plans, and high ceilings.

When discussing the ways and methods of combining the natural characteristics of the vicinities with the built environment to better support the restoration status in the surrounding urban areas, the potential benefits of urban nature should be considered when connected with the characteristics of buildings around parks and along nearby streets and everything related to the way the architectural characteristics of buildings positively affect the improvement and evaluation of the features of restoration of the internal environment. Most of the studies that dealt with residents' preferences for urban places near the rows of buildings blocks with paved streets took into account the most important cognitive traits beyond those preferences, such as the degree of openness and surrounding, the depth and extension of the axis of sight and the visual scene with what is there of natural scenes and visual

horizon, as it is necessary to deal methodologically with those characteristics, such as the details of the opposite front, scale, color, shape, buildings arranged in a block or row, and everything related to groups of architectural and natural elements that may make urban streets as of a higher quality of improvement and restoration for the recipient from inside the building. For example, streets lined with ugly or uninteresting buildings may be viewed more positively if they are also lined with trees that hide disturbing fronts and trees may not be seen as positive if they hide beautiful buildings (Lindal, 2013; Al Shahiry and Al Dabbagh, 2017).

## 4.2. Entropy

The measurement of entropy for spaces highlights how the space components of the housing unit system are organized and produced to achieve the highest view of the user from the site of access to the rest of the spaces, for example, if the entrance is connected to the main corridor, there is a noticeable disturbance at the depths of the point from the angle of sight that forms the entrance, as there may be only a few visible sites from the entrance, i.e. the order of the space system determines how the main corridor of the housing unit integrates or entrance with its vicinity.

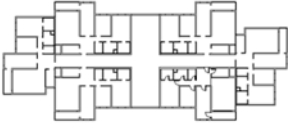
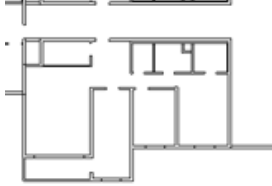
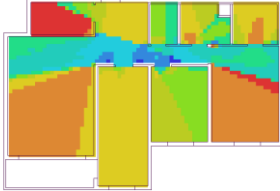
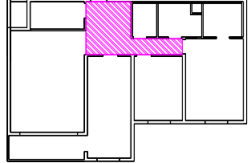
The depth of the point of sight which is measured by Depthmap software calculates the comprehensive information from that point using the expected frequency or repetition to see the sites at each depth, the question here is about the importance of measuring entropy or the amount of information from a specific point? This intuitively calls for a temporary model of individuals' view of a system, where entropy matches the extent of ease in passing a certain depth within the system (ease of passing spaces leads to reducing confusion, and chaos in passing increases the difficulty of space view) as well as it addresses the problem represented in the integrity visual space of the unit in its view towards the visual open scenes outside, i.e. the large visual spaces have a good evaluation only through its increased space contacts, not through their areas, using a topological scale such as entropy (point of depth) and its relationship to the level of complexity of the space system, we eliminate the reliance of position or location on its measurements, but focus on visual access to one point of all other points (Turner, 2001).

## 5. Practical study

The practical study was adopted in measuring the relationship of the level of complexity of the optical system (structural body) with the level of view of the space depth with the external environment (natural) and its formation of the visual scene extending from the entry point as one of the main factors of the direct effect in adding features of restoration to the housing unit, the practical study was conducted in three steps:

- Electing a research sample that consists of 10 different patterns of housing units in multi-story complexes in Erbil/Iraq (Appendix A).
- Measuring the degree of entropy according to Isovist-graph which belongs to Depthmap software to determine the degree of the access point at the outer boundaries of the housing unit as it contains the visual scenes extending to nature through window patterns.
- Determining the patterns of the structural relationship of the main corridor and the location of the entrance for the housing units with the rest of the spaces (entry point location, length of the main corridor, area, degree of openness of the corridor %, number of external fronts). Table 4 shows the measurement stages.

**Table 4:** Stages of measuring restorative features of the chosen sample housing unit

Building type	Sample housing unit	Entropy	Main Distributor Characteristics
			

## 6. Finding and conclusions

### 6.1. Results

The results of the practical study were indicated following the stages of its conduction, and Table 5 indicates the values of the approved variable (Entropy) and the independent variable (characteristics of the housing unit) as the following:

- The results of entropy of housing units indicated a limited variation in the visual depth patterns of the space systems of the study sample, which indicate that the structural body of the relationship of spaces with each other plays a limited role in the formation of visual scenes overlooking the outside, but the important role is in the view of the location of the entrance and the main corridor on the outer boundaries of the vicinity spaces and thus the degree of the honorable location of the entry site on the visual scenes extending out, in other words, the role of the visual structure of the motion system in achieving direct contact with the vicinity, which leads to the diversity and restoration of visual scenes over one day for the users of the housing unit (Table 6):
- The results of the detection of the characteristics of the main movement system and the location of the entrance for the housing units of the elected sample were indicated by quantifying these characteristics (the location of the entry point, the length of the main corridor, their areas, the degree of openness of the corridor, and the number of outside fronts), they indicated an important variation in those characteristics between the housing units, which indicates the importance of the structural body of the movement system and entering into the formation of the optical system, and the visual extension with important effect in the formation of visual views with the outside (Table 6).

- The results of the correlation between entropy factors and the characteristics of the main motion system and the entry site of the elected sample units indicated an important variation in the impact of some characteristics from others, like the following (Table 7):

- A strong direct relationship (0.748) between V1 and V2, indicates that the side-located entrances of the site of the housing unit achieve a higher level of depth of visual extension of the entrance site with the external view of the rest of the spaces.
- A strong direct relationship (0.652) between V1 and V4, indicates that the capacity of the main distributor increases the level of visual extension of the entrance site with the external view of the rest of the spaces.
- A strong inverse relationship (-0.803) between V1 and V5, indicates that the high openness of the main distributor of the movement reduces the level of visual extension of the entrance site with the external view of the rest of the spaces due to the dispersion of the penetrating optical axes resulting from the interference of spaces with each other.
- The rest of the variables (V6, V3) did not show an important relationship with the approved variable (V1), indicating that the length of the main corridor and the number of fronts overlooking the outside with the view of the entrance site on the rest of the spaces have been no effect.

### 6.2. Conclusion

The study reached several conclusions as to the following:

- The conclusions of the theoretical framework indicated the impact of direct and indirect addition of restorative features to the internal environment on the physical, mental and psychological health of the residents, as it represents the direct effect on both the appearance characteristics of space and

the structural characteristics of the space system and finally the sensory cognitive characteristics resulting from the performance of daily events, while the indirect effect was reflected through the

interaction of the individual with the internal environment and with many organic, psychological and behavioral effects.

**Table 5:** The verified variable values and the independent variable of the elected housing units

No.	Projects	V1	Characteristics of the housing unit					
			V2	V3	V4	V5	V6	
1	Cihan	1.41859	Middle	1	7.411	12.441	36.61	1
2	Newroz	1.49751	Side	2	8.813	15.941	32.81	2
3	Avro city - B	1.58419	Side	2	10.564	20.511	25.67	2
4	Parosh type- B	1.41253	Side	2	8.425	11.991	37.30	2
5	Parosh type- D	1.42099	Side	2	8.938	12.651	31.90	2
6	Zaniary - B	1.33742	Middle	1	11.309	14.801	49.35	1
7	Kamarany	1.35525	Middle	1	8.659	11.041	51.30	3
8	Sky towers- E	1.44796	Side	2	13.229	18.911	41.98	2
9	Sky towers- D	1.50648	Side	2	9.544	12.871	36.33	1
10	Eskan Tower	1.24186	Middle	1	9.4676	11.501	45.90	2

V1: Entropy, V2: Entrance position, V3: distributer length, V4: distributer area, V5: distributer enclosure, V6: No. of elevation

**Table 6:** The statistical descriptions of the study variables according to SPSS software

Descriptive Statistics				
VAR	N	Mean	Std. Deviation	Variance
VAR-1	10	1.4223	0.0966	0.009
VAR-2	10	1.6600	0.5164	0.267
VAR-3	10	9.6360	1.67142	2.794
VAR-4	10	14.2660	3.2450	10.530
VAR-5	10	38.9150	8.14437	66.331
VAR-6	10	1.8000	0.63246	0.400

- The conclusions of the practical study indicated the existence of some of the physical characteristics of the main movement system, which begins with the entrance and then the main corridor and its relations with the rest of the spaces, including what was associated with the position of the entrance relatively to the residential unit as a whole, including what was associated with the length of the main corridor relatively to the area of the unit and finally the degree of openness of the main corridor to the rest of the spaces, which affected the direct and reverse relationships as a whole with the visual depth and view of the outside Entropy.
- The visual system formed by the spaces of the housing unit plays an important role in

determining the degree of visual view of the natural surrounding environment, which directly reflects on the addition of the characteristic of restoration and diversity to the majority of the spaces of the housing unit due to the association of the inner space with external natural factors like the change in daylight and change of visual scenes, and thus the diversity of the user's visual experience of them throughout the day.

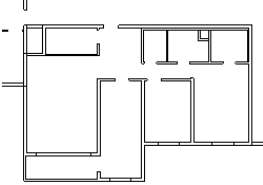
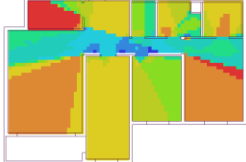
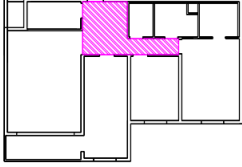
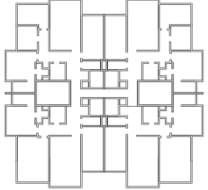
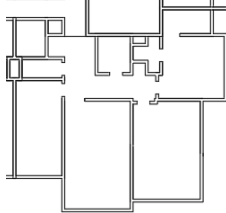
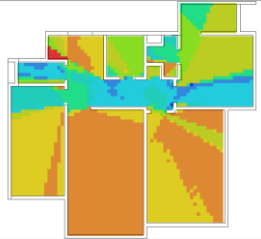
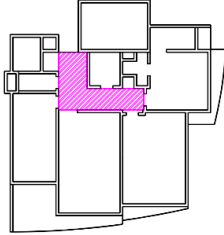
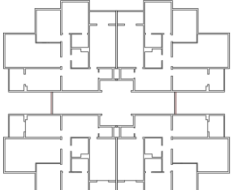
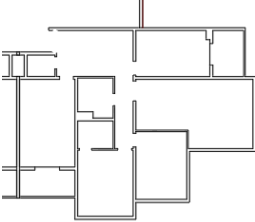
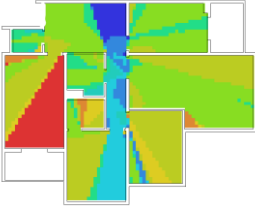
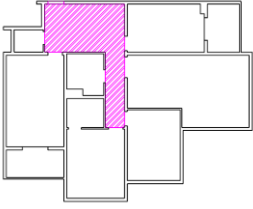
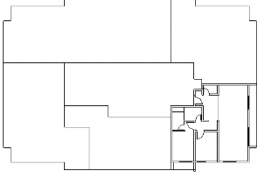
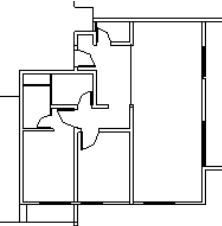
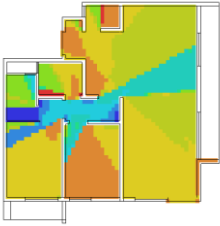
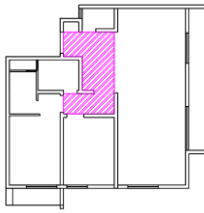
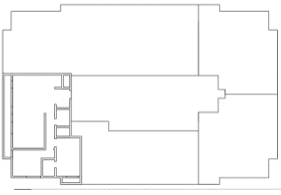
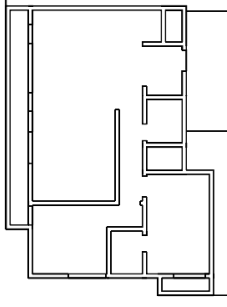
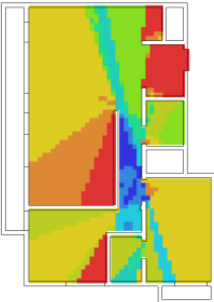
- The ability to adopt Depthmap software in measuring many important visual characteristics that affect the performance of daily activities and events of the housing sector on one hand, and for many types of buildings related to cognitive and behavioral studies on the other.

**Table 7:** The values of link correlations between the verified variable and the dependent variable of the selected sample

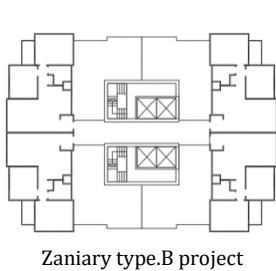
	VAR-1	VAR-2	VAR-3	VAR-4	VAR-5	VAR-6
VAR-1: Pearson correlation	1	.748	.102	.652	-.803	-.114
Sig.(2-tailed)	0	.013	.780	.041	.605	.754
N	10	10	10	10	10	10
VAR-2: Pearson correlation	.748	1	.218	.483	-.727	.068
Sig.(2-tailed)	.013	0	.544	.158	.017	.852
N	10	10	10	10	10	10
VAR-3: Pearson correlation	.102	.218	1	.696	.164	-.035
Sig.(2-tailed)	.780	.544	0	.027	.650	.924
N	10	10	10	10	10	10
VAR-4: Pearson correlation	.652	.483	.696	1	-.461	-.029
Sig.(2-tailed)	.041	.158	.027	0	.180	.936
N	10	10	10	10	10	10
VAR-5: Pearson correlation	-.803	-.727	.164	-.461	1	.148
Sig.(2-tailed)	.605	.017	.650	.180	0	.684
N	10	10	10	10	10	10
VAR-6: Pearson correlation	-.114	.068	-.035	-.029	.148	1
Sig.(2-tailed)	.754	.852	.924	.936	.684	0
N	10	10	10	10	10	10

**Appendix A. Selected sample measurement results**

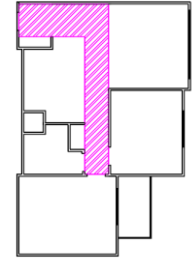
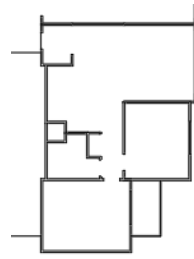
**Table A1:** Stages of measuring restorative features of selected housing units

No.	Building type	Sample housing unit	Entropy	Main Distributor characteristics
1	 <p>project Chian</p>			
2	 <p>project Newroz</p>			
3	 <p>project Avro city-typ.B</p>			
4	 <p>Parosh type - B project</p>			
5	 <p>Parosh type- D project</p>			

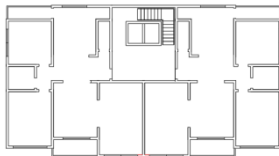
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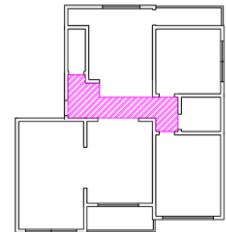
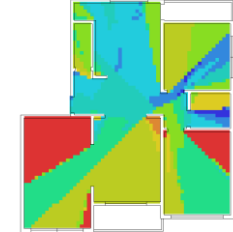
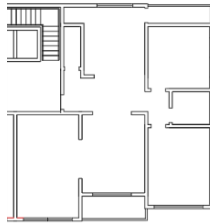
Zaniary type.B project



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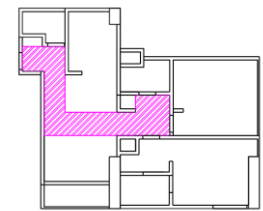
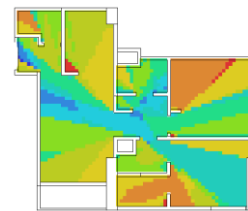
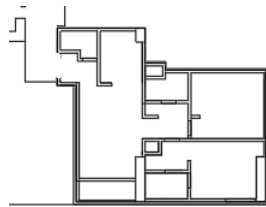
Kamarany project



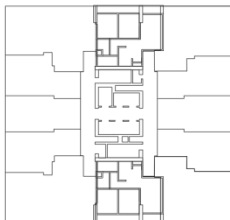
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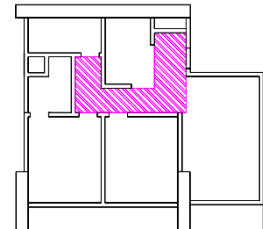
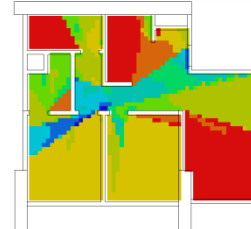
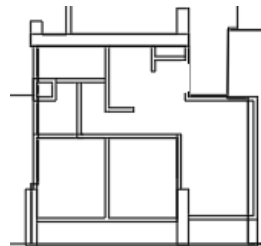
Sky Towers- E project



9



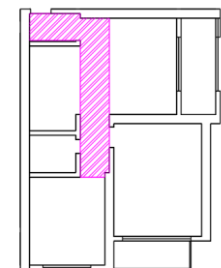
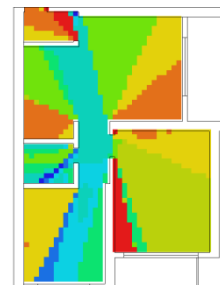
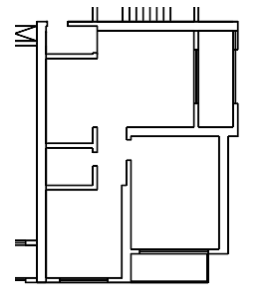
Sky Towers-D project



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Eskan Tower project



## Data availability

Some or all data, models, or codes that support the findings of this study are available from the corresponding author upon reasonable request; all data, models, and codes generated or used during the study appear in the submitted article.

## Compliance with ethical standards

## Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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