JLSB
Journal of
Life Science and Biomedicine

J. Life Sci. Biomed. 5(2): 43-47, March 30, 2015
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ISSN 2251-9939

An Evaluation into Monitoring Management and the Concrete Retrofitting from Project Management Perspective

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ABSTRACT: The building projects management is developed by ever increasing growth of construction all over the world. In this project the monitoring management evaluation and the concrete retrofitting from project management perspective are considered because the growth of execution for reinforced concrete structures and their rate of vulnerability as result of different events and on the other hand lack of manager's acquaintance of monitoring concepts ant evaluation method and retrofitting approaches. One of the important aims of monitoring management is the creation of methods for evaluation and monitoring that the best conditions will be considered with best concepts of concrete retrofitting in practice. Furthermore the demolition development can be prevented by the accomplishment of review forms and frequent investigations and the increase of efficient lifetime of concrete structures is also created by them.

ORIGINAL ARTICLE
PII: S225199391500010-5
Received 12 Aug.. 2014
Accepted 15 Mar. 2015

Key words: Project Management, Retrofitting, Concrete Structures, Monitoring Management, Construction

INTRODUCTION

The building projects management is developed by ever increasing growth of construction all over the world. Successful structures are the necessary needs and they are considered especially in the concrete structures and resistor monitoring that in this research these topics will be evaluated completely [1].

The concrete structures are known as a most consumer of materials and structures in the world. The significant features that lead to its superiority management can lead to improvement of project conditions from planning and structured works. The developed use of project management standards for evaluation and development of professional competency is based on a rational view that lead to competency to be observable by creation of some features and specifications as predefined scientific topics. There is still low knowledge about the methods of using these specifications by project managements in the workplace. Among construction projects, the continuous monitoring of executive projects, providing constitution for site construction, the stability and lifetime of concrete in comparison with other materials are to be economic and easy accessibility to formed components and relative stability of this combination. Of course the use of concrete in the structures likes other materials, the need of enough attentions in proper decision of components, correct 5ct building and quality control. The important specification of concrete is the high stress resistor of it in the construction of each kind of structure and its weak is its low tensile strength, but it has been compensated by creating reinforcement [2].

The high resistor concrete is provided by adding different material and some changes in the disturbance plan of concrete. The determination of these concrete specifications has effective results in project managers. Monitoring of structure resistor and evaluation of relative older structures or structures that were developed in the demolition levels are so necessary in accordance with the evaluation of their performances and for earning information about the rate of demolition, the definition of the reason of this condition is considered[6]. This information can be achieved by review of principles, efficiency reports, construction details and main design.

The concrete performance is different in different climates and weathers and the quality of concrete products is related to project conditions and it is controlled by some factors such as climate and weather, the ability of compatibility of materials in concrete and the sort of materials [3].

So, the selection of proper methods of immunization and retrofitting for concrete structures and their performance evaluation by prioritized plans is related to the one last decade in all over the world. The important financial and human damages arising from destruction of building, bridge and other vital arteries cause that the scientific and massive performances should be carried out in different countries in order to codify new prescription for determination of performance level and selection of proper retrofitting method because the important factors such as the transformation of geographic conditions of buildings and the scales of designing and finally different problems in design level and accomplishment of structures [4].

To cite this paper: Zekavat M and Momenian A. 2015. An Evaluation into Monitoring Management and the Concrete Retrofitting from Project Management Perspective. *J. Life Sci. Biomed.* 5(2): 43-47.
Journal homepage: http://jlsb.science-line.com/

Kala et al. [5] evaluate limited conditions and accomplishment of steel-concrete structures in the article of "the stability problems of steel-concrete structures that are produced from high resistor materials". They explain that the ability of load endurance for steel-concrete columns that are produced from steel profiles is evaluated in under pressure resistive concrete. The tensile principles are classified for determining materials and earth defects. The results of theoretical evaluations are also compared with the results of experimental researches. The numerical simulation methods LHS and Monte Carlo are used in this research that they evaluates the effects of defects transformation in structures. The effects of tensile resistor applications in determination of the ability of load endurance for structure are also determined. The effects of earth defects on initial load carry are also provided.

Helmerich et al. [6] founds in the article of "evaluation and investigation of bridge and the evaluation of its conditions in Europe" that the infrastructure finances were developed during history and the construction process of different nations are differ. The investigation and evaluation of maintenance condition and processes from a nation to another nation are different. The national infrastructure finance are kept in different levels are resulted from political and historical conditions. As the budget is lower for keeping bridge infrastructure and the demands related to bridge development are lower brought, the evaluation and maintenance and estimation of bridge lifetime have more importance. This point leads to creation of effective determination tools for determination of defects and structure problems during investigation. It helps to keep infrastructures of bridge in the efficient level of safety and economic.

Sanchez and Lopez [7] believe that some groups of unaccountable stability scales are created from occurrence of the concept of stable development and its application in urban planning and civil projects in the article of "ecologic index: a method for determination of stable indexes and their application in infrastructures projects in the Spain". This article evaluates problems of these groups and it considers the needs of method creation for determination, and indexes that contain all persons exist in the project lifetime that they can create an efficient balance among all actives. The stability is as a position for project development. Thus this article provides a method for determination and classification of stability indexes in accordance with risk management standards. The applications of this method for infrastructure projects in Spain, lead to appearance of strengths and weaknesses of proposed method and it is the first step for the civil engineering.

The projects need to proper management in order to accomplish with their budget and on time and whatever the project develops, the efficient management will need to stability and more efforts. A proper manager should turn concepts and unknown ideas of management into calculation and reliable system that all the scientific, technical and resource range are guided in the direction of project goals.

Monitoring management in order that project management

The monitoring is a continuous activity in accordance with the definition of crisis management organization that in the first stage, it will carried out that the early signs of quality and quantity of development should be available for main stakeholders of project [8].

All the projects and activities should be evaluated and monitored continuously by executives of project in accordance with determined indexes. The effective monitoring requires evaluation of project development in comparison with plan. The project document and work plans provide the basic of advanced evaluation. It is necessary in accordance with monitoring and investigation system that all the structure members and retrofitting systems should be evaluated. These orders will always be carried out for bridges annually and generally each six year. But the regular investigation rarely has not been carried out. These investigations are carried out when a change occurs in the sort of usage or its ownership. The three main levels of monitoring and reparation contain: evaluation of structure, determination of damage and designing the method of reparation [9].

The retrofitting of concrete structure

The reparation in concrete structure and its retrofitting is necessary in accordance with building new structures. Consideration of these orders is necessary for an exact evaluation in structure conditions and damage reasons and technical points for designing and reparation specifications and variability of site performance that has the construction techniques. Thus evaluation, maintenance and reparation of a structure should be noted simultaneously [10]. For carrying out these levels clearly, collecting the information and data in reparation and maintenance of concrete structures is necessary in accordance with achievement to a proper and real determination of defect reason and preparation of technical advisement in material selection. When the efficiency of a structure is considered, these levels can follow different strategies. These strategies are used for determining efficient tools of maintenance or structure reparation that are related to development of probable damages [11].

Some reparation method should be provided in accordance with most executive selection and most economic method when the engineers conclude that in the end of resistor and performance evaluation the structure needs reparation and strengthening. In this level it is possible that engineers have the specific studies about major parameters of reparation and strengthening method. The important point is that the reparation and strengthening executive performance needs to exact workshop investigations and monitoring in order that general reliance for operation [12].

MATERIAL AND METHODS

ACO Algorithm for Column Layout Optimization

The ant algorithms mimic the characteristics of real ants that can rapidly establish the shortest route from food source to their nest and vice versa. The Ant Colony Optimization (ACO) method can be categorized as stochastic methods. There are various types of ACO algorithm with a variety of implementations. Most of the present Ant Colony Optimization (ACO) algorithms, such as Max Min Ant System (MMAS), are direct successors to the Ant System (AS) algorithm. The main phases of the AS algorithm are the Ants' solution construction and the pheromone update. MMAS introduces some main modifications with respect to AS. First, it strongly exploits the best solution found. Only either the iteration-best ant or the best-so-far ant is allowed to deposit pheromone [13]. Since, such a strategy may result in a stagnation in which all the ants follow the same solution, due to the excessive growth of pheromone trails on arcs of a good, although suboptimal tour. To counteract this effect, a second modification introduced by MMAS is that it limits the possible range of pheromone trail values to the interval [τmin, τmax]. Moreover, the pheromone trails are initialized to the upper pheromone trail limit, which, together with a small pheromone evaporation rate, increases the exploration of solutions at the start of the search. Finally, in MMAS, pheromone trails are reinitialized each time the system approaches stagnation or when no improved solution has been generated for a certain number of consecutive iterations. MMAS achieves a strongly improved performance, compared to AS and to other improved versions of AS, for a wide range of combinatorial optimization problems [14]. One feature, MMAS has in common with other improved AS algorithms, is the fact that the best solutions found during the search are strongly exploited to direct the ants' search. MMAS has related this feature to recent results of the analysis of search space characteristics for combinatorial optimization problems. Earlier research has shown that there exists a strong correlation between the solution quality and the distance to a global optimum for the TSP and for some other problems. MMAS can provide an effective guidance mechanism to direct the search towards the best solutions. Yet, exploitation of the best solutions is not the only remedy to achieve very high performing ACO algorithms. To avoid premature convergence, the exploitation of the best solutions has to be combined with effective mechanisms for performing search space exploration. MMAS explicitly addresses this aspect, which is possibly the main reason why it is currently one of the best performing ACO algorithms [15].

The main ideas introduced by MMAS, the utilization of pheromone trail limits to prevent premature convergence, can also be applied in a different way, which can be interpreted as a hybrid between MMAS and action choice rule: The principles of the ACO algorithm are presented by Al-Sahab et al. [8]. The present ACO algorithm for column layout optimization of RC buildings is an MMAS. The MMAS algorithm comprises three phases: initializing data, constructing ant solution and updating pheromone. The aim is to determine a set of integers as the spans lengths in both x and y directions to minimize the cost function. The algorithm deals with the discrete form of the problem. The domain must be discretized by forming the construction graph as a multilayered graph. In the column layout optimization of frames the number of layers represents the number of design variables, which are spans' lengths in the x and y directions, and the number of nodes in a particular layer represents the number of discrete probable values permitted for the corresponding design variable. Thus each node on the graph is associated with an allowable discrete value of a design variable, which results in a graph with Nx+Ny layers. Knowing that each span length is bounded in [L_{emax}, L_{emin}], the permissible values for each span length, which are represented by the nodes on the graph, can be discretized with intervals (accuracy) equal to ε. That is, each Le rests in the set of {Lmin , Lmin + ε, Lmin + 2ε ,…, Lmax - ε , Lmax}. Each member of this set corresponds to a node on the graph. So, the number of nodes for each layer is (L_{emax}-L_{emin})/ε. The smaller ε is, the more accurate the results will be and the more running time the algorithm needs. The smaller ε is, the more accurate the results will be and the more running time the algorithm needs. In the phase of initial design, some parameters need to be assigned values. The heuristic values are specified according to the designers' preferences. In the present case, if there are any preferences for a certain span, say due to architectural constraints, higher values are assigned to the heuristic arrays corresponding to those span. Such an assignment will cause the desired lengths to be more likely to be chosen by ants for the corresponding spans. By choosing appropriate values for α and β the degree of influence of the heuristic values relative to the pheromone trail is set. In order to save time, some criteria such as the symmetry of the plan are considered when the heuristic matrix is formed. Using such a heuristic matrix or defining the initial pheromone matrix using the above-mentioned structural rules helps the algorithm converge sooner. The initial magnitude of pheromone on the construction graph in MMAS, is initialized to the upper pheromone trail limit, which is a value slightly higher than the expected amount of pheromone deposited by the ants in one iteration. A rough estimate of the value can be obtained by setting $\forall(i,j)\tau_{ij} = \tau_0 = N_A/C^{nn}$ where N_A is the number of ants, and C^{nn} is the cost of a tour generated by the nearest neighbor heuristic. Since boundary conditions, constraints and the loading condition can affect the spans lengths, the entries of heuristic matrix and initial pheromone matrix might be organized in a way that considers such parameters according to designer's experience. Each value (i,j) of choice information matrix, which is obtained by multiplying the corresponding arrays of heuristic matrix by those of pheromone matrix, shows the tendency or desirability of the ant located on Node i of the construction graph to choose Edge j to move towards Node i+1. N ants are located on the home node construct their solution by selecting only one node in each layer in accordance with the random proportional rule (also known as action choice rule) given by equation below [8].

$$p_{ij}^{k} = \begin{cases} \dfrac{[\tau_{ij}]^{\alpha}[\eta_{ij}]^{\beta}}{\sum_{l \in N_i^k}[\tau_{il}]^{\alpha}[\eta_{il}]^{\beta}} & \text{if } j \in N_i^k \\ 0 & \text{if } j \notin N_i^k \end{cases}$$

In each iteration, there are as many as (Lmax - Lmin)/ ε possible options (nodes) to be selected. This relationship forms the basis of the Ant System (Ant System) algorithm and shows that if Ant k is positioned on Node i, it will move to the next Node j with the probability of p_{ij}^{k}. In this relationship, τij is the magnitude of pheromone on the trails and ηij is the heuristic value. The parameters α and β determine the relative influence of the pheromone trail and the heuristic information respectively. Nik is the feasible neighborhood of Ant k when being at Node i, that is, the set of edges that Ant k is allowed to choose as its next destination, and is decided depending on the problem condition. The nodes selected along the path visited by an ant represent a candidate solution. After all ants have constructed a solution, pheromones are updated by applying evaporation (lowering the pheromone value on all edges) by a constant factor ρ according to equation below, followed by the deposit of new pheromone (adding pheromone on selected edges) according to equation below.

$$\tau_{ij} \leftarrow (1-\rho)\tau_{ij} \quad \forall (i,j) \in A$$

$$\tau_{ij} \leftarrow \tau_{ij} + \Delta\tau_{ij}^{best}, \ \forall (i,j) \in A$$

where

$\Delta_{\tau ij}^{best}$ is $1/C^{best}$. The ant which is allowed to add pheromone may be either the best-so-far, in which case $\Delta_{\tau ij}^{bes}$ is $1/C^{bs}$, or the iteration-best, in which case $\Delta_{\tau ij}^{best}$ is $1/C^{ib}$, where C^{ib} is the length of the iteration-best tour.

Pheromone deposit increases the probability that other ants will follow the same path. That is, by letting ants deposit a higher amount of pheromone on short paths, the ants' path searching is more quickly biased toward the best solutions. Pheromone evaporation can be seen as an exploration mechanism that avoids quick convergence of all the ants toward a suboptimal path. In fact, the decrease in pheromone intensity favors the exploration of different paths during the whole search process. Making pheromone update a function of the generated solution quality can help in directing future ants more strongly toward better solutions. In general, in MMAS, both the iteration-best and the best-so-far update rules are alternatively used. Obviously, the choice of the relative frequency with which the two pheromone update rules are applied has an influence on how greedy the search is. In MMAS, lower and upper limits τ_{min} and τ_{max} on the possible pheromone values on all edges are imposed in order to avoid search stagnation. MMAS uses $1/C^{bs}$, to define τ_{max}: each time a new best-so-far tour is found, the value of τmax is updated. The lower pheromone trail limitis set to τmin= τmax /a where "a" is a parameter. In each iteration, all the ants, in parallel, start from the home node and end at the destination node by randomly selecting a node in each layer. The optimization process is terminated if no better solution is found in a pre-specified number of successive iterations. The above procedure continues until the termination criterion is satisfied; then the optimum spans will be given by the best-so-far solution. In each step, a basic structural analysis is required to calculate the section action effects. Making use of a structural analysis approach, say finite element method or simplified methods based on the design standards, such a calculation takes a small amount of time for each section. Using Eq.(1) as the objective function would be significantly more time-consuming than using Eq. (18). Due to the variation of lengths in each step, the estimation of design variables in each step would be considerably encumbered; apart from the fact that, in each step, the algorithm would iteratively need to deal with the design formulas. Eq. (18) makes the optimization process much tangible and greatly usable in the layout optimization of large structures.

RESULTS AND DISCUSSION

A four-storey RC building with a plan as shown in Fig. 4 is optimized. The live load o intermediate floors are 5.0 kN/m^2 and on the roof is 1.5 kN/m^2. Dead loads are self-weight and the imposed dead load of 1.5 kN/m^2. The average unit price for concrete is assumed to be 54units/m^3, and 3140 units/m^3 for reinforcing steel. The average unit price for formwork is 19 units/m^2. The characteristic strength of the main reinforcement f_y is 460 N/mm^2, the characteristic strength of the shear reinforcement f_{yv} is 250 N/mm2, the characteristic strength of concrete f'_c is 35 N/mm^2; the top and bottom covers of steel bars are 20 and 25 mm for slabs, respectively and the cover of bars in columns is 40 mm. This example was analyzed in a report on comparative costs of concrete framed buildings that has been recommended as a benchmark for future studies. The conventional design of this example has been carried out and optimized by a team of professional structural engineers. The total length and width of the building are 20 m and 18 m respectively, and the height of each story is 2.95 m. The permissible spans are defined within the bounds of L_{max} = 8.5 m and L_{min} = 5 m. Goodchild et al. [9] suggest the cost of 239575 units for $L_{x1} = L_{x2} = L_{x3} = L_{x4}$ = 5.0 m and $L_{y1} = L_{y2} = L_{y3}$ = 6.0 m. Three control sections are selected for every member. The values of K_1 through K_{19}, and consequently the values of c_1 through c_7 for all selected slabs, columns and beams sections are obtained. Having the necessary coefficients, the optimization problem can be formulated based on Eq.

(20). Now, considering the above design as a primary design for proposed ACO algorithm, the Ant algorithm search for the optimum spans based on the objective function and observing other relevant constraints.

Computations were performed on P9700 @2.80 GHz computer running MATLAB R2009b. The termination criterion for the ACO algorithms is defined as the number of iterations, when the improvement in the solution quality was less than 0.02% after ten consecutive iterations. After 110 iterations, and at CPU time of 56.6 seconds, the optimum span lengths of L_{x1} = 4550 mm, L_{x2}= 5450 mm, L_{x3} = 5450 mm and L_{x4} = 4550 mm in the x direction, and L_{y1} = 5850 mm, L_{y2} = 6300mm and L_{y3} = 5850 mm in the y direction are obtained, resulting in a total cost of 217534 units, which equals 9.2% cost saving compared to the initial design [9].

CONCLUSION

In accordance to past subjects, as the concrete structures are affected by different factors, in addition to consideration of structure efficiency in designing, the planning for maintenance in the time of project exploitation and frequent monitoring are so effective in efficient lifetime increase in accordance with prevention of damage development. Furthermore the accomplishment of review forms and frequent investigations can lead to increase of efficient lifetime of concrete structures and prevention of damages and the managers should completely be known with the monitoring levels and retrofitting of structures that they can accomplish the necessary acts.

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