Survey of High Rise Construction Vulnerability and Changing Aggregation in Urban Designs
Case Study: Mashhad district 1

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ABSTRACT

Compact city model is one of the urban development approaches in recent decades, it is applied in order to use urban land optimally and to solve problems associated to appearance, public transportation and space in many advanced and under developed countries. The compact city approach has been revealed as increasing aggregation and of high rise buildings construction in Iran country and Mashhad as well. But the real matter is how much this increasing aggregation and constructing of high rise buildings adapt with social, economical, population principles and indicators and sustainable urban development. This research attempts to response the above issue. The methodology in this research is analytic descriptive. In this study, the skeletal, economical, social indicators and sustainable development are examined by statistical and GIS software. The used data in this study are provided through location data of the studied area and completing questionnaire (n=384) and then it was analysed by Lisrel software. The obtained results suggest increasing aggregation and constructing tall buildings in Mashhad district 1 city in different skeletal, economical and social aspects, aren`t adapted with sustainable urban development principles and increasing aggregation meanwhile decreasing environmental quality which have caused reduction of the citizens` different required services including educational, recreational and green space on the area and it has made problems for the citizens in the considered area. Also the purpose of increasing aggregation and high-rise building in the considered district was profitability.

Introduction

The fast growing process of urban population and consequently quick urbanity have caused more necessity of cities spatial development. The cities can develop horizontally or vertically and in this way required space for residence and activity is available for their habitants. Horizontal and sparse development of cities have caused destruction of agricultural lands and fields surrounding the cities and   increase of ecological pressure on environment as well, besides natural phenomenon in many cases doesn`t provide the possibility of horizontal growth of city. So today, the implication of compact city has posed in response of above issues. Therefore it can be said optimal use of urban land and resolving the issues related to urban appearance, space, transportation and... have posed high rise building or compact city model along urban sustainable development in many advanced and under development countries and high rise building in accordance to the above objectives has implemented in

many cities in these countries . Then compact city strategy or high rise projects can be the central base of future development of cities along the current and future issues of city (Mabhoot et al, 1392:1). Thereupon this research is focused on high rise building and increasing aggregation in Mashhad's district 1.

1. Statement of issue

In the recent decades, metropolises have expanded unprecedentedly. This skeletal expansion in many cases has been more than increase of population. High traffic within city, excessive distance between work place and home, environmental pollutions, irregular development of cities on agricultural lands, time, fuel waste and etc, all have been born by the discordant expansion of the city (Mabhoot et al, 1392:1). Optimal use of urban land and resolving the issues related to the urban appearance, space and transportation and,... have posed high rise building and compact city model in urban sustainable development in many advanced and under developed countries.

So in resolution of current and future issues of the city, the compact city strategy and high rise projects can be central base of future development of cities (the same reference: 2). However these kind of structures often are criticized, they always have proved their continual   appearance regarding to necessities and have added to provide their own activation as well (Kamali Poor, 3; 1388). As today increasing aggregation and construction of high rise building is the base of many urban designs, as much as possible engagement level of building have been reduced to accommodate   more population and to use open land in providing public campus and required services (Farhoodi and Mohammadi, 1380: 71). In addition through appropriate planning can make an appropriate relationship between usages of "habitancy, job, leisure time and commuting) within the city and it can provide proper life for current and future generation. The theory of compact city model has been pointed out by lots of urban experts to obtain urban sustainable development. In this regards issue of aggregation and specially "structure of aggregation" has been posed as the main tool of development control and urban compression and in other words city shape.

The urban experts who is in favor of high rise building, have mentioned benefits such as optimal and economical usage of urban land, short distance between urban usages, reduction of air pollution, reduction of fuel consumption, reduction of time waste and finally reaching to urban sustainable development for high rise building. On contrary, the opponents of this theory discuss problems such as cost and heavy technology of construction, being exclusive of this technology for particular number of advanced countries, centralization and excessive aggregation of population, invasion to the citizenship rights and activity in a point, environmental problems, impact of the earth and,… to criticize the compact city model.

But the point ought to be considered more than these cases is that high rise building in under developing countries and our country is expanding while it has not already been made indigenous, it doesn`t follow the systematic model of advanced countries and there isn`t proper recognition of the results and consequences of its development process. The lack of correct rules and regularities about high rise building has intensifies this concern, the aspects and phenomenon resulted from it, they are and will be more catastrophic than similar cases and benefits of high rise building as well.

Mashhad city`s high rise building had thrived before revolution and early of 1350s with hotel usage and residential apartments including construction of Mortafa` apartments or 550 units and 600 appurtenances apartments. After the revolution, construction of these structures also have continued including Zist Xavar with 18 floors involves commercial and residential units, construction of bank Melli residential complex and construction of residential apartments in developmental towns and areas such as Qasem Abad and Emamiye (Azizi et al, 1391:92).

The important factor should be concerned before construction of high rise building is optimal location and distribution of high rise buildings within the city, because this factor can influence on morphology of city, such as it reduces the deleterious consequences of aggregation by division of urban spaces equally and it moves toward urban sustainability recognition (Behravan, 1385: 3-4) and when urban development moves along sustainability, it can provide definite procedures to meet optimal service requirements of habitants (Moradi Masihi, 1384: 151). So a sustainable city is the city exploits its natural resources and get independent and give meaning to the habitants' life. As the goal of sustainable urban development process is reaching sustainability state of urban communities, through which establishment and reinforcement of sustainability features in economical, social, cultural and environmental life of city occur (Kalantari, 1385: 4-5).

Since in the recent decade high rise buildings have been considered in different views, it is necessary high rise buildings are known in different aspects and urban sustainable development is considered in their designing and planning. On one hand, it is considered in the recent years, construction of high rise buildings, particularly in

commercial use has grow significantly in Mashhad municipality district 1. Also this district has been known as a relatively proper zone for high rise building by Part counseling engineering company. therefore as to the above mentioned material, this research is focused on high rise building and increasing aggregation in Mashhad district 1.

3. Objectives of the research
   - Considering of urbanization criterions and causes of high rise construction and aggregation.
   - Evaluating of high rise construction state and resolving the problems in Mashhad district 1
   - Developing procedures for resolving the problems to increase aggregation and high rise construction in the studied district.

4. Research theories

1. It is seemed high rise construction in Mashhad district 1 hasn`t fitted with human criterions and urbanization rules and it is correlated positively with some problems for the citizens.
2. It is seemed high rise construction in Mashhad district 1 has been accompanied with the goal of profitability and land cost increasing and it is correlated positively.

5. **Methodology of research (society, statistical sample, tool of data collection and statistical method)**

Based on subject and studied objectives, the type of this research is scientific and functional scholarship. It has been studied in descriptive and analytical method. The required information have gathered by citation, library and field studies. In citation studies with assistance of data and statistics, little information is obtained. In library studies, research and geographical thesis, books and quarters have been used. And in field studies, data has collected by direct observation and preparing questionnaire and distributing between habitants in Mashhad district 1 city. The Arc GIS soft ware was used to consider the accessibility state and the rate of each uses per year in the studied area and the distance and rate of considered use extent were analyzed. It is also necessary to explain for evaluation of current state with optimal state, the base of urbanization standards and circumstantial plan of Mashhad city have been concerned. At first descriptive-statistical methods were used to analyze the resulted data from the questionnaire and then Lizrel soft ware used to consider quantitative data. In addition to measure durability of the questionnaire, Alfaker & Nabbax`s coefficient was used, the obtained coefficient is 0.875, it shows the prepared questionnaire has good durability.

6-Society and statistical sample

Statistical society in this research are the citizens of Mashhad district 1 city. The population of this district are 172.547. Since this sample size is very extensive and it isn`t possible to prepare questionnaire for all the citizens, therefore the sample size has to be determined. By applying Kokaran model and confidence coefficient of %95, the sample size for questioning this society is 384 persons.

7. Theoretical fundamentals

7.1 high rise

In Mo`een dictionary, high rise means having dignity and statue and degree and high state, high place and high location. There are diversified definitions of high rise and high buildings including:

Definition based on specification of building`s height extent: In Iran according to the magazine 112 of the country`s planning and management organization (executive laws of building`s protection against fire), the definition of high buildings is posed in this way: every structure its height (vertical distance between bottom level of the highest disposable floor and lowest level of achievable surface for firefighting vehicles) is more than 23 meters, is considered high building. Another definition is that the building which are higher than maximum height, people can go up them easily and in this case lift is necessary since as to the municipality`s terms in Iran, five floors building and more than it are obliged to install lift. As to this theory, five floor and more than it is assumed high rise. From building engineers` point of view when a structure is called high rise, its height causes side forces resulted from earthquake and wind influence significantly on its design and based on this fact, the buildings more than 10 floors are considered high rise. Moreover the buildings more than 32 are considered high rise in structurally engineering that its height to diagonal`s ratio is $\frac{14}{3}$ (Mabhoot et al. 1392:3).

7.2 Aggregation

Aggregation can be defined as a measuring system. The mentioned measuring system enables us to account and define the individuals' number in a specified surface of the earth as the population aggregation or the located

infrastructure in a specified surface of the earth as building aggregation mathematically and simply (Azizi, 1388:28).

7.3 Population aggregation

The ratio of population to the geographical area is called population aggregation. The unit of this index is population on hectare. This index represents in a given area how many people exist. On the other words more the amount of population aggregation, more the rate of activity in unit of surface would be.

7.4 Skyscraper

When high rise building is discussed, it is assumed all the people have the same vision about it. While it isn`t really in this way, not only among public but also in the frame of different views among experts as well there are different ideas in relation with the definition of these buildings. Generally high individual buildings which are with square or circle shape of plan or similar shapes such as star or cross geometrically and on one hand with height more than the embedded circle`s diagonal of the plan, is called tower .(Ayat Elahi, 75,18) In building engineering when we can call a structure high rise, its height causes lateral forces resulted from earthquake and wind have significant impact on its design and based on height, the buildings more than 10 floors are accounted high rise buildings. (Bemanian, 77, 8) From installation engineering point of view, a short building can describe a building its exploiters don`t need lift to reach to their considered floor. But if there is a lift, they use it permanently. Such as these buildings are mostly 3 or 5 floors. A mid-rise building is a building with 8 or 10 floors with the necessity of using lift by the exploiters. The high rise building includes 15 or 16 floors may equipped with a lift that serve to parts. Finally very high buildings are buildings with 30 or 40 floors which are equipped with shuttle lifts to serve the Sky lobbies. Barney,2003[*]) urban planners and designers often assume the buildings with more than 10 floors as high rise building . As Engineer Ahmad Saeedi Nia in fourth volume of his book "Green of municipalities" pointed out: "High rise apartments with more than 10 storeys so called tower" (Saeed Nia, 1382, 87).

From firing aspect in Iran, according to the building administrational instructions, protection against fire, the minimum floors of high building is defined 8 floors. From social issues aspect, the distance to monitor children and youth`s activities outdoors and calling them easily would be possible, it determines high rise building and this amount is between 30 to 50 meters and the height extent of being high rise for residential building is 32 meters. (Bemanian, 1377, 9 and 8) If such definitions are introduced for high rise buildings, but a particular criterion isn`t provided for such buildings. The altitude of building is relative and depends to the conditions as social conditions and individual`s images about environment and it is defined considerably as to the neighborhood`s custom. Since among skyscrapers of cities such as New York and Chicago, 40-50 floors buildings seem short floor, while these structures for big European cities are accounted high rise buildings (the same as 9). It can be concluded in this way, being tall of a structure is a relative issue is interpreted in time and place conditions and the terms of acceptation and definition of tall structures are different. In the current research with regard to time and place conditions of Mashhad city, the buildings with 10 floors and more, their height from the adjacent pathway surface are more than 20 meters are considered as tall structures.

7.5 The philosophy of establishing high rise construction

The construction of high rise structures since early forming human cultures so far has attracted man`s attention. The state and origin of this attention has mainly religious and political origin and it leads to the belonging and bondage feeling for the masses without necessity against the owners of these structures. Constructing the structures such as ancient temples, churches, mosques and … which are applied as like single high structure and with authority, dominance and absolute Sovereignty in urban space around themselves, are witness of this claim. Based on historians` opinion, the first residential high buildings are belonged to the ancient Room, in third century B.C gradually by increasing the population, the height of buildings were increasing with the same ratio as well (Azizi and Motevasseli, 1391: 92). The event of European industrial revolution and the following changes occurred in 18 and 19 century A.D, made underlying changes in people`s style of life. At the same time, several inventions and discoveries have accelerated this process. This changes caused building new cities and also fast developing many of the current cities and following it, benefiting tall buildings with today style is used as one of the urban development solutions (Bemanian, 1390:9) .

High buildings have popularized as the result of ever growth of population, lack and expensiveness of land and problems due to horizontal development of cities. The structures were initially introduced to exploit the lands of

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[*]- http://www.elevator-world.com/magazine/archive01/9703-001.htm

downtown and with regard to the city`s economics. In fact for land limitations in this district of the city, increase of structural aggregation is exploited as a solution for increase of infrastructural surface. Comprehensive use of this method gradually involved administrational and commercial application in addition of residential application and it also extended to the surroundings of the city (Eqbali, 1387: 123). In general speaking, the vertical development of the city can response to many urban issues such as lack of land and housing, reduction of transportation, reduction of urban installation, prevention of horizontal growth of cities, reduction of imposed loss on environment etc (Yar Ahmadi, 1378: 29).So today the concept of compact city has pointed out as a response to the above issues. Intensive growth of city need constructing on the height and changing the urban construction model. In this way high rise buildings have transformed to one of the symbols and requirements of metropolises of century 21(Adeli and Sardarre 1390: 2). These buildings initially established as an indication of communities` technological advances and symbols of power in advanced cities and a response to intensive growth of population and lack of land to construct residential units. But gradually the crisis of energy and environmental pollutions in machine cities, have caused changing the views in deciding about urban policies (Rahnama and Abass Zade, 1385: 101). However the tall buildings are final outcome of a complicated process whose elements have mutual effects on each other and several factors such as cultural, social and economical features have influence on it, the possibility of optimal and proper use of high structures are provided by following fundamentals and criterions of architecture and urbanization. Generally regarding to particular conditions of current century, proper and of course conditional use of tall buildings is a realistic and idealistic solution to accommodate people and to provide other needs related to social and economical activities in big cities (Bemanian, 1390: 10). The factor adds the importance of high rise construction more than other factors in the current century is growth rate survey of world population. The world population in 2013 reaches 7 billion people and 1.16% or in other words around 80 million people are added to the world population yearly. Three countries China, India, America consist more than 40% of the current world population. If warning rate of urbanite population of the world is added to this huge figure, it isn`t difficult to understand why there are excessive impact on high rise construction. During the recent years Satellite cities have appeared in potential response to the wonderful growth of the population in the emerging economics of China, India, Saudi Arabia and Dubai. These new societies are cities with aggregated development for 100 and 150 thousand people where work, life, leisure, education and shopping all are placed with walking accessibility beside each other and they just take up one kilometer of land area. One main factor of these cities success is that they are walking oriented. As a result expensive structures of parking are reduced and provided more environments without automobile by the minimum vehicle ownership and minimum demand and parking facilities. This factor also reduces the trace of carbon in the societies considerably. The Satellite cities are designed to be completely sustainable and to have maximum gain from techniques and fundamentals of mass construction planning in using wind, solar and geothermal energy. In some cases these cities are equipped with central systems to collect rubbish and to transform it to energy, collecting water and reusing, smart network technology, green roofing technology and collective planting of food products and production systems of hydroponic foods (to reduce water consumption). The average aggregation of these cities is 10 and 12 floors and the most aggregated structures are located next to the transportation stations (Islamic counsel center of researches in Mashhad city, 1393: 1-2).

In Iran high rise construction is applied in metropolises and big cities more than half a century. This subject in the recent decades mostly is influenced by functional requirement and generally residential use and it is attended by the purpose of using expensive land and has extended as a response to the house requirement. Establishment of tall building and towers in different kinds, tall, half tall and disconnected and continued form in different cities express the correctness of this issue (Azizi and Motevaseli, 1391: 92). Of course it is noted in Iran enough experiences have not achieved yet by the holders of high rise construction and the needed system and terms have not provided such as facilities including gyms, library, theater, private shopping center and even public spaces such as proper parking and enough and suitable green space as saving are removed initial schemes and they get only residential units. Meanwhile discussion of cultural intervention and contrasts also hasn`t considered. In the other words in Iran, high rise construction has often formed without localization. So the conducted surveys represent significant negative consequences and impacts on citizens that affect on conventional human life scopes. Therefore the proper ground and context has provided to weaken the cities` stability and urban life quality (Safavi, 1380:69).

8. Deductive statistics and testing theories

In this section at first description of analysis methodology in this research (structural equation modeling) is argued and then the research theories are evaluated and tested by this method.

9.Structural equation modeling

Structural equations modeling are a very general multi variables technique in a multi variables regression family which enables the scholors to test a set of regression equations simultaneously. Structural equation modeling is a comprehensive approach to test theories about the observed and latent[†]variables relationships that analysis based on covariance is sometimes called casual modeling and is sometimes called Lizerel, but the dominant term these days is structural equation modeling or SEM in abbreviation. Its main application is multi variables subjects that can`t be performed by two variable method and considering an independent variable with a dependant variable. The ability of this tool is in simultaneous evaluation of different relationships among variables, testing and comparison of similarities and differences among different groups who participate in the study, in a way the relationships among several independent and dependant structure is evaluated at the same time.

So in this study according to the mentioned materials above, the Lizrel soft is is used to test the theories. Lizerel is a soft ware product that has been designed to estimate and test the structural equations modeling designing; it is supplied by "Beh Bazar international scientific soft ware company". This soft ware can estimate or deduce the values of load factors, variances and the errors of latent variables by applying measured covariance dependence and it can be used to conduct discoverable factorial analysis, the second analysis, confirmatory factor analysis and route analysis (cause and effect modeling with latent variables) too.

To evaluate structural equations modeling, there are different indexes that are called propriety indexes, these indexes are continuously compared, developed and evolved but it isn`t compromised even about a universal optimal test.

Indexes which are used in this research including: relative chi-square that is calculated by simple dividing of chi square value by freedom degree ($\chi2/df$) that acceptable value is between1 to 3. The [‡]RMSEA index shows acceptable models have the value less than 0.08. Also the indexes of AGFI[§]،GFI[**] ،IFI[††] ، CFI[‡‡] و NFI[§§] show the acceptable value for these indexes should be more than 0.9. It is mentioned to evaluate required significant, t-values are used, if they are more than 1.96 or less than -1.96, they will be significant on 95% confidence level.

Diagrams 1 and 2, the route coefficients and t-values respectively related to the structural equation model, represent studied theories to evaluate.

[2.] The variables aren`t measured directly and their value is calculated from estimation of observed variables in the model.

[‡] . Root mean squared error of approximation

[§] . Adjusted Goodness of Fit Index

[**] . Goodness of Fit Index

[††] . Incremental Fit Index

[‡‡] . Comparative Fit Index

[§§] .Normal Fit Index

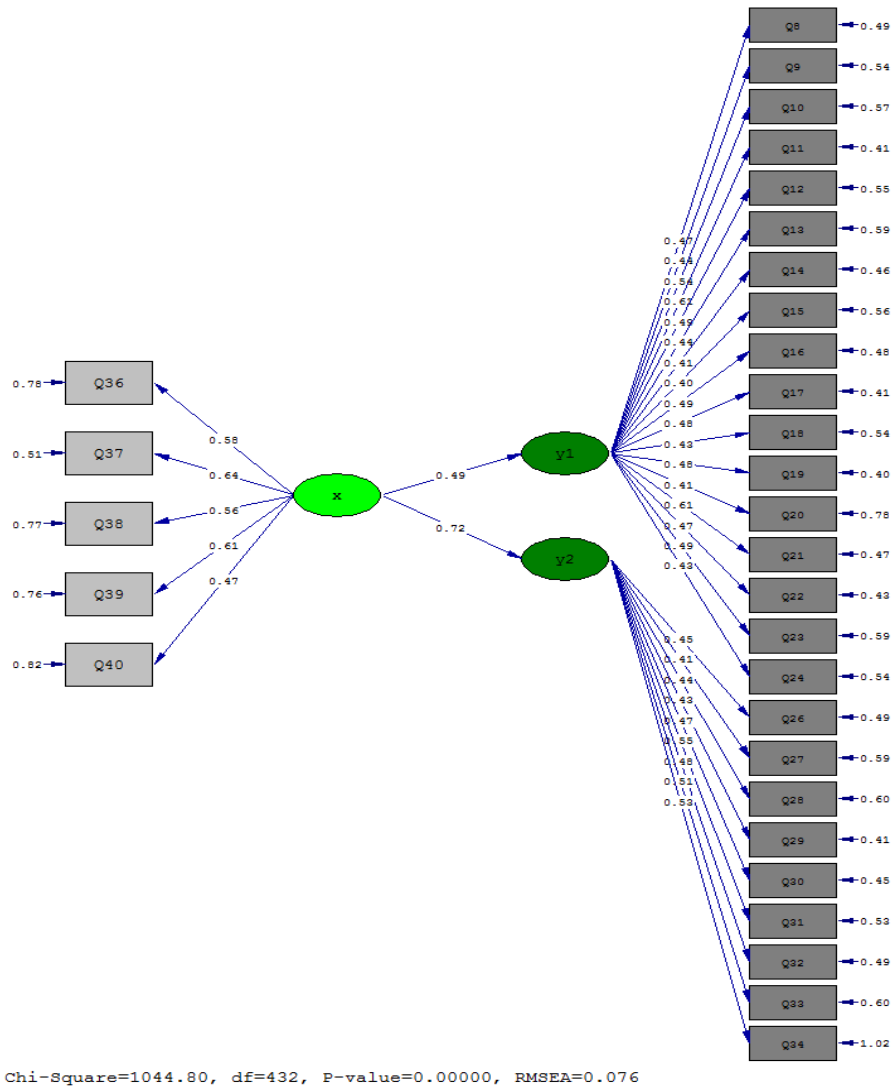Chi-Square=1044.80, df=432, P-value=0.00000, RMSEA=0.076

Diagram1. The factorial coefficients Diagram and route coefficient of research model
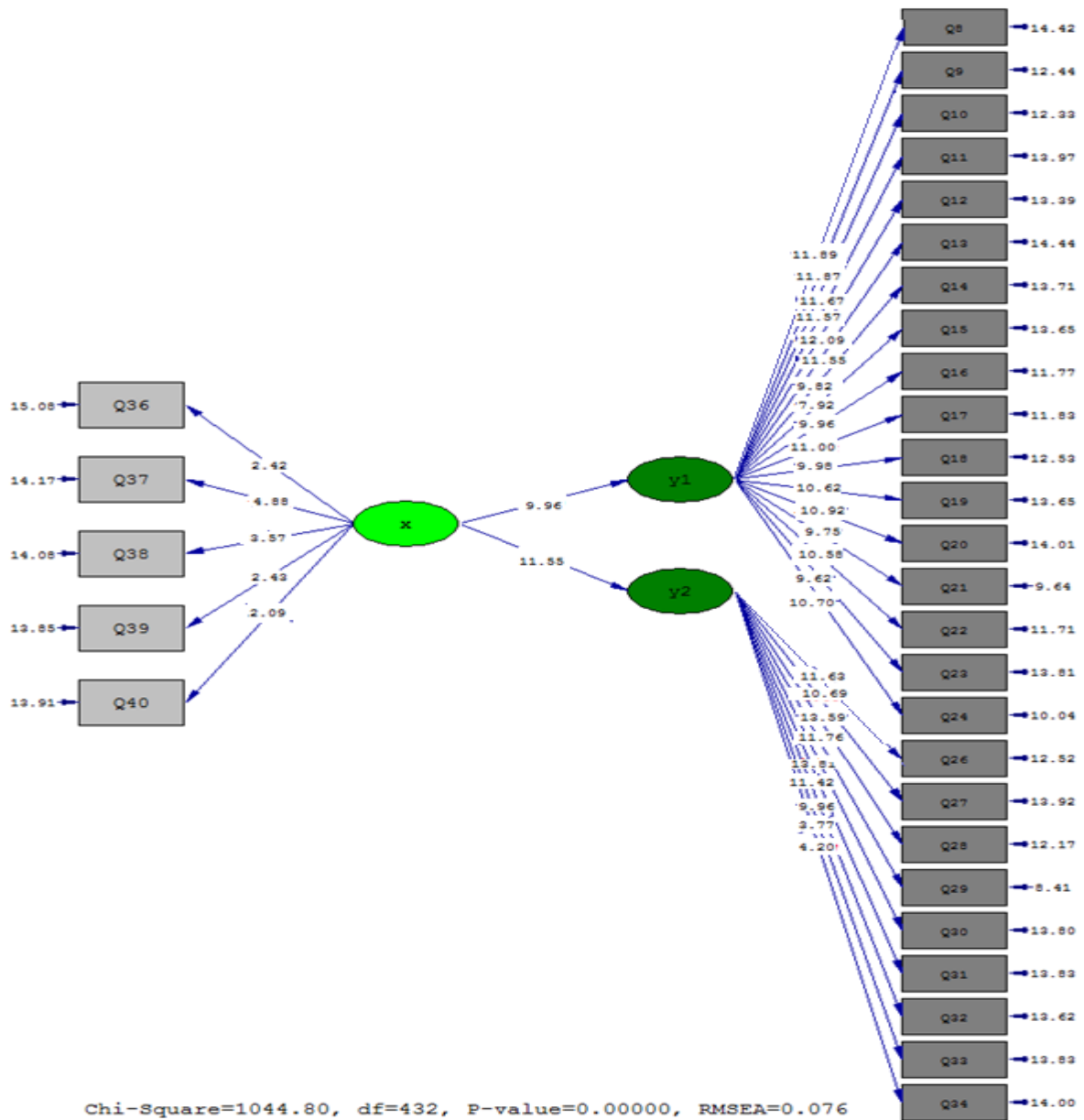
Diagram 2. T. statistic rates diagram for research model

Where:

x:aggregation (independent variable), yl: problems occurrence and y2: profitability (dependant variables)

The results of confirmatory factor analysis are provided in the following table. As it is observed in table1. The t-values related to the load factor are more than 1.96 so it can be concluded the selected questions provide proper factor structures to measure the studied variables in this model.

Table2. The results of confirmatory factor analysis model

t-value	load factor	questions	variables
11.89	0.47	Q8	problems occurrence
11.87	0.44	Q9	
11.67	0.54	Q10	
12.08	0.61	Q11	
11.57	0.49	Q12	
12.09	0.44	Q13	
11.55	0.41	Q14	
9.82	0.40	Q15	
7.92	0.49	Q16	
9.96	0.48	Q17	
11.00	0.43	Q18	
9.98	0.48	Q19	
10.62	0.41	Q20	
9.75	0.61	Q21	
10.58	0.47	Q22	
9.62	0.49	Q23	
10.70	0.43	Q24	
11.63	0.45	Q26	profitability
10.69	0.41	Q27	
13.59	0.44	Q28	
11.76	0.43	Q29	
13.81	0.47	Q30	
11.42	0.55	Q31	
9.96	0.48	Q32	
3.77	0.51	Q33	
4.20	0.53	Q34	
2.42	0.58	Q36	aggregation
4.88	0.64	Q37	
3.57	0.56	Q38	
2.43	0.61	Q39	
2.09	0.47	Q40	

Also in table 2, pertinence values indexes are represented. The RMSEA value is 0.076 and since it is less than 0.08, it shows this model is acceptable. Also the relative chi- square means chi square divide by the freedom degree that is $(\frac{1044.80}{432})$ and it is between 1 and 3 and the values of AGFI ، GFI ، IFI، CFI وNFI indexes are more than 0.9. In sum, the indexes values are matched with interpretive criterion and confirmatory factor analysis approves the considered structure of the variables in this research.

Table 3 .The indexes of research model fit

χ2/df	RMSEA	NFI	CFI	IFI	GFI	AGFI
2.41	0.076	0.94	0.93	0.92	0.91	0.92

Since validation of the questions related to the variables and questionnaires aspects, in next section testing and surveying the research theories are argued. As to diagrams 1 and 2 the summery of the obtained results from the fitted model are represented on table 3. As mentioned the routes their t-values are more than 1.96 and less -1.96, are significant.

Table4. The results to test research theories

Theory	The relation of the case study	Route coefficient***	t-value	Result
First	Aggregation ⟹ problems occurrence	0.49	9.96	significant
second	Aggregation ⟹ profitability	0.72	11.88	significant

Survey of the first theory: it is seemed high rise construction on Mashhad district 1 municipality hasn`t been matched by human criterions and urbanization rules and it correlated positively with problems for citizens. In this theory according to the table 3, the route coefficient between aggregation and problems occurrence is 0.49 that is a positive value. The t-value related to it is 9.96 that is more than 1.96, hence with 95% confidence it can be concluded the route coefficient is significant on error level of 0.05 and the significant and positive (direct) relationship between these two factors is approved and it can be said high rise construction on Mashhad district 1 municipality hasn`t been matched by human criterions and urbanization rules and it correlated positively with problems for citizens. So the first theory of the research is validated.

Survey of the second theory: it is seemed high rise construction and increasing aggregation of Mashhad`s district 1 was incorporated with profitability and growth of land price and correlates positively with them.

In this theory according to the table 3 the route coefficient between aggregation and profitability is 0.72 that is a positive value. The t- value related to it is 11.88 and it is more than 1.96, hence with 95% confidence it can be concluded the route coefficient is significant on error level of 0.05 and the significant and positive (direct) relationship between these two factors is approved and it can be said high rise construction on Mashhad district 1 municipality has incorporated with growth of land price and correlates positively with it. Thus the second research theory is validated.

Conclusion

The conducted surveys show the citizens and habitants in Mashhad district 1 believe high rise construction hasn`t caused just and fair distribution of opportunities for all the citizens. The results of the second chi square test represent most of the responses have been arranged between low and very low that represent the citizens don`t satisfy with this issue and it has made problems for the habitant citizens of this area.

Moreover the conducted surveys show high rise construction and increased investment on district 1 has increased the validity of the neighborhood. The result of the second chi square test show most of the obtained responses from the habitants have been ranged between high and too high that represent the citizen believe the validity of the neighborhood has been increased after construction of high rise buildings and the purpose of investment has been to gain profit for the investors.

Suggestions

1. As to increasing the building aggregation and increasing the buildings in the studied area, it is suggested along these constructions, some actions are performed to increase educational per capita, green space, sport spaces.
2. As to increasing the building aggregation and increasing the buildings in the studied area it is suggested the municipality of this district increased the amount and quality of the urban services.
3. As to the abundant social and economical consequences of the increased aggregation of high rise buildings it is suggested the urban managers consider public benefits.

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