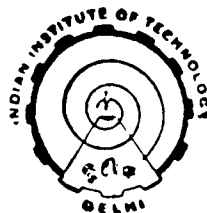


**SOME FACILITY PLANNING TECHNIQUES
FOR
CONSTRUCTION SITE LAYOUTS**

By

SHRIRANG DATTATRAYA DESHPANDE

A THESIS SUBMITTED
IN FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY



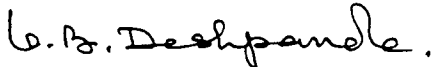
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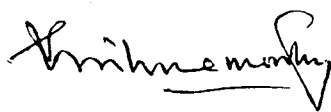
CERTIFICATE

This is to certify that the thesis entitled, "SOME FACILITY PLANNING TECHNIQUES FOR CONSTRUCTION SITE LAYOUTS" being submitted by Mr. Shrirang Dattatraya Deshpande to the Indian Institute of Technology, Delhi for the award of degree of 'Doctor of Philosophy', is a record of bonafide research work carried out by him. He has worked under our guidance and supervision, and has fulfilled the requirements for the submission of the thesis which, to our knowledge, has reached the requisite standard.

The results contained in this thesis have not been submitted, in part or full, to any other University or Institute for the award of any degree or diploma.

One research paper is published and the other is accepted for publication in OMEGA, The International Journal of Management Science.


(Dr. V.B. Deshpande)
Asst. Professor
Deptt. of Civil Engg.,
Indian Institute of Technology,
New Delhi-110 016, INDIA


(Dr. S. Krishnamoorthy)
Professor
Department of Civil Engg.,
Indian Institute of Technology,
New Delhi-110 016, INDIA

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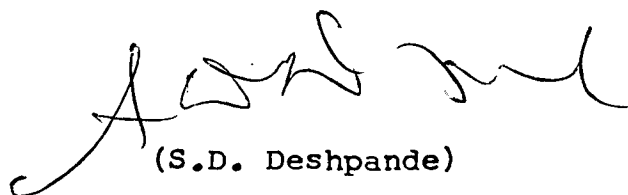
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I.I.T. New Delhi



(S.D. Deshpande)

ABSTRACT

This thesis deals with site layout planning on construction projects. Three algorithms/techniques/computer programs are developed, described, and their use illustrated with the help of several examples.

The work of site layout on construction projects involves providing and/or assigning spaces for storage of materials. Spaces for equipment and machinery, spaces for roads and pathways on the site. Depending upon the need of the construction work, different workmen of different trades have to come on the site, do their job and vacate for the next trade. In addition to this, the construction site area is fixed and the product or the building, its location, size and shape, is also prelocated. The problem, therefore, becomes more difficult when compared with the plant layout problems in manufacturing industries. There is also interaction among the different spaces for storage of materials, equipment etc. The problem is, therefore, considered as a quadratic assignment problem (QAP). The optimal solution will require considerable and prohibitive computational effort. Heuristic procedures are therefore developed.

A critical and comprehensive review of the available literature revealed that the available algorithms/computer programs are having limitations in directly applying them to construction site layout problems. The need was, therefore, felt to develop an algorithm which can build the layout from scratch,

take the variations in space requirements of activities into consideration, work from the objective data and give its own evaluation criterion.

Three algorithms are developed. They are:

- i) Algorithm based upon modified Whitehead's approach.
- ii) "CLULAYOUT" an algorithm based upon cluster analysis approach. and
- iii) "MSTCM" an algorithm based upon graph theoretic approach.

The algorithm based upon modified Whitehead's approach, builds the layout starting from scratch choosing the position which is at least "distance-cost". Considerations of compatibility are introduced so as to have a number of sets of parallel operations with some activities common and some other for the individual set only.

The computational effort required for the algorithm based upon modified Whitehead's approach was found excessive. To obtain site layout solutions of comparable economy and accuracy but at much less computational effort, a computer program "CLULAYOUT", based upon the cluster analysis approach is developed. It reduces the computational time nearly by 60% for the cases studied, while giving site layouts more or less of the same cost. The activities are grouped to form different clusters on the basis of their similarities derived from their activity-product relationships.

'MSTCM' program was developed to reduce the computational effort further. This program is based upon "maximal spanning

tree and connectedness matrix" concepts from graph theory. The sequence of activities, for location purpose, is decided from the maximal spanning tree and taking connectedness matrix into consideration. The 'MSTCM' program reduces the computational effort nearly by 70% compared to that with Whitehead's.

Sensitivity analyses are carried out for all the three programs developed and the results discussed.

Several examples, in addition to the cases studied, and their solutions obtained by any one of the programs are presented.

The programs are found quite 'robust' and 'general' in nature. They can be used where :

- i) A number of activities, having interaction with each other ;
 - ii) Several sets of parallel activities, serving the same area
- exit in other fields, like plant layout, town planning, electrical/electronics engineering etc., as well.

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