



Growing Capacity in Assam

Subject Design for new
Professional Short Course in
Construction Management

Assam Engineering College
Guwahati, Assam, India





Annexure I

Academic Calendar 2019/2020

Construction Management Short Courses for Professionals - A competency based skill development initiative through MULTI-SKILLING AND SUSTAINABILITY CENTRE of AEC

STAKEHOLDERS MAPPING WITH RESPECT TO THE SHORT COURSE MODULES

Short Course	Modules	Target Outcomes	Target Stakeholders	Status/Target
SC1	Project Financial Modelling Techniques & Evaluation	- Develop skills in project financial modelling & evaluation, making investment decisions and assessing project impacts & benefits against costs. - Understand the financial, economic & other technical aspects of project evaluation. - Develop analytical & problem-solving skills in relation to such aspects. - Evaluate project feasibility & success. - To facilitate decision-making on project investments. - Develop criteria for appraisal & optimization that incorporates financial returns & benefits to community and stakeholders'	PWD(Buildings)- CE/ACE, SE, EE PWD(Roads)- CE/ACE, SE, EE T&CP- DD, AD,JD/SE, EE GMDA- CEO, Secretary PHE- CE/ACE, SE, EE	Completed (PP)
SC4	Project Risk Analysis & Value Engineering	- Demonstrate ability to identify and analyze potential issues that could negatively impact key business initiatives or critical projects in order to help organizations avoid or mitigate risks. - Demonstrate ability to use core tools and techniques to identify and resolve risk in projects. - Demonstrate ability to solve problems and identify and eliminate unwanted costs, while improving function and quality. - Demonstrate ability to link risk and value analysis concepts to the project framework. - Demonstrate a reflective and professional approach to project management practice.	PWD(Buildings)- EE, AEE, AE PWD(Roads)- CE/ACE, SE, EE T&CP- DD, AD, JD/SE, EE GMDA- CE, PE PHE- SE, EE	Completed (PP)
SC8	Construction Delay Analysis	- Able to relate the construction schedule's activities by logic relationship - Identify and reduce the causes of delay - Able to adjust the schedule to recover a delay and bring back the completion date to a desired date - Able to perform delay analysis and recover the losses	PWD(Buildings)- CE/ACE, SE, EE PWD(Roads)- CE/ACE, SE, EE T&CP-X GMDA- PE, AEE, AE, JE/AA PHE- EE, AEE	Completed (MH)



SC9	New & Innovative Construction Materials	- Ability to understand properties and behaviour of new construction materials. - Select appropriate innovative construction materials based on the functional requirements of modern structures. - Ability to understand the importance of sustainable materials and green methods of building and road construction - Undertake R&D works for development of new construction materials.	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE, AEE, AE, JE T&CP-X GMDA- PE, AEE, AE, JE PHE- EE, AEE, AE, JE	Completed (MH)
SC10	Understanding of Building Regulations	- Develop skill in professional /industry communication relating to construction regulation - Develop the ability to read and interpret construction drawings and understand compliance to building regulations - Develop the ability to communicate construction solutions by means of sketches and drawings. - Understand all the planning, construction and operational aspects of building construction - Work in teams to collect and collate data on a real building; - Facilitate analytical and problem solving skills; - Facilitate strategic analysis of community risk and how to solve them.	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE, AEE, AE, JE T&CP- X GMDA- CEO, Secretary, TP, PE, AEE, AE, JE/AA PHE- CE/ACE, SE, EE	Completed (PP)
SC12	Contract Practice & Administration	- Work effectively with other professionals on a project; - Develop team building ability; - Develop the abilities of critical thinking and problem solving; - Adapt to and work effectively in different contract environments, both locally and internationally.	PWD(Buildings)- EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE T&CP-X GMDA- CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE/AA PHE- SE, EE	Completed (PP)
SC13	3R (Repair, Rehabilitation & Retrofitting) in Construction	- Make assessment of distress and damage in existing structure - Identify critical scenario which may render a structure unsafe or unserviceable - Analyze the various processes and specifications of 3R - Manage and control the contractual environment of 3R works - Work effectively with other professionals on a 3R project - Understand the advantages/disadvantages of various options and materials for 3R project - Adapt to and work effectively in very specific contract environments	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- EE, AEE, AE T&CP- GMDA- CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE/AA PHE- AEE, AE, JE	Completed (MH)



SC14	Understanding of Basic Operation and Services to be Provided in Buildings	- Develop an understanding of different types of electrical, mechanical & engineering services needed in buildings; - Develop an understanding of basic concepts regarding plumbing, sewage disposal, & household waste management services. - Develop an understanding of basic modes of energy transfer - Develop an understanding of spatial & installation requirements for services; - Develop an understanding of the construction processes involved. - Identify & compare different types of services used in building. - Evaluate the ability of different types of service to meet expected user requirements for comfort levels. - Analyze the technical, time & cost implications of installing & coordinating services in buildings.	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- JE T&CP-x GMDA- CEO, Secretary, CE, TP, CAO, PE, AEE PHE- AE, JE	Completed (PP)
SC15	Project Time Planning & Management	- Able to effectively plan the time needed for project activities and completion - Able to track project activities and respond accordingly - Capable of using different schedule development tools and techniques to deliver a project schedule - Able to develop efficient time plan/schedule for a project	PWD(Buildings)- CE/ACE, SE, EE, AEE PWD(Roads)- CE/ACE, SE, EE, AEE T&CP- DD, AD, JD/SE GMDA- CEO, Secretary, CE, TP, CAO, PE PHE- CE/ACE, SE, EE, AEE	Completed (MH)
SC16	Project Procurement and Direct & Indirect Cost Estimate	- Understand the core principles of project procurement. - Develop and demonstrate hands-on expertise in project evaluation, procurement planning, and contract strategy. - Practice effective techniques for successfully delivering projects. - Develop knowledge on innovative and effective procurement model. - Get basic knowledge on doing research for framing strategic & collaborative procurement model.	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE PWD(Roads)- CE/ACE, SE, EE, AEE, AE T&CP- AD, JD/SE, EE, AE, JE GMDA- TP, CAO, PE, AEE, AE, JE/AA PHE- EE, AEE, AE, JE	Completed (PP)
SC17	Risk & Contingency Management	- Determine the nature & causes of risk, their consequences and how to measure them. - Learn how to define likelihood, time frames of the likelihood & consequences - Determine levels of risk & choose optimal measures to be implemented - Learn how to develop & write a contingency plan.	PWD(Buildings)- EE, AEE, AE PWD(Roads)- CE/ACE, SE, EE T&CP- DD, AD, JD/SE, EE GMDA- CE, PE PHE- SE, EE	Completed (PP)



		- Facilitate decision-making taking into account views of risk assessors, stakeholders & communicate effectively - Develop criteria for appraisal and optimization that incorporates financial returns & benefits to community and stakeholders'		
SC19	Project Management in Construction	- Develop a thorough understanding of all key competency areas in project management in construction - Apply the principles of project management effectively in a project - Work effectively either as a team leader or a team member with other professionals - Communicate ideas, concepts and solutions to both technical and non-technical audiences effectively, clearly and concisely	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE, AEE, AE, JE T&CP- DD, AD, JD/SE GMDA- CE, PE, AEE, AE, JE PHE- SE, EE, AE, JE	Completed (MH)
SC20	Waste Management in Construction	- Develop a thorough understanding of the key areas in construction waste management - Apply the principles of construction waste management effectively in a project - Design effective waste management system for urban as well as rural areas - Apply innovative ways of reduction, recycling, and reuse of wastes for sustainable management of resources	PWD(Buildings)- EE, AEE, AE, JE PWD(Roads)- EE, AEE, AE, JE T&CP- X GMDA- AEE, AE, JE/AA PHE- AEE, AE, JE	Completed (MH)
SC23	Construction Methods & Equipment	- Select equipment based on applications, utilization, and productivity - Estimate the cost as well as the machine power requirements - Identify the issues affecting the construction equipment as a particular site; - Learn how to apply engineering fundamentals and analyses to the planning, selection and utilization of construction equipment. - Ability to critically analyse the issues of sustainable construction keeping in view the various environmental, economic and other aspects. - Be able to demonstrate awareness of construction safety	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE, AEE, AE, JE T&CP- X GMDA- AEE, AE, JE/AA PHE- EE, AEE, AE, JE	Completed (MH)
SC24	Quality Control & Quality Assurance	- Apply activities or techniques to analyze data and information for managing projects. - Prevent quality problems through planned & systematic activities including documentation. - Develop the skill of finding & eliminating causes of quality problems so that customer's requirements are continually met. - Develop the skills to establish a good quality management system. - Develop the ability to assess the adequacy & conformance audit of the operation system & the review of the system itself.	PWD(Buildings)- AEE, AE, JE PWD(Roads)- EE, AEE, AE, JE T&CP- DD, AD, EE GMDA- JE/AA PHE- CE/ACE, SE, EE	Completed (PP)



SC26	Construction Safety	- Understand the key requirements of basic safety and health hazards and practices in construction - Aware about the globally recognized guidelines/codes of practice for safety in construction - Able to learn workers' rights and employer responsibilities - Able to become professional construction managers with a sense of civic duty and responsibility - Able to recognize common hazards in construction and take measures to prevent accidents - Use the latest techniques for safety measures	PWD(Buildings)- CE/ACE, SE, EE, AEE, AE, JE PWD(Roads)- CE/ACE, SE, EE, AEE, AE, JE T&CP- DD, AD, JD/SE, EE, AE, JE GMDA- CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE PHE- CE/ACE, SE, EE, AEE, AE, JE	Completed (MH)
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Cross-cultural Analysis and capacity building in construction management practices focusing on housing and infrastructure sectors in Assam and Australia - Version 1/ 17 May 2016

Academic Visitors' Report

Design of the subjects for new Professional Short Courses in Construction Management at AEC

Visitors

Dr Purobi Patowary

Dr Manjuri Hazarika

Duration

29 April – 16 June 2019



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC1: Project Financial Modelling Techniques and Evaluation

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

The process of building an abstract representation or model that is in line with a real world financial situation is called financial modelling. It is designed to represent a financial asset's performance to aid and inform business decisions. Financial modelling includes spreadsheet models, applications for investment analysis, company valuation, forecasting and modelling techniques. Financial modelling skills are becoming increasingly popular in the industrialized world due to the growing need for businesses and organizations to make informed and effective financial business decisions while also curbing the risks that may incur that decision.

This course will enable participants to acquire insights and tools for financial appraisal and decision optimization. It aims at imparting basic knowledge and competencies required in project appraisal and financial management, applicable to all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies. At the end of the course, the participants will develop skills in Financial Modeling and Evaluation Techniques in order to make optimal investment decisions in projects across all sectors.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

This course aims to develop fundamental knowledge in Project Financial Modeling and Evaluation by taking a broad view on business viability analysis of public and private sector projects. Topic covered include cost estimation and baseline planning, capital formation, role of interest rates, assessing financial feasibility and the investment decision, project financing and financing instruments, profitability, socio-economic impact of projects, cost-benefit analysis, and revision of forecasts and financial decisions during project implementation. This two-day course is designed for participants without assuming any prior knowledge in the field and the learning is fully complemented with easy to follow examples. Participants will be encouraged to learn to apply the tools to financially analyze projects, programs and ventures. The emphasis is on simultaneous acquisition and application of the relevant concepts, tools and techniques and hands on practices.

The core objectives of the course are:

- To develop skills in project modelling and evaluation, making investment decisions and assessing project impacts and benefits against costs.
- To help understand the financial, economic and other technical aspects of project evaluation.
- To develop analytical and problem-solving skills in relation to such aspects.
- To evaluate project feasibility and success.



- To facilitate decision-making on project investments.
- To develop criteria for appraisal and optimization that incorporate not only financial returns but also community and stakeholders' benefits

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will develop skills in financial evaluation and analysis in order to make optimal investment decisions in projects across all sectors.

On successful completion, participants should be able to:

- Develop skills in project modelling and evaluation, making investment decisions and assessing project impacts and benefits against costs.
- Understand the financial, economic and other technical aspects of project evaluation.
- Develop analytical and problem-solving skills in relation to such aspects.
- Evaluate project feasibility and success.
- Facilitate decision-making on project investments.
- Develop criteria for appraisal and optimization that incorporates financial returns & benefits to community and stakeholders'

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What are financial modelling techniques?

Financial modelling is instrumental in generating cost-effective business ideas and risk management. That's why it is widely used by companies for budgeting strategy, raising capital and making acquisitions.

2. What are some of the effective financial modelling techniques?

Financial models are designed to showcase an organizations' past and also future financial performance. The best way to design a financial model is through excel



modelling as the programme's tools are able to appropriately forecast a company's future operations. It is therefore essential to have an in-depth knowledge about excel to build an impeccable model as well as a foundational understanding of cooperate finance and accounting.

There are certain financial modelling techniques that are leading the financial world today which are crucial for an organization's financial decision-making process. Here are some of the most widely used and effective financial modelling techniques:

- **Historical data:** This is instrumental in determining future trends. Since the data collected from past references is going to be the foundation of your future predictions, it is essential that the data collected is credible and accurate.
- **Assumptions:** Assumptions involve analyzing a company's historical data and coming up with a strategy for building a financial model. While the term suggests that it is merely guesswork, assumptions in financial modelling must be vivid and well-defined. This is because they are used as the 'drivers' or 'inputs' for financial models of a business while also representing a company's expectations and realities.
- **Color coding or linkages:** Formatting through color codes is an essential part of financial modelling. Different cells contain values corresponding to different parameters. Color coding these cells and your financial model can help your colleagues to understand the model more easily.

Common types of financial models

There are various types of financial models that are employed to support the financial decision-making of an organization.

1. Three Statement Model
2. Discounted Cash Flow (DCF) Model
3. Merger Model (M&A)
4. Initial Public Offering (IPO) Model
5. Leveraged Buyout (LBO) Model
6. Sum of the Parts Model
7. Consolidation Model
8. Budget Model
9. Forecasting Model
10. Option Pricing Model

1 Three Statement Model

This finance model uses three basic statements to determine a company's financial performance. They are:



- Income Statement
- Balance Sheet
- Cash-flow statement

These types of financial models are typically used by banks and other financial institutions to examine the past financial performance of their corporate borrower. The objective is to set it up so all the accounts are connected, and a set of assumptions can drive changes in the entire model. It's important to know how to link the 3 financial statements, which requires a solid foundation of accounting, finance and Excel skills. However, when the Three Statement Model is implemented, ensure that the parameters and assumptions are categorized in a way that the organization's decision to increase or decrease cash flow, revenue and profit is not biased.

2 Discounted Cash Flow (DCF) Model

The DCF model involves financial analysis based on predictions and evaluations about future cash flow. It is employed to determine an organization's worth or value. These type of financial models are generally used by investors, in order to comprehend the actual value of a start-up before they invest capital into it. Stock market investors also use the DCF model to see if a company is trading higher or lower as compared to its true value. The DCF model builds on the 3 statement model to value a company based on the **Net Present Value (NPV)** of the business' future cash flow. The DCF model takes the cash flows from the 3 statement model, makes some adjustments where necessary, and then uses the XNPV function in Excel to discount them back to today at the company's Weighted Average Cost of Capital (WACC).

These types of financial models are used in equity research and other areas of the capital markets.

3 Merger Model (M&A)

The M&A model is a more advanced model used to evaluate the pro forma accretion/dilution of a merger or acquisition. It's common to use a single tab model for each company, where the consolidation where $\text{Company A} + \text{Company B} = \text{Merged Co.}$ The level of complexity can vary widely and is most commonly used in investment banking and/or corporate development.

4 Initial Public Offering (IPO) Model

Investment bankers and corporate development professionals will also build IPO models in Excel to value their business in advance of going public. These models involve looking at comparable company analysis in conjunction with an assumption about how much investors would be willing to pay for the company in question. The



valuation in an IPO model includes “an IPO discount” to ensure the stock trades well in the secondary market.

5 Leveraged Buyout (LBO) Model

This is similar to the DFC model in terms of valuation analysis methods. However, what separates the two is that the LBO model takes debt financing into consideration while rolling out the financial model. The purpose of the LBO model has three layers, which are:

- Balance sheet adjustment or debt-heavy capital structure,
- Coming up with an acceptable **IRR** (Internal Rate of Return)
- Exit value based on EV/EBITDA multiple

A leveraged buyout transaction typically requires modeling complicated debt schedules and is an advanced form of financial modeling. An LBO is often one of the most detailed and challenging of all types of financial models as they create many layers of financing create circular references and requires cash flow waterfalls. These types of models are not very common outside of private equity or investment banking. The LBO model is typically used when an acquirer company uses a considerable amount of debt financing to cover the cost of acquisition.

6 Sum of the Parts Model

This type of model is built by taking several DCF models and adding them together. Next, any additional components of the business that might not be suitable for a DCF analysis (i.e. marketable securities, which would be valued based on the market) are added to that value of the business. So, for example, you would sum up (hence “Sum of the Parts”) the value of business unit A, business unit B, and investments C, minus liabilities D to arrive at the Net Asset Value for the company.

7 Consolidation Model

This type of model includes multiple business units added into one single model. Typically each business unit is its own tab, with consolidation tab that simply sums up the other business units. This is similar to a Sum of the Parts exercise where Division A and Division B are added together and a new, consolidated worksheet is created.

8 Budget Model

This is used to model finance for professionals in financial planning & analysis (FP&A) to get the budget together for the coming year(s). Budget models are typically designed to be based on monthly or quarterly figures and focus heavily on the income statement.



9 Forecasting Model

This type is also used in financial planning and analysis (FP&A) to build a forecast that compares to the budget model. Sometimes the budget and forecast models are one combined workbook and sometimes they are totally separate.

10 Option Pricing Model

The two main types of models are binomial tree and Black-Sholes. These models are based purely on mathematical models rather than subjective criteria and therefore are more or less a straightforward calculator built into Excel.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Financial Modeling and Evaluation Techniques.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE
PWD(Roads)	CE/ACE, SE, EE
T&CP	DD, AD, JD/SE, EE
GMDA	CEO, Secretary
PHE	CE/ACE, SE, EE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Project Financial Modeling Techniques and Evaluation			
Day	Lecture	Topic	Learning Activities
Day 1 .../.../....	Lecture 1 9:00 am–10:30 am (1h 30min) Introduction to techniques & models	- Project Financial Techniques & Evaluation - ROI - NPV - Worked Examples	Material Used: - Lecture slides - Ref 1.1 - Ref 1.2 - Ref 1.3 - Ref 1.4
	10.30 am – 10.45 am: Tea/Coffee break		



Project Financial Modeling Techniques and Evaluation			
Day	Lecture	Topic	Learning Activities
	Lecture 2 10.45 am–12 noon (1h 15min) Valuation & Depreciation	- Valuation & Depreciation - Worked Examples	Material Used: - Lecture slides - Ref 2.1 - Ref 2.2
	Lecture 3 12 noon–1.15 pm (1h 15min) Replacement studies	- Replacement Studies - Worked Examples	Material Used: - Lecture slides - Ref 3.1 - Ref 3.2
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h) Project Cost	- Estimating Cost of Project - Project specifications - Estimating Fixed Capital - Investment in Project - Worked Examples	Material Used: - Lecture slides - Ref 4.1 - Ref 4.2 - Ref 4.3 - Ref 4.4
	Lecture 5 3.15 pm–4.15 pm (1h) Sources of Finance	- Funding Agency - Debt - Venture Capital - Equity - Bond and Debenture	Material Used: - Lecture slides - Ref 5.1 - Ref 5.2
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) Project Life cycle management & Cost Analysis	- Project Life Cycle Management - Life Cycle Cost Analysis - Development of project alternatives - Worked Examples	Material Used: - Lecture slides - Ref 6.1 - Ref 6.2 - Ref 6.3 - Ref 6.4 - Ref 6.5 - Ref 6.6 - Ref 6.7 - Ref 6.8
	10.30 am – 10.45 am: Tea/Coffee break		

Project Financial Modeling Techniques and Evaluation			
Day	Lecture	Topic	Learning Activities
	Lecture 7 10.45 am–12 noon (1h 15min) Project analysis & Risk Assessment	• Project Analysis • Appraisal Tool • Risk analysis and economic estimation • Worked Examples	Material Used: • Lecture slides • Ref 7.1 • Ref 7.2 • Ref 7.3 • Ref 7.4 • Ref 7.5
	Lecture 8 12 noon–1.15 pm (1h 15min) Project Finance	• Evolution of project finance • Project Types • Short term & Long term project finance • Non-Banking Finance Institutions • Worked Examples	Material Used: • Lecture slides • Ref 8.1 • Ref 8.2 • Ref 8.3 • Ref 8.4 • Ref 8.5
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Project Feasibility & Investment Criteria	• Feasibility Criteria • Economic Feasibility Investment criteria and methodologies • Multi stage multi criteria • Worked Examples	Material Used: • Lecture slides • Ref 9.1 • Ref 9.2 • Ref 9.3 • Ref 9.4 • Ref 9.5 • Ref 9.6
	Lecture 10 3.15 pm–4.15 pm (1h) Cash Flow Schedule	• Linear Schedule Analysis • Optimization • Contracts and Payment Schedule • Constrained Project Schedule • Worked Examples	Material Used: • Lecture slides • Ref 10.1 • Ref 10.2 • Ref 10.3 • Ref 10.4

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.



Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
Ref 1.1	Lecture 1	Franze E. Ross, Technical reviews and audit, keeping track of progress in development projects, Management Review, August, 1976.
Ref 1.2		Bekhzod Yusupov and Azrai Abdullah, Recent Trends in Energy Project Financing in Emerging Markets, Global Business and Management Research: An International Journal Vol. 6, No. 4 (2014).
Ref 1.3		Hussein A. Abdou and John Pointon, Credit scoring, statistical techniques and evaluation criteria: a review of the literature, Intelligent systems in accounting, Finance and management Intell. Sys. Acc. Fin. Mgmt. 18, 59, 2011.
Ref 1.4		Tennent John, <i>Guide to Financial Management</i> . 2008, p145-178. 34p.
Ref 2.1	Lecture 2	Joshua Krausz, Joel Hoohman, and Allen Sohiff, The Impact of Taxation on Project Valuation for Alternative Depreciation Methods, Accounting Horizons/September 1987.
Ref 2.2		Kathy G, and Spietler ASA, Appraising Properties with Declining Utility, Journal of Property Tax Assessment & Administration • Volume 8, Issue 4, 2010.
Ref 3.1	Lecture 3	James C et al., Human resources accounting: measuring positional replacement costs, Human Resource Management, Spring, 1973.
Ref 3.2		WENBO SHI and K. JO MIN. Product Remanufacturing and Replacement Decisions Under Operations and Maintenance Cost Uncertainties, The Engineering Economist, 59:154–174, 2014.
Ref 4.1	Lecture 4	S.M. Abou Rizk, G.M. Babey, and G. Karumanasseri, Estimating the cost of capital projects: an empirical study of accuracy levels for municipal government projects, Canadian Journal Civil Engineering, 29: 653–661 (2002).
Ref 4.2		Alfredo F. Serpell, Towards a knowledge-based assessment of conceptual cost estimates, BUILDING RESEARCH & INFORMATION (2004) 32(2), March–April, 157–164.
Ref 4.3		Sayed Elkhoully et al., Application of a Decision Tree Model to a Business Case from Egypt, Competition Forum of American Society, Vol. 13 (2), 2015.
Ref 4.4		Daniel ARMEANU, THE NPV CRITERION FOR VALUING INVESTMENTS UNDER UNCERTAINTY, Economic Computation and Economic Cybernetics Studies and Research, 2007.



Reading	Reference	Suggested Literature
Ref 5.1	Lecture 5	Paulo Rogério Faustino Matos, Alternative funding sources' impact on efficiency and productivity of subnational entities in Brazil after the Fiscal Responsibility Law, BRAZILIAN JOURNAL OF PUBLIC ADMINISTRATION Rio de Janeiro 51(4):482-508, July - Aug. 2017
Ref 5.2		Chapter 5: The competitive market system for debt and equity funding, 2017 JOURNAL OF AUSTRALIAN TAXATION Vol 19 No 3.
Ref 6.1	Lecture 6	Hassan Zalaghi et al., The Relationship between Life Cycle and Cost of Equity on the Firms Listed In Tehran Stock Exchange (TSE), International Journal of Management, Accounting and Economics Vol. 4, No. 6, June, 2017.
Ref 6.2		Jan Vlachy, Using life cycle costing for product management, Management, Vol. 19, 2014,2, pp. 205-218.
Ref 6.3		Ana MUNTEANU and Gabriela MEHEDINTU, THE IMPORTANCE OF FACILITY MANAGEMENT IN THE LIFE CYCLE COSTING CALCULATION, Review of General Management Volume 23, Issue 1, Year 2016.
Ref 6.4		JohnV.Farra et al., Simulation-based costing for early phase life cycle cost analysis: Example application to an environmental remediation project, THE ENGINEERING ECONOMIST, Vol 21, 2016.
Ref 6.5		Jason Westland, The Project Management Life Cycle, AEW Services, Vancouver, BC ©2007.
Ref 6.6		Peter O. Steineb, The role of alternative cost in project design and selection, Quarterly Journal of Economics, MIT press.
Ref 6.7		Elizabeth L. Carter, Community planning, sharing law and the creation of intentional communities: promoting alternative economies and economic self-sufficiency among low-income communities, SOUTH WESTERN LAW REVIEW, Vol. 44, 2015.
Ref 6.8		Abdul Ali et al., Selecting Product Development Projects: Pioneering versus Incremental Innovation Strategies, Management science/Vol. 39, No. 3, March 1993.
Ref 7.1		BARRY G. SILVERMAN, Project appraisal methodology: a multidimensional R & D benefit/cost assessment tool, MANAGEMENT SCIENCE Vol. 27. No. 7. July 1981.
Ref 7.2		Simone I. Flynn, Cost Benefit Analysis:Decision Making in the Public Sector, EBSCO Research Starters, 2014 EBSCO Information Services, Inc.



Reading	Reference	Suggested Literature
Ref 7.3	Lecture 7	Ferda Halicioglu, Estimation of economic discounting rate for practical project appraisal: the case of turkey, Journal of Developing Areas is the property of Tennessee State University, College of Business.
Ref 7.4		Barbara GLADYSZ and Dorota KUCHTA, Estimation of long-term project risk during project realization - combination of the earned value and present value methods, BADANIA OPERACYJNE I DECYZJE, 2008.
Ref 7.5		Francois JOUBERT and Leon PRETORIUS, Using risk simulation to reduce the capital cost requirement for a programme of capital projects, Business, Management and education, 2017.
Ref 8.1	Lecture 8	Claude Besner and Brian Hobbs, An Empirical Identification of Project Management Toolsets and a Comparison Among Project Types, October 2012 Project Management Journal.
Ref 8.2		Moti Frank et al., The Relationship Among Systems Engineers' Capacity for Engineering Systems Thinking, Project Types, and Project Success, September 2011 Project Management Journal.
Ref 8.3		MARCO SORGE and BLAISE GADANECZ, The term structure of credit spreads in project finance, INTERNATIONAL JOURNAL OF FINANCE AND ECONOMICS Vol. 13: 68–81 (2008).
Ref 8.4		Jugurnath Bhavish Rucktooa Ayush Fauzel Sheereen Soondram Hema, What determines the profitability of non-bank deposit taking institutions? some evidence from Mauritius, The Journal of Developing Areas, Volume 51, no. 4, fall 2017.
Ref 8.5		Yasmin Sayed, Lifting the Urban Poor Out of Poverty: Assessing the Role of Non-banking Financial Institutions in India, Strat. Change 25: 585–601 (2016) Published online in Wiley Online Library.
Ref 9.1	Lecture 9	Teresa SZOT-GABRYŚ, Application of the feasibility study in project finance on the basis of a selected investment project, Siedlce University of Natural Sciences and Humanities, Institute of Management and Marketing.
Ref 9.2		Dipak A. Mehta, Project Feasibility of Pilot Plant for Biorenewables to Biofuel Part - 2: Biomass to BioDME (Dimethyl Ether) by Gasification, CHEMICAL BUSINESS ♦ OCTOBER 2014.
Ref 9.3		Mark T. Chen, Simplified project economic evaluation, Cost Engineering, Vol 40, 1998.
Ref 9.4	(cont'd) Lecture 9	TYZOON T. TYEBJEE AND ALBERT V. BRUNO, A model of venture capitalist investment activity, MANAGEMENT SCIENCE Vol. 30. No. 9, September 1984.



Reading	Reference	Suggested Literature
Ref 9.5		Abdollah Arasteh · Alireza Aliahmadi, A Multi-stage Multi Criteria Model for Portfolio Management, Arab J Sci Eng (2014) 39:4269–4283.
Ref 9.6		Ming-Gao Dong and Shou-Yi Lia, Project investment decision making with fuzzy information: A literature review of methodologies based on taxonomy, Journal of Intelligent & Fuzzy Systems 30 (2016) 3239–3252.
Ref 10.1	Lecture 10	Gunnar Lucko, Optimizing Cash Flows for Linear Schedules Modeled with Singularity Functions by Simulated Annealing, Journal of Construction Engineering and Management, ASCE, 2011.
Ref 10.2		Pieter Leymana and Mario Vanhoucke, A new scheduling technique for the resource–constrained project scheduling problem with discounted cash flows, International Journal of Production Research, 2015 Vol. 53, No. 9, 2771–2786.
Ref 10.3		Nalini Dayanand • Rema Padman, Project Contracts and Payment Schedules: The Client’s Problem, Management Science © 2001 INFORMS Vol. 47, No. 12, December 2001 pp. 1654–1667.
Ref 10.4		Gunnar Lucko, Optimizing Cash Flows for Linear Schedules Modeled with Singularity Functions by Simulated Annealing, Journal of Construction Engineering and Management, ASCE, 2011.

9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC4: Project Risk Analysis & Value Engineering

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

Risk analysis is the study of the underlying uncertainty of a given course of action and refers to the uncertainty of forecasted cash flow streams, variance of portfolio/stock returns, the probability of a project's success or failure, and possible future economic states. It is the process of identifying and analyzing potential issues that could negatively impact key business initiatives or critical projects in order to help organizations avoid or mitigate those risks. *Value engineering* is a systematic and organized approach to providing the necessary functions in a project at the lowest cost. Value engineering promotes the substitution of materials and methods with less expensive alternatives, without sacrificing functionality. Contextually risk and value have been treated as separate topics but modern studies have indicated that the notion of risk is irreducibly intertwined with the notion of value and more specifically, that risk assessment is a particular case of value ascription. Thus applying methodologies and techniques developed in marketing and economics for value analysis to the case of risk analysis and vice versa are possible. In this course both topics are discussed together because a clear understanding of the different methodologies of analyzing risks and conducting value engineering is a fundamental necessity for optimal project management.

This course will enable participants to acquire insights and tools for project risk analysis and value engineering. It aims at creating an understanding of the connection between the concepts of risk and value and the competencies required to focus on the important elements that could threaten the project's smooth operation and ensure its path to successful completion.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

Risks constitute a common reality on all projects. The risk analysis process in project management is one of the most important procedures in project management. Value engineering is a structured technique commonly used in project management. Topics covered include ontology of risk & value, components & methodologies of risk analysis, planning for and identifying risks, performing risk analysis, and responding to and controlling risk. Topics on value engineering include reducing production time, reducing expenses, increasing earnings, expanding market share, using existing resources more efficiently, and improving product quality.

The core objectives of the course are:

- To develop the ability to effectively use oral and written communication in projects at a professional level.
- To develop the ability to source and apply tools and techniques to meet contextual demands.



- To develop the ability to apply foundational project management knowledge in projects.
- To develop the ability to apply methods and tools to analyze data and information for managing projects.
- To develop the ability to think critically and synthesize complex data.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will develop skills in Risk Analysis in order to identify and manage potential problems that could undermine key business initiatives or projects. The knowledge of Value Engineering will help the project manager identify and eliminate unwanted costs, while improving both function and quality.

On successful completion, participants should be able to:

- Demonstrate ability to identify and analyze potential issues that could negatively impact key business initiatives or critical projects in order to help organizations avoid or mitigate risks.
- Demonstrate ability to use core tools and techniques to identify and resolve risk in projects.
- Demonstrate ability to solve problems and identify and eliminate unwanted costs, while improving function and quality.
- Demonstrate ability to link risk and value analysis concepts to the project framework.
- Demonstrate a reflective and professional approach to project management practice.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What is the meaning of risk analysis in project management?

Risk Analysis is a process that helps the project manager identify and manage potential problems that could undermine key business initiatives or projects. This process includes identifying and quantifying uncertainties, estimating their impact on outcomes that we care about, building a risk analysis model that



expresses these elements in quantitative form, exploring the model through simulation and sensitivity analysis, and making risk management.

2. Why is risk analysis important?

Risk Analysis is important because

- a. It helps one understand risk so that the risk can be managed and minimum disruption to project events is caused.
- b. It helps control the risk in an effective way.
- c. It helps identify and manage potential problems that could undermine project activities.

3. What is risk analysis based on?

Risk analysis is based upon identifying and analyzing potential issues that could negatively impact key business initiatives or critical projects in order to help organizations avoid or mitigate those risks.

4. What are the main components of a risk analysis?

Risk analysis is defined as "A process consisting of three components: risk assessment, risk management and risk communication."

5. What are the different methods of Risk Analysis Process in Project Management?

There are three kinds of methods used for determining the level of risk of business. The methods are: Qualitative Methods, Quantitative Methods & Semi-quantitative Methods.

6. What is Qualitative Risk Analysis?

Qualitative Risk Analysis is the process during which one prioritizes risks for further action by assessing their probability of impacting project development.

7. What are the different stages in Qualitative Risk Analysis?

The different stages in Qualitative Risk Analysis are:

Risk probability and impact assessment: During this stage every particular risk that might occur is investigated and analyzed in relation to its plausible effects, both positive opportunities and negative threats, on the project's objectives (e.g. cost, schedule, quality, performance). Each risk is defined in levels by means of an interview, an investigation or a meeting with all related stakeholders to document the identified results.



Impact risk rating matrix: The documented results of risk probability can be described in qualitative terms, such as very high, high, neutral, low and very low. The risk rating is developed using a matrix which represents risk scales for each of the risks. The matrix documents the risk probability scale between no possibility (0.0 rate) and certainty (1.0 rate), as well as the risk's impact scale, reflecting the severity of its influence on the project's objective. This matrix helps to improve the quality of the data and make the process easier to replicate several times during the project.

Risk categorization: In this stage, risks are grouped by common causes to determine the most exposed areas of the project and to help develop an effective risk response plan.

Risk urgency assessment: In some cases, the risk of urgency can be combined with the risk ranking, a method used to evaluate the degree to which data about risks is useful for risk management, generating a final sensitivity rating.

Expert judgement: On many occasions it can be helpful to take advice from experts, such as individuals with recent experience on similar project cases, through interviews or risk facilitation workshops.

8. What is Quantitative Risk Analysis?

Quantitative Risk Analysis Process aims to numerically analyze the possibility of every risk and its effect on project objectives, as well as the degree of overall project risk. This procedure uses several techniques or methods such as data collection and representational techniques to determine the probability of achieving project objectives, to quantify the exposure to risks and develop a size and cost assessment schedule.

9. What are the different stages of Quantitative Risk Analysis?

The different stages in Qualitative Risk Analysis are:

Interviewing stakeholders: To this end, one might carry out interviews to gather information and form optimistic (low rating) and pessimistic (high rating) risk scenarios.

Sensitivity analysis: Helps to define which risks have the most potential effect on the project. Generally, this analysis investigates the extent to which the uncertainty of each of the project's elements influences the examination of the objective when other unclear elements are held at their baseline values and can be represented via a tornado diagram.



Expected monetary values analysis (EMV): Is a statistical method that measures the average outcome when the future includes scenarios that may or may not occur (such as positive values-opportunities, or negative values-risks). These are usually depicted by a *Decision Tree Analysis*, which is a diagram describing a decision under consideration and the implications of choosing from the available alternatives. This diagram includes probabilities of risks and the subsequent cost or gain of each logical path.

Modeling and simulation: Is a tool that uses a model that converts the uncertainties into their potential impact on project objectives, generalized to the level of the total project. To help with this, one might use the *Monte Carlo* technique.

Cost risk analysis: For cost estimation analysis traditional project WBS can be used, otherwise, cost estimates can be used as input values, chosen for each iteration incidentally, according to the values probability distribution, in order to define the total cost.

Schedule risk analysis: The *Precedence Diagramming Method* (PDM) can be used for schedule risk analysis. It is a method of constructing a project network diagram that represents the activities and their connection with arrows to show dependencies. One can use this activity-on-node diagram to check whether the project objective will be completed by a certain date and within the cost estimation.

Expert judgement: Obtaining advice from experts to identify potential cost and schedule effects, evaluate possibilities, interpret data and identify weaknesses and strengths can be of great value.

10. How do you analyze a project risk?

Risk analysis involves examining how project outcomes and objectives might change due to the impact of the risk event. Once the risks are identified, they are analyzed to identify the qualitative and quantitative impact of the risk on the project so that appropriate steps can be taken to mitigate them.

11. When is Risk Analysis used?

Risk analysis is useful in many situations:

- a) When planning projects, it helps the manager anticipate and neutralize possible problems.
- b) When manager has to decide whether or not to move forward with a project.
- c) When improving safety and managing potential risks in the workplace.
- d) When preparing for events such as equipment or technology failure, theft, staff sickness or natural disasters.
- e) When planning for changes in the work environment, such as new competitors



coming into the market or changes in government policy.

12. How does one identify project risk?

The first step in Risk Analysis is to identify the existing and possible threats that one might face. These can come from many different sources. For instance, they could be:

Human – Illness, death, injury, or other loss of a key individual.

Operational – Disruption to supplies and operations, loss of access to essential assets, or failures in distribution.

Reputational – Loss of customer or employee confidence, or damage to market reputation.

Procedural – Failures of accountability, internal systems, or controls, or from fraud.

Project – Going over budget, taking too long on key tasks, or experiencing issues with product or service quality.

Financial – Business failure, stock market fluctuations, interest rate changes, or non-availability of funding.

Technical – Advances in technology, or from technical failure.

Natural – Weather, natural disasters, or disease.

Political – Changes in tax, public opinion, government policy, or foreign influence.

Structural – Dangerous chemicals, poor lighting, falling boxes, or any situation where staff, products, or technology can be harmed.

13. What is Value Engineering in project management?

Value engineering is a systematic method to improve the “value” of a product or service that the project produces. It is an integral component of project quality. Value is defined as containing two components, function and cost.

Value = Function / Cost.

Function is a measure of the performance capabilities of the product, service, or project. Cost is the resources required to achieve the function. Clearly, project value is increased when the function is increased, the cost is decreased, or both. Alternatively, the function and cost could both be increased or decreased, as long as the cost becomes proportionately less to the function, the value will increase.

14. How does Value Engineering work?

Value engineering most often takes place after a design (functional or detailed) has taken place, although the best time to do it is actually before design. A value analysis is undertaken whereby practitioners or subject matter experts gather together to perform the value methodology. The standard job plan consists of six phases:

Information: Gathering project information and understanding its primary goals.



Function Analysis: Identifying the functions of the product or project, and describing them with verb/noun pairs, for example, “Preserve wildlife habitat.”

Creative: Generating alternative solutions which accomplish the intended functions but add value.

Evaluation: Reduce the ideas to a short list that can be implemented.

Development: Develop the alternatives into viable, actionable plans.

Presentation: Present the results to management or other stakeholders.

With value engineering, cost reduction should not affect the quality of the product being developed or analyzed.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Project Risk Analysis & Value Engineering.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	EE, AEE, AE
PWD(Roads)	CE/ACE, SE, EE
T&CP	DD, AD, JD/SE, EE
GMDA	CE, PE
PHE	SE, EE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Project Risk Analysis & Value Engineering			
Day	Lecture	Topic	Learning Activities
Day 1 .././....	Lecture 1 9:00 am–10:30 am (1h 30min)	• Risk, hazard, uncertainty- concepts & definitions • classifications • Framework of risk analysis • Importance of Risk Analysis • Similarities between value & risk • Value & value engineering- concepts & definitions • Five Steps in Risk Analysis • Ontology of value & risk	Material Used: • Lecture slides • REF 1.1 • REF 1.2 • REF 1.3 • REF 1.4 • REF 1.5
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min)	• risk assessment, risk management & risk communication- concepts • Risk estimate matrix • Methods of Risk Analysis- Qualitative, Semi-Quantitative & Quantitative • Risk model & its importance • Using probability- Impact matrix in risk analysis • Risk analysis in project management-necessity & how to use it	Material Used: • Lecture slides • REF 2.1 • REF 2.2 • REF 2.3 • REF 2.4
	Lecture 3 12 noon–1.15 pm (1h 15min)	• Methods for Identifying Risks- brainstorming, flowchart method, SWOT analysis, risk questionnaires & risk surveys. • Risk Quantification-necessity • Statistical Inference • Weibull Analysis • Dynamic modeling & simulation	Material Used: • Lecture slides • REF 3.1 • REF 3.2 • REF 3.3 • REF 3.4 • REF 3.5
	1.15 pm – 2.15 pm: Lunch break		



Project Risk Analysis & Value Engineering			
Day	Lecture	Topic	Learning Activities
	Lecture 4 2.15 pm–3.15 pm (1h) Tools & Techniques for Quantitative Risk Analysis	• FMEA/FMECA • Fault hazard analysis • Fault & Event trees • Common cause failure analysis • Sneak circuit analysis • Other methodologies • Risk Management	Material Used: • Lecture slides • REF 4.1 • REF 4.2 • REF 4.3 • REF 4.4 • REF 4.5 • REF 4.6
	Lecture 5 3.15 pm–4.15 pm (1h) Project Risk Analysis & Management	• Project planning & risk • What is involved • Techniques & Methods • Estimation of risk value • Finalizing project risk analysis • Risk monitoring & control • Case study	Material Used: • Lecture slides • REF 5.1 • REF 5.2 • REF 5.3
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) Introduction to Value Analysis	• Basic concepts & definitions • Principles of the methodology • Value methodology standard • Areas of application • Stages of the Job plan • Steps in the process of Value Engineering with Risk Assessment	Material Used: • Lecture slides • REF 6.1 • REF 6.2 • REF 6.3 • REF 6.4
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Value Methodology Job Plan	• Pre-study • Value study • Post study • VRM approaches • VE program • Economic Analysis Concept-guidelines & approaches • Integrating Value & Risk Management	Material Used: • Lecture slides • REF 7.1 • REF 7.2 • REF 7.3
	Lecture 8 12 noon–1.15 pm (1h 15min) Managing Project Risk	• Project skills • Creating risk management plan • Identifying project risk • Performing risk analysis • Planning & controlling risk responses • Application of VE with RA	Material Used: • Lecture slides • REF 8.1 • REF 8.2 • REF 8.3 • REF 8.4

Project Risk Analysis & Value Engineering			
Day	Lecture	Topic	Learning Activities
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Integrating Risk Management & Value Engineering	Integration of Risk Management & Value Engineering in Industrial Projects • Case Study 1 • Case Study 2 • Case Study 3	Material Used: • Lecture slides • REF 9.1 • REF 9.2 • REF 9.3
	Lecture 10 3.15 pm–4.15 pm (1h) Integrating Risk Management & Value Engineering	• Case Study 4 • Case Study 5 • RM and VM in Public Private Partnerships • Benefits of Integration	Material Used: • Lecture slides

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF 1.1	Lecture 1	T P Sales, F Baião, G Guizzardi, J P A. Almeida, N Guarino, and J Mylopoulos, The Common Ontology of Value and Risk, University of Trento, Italy, 2017.
REF 1.2		Risk Analysis Framework, Australian Government, Dept. of Health & Aging, Jan 2005.
REF 1.3		Solenne Costard, Introduction to Risk Analysis and Risk Assessment, ILRI, Nairobi, 2- 3 October 2008
REF 1.4		Enterprise Risk Management Framework, Version 1: Approved by University Audit and Risk Committee 5 June, 2017.
REF 1.5		Risk Analysis, https://uwm.edu/studentinvolvement/wp-content/.../Risk-Analysis-Power-Point.pptx
REF 2.1	Lecture 2	I. Häring, Risk Analysis and Management: Engineering Resilience, Springer Science & Business Media Singapore 2015.
REF 2.2		Risk Analysis and Quantification, www.madrid.org/cs/StaticFiles/.../pdf/.../4AnalisisycuantificaciondelRiesgo(AR)_en.pdf



Reading	Reference	Suggested Literature
REF 2.3		Roberto Rudari, Assessing & Understanding Risk & Integrating Risk Management In Development Planning, CIMA Research Foundation, UNISDR.
REF 2.4		V Dumbravă, T Maiorescu V S Iacob & Stefan Mare, Using Probability- Impact Matrix in Analysis & Risk Assessment Projects, Journal of Knowledge Management, Economics and Information Technology, pp. 76-96, Dec 2013.
REF 3.1	Lecture 3	Tim Bedford & Roger Cooke, Probabilistic Risk Analysis: Foundation & Methods, Cambridge University Press, 2001.
REF 3.2		Farnad Nasirzadeh, Abbas Afshar, and Mostafa Khanzad, Dynamic Risk Analysis In Construction Projects, Can. J. Civ. Eng. 35: 820–831, 2008.
REF 3.3		Rovins, J.E.; Wilson, T.M.; Hayes, J.; Jensen, S. J.; Dohaney, J., Mitchell, J.; Johnston, D.M.; Davies, A, Risk Assessment Handbook, GNS Science Miscellaneous Series, pp. 84-71, 2015.
REF 3.4		John G. Zhao, Significance of Risk Quantification, Palisade RISK Conference 2007.
REF 3.5		Ana-Mari, Modern Methods of Risk Identification in Risk Management, International Journal of Academic Research in Economics and Management Sciences, Vol. 1, No. 6, pp. 67-71, Nov 2012.
REF 4.1	Lecture 4	Risk Analysis Method: FMEA/FMECA in the Organizations, International Journal of Basic & Applied Sciences IJBAS-IJENS Vol. 11 No: 05, pp.49-57, Oct 2011.
REF 4.2		Quantitative Risk Analysis, faculty.kfupm.edu.sa/CEM/.../PDF.../L05%20Quantitative%20Risk%20Analysis.pdf
REF 4.3		Analysis Techniques, FAA System Safety Handbook, December 30, 2000.
REF 4.4		V D N Ramanamurthy and K. U Balasubramanian, Effective Risk Management: Risk Analysis Using An Enhanced FMEA Technique, Tata Consultancy Services.
REF 4.5		K Padayachee, Techniques used In Risk Analysis of Software Development, 16 October 2014.
REF 4.6		P.Sheikh Damanaba, S.S. Alizadeha, Y. Rasoulzadeha, P. Moshashaiea, S. Varmazyarb, Failure Modes And Effects Analysis (FMEA) Technique: A Literature Review, Scientific Journal of Review 4(1) pp.1-6, 2015.
REF 5.1	Lecture 5	C Norris, J Perry & P Simon, Project Risk Analysis & Management, Guide by the Association of Project Management, Jan 2000.
REF 5.2		R R J. McAllister, B M Taylor, and B P Harman, Partnership Networks for Urban Development: How Structure is Shaped by Risk, The Policy Studies Journal, Vol. 43, No. 3, pp. 379-398, 2015.
REF 5.3		Ken L. Smith, Cost Risk Assessment & Value Engineering, CSVA 2011 Conference Toronto, Ontario Nov 14 -16, 2011.
REF 6.1	Lecture 6	David K H Chua, Value Improvement Methods, CRC Press LLC, 2003.



Reading	Reference	Suggested Literature
REF 6.2		Value Engineering VE with Risk Assessment RA, www.wsdot.wa.gov/publications/fulltext/CEVP/VERA.pdf
REF 6.3		Karim Eldash, Value Engineering, 07 February 2015. ResearchGate, www.ProjacsTraining.com
REF 6.4		Value Engineering, The Engineering Industry Training Board. St. Martin's House, 140 Tottenham Court Road, London.
REF 7.1	Lecture 7	S B Abd Karim, Mohd Ali Berawi, Imran A Yahya, Hamzah A Rahman & O Mohamed The Integration of Value And Risk Management In Infrastructure Projects: Learning From Others, Quantity Surveying Int. Conf., 4-5 pp. 1-13, Sept, 2007 Kuala Lumpur, Malaysia.
REF 7.2		Jay Mandelbaum & Danny L. Reed, Value Engineering Handbook, Institute for Defense Analyses, Sept 2006.
REF 7.3		Value Methodology Standard, SAVE International Value Standard, March 2015 edition.
REF 7.4		Wei-Tong Chen & Shen-Li Liao, A Job-Plan Based Performance Evaluation for Construction Value Engineering Study, Journal of the Chinese Institute of Engineers, Vol. 33, No. 2, pp. 317-333, 2010.
REF 8.1	Lecture 8	Paul Newton, Managing Project Risk, www.free-management-ebooks.com
REF 8.2		Jurnal Ilmiah, Considering The Integrated Value Engineering And Risk Management Techniques During The Design Phase In Construction Projects – Its Implications To Project Objectives, Media Engineering Vol.3 No.3, pp. 214-226, Sept 2013.
REF 8.3		S N Ambaliya, J Shah, A K Raval, A Review: Application of Value Engineering for Affordable Housing, Global Research and Development Journal for Engineering, Emerging Research and Innovations in Civil Engineering (ERICE - 2019) Feb 2019.
REF 8.4		Joel Wao, A Review of the Value Engineering Methodology: Limitations and Solutions for Sustainable Construction, 55TH SAVE International Annual Conference: SAVE Value Summit, San Diego, CA, USA, June 7-9, 2015
REF 9.1	Lecture 9	H.R Feili, S. Nasiri, N. Akar, Integrating Risk Management & Value Engineering in the Development of Renewable Energy Project, 6 th SASTech, pp. 1-10, 2012.
REF 9.2		M M. El Khatib, Integrating Project Risk Management & Value Engineering in Tendering Processes, Int. Journal of Engineering Research, Vol.4, Issue No.8, pp. 442-445, Aug 2015.
REF 9.3		B Askari Sabzkohi, T Pourrostam, Integrated Model Of Value Engineering And Risk Management Approaches In Empowerment Projects, Proc. of 17th IASTEM Int. Conf., Istanbul Turkey, 26 March 2016.
REF 10.1	Lecture 10	Mohamad Jamin Pedju & Emelly Mawu, Considering The Integrated Value Engineering & Risk Management Techniques During The Design Phase In Construction Projects – Its Implications To Project Objectives, Jurnal Ilmiah Media Engineering Vol.3 No.3, pp. 214-226, Sept 2013.



Reading	Reference	Suggested Literature
REF 10.2		L Haghnegahdar, & E Asgharizadeh, The Risk and Value Engineering Structures and their Integration with Industrial Projects Management, Int. Journal of Mech., Aerospace, Industrial, Mechatronic & Manufacturing Engineering Vol:2, No:4, 2008.
REF 10.3		Ranesh, A. Zillante, G., and Chileshe, N., Towards the Integration of Risk and Value Management, Australasian Journal of Construction Economics and Building Conference Series, 1 (2) 43-51, 2012.

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC-8: CONSTRUCTION DELAY ANALYSIS
(SUBJECT GUIDE)

(Version-1.0)

by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

Construction projects are, by nature, difficult to control because of their dynamic and complex environment, resulting in frequent changes, delays, and cost overruns. They often suffer from delays due to a wide variety of reasons, which can have severe financial impact on the project. Common causes of delay encountered on construction projects may be: missing and conflicting information, absence of a phasing plan, not having enough labour force on site, contractual problems between the prime contractor and subcontractors, cash flow issues, lack of proper planning and management of the project, strikes, manufacturer's shut down, unusual weather conditions, changes in design, etc. Delays can lead to many negative effects such as lawsuits between owners and contractors, increased costs, loss of productivity and revenue, and contract termination. To recover the damage caused by delays, both the delays and the parties responsible for them should be identified. The analysis of these delays involves not only the calculation of the delay time but also the identification of the root causes and the responsibility for delays. Such an analysis therefore becomes a basis for the financial calculations that determine penalties or other damages to be assigned to the parties responsible for the delays.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

This short course summarizes the causes and types of delay in construction projects and the delay analysis methods in detail. It will guide the participants to apply the engineering and mathematical fundamentals for delay analysis in construction projects. The analysis of delay requires an expert with extensive knowledge of construction projects, means and methods, scheduling and the ability to develop a sound methodology to conduct the analysis. Detailed intensive research of the documents is required to verify schedules, events, sequence of work, changes during construction and the delay impact. It is important to avoid delays in construction schedules to achieve the goal of producing good quality construction work within the specified duration. Construction schedule delays should be analysed and corrective measures should be taken in a timely manner. Researchers and practitioners have used many techniques to assess project delays. The course will impart the participants the capability to do such type of delay analysis.

The objective of the short course is to enable the participants to:

- Become familiar with the causes of construction delay
- Identify the critical issues to be addressed in avoiding construction delay
- Develop an increased awareness of civil construction blueprints



3.0 LEARNING OUTCOMES

On completion of this two-day short course, the participants will be:

- Able to relate the construction schedule's activities by logic relationship
- Identify and reduce the causes of delay
- Able to adjust the schedule to recover a delay and bring back the completion date to a desired date
- Able to perform delay analysis and recover the losses

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from government/corporate/ business sectors from any background. The participants are expected to join with minimum professional experience across the sectors including construction, design consultancy, academics, and engineering services etc.

5.0 FREQUENTLY ASKED QUESTIONS

Q. What is delay in construction?

Ans. Delay is the time overrun either beyond the completion date specified in the contract or beyond the agreed-upon date for delivery of the project.

Q. What are the common causes of delay in construction?

Ans. Some of the common causes of delay in construction are absence of a phasing plan, not having enough labour force on site, contractual problems between the prime contractor and subcontractors, cash flow issues, lack of proper planning and management of the project, strikes, manufacturer's shut down, unusual weather conditions, changes in design, dispute among the team members, etc.

Q. What is the effect of delay in construction?

Ans. Delay is one of most common problems in construction projects resulting in construction disputes and claims. Most large projects are completed later than agreed-upon dates for a number of reasons. These delays can have severe financial impact on the project. Basically, delays are a net loss situation for all the stakeholders.



6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Construction Delay Analysis.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE
PWD(Roads)	CE/ACE, SE, EE
GMDA	PE, AEE, AE, JE/AA
PHE	EE, AEE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

CONSTRUCTION DELAY ANALYSIS			
Day	Lecture	Topic	Learning Activities
Day 1	Lecture 1 9:00 am–10:30 am Introduction to Construction Delay	• Introduction to construction delay • Common causes of delay - Design related - Contractor related - Consultant related - Owner related - Others	Reading list: Lecture Slides CDA-1-1 CDA-1-2 CDA-1-3 CDA-1-4
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon Types of Construction Delay	• Introduction • Critical vs non-critical delay • Excusable vs non-excusable delay • Compensable vs non-compensable delay • Concurrent delay	Reading list: Lecture Slides CDA-2-1 CDA-2-2 CDA-2-3



CONSTRUCTION DELAY ANALYSIS			
Day	Lecture	Topic	Learning Activities
	Lecture 3 12 noon–1.15 pm Phases of Construction Delay Analysis	Division of Delay Analysis into Three Broad Phases: - Investigation Phase: evidence collection - Description Phase: analysis of facts collected during investigation - Presentation Phase: presentation of the facts to the jury to prove the claim	Reading list: Lecture Slides CDA-3-1
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Delay Analysis Techniques	- As-Planned vs. As-Built method - Impacted As-Planned method - Collapsed As-built method - Window analysis method - Time impacted analysis method - As planned but-for method - Comparison of the methods	Reading list: Lecture Slides CDA-4-1 CDA-4-2 CDA-4-3 CDA-4-4 CDA-4-5
	Lecture 5 3.15 pm–4.15 pm Delay Claim	- Introduction and Definition - Reasons for Delay Claims - Types of Delays Resulting in Claims - Delay-Claims Prevention - Project Schedule Documentation - Delay-Claims Resolution - The Importance of CPM Schedule in Delay Claims - Methods of Schedule Analysis - Float Ownership.	Reading list: Lecture Slides CDA-5-1 CDA-5-2 CDA-5-3 CDA-5-4
	Lecture 6 9:00 am–10:30 am Recommended Practice on Forensic Schedule Analysis	- Purpose of forensic scheduling - Identify and quantify all delays - Identify and quantify schedule variance, disruption, acceleration - Source validation protocols - Method implementation protocols - Analysis evaluation protocols	Reading list: Lecture Slides CDA-6-1 CDA-6-2



CONSTRUCTION DELAY ANALYSIS			
Day	Lecture	Topic	Learning Activities
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Construction Delay and Disruption Protocol	• Introduction • Construction Law & Delay and Disruption Protocol • Guidance: Delay, Disruption & Acceleration Concepts • Guidance: Core Principles • Guidance: Financial Heads of Claim	Reading list: Lecture Slides CDA-7-1 CDA-7-2
	Lecture 8 12 noon–1.15 pm Construction Delay Scenario in India	• Critical factors for delay in Indian construction • Time overruns • Cost overruns • Contractual shortcomings • Organizational shortcomings • Remedies	Reading list: Lecture Slides CDA-8-1 CDA-8-2 CDA-8-3 CDA-8-4 CDA-8-5 CDA-8-6
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Case Studies from India	• Case Study 1 • Case Study 2 • Case Study 3	Reading list: Lecture Slides CDA-9-1 CDA-9-2 CDA-9-3
	Lecture 10 3.15 pm–4.15 pm Case Studies from Abroad	• Case Study 1 • Case Study 2 • Case Study 3 • Case Study 4	Reading list: Lecture Slides CDA-10-1 CDA-10-2 CDA-10-3 CDA-10-4



8.0 READING MATERIALS

Participants are expected to refer to literatures from various sources, which might include case studies, conferences papers, library collections, eBooks and e Journals. A reading list is provided in Table–3. However, this list is not an extensive one and may be updated and altered as and when necessary.

Table 3: Reading List

Lecture	Reading	Suggested Literature
Lecture 1 Introduction to Construction Delay	CDA-1-1	M Abbas, Delay analysis for construction projects, Conference Paper January 2008: https://www.researchgate.net/publication/257947267
	CDA-1-2	Songül Day, Schedule Delay Analysis in Construction Projects: A case study using Time Impact Analysis Method, Master's Thesis, 2010
	CDA-1-3	Ar. Meena. V, Ar. K. Suresh Babu, Study on Time Delay Analysis for Construction Project Delay Analysis, International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 03, pp 1076-1083, March-2015
	CDA-1-4	Owolabi James et al, Causes and effect of delay on project construction delivery time, International Journal of Education and Research, Vol. 2 No. 4, pp 197-208, 2014
Lecture 2 Types of Construction Delay	CDA-2-1	M Abbas, Delay analysis for construction projects, Conference Paper January 2008: https://www.researchgate.net/publication/257947267
	CDA-2-2	Saad Hegazy, Delay analysis Methodology in UAE construction Projects: Delay Claims, Literature Review, PM World Journal, Vol. I, Issue II – September 2012, pp 1-21.
	CDA-2-3	https://www.forensisgroup.com/construction-delay-analysis-methods-2/
Lecture 3 Phases of Construction Delay Analysis	CDA-3-1	https://sites.google.com/site/metropolitanforensics/construction-delay-analysis-methods
Lecture 4 Delay Analysis Techniques	CDA-4-1	A Jack Lazarczyk, Schedule Delay Analysis, McGovern & Greene, www.mcgovernngreene.com https://sites.google.com/site/metropolitanforensics/construction-delay-analysis-methods
	CDA-4-2	S Mohammed, S Jafar, Construction delay analysis using daily windows technique, Journal of Engineering, Researchgate, vol-17, pp 186-199
	CDA-4-3	N Braimah, Construction Delay Analysis Techniques—A Review of Application Issues and Improvement Needs,



Lecture	Reading	Suggested Literature
		Buildings 2013, 3, 506-531; doi:10.3390/buildings3030506, pp 506-531
	CDA-4-4	N H Muhamad et al, Delay Analysis Methodologies (DAMs) in Delivering Quality Projects: Contractors and Consultants' Perceptions, Procedia - Social and Behavioral Sciences 222 2016, pp 121 – 131
	CDA-4-5	A Arun Salunkhe, R S. Patil, Statistical Methods for Construction Delay Analysis, IOSR Journal of Mechanical and Civil Engineering, Vol 9, pp 58-62, 2013
Lecture 5 Delay Claim	CDA-5-1	A Yahiya, M Abboshi, Construction Delay Claims, Ch-12, An-Najah National University Faculty of engineering civil engineering department PPT Presentation
	CDA-5-2	R J Long, Analysis of Concurrent Delay in Construction Claims, Long International Inc., Book, 2018.
	CDA-5-3	P P Shrestha, N W Meyer, Delay Claim Analysis in the Construction Industry, 50th ASC Annual International Conference Proceedings, 2014
	CDA-5-4	Hany Ismail, Construction Claims Management & EOT Delays Analysis, www.planningengineer.net
Lecture 6 Recommended Practice on Forensic Schedule Analysis	CDA-6-1	J G Jack, Delay and Delay Analysis: Isn't It Simple?, 1 st ICEC & IPMA Global Congress on Project Management, 2006, California.
	CDA-6-2	M C Sanders, Forensic Schedule Analysis: Example Implementation, 2008 AACE INTERNATIONAL TRANSACTIONS, CDR.11
Lecture 7 Construction Delay and Disruption Protocol	CDA-7-1	Construction Law Delay and Disruption Protocol, 2nd edition February 2017, Published by the Society of Construction Law (UK), 234 Ashby Road, Hinckley, Leicestershire, LE10 1SW. www.scl.org.uk
	CDA-7-2	CONSTRUCTION SOLUTIONS- EMEA SCL Delay and Disruption Protocol 2nd Edition Review
Lecture 8 Construction Delay Scenario in India	CDA-8-1	R Singh, Delays and Cost Overruns in Infrastructure Projects: Extent, Causes and Remedies, Special article, Economic & Political Weekly, 2010 vol xlv no 21, pp 43-54
	CDA-8-2	H Doloi, A Sawhney, K C Iyer, S Rentala, Analysing factors affecting delays in Indian construction projects, International Journal of Project Management, vol-30, pp 479-489, 2012
	CDA-8-3	H Doloi, A Sawhney & K.C. Iyer, Structural equation model for investigating factors affecting delay in Indian construction projects, Construction Management and Economics, pp 1-16, 2012



Lecture	Reading	Suggested Literature
	CDA-8-4	R Dinesh Kumar, Causes and Effects of Delays in Indian Construction Projects, International Research Journal of Engineering and Technology, Vol: 03, pp 1831-1837, 2016
	CDA-8-5	Dispute perspectives Delay claims: Damage quantification in construction sector, Article in Dispute Perspectives—a monthly newsletter. www.pwc.com/India
	CDA-8-6	A Govt of India report on ‘Study on project schedule and cost overruns Expedite infrastructure projects’ 2012
Lecture 9 Case Studies from India	CDA-9-1	A Upadhyay, V Gupta, M Pandey, A case study on schedule delay analysis in construction projects in Gwalior, International Research Journal of Engineering and Technology, Vol: 03, pp 1312-1315, 2016
	CDA-9-2	Y Honrao and D.B.Desai, Study of Delay in Execution of Infrastructure Projects–Highway Construction, International Journal of Scientific and Research Publications, Volume 5, Issue 6, 2015
	CDA-9-3	P Rao, J Camron Culas, Review article, Causes of delays in construction projects – A case study, International Journal of Current Research, vol-6, pp 7219-7222, 2014
Lecture 10 Case Studies from Abroad	CDA-10-1	Shebob, A, Dawood, N and Xu, Q (2011) Analysing construction delay factors: A case study of building construction project in Libya In: Egbu, C. and Lou, E.C.W. (Eds.) Procs 27th Annual ARCOM Conference, 5-7 September 2011, Bristol, UK, Association of Researchers in Construction Management, 1005-1012.
	CDA-10-2	Nabil Al-Hazim, Zaydoun Abu Salem, Hesham Ahmad, Delay and Cost Overrun in Infrastructure Projects in Jordan, 7th International Conference on Engineering, Project, and Production Management, 2016
	CDA-10-3	Mulenga Mukuka, Clinton Aigbavboa, Wellington Thwala, Effects of construction projects schedule overruns: A case of the Gauteng Province, South Africa, 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015
	CDA-10-4	Ahmed Senoucia, Alaa Ismailb, Neil Eldina, Time Delay and Cost Overrun in Qatari Public Construction Projects, Creative Construction Conference 2016, CCC 2016, 25-28 June 2016



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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

**SC-9: NEW AND INNOVATIVE
CONSTRUCTION MATERIALS**
(SUBJECT GUIDE)

(Version-1.0)
by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

With rising globalisation, construction industry is booming at present and buildings/structures and roads have become vital infrastructures that call for better and sustainable development. The functional demand of such infrastructures needs the use of new and innovative construction materials. Apart from the basic structural materials, modern projects require a variety of secondary materials such as construction chemicals, waterproofing materials, durability aids etc. There is use of recycled materials for construction to replace the conventional materials in most of the developed countries. Innovative practices in building and road construction are being implemented globally in various nations, e.g. US, Hamburg, Germany, UK, Australia. These practices indicate that the need arises to move towards green methods of building and road construction to address environmental issues such as global warming and climate change.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

This two-day short course will focus on the new and innovative developments in construction materials and technology around the globe. Insight to the modern building materials like high performance concrete (HPC), self-compacting concrete (SCC), mineral admixtures, high volume fly ash concrete (HVFA), high performance lightweight concrete (HPLC), steel fibre reinforced concrete (SFRC), hydrophobic concrete waterproofing system etc. will be provided in the course. Similarly, new innovations in road construction offers the use of new materials and technology, such as solar technology-based roads, eco-friendly roads, plastic roads, roads made from recycled materials, foamed bitumen, automated computerised systems of traffic indicators, etc. It will focus on the current practices in construction materials in the developed countries. The participants will get first-hand knowledge on characteristics and behaviour of different new innovative construction materials.

The objective of the short course is to enable the participants to:

- Gain & apply in-depth knowledge of new innovative construction materials.
- Understand evolution and functional requirements of construction materials.
- Understand and apply the knowledge on innovative and energy efficient materials.
- Continue research for sustainable construction materials.

3.0 LEARNING OUTCOMES

On completion of the two-day short course participants will develop the following learning outcomes:



- Ability to understand properties and behaviour of new construction materials.
- Select appropriate innovative construction materials based on the functional requirements of modern structures.
- Ability to understand the importance of sustainable materials and green methods of building and road construction
- Undertake R&D works for development of new construction materials.

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from government/corporate/ business sectors specially from civil engineering and architectural background. The participants are expected to join with minimum professional experience across the sectors including construction, design consultancy, academics, and engineering services etc.

5.0 FREQUENTLY ASKED QUESTIONS

Q. What are the modern construction materials?

Ans. Modern construction materials like durable concrete, high performance concrete (HPC), self-compacting concrete (SCC), Mineral Admixtures, High Volume Fly Ash Concrete (HVFA), High Performance Lightweight Concrete (HPLC), Steel Fibre Reinforced Concrete (SFRC), Hydrophobic Concrete Waterproofing System etc. are gaining widespread acceptance for buildings and high-rise structures.

Q. What are the latest innovations in road construction?

Ans. Some of the latest innovations in road construction are:

- Solar technology-based road
- Sustainable eco-friendly road
- Plastic road
- Roads made from waste/recycled materials

Q. What are the materials used to build a house?

Ans. Available conventional materials for building a house are:

Concrete, metal, concrete tiles, brick and block, wood, bamboo etc. Some of the new innovative materials developed are HVFA, SCC, HPC, HPLC, SFRC, Composites, Recycled Steel, etc.



6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Construction Materials (Roads & Building).

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
GMDA	PE, AEE, AE, JE
TP- Town Planner CAO-Chief Accounts Officer PE-Project Engineer AA-Architectural Assistant	
PHE	EE, AEE, AE, JE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

New and Innovative Construction Materials			
Day	Lecture	Topic	Learning Activities
Day 1 ..!./!....	Lecture 1 9:00 am–10:30 am Introduction to Construction Materials	• Introduction • Traditional and innovative construction materials • Functional requirements and properties of construction materials	Reading list: Lecture Slides CM-1-1 CM-1-2 CM-1-3
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon Types of Construction Materials	• Cement • Metals • Timber Based Products • Plastics and Polymers in Construction • Glass • Role of Admixture in Workability • Aluminium Composite Panels • Galvalume Sheets	Reading list: Lecture Slides CM-2-1 CM-2-2 CM-2-3 CM-2-4 CM-2-5 CM-2-6 CM-2-7
	Lecture 3 12 noon–1.15 pm	• Development of new materials and their benefits • Special Concretes: HPC, SCC,	Reading list: Lecture Slides CM-3-1 CM-3-2



New and Innovative Construction Materials			
Day	Lecture	Topic	Learning Activities
	Evolutionary Trends in Construction Materials	HVFA, HPLC, SFRC, SIFCON, SIMCON, CRC - Innovative road construction materials - Construction Chemicals	CM-3-3 CM-3-4 CM-3-5 CM-3-6 CM-3-7
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Innovative Materials for Building/Structures	- Innovative Materials and Benefits - Solid and Hollow Concrete Blocks - Autoclave Aerated Concrete - Innovative Excavation - Commercialization of new Technology	Reading list: Lecture Slides CM-4-1 CM-4-2 CM-4-3 CM-4-4 CM-4-5 CM-4-6 CM-4-7
	Lecture 5 3.15 pm–4.15 pm Innovative Materials for Road Construction	- Solar technology-based road - Sustainable eco-friendly road - Plastic road - Roads made from waste/recycled materials - Inter-locking Paver Block	Reading list: Lecture Slides CM-5-1 CM-5-2 CM-5-3 CM-5-4
Day	Lecture	Topic	Learning Activities
Day 2 ..!./.....	Lecture 6 9:00 am–10:30 am Green Building Materials	- Why green building materials? - Types of green building material - Green building construction process - Green building programs across the world	Reading list: Lecture Slides CM-6-1 CM-6-2
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Green Construction	- The Concept - Green Technology - Working Mechanism - Case Study	Reading list: Lecture Slides CM-7-1 CM-7-2 CM-7-3



New and Innovative Construction Materials			
Day	Lecture	Topic	Learning Activities
	Solutions to Affordable Housing	Analysis	
	Lecture 8 12 noon–1.15 pm Construction Materials for Disaster Resilient Building	- Disaster Management: Perspective - Disaster-resilient Housing Design - Construction Strategies - Roof, Wall, Foundation, Site - National Disaster Management Guidelines, India	Reading list: Lecture Slides CM-8-1 CM-8-2 CM-8-3 CM-8-4 CM-8-5
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Case Studies	CASE STUDIES - Road made from recycled materials - Innovative eco-friendly road solution - Solar roads - Futuristic highways - Plastic roads	Reading list: Lecture Slides CM-9-1
	Lecture 10 3.15 pm–4.15 pm Case Studies	CASE STUDIES - Green Building - Energy Efficient Building	Reading list: Lecture Slides CM-10-1 CM-10-2

8.0 READING MATERIALS

The reading list (as provided in Table 3) provides the literature that the participants are expected to go through to understand the new innovative materials and techniques in construction encompassing buildings and roads. However, this list is not an extensive one and may be updated and altered as and when necessary.



Table 3: Reading List

Lecture	Reference	Suggested Literature
Lecture 1	CM-1-1	S. Somayaji, Civil Engineering Materials, Prentice Hall, New Jersey, 2001. M. S. Mamlouk and J. P. Zaniewski, Materials for Civil and Construction Engineers, Pearson, 2nd Edition, 2006. N. Jackson and R.K. Dhir, Civil Engineering Materials, McMillan, 4th Edition, 1997. K. S. Jagadish, B. V. V. Reddy & K. S. N. Rao, Alternative Building Materials and Technologies, New Age International, 2006.
	CM-1-2	A F. Asdrubali, B. Ferracuti, L. Lombardi, C. Guattari, L. Evangelisti and G. Grazieschi (2017) Review of structural, thermo-physical, acoustical, and environmental properties of wooden materials for building applications, Building and Environment, Vol. 114, pp-307-332.
	CM-1-3	E. Franzoni (2014) Rising damp removal from historical masonries: A still open challenge, Construction and Building Materials, Vol. 54 pp. 123-136.
Lecture 2	CM-2-1	C. J. Billington(1987) Developments in the use of Steel in Construction, Construction and Building Material Vol. 1, No. 1, pp. 19-23.
	CM-2-2	IS 1786 (2008): High strength deformed steel bars and wires for concrete reinforcement
	CM-2-3	K. J. Fridley (2002) Wood and Wood-Based Materials: Current Status and Future of a Structural Material, <i>Journal of Materials in Civil Engineering</i> , ASCE, Vol. 14, No. 2, pp. 91-96.
	CM-2-4	List of Indian Standards to be consulted for Timber and Timber Products
	CM-2-5	IS : 2395(Part –II) – 1994 Code of Practice For Painting Of Concrete, Masonry and Plaster Surfaces - Code of Practice
	CM-2-6	P. C. Aïtcin (2000) Cements of yesterday and today Concrete of tomorrow, Cement and Concrete Research, Vol. 30, pp 1349-1359.
	CM-2-7	J. Plank, E. Sakai, C.W. Miao, C. Yu and J.X. Hong (2015) Chemical admixtures — Chemistry, applications and their impact on concrete microstructure and durability, Cement and Concrete Research, Vol. 78, pp 81-99.
	CM-3-1	F. Pacheco-Torgal, and J. A. Labrincha (2013) The future of construction materials research and the seventh UN Millennium Development Goal: A few



Lecture	Reference	Suggested Literature
Lecture 3		insights, Construction and Building Materials, Vol. 40, pp 729-737.
	CM-3-2	Details of different types of Concrete
	CM-3-3	Innovation in the road construction sector and its benefits to the industry, Master of Engineering (Research), Pradip Kumar
	CM-3-4	IS : 9103 – 1999 <i>Indian Standard Concrete Admixtures – Specifications</i> .
	CM-3-5	J. Plank, E. Sakai, C.W. Miao, C. Yu and J.X. Hong (2015) Chemical admixtures — Chemistry, applications and their impact on concrete microstructure and durability, Cement and Concrete Research, Vol. 78, pp 81-99.
	CM-3-6	Salman Asad, Paul Fuller, Wei Pan and Andrew R.J Dainty, LEARNING TO INNOVATE IN CONSTRUCTION: A CASE STUDY, Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, 7-9 September 2005, SOAS, University of London
	CM-3-7	Cold-Formed Steel in Building Construction, Cold-Formed Steel Profile (2010)
Lecture 4	CM-4-1	Gerd Bolte, Innovative building materials – reduction of pollutants with TioCem, Materials Science, pp 63-70
	CM-4-2	Mikhail Shandalovich Co-Authors: Zachary Hawkins, Deniz Löktas, Peteris Putelis Innovative Building Materials: Helsinki Metropolia University of Applied Sciences Bachelour of Science, Sustainable Building and Engineering
	CM-4-3	IS 15658 (2006): Precast concrete blocks for paving - [CED 5: Flooring
	CM-4-4	IS 2572 (2005): Construction of hollow and solid concrete block masonry - Code of practice
	CM-4-5	Different types of Concrete
	CM-4-6	Ming-Guang Li ¹ ; Jin-Jian Chen, A.M.ASCE ² ; An-Jun Xu ³ ; Xiao-He Xia ⁴ ; and Jian-Hua Wang ⁵ , Case Study of Innovative Top-Down Construction Method with Channel-Type Excavation, J. Constr. Eng. Manage, 2015
	CM-4-7	Commercialisation of Innovative Building Material Technologies, Building Materials and Technology Promotion Council, Government of India
Lecture 5	CM-5-1	Innovation in the road construction sector and its benefits to the industry, Master of Engineering (Research), Pradip Kumar



Lecture	Reference	Suggested Literature
	CM-5-2	Amit Goel and Animesh Das, Emerging road materials and innovative applications, National Conference on Materials and their Application in Civil Engineering, August 26-27, 2004, Hamirpur – INDIA
	CM-5-3	PPT on New and innovative materials for long lasting road infrastructure
	CM-5-4	IS 15658 (2006): Precast concrete blocks for paving - [CED 5: Flooring, Wall Finishing and Roofing]
Lecture 6	CM-6-1	Ishan G.Kevadiya, Ankush A.Patil & Shruti-Mrudula N.Waghmode, Sustainable Construction: Green Building Concept – A Case Study, International Journal of Innovative and Emerging Research in Engineering, 2014
	CM-6-2	Green Building Materials: A Guide to Product Selection and Specifications, Second Edition, Ross Spiegel and Dru Meadows, John Wiley & Sons, Inc.
Lecture 7	CM-7-1	Green, Sustainable Construction: Solutions for Affordable Housing
	CM-7-2	https://igbc.in/igbc/redirectHtml.htm?redVal=showGreenNewBuildingsnoisign
	CM-7-3	http://www.grihaindia.org/index.php?option=com_content&view=article&id=73
Lecture 8	CM-8-1	DISASTER MANAGEMENT: THE DEVELOPMENT PERSPECTIVE
	CM-8-2	Resilient Design Guide, Federal Alliance for Safe Homes (FLASH)
	CM-8-3	Disaster-resilient housing design and construction strategies, 25th Annual National Convention October 12-15, 2016 CAP John Hay Trade & Cultural Center, Baguio City
	CM-8-4	National Disaster Management Plan (NDMP), National Disaster Management Authority Government of India
	CM-8-5	National Disaster Management Guidelines, September 2010,
Lecture 9	CM-9-1	National Disaster Management Authority Government of India
Lecture 10	CM-10-1	UBC CASE STUDY/ GREEN BUILDING Content By: UBC Campus Sustainability Office
	CM-10-2	Case Studies of Energy Efficient Buildings By Elyse Henderson, M.Sc., LEED Green Associate



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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC10: Understanding of Building Regulations

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

Building Regulations are intended to protect people's safety, health and welfare in and around buildings. The regulations are also designed to improve conservation of fuel and power, protect and enhance the environment and promote sustainable development. Buildings must conform to the code to obtain planning permission, usually from the urban local bodies or other local governments. Building codes are generally intended to be complied with by architects, engineers, interior designers, constructors and regulators but are also used for various purposes by safety inspectors, environmental scientists, real estate developers, subcontractors, manufacturers of building products and materials, insurance companies, facility managers, tenants, and others. The practice of developing, approving, and enforcing building regulations or building code varies considerably among nations. In some countries building codes are developed by the government agencies or quasi-governmental standards organizations and then enforced across the country by the central government. Such codes are known as the *National Building Codes* as in case of India, National Building Code drafted by the Bureau of Indian Standard (BIS) is adopted by various state governments as the governing regulations by incorporating in to the building bye laws of the local governments. In India, each municipality and urban development authority has its own building code, which is mandatory for all construction within their jurisdiction. All these local building codes are variants of a National Building Code, which serves as model code providing guidelines for regulating building construction activity.

Understanding Building Regulations is important because it sets a minimum standard for the design and construction of buildings, in order to ensure the safety and health for people. At the end of the course, the participants will get an overview of building regulations existing in different parts of the world and their importance in addressing the problems of unmonitored development and increasing disaster.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

Building Bye-Laws are legal tools used to regulate coverage, height, building bulk, and architectural design and construction aspects of buildings so as to achieve orderly development of an area. They are mandatory in nature and serve to protect buildings against fire, earthquake, noise, structural failures and other hazards. In India, there are still many small and medium sized towns which do not have building bye-laws and in the absence of any regulatory mechanism, such towns are confronted with excessive coverage, encroachment and haphazard development resulting in chaotic conditions, inconvenience for the users, and disregard for building aesthetics, etc. It is in this context, TCPO has made an effort to prepare "Model Building Bye-Laws- 2016" for the guidance of the State Governments, Urban Local



Bodies, Urban Development Authorities, etc. which is an improvement over the previous Model Building Bye Laws brought out in 2004.

This course highlights the importance of complying with national guidelines/standards/codes/manuals developed in the country while building any structures. This subject provides an overview of the existing building regulations in the form of various building codes and building bye-laws and by showing how the established set of building codes and regulations applies to building constructions to provide minimum standards for safety. Participants will be made aware of the regulation issues pertaining to standards for functional requirement of the building structure, energy efficiency, installation and safety aspects of mechanical, electrical, plumbing systems, compliance to site drainage & storage requirements, occupancy rules, rules regarding parking and traffic impact, fire code rules to minimize the risk of a fire and to ensure safe evacuation in the event of such an emergency, requirement for earthquake safety, cyclone, flood, and tsunami resistance, especially in disaster prone areas or for very large buildings where a failure would be catastrophic.

The core objectives of the course are:

- To provide an understanding of the regulations pertaining to the planning and construction of buildings;
- To explain legislative controls that impact on the building industry, both design & construction
- To help interpret and apply the National Building Code (NBC) of India to simple buildings or designs;
- To create awareness of community risks that impact on the building industry and an understanding of how those risks are managed at a policy and legislative level;
- To provide a fundamental understanding of the regulations pertaining to safety in buildings construction
- To explain the nature and cause of fire in relation to the built environment and the principles of fire safety engineering.
- To develop ability to adopt sustainable building practice in the context of the legislation, regulations standards and codes.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will get an overview of building regulations existing in different parts of the world and their importance in addressing the problems of unmonitored development and increasing disaster.

On successful completion, participants should be able to:



- Develop skill in professional /industry communication relating to construction regulation
- Develop the ability to read and interpret construction drawings and understand compliance to building regulations
- Develop the ability to communicate construction solutions by means of sketches and drawings
- Understand all the planning, construction and operational aspects of building construction
- Work in teams to collect and collate data on a real building
- Facilitate analytical and problem solving skills
- Facilitate strategic analysis of community risks and how to solve them.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What are Building Codes?

Building codes are sets of regulations governing the design, construction, alteration and maintenance of structures. They specify the minimum requirements to adequately safeguard the health, safety and welfare of building occupants.

2. What are the kinds Building Regulations followed in other countries?

Building regulations set standards for the design and construction of buildings to ensure the safety and health for people in or about those buildings.

Building regulations in the *United Kingdom* are statutory instruments that seek to ensure that the policies set out in the relevant legislation are carried out. Building regulations approval is required for most building work in the UK.

In Australia, The *Building Code of Australia* (BCA) is a uniform set of technical provisions for the design and construction of buildings and other structures throughout the country. It is produced and maintained by the Australian Building Codes Board (ABCB), whose primary aim is to achieve nationally consistent, minimum standards.



These standards are published documents which set out specifications and procedures to ensure that a material, product, method or service is fit for its purpose and consistently performs the way it was intended.

3. What is the main difference between planning permission and building regulations?

Planning seeks to guide the way our towns, cities and countryside develop. This includes the use of land & buildings, the appearance of buildings, landscaping considerations, highway access and the impact that the development will have on the general environment. It is generally realized that a form of permission is required for building work or alterations of properties. It may also include responsibilities under the construction health and safety regulations. On the other hand, Building regulations set standards for the design and construction of buildings to ensure the safety and health for people in or about those buildings. They also include requirements to ensure that fuel and power is conserved and facilities are provided for people, including those with disabilities, to access and move around inside buildings.

When a Building Regulation application is made basically the applicant is seeking to have the details of his/her development checked and approved for compliance with the standards of construction.

4. What is the construction scenario in India with regards to regulations?

In India rapid urban growth both controlled and uncontrolled, has led to failure of urban authorities to regulate and implement safe building standards and practices, resulting in risk accumulation in the urban centers. Building regulation is an important tool to address the problems of uncontrolled development and increasing disaster risk. In spite of existence of various codes and guidelines (BIS codes, NDMA guidelines, and PWD/CPWD manuals), nothing has proved accountable enough to scale down the magnitude of the vulnerabilities of building stocks. State governments, local bodies (urban and rural), development authorities, special and new town development agencies, etc. are directed to modify, revise, and revamp the existing building regulations, planning, and safety standards in line with the National Building Code (NBC) 2015 with due consideration for the local variations. But implementation has remained a challenge due to weak institutional and financial capacities of the urban local bodies and non-emergence of specified agencies/expertise in the country. The strengthening and capacity building of various building development and regulating agencies with adequate level of expertise for proactive responses need to be supported by the building professionals and builder's lobby.



5. What is the national building code of India?

The National Building Code of India (NBC), a comprehensive building Code, is a national instrument providing guidelines for regulating the building construction activities across the country. It is widely referred and used by state/local bodies regulating development and building construction activities, Government construction departments and agencies, private construction agencies/builders/developers, building professionals and consultants, academic and research institutions, and building material and technology suppliers throughout the country. The Code mainly contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction (including safety); building and plumbing services; landscape development, signs and outdoor display structures; guidelines for sustainability, asset and facility management, etc.

The Code was first published in 1970 at the instance of Planning Commission and then first revised in 1983. Thereafter three major amendments were issued to the 1983 version, two in 1987 and the third in 1997. The second revision of the Code was in 2005, to which two amendments were issued in 2015.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Understanding of Building Regulations.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
T&CP	X
GMDA	CEO, Secretary, TP, PE, AEE, AE, JE/AA
PHE	CE/ACE, SE, EE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Understanding of Building Regulations			
Day	Lecture	Topic	Learning Activities
Day 1 ../.../....	Lecture 1 9:00 am–10:30 am (1h 30min) Introduction to National Building Code (NBC) & Model Building Bye Laws (MBBL)	- History of development of Building Regulations - Objectives and applications of Building Regulations in constructions - Integrated approach for applying provisions of code - Briefing about NBC & MBBL - Applicability with case study	Material Used: - Lecture slides - REF1 - REF2 - REF3 - REF4 - REF5 (essential) - REF7.1, REF7.2 - REF11 (optional)
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min) International Building Codes & Overview of Building Regulations	- International Building Codes - Jurisdiction / applicability - Building documentation - Procedures - Procedure for obtaining building permit - New Permit & Renewal Process - Responsibilities & duties of owner	Material Used: - Lecture slides - REF1 - REF2 - REF3 - REF4 - REF5 - REF6 (essential) - REF8 - REF9
	Lecture 3 12 noon–1.15 pm (1h 15min) Building Regulations & Control	- Procedure during Construction Work - Drawings and Documents for construction - Requirements for building sites - Inspection, occupancy permit - Post-occupancy inspection - Plans for Multi-Storey/Special Buildings, Setback Regulations - Understanding Land use - Planning Permission /Zoning Regulations for Buildings	Material Used: - Lecture slides - REF1 - REF2 - REF3 - REF4 - REF5 (essential) - REF10 - REF12



Understanding of Building Regulations			
Day	Lecture	Topic	Learning Activities
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h) Development of Control Regulations	• Developing control rules & general building requirements for health and safety • Limitation of area & height of buildings of different occupancy classes & types of construction • Building height regulations, FAR, FSI, additional FAR, purchasable FAR, floating FAR • Understanding parking norms for diff. building classifications	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5 (essential) • REF13 • REF14
	Lecture 5 3.15 pm–4.15 pm (1h) Procedure & Compliance during Construction	• Conformity to Building Code • Commencement of work • Drawings & Documents control at Site • Inspection of Building during Construction • Construction stage inspection & certifications • General building requirements and services	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5 (essential) • REF13
Day	Lecture	Topic	Learning Activities
Day 2 ../../....	Lecture 6 9:00 am–10:30 am (1h 30min) Requirements for fire prevention, life safety in relation to fire & Fire Protection of Buildings	• Fire safety requirement • Fire prevention & safety requirements • Fire Zones based on fire hazard inherent in the buildings • Restrictions on the type of construction for new buildings • Fire Resistance Ratings of Structural and Non-Structural Elements (Hours) • Provisions of fire safety for occupation of whole or part of building during construction, repairs, alterations or additions • Procedure for clearance from	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5



Understanding of Building Regulations			
Day	Lecture	Topic	Learning Activities
		fire service • Renewal of fire clearance • Fire Escapes or External Stairs • Provision of lifts • Service ducts/refuge chute • Electrical services • Staircase and corridor lights	
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Fire protection and fire safety requirements in buildings	• Air-conditioning • Alternate source of electric supply • Safety measures in electric sub-station. • Static water storage tank • Automatic sprinklers • Fixed CO₂/foam/ water spray • Fire alarm system • Control Room • Fire drills and fire orders • Materials used for construction of building • LPG & House keeping • Fire prevention • Occupancy restrictions • Requirements for Industrial & Educational Buildings	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5
	Lecture 8 12 noon–1.15 pm (1h 15min) Special requirements for occupancy/ Land Development	• Assembly Building (Cinema, Theatres, etc.) • Petrol filling station – ingress / Applicability • Guidelines and Provisions • Barrier free guidelines as notified by the Government • Appropriate signage • Public Building regulations	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15	• Rain Water Harvesting provisions in various Building	Material Used: • Lecture slides



Understanding of Building Regulations			
Day	Lecture	Topic	Learning Activities
	pm (1h) Rainwater Harvesting & Green buildings and sustainability provisions	- categories • Rain Water Harvesting Provisions for Open spaces around buildings in cities • Provision for Ground Water Recharge • Enforcement and Monitoring • Provisions and Applicability • Provisions for Sanction • Various Guidelines for Green Rating systems	• REF1 • REF2 • REF3 • REF4 • REF5
	Lecture 10 3.15 pm–4.15 pm (1h) Conservation of heritage sites including heritage Buildings, heritage precincts and natural feature Areas	• Guidelines for Green Rating systems • GRIHA & IGBC Compliances • Applicability • Responsibility of the owners of heritage buildings • Restrictions on development / re-development / repairs • Alteration / modification / relaxation in development norms • Penalties • Environmental conditions for compliance during Building approvals	Material Used: • Lecture slides • REF1 • REF2 • REF3 • REF4 • REF5

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.



Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF 1 REF 2 REF 3 REF 4 REF 5	Lecture 1	NATIONAL BUILDING CODE OF INDIA Foreword Volume 1 & Volume 2 PART 2 Administration MODEL BUILDING BYE-LAWS 2016 Prelude Section 2. Jurisdiction/Applicability and building Documentation Procedures –Introduction
REF7.1 REF 7.2		General Building Requirements, https://law.resource.org/pub/bd/bnbc.2012/gov.bd.bnbc.2012.03.01.pdf http://mohua.gov.in/upload/uploadfiles/files/Chap-4.pdf
REF11		National Construction Code 2016, Volume 1, Building Code of Australia, Class 2 to Class 9 Buildings.
REF 6 REF 1 REF 2 REF 3 REF4 REF5	Lecture 2	INTERNATIONAL BUILDING CODE About ICC, General, Applicability NATIONAL BUILDING CODE OF INDIA PART 2 Administration Section 1, Section 2, Section 3 PART 1 Definition PART 3 Development Control – Introduction MODEL BUILDING BYE-LAWS 2016 SECTION 2. Jurisdiction/Applicability and Building Documentation procedures –Introduction SECTION 3. Development Code
REF8		The Building Code Process: An Introduction, S. K. Ghosh, Ph.D. President S. K. Ghosh Associates, Inc. Northbrook, Illinois, Article PCI journal, July-August 2002
REF9		The Value and Impact of Building Codes, Ellen Vaughan, Policy Director, Environmental and Energy Study Institute, Jim Turner, former Chief Counsel, Committee on Science and Technology, U.S. House of Representatives.
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 3	NATIONAL BUILDING CODE OF INDIA PART 3 Development Control Rules And General Building Requirements MODEL BUILDING BYE-LAWS 2016 SECTION 3. Development Code SECTION 4. General Building Requirements & Services SECTION 5. Provisions For High Rise Development
REF10		Building Regulations 2018 Summary of Changes, Environment, Land, Water & Planning, Victoria State Government



Reading	Reference	Suggested Literature
REF12		A. Kumar, Pushplata, Building Regulations for Hill Towns of India, HBRC Journal, 2014, Elseiver.
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 4	NATIONAL BUILDING CODE OF INDIA PART 3 Development Control Rules And General Building Requirements MODEL BUILDING BYE-LAWS 2016 SECTION 3. Development Code
REF13		REGULATORY IMPACT STATEMENT (RIS) BUILDING REGULATIONS 2006, PricewaterhouseCoopers.
REF14		Developments in Performance-Based Building Codes and Standards, Article in Forest Products Journal · July 2000
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 5	NATIONAL BUILDING CODE OF INDIA PART 3 Development Control Rules And General Building Requirements PART 7 Constructional Practices & Safety – Introduction MODEL BUILDING BYE-LAWS 2016 SECTION 3. Development Code
REF13		REGULATORY IMPACT STATEMENT (RIS) BUILDING REGULATIONS 2006, PricewaterhouseCoopers.
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 6	NATIONAL BUILDING CODE OF INDIA PART 4 – Fire & Life Safety MODEL BUILDING BYE-LAWS 2016 SECTION -11 Fire Protection & Fire Safety Requirements
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 7	NATIONAL BUILDING CODE OF INDIA PART 4 – Fire & Life Safety MODEL BUILDING BYE-LAWS 2016 SECTION -11 Fire Protection & Fire Safety Requirements SECTION -7 Special Requirements for Occupancy/Land Development & Other
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 8	NATIONAL BUILDING CODE OF INDIA MODEL BUILDING BYE-LAWS 2016 SECTION -7 Special Requirements for Occupancy/Land Development & Other SECTION-8 Provisions For Differently abled, Elderly & Children



Reading	Reference	Suggested Literature
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 9	NATIONAL BUILDING CODE OF INDIA MODEL BUILDING BYE-LAWS 2016 SECTION 9 - Rainwater Harvesting SECTION 10 - Green Buildings & Sustainability Provisions
REF 1 REF 2 REF 3 REF 4 REF5	Lecture 10	NATIONAL BUILDING CODE OF INDIA MODEL BUILDING BYE-LAWS 2016 SECTION 10 - Green Buildings & Sustainability Provisions SECTION 12- Conservation Of Heritage Sites Including Heritage Buildings, Heritage Precincts & Natural Feature Areas SECTION 14- Climate Resilient Construction: Integration of Environmental Clearances with Sanction

9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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For any query, please don't hesitate to contact the Coordinators over phone or email.

**The study materials for the entire subject have been
developed and will be available electronically.**



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC12: Contract Practice & Administration

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

Contract administration is the management of contracts made with customers, vendors, partners, or employees. It thus refers to the task or function of ensuring that a construction contract is executed in accordance with the terms of the contract. The contract administrator may be a representative of either party or may be a third party, depending on the terms. The terms contract administration and contract management are often used interchangeably. Although they share many similarities, at a granular level, they are technically different phases of the contract lifecycle.

This course aims at enabling participants to acquire suitable skills to negotiate, support and manage contracts so that unnecessary disputes and claims can be avoided and projects can be completed within the stipulated budget and time frame. At the end of the course, participants will learn to focus on the planning and implementation of contracts such as sourcing potential contracting partners, helping with ironing out details of the contract arrangement, working with prospective partners to negotiate on contract matters such as price, delivery schedules, and performance expectations.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

This course examines the principles and procedures for effective contract management from both clients' and contractors' perspectives. Contract administration requires a great deal of strategy and business savvy. Entering into legally sound, mutually advantageous contracts is critical to the financial success of many businesses, so it is imperative to find the right partners and put into place fair agreements. Practices and techniques of planning and managing a contract through to a successful conclusion are presented. Topics include: development of legal framework for project delivery (contract formation – principles and philosophies of contract drafting); contract negotiation techniques and execution; contract performance, monitoring and enforcement; managing project close-out; relationship management during the construction phase; project procurement and allocation of risks; payment systems; contractual responsibilities and liabilities imposed by general conditions of contracts; construction delay claims management; conflict and dispute management.

The two day course also examines allowancing and partnering contracts, performance-based contracts as well as contract management in the context of BIM based projects. Contract management software applications are used where applicable.



The core objectives of the course are:

- To interpret, explain and compare the obligations and responsibilities imposed by selected general conditions of contracts used locally and internationally.
- To identify potential situations which can lead to legal consequences and negatively affect the project delivery outcomes
- To analyze the complex and interrelated issues associated with contract management and identify when to seek professional advice on a project.
- To manage and control the contractual environment of projects.
- To identify, prepare, and analyze extension of time claims as well as explain the management and legal principles involved.
- To differentiate and explain various conflicts and dispute resolution processes.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will acquire a clear understanding of contract administration and the importance of entering into legally sound, mutually advantageous contracts which are critical to the financial success of any organization.

On successful completion, participants should be able to:

- Work effectively with other professionals on a project;
- Develop team building ability;
- Develop the abilities of critical thinking and problem solving;
- Adapt to and work effectively in different contract environments, both locally and internationally.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What is the purpose of contract administration?

The purpose of contract administration is to ensure that the contractor performs in accordance with all of the terms and conditions of the contractual agreement.



2. What is contract practice?

Contract practice is a core Level 3 competency for those on the quantity surveying and project management pathways, and an optional competency for those on the building surveying and built infrastructure pathways. They may also gain relevant experience acting for a contractor, or managing subcontractor contracts.

3. What is the main difference between contract administration and contract management?

Contract administration is the work done before contract formation. The professionals responsible for a company's contract administration focus their work on the planning and implementation of contracts. On the other hand, contract management occurs after a contract has been completed and taken effect. Thus, this entails working to ensure that the terms and conditions contained within the contract are adhered to and that all of a party's contractual obligations are met satisfactorily.

4. What is the role of a contract administrator?

The overall role of a Contracts Administrator is to ensure that all parties fulfil the particular directives and standards in a contract. Contracts Administrators may work for a variety of organizations or companies, but the majority work within the construction industry.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Contract Practice & Administration.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE
T&CP	X
GMDA	CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE/AA
PHE	SE, EE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Contract Practice & Administration			
Day	Lecture	Topic	Learning Activities
Day 1 .././....	Lecture 1 9:00 am–10:30 am (1h 30min) Introduction	• Contract pre-award activities • Contract post-award activities • Traditional process • Two Stage Tendering • Critical Risk Analysis • Organization Roles & Responsibilities • Procurement of Materials & Services Milestones • Construction phase logistics	Material Used: • Lecture slides • REF CPA-1 • REF CPA-2 • REF CPA-4 • REF CPA-5 • REF CPA-9 (essential) - REF CPA-10
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min) General & Special Conditions of Contract	• Jurisdiction / applicability • Provisions for project control and variations • Guidelines for Safety, Insurance, Welfare • Legal issues, disposal of disputes • Project specific conditions • International project requirements • Identifying long-lead items of procurement for Contract administration • Responsibilities and Duties of the Contract Administrator • Lines of formal project communication • Site set up & security arrangement	Material Used: • Lecture slides • REF CPA-4 • REF CPA-5 • REF CPA-6 • REF CPA-8 • REF CPA-9 (essential) - REF CPA-10
	Lecture 3 12 noon–1.15 pm (1h 15min) Contract Mobilization &	• Requirement and compliances for mobilization for Client & Contractor • Standard model for Communication • Standard template for reporting	Material Used: • Lecture slides • REF CPA-2 • REF CPA-3 • REF CPA-4 • REF CPA-7



Contract Practice & Administration			
Day	Lecture	Topic	Learning Activities
	Project Communication	• Security and access control • traceability of documents • Intelligent numbering • Revision control • BIM protocol	• REF CPA-8
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h) Risk Identification and Management	• Risk versus issues • Risk assessment & Risk-impact matrix • Risk Response and Risk Impact rating matrix • Issue Log and Issue type • Issue management framework • Dealing with Risk • Insurance Risk • Bonds and Guarantee Risk • Working towards reducing value of advance payment / performance bond	Material Used: • Lecture slides • REF CPA-1 • REF CPA-2 • REF CPA-5 • REF CPA-10
	Lecture 5 3.15 pm–4.15 pm (1h) Managing Construction Stage Performance & Payment to Contractor	• Supervising Contractor's Performance • Inception Report • Construction Project Control Loop • Pricing Documents & Structure of Bill of Quantities • Schedule of rates and Measurements • Procedure for Interim Payments	Material Used: • Lecture slides • REF CPA-1 • REF CPA-2 • REF CPA-4 • (essential) • REF CPA-11
Day	Lecture	Topic	Learning Activities
Day 2 .././....	Lecture 6 9:00 am–10:30 am (1h 30min) Payment to Contractor, Variations & Changes	• Payment for procurement of materials on site and off site • Activity schedule & Retention as per contract documents • Asset management & Taxation • Cost Monitoring • Variations - types & causes • Controlling Variations at Design & Construction stage • Issuing variation & valuing variations	Material Used: • Lecture slides • REF CPA-2 • REF CPA-4 • REF CPA-5 • REF CPA-6



Contract Practice & Administration			
Day	Lecture	Topic	Learning Activities
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Subcontract in Project	• Relationship between Main & Sub-Contractor • Relationship between Sub-contractor & Employer • Collateral warranties & rights of third parties • Subcontract vs. Assignment • Value Management process • Time-Cost-Quality Triangle mapping on project	Material Used: • Lecture slides • REF CPA-4 • REF CPA-5 • REF CPA-6
	Lecture 8 12 noon–1.15 pm (1h 15min) Value Management & Cost Reduction	• Value System Matrix for a construction project • Completion and Close out • Early Termination of Contract and Suspension of Work • Termination & Suspension by Employer • Termination & Suspension by Contractor • Completion under standard form of Contract • Delays and Extension of Time • Main cause of Delay in Project • Damages & Penalties for non-completion	Material Used: • Lecture slides • REF CPA-1 • REF CPA-4 • REF CPA-5
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Delays, Damages & Defects	• Deficiency due to design, construction, materials etc. • Patent and Latent Defects • Snagging List & Punch List • Testing & Commissioning • Final Completion • Contract Close-out • Legal Basis covering Contractual claims • Breach of Contract	Material Used: • Lecture slides • REF CPA-1 • REF CPA-2 • REF CPA-5 • REF CPA-6
	Lecture 10 3.15 pm–4.15 pm (1h) Claims, Disputes,	• Components of claim documents • Importance of records in contract • Adjudication- advantages and	Material Used: • Lecture slides • REF CPA-4 • REF CPA-5 • REF CPA-9



Contract Practice & Administration			
Day	Lecture	Topic	Learning Activities
	Adjudication, Arbitration and Litigation	disadvantages • Arbitration- advantages and disadvantages • Comparison of the two • Litigation & pre-action protocol • Ethics and Fair dealings • Act of Integrity	

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF CPA-1	Lecture 1	Contract Management Guide , The Chartered Institute of Purchasing & Supply (CIPS), R D Elsey October 2007
REF CPA-2		Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-4		Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-9		Seppo Niittymaki & Olli Ilveskoski, Construction Management Study Book , HAMK, 2015
REF CPA-10		Kam Shadan & Gannett Fleming, Construction Project Management Handbook , FTA Report No. 0015 Federal Transit Administration, MARCH 2012.
REF CPA-4	Lecture 2	Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-6		<i>Construction Project Management</i> , Emad Elbeltagi, Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 27 May 2017.



Reading	Reference	Suggested Literature
REF CPA-8		HANDBOOK For project and construction management – Fundamental concepts, Københavns Erhvervsakademi and VIA University College December 2018
REF CPA-9		Seppo Niittymäki & Olli Ilveskoski, Construction Management Study Book , HAMK, 2015
REF CPA-10		Kam Shadan & Gannett Fleming, Construction Project Management Handbook , FTA Report No. 0015 Federal Transit Administration, MARCH 2012.
REF CPA-2	Lecture 3	Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-3		<i>Building Information Modelling (BIM) Protocol</i> , Second Edition, Standard Protocol for use in projects using Building Information Models, CIC/BIM 2018
REF CPA-4		Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-7		Understanding and Negotiating EPC Contracts, Volume 2, Howard M. Steinberg, Routledge, Taylor & Francis Group, London & New York, 2017
REF CPA-8		HANDBOOK For project and construction management – Fundamental concepts, Københavns Erhvervsakademi and VIA University College December 2018
REF CPA-1		Contract Management Guide , The Chartered Institute of Purchasing & Supply (CIPS), R D Elsey October 2007
REF CPA-2	Lecture 4	Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-10		Kam Shadan & Gannett Fleming, Construction Project Management Handbook , FTA Report No. 0015 Federal Transit Administration, MARCH 2012.
REF CPA-1	Lecture 5	Contract Management Guide , The Chartered Institute of Purchasing & Supply (CIPS), R D Elsey October 2007
REF CPA-2		Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-4		Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-11		Ivana Maksimović, Construction Administration & Construction Management , ICSC European Retail Property School, July 2014



Reading	Reference	Suggested Literature
REF CPA-2	Lecture 6	Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-4		Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-6		<i>Construction Project Management</i> , Emad Elbeltagi, Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 27 May 2017.
REF CPA-4	Lecture 7	Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-6		<i>Construction Project Management</i> , Emad Elbeltagi, Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 27 May 2017.
REF CPA-1	Lecture 8	Contract Management Guide , The Chartered Institute of Purchasing & Supply (CIPS), R D Elsey October 2007
REF CPA-4		Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-1	Lecture 9	Contract Management Guide , The Chartered Institute of Purchasing & Supply (CIPS), R D Elsey October 2007
REF CPA-2		Dr. E. Mwanaumo Prof. M. Muya Dr L. Matakala Ms B. Mwiya Mr C. Kaliba Mr S. Sanga, Introduction to Construction Project Management , National Council for Construction, Training Manual.
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 2009
REF CPA-6		<i>Construction Project Management</i> , Emad Elbeltagi, Professor of Construction Management Structural Engineering Department, Faculty of Engineering, Mansoura University, 27 May 2017.
REF CPA-4	Lecture 10	Jack Ramus, Simon Birchall & Phil Griffiths, Contract Practice for Surveyors , 4 th Edition, Elsevier, May 2006
REF CPA-5		<i>Lecture Notes on Construction Project Management</i> , Emad Elbeltagi, Ph.D., P.Eng., Professor of Construction Management Structural Engineering Department, Faculty of Engineering,



Reading	Reference	Suggested Literature
		Mansoura University, 2009
REF CPA-9		Seppo Niittymäki & Olli Ilveskoski, <i>Construction Management Study Book</i> , HAMK, 2015

9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC-13: 3R IN CONSTRUCTION
(REPAIR REHABILITATION AND RETROFITTING)
(SUBJECT GUIDE)

(Version-1.0)
by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1. INTRODUCTION

Deterioration of infrastructures over time and use is a natural phenomenon which reduces the life of the costly infrastructures. It is of utmost importance to maintain infrastructures in functional condition. The structures deteriorate due to original construction defects, corrosion and carbonation due to aggressive chemical attack, cracking due to thermal gradient, plastic shrinkage cracks and foundation settlement, cyclic temperature variations, overloading, etc. and fail to meet the functional requirement for its designed service life. Identification of the causes of deterioration, consequent repair/rehabilitation strategy, and maintenance at optimum cost is the key to proper functioning of the infrastructures. Reinforced cement concrete (RCC) is the most widely used construction material across the globe during the last century. Many essential infrastructures, e.g. buildings, bridges, sports stadium etc. are built with RCC. Repair, rehabilitation and retrofitting (3R) and their related aspects are to be emphasised for longer life of a structure. There have been significant advancements in the field of protection, repairs, rehabilitation, strengthening and retrofitting of the existing RCC structures with the new innovations in the fields of materials science and polymer science. The durability provisions for RCC (as available in revised 'Code of Practice on Plain and Reinforced Concrete: IS:456-2000) are to be emphasized during construction and/or maintenance.

2. OVERVIEW & OBJECTIVE OF THE SHORT COURSE

The two-day short course is designed for participants without in-depth knowledge in the field and the learning is complemented with examples and case studies. The 3R in construction: repair, rehabilitation and retrofitting and their related aspects are focussed in this course. It covers several relevant topics in infrastructure/construction, viz. causes of deterioration, investigative methods, design principles, selection criteria of repair materials & methods, selection of consultant, contractors and preparation of contract documents for repair/ rehabilitation. A variety of case studies with examples of good-practice is included to help the participants to have clear understanding of the subject. The course deals with various causes of deterioration, Non-Destructive Evaluation (NDE) techniques, laboratory tests and Condition Survey Techniques, selection of the right type of compatible repair material and repair technique for a specific job, analysis and design of repairs, etc. The short course has been largely developed based on the Handbook of Repair, published by CPWD. The handbook and the Code of Practice on Plain and Reinforced Concrete: IS:456-2000 are listed as the essential reading materials for this course. The directory of Indian manufacturers of repair materials and testing laboratories has been included for information of users as given in the Handbook (CPWD).



The objective of the short course is to enable the participants to:

1. Understand the causes and factors affecting durability of structures
2. Develop skills for conducting Condition Survey and Non-Destructive Testing Procedures and recognize deterioration/ damage/distress
3. Able to apply the various repair and strengthening materials and methods available
4. Develop the ability to apply various specifications and procedure for 3R
5. Apply guidelines for contracting 3R work: both consultancy and construction work
6. Use standard proforma & checklist for contract management of 3R work

3. LEARNING OUTCOME

On completion of this two-day short course, the participants are expected to develop a thorough understanding of all key competency areas in Repair, Rehabilitation and Retrofitting (3R) in Construction and apply them in practical field. They should be able to:

- Make assessment of distress and damage in existing structure
- Identify critical scenario which may render a structure unsafe or unserviceable
- Analyse the various processes and specifications of 3R
- Manage and control the contractual environment of 3R works
- Work effectively with other professionals on a 3R project
- Understand the advantages/disadvantages of various options and materials for 3R project
- Adapt to and work effectively in very specific contract environments

4. WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical government/corporate/ business sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5. FREQUENTLY ASKED QUESTIONS

Q. What is 3R and who is involved?



Ans. Repair, Rehabilitation, and Retrofitting are the 3R in construction industry and 3R projects include experts from both civil engineering and computer and mathematical fields. The objective is to work for rehabilitation, repair and retrofitting the construction structures, comprehensively and effectively. The relevant fields are: Advanced Sustainable Composite Materials, Sustainable Infrastructure, Structural Health and Safety, Structural and Material Forensics, Renewable Composite, Engineering Education.

Q. What is the need for structural repair, rehabilitation, and retrofitting?

Ans. Need for a structure to undergo repair, rehabilitation, and retrofitting are:

- Change in the intended use of the structure. e.g. Increased loads etc.
- Changes in seismic zones, prompting seismic retrofitting for critical structures like healthcare facilities, defence establishments etc.
- Changes in prevailing codes. E.g. changes in the minimum grade of concrete to be used, for example.
- Additional floors or equipment added to the structure. Change in the intended use of the structure.
- Damage to the structure due to ageing (mostly due to corrosion). E.g. Building and Bridges.

Q. What is the difference between repair, rehabilitation, and retrofitting?

Ans. Repairs are performed on damaged buildings to restore the strength which includes reconstruction of non-structural walls, chimneys, boundary walls, checking and repairing electrical connections, plumbing, ventilation, repairing of cracks, etc.

Rehabilitation is performed to reattain the strength of existing building to the original strength. It enables to get at least the original strength of piers, Columns, beams and walls by grouting, strengthening using wire mesh, rebuilding the cracked portions, using rich non-shrinkable mortar after removal of cracked portion.

Retrofitting is assessing the existing condition of the structure and deciding which component of the structure should be repaired or restored based on all the future requirements of structure. Retrofit enables to increase the original strength of the building. Retrofitting includes, addition of shear wall or diagonal braces, modification of roofs, strengthening of foundation, modification of building plan etc.



6. TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on 3R in Construction.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
GMDA	CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE/AA
<i>TP- Town Planner CAO-Chief Accounts Officer PE-Project Engineer AA-Architectural Assistant</i>	
PHE	AEE, AE, JE

7. DETAILED SCHEDULE OF SHORT COURSES

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

3 R IN CONSTRUCTION			
Day	Lecture	Topic	Learning Activities
Day 1 .././.....	Lecture 1 9:00 am–10:30 am Introduction to 3R	- An overview of current Repair/Rehabilitation/Retrofitting practices - Damage/Distress Identification and Extrinsic and Intrinsic Causes of Damage/Distress - Causes of Deterioration and Durability aspects - Holistic Model of Deterioration - Permeability of Concrete & Micro-cracks	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code 3R-Intro - RRR1(Optional)
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2	Introduction to Condition Survey	Reading list:



3 R IN CONSTRUCTION			
Day	Lecture	Topic	Learning Activities
	10.45 am–12 noon Condition Survey	- Definition, Objective, Various Stages of Evaluation, Visual Inspection - Field and Laboratory Testing stage - Consideration of Repair Strategy	- Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - RRR1(Optional) - RRR2(Optional)
	Lecture 3 12 noon–1.15 pm Non-Destructive Testing/Evaluation	- Visual Evaluation - Core sampling and various types of tests to perform - Resistivity Measurement - Fire Damage Assessment - Discussion and Interpretation of Results of NDT	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - NDT Literature - RRR2(Optional) - RRR7 (Optional)
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Concrete Strength and Structural Integrity Assessment, Interpretation of Test Results	- Rebound Hammer Test, Ultrasonic Pulse Velocity Test, Radiography, Impact-Echo Test - Dynamic Testing of Structure - Interpretation of Test Result - Resultant Scenario development based on Condition Survey and Test Results	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - RRR2(Optional) - RRR3(Optional)
	Lecture 5 3.15 pm–4.15 pm Rehabilitation and Retrofitting Methods	- Repair stages and Methods - Repair using Mortars, Epoxy, PAC, Shotcrete - Polymers, Plate bonding - RCC Jacketing - Props and Supports - Fibre Wrap Technique - Foundation Rehabilitation	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - RRR2(Optional) - RRR3(Optional) - RRR4(Optional) - RRR6(Optional) - RRR7(Optional)



3 R IN CONSTRUCTION			
Day	Lecture	Topic	Learning Activities
Day	Lecture	Topic	Learning Activities
Day 2 .././....	Lecture 6 9:00 am–10:30 am 3R Strategy	- Repair/Retrofitting of Beams/ Columns/ Slabs/Cracks/Joints - Estimating quantum of RRR Job - Engagement of Consultant, Contractor - Execution of Work, Post Repair Inspection - Performance Guarantee	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 3R-Intro - RCC-IS-Code - RRR4(Optional) - RRR5(Optional) - RRR6(Optional) - RRR7(Optional)
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Schedule of Special Items for 3R works	- Form work and Props, cantering and shuttering - Providing and Fixing temporary protective barricades - Dismantling existing RC work, Cutting of Reinforcement bars and Introducing new ones - Grouting and Curing processes - Post Repair Inspection	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - RRR5(Optional)
	Lecture 8 12 noon–1.15 pm Specifications for Structural Repair Work	- Quality Assurance - Environment Requirement - Engagement of Persons, Tools - Safety of 3R work - Field Testing Laboratory - Internal and External Supervision	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code - RRR5(Optional) - RRR6(Optional) - RRR7(Optional)
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Site Requirement for RRR work	Propping and Supporting, Watertight shuttering, Steel Tubular Scaffolding, Barricades & Protection	Reading list: - Lecture Slides - CPWD-Handbook1 - CPWD-Handbook2 - RCC-IS-Code



3 R IN CONSTRUCTION			
Day	Lecture	Topic	Learning Activities
		• Surface Preparation, Removal, Cleaning of concrete / Mortar cover • Cutting and Repayment of Steel Reinforcements	• RRR5(Optional) • RRR6(Optional) • RRR7(Optional)
	Lecture 10 3.15 pm–4.15 pm Crack & Honeycomb Repair	• Curing, Waterproofing and protective coating • Repair Processes for Cracks in Masonry • Testing of Materials and Pre/ Post Repair of Structures • Sealing by grouting, Provision of bonding coat • Micro concrete, Shotcrete, Polymer & Epoxy	Reading list: • Lecture Slides • CPWD-Handbook1 • CPWD-Handbook2 • RCC-IS-Code • RRR5(Optional) • RRR6(Optional) • RRR7(Optional)

8. READING MATERIALS

Participants are expected to refer to various Repair, Rehabilitation and Retrofitting related topics from various sources, which might include case studies, conferences papers, E-Books and journals. A list of reading list is provided with the detail schedule of the short course. The reading list provides the literature for thorough understanding of the various state of practices in 3R implementation in construction industry. The literatures are important for in-depth understanding of the topic. However, this list may be updated as and when necessary.



Subject Coordinator contact details:

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT

ASSAM ENGINEERING COLLEGE

GUWAHATI-781013

SC14: Understanding of Basic Operation & Services to be provided in Buildings

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

Building services are the systems installed in buildings to make them comfortable, functional, efficient & safe. They can include fire safety, HVAC (heating, ventilation & air conditioning), lighting, plumbing, ICT (information & communications technology), etc. Efficient building services can have a significant impact on cost & energy savings. It is therefore important to learn how to optimize the performance of a building by understanding the factors that drive efficiency. The aim of the course is to communicate the latest concepts in building services that result in better performing buildings with lower operating costs. At the end of the course, participants will understand building services - what they do, why we need them & how we can get the best out of them.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

The focus of this course lies in the integration of services & energy efficient strategies into the fabric of the building & its construction process. After introductory material on environmental quality & energy related issues, the course provides students with knowledge in the field of electrical, mechanical, air handling, hydraulic & communication services & particularly the construction issues they generate: levels of documentation & decision-making required; connections with process planning; spatial requirements for functioning, installation & access purposes; protection & quality assurance; building tolerances; systems integration; layout strategies; work sequences & temporary works; contract coordination; testing; maintenance; & upgrading replacement.

The core objectives of the course include:

- To introduce students to systems & types of mechanical & engineering services needed in buildings;
- To develop an understanding of basic modes of energy transfer;
- To gain understanding of spatial & installation requirements for services;
- To improve an understanding of the construction processes involved.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will have a clear understanding of the technical aspects of building operation & services including power supply, ventilation, heating & cooling, water & drainage systems, lighting, & communications.

On successful completion, participants should be able to:

- Develop an understanding of different types of electrical, mechanical & engineering services needed in buildings;



- Develop an understanding of basic concepts regarding plumbing, sewage disposal, & household waste management services.
- Develop an understanding of basic modes of energy transfer;
- Develop an understanding of spatial & installation requirements for services;
- Develop an understanding of the construction processes involved.
- Identify & compare different types of services used in building.
- Evaluate the ability of different types of service to meet expected user requirements for comfort levels.
- Analyze the technical, time & cost implications of installing & coordinating services in buildings.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle & senior level executives from both technical & non-technical corporate, business, government & semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT & Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What does a building service engineer do?

Building services engineers advise about, design, install & maintain cost-effective & energy efficient systems for building services such as water, lighting, heating, air conditioning, lifts, & telecoms.

2. What is the job description of a building service engineer?

Building services engineers develop the systems that bring buildings & structures to life – to ensure that they are more than a shell. The job covers a wide variety of technical aspects, including power supply, ventilation, heating & cooling, water & drainage systems, lighting, & communications.

3. What is an essential service building?

The term “essential services building” shall include all buildings, structures, appurtenances & related systems or facilities as defined in Section 4-207. These rules & regulations establish reasonable standards & minimum requirements for the design & construction of an essential services building.

4. What are MEP building services?



Building Services are the electrical, plumbing, & mechanical systems in a building. For this reason they are also called **MEP** services, for mechanical, electrical, & plumbing.

5. What is building operation & maintenance?

Heating, ventilating & air-conditioning (HVAC) systems & equipment are primary as they account for a great deal of operation & maintenance efforts. However, operation & maintenance of plumbing, electrical, life safety systems & other elements of building systems are also included in building services.

6. What are mechanical building services provided?

Mechanical building service is any service using machines. They include plumbing, elevators, escalators, heating & air-conditioning systems.

7. What are electrical building services provided?

Electrical building services include maintenance, installation & alteration of electrical systems & components from low to high voltage distribution & end usage devices; management of projects involving lighting, electrical service upgrades, lab equipment, office requirements, communications conduit systems etc.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry & business including services, business investment, R&D, capital projects & projects in local, state & national government departments & agencies will benefit from this course on Understanding of Basic Operation & Services to be provided in Buildings.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	JE
T&CP	X
GMDA	CEO, Secretary, CE, TP, CAO, PE, AEE
PHE	AE, JE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Understanding of Basic Operation & Services to be provided in Buildings.			
Day	Lecture	Topic	Learning Activities
Day 1 .././....	Lecture 1 9:00 am–10:30 am (1h 30min)	• Building Types • Design Team • Project Life Cycle • Background of building services • Integration of building services & their operations • Human Comfort • Environmental measurements	Material Used: • Lecture slides • REF 1.1 • REF 1.2 • REF 1.3 • REF 1.4 • REF 1.5 • REF 1.6
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min)	• Energy Audit • Annual energy costs • Accounting for energy-economizing insulation. • Conduction & infiltration • Real world issues • Heat loss through a slab or basement wall. • Moderation of heat-loss.	Material Used: • Lecture slides • REF 2.1 • REF 2.2 • REF 2.3 • REF 2.4 • REF 2.5 • REF 2.6
	Lecture 3 12 noon–1.15 pm (1h 15min)	• Heat Dem& • Heating equipment • Hot-water heating systems • Combustion • Building energy management systems • Geothermal heating • Ventilation requirements • Ventilation systems • Air-conditioning systems • Sick Building syndrome(SBS) • Air Temperature Profile	Material Used: • Lecture slides • REF 3.1 • REF 3.2 • REF 3.3 • REF 3.4 • REF 3.5 • REF 3.6
	1.15 pm – 2.15 pm: Lunch break		



Understanding of Basic Operation & Services to be provided in Buildings.			
Day	Lecture	Topic	Learning Activities
	Lecture 4 2.15 pm–3.15 pm (1h) Hot & cold-water supplies, Soil & Waste system	• Water treatment • Base exchange • Demineralization • Cold-water services • Hot-water services • Pipe sizing. • Household waste generation • Waste disposal systems • Septic tanks	Material Used: • Lecture slides • REF 4.1 • REF 4.2 • REF 4.3 • REF 4.4 • REF 4.5 • REF 4.6
	Lecture 5 3.15 pm–4.15 pm (1h) Surface-water drainage	• House hold composting • Roof drainage • Kitchen, wash room • Drain size	Material Used: • Lecture slides • REF 5.1 • REF 1.2 • REF 5.3
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) Below ground drainage & Condensation	• Roof drainage • Kitchen, wash room • Drain sizing. • Source of moisture • Condensation & mould growth • Vapour diffusion • Temperature gradient • Dew-point temperature gradient • Installation note.	Material Used: • Lecture slides • REF 6.1 • REF 6.2 • REF 6.3 • REF 6.4 • REF 6.5
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Lighting & Gas	• Natural & artificial illumination • Maintenance • Utilization factor • Lamp types • Control of lighting services • Gas size piping • Gas service entry into a building • Ignition & safety controls	Material Used: • Lecture slides • REF 7.1 • REF 7.2 • REF 7.3 • REF 7.4 • REF 7.5
	Lecture 8 12 noon–1.15 pm	Electrical Installations	Material Used: • Lecture slides



Understanding of Basic Operation & Services to be provided in Buildings.			
Day	Lecture	Topic	Learning Activities
	(1h 15min)	• Electricity distribution • Circuit design • Cable capacity & voltage drop • Construction site distribution • Construction site safety • Safety cut-outs • Testing • Telecommunication & network • Lighting conductors.	• REF 8.1 • REF 8.2 • REF 8.3 • REF 8.4 • REF 8.5 • REF 8.6
	Electrical Installations & Room acoustics	• Acoustic principles • Sound power & pressure levels • Absorption of sound • Reverberation time • Plant sound power level • Transmission of sound • Sound pressure level in plant room, outdoors, intermediate space, target room • Noise rating.	
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Fire Protection & Plant & Service areas	• Fire classification • Portable extinguishers • Fixed fire-fighting installations • Fire detectors & alarms • Main & services • Plant room space requirements • Computer Servers • Lifts, Pipe, duct & cable supports • Co-ordinated service drawings - Boiler room ventilation	Material Used: • Lecture slides • REF 9.1 • REF 9.2 • REF 9.3 • REF 9.4
	Lecture 10 3.15 pm–4.15 pm (1h) Mechanical Transportation	• Transportation systems • Lifts • Paternoster • Escalator • Passenger conveyors • Driving machinery	Material Used: • Lecture slides • REF 10.1 • REF 10.2 • REF 10.3



8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF 1.1	Lecture 1	D J Croome (1990), Building Services Engineering -The invisible Architecture, Building Services Engineering Research & Technology, Vol. 11 (1), pp. 27-31.
REF 1.2		Kari Alanne (2016) An overview of game-based learning in building services engineering education, European Journal of Engineering Education, 41:2, pp. 204-219.
REF 1.3		Abdul Lateef Olanrewaju, Paul Junior Anahve (2015), Duties & responsibilities of quantity surveyors in the procurement of building services engineering, Procedia Engineering, Vol. 123, pp. 352-360. Creative Construction Conference 2015(CC2015).
REF 1.4		Manuel Wolff, Annegret Haase, Dagmar Haase, Nadja Kabisch (2016), The impact of urban regrowth on the built environment, Urban Studies.
REF 1.5		Joshua Abush (2000), Energy Environmental Performance & the Built Environment, Bulletin of Science, Technology & Society, Vol. 20, No. 5, October 2000, pp. 379-382.
REF 1.6		Ferdin & Lewis (2011), Towards a general model of built environment audits, Planning Theory 11(1), pp. 44-65.
REF 2.1	Lecture 2	G J Levermore (1993) Building Energy Management Systems. Building Services Engineering Research & Technology, 14(4)B1-B18.
REF 2.2		Simon Guy (2006), Designing urban knowledge: Competing perspectives on energy & buildings, Environment & Planning C: Government & Policy 2006, Vol. 24, pp. 645-659.
REF 2.3		Fiona Charnley, Paul Fleming, Tony Dowsett, Margaret Fleming, Malcom Cook, Greig Mill (2010), Engaging schools in the science of low-energy buildings, Public Understanding of Science, 21(7), pp. 875-890.
REF 2.4		J B Siviour (1985), Areas in building heat loss calculations, Building Services Engineering Research & Technology, Vol 6(3), pp.134-136.
REF 2.5		Hans Janssen, Jan Carmeliet & Hugo Hens (2002), The Influence of Soil Moisture in the Unsaturated Zone on the Heat Loss from Buildings via the Ground, Journal of THERMAL ENV. & BLDG. SCI., Vol. 25, No. 4 - April 2002, pp. 275-298.
REF 2.6		J Uyttenbroeck (1990) Building heat loss calculations: Choice of internal temperature & of heat exchange coefficient h_i , Building Services Engineering Research & Technology, 11(2) pp. 49-56.
REF 3.1		M Daviest, A Tindale & Dagger & J Littler & dagger (1995), Importance of multi-dimensional conductive heat flows in & around buildings, Building Services Engineering Research & Technology, 16(2) pp. 83-90.



Reading	Reference	Suggested Literature
REF 3.2	Lecture 3	James Parker, David Glew, Martin Fletcher, Felix Thomas & Christopher Gorse (2017), Accounting for refrigeration heat exchange in energy performance simulations of large food retail buildings, Building Services Engineering Research & Technology, Vol. 38(3), pp. 253-268.
REF 3.3		S W Rees, H R Thomas (1997), Two-dimensional heat transfer beneath a modern commercial building: Comparison of numerical prediction with field measurement, Proceedings of CIBSE A: Building Services Engg. Research & Technology, Vol. 18(3), pp. 169-174.
REF 3.4		Ventilation & air pollution: Buildings located in urban & city centres Summary of a Building Research Establishment/CIBSE Natural Ventilation Group Seminar, Proceedings of CIBSE A: Building Services Engineering Research & Technology, Vol. 18(4), B11-B18 (1997).
REF 3.5		E Djunaedy, JLM Hensen, MGLC Loomas (2004), Selecting an appropriate tool for airflow simulation in buildings, Building Services Engineering Research Technology, Vol. 25 (3), pp. 269-278.
REF 3.6		Y Ji, M J Cook (2007), Numerical studies of displacement natural ventilation in multi-storey buildings connected to an atrium, Building Services Engineering Research & Technology, 28(3), pp. 207-222.
REF 4.1	Lecture 4	Articles on the state of the art developments in building services engineering-Water supply & drainage for buildings, Proc. of CIBSE A: Building Services Engineering Research & Technology, Vol. 20(3), B19-B25 (1999).
REF 4.2		P G Jones (1982), The Consumption of hot water in commercial buildings, Building Services Engineering Research & Technology, Vol. 3, No. 3 pp. 95-100.
REF 4.3		CL Cheng, JJ Peng, WJ Liao & CW Chang (2016) Relationship between buildings hot water usage & energy & carbon reduction, Building Services Engineering Research & Technology, 37(6), pp. 682-693.
REF 4.4		Chooi Mei Mah, Takeshi Fujiwara & Chin Siong Ho (2016) Construction & demolition waste generation rates for high-rise buildings in Malaysia, Water management & Research, 36(12), pp. 1224-1230.
REF 4.5		Paola Villoria Sáez, Mercedes del Río Merino & César Porras-Amores, Estimation of construction & demolition waste volume generation in new residential buildings in Spain, Water management & Research, 30(2), pp. 137-146.
REF 4.6		Jeong Tai Kim & Chuck WF Yu (2014), Hazardous materials in buildings, Indoor & Built Environment, 23(1), pp. 44-61.
REF 5.1		JA McDougall and JA Swaffield (2003), The influence of water conservation on drain sizing for building drainage systems, Building Service Engineering Research & Technology, 24(4), pp. 229-243.



Reading	Reference	Suggested Literature
REF 5.2	Lecture 5	John A Swaffield, John A Mc Dougall & David P Campbell (1999), Drainage flow and solid transport simulation in defective building drainage networks, Proceedings of CIBSE A: Building Services Engineering Research & Technology, Vol. 20(2), pp. 73-81.
REF 5.3		Articles on the state of the art of developments in building services engineering, Water supply & drainage for buildings, Proceedings of CIBSE A: Building Services Engineering Research & Technology, Vol. 20(3), B19-B25.
REF 6.1	Lecture 6	Shereen Ratnagar (2014), The drainage systems at Mohenjo-Daro and Nausharo: A technological breakthrough or a stinking disaster? Studies in People's History, pp. 1-6.
REF 6.2		JA Swaffield, G B Wright (1998), Drainage ventilation for underground structures I: Transient analysis of operation, Proceedings of CIBSE A: Building Services Engineering Research and Technology, 19(4), pp. 187-194.
REF 6.3		MC Phillipson, A McNaughtan (2007), Moisture measurement in building materials: an overview of current methods & new approaches, Building Services Engineering Research & Technology, 28(4), pp. 303-316.
REF 6.4		EBH Stevens and M Fordham (1996), Interstitial condensation in building structures: Dynamic model for predicting the amount of condensation, Building Services Engineering Research & Technology, 17(1), pp. 47-54.
REF 6.5		RJ Oughton (1982), Building Services Engineering Research & Technology, Vol. 3, No. 1, pp. 40-42.
REF 7.1	Lecture 7	Peter R Boyce (2010), The Impact of Light in Building on Human Health, Indoor & Built Environment, 19(1), pp. 8-20.
REF 7.2		E. Neeman (1974), Visual aspects of sunlight in buildings, Lighting Research & Technology, Vol. 6(3), pp. 159-164.
REF 7.3		BH Cross (1963), Artificial Lighting in Hospital Wards, Trans, Illumination Engg. Soc. Vol. 28 (4), pp. 155-173.
REF 7.4		N R Junkison, DR Wills (1960), The Use of Modern Gas Equipment in Flats & Other Large Buildings, R.S.H. 5.
REF 7.5		John Venn (2005), Rapid access to modern energy services using LP Gas, Energy Environment, Vol. 16(5), pp. 781-801.
REF 8.1	Lecture 8	SL Lyons (1972), Electric lighting for building sites & construction, Lighting Research & Technology, Vol. 4, No. 2, pp. 67-79.
REF 8.2		VHC Crisp (1978), The light switch in buildings, Lighting Research & Technology, Vol. 10(2), pp. 69-82.
REF 8.3		F Fouchal, T M Hassan and L Loveday (2012), Design approach for the integration of services in buildings, Building Services Engineering Research and Technology, 34(3), pp. 333-348.
REF 8.4		G Péreza, Julià Comaa, C Barrenechea, A de Graciac, M Urrestarazud, S Burése, L F. Cabezaa (2016), <i>Acoustic insulation capacity of Vertical Greenery Systems for buildings</i> , Applied Acoustics, Elsevier, Vol. 110, Sept. 2016, pp. 218-226.
REF 8.5		Peter W. Wessels, Tom G.H. Basten (2016), Design aspects of acoustic sensor networks for environmental noise monitoring,



Reading	Reference	Suggested Literature
		Applied Acoustics, Elsevier, Vol. 110, Sept., 2016, pp. 227-234.
REF 8.6		C Ming Mak, Z Wang (2015), Recent advances in building acoustics: An overview of prediction methods & their applications, Building & Environment, Elsevier, Vol. 91, pp. 118-126.
REF 9.1	Lecture 9	W K Chow, L T Wong (1998), Fire safety codes for Hong Kong: Inadequacy for atrium design, Proc. of CIBSE A: Building Services Engineering Research & Technology, 19(2), pp.93-99.
REF 9.2		C M Mak, M M Mashrae and Christopher YH Chao (1998), Fire alarm bell audibility in a housing block in Hong Kong, Proceedings of CIBSE A: Building Services Engineering Research and Technology, 19(3), pp.123-127.
REF 9.3		Juergen H Troitzsch (2016), Fires, statistics, ignition sources, & passive fire protection measures, Journal of Fire Sciences, Vol. 34(3), pp. 171-198.
REF 9.4		Michael J Gestwck, Alaaeldin Kandil and James A Love (2014), Heating plant input-output efficiency in two cold-climate institutional buildings with condensing hot water boilers, Building Service Engineering Research & Technology, Vol. 35(6), pp. 634-652.
REF 10.1	Lecture 10	Richard Peters (2011), The appraisal of lift passenger demand in modern office buildings, Building Services Engineering Research and Technology, 32(2), pp. 159-170.
REF 10.2		Valerie J Rice, Michale Murphy, Marilyn A, Sharp, Randall K. Bills, Robert P.Mello (1996), The Effect of lift height on maximal lifting capabilities of men and women, Proceedings of the Human factors & Ergonomics society, 40 th Annual Meeting-1996, pp. 619-623.
REF 10.3		Albert So, Wai L Chan, Steve KM Tsang (2017), On the total power factor of lift systems, Building Services Engineering Research & Technology, pp. 1-4.



9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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For any query, please don't hesitate to contact the Coordinators over phone or email.

The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

**SC-15: PROJECT TIME PLANNING AND
MANAGEMENT**

(SUBJECT GUIDE)

(Version-1.0)

by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

Project time planning is one of the most critical management tasks as it decides the specific time frames in which the project will be completed and sequence of tasks to be completed for the project. It is defined as the process of determining the time when project activities will take place depending upon defined durations and precedent activities. Constraints in time planning/scheduling specify when an activity should start or end, based on duration, predecessors, external predecessor relationships, resource availability, target dates or other time constraints. Using good time estimation techniques may reduce large projects to a series of smaller projects. Accurate time estimation is a skill essential for good project management. Time estimates often determine the setting of deadlines for delivery, the pricing of contracts and hence the profitability of the contract/project in commercial terms. There should be a fine balance among the triple constraints of a project: project scope, time, and cost. High quality projects deliver required results within scope, on time, and within budget. A project time table lists planned dates for performing activities and meeting milestones identified in the project management plan. Developing a project time table/schedule involves analysing project activity sequences, durations, and resource requirements to determine start and finish dates for project activities.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

This short course summarizes the different phases of project time planning and management in detail. Project schedule development is a critical process where project planner analyses sequences of activities, for each activity what are the durations required, resource required, and constraints arising due to scheduling. The project time plan includes the planned dates for starting and completing all activities. This short course will guide the participants to apply the management, engineering and mathematical fundamentals for accurate project schedule development. It will impart the participants the knowledge of using tools like Primavera, CPM, PERT, etc. to perform an accurate time analysis for a project.

The objective of the short course is to enable the participants to:

- Become familiar with the process of planning the time to complete a project
- Identify the critical issues to be addressed for efficient use of time and avoid delays
- Develop skill of developing an efficient time plan/schedule for a project.



3.0 LEARNING OUTCOMES

On completion of this two-day short course, the participants will be:

- Able to effectively plan the time needed for project activities and completion
- Able to track project activities and respond accordingly
- Capable of using different schedule development tools and techniques to deliver a project schedule
- Able to develop efficient time plan/schedule for a project

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from government/corporate/ business sectors from any background. The participants are expected to join with minimum professional experience across all the sectors including management, construction, design, consultancy, academics, and engineering services etc.

5.0 FREQUENTLY ASKED QUESTIONS

Q. What is a project time plan/schedule?

Ans. The Project project time plan/schedule is a timetable which indicates the work which needs to be done, how long the tasks will take, when they will start and end, who will work on them and how long the entire project will take to complete. Project scheduling is a mechanism to communicate what tasks need to get done and which organizational resources will be allocated to complete those tasks in what time frame.

Q What is project time planning management?

Ans. Project time planning management refers to a set of activities and procedures to direct and control completion of a project or process under a proposed schedule. It aims to develop a time plan/schedule that is effective in terms of time and resource estimates.

Q. Can the critical path change?

Ans. Yes, because it is an estimation of a project duration. Changes in the start/end dates of tasks will modify the critical path automatically.

Q. Define Time management.

Ans. Time management is the process of planning and exercising conscious control of time spent on specific activities, especially to increase effectiveness, efficiency or productivity.



6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Project Time Planning & Management.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE
PWD(Roads)	CE/ACE, SE, EE, AEE
T & CP	DD, AD, JD/SE
<i>DD- Deputy Director</i>	<i>JD- Joint Director</i> <i>AD- Asstt Director</i>
GMDA	CEO, Secretary, CE, TP, CAO, PE
<i>TP- Town Planner</i>	<i>CAO-Chief Accounts Officer</i> <i>PE-Project Engineer</i>
PHE	CE/ACE, SE, EE, AEE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

PROJECT TIME PLANNING & MANAGEMENT			
Day	Lecture	Topic	Learning Activities
Day 1	Lecture 1 9:00 am–10:30 am Introduction	- Need for project time planning & management - Stages of project time planning & management - Define project parameters and scope of the project - Visualize and define activities - Sequence the activities - Estimate the activity duration - Schedule the project or phases - Allocate and balance resources - Review/optimisation of the initial schedule - Examples	Reading list: Lecture Slides PTPM-1-1 PTPM-1-2 PTPM-1-3 PTPM-1-4
	10.30 am – 10.45 am: Tea/Coffee break		



PROJECT TIME PLANNING & MANAGEMENT			
Day	Lecture	Topic	Learning Activities
	Lecture 2 10.45 am–12 noon Activity Definition & Work Breakdown Structure (WBS)	• INPUTS ○ Work Breakdown Structure ○ Scope statement ○ Constraints & Assumptions • TOOLS AND TECHNIQUES ○ Decomposition ○ Templates • OUTPUTS ○ Activity list ○ Supporting detail ○ Work breakdown structure updates	Reading list: Lecture Slides PTPM-2-1 PTPM-2-2 PTPM-2-3
	Lecture 3 12 noon–1.15 pm Sequencing of Activity	• INPUTS ○ Activity list ○ Activity attributes ○ Milestones ○ Dependencies ○ Constraints and Assumptions • TOOLS AND TECHNIQUES ○ Precedence diagramming method (PDM) ○ Dependency determination ○ Applying leads and lags ○ Schedule network templates • OUTPUT ○ Project schedule network diagram ○ Activity list updates	Reading list: Lecture Slides PTPM-3-1 PTPM-3-2 PTPM-3-3
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Estimation of Activity Resources	• INPUTS ○ Activity list ○ Activity attributes ○ Resource availability ○ Project management plan • TOOLS AND TECHNIQUES ○ Expert judgment ○ Alternatives analysis ○ Published estimating data	Reading list: Lecture Slides PTPM-4-1 PTPM-4-2 PTPM-4-3



PROJECT TIME PLANNING & MANAGEMENT			
Day	Lecture	Topic	Learning Activities
		○ Bottom-up estimating ○ Project management software • OUTPUT ○ Activity resource requirement ○ Activity attribute updates ○ Resource breakdown structure ○ Requested changes	
	Lecture 5 3.15 pm–4.15 pm Estimation of Activity Durations	• INPUTS ○ Activity list ○ Constraints ○ Assumptions ○ Resource requirements ○ Resource capabilities • TOOLS AND TECHNIQUES ○ Expert judgement ○ Analogous estimating ○ Simulation • OUTPUT ○ Activity duration estimates ○ Basis of estimates ○ Activity list updates	Reading list: Lecture Slides PTPM-5-1 PTPM-5-2 PTPM-5-3
	Lecture 6 9:00 am–10:30 am Development of Time Plan/Schedule	• INPUTS ○ Project network diagram ○ Activity duration estimates ○ Resource requirements ○ Constraints and Assumptions ○ Leads and Lags • TOOLS AND TECHNIQUES ○ Mathematical analysis ○ Simulation ○ Project management software • OUTPUTS ○ Project schedule ○ Supporting detail ○ Schedule management plan ○ Resource requirement updates • Automation in Scheduling • Examples of Scheduling	Reading list: Lecture Slides PTPM-6-1 PTPM-6-2 PTPM-6-3 PTPM-6-4 PTPM-6-5 PTPM-6-6



PROJECT TIME PLANNING & MANAGEMENT			
Day	Lecture	Topic	Learning Activities
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Optimization & Control of Time Plan/Schedule	• INPUTS ○ Project schedule ○ Performance reports ○ Change requests ○ Schedule management plan • TOOLS AND TECHNIQUES ○ Schedule change control system ○ Performance measurement ○ Additional planning ○ Project management software • OUTPUTS ○ Schedule updates ○ Corrective action • Optimization of Schedule	Reading list: Lecture Slides PTPM-7-1 PTPM-7-2 PTPM-7-3
	Lecture 8 12 noon–1.15 pm Tools & Techniques	• CPM • PERT • Gantt Chart • MSP • PMO • Primavera • Timberline	Reading list: Lecture Slides PTPM-8-1 PTPM-8-2 PTPM-8-3 PTPM-8-4 PTPM-8-5
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Typical Issues with Project Time Planning & Management	• How to shorten the project duration • Realistic time estimate • Delay analysis and corrective action • Criticality analysis	Reading list: Lecture Slides PTPM-9-1 PTPM-9-2
	Lecture 10 3.15 pm–4.15 pm Case Studies	• Case Study 1 • Case Study 2	Reading list: Lecture Slides PTPM-10-1 PTPM-10-2



8.0 READING MATERIALS

Participants are expected to refer to literatures from various sources, which might include case studies, conferences papers, library collections, eBooks and e Journals. A reading list is provided in Table–3. However, this list is not an extensive one and may be updated and altered as and when necessary.

Books

- Erik L. Demeulemeester Willy S. Herroelen, PROJECT SCHEDULING: A Research Handbook, Kluwer Academic Publishers Dordrecht, 2002.
- Arno Sprecher, Resource-Constrained Project Scheduling, Exact Methods for the Multi-Mode Case, © Springer-Verlag Berlin Heidelberg 1994.
- A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition.

Table 3: Reading List

Lecture	Reading	Suggested Literature
Lecture 1 Introduction	PTPM-1-1	Project Planning, Scheduling, and Control – Student Guide, Georgia Technology Authority, GTA.
	PTPM-1-2	PROJECT TIME PLANNING, Process and Bar Chart Technique, Presentation.
	PTPM-1-3	Project Time Management Study Notes, Project Management Institute, PMI Registered Education Provider, 2012
	PTPM-1-4	Project Planning & Scheduling, ABB PM Council, Presentation, 2012.
Lecture 2 Activity Definition & Work Breakdown Structure (WBS)	PTPM-2-1	A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition, pp 51-68.
	PTPM-2-2	Project Time Management: Project Skills, Team FME, ISBN 978-1-62620-981-3, www.free-management-ebooks.com
	PTPM-2-3	The Project Planning Stage, General Civil Aviation Authority, Presentation, pp 1-28.
Lecture 3 Sequencing of Activity	PTPM-3-1	A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition, pp 68-71.
	PTPM-3-2	The Project Planning Stage, General Civil Aviation Authority, Presentation, pp 33-42.
	PTPM-3-3	Notes on Planning and Scheduling, pp 9-12.



Lecture	Reading	Suggested Literature
Lecture 4 Estimation of Activity Resources	PTPM-4-1	The Project Planning Stage, General Civil Aviation Authority, Presentation, pp 43-63.
	PTPM-4-2	Notes on Planning and Scheduling, pp 13-16.
	PTPM-4-3	Project Time Management, © Springer Nature Singapore Pte Ltd. 2018 L.S. Pheng, Project Management for the Built Environment, Management in the Built Environment, pp 88-94.
Lecture 5 Estimation of Activity Durations	PTPM-5-1	A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition, pp 71-73.
	PTPM-5-2	The Project Planning Stage, General Civil Aviation Authority, Presentation, pp 43-63.
	PTPM-5-3	Notes on Planning and Scheduling, pp 13-16.
Lecture 6 Development of Time Plan/Schedule	PTPM-6-1	A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition, pp 73-79.
	PTPM-6-2	Erik Demeulemeester, Rainer Kolisch, Ahti Salo, Project management and scheduling, Flex Serv Manuf J (2013) 25: pp 1–5, DOI 10.1007/s10696-012-9168-x
	PTPM-6-3	Sanjay Tiwari, Sparsh Johari, Project Scheduling by Integration of Time Cost Trade-off and Constrained Resource Scheduling, J. Inst. Eng. India Ser. A (January–March 2015) 96(1): pp 37–46 DOI 10.1007/s40030-014-0099-2
	PTPM-6-4	Vahid Faghihi, Ali Nejat, Kenneth F. Reinschmidt, Julian H. Kang, Automation in construction scheduling: a review of the literature, Int J Adv Manuf Technol (2015) 81: pp1845–1856 DOI 10.1007/s00170-015-7339-0
	PTPM-6-5	Basics of Scheduling, © Springer Science+Business Media Singapore 2017 N. Gurjar, A Forward Looking Approach to Project Management, Lecture Notes in Management and Industrial Engineering, DOI 10.1007/978-981-10-0782-8_15
	PTPM-6-6	Notes on Planning and Scheduling, Appendix-3, For Examples: Appendix-6 (pp 3-10)
Lecture 7 Optimization & Control of Time Plan/Schedule	PTPM-7-1	A Guide to the Project Management Body of Knowledge, Project Management Institute, Newton Square, Pennsylvania, USA, 2000 Edition, pp 79-81.
	PTPM-7-2	Notes on Planning and Scheduling, pp 19-22.
	PTPM-7-3	Changzhi Wu, Xiangyu Wang and Lin Jiang, Optimizations in Project Scheduling: A State-of-Art Survey, Intelligent Systems, Control and Automation: Science and Engineering 72, DOI: 10.1007/978-94-017-8044-5_10, © Springer Science+Business Media Dordrecht, pp 161-177, 2014



Lecture	Reading	Suggested Literature
Lecture 8 Tools & Techniques	PTPM-8-1	Tools and Techniques of Project Management, ACORN Professional Tutors
	PTPM-8-2	Project Planning & Scheduling, ABB PM Council, Presentation, pp 13-30 and 39-42, 2012.
	PTPM-8-3	Ahmed E. Hassan, Project Scheduling (PERT/CPM), Slides.
	PTPM-8-4	Guidelines: Project Schedule Project Management Office (PMO), Carleton University, Canada
	PTPM-8-5	Planning and Scheduling, © Springer International Publishing AG, part of Springer Nature 2018 A. De Marco, Project Management for Facility Constructions, https://doi.org/10.1007/978-3-319-75432-1-7
Lecture 9 Typical Issues with Project Time Planning & Management	PTPM-9-1	Project Planning & Scheduling, ABB PM Council, Presentation, pp 31-38, 2012.
	PTPM-9-2	Hadi Jaber, Franck Marle, Ludovic-Alexandre Vidal Lionel Didiez, Criticality and propagation analysis of impacts between project deliverables, Res Eng Design (2018) 29:87–106.
Lecture 10 Case Studies	PTPM-10-1	Tatiana Simankina, Iuliia Kibireva, Angela Mottaeva, and Miroslava Gusarova, Application of the PERT Method in Scheduling of Construction of Apart-Hotel for Energy Consumption Economy, Springer Nature Switzerland AG 2019 V. Murgul and M. Pasetti (Eds.): EMMFT-2018, AISC 983, pp. 138–145, 2019.
	PTPM-10-2	Romel G. and Gilberto A., Project Time Management and Schedule Performance in Mexican Construction Projects, Conference paper, 2016, https://www.researchgate.net/publication/303515564



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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

**SC16 - Project Procurement and
Direct & Indirect Cost Estimate**

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

Project management will at some points require project procurement, which is the process of finding and agreeing to terms, and acquiring goods, services, or works from an external source, often via a tendering or competitive bidding process. Procuring these goods or services provides several advantages over producing them inside the organization, helping to keep project costs down while still achieving the company's desired objectives. Procurement generally involves making buying decisions under conditions of scarcity. Project procurement is different from other forms of procurement primarily because the series of procurement activities carried out during the execution of a project involve a corresponding set of activities undertaken in accordance with the project procurement plan over a period of time to achieve the project objectives.

Direct costs are costs that can be directly attributed to a specific project, e.g. labor, raw materials, and equipment rental costs. Indirect costs are costs that cannot be directly attributed to a specific project, e.g. management, general administration, rental and utility costs.

At the end of the course participants will understand the basic objectives of Project Procurement, be capable of differentiating direct and indirect costs and the methodologies used to manage and estimate them.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

Project procurement is dependent on the objectives and goals of the project which it supports. It is a fundamental part of **project management** because it is crucial to the success of the project that procurement activities are appropriately planned and executed. These series of procurement activities carried out during the execution of a project may or may not be interdependent. Project objectives are predetermined primarily in the project proposal, and there are a corresponding set of procurement activities undertaken in accordance with the project procurement plan over a period of time to achieve the project objectives. Hence, the concept of project procurement planning and strategy development is vital to the implementation and successful outcome of a project.

This course will focus on the development of the related knowledge to understand and apply correct tools / techniques to procure materials commonly used in construction industry. The participants in the course will get first-hand knowledge on types of contracts available, requests for proposals, invitations to tender and selection etc. within the processes of plan, conduct, control and close of procurement.



The core objectives of the course are:

- To help participants identify various types of procurement policies having relative advantages to professional practice.
- To develop communication and professional skills in dealing with diverse project management stakeholders.
- To develop the ability to select appropriate type, tool and technique to make optimal procurement of material.
- To develop the ability to apply logical and creative thinking to formulate evidenced based solution of procurement problem.
- To develop the ability to examine and reflect critically on the profession to improve existing policies or developing new policies of procurement.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will develop skills in Project Procurement and understand how to estimate direct & Indirect Costs effectively. Good project procurement planning and strategy development are vital to the implementation and successful outcome of any project.

On successful completion, participants should be able to:

- Understand the core principles of project procurement.
- Develop and demonstrate hands-on expertise in project evaluation, procurement planning, and contract strategy.
- Practice effective techniques for successfully delivering projects.
- Develop knowledge on innovative and effective procurement model.
- Get basic knowledge on doing research for framing strategic and collaborative procurement model.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What is a resource?



A resource is anything that is needed to execute a task or project — this can be the skill sets of employees or the adoption of software. For example, in planning an event, a few resources include scheduling out staff for the event, planning what vendors to use for promotional materials, investing software that allows attendees to register, and budgeting for everything from giveaways to catering.

2. What are the different kinds of project resources?

There are three different types of resources that need management: *People, equipment and material*. It may be difficult to understand how to manage equipment or material effectively, and how that falls into project management. This involves putting the right people on the right jobs, and ensuring that they have the required equipment and material to get the job done.

3. Why do project resources matter?

Project resources matter because they are an important part in the process of project planning. Often managers may make the mistake of focusing on the task at hand, rather than planning far ahead. This can lead to issues of non-availability of necessary resources for the next phase of the project. Lacking necessary resources will most likely halt progress and cause a project to run behind schedule. This can affect the whole project especially when the manager has to meet deadlines and stay within budget.

4. How can you ensure resource availability?

Project resources are critical to success, but there is never any guarantee that all people, equipment, and capital will be available in the right amounts and at the right time. There is always the risk that issues may arise, but being well-prepared, ensures that the manager is better equipped to handle the situation and move on quickly. Ensuring resource availability also means no member of the team will be overworked or overbooked as the resource manager will always have a clear understanding of everyone's workloads and can plan accordingly.

5. What is resource management?

Resource management is the process of pre-planning, scheduling, and allocating resources to maximize efficiency.

6. Why is resource management important?

Resource management as part of project management is all about doing more with less. Nobody likes waste, especially in business. Resource management is centered around optimization and efficiency. When a manager has a clear concept of what is



needed to make a project successful, he/she can effectively plan out the optimal way to use those resources.

7. What does a resource manager do?

While project managers are responsible for creating and assigning tasks to get the project done, resource managers are accountable for allocating the resources needed to make the project a success.

8. Give a few examples of Direct & Indirect Costs and why estimation of these costs is important?

Examples of direct costs are direct labor, direct materials, commissions, piece rate wages, and manufacturing supplies. Examples of indirect costs are production supervision salaries, quality control costs, insurance, and depreciation. Cost estimating is one of the most important steps in project management. A cost estimate establishes the base line of the project cost at different stages of development of the project. A cost estimate at a given stage of project development represents a prediction provided by the cost engineer or estimator on the basis of available data. According to the American Association of Cost Engineers, cost engineering is defined as that area of engineering practice where engineering judgment and experience are utilized in the application of scientific principles and techniques to the problem of cost estimation, cost control and profitability.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Project Procurement and Direct & Indirect Cost Estimate.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE
T&CP	AD, JD/SE, EE, AE, JE
GMDA	TP, CAO, PE, AEE, AE, JE/AA
PHE	EE, AEE, AE, JE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Project Procurement and Direct & Indirect Cost Estimate			
Day	Lecture	Topic	Learning Activities
Day 1 .../.../....	Lecture 1 9:00 am–10:30 am (1h 30min) Introduction to Project Procurement, Organization and structure	• Meaning and Process • Scope and importance • Functions • Relation with other functions • Traditional vs. new concept of procurement • New developments • Challenges ahead • Organization and structure	Material Used: • Lecture slides • Ref 1.1 • Ref 1.2 • Ref 1.3 • Ref 1.4 • Ref 1.5 • Ref 1.6 • Ref 1.7 • Ref 1.8
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min) Collaboration, Planning & Sourcing Strategy	• Purchasing collaboration • Procurement planning • Out sourcing & In sourcing • Partnership sourcing • Global sourcing • Benefits and limitations • Worked Examples	Material Used: • Lecture slides • Ref 2.1 • Ref 2.2 • Ref 2.3 • Ref 2.4 • Ref 2.5
	Lecture 3 12 noon–1.15 pm (1h 15min) Portfolio models & Social responsibility in procurement	• Need and importance • The kraljic matrix • Supplier segmentation • Purchasing strategies • Ethical purchase • Barriers and challenges • Worked Examples	Material Used: • Lecture slides • Ref 3.1 • Ref 3.2 • Ref 3.3 • Ref 3.4 • Ref 3.5 • Ref 3.6 • Ref 3.7
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h)	• Recent trends • Benefits of ethical purchasing	Material Used: • Lecture slides • Ref 4.1



Project Procurement and Direct & Indirect Cost Estimate			
Day	Lecture	Topic	Learning Activities
	Code of conduct & Environment preferable procurement	- Green product - Global warming - Health and safety. - Worked Examples	- Ref 4.2 - Ref 4.3 - Ref 4.4 - Ref 4.5
	Lecture 5 3.15 pm–4.15 pm (1h) IT driven procurement	- E-business - E-auction - Reverse auction - Worked Examples	Material Used: - Lecture slides - Ref 5.1 - Ref 5.2 - Ref 5.3 - Ref 5.4 - Ref 5.5
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) Supplier selection	- Screening process - Selection criteria - Conventional tools - Selection using ISO 9000 & ISO 14000 - Global and local supplier - Evaluation criteria - Worked Examples	Material Used: - Lecture slides - Ref 6.1 - Ref 6.2 - Ref 6.3 - Ref 6.4 - Ref 6.5 - Ref 6.6 - Ref 6.7 - Ref 6.8 - Ref 6.9
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Supply Market & Supplier Development	- Researching & Analyzing supply market - Tools for Analyzing - Tacit knowledge transfer - Activities network. - Worked Examples	Material Used: - Lecture slides - Ref 7.1 - Ref 7.2 - Ref 7.3 - Ref 7.4 - Ref 7.5
	Lecture 8 12 noon–1.15 pm (1h 15min) Contract administration & Collaboration	- Contract administration - Supplier buyer collaboration - Different types of collaboration and models - Worked Examples	Material Used: - Lecture slides - Ref 8.1 - Ref 8.2 - Ref 8.3 - Ref 8.4 - Ref 8.5

Project Procurement and Direct & Indirect Cost Estimate			
Day	Lecture	Topic	Learning Activities
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Procurement and supply chain management	• Supply chain process • Integrated supply management • Future concept of procurement • Worked Examples	Material Used: • Lecture slides • Ref 9.1 • Ref 9.2 • Ref 9.3
	Lecture 10 3.15 pm–4.15 pm (1h) Direct & Indirect Cost Estimate	• Direct vs. Indirect Costs • Cost estimation Concepts • Methodologies • Worked Examples	Material Used: • Lecture slides • Ref 10.1 • Ref 10.2 • Ref 10.3 • Ref 10.4 • Ref 10.5 • Ref 10.6

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
Ref 1.1	Lecture 1	Derek H. T. Walker and Steve Rowlinson, Procurement Systems, First published 2008 by Taylor & Francis 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN
Ref 1.2		Peter W. G. Morris and Jeffrey K. Pinto, the Wiley guide to project technology, supply chain & procurement management, John Wiley & Sons, Inc, 2007.
Ref 1.3		Johan Abrahamsson and Rickard Badenfors, Purchasing Management, Chalmers, 2008.
Ref 1.4		JUDITH A. EDWARDS, Project Procurement Management In Practice, THE AMA handbook of project management, second edition.
Ref 1.5		Peter Holm Andreasen, The Dynamics of Procurement Management, Copenhagen Business School handelshøjskolen Solbjerg plads 3 dk-2000 frederiksberg Danmark
Ref 1.6		Enock Gideon Musau (2015), Determinants of Procurement Function and Its Role in Organizational Effectiveness, IOSR Journal of Business and



Reading	Reference	Suggested Literature
	(Cont'd) Lecture 1	Management (IOSR-JBM) e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 17, Issue 2.Ver. III
Ref 1.7		Five things you should expect from your procurement function, Scott Blackwood Executive Director, Ernst & Young, New Zealand www.ey.com/.../procurement/.../Five_things_you_should_expect_from_procurement .
Ref 1.8		case study – Purchasing organisational structure and competence level, Copenhagen Business School 2012 Master Thesis Hand in date: 16 th of October 2012 studenttheses.cbs.dk/.../elva_sif_ingolfssdottir_og_jonas_henrik_strunge_dyndegaard
Ref 2.1	Lecture 2	Soojung Oh et al., Managerial capabilities of information technology and firm performance: role of e-procurement system type, International Journal of Production Research, 2014 Vol. 52, No. 15, 4488–4506.
Ref 2.2		Karl Inderfurth, The Impact of Information Sharing on Supply Chain Performance under Asymmetric Information, Vol. 22, No. 2, March–April 2013, pp. 410–425 DOI 10.1111/j.1937-5956.2012.01372.x ISSN 1059-1478 EISSN 1937-5956 13 2202 0410 © 2012 Production and Operations Management Society
Ref 2.3		Jane C Linder et al., Toward an innovation Sourcing Strategy, MIT sloan management review summer 2003
Ref 2.4		Masaaki Kotabe et al., Global Sourcing of Services and Market Performance: An Empirical Investigation, Journal of International Marketing Vol. 6. No. 4. 1998. Pp. 10-31 ISSN 1069-031X.
Ref 2.5		Richard Engelbrecht-Wiggans, E-sourcing in Procurement: Theory and Behavior in Reverse Auctions with Noncompetitive Contracts, Management Science, Vol, 52, No, 4, April 2006, pp. 581-596 ISSN 0025-19091
Ref 3.1	Lecture 3	Yoram Wind, Vijay Mahajan & Donald J. Swire, An Empirical Comparison of Standardized Portfolio Models, Journal of Marketing, Spring 1983
Ref 3.2		Harry M. Markowitz, The Early History of Portfolio Theory: 1600-1960, Financial Analysis Journal, July, 1990.
Ref 3.3		Dong Myung Lee and Paul R. Drake, A portfolio model for component purchasing strategy and the case study of two South Korean elevator manufacturers, International Journal of Production Research Vol. 48, No. 22, 15 November 2010, 6651–6682.
Ref 3.4		Jafar Rezaei* and Roland Ortt, A multi-variable approach to supplier segmentation, International Journal of Production Research Vol. 50, No. 16, 15 August 2012, 4593–4611
Ref 3.5		Marta Andrecka, Corporate Social Responsibility and Sustainability in Danish Public Procurement, CSR and Sustainability in Danish Public Procurement, 2017.



Reading	Reference	Suggested Literature
Ref 3.6		Xinming deng, factors influencing ethical purchase intentions of consumers in china, social behavior and personality, 2013, 41(10), 1693-1704 © society for personality research.
Ref 3.7		Michal J., Why Ethical Consumers Don't Walk Their Talk: Towards a Framework for Understanding the Gap Between the Ethical Purchase Intentions and Actual Buying Behaviour of Ethically Minded Consumers, Journal of Business Ethics (2010) 97:139–158 Springer 2010
Ref 4.1	Lecture 4	Mark M. Leach, Ethics Standards Impacting Test Development and Use: A Review of 31 Ethics Codes Impacting Practices in 35 Countries, INTERNATIONAL JOURNAL OF TESTING, 7(1), 71–88 Copyright © 2007, Lawrence Erlbaum Associates, Inc.
Ref 4.2		Nil Ozcaglar-Toulouse, In search of fair trade: ethical consumer decision making in France, International Journal of Consumer Studies, 30, 5, September 2006, pp502–514
Ref 4.3		Scot Case, Environmentally favourable purchasing, Government procurement, October 2002, www.govproc.com .
Ref 4.4		M. Baitz et al., Life cycle assessment of PVC in product optimisation and green procurement – fact-based decisions towards sustainable solutions, Plastics, Rubbers and Composites 2005 VOL 34 NO 3.
Ref 4.5		ELISA D. WILSON. Environmentally Friendly Health Care Food Services: A Survey of Beliefs, Behaviours, and Attitudes, Canadian Journal of Dietetic Practice and Research-Vol 72 No 3, Fall 2011.
Ref 4.6		Joanne Meehan et al., Sustainable Procurement Practice, Business Strategy and the Environment Bus. Strat. Env. 20, 94–106 (2011)
Ref 5.1	Lecture 5	A. Moropoulou, G. Biscontin, A. Bakolas and K. Bisbikou (1997) Technology and Innovation of rubble masonry Mortars, Construction and Building Material Vol. 11, No. 2, pp. 119-129.
Ref 5.2		Victor C. Li and C. K. Y. Leung (1988) Ceramics for Construction, Construction and Building Materials, Vol. 2 No. 2 pp. 59-68.
Ref 5.3		Martin Bichler and Richard Steinberg, Introduction to the Special Issue on E-Auctions for Procurement Operations, Production and operations management Vol. 16, No. 4, July-August 2007.
Ref 5.4		M. Jae Moon, e-procurement management in state Governments: diffusion of e-procurement practices and its determinants, Journal of public procurement, volume 5, issue 1, 54-72, 2005.
Ref 5.5		Thomas Puschmann and Rainer Alt, Successful Use of e Procurement in Supply Chains, Institute of Technology Management, University of St. Gallen,



Reading	Reference	Suggested Literature
		12thomas.puschmann@img.com .
Ref 6.1	Lecture 6	Sajedeh Hasanian and Seyed Mohammad Hossein Hojjati, A Framework for Supplier Selection Criteria in “LARG” Supply Chain based on a Literature Review, International Journal of Management, Accounting and Economics, 3(8), 502-519, 2016.
Ref 6.2		S. Sen and H. Basligil, A framework for defining both qualitative and quantitative supplier selection criteria considering the buyer–supplier integration strategies, International Journal of Production Research, Vol. 46, No. 7, 1 April 2008.
Ref 6.3		Parthiban, H. Abdul Zubar and Pravin Katarar, Vendor selection problem: a multi-criteria approach based on strategic decisions, International Journal of Production Research Vol. 51, No. 5, 1 March 2013.
Ref 6.4		S. Mohammad Arabzad & Mazaher Ghorbani & Jafar Razmi & Hadi Shirouyehzad, Employing fuzzy TOPSIS and SWOT for supplier selection and order allocation problem, Int J Adv Manuf Technol (2015) 76:803–818 DOI 10.1007/s00170-014-6288-3.
Ref 6.5		B. Vahdania and M. Zandieh, Selecting suppliers using a new fuzzy multiple criteria decision model: the fuzzy balancing and ranking method, International Journal of Production Research Vol. 48, No. 18, 15 September 2010.
Ref 6.6		He-Yau Kang et al., Project Management for a Wind Turbine Construction by Applying Fuzzy Multiple Objective Linear Programming Models, Energies 2016, 9, 1060; doi:10.3390/en9121060, www.mdpi.com/journal/energies .
Ref 6.7		Chiaho Chang, A theoretical analysis of ISO 9000 suppliers, Journal of Economics and Economic Education Research, Volume 14, Number 3, 2013.
Ref 6.8		Qinglong Gou, Suresh Sethi, Jinfeng Yue and Juan Zhang, Push and Pull Contracts in a Local Supply Chain with an Outside Market, Decision Sciences Volume 47, Number 6 December 2016.
Ref 6.9		Yavuz Acara, Sukran Kadipasaoglu and Peter Schipperijn, A decision support framework for global supply chain modelling: an assessment of the impact of demand, supply and lead-time uncertainties on performance, International Journal of Production Research Vol. 48, No. 11, 1 June 2010.
Ref 7.1	Lecture 7	Tobias Schoenherr and Vincent A. Mabert, An Exploratory Study of Procurement Strategies for Multi-Item RFQs in B2B Markets: Antecedents and Impact on Performance, Production and Operations Management Vol. 20, No. 2, March–April 2011.



Reading	Reference	Suggested Literature
Ref 7.2		Laura Venn et al., Blackwell Publishing Ltd Researching European 'alternative' food networks: some methodological considerations, Journal compilation © Royal Geographical Society (with The Institute of British Geographers) 2006.
Ref 7.3		Stephan M. Wagnera and Daniel R. Krauseb, Supplier development: communication approaches, activities and goals, International Journal of Production Research Vol. 47, No. 12, 15 June 2009.
Ref 7.4		Olugbenga Jide Olaniran, Barriers to Tacit Knowledge Sharing in Geographically Dispersed Project Teams in Oil and Gas Projects, Project Management Journal, June – July 2017.
Ref 7.5		Anupam Kumar Nath, Web 2.0 for Knowledge Management in Organizations and Their Effects on Tacit Knowledge Sharing and Perceived Learning, Journal of Accounting – Business & Management vol. 22 no. 2 (2015).
Ref 8.1	Lecture 8	Niall Reynolds, Managing International Contract Administration, AACE INTERNATIONAL TRANSACTIONS, 2008.
Ref 8.2		Jie Yang, Harnessing value in knowledge management for performance in buyer–supplier collaboration, International Journal of Production Research, Vol. 51, No. 7, 2013.
Ref 8.3		Thomas Claufs, The influence of the Type of Relationship on the Generation of Innovations in Buyer–Supplier Collaborations, CREATIVITY AND INNOVATION MANAGEMENT, Volume 21 Number 4, 2012.
Ref 8.4		Jessica J. Andrews, Deirdre Kerr, Robert J. Mislevy, Alina von Davier, Jiangang Hao, and Lei Liu, Modeling Collaborative Interaction Patterns in a Simulation-Based Task, Journal of Educational Measurement Spring 2017, Vol. 54, No. 1, pp. 54–69.
Ref 8.5		Jennifer Olsen and Vincent Aleven, Statistically Modeling Individual Students' Learning Over Successive Collaborative Practice Opportunities, Journal of Educational Measurement Spring 2017, Vol. 54, No. 1, pp. 123–138.
Ref 9.1	Lecture 9	Srivastava, R., and W. C. Benton Jr., Introduction to Purchasing and Supply Chain Management, Part One, Journal of Operational Research 110 (1998).
Ref 9.2		Yasemin Kocaoğlu et al., Supply Chain Optimization Studies: A Literature Review and Classification, This paper was presented at the "The 15 th International Logistics and Supply Chain Congress (LMSCM)" on October 19-20, 2017.
Ref 9.3		Anantaram Balakrishnan and Harihara Prasad Natarajan, Integrated Procurement Planning in Multi-division Firms, Production and Operations Management, Vol. 23, No. 10, October 2014.
Ref 10.1		Direct VS. Indirect Costs,



Reading	Reference	Suggested Literature
	Lecture 10	https://www.bgsu.edu/content/dam/BGSU/finance-and-administration/controller/grants/documents/Direct-vs-Indirect-Costs.pdf
Ref 10.2		Indirect Costs of Contracts, Fred Shelton, Jr., CPA, MBA, CVA and Mason Brugh, CPA, Journal Of Construction Accounting And Taxation July/August 2002
Ref 10.3		Cost Estimation and Indirect Costs, Lecture slides to accompany Engineering Economy, 7 th edition, Leland Blank & Anthony Tarquin. 2012.
Ref 10.4		Cost Estimation: Concepts and Methodology, John L. Sorrels Thomas G. Walton, Air Economics Group Health and Environmental Impacts Division Office of Air Quality Planning and Standards U.S. Environmental Protection Agency Research Triangle Park, NC 27711, Nov 2017
Ref 10.5		Fundamentals of Capital Cost Estimating A TCM approach, Lou Vidotto Managing Director of Vidotto Group.
Ref 10.6		An Overhead Costs Assessment for Construction Projects at Gaza Strip, Nabil I. El-Sawalhi, Ahmed El-Riyat, American Journal of Civil Engineering 2015; 3(4): pp.95-101.

9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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For any query, please don't hesitate to contact the Coordinators over phone or email.

The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC17: Risk & Contingency Management

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
Dr. Manjuri Hazarika



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1.0 INTRODUCTION

In today's world, more and more reliance is placed upon the project manager and his or her team to complete a project successfully. Effective planning and execution of the plan are essential in ensuring project success. Within the early stages of the project, the team participates in activities that explore risk factors, which may negatively impact the project. This is done via (a) risk identification (b) risk quantification (c) risk response development and (d) risk response control; the four components of *Project Risk Management*. A contingency plan is executed when the risk presents itself. The purpose of the plan is to lessen the damage of the risk when it occurs & serves as the last line of defense against it. Without the plan in place, the full impact of the risk could greatly affect the project. For a project manager, it is better to have the contingency ready for implementation than to have to develop one as the risk is taking its toll. Contingency planning thus involves defining action steps to be taken if an identified risk event should occur and is considered as a necessity in today's project management world to achieve project success.

This course will enable participants to acquire insights and tools for risk analysis and contingency planning to deal with unexpected events so that an organization is unaffected or minimally affected & can return to its daily operation as soon as possible. It aims at imparting basic knowledge and skills to deal with any eventuality and is useful to project managers working in all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

This course aims to develop fundamental knowledge in Risk & Contingency Management by taking a broad view of risk analysis of public and private sector projects. Topics covered include concepts of risk analysis techniques, development of contingency plans and mitigating strategies, aims & objectives of a project, responsibilities of both risk & contingency planning coordinators, stakeholder issues and risk management plan & its impact on project performance. This two-day course is designed for participants without assuming any prior knowledge in the field and the learning is fully complemented with easy to follow examples. Participants will be encouraged to learn to apply the tools to analyze projects, programs and ventures. The emphasis is on simultaneous acquisition and application of the relevant concepts, tools and techniques and hands on practices.

The core objectives of the course are:

- To understand that risk management is an integral part of strategic planning, decision making & project management.



- To perceive the importance of risk & contingency management in contributing towards achievement of objectives and improvement of performance in all areas of project management.
- To develop the ability to draw on a broad range of information sources including expert judgment and stakeholder feedback to support evidence based decisions.
- To develop the ability to respond swiftly to internal and external events, changes in the environment, results of monitoring and reviewing activities, new risks that emerge and others that change or disappear.
- To develop adequate skills to source risk assessment information and implement risk controls so that organizations can move with confidence towards strategic goals.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will perceive that risk management is fundamental to project management and has an impact on estimates of time and effort required for the project. Participants will understand that contingency management is an instrument in the arsenal of tools that a project manager carries to support project success.

On successful completion, participants should be able to:

- Determine the nature & causes of risk, their consequences and how to measure them.
- Learn how to define likelihood, time frames of the likelihood & consequences
- Determine levels of risk & choose optimal measures to be implemented
- Learn how to develop & write a contingency plan.
- Facilitate decision-making taking into account views of risk assessors, stakeholders & communicate effectively
- Develop criteria for appraisal and optimization that incorporates financial returns & benefits to community and stakeholders'

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.



5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What are the techniques of risk management?

Once risks are identified, companies take the appropriate steps to manage them to protect their business assets. The most common types of risk management techniques include avoidance, mitigation, transfer, and acceptance.

2. What are the four steps of Project Risk Management (PRM)?

The four steps of Project Risk Management (PRM) are:

1. Identification of risks
2. Quantification of risks
3. Planning for risks
4. Monitoring and control of risks

3. How do you analyze project risk?

Risk analysis involves examining how project outcomes and objectives might change due to the impact of the risk event. Once the risks are identified, they are analyzed to identify the qualitative and quantitative impact of the risk on the project so that appropriate steps can be taken to mitigate them.

4. How does one identify project risk?

The first step in Risk Analysis is to identify the existing and possible threats that one might face. These can come from many different sources. For instance, they could be:

Human – Illness, death, injury, or other loss of a key individual.

Operational – Disruption to supplies and operations, loss of access to essential assets, or failures in distribution.

Reputational – Loss of customer or employee confidence, or damage to market reputation.

Procedural – Failures of accountability, internal systems, or controls, or from fraud.

Project – Going over budget, taking too long on key tasks, or experiencing issues with product or service quality.

Financial – Business failure, stock market fluctuations, interest rate changes, or non-availability of funding.

Technical – Advances in technology, or from technical failure.

Natural – Weather, natural disasters, or disease.

Political – Changes in tax, public opinion, government policy, or foreign influence.



Structural – Dangerous chemicals, poor lighting, falling boxes, or any situation where staff, products, or technology can be harmed.

5. What is risk quantification?

Risk quantification is a process to evaluate identified risks to produce data that can be used in deciding a response to corresponding risks. The process of risk quantification is an important step of the risk management process and therefore, important to ensuring the success of a project.

6. What is the most widely accepted formula for risk quantification?

Numerous different risk formulae exist, but perhaps the most widely accepted formula for risk quantification is: "Rate (or probability) of occurrence multiplied by the impact of the event equals risk magnitude." i.e.

Risk Value = Probability of Event x Impact (or Cost) of Event

7. What are the different methods of Risk Analysis Process in Project Management?

There are three kinds of methods used for determining the level of risk of business. The methods are: Qualitative Methods, Quantitative Methods & Semi-quantitative Methods.

8. What is Qualitative Risk Analysis?

Qualitative Risk Analysis is the process during which one prioritizes risks for further action by assessing their probability of impacting project development.

9. What is Quantitative Risk Analysis?

Quantitative Risk Analysis Process aims to numerically analyze the possibility of every risk and its effect on project objectives, as well as the degree of overall project risk. This procedure uses several techniques or methods such as data collection and representational techniques to determine the probability of achieving project objectives, to quantify the exposure to risks and develop a size and cost assessment schedule.

10. What is the purpose of contingency planning?

The purpose of a contingency plan is to allow an organization to return to its daily operations as quickly as possible after an unforeseen event. The contingency plan protects resources, minimizes customer inconvenience and identifies key staff, assigning specific responsibilities in the context of the recovery.



11. What is contingency planning in project management?

A contingency plan is essentially a *Plan B*. It is a backup plan in place for when things go differently than expected. In other words, a contingency plan in project management is a defined, actionable plan that is to be enacted if an identified risk becomes a reality.

6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Risk & Contingency Management.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	EE, AEE, AE
PWD(Roads)	CE/ACE, SE, EE
T&CP	DD, AD, JD/SE, EE
GMDA	CE, PE
PHE	SE, EE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Risk & Contingency Management			
Day	Lecture	Topic	Learning Activities
Day 1 .../.../....	Lecture 1 9:00 am–10:30 am (1h 30min)	- Managing risk-definition & concept - Classification of risk - Types of risks in projects - Necessity of Risk Management - Contingency Management-concept & definition - Purpose & Benefits	Material Used: - Lecture slides - REF 1.1 - REF1.2 - REF 1.3 - REF 1.4 - REF 1.5
	Introduction	10.30 am – 10.45 am: Tea/Coffee break	



Risk & Contingency Management			
Day	Lecture	Topic	Learning Activities
	Lecture 2 10.45 am–12 noon (1h 15min) Project Risk Management Techniques	• risk assessment, risk management & risk communication- concepts • Methods of Risk Analysis- Qualitative & Quantitative • Risk model & its importance • Using probability- Impact matrix in risk analysis • Identifying risks- brainstorming, flowchart method, SWOT analysis, risk questionnaires & risk surveys.	Material Used: • Lecture slides • REF 2.1 • REF2.2 • REF2.3 • REF2.4 • REF2.5
	Lecture 3 12 noon–1.15 pm (1h 15min) Tools & Techniques-I	• Choosing risk management techniques • Risk Quantification-necessity • Statistical Inference • Weibull Analysis • Dynamic modeling & simulation	Material Used: • Lecture slides • REF 3.1 • REF3.2 • REF3.3 • REF3.4 • REF 3.5 • REF 3.6
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h) Tools & Techniques-II	• FMEA/FMECA • Fault hazard analysis • Fault & Event trees • Common cause failure analysis • Sneak circuit analysis • Other methodologies	Material Used: • Lecture slides • REF 4.1 • REF 4.2 • REF 4.3 • REF 4.4 • REF 4.5 • REF 4.6
	Lecture 5 3.15 pm–4.15 pm (1h) Risk Management (RM) Strategies	• Objectives of RM • Components of RM • Stages of RM • RM planning • Risk identification, analysis, response planning, monitoring & control • RM in project environment	Material Used: • Lecture slides • REF 5.1 • REF 5.2 • REF 5.3 • REF 5.4 • REF 5.5
Day	Lecture	Topic	Learning Activities

Risk & Contingency Management			
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) Enterprise Risk Management (ERM)	• ERM- definition & concept • Risk management vs. ERM • Framework of ERM • ERM process • Necessity of ERM • Application & advantages • Developing Risk Culture	Material Used: • Lecture slides • REF 6.1 • REF 6.2 • REF 6.3 • REF 6.4 • REF 6.5 • REF 6.6
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon (1h 15min) Mitigation of Project Failure	• Reasons for failure • Dimensions of failure • Using project implementation profile to measure failure • How to avoid common causes of failure • Mitigation of project failure modes	Material Used: • Lecture slides • REF 7.1 • REF 7.2 • REF 7.3 • REF 7.4 • (essential) • REF 7.5
	Lecture 8 12 noon–1.15 pm (1h 15min) Stakeholders & their interest	• Project Stakeholders-definition & types • Analysis of their importance • Problems & uncertainties caused by them • Stakeholder management process • Case study to understand stakeholders influence on project success	Material Used: • Lecture slides • REF 8.1 • REF 8.2 • REF 8.3 • REF 8.4
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Business Contingency Planning	• Contingency planning – concept & definition • Aims and context • Relationship between RM & Contingency Planning • Impact of contingency planning • Contingency Plan framework • RM & contingency planning structure	Material Used: • Lecture slides • REF 9.1 • REF 9.2 • REF 9.3 • REF 9.4
	Lecture 10 3.15 pm–4.15 pm (1h) Writing a Contingency Plan	• Definition & concept • Importance • Sections of a contingency plan • Addressing disruptions • Requirements to be met • Responsibility for writing the plan	Material Used: • Lecture slides • REF 10.1 • REF 10.2 • REF 10.3 • REF 10.4



Risk & Contingency Management			
Day	Lecture	Topic	Learning Activities
		• Contingency plan Format	

8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF 1.1	Lecture 1	Introduction To Managing Risk, Jasmin Harvey & Technical Information Service, Topic Gateway Series No. 28, Feb 2008.
REF 1.2		Solenne Costard, Introduction to Risk Analysis and Risk Assessment, ILRI, Nairobi, 2- 3 October 2008.
REF 1.3		Ch 2- Introduction to Risk Analysis and Risk Management Processes, Risk Analysis and Management: Engineering Resilience, Springer Science & Business Media Singapore, 2015.
REF 1.4		Roberto Rudari, Assessing And Understanding Risk And Integrating Risk Management In Development Planning, CIMA Research Foundation, UNISDR,
REF 1.5		Rovins, J.E.; Wilson, T.M.; Hayes, J.; Jensen, S. J.; Dohaney, J., Mitchell, J.; Johnston, D.M.; Davies, A, Risk Assessment Handbook, GNS Science Miscellaneous Series, pp. 84-71, 2015.
REF 2.1	Lecture 2	C Norris, J Perry & P Simon, Project Risk Analysis & Management, Guide by the Association of Project Management, Jan 2000.
REF 2.2		Risk Analysis and Quantification, www.madrid.org/cs/StaticFiles/.../pdf/.../4AnalisisycuantificaciondeIRiesgo(AR)_en.pdf ...
REF 2.3		Frank Hayford & Sarfraz Ahmed, Tools and Techniques for Project Risk Management: Perspective of Micro to Small Scale Construction Firms in Ghana, Degree of Master Thesis, Stockholm, Sweden 2013.
REF 2.4		V Dumbravă, T Maiorescu V S Iacob & Stefan Mare, Using Probability- Impact Matrix in Analysis & Risk Assessment Projects, Journal of Knowledge Management, Economics and Information Technology, pp. 76-96, Dec 2013.
REF 2.5		Ana-Mari, Modern Methods of Risk Identification in Risk Management, International Journal of Academic Research in Economics and Management Sciences, Vol. 1, No. 6, pp. 67-71, Nov 2012.
REF 3.1	Lecture 3	Anna C Cagliano, Sabrina Grimaldi & Carlo Rafele, Choosing Project Risk Management Techniques. A Theoretical Framework, Journal of Risk Research, Vol. 18, No. 2, 232–248, 2015.



Reading	Reference	Suggested Literature
REF 3.2		William G. Shenkir & Paul L. Walker, Enterprise Risk Management: Tools And Techniques For Effective Implementation, Institute of Management Accountants.
REF 3.3		Tim Bedford & Roger Cooke, Probabilistic Risk Analysis: Foundation & Methods, Cambridge University Press, 2001.
REF 3.4		Farnad Nasirzadeh, Abbas Afshar, and Mostafa Khanzad, Dynamic risk analysis in construction projects, Can. J. Civ. Eng. 35: 820–831, 2008.
REF 3.5		John G. Zhao, Significance of Risk Quantification, Palisade RISK Conference 2007.
REF 3.6		Wolfgang Breymann, Quantifying Risk, Zurich University of Applied Science Winterthur, Switzerland. Bad Honnef, 18.–24.September 2005.
REF 4.1	Lecture 4	Risk Analysis Method: FMEA/FMECA in the Organizations, International Journal of Basic & Applied Sciences IJBAS-IJENS Vol. 11 No: 05, pp.49-57, Oct 2011.
REF 4.2		Quantitative Risk Analysis, faculty.kfupm.edu.sa/CEM/.../PDF.../L05%20Quantitative%20Risk%20Analysis.pdf
REF 4.3		Analysis Techniques, FAA System Safety Handbook, December 30, 2000.
REF 4.4		V D N Ramanamurthy & K. U Balasubramanian, Effective Risk Management: Risk Analysis Using An Enhanced FMEA Technique, Tata Consultancy Services.
REF 4.5		Keshnee Padayachee, Techniques Used In Risk Analysis Of Software Development, ResearchGate, 16 Oct 2014.
REF 4.6		P. Sheikh Damanaba, S.S. Alizadeha, Y. Rasoulzadeha, P. Moshashaiea & S. Varmazyar, Failure Modes And Effects Analysis (FMEA) Technique: a literature review, Scientific Journal of Review 4(1) pp.1-6, 2015.
REF 5.1	Lecture 5	Zahra Asadi, An Investigation Of Risk Management Strategies In Projects, Marketing and Branding Research 2(2015) pp. 89-100.
REF 5.2		Risk Management Plan, https://www.phe.gov/about/amcg/contracts/Documents/risk-management.pdf
REF 5.3		A Risk Management Standard, A Risk Management Standard © IRM: 2002.
REF 5.4		Alvaro Sanchez-Cazorla, Rafaela Alfalla-Luque & Ana Isabel Irimia-Dieguez, Risk Identification in Megaprojects as a Crucial Phase of Risk Management: A Literature Review, Project Management Journal, pp. 75-93, December/January 2017.
REF 5.5		Dr. Brian J. Galli, Risk Management in Project Environments, Journal Of Modern Project Management, pp. 41-49, Sept/Dec 2017.
REF 6.1	Lecture 6	Enterprise Risk Management Framework, Version 1: Approved by University Audit and Risk Committee, pp. 1-20, 5 June, 2017.
REF 6.2		Dr, Olaf Passenheim, Enterprise Risk Management, 2010. Bookboon.com
REF 6.3		Enterprise Risk Management, EBSCO Research Starters® Copyright © 2014 EBSCO Information Services, Inc.



Reading	Reference	Suggested Literature
Ref 6.4		Enterprise Risk Management — Integrated Framework, Executive Summary, Sept 2004.
REF 6.5		A structured approach to Enterprise Risk Management (ERM) & the requirements of ISO 31000, The Public Risk Management Association, © AIRMIC, Alarm, IRM: 2010.
Ref 6.6		Lidia Mandru, How To Control Risks? Towards A Structure Of Enterprise Risk Management Process, Journal of Public Administration, Finance and Law, Issue 9/2016, pp. 80-92.
REF 7.1	Lecture 7	Common Causes of Project Failure, Office of Government Commerce Best Practice, © Crown Copyright 2005.
Ref 7.2		Jeffrey K. Pinto & Samuel J. Mantel, Jr., The Causes of Project Failure, IEEE Transactions on Engineering Management, Vol. 37, No.4, Nov 1990.
REF 7.3		Avoiding the Common Causes of Project Failure, FDIC OMWI Education Module, pp. 1-27.
Ref 7.4		Athar A. Syed, A Systems Approach to Mitigation of Project Failure Modes, MS Thesis, © 2009 Massachusetts Institute of Technology.
REF 7.5		Roque Rabechini Junior & Marly Monteiro de Carvalho, Understanding the Impact of Project Risk Management on Project Performance: an Empirical Study, J. Technol. Manag. Innov. 2013, Volume 8, Special Issue ALTEC.
Ref 8.1	Lecture 8	Jan Terje Karlsen, Norwegian School of Management BI, Project Stakeholder Management, ResearchGate. Engineering Management Journal, Vol. 14, No. 4, pp. 19-24, May 2016.
REF 8.2		Stephen Ward & Chris Chapman, Stakeholders & Uncertainty Management In Project, Construction Management & Economics Vol.26, pp.563–57, June 2008.
REF 8.3		MacArthur, John D., Stakeholder Roles and Stakeholder Analysis in Project Planning: A Review Of Approaches In Three Agencies - World Bank, ODA and NRI, March 1997.
Ref 8.4		Xin Liang, Tao Yu, & Li Guo, Understanding Stakeholders' Influence on Project Success with a New SNA Method: A Case Study of the Green Retrofit in China, Sustainability 9, 1927, 2017.
REF 9.1		Risk Management to Contingency Planning, ICD-10 Operational Readiness Keith Hatch, Florida Blue (BCBS of Florida), Senior Manager.
REF 9.2		Risk Analysis and Contingency Planning, pp. 1-33, FAO learning Programme, 2009.
REF 9.3		Risks, Risk Mitigation & Contingency Planning, The Polio Eradication & Endgame Strategic Plan 2013-2018, pp. 81-86, Global Polio Eradication Initiative.
REF 9.4		S Homuth, B Palsson, S Holmgeirsson & I Sass, Risk Management and Contingency Planning for the First Icelandic Deep Drilling Project Well in Krafla, Iceland, Proceedings World Geothermal Congress 2010 Bali, Indonesia, 25-29 April 2010.
REF 10.1	Lecture 10	Maria I. Marshall & Corinne Alexander, Planning for the Unexpected: Human Resource Risk and Contingency Planning, Purdue Extension, Knowledge to Go.



Reading	Reference	Suggested Literature
REF 10.2		Contingency Plan, pp. 1-21 https://www.cibhs.org/.../thurs_1115_sunset_ballroom_contingency_plan_template.pdf
REF 10.3		Contingency Planning Guide, International Federation of Red Cross and Red Crescent Societies, Geneva, 2012.
REF 10.4		Quality and Contingency Plan, Active and Assisted Living Programme. http://www.personaal-project.eu/

9.0 CONTACT DETAILS OF SUBJECT COORDINATORS:

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC-19: PROJECT MANAGEMENT
IN CONSTRUCTION
(SUBJECT GUIDE)

(Version-1.0)
by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

The construction industry is the largest industry in the world and It is more of a service than an industry. Construction industry is more challenging due to its unique nature, involvement of many stakeholders, and the constraints of time, money, quality and high risk. Construction industry projects exhibit cost overruns, time extensions, and conflicts among the stakeholders (client, design professionals, construction professionals, project manager, etc.) due to various reasons. To address these issues, application of project management is gaining importance as it provides tools that enhances the ability to plan, organize and monitor resources for successful completion of project goals and objectives. Impact of project management in construction has been quite remarkable although it is relatively a recent field. It has become an important practice for improving the efficiency of construction operations around the world.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

This short course provides a brief overview of the steps to manage a construction project from preliminary stages to handover. Participants will understand the basic principles of project management and the different tools and techniques for implementation of project management through structured lectures and case studies. It reflects on the established set of project management skills applied to all phases of building projects' life cycle. Topics covered in the course include key aspects of project definition, project planning and scheduling, scope management, time management, cost management, quality management, risk management, procurement management, monitoring and control. Apart from this, participants will be exposed to IT enabled project planning, scheduling and monitoring.

The objective of the short course is to enable the participants to:

- Gain and apply in-depth knowledge in project management in construction
- Apply the tools and techniques required for each project management knowledge area
- Understand the relevancy and applicability of the project management body of knowledge with respect to the practical cases in construction industry
- Set realistic goals in terms of time, cost and deliverable thus avoiding over-ambitious projects.



3.0 LEARNING OUTCOME

On completion of this two-day short course, the participants are expected to:

- Develop a thorough understanding of all key competency areas in project management in construction
- Apply the principles of project management effectively in a project
- Work effectively either as a team leader or a team member with other professionals
- Communicate ideas, concepts and solutions to both technical and non-technical audiences effectively, clearly and concisely

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical government/corporate/ business sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.

5.0 FREQUENTLY ASKED QUESTIONS

Q. What is project management?

Ans. Project management is the application of skill, knowledge, processes and activities to meet a specific objective. The five phases of project management include conception and initiation, planning, execution, performance/monitoring, and project closure throughout the life cycle of a project.

Q. What are the benefits of project management?

Ans. Benefits of project management includes:

- Better production efficiency
- Increased customer satisfaction
- Improved efficiency in delivering services
- Competitive edge and flexibility

Q. What are the common challenges in project management & their solutions?

Ans. Common challenges in project management are:

- Poorly defined goals
- Unrealistic Deadlines



- Lack of training and Insufficient team skills
- Improper communication
- Geographically dispersed teams

6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Project Management in Construction.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
GMDA	CE, PE, AEE, AE, JE
T & CP	DD, AD, JD/SE
TP- Town Planner DD- Deputy Director	CAO-Chief Accounts Officer JD- Joint Director
PHE	PE-Project Engineer AA-Architectural Assistant AD- Asstt Director
	SE, EE, AE, JE

7.0 DETAIL SCHEDULE OF SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

Project Management in Construction			
Day	Lecture	Topic	Learning Activities
Day 1/....	Lecture 1 9:00 am–10:30 am Introduction to Project Management	• Definition, objectives and need analysis of a project • Project Management (PM) overview • Different tools & techniques of PM • Overview of project life cycle and its phases	Reading list: • Lecture Slides • PMC 1-1(Essential) • PMC 1-2(Essential) • PMC 1-3(Essential)
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon	• Brief introduction to PM in Construction, success factor in construction projects	Reading list: • Lecture Slides



Project Management in Construction			
Day	Lecture	Topic	Learning Activities
	Project Management (PM) in Construction	- Infrastructure projects in India and success rate - Case Study	PMC 2-1(Essential)
	Lecture 3 12 noon–1.15 pm Expression of Interests (EOI) and Tendering Process	- Preparation of EOI reports - Information to be furnished in a tender document - Specification and detailed design for a quality tender document - Case study discussion on tender document	Reading list: - Lecture Slides - PMC 3-1(Essential)
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Scope Planning & Management And Time Planning & Management	- Collecting requirements from the stakeholders' needs - Defining scope and detailing of the project, work breakdown structure - Validation & control of scope - Planning of schedule management: Inputs, Tools & Techniques & output - Sequencing of activities - Estimating activity resources, durations and developing of schedule - Controlling of schedule	Reading list: - Lecture Slides - PMC 4-1(Essential) - PMC 4-2(Essential)
	Lecture 5 3.15 pm–4.15 pm Resourcing, Direct and Indirect Cost Estimates	- Introduction to estimation and management of project cost - Direct cost estimating - Importance of indirect costing - Defining Activity based costing (ABC) and its importance - Implementation of ABC system - Reasons for increasing project overhead cost - Factors affecting the overhead allocated cost and controlling and	Reading list: - Lecture Slides - PMC 5-1(Essential) - PMC 5-2(Essential) - PMC 5-3(Essential)



Project Management in Construction			
Day	Lecture	Topic	Learning Activities
		managing overheads	
Day	Lecture	Topic	Learning Activities
Day 2/..	Lecture 6 9:00 am–10:30 am Quality Planning & Management & Procurement Management	- Quality management and assurance in project, Tools & techniques - Controlling quality in project management - Planning of procurement management, conducting procurement for projects: Tools & Techniques - Controlling procurement - Closing of procurement in projects	Reading list: - Lecture Slides - PMC 6-1(Essential) - PMC 6-2(Essential)
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Risks & Contingencies Management	- Identification of different types of risks in projects - Performing qualitative & quantitative risk analysis - Planning of risk responses in projects - Controlling risk and contingency in projects	Reading list: - Lecture Slides - PMC 7-1(Essential)
	Lecture 8 12 noon–1.15 pm Project Monitoring and Control	- Inputs for monitoring & Control of projects - Tools & techniques used for monitoring & control of projects - Strategies adopted for monitoring and control of activities - Effectiveness of internal control activities in a project	Reading list: - Lecture Slides - PMC 8-1(Essential)
	1.15 pm – 2.15 pm: Lunch break		



Project Management in Construction			
Day	Lecture	Topic	Learning Activities
	Lecture 9 2.15 pm–3.15 pm Human Resources	• Development of human resource plan • Acquiring and forming project management team • Managing project management team	Reading list: • Lecture Slides • PMC 9-1(Essential)
	Lecture 10 3.15 pm–4.15 pm Communication and Integration of Different Phases	• Identification of stakeholders • Distribution of information • Managing stakeholder expectation • Reporting performance of the project • Developing of project charter • Managing project execution • Performing integrated change control • Closing of project	Reading list: • Lecture Slides • PMC 10-1 (Essential) • PMC 10-2 (Essential)

8.0 READING MATERIAL

The reading list (as provided in Table 3) provides the literature that the participants are expected to go through to understand the various state of practice in the field of Project Managements in Construction. The literature marked 'ESSENSTIAL' consists of a published literature. However this list is not an extensive one and may be updated and altered as and when necessary.

Table 3: Reading List: Project Management in Construction

Lecture	Reading	Suggested Literature
Lecture 1 Introduction to Project Management In Construction	PMC-1-1	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 5 th edition. Pg (5-13). (ESSENSTIAL)
	PMC-1-2	A K Munns and B F Bjeirmi (1996) The role of project management in achieving project success.



Lecture	Reading	Suggested Literature
		<i>International Journal of Project Management</i> Vol. 14, No. 2, pp. 81-87, 1996.) (ESSENSTIAL)
	PMC-1-3	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 5 th edition. Pg (15-33). (ESSENSTIAL)
Lecture 2 Project Management (PM) in Construction	PMC-2-1	<i>Terry Williams Identifying Success Factors in Construction Projects: A Case Study.</i> Project Management Journal, Vol. 47, No. 1, 97–112 © 2015 by the Project Management Institute Published online in Wiley Online Library. (ESSENSTIAL)
Lecture 3 Expression of Interests (EOI) and tendering process	PMC-3-1	Samuel Laryea (2011) Quality of tender documents: case studies from the UK, Construction Management and Economics, 29:3, 275-286, (ESSENSTIAL)
Lecture 4 Scope Planning & Management and Time Planning & Management	PMC-4-1	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 5 th edition. Pg (103-128) (ESSENSTIAL)
	PMC-4-2	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 5 th edition. Pg (129-164). (ESSENSTIAL)
Lecture 5 Resourcing, Direct and Indirect Cost Estimates	PMC-5-1	Giacomo Carlia, Maurizio Canavari (2013) Introducing Direct Costing and Activity Based Costing in a Farm Management System: a conceptual model. Procedia Technology 8, 2013, (397 – 405) (ESSENSTIAL)
	PMC-5-2	Herbert Snyder, Elisabeth Davenport, (1997) "What does it really cost? Allocating indirect costs", The Bottom Line, Vol. 10 Issue: 4, pp.158-164,(ESSENSTIAL)
	PMC-5-3	Adnan Enshassi, Abdul Rashid Abdul Aziz, Ala'a El Karriri, (2008) "Investigating the overhead costs in construction projects in Palestine", Journal of Financial Management of Property and



Lecture	Reading	Suggested Literature
		Construction, Vol. 13 Issue: 1, pp.35-47,(ESSENSTIAL)
Lecture 6 Quality Planning & Management & Procurement Management	PMC-6-1	A. R. Ramakrishna Bin Abdullah, A. R. Hamzah, M. Y. Ismail et al (2015) INTEGRATION OF QUALITY MEASURE IN PROJECT CONTROL SYSTEM, International Journal of Construction Project Management ISSN: 1944-1436 Volume 7, Number 1 © 2015 Nova Science Publishers, Inc. (ESSENSTIAL)
	PMC-6-2	Warren J. Staples, John F. Dalrymple, (2011) "Exploring infrastructure procurement by Australian state governments", International Journal of Managing Projects in Business, Vol. 4 Issue: 3, pp.512-523,(ESSENSTIAL)
Lecture 7 Risks & Contingencies Management	PMC-7-1	George A. Zsidisin, Alex Panelli, Rebecca Upton, (2000) "Purchasing organization involvement in risk assessments, contingency plans, and risk management: an exploratory study", Supply Chain Management: An International Journal, Vol. 5 Issue: 4, pp.187-198, (ESSENSTIAL)
Lecture 8 Project Monitoring and Control	PMC-8-1	Adebayo Agbejule, Annukka Jokipii, (2009) "Strategy, control activities, monitoring and effectiveness", Managerial Auditing Journal, Vol. 24 Issue: 6, pp.500-522,) (ESSENSTIAL)
Lecture 9 Human Resources	PMC-9-1	Ian Clark, and Trevor Colling, (2005) "The management of human resources in project management-led organizations", Personnel Review, Vol. 34 Issue: 2, pp.178-191.(ESSENSTIAL)
Lecture 10 Communication and Integration of Different Phases	PMC-10-1	Kathy O. Roper, Deborah R. Phillips, (2007) "Integrating self-managed work teams into project management", Journal of Facilities Management, Vol. 5 Issue: 1, pp.22-36, (ESSENSTIAL)
	PMC-10-2	Paul Ziek, J. Dwight Anderson, (2015) "Communication, dialogue and project management", International Journal of Managing Projects in Business, Vol. 8 Issue: 4, pp.788-803, (ESSENSTIAL)



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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC-20: CONSTRUCTION WASTE
MANAGEMENT
(SUBJECT GUIDE)

(Version-1.0)
by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

Construction waste can be divided into three principal categories namely material, labour, and machinery waste. However, material waste is given the maximum concern as it comes from non-renewable resources. It comprises surplus materials from site clearance, excavation, construction, refurbishment, renovation, demolition and road works. Non-inert construction waste comprises bamboo, timber, vegetation, packaging waste and other organic materials which can be recycled or disposed of at landfills. In contrast, inert waste mainly includes construction debris, rubble, earth, bitumen and concrete, which can be used for land formation. Construction Waste Management is the practice of reducing the actual waste that go to the dump site. The field of waste management has been gaining importance due to the scarcity of landfill areas and peoples' awareness of the concept of zero waste management around the world. Construction waste is one of the major contributors of waste going to landfills and needs to be addressed in a scientific manner for proper management. Managing waste means eliminating waste where possible; minimizing waste where feasible; and reusing materials which might otherwise become waste. Reduction, recycling, and reuse of wastes are essential for sustainable management of resources. Effective management of construction waste requires coordinated action of governmental, business, and professional groups and understanding of applicable regulations. Efficient and effective elimination and minimization of waste, and reuse of materials are essential aspects of design and construction activity.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

In this two-day short course participants will learn about the fundamentals of the waste management with special focus on construction waste in modern as well as rural society. The prevailing regulatory aspects of construction waste around the globe and in India will be discussed. The subject is of particular relevance to engineering disciplines where waste management and design for the total life cycle of an infrastructure should be considered. Construction industry professionals can educate and be educated from this course about issues such as beneficial reuse, effective strategies for identification and separation of wastes, and economically viable means of promoting environmentally and socially appropriate means of reducing total waste disposed. Sustainability programs in government and private sector, life cycle assessment, economics of construction waste, recycling and reuse, design of waste management system for households, environmental impacts of construction waste and good practices in construction waste management will be a part of the course. Organizations and governments can assume responsibilities for



effective disposal of construction waste, promotion of public and industry awareness of disposal issues, and providing stable business-friendly environments for collecting and processing of wastes.

The objective of the short course is to enable the participants to:

- Gain knowledge of major environmental problems caused by inappropriate production and disposal of construction waste
- Identify and describe the various systems of reuse and recycling of wastes.
- Model and design waste management system for rural housing in Assam.
- Apply principles of sustainable development to the management of solid by-products.
- Identify design inputs to enable the avoidance, minimization, recycling, re-use and treatment of solid by-products.

3.0 LEARNING OUTCOMES

On completion of this two-day short course, the participants are expected to:

- Develop a thorough understanding of the key areas in construction waste management
- Apply the principles of construction waste management effectively in a project
- Design effective waste management system for urban as well as rural areas
- Apply innovative ways of reduction, recycling, and reuse of wastes for sustainable management of resources

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical government/corporate/ business sectors. The participants are expected to join with minimum professional experience across the sectors including construction, manufacturing, health sector, Electrical/Mechanical engineering services etc.

5.0 FREQUENTY ASKED QUESTIONS

Q. What is construction waste?

Ans. Construction waste means any substance, matter or thing which is generated as a result of construction work and abandoned. It is a mixture of surplus materials



arising from site clearance, excavation, construction, refurbishment, renovation, demolition and road works.

Q. How to dispose the construction waste?

Ans. Recycling and reusing salvaged building materials and minimizing materials and packaging reduces waste disposal costs and material expenses. Different ways to dispose construction waste are:

- Reusing Materials: Some materials can be reused. Materials in resalable condition may be sold for use on another project.
- Minimizing Waste: Some building-related waste can be minimized by selection and use of recyclable materials and products.
- Eliminating Waste: Some waste in construction can be eliminated by using readily demountable and reusable materials thus eliminating wood, bamboo, plywood wastes associated with formwork.

Q. What is the scenario of construction waste management in India?

Ans. Waste minimization and waste management programs are in its infancy stage in India. The growth of Indian economy has brought significant increase in construction activities and hence the problem of waste generation on construction sites. Congested construction sites, rule violation, lack of ownership of waste, lack of awareness and education among the construction workforce were regarded as major challenges associated with the implementation of waste minimization practices in India. If proper measures to minimize and handle the construction and demolition (C&D) waste are not developed and efficiently adopted, it may threat environment as well as sustainable movement of the country.

6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, business and capital projects will benefit from this course on Construction Waste Management.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	EE, AEE, AE, JE
PWD(Roads)	EE, AEE, AE, JE
GMDA	AEE, AE, JE/AA
<i>TP- Town Planner CAO-Chief Accounts Officer PE-Project Engineer AA-Architectural Assistant</i>	
PHE	AEE, AE, JE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

Construction Waste Management			
Day	Lecture	Topic	Learning Activities
Day 1	Lecture 1 9:00 am–10:30 am Introduction to Waste Management & Resopurces and Waste in Construction Sector	• Different sources and types of solid waste generation • Principle of 3R • Disposal of solid waste • Construction waste as a resource • Recycling and reuse of C & D waste	Reading list: Lecture Slides CWM-1-1 CWM-1-2 CWM-1-3 CWM-1-4
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon International regulations with respect to disposal of C & D waste	• Standard practice and guidelines for C&D recycling and reuse • Industrial ecology • C & D waste guide and National waste policy for Australia • Regulations for industry, Green Building Council of Australia	Reading list: Lecture Slides CWM-2-1 CWM-2-2 CWM-2-3
	Lecture 3 12 noon–1.15 pm CPHEEO Guidelines for SWM, rules for disposal of C& D waste in India, SBM Rural & Urban guidelines 2017	• Functional elements of Municipal Solid Waste management • Collection, segregation, processing and transformation of solid waste • Environmental impact of solid waste disposal • Swachh Bharat Mission (SBM) Urban guidelines 2017 • Swachh Bharat Mission (SBM)	Reading list: Lecture Slides CWM-3-1 CWM-3-2 CWM-3-3 CWM-3-4 CWM-3-5



Construction Waste Management			
Day	Lecture	Topic	Learning Activities
		Rural guidelines 2017 Regulatory framework of waste management in India	
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Life Cycle Assessment of Construction Waste	- Introduction to Life cycle assessment of construction waste and its importance - Use of C&D waste for road construction - Impact assessment and emission modelling - Carbonation of concrete waste - Land filling of C&D waste	Reading list: Lecture Slides CWM-4-1 CWM-4-2
	Lecture 5 3.15 pm–4.15 pm Economics of Construction Waste	- Introduction to economic viability of C&D waste - Types of materials recovered during construction projects and their percentage - Revenue generated from the different fractions of C&D waste	Reading list: Lecture Slides CWM-5-1 CWM-5-2
	Lecture 6 9:00 am–10:30 am Environmental Impact of Construction Waste and Health & Safety Issues in Handling	- Introduction to US EPA guidelines for C&D waste - Prevention of environmental degradation due to hazardous and toxic waste in construction - Occupational health & safety guidelines for handling of waste - Duties of employer in deploying waste handling personal - Handling of special waste like asbestos waste	Reading list: Lecture Slides CWM-6-1 CWM-6-2 CWM-6-3 CWM-6-4 CWM-6-5
	10.30 am – 10.45 am: Tea/Coffee break		



Construction Waste Management			
Day	Lecture	Topic	Learning Activities
	Lecture 7 10.45 am–12 noon Types of Waste in Construction Industry, Managing Concrete and other Wastes, Segregation Methodology	• Introduction to different types of construction waste • Method of Blending waste concrete and glass • Introduction to utilization of concrete slurry waste and benefits of recycling concrete slurry waste • Quantification Methods for C&D waste and their comparison • Planning for segregation of construction waste • Waste management during pre-construction, construction and post-construction phase	Reading list: Lecture Slides CWM-7-1 CWM-7-2 CWM-7-3 CWM-7-4 CWM-7-5 CWM-7-6 CWM-7-7
	Lecture 8 12 noon–1.15 pm Techniques of recycling of construction waste abroad and in India	• Process of recycling of C&D waste • Preparation of recycled aggregate (RA) from demolition waste and their properties • Scope of using such techniques in India • Current construction waste practice of recycling • Discussion on a case study on the first plant started in Delhi for recycling of construction waste	Reading list: Lecture Slides CWM-8-1 CWM-8-2
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Prefabrication for reducing C&D waste and C&D waste recycling	• Introduction to Prefabrication and minimizing construction waste by prefabrication • Comparison of waste levels between on-site production and prefabrication • Processing phases based on	Reading list: Lecture Slides CWM-9-1 CWM-9-2 CWM-9-3



Construction Waste Management			
Day	Lecture	Topic	Learning Activities
	equipments	the type of waste Type of equipments for recycling of C&D waste	
	Lecture 10 3.15 pm–4.15 pm Good practices in construction waste management	- Introduction to integrated waste management concepts - Methodology for best practices - Preparation of Demolition plan - Briefing on Waste audit	Reading list: Lecture Slides CWM-10-1

8.0 READING MATERIALS

Participants are expected to refer to various waste management related topics from various sources, which might include case studies, conferences papers, library collections, eBooks and e Journals. A list of essential and optional reading is provided in Table–3. However, this list is not an extensive one and may be updated and altered as and when necessary.

Table 3: Reading List

Reference	Reading	Suggested Literature
Lecture 1 Introduction to Waste Management & Waste in Construction Sector	CWM-1-1	Handout on Solid Waste Management from Anders Damgaard & Morton A. Barlaz, NC State University, U.S. (Essential)
	CWM-1-2	Risks & Choices, Center for Chemistry Education, Miami University (Ohio) www.terrificscience.org —Permission granted to copy for classroom use only (Optional)
	CWM-1-3	Bleek, Morgan J. (2012) waste and resource management practices, legislation and policy, encouraging and influencing ‘regeneration reuse’ of property assets. Recent researches in engineering mechanics, urban & naval transportation and tourism. Pp 136-141. (Essential)



Reference	Reading	Suggested Literature
	CWM-1-4	Metropolitan Waste and Resource Recovery Implementation Plan Victoria State Government (Optional)
Lecture 2 International regulations with respect to disposal of C & D waste	CWM-2-1	Construction and demolition waste guide - recycling and re-use across the supply chain (2012). Department of sustainability, environment, water, population and communities, Govt. of Australia. (Essential)
	CWM-2-2	Jian Zuo, Hongping Yuan and Hongwei Sun (2015). Legislative Framework For the Construction and Demolition Landfill in Western Regions of China—A Critical Analysis. Proceedings of the 19th International Symposium On Advancement of Construction Management and Real Estate. Pp 835-841 (Optional)
	CWM-2-3	Construction & Demolition Waste Reduction Guideline 2016, <i>Sustainable Procurement Guidelines 4.0 C&D Waste Reduction and Procurement</i> , Issue 01 Aug 2016. The University of Queensland, Australia. (Optional)
	CWM-2-4	Construction and demolition waste guide- LATEST 2019 (Essential)
Lecture 3 CPHEEO Guidelines for SWM, rules for disposal of C& D waste in India, SBM Rural & Urban guidelines 2017	CWM-3-1	Central Public Health Environmental Engineering Organisation (CPHEEO) guidelines on Solid Waste Management (2000). Chapter 2 Pp (5-30). (Essential)
	CWM-3-2	Central Public Health Environmental Engineering Organisation (CPHEEO) guidelines on Construction & Demotion Waste (2000). Chapter 4 Pp (57-63). (Optional)
	CWM-3-3	Swachh Bharat Mission Manual on Solid Waste Management Guidelines 2016 (Optional)
	CWM-3-4	Swachh Bharat Mission Rural Guidelines on Solid Waste Management-Revised-2017 (Essential)
	CWM-3-5	Swachh Bharat Mission Urban Guidelines on Solid Waste Management -Revised-2017 (Essential)
Lecture 4 Life cycle	CWM-4-1	Stefania Butera, Thomas H. Christensen, Thomas F. Astrup (2015) Life cycle assessment of construction and demolition waste management. Waste



Reference	Reading	Suggested Literature
assessment of construction waste		Management 44 (2015) 196–205. (Essential)
	CWM-4-2	Min Wu, Guangwei Chen, Peter Davis, Willy Sher, John Smolders, Shuo Chen, Zhidan Qin, Zhou Yan and Ying Wang (2015). Life Cycle Costs of Metal Roof, Concrete, Tile Roof and the Intelligent Cooling Roof. Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate. (Optional)
Lecture 5 Economics of construction waste	CWM-5-1	Sandeep Shrivastava and Abdol Chini (2015) Construction Materials and C&D Waste in India. (Essential)
	CWM-5-2	Mymrin et al (2015) Construction material from construction and demolition debris and lime Production wastes. Construction and Building Materials 79 (2015) 207–213. (Optional)
Lecture 6 Environmental Impact of Construction Waste and Health & Safety Issues in Handling	CWM-6-1	United states Environmental Protection Agency, Construction Waste Management, Section 01 74 19, Date of Publication December, 2007. (Essential)
	CWM-6-2	Saca et al. (2017) Leaching behavior of some demolition waste. J Mater Cycles Waste Manag (2017) 19:623–630. (Optional)
	CWM-6-3	Marrero et al. (2017) Assessing the economic impact and ecological footprint of construction and demolition waste during the urbanization of rural land. Resources, Conservation and Recycling 117, 160-174. (Optional)
	CWM-6-4	Steven Jerie (2016) Occupational Risks Associated with Solid Waste Management in the Informal Sector of Gweru, Zimbabwe. Journal of Environmental and Public Health Volume 2016, Article ID 9024160, Pp1-14. (Essential)
	CWM-6-5	Occupational Health and Safety Regulations, Victorian Legislation (2007) Version No. 001, S.R. No. 54/2007, Version as at 1 July 2007. (Optional)
Lecture 7 Types of Waste in Construction Industry,	CWM-7-1	Zezhou Wu, Ann T.W. Yu, Liyin Shen, Guiwen Liu (2014) Quantifying construction and demolition waste: An analytical review. Waste Management 34 (2014) 1683–1692. (Essential)
	CWM-7-2	Construction Waste Management Plan Guidelines a



Reference	Reading	Suggested Literature
Managing Concrete and other Wastes, Segregation Methodology		resource for Western Australian local government, developers, property owners and builders. The Western Australian Local Government Association (WALGA). (Essential)
	CWM-7-3	Biglarijoo et al (2017) Modelling and optimisation of concrete containing recycled concrete aggregate and waste glass. Magazine of Concrete Research Volume 69 Issue 6. (Essential)
	CWM-7-4	Md. Uzzal Hossain, Dongxing Xuan, Chi Sun Poon (2017) Sustainable management and utilisation of concrete slurry waste: A case study in Hong Kong. Waste Management 61 (2017) 397–404. (Optional)
	CWM-7-5	Concrete Washout Guideline- Planning and Environment Services: Environmental Management
	CWM-7-6	Shigetaka Seki, Toshiaki Yoshioka (2017) Recycling of PVC pipes and fittings in Japan: proactive approach of industry to and its impacts on legal/technical frameworks, J Mater Cycles Waste Manag (2017) 19:21–31
	CWM-7-7	Okpin Na, Yunping Xi(2017), Mechanical and durability properties of insulation mortar with rubber powder from waste tires, J Mater Cycles Waste Manag (2017) 19:763–773.
Lecture 8 Techniques of recycling of construction waste abroad and in India	CWM-8-1	Behera et al (2014) Recycled aggregate from C&D waste & its use in concrete – A breakthrough towards sustainability in construction sector: A review. Construction and Building Materials 68 (2014) 501–516. (Essential)
	CWM-8-2	India's first plant that recycles construction waste, newspaper article from 'The Hindu' NEW DELHI: August 29, 2014 10:32 IST. (Essential)
Lecture 9 Prefabrication for reducing C&D waste and C&D waste recycling	CWM-9-1	Vivian W. Y. Tam & Jane J. L. Hao (2014) Prefabrication as a mean of minimizing construction waste on site, International Journal of Construction Management, 14:2, 113-121. (Essential)
	CWM-9-2	Construction and Demolition Waste Guide-Recycling and Re-use across the Supply Chain, Department of Sustainability, Environment, Water, Population and



Reference	Reading	Suggested Literature
equipments		Communities. (Optional)
	CWM-9-3	CDE Global C&D waste recycling equipment manufacturer. www.cdeglobal.com/applications/cd-waste-recycling (Essential)
Lecture 10 Good practices in construction waste management	CWM-10-1	Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects. (http://www.envirocentre.ie/includes/documents/WMC onstruction and Demolition) (Essential)

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**The study materials for the entire subject have been
developed and will be available electronically.**



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

**SC-23: CONSTRUCTION METHODS AND
EQUIPMENT**
(SUBJECT GUIDE)

(Version-1.0)

by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

As the world moves towards a new decade, the role of construction industry in building a better and modern world is indispensable. The engineering and construction industry is facing considerable hurdles of responding to ever increasing material price, safety issues, need for sustainability, and other trade-related issues, and absorbing the rapid pace of technology development pervading our lives. Engineering, design, and construction firms have a unique opportunity to leave a mark using advanced technologies to design and build the world. This short course summarizes the scopes, objectives and the future trends of the subject Construction Methods and Equipment in detail. It will guide the participants to apply the engineering fundamentals and analyses to the planning, selection and utilization of construction equipment as well as the construction methods.

2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT

This two-day short course provides an overview of the construction methods and equipment that is used in the construction industry. It is introduced with the underlying concept that construction of buildings, structures, etc requires the utilization of appropriate construction equipment. This includes selection, economy, and productivity of common construction equipment and construction procedures for site development and industrial, heavy and civil construction. The course will introduce participants to civil construction plans, determining earthwork quantities, equipment economics and utilization, equipment production rates, fundamentals of earth moving and excavating, loading and hauling equipment.

The objective of the short course is to enable the participants to:

- Become familiar with construction equipment and their capabilities
- Identify the critical issues to be addressed in utilizing a particular method and construction equipment in a construction project.
- Understand standard designations, sizes, and gradations of equipment
- Develop an increased awareness of civil construction blueprints

3.0 LEARNING OUTCOMES

On completion of this two-day short course, the participants are expected to:

- Select equipment based on applications, utilization, and productivity
- Estimate the cost as well as the machine power requirements
- Identify the issues affecting the construction equipment as a particular site;



- Learn how to apply engineering fundamentals and analyses to the planning, selection and utilization of construction equipment.
- Ability to critically analyse the issues of sustainable construction keeping in view the various environmental, economic and other aspects.
- Be able to demonstrate awareness of construction safety

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from government/corporate/ business sectors specially from civil engineering and architectural background. The participants are expected to join with minimum professional experience across the sectors including construction, design consultancy, academics, and engineering services etc.

5.0 FREQUENTY ASKED QUESTIONS

Q. What are the latest trends in construction methods and techniques?

Ans. Some of the latest trends in construction technique are prefabrication, Building Information Modelling (BIM), Permeable concrete, Energy efficient structures, solar roads and materials, Permanent Modular Construction, use of drones, etc.

Q. What are the construction equipments mostly used?

Ans. Most frequently used construction equipments are Cranes, Dozers, Scrapers, Excavators, Graders, Trucks, Hauling equipments, Concrete Equipment, PileDriving Equipment, Air Compressors and Pumps, etc.

6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Construction Methods and Equipment.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
GMDA	AEE, AE, JE/AA
T & CP	DD, AD, JD/SE
TP- Town Planner DD- Deputy Director	CAO-Chief Accounts Officer JD- Joint Director PE-Project Engineer AD- Asstt Director AA-Architectural Assistant
PHE	EE, AEE, AE, JE



7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

CONSTRUCTION METHODS AND EQUIPMENT			
Day	Lecture	Topic	Learning Activities
Day 1	Lecture 1 9:00 am–10:30 am Introduction to Construction Methods and Equipment	• Introduction • The construction industry and the related processes • Need and classification of construction equipments • Factors behind the selection of construction equipment.	Reading list: Lecture Slides CM&E-1-1 CM&E-1-2 CM&E-1-3
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon Equipment Cost Analysis & Machine Power Requirements	• Introduction • Time value of Money • Evaluation of equipment costs: capital costs, operation costs, maintenance costs considering present, annual, future value • Equipment rent-lease-buy cost • Site specific, Client and project specific machine power • Machine power at different field conditions like slope, pavement, etc.	Reading list: Lecture Slides CM&E-2-1 CM&E-2-2 CM&E-2-3 CM&E-2-4 CM&E-2-5 CM&E-2-6
	Lecture 3 12 noon–1.15 pm Earthwork Construction & Excavation Safety	• Earthmoving materials & machines • Estimating Earthwork Volume • Soil identification, classification, soil volume change characteristics • Planning of earthwork using Mass haul diagram and selection of equipment by haul directions	Reading list: Lecture Slides CM&E-3-1 CM&E-3-2 CM&E-3-3 CM&E-3-4



CONSTRUCTION METHODS AND EQUIPMENT			
Day	Lecture	Topic	Learning Activities
		• OSHA safety rules and methods of excavation wall protections	
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm An Overview of Dozers Scrapers Excavators & Graders	• Overview of different types of dozers used in construction, calculation of cost and productivity • Overview of different types of scrapers used in construction, calculation of cost and productivity • Overview of different types of excavators used in construction, calculation of cost and productivity • Overview of different types of graders used in construction, calculation of cost and productivity	Reading list: Lecture Slides CM&E-4-1 CM&E-4-2 CM&E-4-3 CM&E-4-4 CM&E-4-5 CM&E-4-6 CM&E-4-7
	Lecture 5 3.15 pm–4.15 pm Trucks, Hauling Equipment & Cranes	• Overview of different types of trucks used in construction • Calculation of productivity, cost, optimum number of equipment in a hauling crew • Overview of different types of cranes used in construction, types and calculation of productivity and cost of using cranes	Reading list: Lecture Slides CM&E-5-1 CM&E-5-2 CM&E-5-3 CM&E-5-4 CM&E-5-5
	Lecture 6 9:00 am–10:30 am Drilling, Tunnelling and Blasting Rock	• Overview of different types and applications of drilling • Overview of different types and applications of tunnelling • Calculation of productivity of drilling and tunnelling operations • Tunnel Boring Machines (TBM)	Reading list: Lecture Slides CM&E-6-1 CM&E-6-2 CM&E-6-3 CM&E-6-4 CM&E-6-5



CONSTRUCTION METHODS AND EQUIPMENT			
Day	Lecture	Topic	Learning Activities
		- Blasting operations, needs, and calculation of productivity of blasting - Safety issues related to Blasting.	
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon An Overview of Aggregate Production, Compaction, Stabilization and Asphalt Mix Production	- Overview of different components of aggregate production plants, Aggregate types and components - Principles and importance of compaction and stabilization, equipment used, - Optimum number of rollers for compaction operations, calculation of productivity of rollers - Different types of asphalt mix production plants and equipment. - Requirements for placing asphalt concrete in road construction	Reading list: Lecture Slides CM&E-7-1 CM&E-7-2 CM&E-7-3 CM&E-7-4 CM&E-7-5 CM&E-7-6 CM&E-7-7 CM&E-7-8
	Lecture 8 12 noon–1.15 pm An Overview of Concrete Equipment, Pile-Driving Equipment and Air Compressors and Pumps	- Types of concreting equipment - Concrete mix designs and equipment for batching, mixing and placing concrete - Overview of different types of piles, methods of installation - Overview of different types of air compressors and pumps used in construction - Calculation of power requirements	Reading list: Lecture Slides CM&E-8-1 CM&E-8-2 CM&E-8-3 CM&E-8-4 CM&E-8-5 CM&E-8-6 CM&E-8-7
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Building Construction	- Preplanning of building construction - Safety issues in building construction - Foundations - Wood Construction - Concrete Construction	Reading list: Lecture Slides CM&E-9-1 CM&E-9-2 CM&E-9-3



CONSTRUCTION METHODS AND EQUIPMENT			
Day	Lecture	Topic	Learning Activities
		- Concrete form design - Masonry Construction - Steel construction	
	Lecture 10 3.15 pm–4.15 pm Latest Trends in 2019	- Connected construction method - Prefabrication and modular construction - Building Information Modelling (BIM) - Green construction	Reading list: Lecture Slides CM&E-10-1 CM&E-10-2

8.0 READING MATERIALS

Participants are expected to refer to literatures from various sources, which might include case studies, conferences papers, library collections, eBooks and e Journals. A reading list is provided in Table–3. However, this list is not an extensive one and may be updated and altered as and when necessary.

TEXTS BOOKS

Construction Methods and Management by Nunnally, S.W. Upper Saddle River, N.J.: Prentice Hall.

Concrete Construction Methods and Costs, Harbert P. Gillete, Charles S. Hill, The Myron C. Clark Publishing Co

Table 3: Reading List

Lecture	Reading	Suggested Literature
Lecture 1 Introduction to Construction Methods and Equipment	CM&E-1-1	Cliff Schexnayder and Stuart Anderson (2011), Construction Engineering Education: History and Challenge, Journal of Construction Engineering and Management, 137(10), 730-739, ASCE.
	CM&E-1-2	William R. Haycraft (2011), History of Construction Equipment, Journal of Construction Engineering and Management, 137(10), 720-723, ASCE.



Lecture	Reading	Suggested Literature
	CM&E-1-3	Togar M. Simatupang & Ramaswami Sridharan (2016), A critical analysis of supply chain issues in construction heavy equipment, International Journal of Construction Management, 16:4, 326-338, DOI: 10.1080/15623599.2016.1142250.
Lecture 2 Equipment Cost Analysis & Machine Power Requirements	CM&E-2-1	Govindan Kannan (2011), Field Studies in Construction Equipment, Economics and Productivity, Journal of Construction Engineering and Management, 137(10), 823-828, ASCE.
	CM&E-2-2	Z. Mitchell; J. Hildreth; and M. Vorster (2011), Using the Cumulative Cost Model to Forecast Equipment Repair Costs: Two Different Methodologies Journal of Construction Engineering and Management, 137(10), 817-822, ASCE.
	CM&E-2-3	Gunnar Lucko (2011), Modelling the Residual Market Value of Construction Equipment under Changed Economic Conditions Journal of Construction Engineering and Management, 137(10), 806-816,, ASCE.
	CM&E-2-4	Chan C. M. R. & Harris F. C. (1989) A database/spreadsheet application for equipment selection, Construction Management and Economics, 7:3, 235-247, DOI:10.1080/014461989000000025
	CM&E-2-5	Ali Touran & Khalid A. H. Taher (1988) Optimum fleet size determination by queuing and simulation, Construction Management and Economics, 6:4, 295-306, DOI: 10.1080/014461988000000025
	CM&E-2-6	M.Waris, Mohd. Shahir Liew, Mohd. Faris Khamadi, Arazi Idrus (2014), Criteria for the selection of sustainable onsite construction equipment, International Journal of Sustainable Built Environment (2014) 3, 96–110
Lecture 3 Earthwork Construction & Excavation Safety	CM&E-3-1	Sabah Alkass and Frank Harris (1988), Expert System for Earthmoving Equipment Selection in Road Construction, Journal of Construction Engineering and Management, 114(3), 426-440,, ASCE
	CM&E-3-2	C. B. Tatum; Michael Vorster; Mac G. Klingler; and Boyd C. Paulson Jr. (2006) Systems Analysis of Technical Advancement in



Lecture	Reading	Suggested Literature
		Earthmoving Equipment, Journal of Construction Engineering and Management, 132(9), 976-986,, ASCE
	CM&E-3-3	Andre Lan, Renaud Daigle(), Review of Regulations and Guides for Excavation and Trenches-Comparision with the Quebec Safety Code for the Construction Industry, Practice Periodical on Structural Design and Construction, ASCE, 14(4), pp. 201-209.
	CM&E-3-4	T. Michael Toole and John A. Gambatese (2002)Primer on Federal Occupational Safety and Health Administration Standards, T. Michael Toole and John A. Gambatese, Practice Periodical on Structural Design and Construction, 7(2), 56-60.
Lecture 4 An Overview of Dozers Scrapers Excavators & Graders	CM&E-4-1	Young-Jun Park; Han-Seong Gwak; and Dong-Eun Lee (2017), Dozer Workability Estimation Method for Economic Dozing, Journal of Construction Engineering and Management, 143(2), pp. 04016096(1-13), DOI: 10.1061/(ASCE)CO.1943-7862.0001228., ASCE
	CM&E-4-2	V.J. Kecojevic & M.J. Mrugala (2003) Estimation of Dozer Production and Costs, International Journal of Surface Mining, Reclamation and Environment, 17:3, 171-182,
	CM&E-4-3	Alireza S. Kaboli & David G. Carmichael (2014) Optimum scraper load time and fleet size for minimum emissions, International Journal of Construction Management, 14:4, 209-226, DOI: 10.1080/15623599.2014.967924
	CM&E-4-4	Marina Marinelli and Sergios Lambropoulos (2013), Algorithmic Method for Scraper Load-Time Optimization, Journal of Construction Engineering and Managment, 139 (5), pp. 459-465. DOI: 10.1061/(ASCE)CO.1943-7862 .0000624., ASCE.
	CM&E-4-5	John A. Kuprenas and Teresa Henkhaus(2000), SSSPE – A Tool for Scraper selection and production, Computing in Civil and Building Engineering, 980-987.
	CM&E-4-6	Bopanna T. KOlera and Leonhard E. Bernold (2006) Intelligent Utility Locating Tool for Excavators, Journal of Construction Engineering and Manaagement, 132(9), pp. 919-927



Lecture	Reading	Suggested Literature
	CM&E-4-7	C.B.Tatum and A.T.Funke (1988) Partially Automated Grading: Construction Process Innovation, Journal of Construction Engineering and Management, 114(1), pp. 19-35.
Lecture 5 Trucks, Hauling Equipment & Cranes	CM&E-5-1	Kyong Ju Kim and Kyoungmin Kim (2010), Case study on the evaluation of equipment flow at a construction site, Journal of Computing in Civil Engineering, 24(6), pp. 570-575.
	CM&E-5-2	Hamidou Diawara and Nader Ghafoori (2012), Influence of combined Hauling Time and Temperature on Flow Properties of Self-Consolidating Concrete: Retempering Remediation, Journal of Materials in Civil Engineering, 2012, 24(1): 1-7
	CM&E-5-3	Cliff Schexnayder, Sandra Weber and Brentwood T. Brooks (1999), Effect of Truck Payload Weight on Production, , 125(1): 1-7
	CM&E-5-4	Aviad Shapira, Gunnar Lucko and Clifford J. Schexnayder (2007), Cranes for Building Construction Projects, Journal of Construction Engineering and Management, ASCE, 133(9), pp.690-700. (
	CM&E-5-5	NORMAN-SPENCER – Type of Cranes.
Lecture 6 Drilling, Tunnelling and Blasting Rock	CM&E-6-1	Muhammad Adel and Tarek Zayed (), Productivity Analysis of Horizontal Directional Drilling, Pipelines 2009: Infrastructure's Hidden Assets, ASCE, pp. 835 – 843.
	CM&E-6-2	Moham Sarireh, Mohammad Najafi, Lawrence Slavin and Abhaj Jain (2012), Case study of productivity analysis for horizontal directional drilling, Pipelines 2012: Innovations in Design, Construction, Operations and Maintenance – Doing More with less, ASCE, pp. 857-868
	CM&E-6-3	Joseph Membah & Eric Asa (2015) Estimating cost for transportation tunnel projects: a systematic literature review, International Journal of Construction Management, 15:3, 196-218, DOI: 10.1080/15623599.2015.1067345
	CM&E-6-4	Gerhard Girmscheid and Cliff Schexnayder(2002), Drill and Blast Tunnelling Practices, Practice Periodical On Structural Design And Construction, 2002, 7(3): 125-133



Lecture	Reading	Suggested Literature
	CM&E-6-5	Chen Dezhi and Xu Shunxiang (2009), Tunnel Blasting Adjacent to Existing Tunnel and its safety Technology, International Conference on Transportation Engineering 2009 (ICTE 2009), pp. 3748 – 3753.
Lecture 7 An Overview of Aggregate Production, Compaction, Stabilization and Asphalt Mix Production	CM&E-7-1	Jonathan Jingsheng Shi (1999), Mathematical models for maximizing aggregate plant production, Journal of Construction Engineering and Management, 125(1), pp 53-60.
	CM&E-7-2	Haifang Wen and Kun Zhang (2014), Simulation of Aggregates Heating in Asphalt Plants, Pavement Materials, Structures and Performance, GSP 239, ASCE, pp 19 – 28.
	CM&E-7-3	Dany Hajjar and Simaan M. AbouRizk (1998), Modelling and Analysis of Aggregate Production Operations, Journal of Construction Engineering and Management, 124(5), pp. 390-401.
	CM&E-7-4	V. Anjaneyappa ¹ ; M. S. Amarnath; and B. R. Srinivasamurthy, Compacting Characteristics of Light Compacting Equipment, Journal of Construction Engineering and Management, 140(5), pp. 04014003(1-8)
	CM&E-7-5	Mohamed M. Mekkawy, David J. White, Charles T. Jähren and Muhannad T. Sulieman (2010), Performance Problems and Stabilization Techniques for Granular Shoulders, Journal of Performance of Constructed Facilities, 24(2), pp. 159-169.
	CM&E-7-6	Alistair E. Hunter, Liam McGreavy and Gordon D. Airey (2009), Effect of Compaction Mode on the Mechanical Performance and Variability of asphalt Mixtures, Journal of Transportation Engineering, ASCE, 135(11), pp. 839-851.
	CM&E-7-7	Freddy L. Roberts, Louay N. Mohammad and L.B.Wang (2002), History of Hot Mix Asphalt Mixture Design in the United States, Journal of Materials in Civil Engineering, 14(4): 279-293
	CM&E-7-8	Asphalt Mixture Plant Operations.(available from www.in.gov/indot/files/chapter_03(5).pdf)
	CM&E-8-1	Sabah Alkass, Apraham Aronian and Osama Moselhi (1993), Computer Aided Equipment Selection for Transporting and Placing Concrete, Journal of Construction Engineering and Management, 119(3), 445-465.



Lecture	Reading	Suggested Literature
Lecture 8 An Overview of Concrete Equipment, Pile-Driving Equipment and Air Compressors and Pumps	CM&E-8-2	Tarek M. Zayed and Issam Minkarah (2004), Resource Allocation for Concrete Batch Plant Operation: Case Study, <i>Journal of Construction Engineering and Management</i> , 130(4), pp. 560-569.
	CM&E-8-3	Tarek M. Zayed, Daniel Halpin (2001), Simulation of Concrete Batch Plant Production, <i>Journal of Construction Engineering and Management</i> , 127(2), 132-141.
	CM&E-8-4	Tarek Zayed and Daniel W. Halpin(2005) Pile Construction Productivity Assessment, <i>Journal of Construction Engineering and Management</i> , 131(6), pp. 705-714.
	CM&E-8-5	Tarek Zayed and Daniel W. Halpin(2005), Productivity and Cost Regression Models for Pile Construction, <i>Journal of Construction Engineering and Management</i> , 131(7), pp. 779-789.
	CM&E-8-6	Garland Likins, Gina Beim, Michael Morgano, George Piscsalko, George Goble (2000), Construction Control for Augercast Piling, New Technological Design Developments in Deep Foundations, Deep Foundations, Proceedings of Geo-Denver 2000, August 5-8, 2000, Denver, Colorado, United States, pp. 447-457
	CM&E-8-7	Robert J. Jenny (1983), Compressed Air Use in Sot Ground Tunnelling, <i>Journal of Construction Engineering and Management</i> , 109(2), 206-213.
Lecture 9 Building Construction	CM&E-9-1	Committee on Construction Equipment and Techniques (1991), Trenchless Excavation Construction Methods: Classification and Evaluation, <i>Journal of Construction Engineering and Management</i> , Vol. 117, No. 3, September, 1991. ©ASCE, pp 521-536
	CM&E-9-2	Ximena Ferrada and Alfredo Serpell(2014), Selection of Construction Methods for Construction Projects: A Knowledge Problem, <i>Journal of Construction Engineering Management</i> , 140(4), pp. B4014002(1-7),
	CM&E-9-3	W.H.Diliger and G.S.Tadros and P.Giannelia (1992), Method Proposed for Construction of Multispan Cable-Stayed Bridges, <i>Journal of Construction Engineering and Management</i> , 118(2), pp. 273 – 282.



Lecture	Reading	Suggested Literature
Lecture 10 Latest Trends in 2019	CM&E-10-1	Michelle Meisels, 2019 Engineering and Construction Industry Outlook
	CM&E-10-2	https://www.thebalancesmb.com/top-construction-industry-trends-4125856 https://smallbusinessgrowthpartners.com/trends-2019-store-construction-industry/ https://constructible.trimble.com/construction-industry/2019-construction-trends-8topics-to-watch-in-the-year-ahead

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The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSES IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC24: Quality Control & Quality Assurance

(COURSE GUIDE)

(Version-1.0)

by – Dr. Purobi Patowary
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1.0 INTRODUCTION

Quality is one of the main important aspects that are used to assess cost and efficiency of any product. In civil engineering field, quality deals with safety of a structure and serviceability, so it is more important to ensure that any structure is at an acceptable level of quality. In order to do that, a new science called Quality control was introduced to manage quality effectively. Quality control (QC) is a process by which entities review the quality of all factors involved in production. And it is carried out during the production (construction) process by the contractor's engineers to ensure that the quality of the work is as per requirements. Quality assurance (QA) refers to the planned and systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. It is usually made by a non-biased party after the construction process is over.

This course will enable participants to acquire insights and tools to ensure improved product quality, workmanship & efficiency, decrease in wastage, and increased profit. It aims at imparting basic knowledge and competencies required in quality management in all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies.

2.0 OVERVIEW & OBJECTIVES OF THE COURSE

Quality management is a major enabler of reduced costs, both directly through reductions in the quality assurance function and the cost of rework, and indirectly as it facilitates the reduction of inventory buffers. This course covers both the areas of quality control procedures in construction field, and also the procedures in project management field in scale of planning, execution, and control. Topics covered include concepts & history of QA & QC, standards & specifications, performance & design specifications and their necessity, stages of the QC & QA process and procedures, application in the construction field, importance of quality management systems with regards to project performance and computer based systems for quality management. .

This two-day course is designed for participants without assuming any prior knowledge in the field and the learning is fully complemented with easy to follow examples. Participants will be encouraged to learn to apply the tools. The emphasis is on simultaneous acquisition and application of the relevant concepts, tools and techniques and hands on practices.

The core objectives of the course are:



- To understand techniques that can be used to obtain and maintain product quality, process and service.
- To understand standard specification, performance & design specifications and their importance in the quality management system.
- To think critically and synthesize complex data.
- To focus on planning & documenting all procedures to be followed in order to assure quality including quality control, inspection & test plans.
- To perceive that a built in quality control & assurance system helps alleviate risk and improve performance of the system by conforming to global standards backed by certification.

3.0 LEARNING OUTCOMES

At the end of the two-day course, the participants will develop sufficient knowledge in quality management in order to focus on fulfilling quality requirements & providing confidence that those requirements will be met in projects across all sectors.

On successful completion, participants should be able to:

- Apply activities or techniques to analyze data and information for managing projects.
- Prevent quality problems through planned & systematic activities including documentation.
- Develop the skill of finding & eliminating causes of quality problems so that customer's requirements are continually met.
- Develop the skills to establish a good quality management system.
- Develop the ability to assess the adequacy & conformance audit of the operation system & the review of the system itself.

4.0 WHO SHOULD ATTEND

The course is relevant to professional participants ranging from fresh to middle and senior level executives from both technical and non-technical corporate, business, government and semi-government sectors. The participants are expected to join with minimum professional experience across the sectors including manufacturing, construction, design consultancy, contracting, academics, health sector, IT and Information Services, Electrical/Mechanical engineering services etc.



5.0 ANSWERS TO FREQUENTLY ASKED QUESTIONS

1. What is quality control (QC) in a construction project?

A successful construction project is one which can achieve a balance between cost, time, and quality. Quality control is a branch of quality management and involves ensuring that products and facilities comply with requirements and established standards.

2. How is QC carried out by a contractor?

Quality control work consists of obtaining and performing tests for contractor quality control testing, performing tests for contractor process control, providing inspection, and exercising management control to ensure that work conforms to the contract requirements.

3. Why is quality important in construction?

Quality is an important factor when it comes to any product or service. Quality control is essential to building a successful business that delivers products that meet or exceed customers' expectations. It also forms the basis of an efficient business that minimizes waste and operates at high levels of productivity.

4. How does the quality management process work?

The Quality Management Process helps to:

- Set quality targets to be met by the team.
- Define how those quality targets will be measured.
- Take actions needed to measure quality.
- Identify quality issues and improvements.
- Report on the overall level of quality achieved.

5. What is the role of a QC engineer?

The quality control engineer works directly with quality assurance supervisors, analyzing manufacturing processes for improvement using various methods of testing and inspection. It also includes the need to develop, apply and maintain quality requirements and standards for developing and manufacturing products.



6. What are the responsibilities of a quality engineer?

Across all types of industry, the job description of a quality engineer involves monitoring, testing and inspecting products to make sure they meet specified standards. The quality engineer also designs systems by which production quality can be checked in an ongoing process.

7. What is quality assurance (QA) in a construction project?

A successful quality assurance program aims to ensure that the quality procedures implemented during the design phase of a construction project effectively meet the company-established standards for quality service, performance and production.

8. What is QA plan for construction project?

A construction quality control plan helps ensure that the client can actually use the building. The plan looks at specific areas of a project that could affect quality and outlines the ways to mitigate that risk.

9. What is QCP construction?

A construction quality control plan or QA/QC plan includes an inspection and test plan, but goes beyond inspecting. It includes control of work procedures to improve quality throughout the whole construction process, i.e. not just after the material is delivered or the phase of work is completed.

10. What is a Standard?

According to ISO (international standardization organization), standards are documented agreements containing specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics, to ensure that materials, products, processes and services are fit for their purpose. A standard is a detailed statement of requirements.

11. Why are international standard specifications important?

Presence of international standard specifications is very important and vital nowadays due to the following reasons:

- Standards facilitate communication and prevent misunderstanding.
- Standards make parts interchangeability possible and as a result, mass production is possible.



- Standards can be used in marketing strategy to promote purchase of products that meet recognized requirements, especially when conformance is backed by certification program.
- Standards and specifications are important when the product is manufactured in one country and exported worldwide as markets became more global.

12. What are the steps of a QC system?

The QC system is designed to:

- (a) Provide routine and consistent checks to ensure data integrity, correctness, and completeness;
- (b) Identify and address errors and omissions;
- (c) Document and archive inventory material and record all QC activities.

13. Why is QA necessary?

Quality assurance is important in the engineering and construction industry because of the risk involved in any project. The risk involved in not completing the project on time is high, because many external factors will affect the performance of the project. It is vital that a built-in quality assurance system is developed to avoid any inefficiency that could result in poor quality of products and service being delivered to the customer.

14. What is a QMS?

A QMS can be defined as, A set of coordinated activities to direct and control an organization in order to continually improve the effectiveness and efficiency of its performance.

15. What is the relationship between QMS and project performance?

The main thrust of a QMS is in defining the processes, which will result in the production of quality products and services, rather than in detecting defective products or services after they have been produced. Project quality management includes the processes and activities of performing organization that determine quality policies, objectives, and responsibilities so that the project will satisfy the need for which it was undertaken. It implements quality management system through policy and procedures with continuous process improvement activities conducted through the processes of quality planning, quality control & quality assurance. These processes interact with each other and with all project activities, each occurring at least once during the project and is applicable to any project regardless to its nature.



6.0 TARGET STAKEHOLDERS

The following participants from all sectors of industry and business including services, business investment, R&D, capital projects and projects in local, state and national government departments and agencies will benefit from this course on Quality Control & Quality Assurance..

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	AEE, AE, JE
PWD(Roads)	EE, AEE, AE, JE
T&CP	DD, AD, EE
GMDA	JE/AA
PHE	CE/ACE, SE, EE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Duration: 2 Days

Total Contact Period: 12 hours

Table 2: Detailed Schedule

Quality Control & Quality Assurance			
Day	Lecture	Topic	Learning Activities
Day 1 ../../....	Lecture 1 9:00 am–10:30 am (1h 30min)	• QC & QA- definitions, concepts • Brief history • Standards & specifications- definitions & types • Importance of having standards • ISO 9000 definitions of QC & QA • Difference between QC &QA	Material Used: • Lecture slides • REF 1.1 • REF 1.2 • REF 1.3 • REF 1.4
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon (1h 15min)	Scope & context of • ISO 9000- Quality Management System- Fundamentals & Vocabulary • ISO 9001- Quality Management System- Best Practice for Small Businesses • ISO 9004- Managing for the Sustained Success of an organization— Quality Management Approach • Lean six sigma, ANSI, BSI, etc.	Material Used: • Lecture slides • REF 2.1 • REF 2.2 • REF 2.3 • REF 2.4 • REF 2.5 • REF 2.6



Quality Control & Quality Assurance			
Day	Lecture	Topic	Learning Activities
		Impact of minimum quality standards on industry structure, trade & welfare	
	Lecture 3 12 noon–1.15 pm (1h 15min) QC Tools & Activities- I (Basic)	- Fishbone - Check sheet - Control chart - Histogram - Pareto chart - Scatter diagram - Flowchart	Material Used: - Lecture slides - REF 3.1 - REF 3.2 - REF 3.3 - REF 3.4
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm (1h) QC Tools & Activities- II	- Affinity Diagram - Relation Diagram - Tree Diagram - Matrix Diagram - Arrow Diagram - Process Decision Program Chart - Matrix Data Analysis.	Material Used: - Lecture slides - REF 4.1 - REF 4.2 - REF 4.3 - REF 4.4 - REF 4.5 - REF 4.6
	Lecture 5 3.15 pm–4.15 pm (1h) Elements/ Stages of QA/QC System	- QC/QA in the construction field - Stages of QC - Universal QC/QA System - Universal QMS Systems - Steps for implementing a QMS - Benefits of QMS	Material Used: - Lecture slides - REF 5.1 - REF 5.2 - REF 5.3 - REF 5.4
Day	Lecture	Topic	Learning Activities
Day 2 .../.../....	Lecture 6 9:00 am–10:30 am (1h 30min) QA/QC Plans & Procedures	- Elements of a QA/QC system - Practical Considerations in Developing the System - QA/QC Plan - General QC Procedures (Tier-I) - Specific QC Procedures (Tier-II) - QA Procedures - Documentation, Archiving & Reporting	Material Used: - Lecture slides - REF 6.1 - REF 6.2 - REF 6.3 - REF 6.4
	10.30 am – 10.45 am: Tea/Coffee break		



Quality Control & Quality Assurance			
Day	Lecture	Topic	Learning Activities
	Lecture 7 10.45 am–12 noon (1h 15min) Tools Used in the QA process	• Inputs, & Outputs • Tools & Techniques • Quality Audit • Process Analysis • Quality Management & Control	Material Used: • Lecture slides • REF 7.1 • REF 7.2 • REF 7.3
	Lecture 8 12 noon–1.15 pm (1h 15min) QA Process & Continual Improvement	• Setting up of the QA System • Quality manual • Standard Operating Procedures • Auditing & Checking Compliance • Maintaining QA for continual improvement- PDCA Cycle • Case Study	Material Used: • Lecture slides • REF 8.1 • REF 8.2 • REF 8.3 • REF 8.4 • REF 8.5 • REF 8.6
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm (1h) Quality Management Principles & Project Performance	• 1 – Customer focus • 2 – Leadership • 3 – Engagement of people • 4 – Process approach • 5 – Improvement • 6 – Evidence-based decision making • 7 – Relationship management • Rationale, benefits & actions required • ISO 9001:2008 QMS – requirements for consistent performance • Applications-SQM, higher education	Material Used: • Lecture slides • REF 9.1 • REF 9.2 • REF 9.3 • REF 9.4 • REF 9.5 • REF 9.6 • REF 9.7
	Lecture 10 3.15 pm–4.15 pm (1h) Computer Based System for Quality Management	• Necessity of QM with computers & applications • Design of a computer based system for QM • Computer based quality evaluation-case study • Use of PHP as programming language for QM • TQAMS & its benefits	Material Used: • Lecture slides • REF 10.1 • REF 10.2 • REF 10.3 • REF 10.4 • REF 10.5 • REF 10.6



8.0 REQUIRED READING MATERIALS

The required reading materials (as provided in Table 3) provides the literature that a participant is expected to go through to understand the topics of the syllabus.

Table 3: Required Reading Materials

Reading	Reference	Suggested Literature
REF 1.1	Lecture 1	Introduction to Quality Systems, An NTMA Technology Team Member Training Program
REF 1.2		Quality Control Vs. Quality Assurance, https://elsmar.com/pdf_files/QC%20vs%20QA.pdf
REF 1.3		Chapter Seven-Quality Control, https://www.rand.org/content/dam/rand/pubs/monograph_reports/.../MR1325.ch7.pdf
REF 1.4		Difference Between Quality Assurance And Quality Control, QM001, ThesummaryofdiscussionsatQualityGurus.com, Feb 2011. www.qualitygurus.com/.../QM001DifferenceBetweenQualityAssuranceAndQualityCo...
REF 2.1	Lecture 2	Implementing an ISO 9001 Quality Management System, Copyright ETI Group 2014
REF 2.2		Quality management systems Requirements (ISO 9001:2015, NSAI Standards.
REF 2.3		Carl Gaigne & Bruno Larue, Quality Standards, Industry Structure, and Welfare In a Global Economy, Amer. J. Agr. Econ. 98(5): pp. 1432–1449, June 16, 2016.
REF 2.4		Min Chen & Konstantinos Serfe, Minimum Quality Standard Regulation Under Imperfect Quality Observability, J Regul Econ (2012) 41, pp. 269–291.
REF 2.5		ISO 9001 Quality Management System, Essential Best Practice For Small Businesses, bsigroup.com
REF 2.6		Alessandro Laureani & Jiju Anton, Standards for Lean Six Sigma certification, International Journal of Productivity and Performance Management Vol. 61, No. 1, pp. 110-120, 2012.
REF 3.1	Lecture 3	V. Ismyrlis & O. Moschidis, The Use of Quality Management Systems, Tools, And Techniques In ISO 9001:2008 Certified Companies With Multidimensional Statistics: The Greek Case, Total Quality Management, Vol. 26, No. 5, pp. 497–514, 2015.
REF 3.2		Behnam Neyestani, Seven Basic Tools of Quality Control: Appropriate Tools for Solving Quality Problems in the Organizations, MPRA Paper No. 7768, March 2017. https://mpra.ub.uni-muenchen.de/77681/
REF 3.3		Nadia Mushtaq, Muhammad Aslam & Jaffer Hussain, Design of Attribute Control Chart Based on Regression Estimator, Pak.j.stat.oper.res. Vol. XIII, No.3, pp. 589-601, 2017.
REF 3.4		Varsha M. Magar & Vilas B. Shinde, Application of 7 Quality Control (7 QC) Tools for Continuous Improvement of Manufacturing Processes, International Journal of Engineering Research and General Science, Vol. 2, No. 4, June-July, 2014.



Reading	Reference	Suggested Literature
REF 4.1	Lecture 4	Mohit Singh, I.A. Khan & Sandeep Grover, Tools & Techniques For Quality Management In Manufacturing Industries, Proceedings of the National Conference on Trends and Advances in Mechanical Engineering, pp.853-859, Oct 19-20, 2012.
REF 4.2		Matthew Ticklea, Dotun Adebajob, Robin Mann & Francis Ojadid, Business Improvement Tools & Techniques: A Comparison Across Sectors & Industries, International Journal of Production Research, Vol. 53, No. 2, pp. 354–370, 2015.
REF 4.3		The Seven Management & Planning Tools, Team Tools Series I – Mastering Planning and Decision Making, Affinity Consulting 2000
REF 4.4		The Seven Management and Planning Tools webpages.uidaho.edu/.../The%20Seven%20Management%20and%20Planning%20To...
REF 4.5		Dr Stuart Burge, The Systems Thinking Tool Box, 2006 https://www.burgehugheswalsh.co.uk/uploaded/1/documents/md-tool-box-v1.0.pdf
REF 4.6		Yue Yin, Using Tree Diagrams as an Assessment Tool in Statistics Education, Educational Assessment, Taylor & Francis Group, LLC 17:22–50, 2012.
REF 5.1	Lecture 5	Md. Mahmoud Hashim, Md. Salah Hamed & Moemen Negm El Den, Quality Control Basics & Systems, Faculty of Engineering, . Structural Engineering Program, Helwan University.
REF 5.2		Ch14 - Quality Management Systems, pp. 264-287, TLF-eBOOK https://www.abahe.uk/business-administration/Quality-Management-Systems.pdf
REF 5.3		Guide to the Implementation of a Quality Management System for National Meteorological and Hydrological Services, World Meteorological Organization, 2013 edition.
REF 5.4		Ng Kim-Soon, Quality Management System & Practices, ResearchGate, 21 October 2015. www.intechopen.com
REF 6.1	Lecture 6	Larry Rosengrant & Lisa Jones, Guidelines for Quality Assurance/Quality Control Procedures for Submission of Data for the Land Disposal restrictions Program, U.S. Environmental Protection Agency, July 1991.
REF 6.2		Kishu Manghani, Quality assurance: Importance of systems and standard operating procedures, Sept 28, 2016 http://www.picronline.org
REF 6.3		Quality Assurance & Quality Control, IPCC Good Practice Guidance & Uncertainty Management in National Greenhouse Gas Inventories https://www.ipcc-nggip.iges.or.jp/public/gp/english/8_QA-QC.pdf
REF 6.4		Designer Quality Control Plan Guidelines, MSDGC Designer Quality Control Plan Guidelines, pp. 1-14, 2014
REF 7.1	Lecture 7	Tools and Techniques Useful in Quality Planning, Assurance, and Control, Copyright ©2016 Global Knowledge Training LLC. www.globalknowledge.com
REF 7.2		Quality Assurance & Quality Control, IPCC Good Practice Guidance & Uncertainty Management in National Greenhouse Gas Inventories https://www.ipcc-nggip.iges.or.jp/public/gp/english/8_QA-QC.pdf



Reading	Reference	Suggested Literature
REF 7.3		Quality Assurance & Quality Control, MARSSIM, August 2000. https://www.epa.gov/sites/production/files/2015-05/documents/chapter9.pdf
REF 8.1	Lecture 8	Chapter 4: Quality Assurance, Monitoring Bathing Waters - A Practical Guide to the Design, A. Storey, R. Briggs, H. Jones and R. Russell, Implementation of Assessments & Monitoring Programmes, © 2000 WHO
REF 8.2		Toolkit for Quality Assurance, ftp://ftp.cdc.gov/.../Quality%20Assurance%20Materials/.../10%20-%20Toolkit%20for...
REF 8.3		Issam M F Saltaji, Corporate Governance & External Auditors-High Auditing Quality, Internal Auditing & risk Management, Anul XI, Nr. 2 (42), June 2016.
REF 8.4		Yoram Goldberg & Armin Shmilovici, An Expert System Approach for Quality Assurance Auditing, International J on Advances in Manufacturing Technology 26: pp. 415–419, 2005.
REF 8.5		Mirko Soković, Jelena Jovanović, Zdravko Krivokapić & Aleksandar Vujović, Basic Quality Tools in Continuous Improvement Process, Journal of Mechanical Engineering, pp. 1-9, 55(2009)5.
REF 8.6		Fábio A. Fernandes, Sérgio D. Sousa, & Isabel Lopes, On the Use of Quality Tools: A Case Study, Proceedings of the World Congress on Engineering 2013 Vol I, WCE 2013, July 3 - 5, 2013, London, U.K.
REF 9.1	Lecture 9	Quality management principles, International Organization for Standardization of Quality, ISO 2015, iso.org
REF 9.2		Quality Management & ISO 9001 Standard, AIM Single ECAR QMS – 14 March, 2016 (Antigua)
REF 9.3		Ng Wee Leng, Total Quality Management Principles that Influence the Integration of Information & Communications Technology into the Classroom, The Asia-Pacific Education Researcher 18:2, pp. 317-327, 2009. weeleng.ng@nie.edu.sg
REF 9.4		B. Mrugalska & E. Tytyk, Quality Control Methods for Product Reliability & Safety, 6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015, Procedia Manufacturing 3, pp. 2730 – 2737, 2015.
REF 9.5		Leonhard E. Bernold, Applying Total-Quality-Management Principles to Improving Engineering Education, Journal of Professional Issues in Engineering Education and Practice, Vol. 134, No. 1, January 1, 2008.
REF 9.6		R. Y. AlMaian, K. LaScola Needy, K. D. Walsh, Thaís da C. L. Alvares, & N. M. Scalad, Analyzing Supplier Quality Management Practices In the Construction Industry, Quality Engineering Vol. 28, NO.2, 175–183, 2016.
REF 9.7		Chu-hua Kueia & Min H. Lu, Integrating Quality Management Principles Into Sustainability Management, Total Quality Management, Vol. 24, No. 1, pp. 62–78, 2013.
REF 10.1		Mireille G Battikha, QUALICON: Computer Based System for Construction Quality Management, Journal of Construction



Reading	Reference	Suggested Literature
		Engineering And Management, pp. 164-173, March/April 2002.
REF 10.2	Lecture 10	M S. Kandil, A E. Hassan, Aziza S. Asem, M El-hoseny Ibrahim, Prototype of Web2-based system for Quality Assurance Evaluation Process in Higher Education Institutions, International Journal of Electrical & Computer Sciences, IJECS-IJENS Vol:10 No:2, pp. 1-7, April 2010.
REF 10.3		Renny Rahmadi Putra, Triwilaswandio W.P, and M. Sholikhhan Arif, Computer-Based Applications for Quality Management Process in Shipbuilding, The 2nd International Seminar on Science and Technology, pp. 99-108, August 2nd 2016, Surabaya, Indonesia
REF 10.4		Tao Yu & Gaoshan Wang, Application of Computer-Aided Quality Control System, Conference Paper, ResearchGate, 09 June 2016.
REF 10.5		Hazem M. El-Bakry, Alla M. Riad, Aziza S. Asem, Mohamed E. Ibrahim, Ahmed E. Hassan, Mahmod S. Kandel, & Nikos Mastoraki, Design and Implementation of Total Quality Assurance Management System for Universities, Recent Advances In Business Administration, pp. 89-103, 28 April 2015
REF 10.6		Sou-Sen Leu & Bing-Rong Tzeng, A CPM-Based Construction Quality Inspection and Decision-Aid System, Computer-Aided Civil and Infrastructure Engineering 15 (2000) pp. 233–239.

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For any query, please don't hesitate to contact the Coordinators over phone or email.

The study materials for the entire subject have been developed and will be available electronically.



SHORT COURSE IN CONSTRUCTION MANAGEMENT
ASSAM ENGINEERING COLLEGE
GUWAHATI-781013

SC-26: CONSTRUCTION SAFETY

(SUBJECT GUIDE)

(Version-1.0)

by – Dr Purobi Patowary
Dr Manjuri Hazarika



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1.0 INTRODUCTION

Implementation of safety measures in construction projects is of utmost importance. Safety and health risk assessment is the core of any safety practices in any industry. Construction is a high hazard industry that comprises a wide range of activities involving construction, alteration, and repair. Construction workers engage in many activities that may expose them to serious hazards, such as falling from rooftops, unguarded machinery, being struck by heavy construction equipment, electrocutions, etc. Government has implemented strict rules for recognition and control of Occupation Safety and Health (OSH) Hazards, workers' rights and employer responsibilities while executing a construction project. OSH hazards associated with execution of construction projects, evaluation and control is the most essential for successful completion of a project. Most accidents can be prevented by taking simple measures or adopting proper working procedures. Emphasis needs to be placed on recognition, evaluation and control of safety hazards particularly as they relate to the Occupational Safety and Health Act. The Occupational Safety and Health Ordinance, covers most workplaces in order to protect the safety and health of employees at work. Other legislation applicable to construction sites includes the Factories and Industrial Undertakings Ordinance and its subsidiary legislation, particularly the Construction Sites (Safety) Regulations.

2.0 OVERVIEW & OBJECTIVES OF THE SHORT COURSE

The main objective of this short course is to provide working knowledge on the recognition, avoidance, abatement, and prevention of safety and health hazards in workplaces associated with the construction industry. The course also provides information regarding workers' rights, employer responsibilities, and how to file a complaint. Construction safety measures followed in different countries of the world are presented for exposure to the global scenario. It is designed to cater to the issues to fulfil the safety needs of the entire urban as well as the rural construction. This short course will make the participants aware of the importance of following safety measures and rules in construction industry and help participants to promote the sense of civic duty and responsibility with high moral and ethical standards. It will impart the participants exposure to the use of latest techniques and tools like IoT, Virtual Reality, Robotics, BIM etc. for enhancing safety in a construction project.

The objective of the short course is to enable the participants to:

- Gain knowledge of safety and health hazards in workplaces associated with the construction industry
- Identify the critical issues to prevent accidents in construction sites
- Learn workers' rights and employer responsibilities



3.0 LEARNING OUTCOMES

On completion of this two-day short course, the participants will be:

- Understand the key requirements of basic safety and health hazards and practices in construction
- Aware about the globally recognized guidelines/codes of practice for safety in construction
- Able to learn workers' rights and employer responsibilities
- Able to become professional construction managers with a sense of civic duty and responsibility
- Able to recognize common hazards in construction and take measures to prevent accidents
- Use the latest techniques for safety measures

4.0 WHO SHOULD ATTEND

The two-day course is relevant to professional participants ranging from fresh to middle and senior level executives from government/corporate/ business sectors from any background. The participants are expected to join with minimum professional experience across all the sectors including construction, engineering services, management, design, academics, etc.

5.0 FREQUENTLY ASKED QUESTIONS

Q. What is occupational health and safety?

Ans. Occupational safety and health (OSH), also commonly referred to as occupational health and safety (OHS), occupational health, or workplace health and safety (WHS), is a multidisciplinary field concerned with the safety, health, and welfare of people at work.

Q. What is ISO 45001 standard?

Ans. ISO 45001 is an ISO standard for management systems of occupational health and safety (OH&S), published in March 2018. The goal of ISO 45001 is the reduction of occupational injuries and diseases.

Q. What is an OSHA safety plan?

Ans. An OSHA Safety Plan is a written plan that describes the potential hazards in the workplace, and the company policies, controls and work practices used to minimize those hazards.



6.0 TARGET STAKEHOLDERS

The following professionals of various hierarchy from government departments/corporate/business sectors in services, R&D, business and capital projects will benefit from this course on Construction Management.

Table 1: Target Stakeholders

Organization	Target Stakeholders
PWD(Buildings)	CE/ACE, SE, EE, AEE, AE, JE
PWD(Roads)	CE/ACE, SE, EE, AEE, AE, JE
T & CP	DD, AD, JD/SE, EE, AE, JE
<i>DD- Deputy Director</i>	<i>JD- Joint Director</i> <i>AD- Asstt Director</i>
GMDA	CEO, Secretary, CE, TP, CAO, PE, AEE, AE, JE
<i>TP- Town Planner</i>	<i>CAO-Chief Accounts Officer</i> <i>PE-Project Engineer</i>
PHE	CE/ACE, SE, EE, AEE, AE, JE

7.0 DETAILED SCHEDULE OF THE SHORT COURSE

Table 2: Detailed Schedule

Duration: 2 days

Total contact period: 12 Hours

CONSTRUCTION SAFETY			
Day	Lecture	Topic	Learning Activities
Day 1	Lecture 1 9:00 am–10:30 am An Overview of Occupational Safety and Health (OSH) in Construction Industry	• Introduction • Basic safety rules on construction site • Workplace safety and its benefits • Personal safety and hygiene • Emergency response to accidents • OSHA • Workers' participation and training • Safety checklist • Implementation and updates	Reading list: Lecture Slides OSHA-Guidelines-2016 CS-1-1 CS-1-2 CS-1-3 CS-1-4
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 2 10.45 am–12 noon	<u>Common Sources of Hazards</u> • Fall from height • Ladders and stairways	Reading list: Lecture Slides



CONSTRUCTION SAFETY			
Day	Lecture	Topic	Learning Activities
	Recognition of Hazards in Construction Sites	• Cranes and forklifts • Floor and wall openings • Elevated surfaces • Hazards from chemicals • Excavations • Trench collapse • Scaffold collapse • Electrical and fire hazards • Failure to use personal protective equipment for head, eye, face, foot, and hand	OSHA-Guidelines-2016 OSHA-Pocket Guide CS-2-1 CS-2-2
	Lecture 3 12 noon–1.15 pm Identification and Assessment of Hazards	• Collection of existing information about job site hazards • Inspection of the job site for additional safety hazards (Use Checklist) • Identification of health hazards (Use Checklist) • Identification of hazards associated with emergency and nonroutine situations • Characterization of the nature of identified hazards • Prioritization of the hazards for control • Case Study	Reading list: Lecture Slides OSHA-Guidelines-2016 OSHA-Pocket Guide CS-3-1 CS-3-2 CS-3-3
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 4 2.15 pm–3.15 pm Prevention and Control of Hazards	• Identification of hazard control options • Selection of hazard control method ○ Elimination ○ Substitution ○ Engineering Controls ○ Administrative Controls ○ PPE (Personal Protective Equipment) • Develop and update a hazard control plan • Selection of hazard controls to protect workers during nonroutine tasks and emergencies • Implementation of the selected plan	Reading list: Lecture Slides OSHA-Guidelines-2016 OSHA-Pocket Guide CS-4-1 CS-4-2 CS-4-3



CONSTRUCTION SAFETY			
Day	Lecture	Topic	Learning Activities
		on the job site and follow up for effectiveness Case Study	
	Lecture 5 3.15 pm–4.15 pm Education and Training on OSH	<u>Job Specific Training and Periodic Retraining</u> - Safety and health program awareness training of managers, supervisors, workers, contractor, temporary agency workers - Training of employers, managers, and supervisors on their roles in the safety program - Training of workers on their specific roles in the safety and health program - Training of workers on hazard identification and controls	Reading list: Lecture Slides OSHA-Guidelines-2016 CS-5-1 CS-5-2 CS-5-3 CS-5-4
	Lecture 6 9:00 am–10:30 am OSH Program Evaluation and Improvement	- Establishing effective communication and coordination in all levels of hierarchy - Confirmation of OSH program implementation - Monitoring performance of OSH program - Correction of program shortcomings and identifying opportunities to improve	Reading list: Lecture Slides OSHA-Guidelines-2016 CS-6-1 CS-6-2 CS-6-3 CS-6-4 CS-6-5
	10.30 am – 10.45 am: Tea/Coffee break		
	Lecture 7 10.45 am–12 noon Workers' Right and Employer's Responsibility	- Workers' Rights under the OSH Act - Employer Responsibilities - Protections for temporary workers - Additional Whistleblower Program - Protection from retaliation - Filing a complain - OSHA worksite investigations	Reading list: Lecture Slides CS-7-1 CS-7-2 CS-7-3 CS-7-4 CS-7-5



CONSTRUCTION SAFETY			
Day	Lecture	Topic	Learning Activities
	Lecture 8 12 noon–1.15 pm Code of Practice for OSH in Different Countries	- Existing OSHA Standards - Voluntary OSHA Standards - Construction safety measures in developing and developed countries - National standard for OSH in India	Reading list: Lecture Slides CS-8-1 CS-8-2 CS-8-3 CS-8-4 CS-8-5 CS-8-6 CS-8-7 CS-8-8
	1.15 pm – 2.15 pm: Lunch break		
	Lecture 9 2.15 pm–3.15 pm Innovative & Automated Approaches	- Need for automated safety measures - Automated safety technologies - Building Information Modelling (BIM) - Additive Manufacturing - Virtual Reality (VR) - Internet of Things (IoT) - Robots - Software Engineering for Construction Safety - RAND Appropriateness Study	Reading list: Lecture Slides CS-9-1 CS-9-2 CS-9-3 CS-9-4 CS-9-5
	Lecture 10 3.15 pm–4.15 pm Safety Scenario in Indian Construction & Case Studies	- OSH scenario in India - Indian laws & regulations on OSH - Provision of OSH training - Support mechanisms - Industry-specific policies in OSH - Research in OSH - Case Study 1 - Case Study 2 - Case Study 3	Reading list: Lecture Slides CS-10-1 CS-10-2 CS-10-3 CS-10-4 CS-10-5 CS-10-6 CS-10-7



8.0 READING MATERIALS

Participants are expected to refer to literatures from various sources, which might include case studies, conferences papers, library collections, eBooks and e Journals. A reading list is provided in Table–3. However, this list is not an extensive one and may be updated and altered as and when necessary.

Books

- Rita Yi Man Li, Construction Safety Informatics, ISBN 978-981-13-5760-2 ISBN 978-981-13-5761-9 (eBook) <https://doi.org/10.1007/978-981-13-5761-9>, © Springer Nature Singapore Pte Ltd. 2019.
- Rita Yi Man Li, An Economic Analysis on Automated Construction Safety, Internet of Things, Artificial Intelligence and 3D Printing, ISBN 978-981-10-5770-0 ISBN 978-981-10-5771-7 (eBook) DOI 10.1007/978-981-10-5771-7, © Springer Nature Singapore Pte Ltd. 2018.
- www.elcosh.org/index.php for accessing electronic library for construction OSH

Table 3: Reading List

Lecture	Reading	Suggested Literature
Lecture 1 An Overview of Occupational Safety and Health (OSH) in Construction Industry	OSHA Guidelines- 2016- Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016, pp 2-14.
	CS-1-1	Safety Handbook for Construction Site Workers, Occupational Safety and Health Branch Labour Department, http://www.labour.gov.hk/eng/public/b69.htm
	CS-1-2	All About OSHA, Occupational Safety and Health Administration, US Department of Labour, www.osha.gov
	CS-1-3	INTRODUCTION TO OSHA, Slide-Share
	CS-1-4	<u>Construction Safety & Health Resources</u> Most resource materials can be found on the OSHA website: www.osha.gov , www.osha.gov/SHPGuidelines , https://www.osha.gov/shpguidelines/ Publications can be downloaded from: http://www.osha.gov/pls/publications/pubindex.list



Lecture	Reading	Suggested Literature
		For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazId
Lecture 2 Recognition of Hazards in Construction Sites	OSHA Guidelines- 2016- Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016
	OSHA Pocket Guide- Construction	Workers Safety Series: Construction, OSHA Pocket Guide, OSHA 3252-05N, www.osha.gov , 2005.
	CS-2-1	Rita Yi Man Li, Daniel Chi Wing, Beiqi Tang, Factors Which Affect Construction Safety in Different Types of Construction Work, © Springer International Publishing AG 2018 P. Arezes (ed.), Advances in Safety Management and Human Factors, Advances in Intelligent Systems and Computing 604, DOI 10.1007/978-3-319-60525-8-8
	CS-2-2	For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazId
Lecture 3 Identification and Assessment of Hazards	OSHA Guidelines- 2016- Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016, pp 15-19.
	OSHA Pocket Guide- Construction	Workers Safety Series: Construction, OSHA Pocket Guide, OSHA 3252-05N, www.osha.gov , 2005.
	CS-3-1	S. Ajith, C. Sivapragasam, V. Arumugaprabu, Quantification of risk and assessment of key safety factors for safe workplace in Indian building construction sites, Asian Journal of Civil Engineering, Springer Nature Switzerland AG, https://doi.org/10.1007/s42107-019-00136-y , 2019.
	CS-3-2	Selvam A, Krithika Priyadarshini, Safety Management and Hazards Control Measures in Construction, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, p-ISSN: 2320-334X. PP 97-101, www.iosrjournals.org
	CS-3-3	For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazId
Lecture 4 Prevention and Control	OSHA Guidelines- 2016- Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016, pp 20-23.



Lecture	Reading	Suggested Literature
of Hazards	OSHA Pocket Guide-Construction	Workers Safety Series: Construction, OSHA Pocket Guide, OSHA 3252-05N, www.osha.gov , 2005, pp 1-12.
	CS-4-1	R. Y. M. Li and S. W. Poon, Effectiveness of Safety Measures in Reducing Construction Accident Rates, Construction Safety, Risk Engineering, DOI: 10.1007/978-3-642-35046-74, Springer-Verlag Berlin Heidelberg 2013.
	CS-4-2	Construction Site Safety Handbook, Published by The Real Estate Developers Association of Hong Kong and The Hong Kong Construction Association, 2005.
	CS-4-3	For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazld
Lecture 5 Education and Training on OSH	OSHA Guidelines-2016-Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016, pp 24-26.
	CS-5-1	Training Requirements in OSHA Standards, OSHA 2254-09R 2015, Occupational Safety and Health Administration www.osha.gov .
	CS-5-2	Recommended Practices for Anti-Retaliation Programs, www.whistleblowers.gov (800) 321-OSHA (6742) OSHA 3905-01/2017.
	CS-5-3	Safety Plan Template for a Construction Company
	CS-5-4	https://www.osha.gov/dts/osta/oshasoft/ for eTools and the eMatrix are "stand-alone," interactive, Web-based training tools on occupational safety and health topics. They are highly illustrated and utilize graphical menus. For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazld
Lecture 6 OSH Program Evaluation and Improvement	OSHA Guidelines-2016-Construction	Recommended Practices for Safety & Health Programs in Construction, OSHA-Occupational Safety and Health Administration www.osha.gov , October 2016, pp 27-29.
	CS-6-1	All About OSHA, Occupational Safety and Health Administration, US Department of Labour, pp 14-18, www.osha.gov
	CS-6-2	Safety and health program self-evaluation tool format
	CS-6-3	Safety and health program audit tool format
	CS-6-4	Safety and health program implementation checklist



Lecture	Reading	Suggested Literature
	CS-6-5	https://www.osha.gov/shpguidelines/ For additional resources: https://www.osha.gov/shpguidelines/additional-resources.html#hazld
Lecture 7 Workers' Right and Employer's Responsibility	CS-7-1	Workers' Rights, Occupational Safety and Health Administration, US Department of Labour, OSHA 3021-06R 2017
	CS-7-2	All About OSHA, Occupational Safety and Health Administration, US Department of Labour, pp 9-10, www.osha.gov
	CS-7-3	Recommended Practices for Protecting Temporary Workers, 1-800-CDC-INFO (1-800-232-4636) www.cdc.gov/niosh , 1-800-321-OSHA (6742)
	CS-7-4	Recommended Practices for Anti-Retaliation Programs, www.whistleblowers.gov (800) 321-OSHA (6742) OSHA 3905-01/2017.
	CS-7-5	https://www.osha.gov/as/opa/worker/employer-responsibility.html for Employers responsibility https://www.osha.gov/workers/file_complaint.html for filing a complain https://www.shrm.org/resourcesandtools/legal-and-compliance/employment-law/pages/india-construction.aspx for workers rights in construction safety in India
Lecture 8 Code of Practice for OSH in Different Countries	CS-8-1	Recommended Practices for Safety and Health Programs Crosswalk to Existing OSHA Standards, U.S. Department of Labor, www.osha.gov , (800) 321-OSHA (6742)
	CS-8-2	Recommended Practices for Safety and Health Programs Voluntary Standards Crosswalk, U.S. Department of Labor, www.osha.gov , (800) 321-OSHA (6742)
	CS-8-3	R. Y. M. Li and S. W. Poon, Supply of Safety Measures in Developing and Developed Countries: A Global Perspective, Construction Safety, Risk Engineering, DOI: 10.1007/978-3-642-35046-7_3, Springer-Verlag Berlin Heidelberg 2013
	CS-8-4	Construction work Code of Practice, Safe Work Australia info@swa.gov.au www.swa.gov.au , ISBN 978-0-642-33361-2 (PDF)
	CS-8-5	Elements of OSH Framework in India, Slideshare
	CS-8-6	National Policy on Safety, Health and Environment at Work Place, Government of India Ministry of Labour and Employment
	CS-8-7	LIST OF IMPORTANT INDIAN STANDARDS ON SAFETY & HEALTH
	CS-8-8	https://www.ilo.org/safework/countries/lang--en/index.htm for Country profiles on occupational safety and health



Lecture	Reading	Suggested Literature
		https://www.slideshare.net/BimalChandraDas/isi-safety-code-pdf for construction safety codes in india https://archive.india.gov.in/business/legal_aspects/occupational.php for key regulations of OSH in India
Lecture 9 Innovative & Automated Approaches	CS-9-1	Rita Yi Man Li, An Economic Analysis on Automated Construction Safety, Internet of Things, Artificial Intelligence and 3D Printing, ISBN 978-981-10-5770-0 ISBN 978-981-10-5771-7 (eBook) DOI 10.1007/978-981-10-5771-7, © Springer Nature Singapore Pte Ltd. 2018.
	CS-9-2	Ali Karakhan, Yiye Xu, Chukwuma Nnaji, and Ola Alsaffar, Technology Alternatives for Workplace Safety Risk Mitigation in Construction: Exploratory Study, © Springer Nature Switzerland AG I. Mutis and T. Hartmann (eds.), Advances in Informatics and Computing in Civil and Construction Engineering, https://doi.org/10.1007/978-3-030-00220-6_99 , pp 823-829, 2019.
	CS-9-3	Hyeonwoo Seong, Hyojoo Son, Changwan Kim, A Comparative Study of Machine Learning Classification for Color-based Safety Vest Detection on Construction-Site Images, KSCE Journal of Civil Engineering, 22(11):4254-4262 Copyright ©2018 Korean Society of Civil Engineers DOI 10.1007/s12205-017-1730-3, 2018.
	CS-9-4	Quang Tuan Le-Akeem Pedro-Chan Sik Park, A Social Virtual Reality Based Construction Safety Education System for Experiential Learning, J Intell Robot Syst (2015) 79:487–506 DOI 10.1007/s10846-014-0112-z, Springer.
	CS-9-5	https://www.osha.gov/dts/osta/oshasoft/ for eTools and the eMatrix are "stand-alone," interactive, Web-based training tools on occupational safety and health topics. They are highly illustrated and utilize graphical menus.
Lecture 10 Safety Scenario in Indian Construction & Case Studies	CS-10-1	National Occupational Safety and Health (OSH) Profile, Prepared by: Directorate General Factory Advice Service and Labour Institutes in collaboration with International Labour Organization (ILO)
	CS-10-2	Shyam Pingle, Occupational Safety and Health in India: Now and the Future, Industrial Health, 50, pp 167-171, 2012.
	CS-10-3	Karan Singh, Safety in Indian Construction, International Journal of Engineering Research & Technology (IJERT), Vol. 3 Issue 11, pp 1564-1566, 2014
	CS-10-4	M.M.K. Sardana, Health and Safety at Workplaces in India, ISID Discussion Notes.
	CS-10-5	R. Y. M. Li and S. W. Poon, Case Studies on Safety Measures Implementation, Construction Safety, Risk Engineering, DOI:



Lecture	Reading	Suggested Literature
		10.1007/978-3-642-35046-7_6, Springer-Verlag Berlin Heidelberg, pp 65-80, 2013
	CS-10-6	Afzan Binti Ahmad Zaini, Intan Rohani Endut and Nurzawani Binti Md Sofwan, A Review in Developing a High Rise Building Construction Safety and Health Risk Model, Springer Science and Business Media Singapore, pp 253-262, 2015
	CS-10-7	Hafiz Zahoor, Albert P.C. Chan, Faisal Arain, Ran Gao, Wahyudi P. Utama, An Analytical Review of Occupational Safety Research in Pakistan Construction Industry, International Journal of Construction Project Management ISSN: 1944-1436 Volume 8, Number 2, Nova Science Publishers, pp 125-140, 2016.

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The study materials for the entire subject have been developed and will be available electronically.