A TEXT BOOK OF

CONSTRUCTION MANAGEMENT

(Elective – IV)

FOR

SEMESTER – II

FINAL YEAR (B.E.) DEGREE COURSE IN CIVIL ENGINEERING

Strictly According to New Revised Credit System Syllabus of Savitribai Phule Pune University

(w.e.f. 2018 – 2019)

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Dedicated to ……

B.E. Civil Students

– Authors

PREFACE

It gives us great pleasure to present the book **'Construction Management, (Elective – IV)'** for the students of **Final Year (BE) Degree Course in Civil Engineering** of the Savitribai Phule Pune University. This book is strictly as per the **New Revised Credit System Syllabus 2015 Pattern** and **Effective from the Academic Year 2018 - 2019.**

As per the New Revised Examination Scheme, which has been implemented from the previous academic year, the In-semester examination allots 30 marks for the first three units and the End Semester Examination allots 70 marks for the entire syllabus, out of which first three units carry total 20 marks and the units 4, 5, 6 will have total 50 marks. The theory course will have 3 credits.

The book is written such that all the basic concepts are explained in simplified manner. It is presented in a more conceptual manner rather than mathematical, as required by the new examination system. It is our objective to keep the presentation systematic, consistent, intensive and clear through explanatory notes and figures.

Main feature of this book is, Complete Coverage of the New Credit System Syllabus with Exercises and Model Question Papers of In Sem. and End Sem. Exams.

We are sure that this book will cater to all needs of the students for this subject.

We take this opportunity to express our sincere thanks to Shri. Dineshbhai K. Furia, Shri. Jignesh C. Furia, Mrs. Nirali M. Verma, Shri. M. P. Munde and the entire team of Nirali Prakashan including Mrs. Deepali Lachake (Co-ordinator) and her colleagues who really have taken keen interest and untiring efforts in publishing this text.

The advice and suggestions of our esteemed readers, to improve the text, are most welcomed, and will be highly appreciated.

Pune **Authors**

SYLLABUS

Unit I : Overview of Construction Sector **6 Hrs.**

Role of construction industry in infrastructure development, components of infrastructure sector, construction industry nature, characteristics, size, structure, role in economic development, construction management – necessity, applications, project management consultants – role, types, selection and appointment process, project overruns and means to combat them, project monitoring and reporting systems, managerial correspondence and communications, generation and identification of project investment opportunities.

(*At least 2 expert lectures by experts from field are to be conducted on above topics).

Unit II : Construction Scheduling, Work Study and Work Measurement **6 Hrs.**

Construction Scheduling : Construction project scheduling – purpose, factors affecting scheduling, time as a control tool, work breakdown structure, project work breakdown levels, line of balance technique, repetitive project management.

Work Study and Work Measurement : Definition, objectives, basic procedure of work study, symbols, activity charts, string diagrams, time and motion studies.

Unit III : Labour Laws and Financial Aspects of Construction Projects **6 Hrs.**

Labour Laws : Need and importance of labour laws, study of some important labour laws associated with construction sector workmans compensation act 1923, Building and other construction workers act 1996, child labour act, interstate migrant workers act.

Financial Aspects of Construction Projects : Capital investments: importance and difficulties, means of finance, working capital requirements, project cash flow projections and statements, project balance sheet, profit loss account statements.

Unit IV : Elements of Risk Management and Value Engineering **6 Hrs.**

Risk Management : Introduction, principles, types, origin, risk control, use of mathematical models: sensitivity analysis, break even analysis, simulation analysis, decision tree analysis, risk identification, analysis and mitigation of project risks, role of insurance in risk management.

Value Engineering : Meaning of value, value analysis, value engineering and value management, energy resources, consumption patterns, energy cost escalation and its impact.

Unit V : Materials Management and Human Resource Management **6 Hrs.**

Materials Management : Materials flow system, role of materials management in construction management and its linkage with other functional areas, vendor networking, buyer-seller relationships, eoq model and its variations, material codification and classification, concept of logistics and supply chain management, role of ERP in materials management – material resource information systems.

Human Resource Management : Human Resource in Construction Sector, Staffing policy and patterns, Human Resource Management Process, Human Resource Development Process, Performance Appraisal and Job Evaluation, Training and Career planning, Role of ERP in Human Resource Management – Human Resource Information System (HRIS).

Unit VI : Introduction to Artificial Intelligence Technique **6 Hrs.**

Basic terminologies and applications in civil engineering :

(a) Artificial neural network

(b) Fuzzi logic

(c) Genetic algorithm.

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PART I

Chapter : One
OPENING THE DOOR

1.1 PROFESSIONAL CONSTRUCTION MANAGEMENT

- Modern breakthrough technology has made construction industry more complex. Construction industry substantially contributes to the national growth and economy of a nation. As is well known, construction is the second largest economic activity in India, alongwith mining industry, next only to agriculture.
- The scope and volume of construction industry are directly proportional to the growth of population. With ever increasing population, the requirement for housing and industry enhances. At the same time it provides employment on a larger scale. The basic human needs have also not changed inspite of technological boom all over the world.
- Today, the construction of high rise buildings, dams, barrages, metro–rails, cable stayed bridges, high chimneys, newer industrial corporations etc. are now undertaken easily due to intelligent design and newer technologies having been evolved.
- Also, construction projects, both during construction and the life span of operation, significantly affect the environment in numerous ways. At the same time, the consumption of energy, the release of atmospheric emissions, the use of raw materials, the generation of waste, and the occupation of land are all effects that continue to build as the world's population grows and prospers. As the third world countries become more industrialized, the planet is becoming more fragile and sensitive due to continuing indiscriminate developmental activities.
- Observing all the sporadic development now, LEED (Leadership in Energy and Environmental Design) rating system, developed by the Green Building Council, represents a holistic approach to the design, construction and operation of building structures. LEED has established a road map that can be used by 'design–build teams' to construct more sustainable (green) buildings. Projects are "scored" with respect to site developments, water savings, energy efficiency, material selection and indoor environment.
- 'Platinum represents' the highest level of certification followed by gold and silver. The use of latest plants, machinery, regulations/laws have added newer dimensions to technological updates, than what was envisioned in the super-tall buildings such as Burj Khalifa in Dubai and Maglev (Magnetic levitation) rail systems, as late as 1960's (Gould, 2012).

1.2 CONSTRUCTION INDUSTRY AND MANAGEMENT

- As has been observed the construction industry is one of the oldest and largest industries. The use of plants and machinery and the adoption of the latest construction management methods should be the essential features of construction industries in modern times. The developing countries and the third world countries are more labour intensive but they must use appropriate mechanisation for timely completion of the facilities/infrastructure timely with adequate quality.
- Politicians and labour unions should not hamper the speedy progress of the construction. About 50% of all the expenditure of five year plans goes to construction activity. Construction industry plays a critical role in all the developmental sectors like, agriculture, irrigation, energy, transportation, communication, manufacturing, housing, civil infrastructure and social services.

1.3 CONSTRUCTION MANAGEMENT

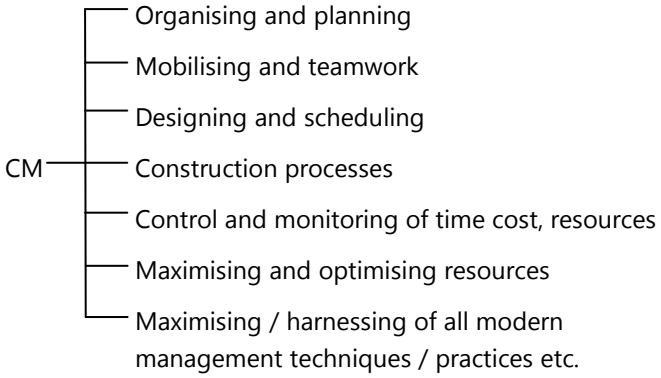
The owner's building needs is finally satisfied by the effective construction techniques. The main players of construction are:

- Owner
- Architect/Engineer (A/E)
- Construction manager
- Project Manager/Project Engineer
- Contractor
  - Prime contractor
  - Sub contractor
  - Specialty contractor
- Engineer – construction firm.

Some of the important integrated definitions of construction management (CM) have been tried out below (as not defined clearly in most of the books on CM).

"Construction management (CM) or Construction Project Management (CPM) is the overall planning, coordination and control of a project from inception to completions aimed at meeting a client's requirements in order to produce a functionally and financially viable project".

This can be schematically explained as functions of CM:



Also, CM can Defined as:

- "Construction Management is the composite of all modern project management methodologies having as their objective, the control of time cost and quality in the design and construction of a new facility." – O' Brien.
- "Simply the Construction Management (CM) is the translation of drawings/specifications and design into a real productive facilities/infrastructure".
- "The physical facility must impart planned output, stated quantity and quality parameters within scheduled time and cost observing requisite specifications".
- "Construction Manager is a specialised firm or organisation which furnishes all the administrative and management services of a general contracting organisation as well as all of the consulting services necessary and as required by the owner from planning through design and construction to commissioning".

– Kwaku A. Tenah

1.4 TYPES AND CATEGORIES OF CONSTRUCTIONS

These are mainly the following broad categories which are self–explanatory.

- Residential Building Construction
- Non-residential Building Construction
- Heavy and Highway Construction
- Marine Construction
- Military Construction

As we have observed and have noticed that construction management envelopes around 'Project Management', as centre stage or pith of the whole construction. All other activities of construction weave around the project management for construction management. – Kwaku A. Tenah

1.5 DIFFERENCE BETWEEN CM AND MANAGEMENT OF CONSTRUCTION

There is a subtle difference between construction management (CM) and Management of Construction.

- CM deals with/and encompasses the whole process right from the conceptual, start to the completion of the construction.
- Whereas management of construction confines itself to the management of actual construction only.

1.6 TRADITIONAL VERSUS MODIFIED CONSTRUCTION PROCESSES

The various disadvantages of the traditional processes are:

- The entire process is sequential in nature.
- Throughout the process the owner has little or no direct control over what his facility will ultimately cost.
- There are very few incentives for the general contractor for reducing the cost.
- Architects or Engineers, sometimes do not have adequate knowledge with the construction process of the facility being developed.
- The traditional processes does not create a unified team for sharing experience feedback and new ideas for sharing together.
- With public procurement practices it takes excessive time span for the whole process and rather there exists no incentive for reducing costs.
- Within the owner's organisation, there is an inadequate economic analysis, a lack of long-term planning and conflict over definitions of user requirements.

Advantages of Modified Approach over Traditional Approach are:

- With the modified approach, schematic drawings, more reviewed design documents are taken care of.
- There a better qualified contractor is selected on the basis of schematic drawings.
- There is variance in 'fixed price' as per the requirement.

- More information and communication flow is there.
- More quality assurance and responsibility exists.
- Also, standardisation of components for developing facility is done.
- Maximisation and optimization of design execution and completion of the project is ensured.

1.7 CONSTRUCTION MANAGEMENT PROCESSES

In any activities like essential developments, innovative constructions, the various processes are very important. The requisite processes are as under, which are self–explanatory:

- Conceptual planning.
- Schematic design, including value engineering and work package or bid package with application of modern technologies.
- Design, development and reviews from time to time including all disciplines of engineering with cash flow analysis checks.
- Procurement phase.
- Constructions – execution with latest trends and construction documents.
- Close–out and rehabilitation of the human elements including environmental dimensions.

Process is defined as an organized group of activities that together create a result of value to customers.

1.8 MECHANISM OF PROJECT/CONSTRUCTION EXECUTIONS

Projects are iterative in nature they begin with a plan that is repeatedly analyzed and adjusted as more learning experience is gained. (Refer Fig. 1.1).

A project is defined by the following characteristics:

- A defined goal or objective.
- Specific tasks not routinely performed.
- A defined beginning and end.
- Defined deliverables.
- Resources being consumed.

The goal of a construction project is simple - it is to build something.

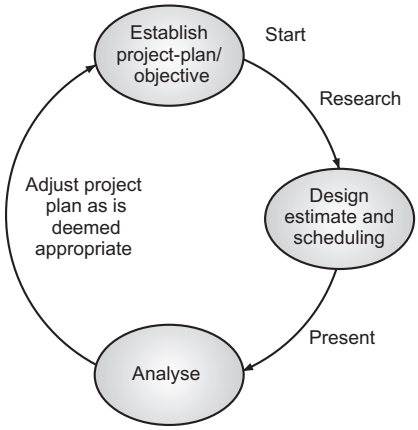


Fig. 1.1: Projects are iterative in nature

As time progresses and moves on, the project team's knowledge spirals outward creatively more is known and more information ushers in (Refer Fig. 1.2).

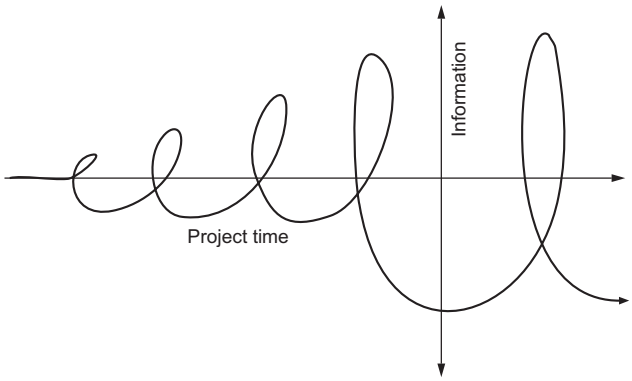


Fig. 1.2: Projects knowledge spirals

Good and early decisions provide significant benefits since financial commitments are generally few, whereas, multiple options and/or directions for the project usually exist.

As project cumulative S–curve and progression, as well as close–up is shown in Fig. 1.3 distinctly from mobilisation and execution.

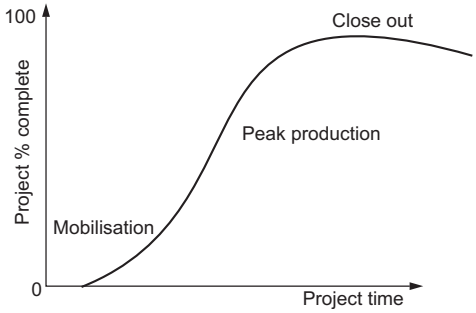


Fig. 1.3: Project progression curve