

Site Selection of Public Parking in Isfahan City, using AHP Model

M. Ahmadi Baseri, R. Mokhtari Malekabadi, A. Gandomkar

Abstract—Nowadays, one of the most important problems of the metropolises and the world large cities is the habitant traffic difficulty and lack of sufficient parking site for the vehicles. Esfahan city as the third metropolis of Iran has encountered with the vehicles parking-place problems in the most parts of fourteen regions of the city. The non principled and non systematic dispersal and lack of parking sites in the city has created an unfavorable status for its traffic and has caused the air and sound pollutions increase; in addition, it wastes the most portions of the citizenship and travelers' charge and time in urban pathways and disturbs their mental and psychical calmness, thus leads to their intensive dissatisfaction. In this study, by the usage of AHP model in GIS environment, the effective criteria in selecting the public parking sites have been combined with each other, and the results of the created layers overlapping represent the parking utilitarian vastness and widths. The achieved results of this research indicate the pretty appropriate public parking sites selection in region number 3 of Esfahan; but inconsequential dispersal and lack of these parking sites in this region have caused abundant transportation problems in Esfahan city.

Keywords—Public parking lots, Parking site selection, Geographical Information System (GIS), Hierarchical Analysis Model, Isfahan city.

I. INTRODUCTION

IN majority of the large cities, the few widths of the pathways and the street margin parking-places, the duple ceasing and furtive movement of the vehicles finding a parking site have caused an intensive disturbance in the passing traffic. The problem of vehicle parking sites shortage in the cities and the inconsequential dispersal and inappropriate parking sites selection are among the intricate and difficulties which have encountered daily life of this city's citizenship and travelers with problems. Esfahan as one of the large cities of Iran contains the intensive population's accumulation and centralization; on the other hand, it has many tourist attraction applications which cause of the coordination shortage and inappropriateness between this city's attraction applications and the parking lot usages, in addition the inaccurate locating and the inconsequential dispersal of the parking lot application, it has faced the intensive traffic problem. This difficulty in number 3 region of Esfahan which from the view point of tourist attractions outranks among the existent fourteen regions is critical and includes abundant inappropriate condition.

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Vang and Sung [1] in an article named "Combinatorial Optimization of Congested Road and Parking Charging" point to the congestion of the traffic as a dominant problem which has stockade the permanent development of the urban transportation; in addition, they have surveyed the analysis of the transportation network, travel charging and cost, and the traffic demand; They have come to this conclusion that TDM is an effective solution to reduce the traffic congestion of the urban regions and it is possible to lessen this congestion notably by the usage of the combinatorial optimization model.

Also, Farzanmanesh and etal [2] in an article named "Parking Site Selection Management Using Fuzzy Logic and multi Criteria Decision Making" have surveyed the parking site selection in traffic jam regions of Esfahan and they have come to this conclusion that among various multi criteria decision making models for parking site selection, the usage of AHP model and fuzzy logic in GIS are the best public parking Sites Selection implements.

Casido [3] in an article named "Real-Time Parking Information Management to Reduce Search Time, Vehicle Displacement and Emissions" has surveyed the real time parking information management in order to reduce search time; in addition, he has pointed to the considerable environmental pollution emanated from the vehicles' search time finding a vacant parking site. He has concluded that by surveying the drivers' behavior and the accessible parking sites, also by evaluating the management and utilization of the parking site information, we can reduce the time and distance for parking site searching and lessen the environmental pollution emanated from this searching.

Lai and etal [4] in an article have considered the fire fighting stations' selection by the combination of GIS and AHP. They came to this conclusion that combination of the above methods for the urban applications selection are very useful and simplify the complicated problems.

Sayed Moosavi [5] in his MS thesis proposal named "The Geographical Analysis of the Problems and the Public Parking Sites Difficulties in Esfahan" studied and analyzed the public parking sites and their shortages and problems in Esfahan; in addition, by considering the problems in creating the public parking sites in Esfahan he concluded that parking sites in Esfahan do not have a logical emission, there is a considerable shortage in this regard and the vehicles parking sites demand in this city has not been accomplished.

Ghanbari [6] in an article named "Parking Site Emission and the Optimized Function in Urban Transportation Network" by emphasizing on parking sites location and selection and the usage of GIS, in addition, by utilization of Network Analysis method and according to the permissive speed of the vehicle's movement in the pathway network and

the length of the related pathways in GIS environment has studied and evaluated the space emission, the establishment site, and the existent public parking sites' function vastness in Esfahan city. Eventually, in order to collate the gained data and information, he has announced the hierarchical analysis model the best one.

Mokhtari [7] in an article named "An analysis in Functional Planning of the Parking Site in Esfahan City" by usage of the regional planning and functional models has surveyed a comprehensive statistical model about the applicability of parking sites in Esfahan with regard to three models of regional planning; in addition, has studied the other 11 regions of Esfahan from the view point of the applicable parking site capitation. From the results of this research, we can allude to the regions exploration about the parking space and capitation, also the regions precedence from the view point of the parking site shortage.

The purpose of this study is to survey and recognize the existent status of the parking site applicability and its present emission in number 3 region of Esfahan, the utilization method of the new parking site selection technologies and its role in parking site organization in number 3 region of this city; in addition, survey of the logical emission of public parking sites has been considered.

II. METHODOLOGY

In this research, at first the effective criteria in parking site selection have been declared; then in GIS environment, the related layers to each criterion have been provided and by the usage of the multi criteria decision making model of AHP, the layers with regard to their importance coefficient have been combined and overlapped with each other. The ultimate layer is the plan of parking width utilitarian.

In evaluation of each subject we need the measurement criterion or index. The appropriate criteria selection gives us this possibility to compare the alternatives and locators appropriately. But when one or some criteria will be considered for evaluation, this function gets complicated. This complexity increases when one or some of these criteria being against each other and from various kinds. In this case, the evaluation and comparison function exist from the simple analytical shape which mind is able to perform it; therefore, a strong analytical implement will be needed. One of the capable implements for such situations is the hierarchical analysis process [8]. The hierarchical analysis model is one of the strongest multi criteria decision making techniques which in 1980 was represented by a researcher named Thomas Sa'ati a professor from Petersburg University. In spite of some critics, it was complimented and praised by many scientific cliques. This method which reflects the natural human's behavior and thought will make the decision maker able to offer the cooperation between various criteria in complicated and non systematic situations. This technique simplifies the decision making through the emotion, cognition, assessments and judgments organization. In addition, it identifies the effective powers on decision making [9].

III. DISCUSSION

In this study, three main criteria and four sub criteria have been selected as the most effective public parking sites selection. Chart number 1 shows the hierarchical structure of the problem. The exchange of the subject or the surveyed problem to a hierarchical structure is considered as the most important part of hierarchical analysis process, because in this part by the analysis of the complicated and difficult problems, the hierarchical analysis process will change them to a simplified form in order to conform to the human's mind and nature.

By application of AHP side program in software Arc Map, during the dual comparisons and in two phases, the ultimate model and the parking site selection result have achieved in layer figure. In the first step, the dual comparison between the sub criteria of tourism attraction centers was performed and in the other phase its result was dual compared to the distance criteria from the pathways network and also the region estate value; according to the results of their overlapping with each other, the utilitarian widths of the parking sites structure have been achieved. In table 1, the dual comparison matrix of the distance sub criteria from the tourism attraction centers, the layers weight vector and the accordance ratio of the dual comparison from the first step have been presented.

According to the hierarchical model calculations in sub criteria phase of tourism attractions centers and the above table, number 1 formula is achieved:

$$I=0.5511(a1) + 0.2642(a2) + 0.1171(a3) + 0.0676(a4) \quad (1)$$

In number 1 formula, a1 is the sub criteria of the distance from the commercial centers; a2 is the sub criteria of the distance from the sanitary-therapeutic centers, a3 is the sub criteria from the official-governmental centers and a4 is the sub criteria of the distance from the educational-recreational centers.

In table II, the dual comparison matrix of the distance main criteria from the tourism attraction centers, the criteria of the distance from the pathways network, the criteria of the estate value importance, the layers weight vector and accordance ratio dual comparison of the main criteria from the second step have been presented.

According to the calculations and dual comparisons of the main criteria in above table, formula number2 as the second phase formula for the overlapping functions has been utilized.

$$I= 0.6548A + 0.2498B + 0.953C \quad (2)$$

In formula number 2, a stands for distance from the tourism attraction centers, B is the distance criterion from the pathways network, and C stands for the criterion of the region estate value.

Figure 1 displays the public parking sites utilitarian widths of region number 3 in five levels; in addition, Figure 2 represents the suggested parking sites in abundant appropriate widths of this region which there are no parking lots in them.

TABLE I
 THE DUAL COMPARISON OF THE DISTANCE SUB CRITERIA FROM THE TOURISM ATTRACTION CENTERS

Sub criteria	Distance from the commercial centers	Distance from the sanitary-therapeutic centers	Distance from the official-governmental centers	Distance from educational-recreational centers	Weight Vector
Distance from the commercial centers	1	3	5	6	0.5511
Distance from the sanitary-therapeutic centers	0.3333	1	4	3	0.2642
Distance from the official-governmental centers	0.2	0.25	1	3	0.1171
Distance from educational-recreational centers	0.1667	0.3333	0.3333	1	0.0676

CR=0.0878

TABLE II
 THE DUAL COMPARISON OF THE MAIN CRITERIA

Criterion	Distance from the tourism attractions centers	Distance from the pathways	Estate Value	Weight Vector
Distance from the tourism attractions centers	1	3	6	0.6548
Distance from the pathways	0.3333	1	3	0.2498
Estate Value	0.1667	0.3333	1	0.0953

CR= 0.0176

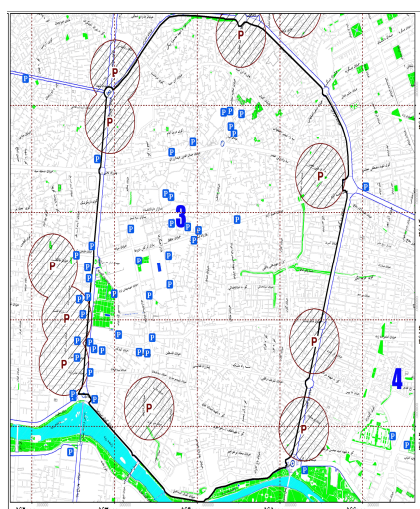


Fig. 1 Public parking sites utilitarian

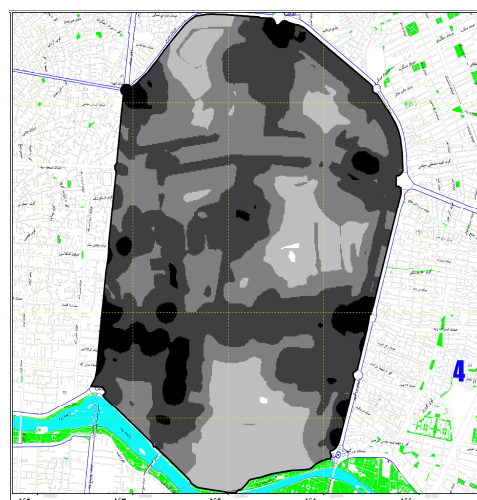


Fig. 2 Suggested parking sites

IV. CONCLUSION

The achieved results of the field studies and the locative analysis in this research represent the unbalanced distribution of the tourism attraction users and also, the inconsequential dispersal of the public parking sites in the region. In northern ranges (around Ghods Square and at the head of Majlesi street), in eastern ranges (Bozorgmehr street and the head of Hashtbehesht street) and also, the southeastern ranges (Bozorgmehr street and Zayanderood River margin) of this region despite the existence of many important applications which are the abundant urban tourism attractions, there is no parking site.

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