Investigation into Different Systems of Material Warehousing: A Proposed Optimum System

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Abstract: Immediate layout and positioning equipment on construction sites to minimize transport distances between locations of equipment, and to improve site performance for usefulness and safety, although important, are complex issues. Traditional systems to optimize tools cannot provide adequate solutions. Given the importance of locating the site for the material warehousing in terms of reduction the cost of shipping materials and a reduction in the amount of storage space for materials, the importance of the research in this area seems clear. In an effort to improve the planning the construction sites location, this paper offers a flexible multi-unit approach for sites and equipment. Also, taking into account different systems of material warehousing, including the system for tools and equipment warehousing on irregular construction site plans, Nonstructural Fuzzy Decision Support System (NSFDSS), computer-supported site positioning systems, and potential application of GIS system for locating the construction equipment, are all touched upon duly. This paper tries, while going over each of these material warehousing systems, to come up with the optimum and proper method as the best alternative.
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1. Introduction

In recent years, special attention to design the different systems of material warehousing, and positioning tower crane in order to cope with the operations relating to transportation of materials has been paid. Over time, the importance of research to provide the optimal system for these essential matters has increased largely. What has made clear this importance is the reduction of the cost and amount of space has been allocated to the material warehouse. Since the research in Iran in this area is meager, it is clear the importance of finding the optimal method.

2. To optimize the design of storage, tools and equipment system on irregular construction site plan

Although immediate layout and locating of equipment on the construction site to minimize transport distances between the locations of equipment and improve site performance as for utility and safety is important, the layout of locating is literally complex. The traditional system of instruments cannot provide sufficient solutions. In an effort to improve the design of construction sites, this paper presents a flexible multi-unit approach for sites and equipment. For the design of models genetic algorithms is used which unlike the traditional optimization tools is the powerful one, and in the meantime an example for the development of the model is described as well.

2.1. Locating places on the site include:

Detecting size and locating the immediate tools and equipment on a construction site is requisite. The span for immediate equipment is as follows:

1) Fabrication shops
2) Maintenance shops
3) Batch plant
4) Residence facilities

In genetic algorithm the reduction of time and cost is managed optimally. This algorithm randomly picks up some places as solution. In this study, each irregular site is of two sizes in the network. Each instrument is placed in one of network's units. Suppose, there are three samples of equipment or instruments to the area of 50, 120 and 90 square meters. In this case the selected number for modular network is 10 square meters. (GCD), for example, of 5 samples for area surface of equipment are 20, 30, 50, 100 and 200 square meters ,then the GCD for the two smallest numbers are ignored. That is, the number 50 is selected and the networking units will be based upon 50. The next stage is to select the row and column for the place of locating. If for place the row is 7 and column is selected 5 the reference location will calculated according to following formula:

Reference location = (Location row - 1) ×Number of columns + position of selected column. Then;

Reference location = (7-1) *11+5=71

Typical situation is depicted in Fig 1.

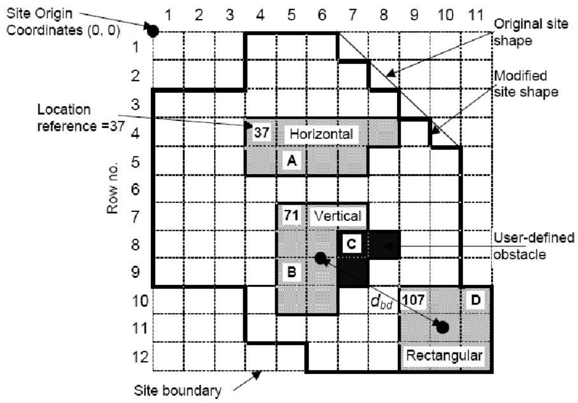

Figure1. Locating site and equipment

The assigning of range can be done either vertically or horizontally. Locating the equipment at points A, B is designed rectangularly. The width of equipment's position is selected the root of integer; unit of networking. For example, the root of 9, 3, or the root of 8, 2, is opted as the width of the area. Excel software is also used for specification of starting point of equipment's network place.

2.2. Optimal positioning of equipment and tools using genetic algorithms

This movement is based on the fact that locating equipment is carried out without any influence on tools' changes and other place. It is done by project manager and logical numerical weighting between two equipment.

Genetic structure of a serial chain system to positioning of the elements constituted the reference location that is equal to the length of the rows together. Each genetic offers a solution to the problems. In this method, the overall distance of going and returning between places is determined by the location of the site. In doing so, the least observing function for reaching the optimal locating will be rendered. Meanwhile, to assess the overall distance of the shuttle on the site, the original intervals are determined and on which the subsequent intervals will be based. Distances between xb, yb from original location B, 5.5 and 8 units have been set. So the distance from D is set equal to xd = 9.5 and yd = 10.5. On the other hand, distance between A and B:

$$\sqrt{(9.5-5.5)^2+(10.5-8)^2} = 4.72$$

Among the random selection of algorithm, we can change picked cell data. Using this method, we avoid the least determination of the locating.

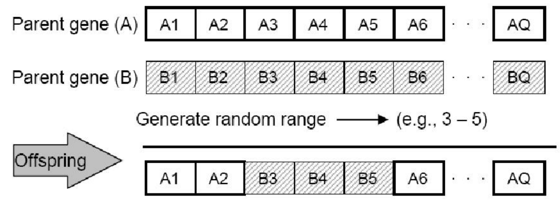

Figure 2. Random positioning of the cells for locating

3. To use Nonstructural Fuzzy Decision Support System (NSFDSS)

By this method, complex systems of construction are evaluated and located by computer.

This processing is carried out even without enough given information. With respect to cost, model, quality and safety requirements are implemented. Regarding different crises arise, type of construction, density of development and site slope in this system decision making is very important, so that this planning in execution of project has a very great impact.

Locating on site in regard to information, approval and availability of equipment is done.

This will take into consideration to minimize time in travelling the distance and cost. This method is executed in three stages of combination and prioritization:

1) At the first stage, the building elements are divided into different grades.
2) At second stage, critical locating will be done.
3) At the third stage, main crises are determined.

While non-critical cases place at lower ranks, the judgment about comparison is thus that the low-level grade will be compared to high-level grade and this comparison is done by means of data matrix. In Fuzzy Logic information is prioritized as 0 and 1. Beauty of fuzzy logic is considered through predication by hand.

But precisely members cannot be defined, like traditional theory, the exact boundaries are not clear.

3.1. Notes

3.1.1 In the absence of detailed information, NSFDSS is suitable for primary site location.

3.1.2 Re-evaluation and selection process for original equipment of site, such as tower cranes, hoisting material devices, storage area are appropriate.

3.1.3 Factors of site assessment will affect the evaluating the results of the site. Therefore, the needs are specified according to the factors of evaluation process.

4. Computer-supported site location

Locating the inventory or equipment is done with the help of AutoCAD software, given the environment and the closest place. The development model is carried out in two stages: site description, space and location analysis.

The model includes:
i) The site subject
ii) The issue of construction
iii) The Subject of constraints

These structural equipment are part of creating a modern new subject and re-using model. In spatial analysis based on geometric reasoning, the closest place to place best equipment is calculated. Resources include:
i) Money
ii) Time
iii) Materials
iv) Laboratory
v) Equipment

Minimizing construction costs and transportation time, the increase in profit and improvement in safety will take place. In an effort to achieve an efficacious model, the score Q was considered. This score combines different weights and re-locates the nearest point.

Other efficient factors include:
i) The number of constraints
ii) The total weight of restrictions
iii) Time of arrival
iv) The number of imported items

The process by means of processed design and also based on weight is prioritized, in this way, will benefit comparison system.

4.1. Positioning control model

At this stage, the two functions are used to control the location of the subject on site:

1) The spatial analysis of the site to determine the optimal or the nearest optimal location on site to determine the most appropriate category.

2) To arrange the issue of construction on site. Each of these duties with respect to the spatial analysis and the location of the main models, are determined respectively.

4.2. Points

i) This method is panned and designed by AutoCAD software.
ii) The graphics in this method is important.
iii) Mostly applicable to industrial projects and change and determining situation will be fulfilled easily.
iv) The accuracy of this method would be slightly lower.
v) Speed will boost in this method.
vi) Time and cost are controlled for locating.
vii) Transport distances are set and the nearest distance is selected.

5. Potential application of GIS for locating the construction equipment

Geographic Information System(GIS) has experienced one of the fastest growth in computer-based technology during the last two decades. But the full potential of this technology has not been exploited yet. The foundation of this method is locating the subject area of construction where GIS can be influential. Immediate placement of equipment such as tanks, production centers, repair centers, concrete curing equipment, construction equipment and local facilities have the greatest impact on reducing the cost and increasing the efficiency of the construction's tools, especially for large projects.

5.1 Analysis of network description out of four composed elements

i) The resources
ii) The re-location where the resources are set.
iii) Reviewing the resources for use in an appropriate direction.
iv) Using the restrictions of existing on site and their locating.

These data is extracted by GIS and converted appropriately for consumer. Different maps are used in this way.

Such as:
1) Thematic maps
2) Choropleth maps
3) Isorithmic maps
4) Dot maps
5) Line maps
6) Animated maps
7) Landform maps
8) and Cartograms

These maps are produced with different graphics:
1) Bar charts
2) Pie charts
3) Scatter plots
4) and Histograms

Qualitative and quantitative methods are exploited for GIS method too. This number evaluates real cost of transportation at one time or the movement of materials at one time at military or shipping zones. This is done through weighing between two tools vis-à-vis other tool. The spatial information is also used at the process of optimizing the deployment of tower Crane. Deciding on the first choice, GIS will indicate the first category along with the ensuing groups respectively and will compute the shared boundary and overlapping spaces. Overlapping border is deleted at a short distance from previous method. GIS tool with AutoCAD projects, Project Management (PM), Equipment Management (EM) are utilized.

6. Results and comments

Considering the vastness of projects and the magnitude of material warehouse and optimal positioning on site, construction projects are divided into three levels: macro, micro, medium. Taking into account the executed analysis in four locating ways, it seems:

6.1 For small construction projects, for example house building with the standard number of floors using genetic algorithm and modular networking which is the first method is optimal. Due to this method is run by professionals with low level of information and even for subcontractors is executable and does not require software skills in some of the workshop. It bears appropriate accuracy for small civil projects .Examples can be buildings of four or five floors, streets curbs, or pavement of sidewalks.

6.2 For medium civil projects use of NSFDSS analysis method, the second method fits better. In view of the importance of primary locating of equipment for medium civil projects, this method can be applicable. Four to eight story buildings shall be mentioned as examples for such projects in this area. At this level too, the computer analysis can be also utilized. As the fuzzy logic method informs the manager of boundary, it is important for decisions' analysis of workshop site.

6.3 For projects of macro-level and industrial projects, software analysis method and GIS method are appropriate. This is because the land slopes or topographic conditions in these systems and even fuzzy approach are involved in determining the location of the materials. However, considering the fact that the exact scope in fuzzy logic is not determined and the exact information are not asked by the operator, it is not a fitting method for macro-level projects. So, the smallest slip in decision making and information processing will incur cost increase. Examples of this level of projects are; dam construction, road construction, airport and runway, high rises, and even military or shipping projects can be named.

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