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Planning of Building Projects Through Network

By J. S. SHARMA and S. P. SINGH, *Central Building Research Institute, Roorkee.*

SYNOPSIS

The traditional methods for construction projects place heavy reliance upon experience and very little is generally done for planning. In the present day pattern of increasing project complexity and carrying out larger number of projects, relevant experience is not always available. The changing construction methods and working conditions often invalidate past know-how. This calls for planning methods which can be successfully applied by groups of organisations, each organisation being responsible for separate parts of the projects. This can be carried out by the network technique also called as CPM, PERT and RAMPS etc. For any construction project, there would be three phases. The first phase would be the pre-tender stage when the sanctions and approval of the project is made. The second phase would be the development of land for the project, and the third phase would be the construction of buildings. This paper describes the points to be considered in planning the three phases and gives illustrative examples of networks for each. A materials procurement and control chart to ensure regular and timely supply thereby avoiding delays in the construction is given. The implementation of the planning technique and its advantages are also described.

1. INTRODUCTION

1.1 The existing shortage of housing and the growing population imposes unprecedented demand on the building industry. Besides this, being a developing country, a large number of other developmental projects are being carried out and all these require large scale construction works. The building production process has two fairly distinct stages viz., the manufacturing of building materials/components and the construction or assembly on the building sites. The products are of extremely diverse nature and the persons responsible for executing the projects have no control on the most important phase of design. The split pattern of production process is further aggravated by the division of responsibilities for the final building amongst the client or indenter, the architect, the designer and the other experts taking part in the project. Each participant in this collective work may do his best as seen from his own narrow angle, but without caring much about what lies outside his own profession.

1.2 The past experience during the Five Year Plans has shown that most projects have not been completed within the scheduled time and the cost estimates have

gone up considerably. A critical analysis of the projects has shown that one of the major reasons for overrun in time and cost has been due to inadequate planning right from the start of the project besides several other reasons. There is thus a greater need for the application of scientific principles of management in the building construction activity for bringing out speed and economy.

2. PLANNING TECHNIQUE

2.1 The difference between success and failure, profit and loss, depends upon the outcome of well-laid plans. The degree of detail incorporated in the plans varies considerably. As many persons become involved, it becomes necessary to plan systematically. Also, the problem of communication of ideas from one individual to the other assumes importance. Therefore, it becomes necessary to place reliance upon formalized systems of information communication such as diagrams, written messages, codes and symbols to ensure that the meaning does not change as the information is passed on but represents what is to be done and the part each task plays in the whole project.

2.2 The network planning concept where plans are illustrated by arrow diagrams goes a long way towards meeting these requirements. It offers an integrated management control system, eliminates ambiguity and reduces misunderstanding between working groups. It assists all levels of project management to define the work to be carried out, produce better work schedules based on knowledge of resources required and resources available, decide the best way of applying resources to achieve project objectives, monitor progress and detect in advance the points where delays would be caused. A number of articles have been published on the network planning during the last decade in various foreign and Indian journals. The Military Engineer Services have made it obligatory that all building projects are to be planned on the network technique. Though the network is simple to understand but without training and enough practice people find it difficult to construct network diagrams specially for projects where the inter-dependencies of activities is complex.

2.3 In general, any building project comprises three distinct phases. The first is the pre-tender planning, the second is the development of land and the third is the construction of buildings. Since the building activities mostly remain similar unless the technique of construction and execution is changed, typical networks for the three phases have been drawn to serve as a guide line

and help the various organisations to become familiar with this planning and control system. There is no one unique method of drawing a network for a project. The same project can be planned in many varying degrees of detail. It is necessary to draw the network which suits the particular planning to be done, neither wasting time and effort by too much detail nor making it with insufficient detail. Nearly all networks omit something. Auxiliary jobs like the provision of resources or obtaining drawings etc. may be automatic and thus may safely be omitted. But in case they are time-consuming bottlenecks, these should be included to highlight the fact. As several different organisations are involved in the building projects, it is better to draw zoned networks to clearly show the responsibilities.

3. NETWORK FOR PRE-TENDER PHASE

3.1 The first step for any building project is selection of a suitable site and then its acquisition. When this is done by the indenting organisation, the requirements of the project are worked out and the architect/town planner prepares a layout plan showing the road pattern, the essential buildings, parks and open spaces etc. required. The engineering and the service organisations assess the requirements for water supply and electricity, disposal of sewage and storm water, and prepare preliminary estimate for obtaining approval of the indenting organisation. In certain towns and cities, plans and layouts have to be approved by the Municipal Corporation/Committee. It is worthwhile including this organisation also in the network diagram as quite often, there are considerable delays when plans are not sent for approval at proper time. There are several activities that are interdependent during this phase such as the preparation of preliminary plans by the architect and the agreement on structural principles by the design engineer. The preparation of detailed drawings, designing, estimating and carrying out the safe bearing capacity tests etc., are all so much inter-related that the individual organisations or departments would need to resort to the network technique to find out when each activity can be done. Since several organisations are involved and the time estimates for different activities are generally approximate, in these programmes updating may be required 2 to 3 times and therefore, in the typical network for pre-tender stage, (Drg. No. CPM/PP/1) the events have been shown by rectangular blocks where the event number, the earliest and latest starts of first and subsequent two revisions as well as the actual dates can be incorporated. This may be treated as a master network with broad based activity breakdown, and in actual practice, a micro-breakdown of activities may have to be done for a detailed network.

4. NETWORK FOR DEVELOPMENT OF LAND

To make a plot of land suitable for building construction, a number of activities such as levelling the area, construction of roads, laying the sewers, filtered and unfiltered water lines, electrical distribution lines and street lights, storm water drains etc. are required to be carried out. The ingenuity in planning the sequence of these activities goes a very long way towards satisfactory execution of the project both with respect to time and cost. In planning the development phase, the main consideration is to coordinate the working of

various services in such a way that the construction of buildings can be started at the earliest and preferably go on side by side with the developmental works. This poses several complications and problems. For instance unless main roads are completed, materials for construction cannot be transported to building site. The movement and haphazard stacking of materials on the other hand make the road work and drainage work difficult. Also, due to the excavation for sewers and storm water etc., there would be heaps of earth which make it difficult for work to be started. There are several other problems that crop up when various organisations work on the site at the same time. A suitable sequence for the activities pertaining to the developmental works viz., roads, sewers, storm water drains, water lines, electrical installations and street lighting etc. is to be planned in such a way that they interfere to the minimum extent with each other. It is convenient to divide the area into sectors and plan the roads, services, and building work such that the work of the different organisations are carried out in a sequence from sector to sector. A typical network for development of land for building construction project is shown in Drg. No. CPM/DL/1. This is a broad based activity breakdown network to illustrate the importance of preplanning. The inter-relationships of different services have been so programmed that one organisation starts work in one sector or part, completes it and then only the next organisation starts the work there. This is followed in all the sectors and by all the organisations; for example, as soon as the road work in sector I is completed, the sewage work starts in sector I and the road work is started in sector II and so on. Different networks will have to be prepared for different projects depending on the area, the point of approach to the area, the types of buildings etc. The illustrative example worked out depicts the types of problems that may arise and how these can be solved at the planning stage itself. Since the objective in this network diagram is to clearly show the inter-relationships and inter-dependencies between the various organisations, detailed breakdown of the building work is not necessary to be shown.

5. NETWORK FOR BUILDING CONSTRUCTION

Generally, the housing projects comprise several types of buildings and a large number of each type. The best method for planning such projects is to show a detailed network diagram for one block, and then draw a master network with broad based activity breakdown of the block for the entire number of blocks. The first network will show the inter-relationships and inter-dependencies of the various activities and help in planning the resources of men and material. The durations for the activities will be worked out by the quantity of work for the activity and the output of labour. Depending on the availability of labour on site, the activities scheduling is done and this is modified by increasing the resources if necessary on the basis of the target completion period. In traditional construction methods, besides the labour, the other important item which governs the completion period is the quantity of shuttering and centering material on site. The network diagram clearly depicts the amount of shuttering and centering material required for the target completion date, keeping the other resources of material and labour as per programme. A network for the construction of a block

of 16 units is shown in Drg. No. CPM/BP/1. As the people working on the site are familiar with the bar charts, it is better to draw the network for construction work to a time scale. This will be easily understood by the people at site and also they would be able to note the progress of work and mark it in the network as is generally done in bar charts.

5.2 Based on the detailed network of a block, a master network diagram for the construction of 12 more similar blocks has been drawn as shown in Drg. No. CPM/BP/2. In this diagram all the critical activities have been shown and some of the non-critical activities have been grouped into one activity to reduce the size of the diagram. Depending upon the availability of labour and other resources, the starting of various blocks can be adjusted. Apart from the network diagram for the blocks of houses, a bar chart has also been drawn in the master network to show the reduction in the completion time due to increased shuttering and centering material. The build up of total labour requirement at different timings can be easily drawn in the form of histograms by the help of this network diagram. Separate detailed networks and master networks for different types of houses may be prepared on similar lines.

5.3 In case of one off type job such as office building it is convenient to divide the building into smaller units and draw the network for each unit more or less on similar lines. The network diagram would provide an improved coordination between the various organisations at site, and they will be able to organise the labour gangs in a proper way such that the incidences of delays and idleness due to men being in each other's way would be reduced, and thereby increase their productivity, leading towards speed and economy.

6. MATERIALS PLANNING

The network diagrams show the activities, their starting and completion period. Thus the requirement of materials for the activities and the dates when these are required is also obtained. Since the supply and lead time for different materials varies and also the procurement of materials should be aimed for at least a week in advance than the requirement period, it is advantageous to draw a separate chart for the procurement and control of materials. A typical format for the chart is shown in Drg. No. CPM/BP/3. All the important materials and components can be listed down, and based on the network programme the period of requirement for the required quantity can be marked in the chart. Based on the supply and lead time of materials, the period when orders are to be placed can also be marked in the same chart. This chart is simple to construct and by marking the action taken and procurement periods, complete position of the materials/components at the site is known.

7. IMPLEMENTATION

There is a need for organising special courses and lectures on the network technique. These courses should be of different durations for various classes of management. To begin with, there should be a network cell of well trained staff in the network technique with each

Chief Engineer, to prepare the planning networks for all the projects. And a suitable progress reporting system should be designed for each project to have proper control. Gradually when all staff members have been trained in the system, they would be handling the projects with network technique and the cell would take up further improvements and research work in the system.

8. ADVANTAGES

The planning by network compels logical understanding of the project from start to completion. Since the planning of sequence and scheduling the time are done distinctly, full concentration is possible to be given on planning the sequence which is very important for achieving speed and economy for the project. The identification of critical activities help in management through exception. The zoned network diagrams help the various organisations to know the inter-dependence of their activities with other organisations, and the bottlenecks can be seen much in advance than when they actually occur. Thus timely action to overcome the difficulties can be taken. It is a service tool to management and can be applied at all levels of management for the building projects.

9. CONCLUSIONS

The network technique has been applied on a number of projects by the Central Building Research Institute, Roorkee. In the early applications, it was viewed with suspicion but afterwards when the benefit of the technique were realised, it has been requisitioned on more and more projects. The technique provides both planning and control system. In the paper, planning system alone has been described in detail as being suitable for building projects. Although the control system is equally important, since it is described in several books and articles on the subject, it has been omitted. This system does not need any special scientific education. An average person can easily learn it.

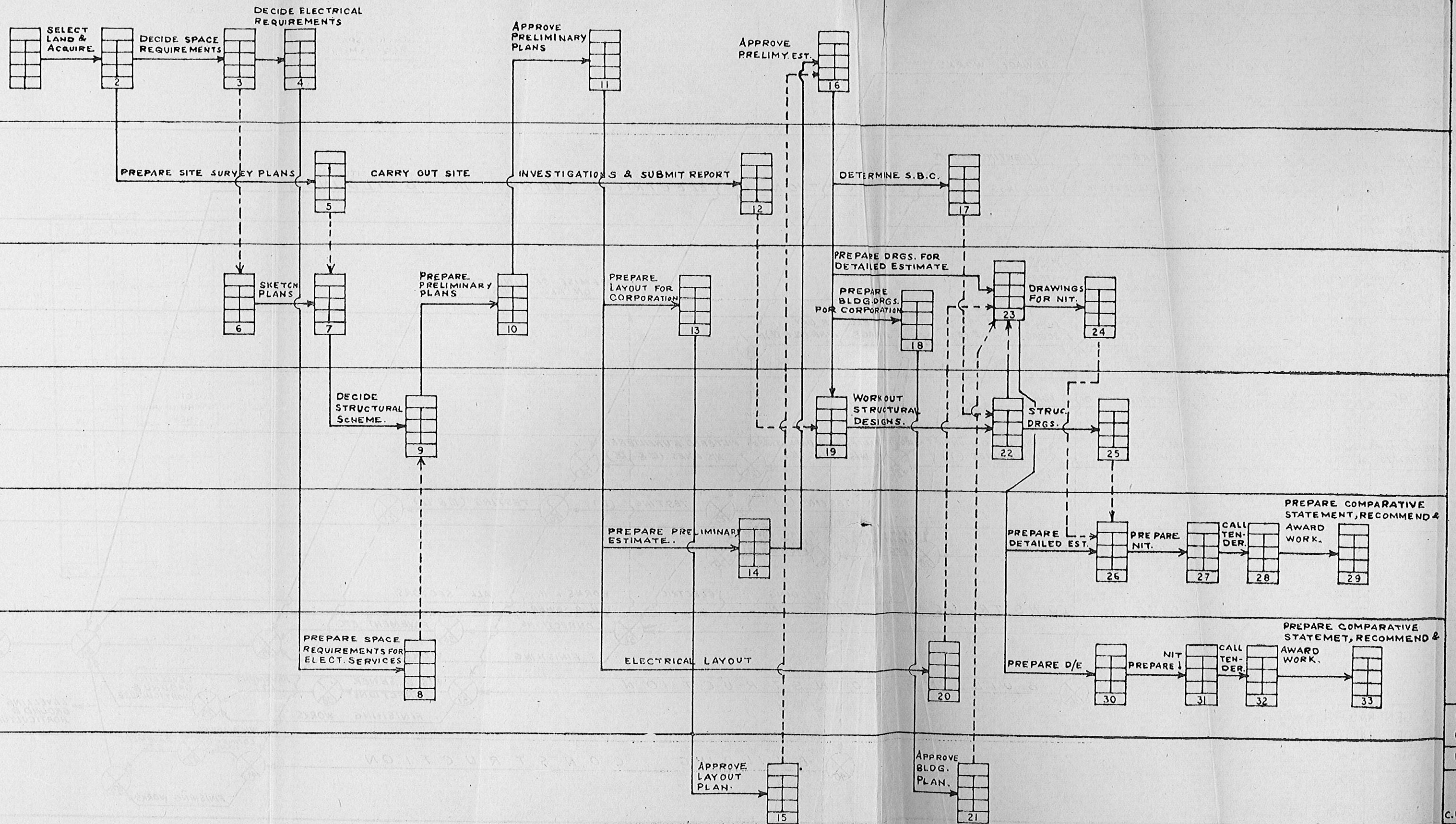
10. ACKNOWLEDGEMENT

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REFERENCES

1. Sharma, J. S.; Goel, K. C.; Suresh Chand: Programming and control for Higher efficiency in Traditional Building—Part I and Part II. Symposium on Construction Cost, NBO, New Delhi.
2. Harish Chandra: Application of the CPM to the Vigyan Bhawan Annexe Project, Indian Concrete Journal, May 1969.
3. Harish Chandra: Network Techniques in Building Construction. Two case studies.

GENERAL NETWORK FOR PRETENDER PLANNING OF BUILDING PROJECTS



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