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Analysis of Intelligent Indicators in Reduction of Urban Housing Damage (Case Study District 1 in Tehran)

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Abstract: Housing and sanitation as one of the most essential human needs has always been at the top of human demands. Smart houses are among the latest achievements of the housing industry in the present era which have been taken into consideration in recent decades. The research method of this paper is descriptive-analytic. In the first part the paper deals with the definition of intelligent housing fields components functions. Also by objective observation and completion of the questionnaire information about the intelligent housing indices was collected. Using the AHP hierarchy technique the degree of physical vulnerability of residential units in the first district of Tehran has been determined; the results show that many residential areas are exposed to severe vulnerability. Also in order to answer the research hypothesis 30 professors and experts of the housing department were analyzed by the path analysis technique.

The results of path analysis show that all factors have a direct and significant effect on reducing the vulnerability of urban housing. Separating direct and indirect effects of variables on reducing the vulnerability of urban housing shows that the safety and security agent with the highest value of 0.892 has the most direct, a positive and significant effect on reducing the vulnerability of urban housing. The remarkable thing about this factor is that the indirect effect of this agent through the factor of well-being and comfort is 0.863 which is very significant; in other words the factor of safety and safety through the factor of welfare and comfort will significantly reduce the vulnerability of housing. Also the direct effect of the comfort and comfort factor of 0.422 and energy savings of 0.398 significantly contribute to reducing the vulnerability of urban housing.

Key words: Housing planning, smart housing, housing indicators, physical vulnerability, district 1 of Tehran.

Introduction and Expression of the Problem

Urban vulnerability assessment has increasingly become important issue in both planning agenda and academia (Salas and Yepes, 2018). At the same time, with the formation of human societies and therefore the serious effort of mankind to create comfort in his personal life the provision of adequate housing has been raised as one of the most important humanitarian needs. The right to adequate housing as part of the right to life in many international instruments has been consistently emphasized. Among other things in Article 25 of the Universal Declaration of Human Rights and Article 11 of the International Covenant on Economic Social and Cultural Rights of the United Nations as well as in the Second Summit of Human Settlements in Istanbul the right to housing was recognized for all individuals; therefore with regard to the definition of the committee UNESCO's Economic Social and Cultural Rights (ICESCR) is an adequate housing for

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business with enterprise security access to services facilities and infrastructure with appropriate and durable materials that are tailored to the financial potential of individuals and the cultural and social conditions of each community. It has been constructed in a proper place (Shahrokhi, 2016).

In our country, according to the principles of Articles 31 and 43 of the Constitution of the Islamic Republic of Iran, the right to housing is proportionate to the needs and also the provision of basic needs including housing to be right of every individual and Iranian household. Therefore, the government is obliged to give priority to those who need it with a view to priority (Comprehensive Housing Plan, 2006). Housing is one of the most important uses of the city that should not be harmed during natural and human disasters. To this end it should be used for simple housing construction projects and adjoining neighbours especially housing should be away from hazardous uses such as industrial workshops, pump stations and oil and fuel storage tanks and warehouses. The use of light construction materials and the rapid depletion of residential areas is very effective in reducing vulnerability in these areas (Bazrafkan, 2015).

The study of how to deal with the dimensions of housing using the experience of countries shows that the qualitative aspects of housing have become widespread and cover a range of issues ranging from structural aspects to the use of it. Kohl points out that there is a close relationship between the quality and activities carried out in the interior and exterior of the home (Lotfi et al., 2015). Therefore, considering the qualitative aspects of housing along with addressing the aspects of supplying housing needs should become one of the essential components of housing programmes (Habibi and Ahari, 2004). With the introduction of superior technologies into the building industry and the need to meet the new needs of the community intelligent housing has emerged as a developing and highly attractive phenomenon.

In all the advanced countries of the world, academic centres have taken many research and operational projects for their better understanding and evolution with due regard to the merits and also the users' satisfaction. The most important factors and capabilities of smart housing that are welcomed by consumers include security and safety comfort and comfort management and energy saving, helping to improve health and more. Due to the increasing importance of housing and its issues and dimensions the analysis of quantitative and qualitative issues of housing is carried out through a tool which is called variables or housing indices and represents different dimensions of economic, social, cultural and physical aspects of housing (Azizi, 2005). And one of the new indicators that has been introduced in recent years with the emergence of technology by users, builders, planners and managers of the housing sector and has significantly increased the quality of residence and satisfaction of its residents is smart housing and smart housing indicators.

These new and up-to-date indicators are of great interest and attention to improving the quality of life of individuals, increasing the efficiency of buildings, saving energy, saving on housing costs and other capabilities. The phenomenon of smart housing in the advanced European and North American countries has long been the focus of research and executive debate. In our country too it has been taken into consideration in recent years. On the other hand, despite the fact that the phenomenon of smart housing in the country and especially in Tehran has been increasingly addressed to users, this has been neglected by academics and academic institutions. Therefore, in this research, it has been tried to explain the principles of intelligent housing by using and contributing to the sources and scientific literature the importance of this category in the construction industry of the country. It is the study of the area of one of Tehran as a case study which examine the phenomenon of smart housing and the challenges ahead as well as the impact of smart housing indicators on reducing the vulnerability of urban housing. So the present research seeks to answer the question: How smart indicators are effective in reducing the vulnerability of urban housing?

Research Methodology

The research method in this study is descriptive-analytical based on the nature and objectives of the subject and in relation to the research hypothesis test. Considering the fact that the present research seeks to identify and investigate the effect of smart and new indicators of housing on the degree of physical vulnerability of urban housing. The population of this study consists of 117,932 residential units based on the census in 2011 in district 1 of Tehran. To evaluate the research hypothesis 30 professors, experts and activists in the housing sector have been collected and analyzed in a questionnaire. Also in order to complete and improve the research work using the data obtained from relevant centres and the AHP hierarchy technique, the degree of physical vulnerability of residential units in District 1 of Tehran has been investigated.

Table 1: Smart housing indicators

Description	*Indicators*	*Dimensions*	*Meanings*
Motion monitoring systems are electronic sensors designed to detect motion and convert it into an electrical signal which is susceptible to the presence of individuals or some objects in the controlled environment often based on PIR-based systems.	Intelligent motion detection system living creature	Safety and security	Smart housing indicators
It is said to be a system that is sensitive to smoke heat or both and it receives and processes received information from the environment as soon as it receives electronic signals indicating the hazard.	Intelligent fire alarm system and fire and smoke control		
These sensors are capable of detecting hazardous gases such as CO, CO_2, O_2 and NH_3 in the home and by detecting these gases activate hazard warning systems sirens and ventilation and exhaust ventilation systems.	Intelligent detection system for hazardous gases		
These locks by various radio waves detect authorized people in the residential environment and allow them to travel; these systems are in various types, smart card lock, fingerprint lock, face scan and so on.	Smart and smart lock control		
In this system with the establishment of communication between the vehicle and the receiver of the controller's radio waves the system will issue a license for the entry of vehicles for licensed users; this is done in a semi-automated and fully automated manner.	Smart parking control gates		
These systems include all that is by converting renewable energy in nature to the energy consumed in residential buildings; is the most commonly used modern solar energy system and solar absorption refrigeration system.	Intelligent power supply systems	Energy saving	
This system includes sensors control valves on fluid pipes, damper air transfer channels and scenario writing to control the temperature of the target point which by receiving and analyzing the data in the environment and interacting with the thermostats in the room ensures air quality as needed. They will show.	Intelligent temperature control system		
These systems through the sensors of motion detection and the presence of individuals and if someone is within their control are responsible for converting people's movement into electrical signals and issuing a command for lighting the environment.	Intelligent lighting control system and lighting		
In these windows the smart glass also controls the temperature in addition to light. For example in hot weather the transparency of this glass is reduced and it prevents the warming of space and in cold seasons these glasses while passing through and amplifying the sunlight into space increase the temperature and ambient light.	Intelligent window system		
The intelligent control system of the curtains can be controlled by defining a scenario for each screen and using different scenarios that can be combined with lighting and temperature control scenarios while maximizing the natural light; creates an attractive and dreamy environment.	Smart curtain system		
The system provides facilities that can be controlled by touch screens remote control telephone etc. to all home audio and video equipment and systems either based on predetermined plans and scenarios based on interests. And customize the user's desires.	Intelligent audio and video systems	Comfort	

Table 1: (*Contd.*)

Description	*Indicators*	*Dimensions*	*Meanings*
In this system by communicating between the keys and sensors in the location the user automatically enters the ambient lighting command and at the same time as the signal enters the system the light system is set to off or the light is dimmed to the required extent.	Smart key system		
In this system sensors in the soil continuously examine the amount of soil dryness and moisture required by the house plants and according to a predetermined scenario or can regularly irrigate at regular intervals from day to day.	Intelligent system for controlling irrigation and feeding of pets		
The residential building should be durable at the time of operation. The durability and stability of any type depends primarily on its structure. In general the skeletal structure of buildings is divided into four general categories: buildings with concrete, skeleton metal, brick clay and mud.	Housing component		Vulnerability
The useful life of a building in Iran has been set at a maximum of 30 years which is a significant difference in comparison with European countries. Error in the design implementation, operation and maintenance, lack of stability in urban planning laws are among the factors that cause early aging of buildings and their wear and tear and become worn out.	The life and style of the building		
The per capita base of residential units is one of the key indicators in identifying the housing situation. The occupancy level coefficient is the ratio of the permissible land for construction to the total area of the land which is introduced as percent. Usually this coefficient varies according to comprehensive plans in each region.	Housing ground level		
Another factor that has a significant impact on the physical housing vulnerability is urban usage and how they are related to one another. In the context of urban users the way of neighbourhood of applications, types of densities (population, construction and residential), the density of the aforementioned segmentation of the land with different uses, the order and size of parts, the amount of compression and their continuity etc. should be reviewed.	Land use		
Population density is a potential source of great damage during accidents and disasters. The casualties are the most important blow to the disaster. Proper distribution of the population in different parts of the city and relief to residents after the earthquake are among the most important issues that are effective in dealing with vulnerability.	Population density		
Faults play an important role in vulnerability as they are the agent and source of many other natural events such as earthquakes and landslides. Therefore the proximity and placement of human phenomena such as urban and residential environment to faults are of great importance in reducing vulnerability.	Fault		
This indicator plays a key role in the city's vulnerability to disasters especially immediately after the occurrence of accidents. Passages are one of the most important elements in urban vulnerability as the need to evacuate the area from wounded and injured people and relief efforts as soon as possible is discussed.	Transit network		
Slope is one of the factors that has the effect of reducing or intensifying the amount of damage to buildings and structures in a region.	Slope area		
	Indicators		

Results

Path Analysis

The path analysis method was first introduced by Seattle Wright to explain the causal relationships in genetic populations. He used this model to study the direct and indirect effects of causal variables on the disability variable and the purpose of path analysis is a means for the logical expression of observed correlations between variables that are subject to causal relationships. In relation to the causality of one or more variables one or more causal variables are affected. This relationship is shown in regression model with correlation coefficient. Therefore, path analysis and regression models are almost similar but they also have differences. Nevertheless, the path analysis model incorporates all the effects of the regression model and in addition to the direct effects of independent variables on the dependent variable their indirect effects can be analyzed through the other variables on the dependent variable. On the other hand some variables can directly affect others indirectly and some of the other variables in both ways may affect the dependent variable. In addition, the standard coefficients of the path analysis model are among other advantages of this model on ordinary regression model which facilitates the ability to compare the effects of variables on the response variable. Therefore, in this model two types of intrinsic (dependent) and exogenous (independent) variables are determinable.

Hierarchical Analysis (AHP)

In order to measure the degree of physical vulnerability of urban housing according to the articles, documents and theoretical foundations of the research, eight main data that are critical to the physical vulnerability of urban housing have been studied which include population, building materials, dating of residential units, existing faults of the region, the slope of the study area, urban utilities of the region and roads of the region as data and indicators of the physical vulnerability of urban housing in the selected area and their information using different data obtained from statistical centres and institutions of the city. Bagta has attempted to determine the degree of physical vulnerability of residential units in District 1 of Tehran using the AHP hierarchy method. For this and more using the ArcGIS software we have been developing Raster Indicator Maps.

Preparation of Raster Maps and Their Fuzyation

In this regard based on the data of the Statistical Yearbook of 2011 the Iranian Center for Statistics has been provided with layers of materials used in buildings, residential units and infrastructure. In order to produce the map of materials in the region according to the data of the Iranian Statistical Center all materials in the region were divided into three categories: metal structure, reinforced concrete and other materials; each one was made of a rust. Then these three layers were combined together. We have weighed the importance of each of these materials which weighed on a metal structure of 0.2, a reinforced concrete with a weight of 0.3 and other materials with the highest risk of 0.5.

In order to produce a map of the age and life of the residential units in the region according to the data of the Iranian Center for Statistics, the monuments in the region are divided into three general categories of age for the buildings of the years 1916 to 1996, the buildings of the years 1976 to 1994 and the buildings before the age of 55. We made each one of them a riddle; then we combined these three layers and given the importance of each of the groups we weighed where the buildings of 1994 to 2016 weighs 0.2, buildings of 1976 to 1994 weighs 0.3 and to the monuments before the 55th year we had a maximum risk of 0.5 and we provided a rough map of the entire old age.

Source Research Findings

Also in order to produce a map of the infrastructure of existing buildings in the region, according to the data of the Iranian Statistics Center, the existing buildings in the region are divided into three categories in terms of infrastructure for buildings: with an infrastructure of less than 100 square metres buildings with an infrastructure of 100 to 200 square metres and buildings with an infrastructure of more than 200 metres. Each riddle was made; then we combined these three layers and according to the importance of each of these three groups we have weighed where buildings with an underwater floor of less than 100 metres weighing 0.2, to buildings with an infrastructure of between 100 and 200 metres in weight 0.3 and in buildings above 200 m we had the highest risk. We finally got a total rast map. To create the raster map of existing applications in our area we first made a rut from each of the uses. Then considering the importance of each application we weighed on the physical housing vulnerability and eventually we multiplied all the rasters with the respective weights which was a raster. An overview of all uses gave us an indication of the importance of each application in the context of housing vulnerability.

The area of a Tehran municipality with a total of 3604.8944 hectares is the northernmost region of

Tehran with its boundary on the northern border of Tehran (1800 metres high) (detailed plan of Tehran's 1st district 2005) in Tehran's high. The area of about 64 km^2 is based on the latest census of 439,467 people. The geographical coordinates of this area on the north side are limited to 1800 m high altitudes of the Alborz mountains from the south to the Chamran highway between the Azadi and Modras highways and the Ayatollah Sadr bridge and from the west to the Dareka River lands and from the east to the end of the Army. The cement plant and oil source of northeast of Tehran are limited (http//Region1.Tehran.ir).

The Strengths and Weaknesses of the City of Tehran in Relation to the Topic

The 1st district of Tehran is a town with a semi-rural texture and can be called "Garden of the City". This region is famous for most of the historical texts. This area is special due to geographical-natural conditions such as the slope of the last part of the southern slopes of the Alborz mountains and many factors affecting it such as drifts and landslides as well as being located on one of the main faults in the Tehran region i.e. the North Tehran fault. The natural risk as well as the long history of this region in urbanization and the existence of abundant tissue that can lead to the vulnerability of urban housing located in this area necessitated the attention of this and other researches in Iran to justify and rationalise the first district of Tehran. It shows, in addition, that due to the relative economic and social well-being of the inhabitants of this region, it has been created in this area in terms of buildings and physical facilities a special structure that is a mixture of modern and traditional urbanism. The same economic welfare has made its inhabitants more prosperous which is one of the primary areas of peace and well-being of human beings and their place of residence. This has led to the creation of very modern buildings which have made many homes in this area of high quality as well as the latest ideas and models in the design construction, maintenance and other sectors.

Research Findings

In this section, in order to measure the physical vulnerability of residential units in District 1 of Tehran according to the articles, documents and theoretical foundations of the research, eight main indicators that play an essential role in the physical vulnerability of urban housing have been surveyed which are population density of the region, materials of buildings, dating of residential units, infrastructure of residential units, faults in area 1 of Tehran, slope of land, land use of the region and roads in the region with their data from the centres and the relevant agencies and using the analytical method of hierarchy AHP and ArcGIS and Edrisi software. According to the indexes the weight of the building materials is 0.3313, the weight of the factor of the fault is 0.2307, the weight of the operating life and the age of the residential units is 0.1572, the ground gradient is equal to 10.109, the ground weight of the residential unit is 0.0709 and the population weight is 0.0477. The land use weight is 0.0327 and at the end of the road and communication lines is 0.0236. The compatibility rate is 0.03 which is acceptable. After gaining the weights of various factors in the ArcGIS environment these weights add to the software and give us the final map.

The final map of the physical vulnerability of residential units in Tehran's area 1 shows that most of the residential area of Tehran's 1st district is severely damaged as the descriptive and analytical data show on the one hand by passing a very large fault in northern Tehran from the centre of this region. Besides traditional and historical texture, high-rise busiest and non-expert construction, the great slope of the region due to its proximity to the Alborz Mountains has made this region one of the most vulnerable residential areas in Tehran. As it is in the map clearly visible, reddish colours indicate the risk prone and disaster prone areas. Where the total risk factors such as fault slope, fine texture and inappropriate construction are adjacent to each other, there are critical and complicated conditions for residential units and their inhabitants which are marked in bold above orange map. These vulnerable areas were specifically identified in the historical and residential areas of District 1 including Tajrish, Imamzadeh Qasem, Jamaran, Desziab and even part of the Velenjak region. What is clear from this tangible map is that residential units in most parts of Tehran's area 1 are vulnerable and subject to severe natural and human hazards.

In the following, based on the studies and summaries of documentary and library data, various indicators of intelligent housing as well as the physical vulnerability of housing have been extracted. And presented in the form of a questionnaire to the opinion of the professors, elites and experts in the housing sector that determine the effect of each of the indicators of smart housing on reducing the physical vulnerability of urban housing which is followed by descriptive results.

Table 2 which relates to measuring the effect of smart housing indicators on the impact of urban housing in the first district of Tehran is one of the professors, experts

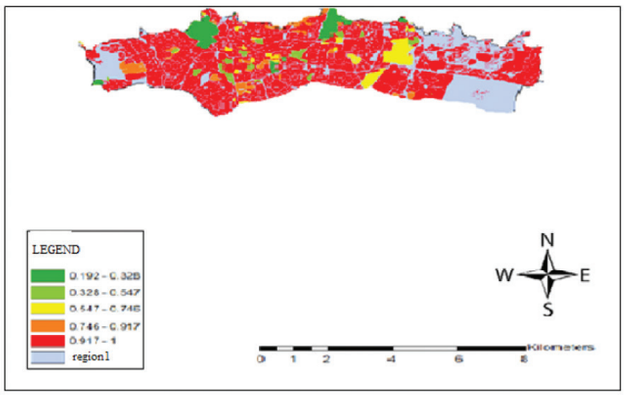

Figure 1: Fuzzy map of building materials in District 1 of Tehran.

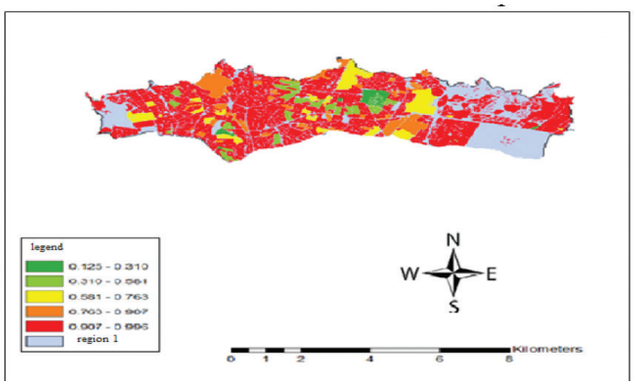

Figure 2: Fuzzy map of infrastructure of residential units in District 1 of Tehran.

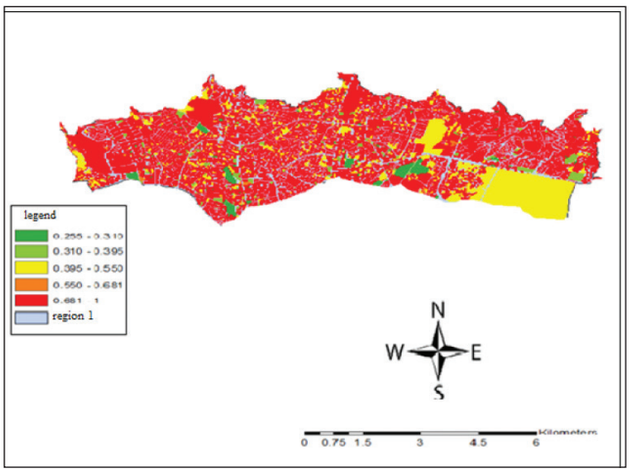

Figure 3: Fuzzy map of urban use in District 1 of Tehran (Source: Research findings).

and elites in the housing sector indicating that the indicator of intelligent fire alarm systems and fire and smoke control with a very high score and 23% of the average score have the most impact on the respondents'

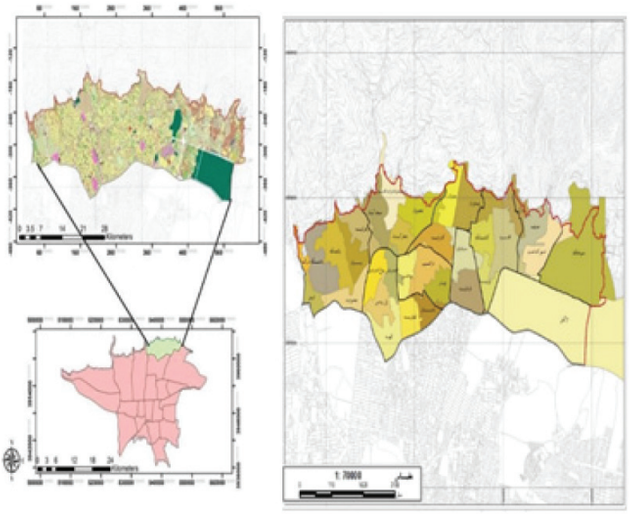

Figure 4: Location districts and neighbourhoods of District 1 of Tehran (Baft Consulting Engineers 2005).

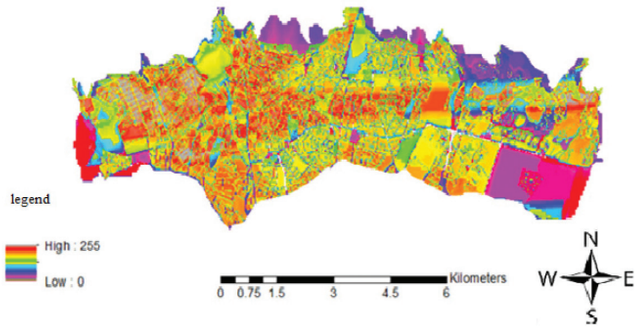

Figure 5: Physical vulnerability map of residential units in District 1 of Tehran.

community in reducing the physical vulnerability of urban housing in the area of Tehran. And after that the indicator of the system for detecting hazardous gases with 10% is very high, 30% high and 23% average. On the other hand experts believe that indicators of intelligent irrigation and pet food systems with a low 60 per cent rating are very low and 40 per cent the least important smart housing index in reducing the physical vulnerability of urban housing. Also the indicator of smart key systems and systems with 60% of the very low and 36% of low ratings are the least important of the smart housing indicators in reducing the level of physical vulnerability of urban housing in the region of Tehran. Among the three main components of safety and security, energy saving and comfort safety and security components have received the highest scores from the experts so that the four indicators of the five safety and security indicators in the row of the most influential indicators. Reducing the physical vulnerability of urban

Table 2: Elite questionnaire data

Points										*Indicator*	
Very much		*Much*		*Medium*		*Low*		*Very Low*			
Percentage	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*	*Percentage*	*Number*		
10	3	13	4	30	9	23.3	7	23.3	7	Intelligent Live Detection System	Security and safety
16.6	5	46.6	14	23.3	7	13.3	4	0	0	Intelligent fire alarm system and fire and smoke control	
10	3	30	9	23.3	7	20	6	16.6	5	Intelligent detection system for hazardous gases	
3.3	1	10	3	23.3	7	36.6	11	26.6	8	Smart and smart lock Control	
0	0	10	3	26.6	8	30	9	33.3	10	Smart Parking Control Gates	
0	0	0	0	10	3	40	12	50	15	Intelligent Power Supply systems	Energy saving
0	0	0	0	6.6	2	40	12	53.3	16	Intelligent temperature control system	
0	0	0	0	16.6	5	36.6	11	46.6	14	Intelligent lighting control system and lighting	
3-3	1	10	3	20	6	23.3	7	43.3	13	Intelligent Window System	

housing and in contrast to all three indexes welfare and comfort are one of the least effective indicators of the degree of urban physical housing vulnerability.

Background Research Results

In order to answer the question of whether our indicators in this study have been effective in reducing the vulnerability of urban housing, the path analysis model was used in SPSS environment. The results of causality analysis in one of Tehran indicate that all factors have a direct and significant effect on reducing urban housing vulnerability. The distinction between the causal and non-causal effects of variables on reducing the vulnerability of urban housing in Table 3 shows that welfare has the most direct effect on urban housing vulnerability (0.892). Direct effect of the welfare variable on the reduction of vulnerability of urban housing is significant and positive. The remarkable thing about this factor is that the indirect effect of this factor (0.863) is greater than its direct effect (0.422) through the safety and security factor (4.262) and is very significant. In other words, the welfare variable through the other variable i.e. security and safety will significantly increase the vulnerability of housing. Further the analysis of the results shows a direct and significant effect of the energy saving variable. The direct effect of this variable (0.398) constitutes the major part of its correlation coefficient with decreasing the vulnerability of urban dwellings.

At the same time with the formation of human societies and therefore the serious effort of mankind to create comfort in his personal life, the provision of adequate housing has been raised as one of the most important humanitarian needs. Today there is a change in culture, interests, demands and needs of individuals due to the introduction of technology in all areas of life including housing and living space. The introduction of superior technologies into the building industry and the need to meet the new requirements of the people, the smart housing community has emerged as an upcoming but highly attractive phenomenon. The most important factors and capabilities of smart housing that consumers have put in place include security and safety, comfort, comfort management and energy saving, health promotion and more. On the other hand, despite the fact that the phenomenon of smart housing in the country and in particular of Tehran has become increasingly of concern to users, this research has been conducted in order to understand the effect of intelligent housing on reducing physical vulnerability based on scientific resources in a Tehran city.

In this regard the question is the extent of the impact of smart indicators on reducing the vulnerability of urban housing in the study area. To answer the question, confirm or reject the hypothesis of the elite community questionnaire (30) and to improve the research work using the AHP hierarchy technique the degree of physical vulnerability of residential units in the first district of Tehran has been investigated. Also with studies on the physical vulnerability of urban housing in District 1 of Tehran using the AHP hierarchical method, it has been determined that many residential areas in Tehran's 1st district are vulnerable because of the traditional and historical context of the first district of Tehran. Besides high-rise buildings, the great slopes of this area due to the proximity or range of Alborz mountains have also made lucrative and non-expert construction of this region as one of the most vulnerable residential areas in Tehran. And as clearly visible on Figure 4 red-tinted colours indicate the danger of being bogged down. Where risk factors such as faults, slopes and inappropriate structures are adjacent to each other they create critical and complex conditions for residential units and their inhabitants which are clearly marked in the above chart with more attention paid to the program RIZAN managers and residents themselves in the region. The results of the path analysis model also show that smart indicators have a positive and significant effect both directly and indirectly on reducing the physical vulnerability of urban housing in Tehran's first district. In general, it can be concluded that all three factors have a positive and significant impact on urban housing vulnerability reduction. But according to the obtained results it is possible to recognize the extraordinary importance of safety and security variables since they have the highest direct effect among the other two factors as well as its

Table 3: Results of path analysis of indicators effecting on the reduction of urban housing vulnerability

Correlation with the reduction of physical housing vulnerabilities	*Indirect effect*					*District 1 in Tehran*
	Total	*Comfort*	*Energy saving*	*Security and safety*	*Direct impact*	*Variables entered into the model*
0.890	0.402	0.009	0.009	-	0.892	Security and safety
0.243	0.025	0.021	-	0.004	0.398	Energy saving
0.230	0.843	-	-0.02	0.863	0.422	Comfort

non-direct impact on the well-being and attraction of attention. In other words, it can be said that all measures to reduce the vulnerability in this factor are summarized and require the adoption of positive measures and the attention of the authorities to improve the security and safety of citizens housing. Therefore, based on the results, the research hypothesis is confirmed. It can be said that the definition and representation of intelligent housing, the degree of its acceptance and existence in compilation and conclusion the country and the study area the effect of smart housing on physical damage are the most important findings of this research.

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