



# Growing Capacity in Assam

Subject Design for new  
Master of Construction  
Management Course



Assam Engineering College  
Guwahati, Assam, India





*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 Construction  
Management course at AEC

## Visitors

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## Duration

24 April – 18 June 2017



## **Subject Schedule**

### Proposed course in Construction Management

### Assam Engineering College, Jalukbari

#### **Introduction**

As part of the recent research project in collaboration with the University of Melbourne, one of the key deliverables is the development of a new Construction Management course in Assam Engineering College. The course is required for providing relevant technical education to meet the growing demand in the construction industry across multiple sectors. The course will be of multidisciplinary nature. Students from any discipline upon completing the undergraduate degree can potentially develop the required technical knowledge in the construction management focusing on any areas of specialisation. Some of the areas of specialisation will be *Sustainability Management, Cost Management, Project Management, Building Construction & Technology* etc.

<b>Construction Management Course (AEC)</b>			
<i>Specilisation 1</i> <b>Sustainability Management</b>	<i>Specilisation 2</i> <b>Cost Management</b>	<i>Specilisation 3</i> <b>Project Management</b>	<i>Specilisation 4</i> <b>Building Construction &amp; Technology</b>
<i>Common Core Subjects</i>			
Introduction to sustainability	<b>Building Services and operations (SB)</b>	<b>Fundamentals of project management (PB)</b>	Building materials (BT)
<i>Specialisation Core Subjects</i>			
<b>Sustainable Solutions for Building (SB)</b>	Building regulations (JP)	Contract Management (JP)	Construction Law (BT)
Sustainable Materials and Performance	Construction Law	Project procurements (JP)	Building Technology (BT)
<b>Construction Waste Management (PB)</b>	<b>Construction Methods and Equipment (SB+PB)</b>	Project Monitoring and Control	<b>Construction Methods and Equipment</b>
Open Elective	Open Elective	Open Elective	Open Elective
<i>Elective Subjects</i>			
Laws and regulations for sustainability	Cost planning and budgeting	Project Finance and Economics	Building regulations
Environmental Risks and Impacts Assessments	Measurement and Estimation	Construction Planning	<b>Construction Methods and Equipment</b>
Social Sustainability Analysis	Cost monitoring and control	Project Risks management	TBA
Building regulations	Project procurements	TBA	TBA
Research Project	Research Project	Research Project	Research Project





MASTER OF CONSTRUCTION MANAGEMENT  
ASSAM ENGINEERING COLLEGE  
GUWAHATI-781013

## BUILDING SERVICES AND OPERATIONS

(SUBJECT GUIDE)

(Version-1.0)

Revised by - Mr Sasanka Borah



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## 1.0 INTRODUCTION

The essential role that building services and operations play in providing functional and comfortable, living and working areas to its users is covered in this subject. It also deals with the comfort and energy performance of buildings. Operations and the cost implications of service installations for construction projects. This subject guide helps the intended student and other readers to understand the basic objectives of this subject and how the students will be assessed during and after the completion of the course.

## 2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT

This subject will focus on the development of the related knowledge of building systems both in the Urban and Rural Perspective. The rural perspective will deal with the construction services state of practice in context of Assam. Another focus of this subject lies in the integration of services and energy efficient strategies into the fabric of the building and its construction process. After introductory material on environmental quality and energy related issues, the subject provides the students with knowledge in the field of electrical, mechanical, air handling, hydraulic and communication services and particularly the construction issues they generate: level of documentation and decision-making required; connections with process planning; spatial requirements for functioning, installation and access purposes; protection and quality assurance; building tolerances; systems integration; layout strategies; work sequences and temporary works; contract coordination; testing; maintenance; and upgrading replacement.

## 3.0 LEARNING OUTCOMES

This subject will develop the following program learning outcomes.

On successful completion, students should be able to:

- Introduce students to systems and types of electrical, mechanical and engineering services needed in buildings;



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

#### 4.0 GENERIC SKILLS

On completion of the subject students should have developed the following skills and capabilities:

- Ability to critically analyse systems needed for particular building for both in urban and rural areas in Assam;
- Ability to use correct technical terminology and ability to comprehend construction constraints and building operations.
- Ability to implement policies and practices to ensure management of facilities and provision of related services.
- Ability to understand and critically evaluate the various socio-economic problems related to building construction in the rural areas.



## 5.0 DETAILED SUBJECT SCHEDULE

**Total contact period:** 45 hours

**Duration of Lecture:** 1 Hour

**Duration of Tutorial:** 3 hours

**Table 1: Detailed subject schedule**

Week	Lecture	Topic	Learning Activities
1	<b>Lecture 1:</b>	Introduction to Building Services and Operations: <ul style="list-style-type: none"><li>• Introduction</li><li>• Main Building Types</li><li>• Building Services Design Team</li><li>• Building Services Project Life Cycle</li><li>• Basic background to building services engineering and operations</li><li>• Integration of building services and their operations.</li></ul>	<b>Reading list:</b> BSO-1-1 (Essential) BSO-1-2 (Optional) BSO-1-3 (Optional)
	<b>Lecture 2:</b>	Built Environment <ul style="list-style-type: none"><li>• Introduction</li><li>• Human Comfort</li><li>• Environmental measurements</li></ul>	<b>Reading list:</b> BSO-2-1 (Essential) BSO-2-2 (Optional) BSO-2-3 (Optional)
	<b>Tutorial 1:</b>	Worked Examples and Reflections (Lecture 1 & 2)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 1 & 2.
2	<b>Lecture 3:</b>	Energy Economics <ul style="list-style-type: none"><li>• Introduction</li><li>• Energy Audit</li><li>• Annual energy costs</li><li>• Accounting for energy-economizing insulation.</li></ul>	<b>Reading list:</b> BSO-3-1 (Essential) BSO-3-2 (Optional) BSO-3-3 (Optional)
	<b>Lecture 4:</b>	Heat Loss <ul style="list-style-type: none"><li>• Introduction</li><li>• Conduction &amp; infiltration</li><li>• Real world issues</li><li>• Heat loss through a slab or basement wall.</li><li>• Moderation of heat-loss.</li></ul>	<b>Reading list:</b> BSO-4-1 (Essential) BSO-4-2 (Optional) BSO-4-3 (Optional)



Week	Lecture	Topic	Learning Activities
	<b>Tutorial 2:</b>	Worked Examples and Reflections (Lecture 3 & 4)	Discussions / quiz etc. based on the contents of Essential Readings of Lecture 3 & 4.
3	<b>Lecture 5:</b>	Heating <ul style="list-style-type: none"><li>• Introduction</li><li>• Heat Demand</li><li>• Heating equipment</li><li>• Hot-water heating systems</li><li>• Combustion</li><li>• Building energy management systems</li><li>• Geothermal heating</li></ul>	<b>Reading list:</b> BSO-5-1 (Essential) BSO-5-2 (Optional) BSO-5-3 (Optional)
	<b>Lecture 6:</b>	Ventilation and Air Conditioning <ul style="list-style-type: none"><li>• Introduction</li><li>• Ventilation requirements</li><li>• Ventilation systems</li><li>• Air-conditioning systems</li><li>• Sick Building syndrome(SBS)</li><li>• Air Temperature Profile</li></ul>	<b>Reading list:</b> BSO-6-1 (Essential) BSO-6-2 (Optional) BSO-6-3 (Optional)
	<b>Tutorial 3:</b>	Worked Examples and Reflections (Lecture 5 & 6)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 5 & 6.
4	<b>Lecture 7:</b>	Hot and cold-water supplies <ul style="list-style-type: none"><li>• Introduction</li><li>• Water treatment</li><li>• Base exchange</li><li>• Demineralization</li><li>• Cold-water services</li><li>• Hot-water services</li><li>• Pipe sizing.</li></ul>	<b>Reading list:</b> BSO-7-1 (Essential) BSO-7-2 (Optional) BSO-7-3 (Optional)
	<b>Lecture 8:</b>	Soil and Waste system <ul style="list-style-type: none"><li>• Introduction</li><li>• Household waste generation</li><li>• Waste disposal systems</li><li>• Septic tanks</li><li>• House hold composting</li></ul>	<b>Reading list:</b> BSO-8-1 (Essential) BSO-8-2 (Optional) BSO-8-3 (Optional)
	<b>Tutorial 4:</b>	Worked Examples and Reflections (Lecture 7 & 8)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 7 & 8.
	<b>Assignment 1</b>	Building Services and Operation –Draft report due	



Week	Lecture	Topic	Learning Activities
5	<b>Lecture 9:</b>	Surface-water drainage <ul style="list-style-type: none"><li>• Introduction</li><li>• Roof drainage</li><li>• Kitchen, wash room</li><li>• Drain size</li></ul>	<b>Reading list:</b> BSO-9-1 (Essential) BSO-9-2 (Optional) BSO-9-3 (Optional)
	<b>Lecture 10:</b>	Below ground drainage <ul style="list-style-type: none"><li>• Introduction</li><li>• Roof drainage</li><li>• Kitchen, wash room</li><li>• Drain sizing.</li></ul>	<b>Reading list:</b> BSO-10-1 (Essential) BSO-10-2 (Optional)
	<b>Tutorial 5:</b>	Worked Examples and Reflections (Lecture 9 & 10)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 9 & 10.
6	<b>Lecture 11:</b>	Condensation in Buildings <ul style="list-style-type: none"><li>• Introduction</li><li>• Source of moisture</li><li>• Condensation and mould growth</li><li>• Vapour diffusion</li><li>• Temperature gradient</li><li>• Dew-point temperature gradient</li><li>• Installation note.</li></ul>	<b>Reading list:</b> BSO-11-1 (Essential) BSO-11-2 (Optional) BSO-11-3 (Optional)
	<b>Lecture 12:</b>	Lighting <ul style="list-style-type: none"><li>• Introduction</li><li>• Natural and artificial illumination</li><li>• Maintenance</li><li>• Utilization factor</li><li>• Lamp types</li><li>• Control of lighting services</li></ul>	<b>Reading list:</b> BSO-12-1 (Essential) BSO-12-2 (Optional) BSO-12-3 (Optional)
	<b>Tutorial 6:</b>	Worked Examples and Reflections (Lecture 11 & 12)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 11 & 12.
7	<b>Lecture 13:</b>	Gas <ul style="list-style-type: none"><li>• Introduction</li><li>• Gas size piping</li><li>• Gas service entry into a building</li><li>• Ignition and safety controls</li></ul>	<b>Reading list:</b> BSO-13-1 (Essential) BSO-13-2 (Optional)
	<b>Lecture 14:</b>	Electrical Installations <ul style="list-style-type: none"><li>• Introduction</li><li>• Electricity distribution</li></ul>	<b>Reading list:</b> BSO-14-1 (Essential) BSO-14-2 (Optional)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Circuit design</li><li>• Cable capacity and voltage drop</li><li>• Construction site distribution</li><li>• Construction site safety</li><li>• Safety cut-outs</li><li>• Electrical distribution within a building.</li><li>• Testing</li><li>• Telecommunication and network</li><li>• Lighting conductors.</li></ul>	BSO-14-3 (Optional)
	<b>Tutorial 7:</b>	Worked Examples and Reflections (Lecture 13 & 14)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 13 & 14.
	<b>Assignment 2</b>	Peer Review of draft report of Assignment 1(peer review report due)	
8	<b>Lecture 15:</b>	Room acoustics <ul style="list-style-type: none"><li>• Introduction</li><li>• Acoustic principles</li><li>• Sound power and pressure levels</li><li>• Sound pressure levels</li><li>• Absorption of sound</li><li>• Reverberation time</li><li>• Plant sound power level</li><li>• Transmission of sound</li><li>• Sound pressure level in plant room, outdoors, intermediate space, target room</li><li>• Noise rating.</li></ul>	<b>Reading list:</b> BSO-15-1 (Essential) BSO-15-2 (Optional) BSO-15-3 (Optional)
	<b>Lecture 16:</b>	Fire Protection <ul style="list-style-type: none"><li>• Introduction</li><li>• Fire classification</li><li>• Portable extinguishers</li><li>• Fixed fire-fighting installations</li><li>• Fire detectors and alarms</li></ul>	<b>Reading list:</b> BSO-16-1 (Essential) BSO-16-2 (Optional) BSO-16-3 (Optional)
	<b>Tutorial 8:</b>	Worked Examples and Reflections (Lecture 15 & 16)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 15 & 16.
9	<b>Lecture 17:</b>	Plant and Service areas <ul style="list-style-type: none"><li>• Introduction</li></ul>	<b>Reading list:</b> BSO-17-1 (Essential)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Main and services</li><li>• Plant room space requirements</li><li>• Computer Servers</li><li>• Lifts</li><li>• Pipe, duct and cable supports</li><li>• Plant connections</li><li>• Co-ordinated service drawings</li><li>• Boiler room ventilation</li></ul>	
	<b>Lecture 18:</b>	Mechanical Transportation <ul style="list-style-type: none"><li>• Introduction</li><li>• Transportation systems</li><li>• Lifts</li><li>• Paternoster</li><li>• Escalator</li><li>• Passenger conveyors</li><li>• Driving machinery</li></ul>	<b>Reading list:</b> BSO-18-1 (Essential) BSO-18-2 (Optional) BSO-18-3 (Optional)
	<b>Tutorial 9:</b>	Worked Examples and Reflections (Lecture 17 & 18)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 17 & 18.
	<b>Assignment 3</b>	Building Services and Operation Basics-Final Report due	
10	<b>Group Discussions</b>	Date and Topics TBA later	
	<b>Final Presentations</b>	Date and Topics TBA later	

## 6.0 PEDAGOGICAL APPROACH, ACTIVITES

The pedagogical approach is based on classroom lectures of up to 1 hour duration twice a week during the course. The lectures will involve a range of teaching topics, which will include theoretical background on basic building services and their operations. The teaching modes apart from classroom lectures will include group various activities such as, group tasks, site visits, preparation of case studies, evaluation of existing buildings/infrastructure in terms of their performance, and guest presentations from industry professionals on specific topics to provide both specialist knowledge and state of the practice to give an insight to real world issues. Seminars will be held every week so that each student can share their knowledge, ask questions and dive further in to the subject materials.



The timings of the scheduled activities will be provided at the beginning of the course, depending on the annual academic calendar of the college.

## 7.0 ASSESSMENT

Assessment in this subject has both formative and summative aspects to it. The students will have an opportunity to provide formative feedback to their peers and receive constructive feedback in return, as well as from the subject coordinator. This will give them the opportunity to develop and improve on particular skills throughout the course of the subject.

There are five assessment tasks in this subject. The assessment tasks (class participation, assignment 1 to 3 and final presentation) mimic the activities that a student is most likely to undertake in a real situation. This task will be used to demonstrate that the student have developed the skills needed to assess complex building services and operations related topics and possible solutions to improving their performance and communicate their findings in a professional context.

The students main tasks will be to map, assess and suggest improvements to a buildings (existing or to be constructed) services and operations and present their findings in a professional report and an oral presentation. A summary of the marking scheme is provided in Table 2. Specific requirements for each task are provided in section 7.1 and 7.2.

### 7.1 Class participation

The subject involves a range of activities and participation of the student is critical for achieving the learning outcome of the subject.

The assessment for this task will involve a number of in-class discussion and quizzes relating to content covered during tutorials.

The students will be assessed on their ability to

- Understand and interpret themes discussed during seminars
- Respond appropriately to questions.

### 7.2 Assignment

#### 7.2.1 Building Services and Operations Report (Draft)

As a part of an inspection team for a residential/commercial building of Guwahati Municipal Corporation (GMC) the student will be asked to undertake an analysis of the systems and services of a building in its present condition, which will include identification of ways to increase the performance of the building (if required) so that it provides best value to the residents.



The students should primarily focus on the various building services related topics such as electrical connections, mechanical devices, plant assemblies and integration of the services in the building under study. The student will propose ways to improve the existing amenities and how they will lead to increased values of the building in terms of performance.

The analysis of the current study as well as the recommendations with explanations will have to be submitted to the Chairman, GMC in the form of a report.

The exact structure of the report is up to the student, but the student should attempt to address the following areas:

- Map and analyse the existing building services and operations strategy in the present building
- Identify and critically assess the pros and cons of the existing building services with a comparison to the present state of practice.
- Suggest how to improve the performance of the building.
- Identify what integration of services etc might be required to sustain the performance of the building.
- Quantify potential improvements (quantitatively and qualitatively).
- Suggest (with explanations) and draft a new flowchart for the evaluation of the new buildings in the GMC administrative area.

### **About the GMC**

*Guwahati Municipal Corporation (GMC) is the urban local body responsible for governing, developing and managing Guwahati. It administers an area of 216.79 km<sup>2</sup> of Guwahati city. The entire GMC area is divided into 31 municipal wards and each municipal ward is further divided into 2, 3 or 4 Area Sabhas. Presently, there are 90 Area Sabhas. GMC works under Guwahati Development Department, Assam.*

*The GMC is the creation of the Guwahati Municipal Corporation Act 1971. The corporation was duly constituted in 1974 in the first meeting of the elected councillors as per provision of Sec.45 of this Act.*

*GMC administers through various branches/sections/cells located at its different offices situated mainly at various places of Guwahati city.*

***The municipal services provided by GMC are-***

- ***Property assessment/reassessment/mutation***
- ***Development and maintenance of roads/drains***
- ***Issue and renewal of trade license.***
- ***Development and maintenance of municipal markets.***



- ***Construction and maintenance of Public Toilets/e-Toilets***
- ***Building permission.***
- ***Development and allotment of parking slots.***
- ***Development and maintenance of parks and ponds.***
- ***Hoarding and advertisement.***
- ***Issue of Birth/Death certificates.***
- ***Installation and maintenance of Street Lights***
- ***Cesspool emptier***
- ***Construction and maintenance of crematorium.***
- ***Implementation of different central/state Government programmes schemes and projects.***
- ***Water supply with metered/non-metered connection. etc.***

### **Report format**

The report should be presented in A4 format with margins of 2.50m in each side and the pages numbered. The line spacing should be 1.50 cm. Both sides of the page should be utilized for printing.

Heading, tables, diagrams are to be used and appropriately numbered. An abstract or executive summary at the beginning of the report is to be included (which will include key findings and recommendations). There is no page limit as such for the report, but it should be approximately 5000 words in length (excluding tables, diagrams and references)

Use of references to existing research/literature in order to support the argument of the report is to be included and properly referenced. The Harvard referencing format (i.e. Author (year)) should be used to cite specific references and all the references should be referred to in a ‘References’ section at the end of the report.

As the student will be presenting the report and its major findings to the GMC (subject coordinator and invited panel members) during the last week of the semester, the report should be written in a style and format that reflects its intended purpose, considering that the report is being drafted by a member of GMC.

The students are advised to refer to online skill development courses provided by [www.coursera.org](https://www.coursera.org) to get a better idea of how to put their ideas to words. The following links may be useful for the students

<https://www.coursera.org/learn/business-writing>

<https://www.coursera.org/specializations/academic-english>



## Submission – Draft Report

The students are required to submit a draft of their report in week 4. The draft report should, as a minimum be structured and formatted as it is planned to present the final report. As a minimum the student should include a table of contents, maps of existing building evaluation techniques used by GMC and an indication of the potential areas for improvement and potential solutions.

**The Draft Report should not provide** any identifying details (name, enrolment number etc) that could be used to identify the student, as the peer review process will be anonymous.

Submit your draft report in print form with proper spiral bind.

### 7.2.2 Peer Review

Students are required to critically review one of their colleagues' draft Building Services an Operations Draft Reports and provide constructive feedback on how they might be improved. The review should be approximately between 500-1000 words. Primary focus should be on the strengths and weakness of the peer's draft report and how well they address the requirement of the task across the following criteria.

- Abstract / Executive summary
- Table of contents provided
- Ability to map the existing building services and operations procedure.
- Use of diagrams to effectively illustrate the problem at hand.
- Indication of potential areas for improvement in the building services and operations.
- Indication of potential areas for improvement in the building services and operations evaluation methodology used by GMC.
- Suggested solutions.
- Understanding the broad principles of building services and operations
- Presented in a concise, professional and well-structured manner.
- Integration of references to relevant literature.

The peer review should focus on making suggestions to help the peer further develop and improve their report.

### Peer review assessment criteria

The student will be assessed in his ability to:

- Demonstrate an understanding of the broad principles of building services and operations.
- Apply that understanding to the analysis and critique of the peer's draft report.



- Critically evaluate the work of peer's and provide constructive feedback.
- To use skill and sensitivity in providing formative (constructive) feedback to peers.

The peer feedback of a draft report of a student will be provided to the student after the completion of the process i.e. by Week 8.

### **7.2.3 Submission – Final Report**

The final report should be submitted in printed form after considering and incorporating the suggestions made in the peer review comments (if any).

Reports submitted after the due date will incur a 10 % penalty of the available marks in that section, unless prior application for special consideration has been submitted and approved.

#### **Final Report Assessment Criteria**

The student will be assessed on their ability to

- Identify and critically analyse the strengths and weakness in the domain of traditional building services and operations.
- Map the building services and operations system.
- Use diagrams to effectively illustrate building services and operations related data.
- Present an argument of the re-design of the traditional system.
- Present the report in concise, professional and well-structured manner.
- Respond to peer review.
- Integrate references to relevant literature.
- Provision of appropriate of literature in references.

### **7.2.4 Final Presentation**

The student will present the major findings from his/her final report to the panel members (co-ordinator and invited reviewers). The ideas that have been identified have to be presented.

#### **Format**

The presentation should be addressed to the panel members, as an employee of GMC. The student is welcome to present in an own format, but it has to be remembered that the format maximises the exposure to the content of the presentation.

Presentation : 15 minutes followed by Q&A : 5 minutes



## Assessment Criteria

The presentation will be assessed by the panel members on the way of presentation and communication skills and how well a student is able to convince the panel members that they should take a different approach to the evaluation to the overall practices followed by GMC.

The student will be assessed on his/her ability to:

- Describe the issues with GMC current practices.
- Describe the suggested changes to GMC.
- Convince the panel members of the need to change the practices and explain the rationale behind it.
- Communicate the findings of the evaluation of the present building.

**Presentation date:** Week 10.

Students are required to be available for the entire week. The time of presentation will be advised at a later date.

### 7.3 Marking Scheme

Table 2 provides the detailed marking scheme in this subject.

**Table 2: Summary of Assessment Tasks and Marking scheme**

<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to</b>	
				<b>obtain a minimum marks of</b>	<b>Out of</b>
Class participation	Participation in weekly activities and active involvement in class discussion	10	4	8	20
Assignment 1 (Building Services and Operation - Draft)	See Below	10	4	8	20
Assignment 2 (Peer Review)	Review of peer report (1000 words)	10	4	8	20



<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to obtain a minimum marks of</b>	
				<b>Out of</b>	<b>minimum marks of</b>
Assignment 3 (Building Services and Operation Basics-Final)	Professional report outlining as assessment of building services and operations and suggestions for improvement. (5000 words)	10	4	8	20
Final Presentation	Presentation of report findings and recommended improvements.	10	4	8	20
End semester exam	Theory based.	50	20	40	100
<b>Total</b>	--	<b>100</b>	<b>40</b>	<b>80</b>	<b>200</b>

The students will have to appear in an end semester examination (as per the guidelines of the University under which AEC is affiliated) which will be subjective in nature. A minimum mark of 40% (each assessment category) must be achieved in the examination in order to pass the subject. The assignments/ presentations can be re-submitted in a semester if a student fails to score the requisite pass marks. However, if a student fails to achieve 40 % marks in the theory exam he will be deemed to fail in the subject and will have to clear in the next attempt.

## **8.0 REQUIRED READING**

Students are expected to refer to various building operations and services related topics from various sources, which might include case studies, conferences papers, library collections, eBooks and eJournals. A list of essential and optional reading is provided in Table – 3, Clause 13.



## 9.0 REQUIRED TEXTS

Building Services Engineering by David V. Chadderton, Routledge

Building Services Handbook by Fred Hall & Roger Greeno, Elsevier Ltd.

How Buildings Work by Allen, Edward S., David, Oxford University Press, 2005.

## 10.0 ATTENDANCE POLICY

The attendance policy is as per the standard university guidelines (under which AEC is affiliated).

## 11.0 PLAGIARISM, COLLUSION AND CONSEQUENCES

Merriam-Webster's online dictionary explains that **Plagiarism** is the act of stealing and passing off (the ideas or words of another) as one's own; or using another's production without crediting the source; or to commit literary theft i.e. to present as new and original an idea or product derived from an existing source.

**Collusion** is the presentation by a student of an assignment as his or her own which is in fact the result in whole or part of unauthorised collaboration with another person or persons.

In any case where a student has been involved in plagiarism or collusion in an assessable assignment on task the marks awarded for that will be zero, and no substitution of an alternative task will normally be permitted.

## 12.0 Reading List

The reading list (as provided in Table 3) provides the literature that a student is expected to go through to understand the various state of practice in the field of Building Services and Operations. The literature marked 'ESSENTIAL' consists of a published literature which is a must read for the students, the literature marked 'OPTIONAL' suggests that the student has the option either, to go through or, not to go through the said published literature. However this list is not an extensive one and may be updated and altered as and when necessary. Students are encouraged to come up with suggested literature in this field for discussion in or off the class.



Table 3: Reading List

Reading	Reference	Suggested Literature
BSO-1-1		D J Croome (1990), Building Services Engineering-The invisible Architecture, Building Services Engineering Research and Technology, Vol 11 (1), page 27-31. <b>(ESSENTIAL)</b>
BSO-1-2	Lecture 1 (Introduction to Building Service and Operations)	Kari Alanne (2016) An overview of game-based learning in building services engineering education, European Journal of Engineering Education, 41:2, 204-219, <b>(OPTIONAL)</b>
BSO-1-3		Abdul Lateef Olanrewaju, Paul Junior Anahve (2015), Duties and responsibilities of quantity surveyors in the procurement of building services engineering, Procedia Engineering, Vol. 123, pp 352-360. Creative Construction Conference 2015(CC2015) <b>(OPTIONAL)</b>
BSO-2-1		Manuel Wolff, Annegret Haase, Dagmar Haase, Nadja Kabisch (2016), The impact of urban regrowth on the built environment, Urban Studies,. <b>(ESSENTIAL)</b>
BSO-2-2	Lecture 2 (Built Environment)	Joshua Abush (2000), Energy Environmental Performance and the Built Environment, Bulletin of Science, Technology & Society, Vol. 20, No. 5, October 2000, pp, 379-382 <b>(OPTIONAL)</b>
BSO-2-3		Ferdinand Lewis (2011), Towards a general model of built environment audits, Planning Theory 11(1),44-65, <b>(OPTIONAL)</b>
BSO-3-1		G J Levermore (1993) Building Energy Management Systems. Building Services Engineering Research and Technology, 14(4) B1-B18. <b>(ESSENTIAL)</b>
BSO-3-2	Lecture 3 (Energy Economics)	Simon Guy (2006), Designing urban knowledge: competing perspectives on energy and buildings, Environment and Planning C: Government and Policy 2006, Volume 24, pages 645-659 <b>(OPTIONAL)</b>
BSO-3-3		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. <b>(OPTIONAL)</b>
BSO-4-1	Lecture 4 (Heat Loss Calculations)	J B Sivior (1985), Areas in building heat loss calculations, Building Services Engineering Research & Technoogy, Vol 6(3), pp.134-136. <b>(ESSENTIAL)</b>
BSO-4-2		Hans Janssen, Jan Carmeliet and 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 <b>(OPTIONAL)</b>



Reading	Reference	Suggested Literature
BSO-4-3		J Uyttenbroeck Ir (1990) Building heat loss calculations: Choice of internal temperature and of heat exchange coefficient hi, Building Services Engineering Research and Technology, 11(2) pp 49-56. <b>(OPTIONAL)</b>
BSO-5-1		M Daviest, A Tindale&Dagger and J Littler & dagger (1995), Importance of multi-dimensional conductive heat flows in and around buildings, Building Services Engineering Research and Technology, 16(2) pp 83-90. <b>(ESSENTIAL)</b>
BSO-5-2	Lecture 5 (Heating)	James Parker, David Glew, Martin Fletcher,Felix Thomas and Christopher Gorse (2017), Accounting for refrigeration heat exchange in energy performance simulations of large food retail buildings, Building Services Engineering Research and Technology, VOI 38(3), pp. 253-268. <b>(OPTIONAL)</b>
BSO-5-3		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 Engineering Research and Technology, VOI 18(3), pp. 169-174. <b>(OPTIONAL)</b>
BSO-6-1		Ventilation and air pollution: Buildings located in urban and city centres Summary of a Building Research Establishment/CIBSE Natural Ventilation Group Seminar, Proceedings of CIBSE A: Building Services Engineering Research and Technology, VOI 18(4), B11-B18 (1997). <b>(ESSENTIAL)</b>
BSO-6-2	Lecture 6 (Ventilation and Air Conditioning)	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. <b>(OPTIONAL)</b>
BSO-6-3		Y Ji, M J Cook (2007), Numerical studies of displacement natural ventilation in multi-storey buildings connected to an atrium, Building Services Engineering Research and Technology, 28(3), pp. 207-222. <b>(OPTIONAL)</b>
BSO-7-1	Lecture 7 (Hot and Cold Water Supplies)	Articles on the state of the art developments in building services engineering-Water supply and drainage for buildings, Proceedings of CIBSE A: Building Services Engineering Research and Technology, VOI 20(3), B19-B25(1999). <b>(ESSENTIAL)</b>
BSO-7-2		P G Jones (1982), The Consumption of hot water in commercial buildings, Building Services Engineering Research and Technology, Vol. 3, No. 3 pp. 95-100. <b>(OPTIONAL)</b>



Reading	Reference	Suggested Literature
BSO-7-3		CL Cheng, JJ Peng, WJ Liao and CW Chang (2016) Relationship between building hot water usage and energy and carbon reduction, Building Services Engineering Research and Technology, 37(6), pp 682-693. <b>(OPTIONAL)</b>
BSO-8-1	Lecture 8 (Soil and Waste Systems)	Chooi Mei Mah, Takeshi Fujiwara and Chin Siong Ho (2016) Construction and demolition waste generation rates for high-rise buildings in Malaysia, Water management and Research, 36(12), pp 1224-1230, <b>(ESSENTIAL)</b>
BSO-8-2		Paola Villoria Sáez, Mercedes del Río Merino and César Porras-Amores, Estimation of construction and demolition waste volume generation in new residential buildings in Spain, Water management and Research, 30(2), pp 137-146, <b>(OPTIONAL)</b>
BSO-8-3		Jeong Tai Kim and Chuck WF Yu (2014), Hazardous materials in buildings, Indoor and Built Environment, 23(1), pp 44-61, <b>(OPTIONAL)</b>
BSO-9-1	Lecture 9 (Surface Water Drainage)	JA McDougall and JA Swaffield (2003), The influence of water conservation on drain sizing for building drainage systems, Building Service Engineering Research and Technology, 24(4), pp 229-243. <b>(ESSENTIAL)</b>
BSO-9-2		John A Swaffield, John A Mc Dougall and David P Campbell (1999), Drainage flow and solid transport simulation in defective building drainage networks, Proceedings of CIBSE A: Building Services Engineering Research and Technology, Vol 20(2), pp. 73-81. <b>(OPTIONAL)</b>
BSO-9-3		Articles on teh state of the art of developments in building services engineering, Water supply and drainage for buildings, Proceedings of CIBSE A: Building Services Engineering Research and Technology, Vol 20(3), B19-B25. <b>(OPTIONAL)</b>
BSO-10-1	Lecture 10 (Below Ground Drainage)	Shereen Ratnagar (2014), The drainage systems at Mohenjo-Daro and Nausharo: A technological breakthrough or a stinking disaster?, Studies in People's History, 1, 1, pp 1-6 <b>(ESSENTIAL)</b>
BSO-10-2		JA Swaffield, GBWright (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. <b>(OPTIONAL)</b>
BSO-11-1	Lecture 11 (Condensation in)	MC Phillipson, A McNaughtan (2007), Moisture measurement in building materials: an overview of current methods and new approaches, Building



Reading	Reference	Suggested Literature
	Buildings)	Services Engineering Research and Technology, 28(4), pp. 303-316. <b>(ESSENTIAL)</b>
BSO-11-2		EBH Stevens and M Fordham (1996), Interstitial condensation inbuilding structures: Dynamic model for predicting the amount of condensation, Building Services Engineering Research and Technology, 17(1), pp 47-54. <b>(OPTIONAL)</b>
BSO-11-3		RJ Oughton (1982), Building Services Engineering Research and Technology, Vol 3, No. 1, pp. 40-42 <b>(OPTIONAL)</b>
BSO-12-1	Lecture 12 (Lighting)	Peter R Boyce (2010), The Impact of Light in Building on Human Health, Indoor and Built Environment, 19(1), pp 8-20. <b>(ESSENTIAL)</b>
BSO-12-2		E. Neeman (1974), Visual aspects of sunlight in buildings, Lighting Research and Technology, Vol 6(3), pp. 159-164. <b>(OPTIONAL)</b>
BSO-12-3		BH Cross (1963), Artificial Lighting in Hospital Wards, Trans, Illum Eng. Soc. Vol. 28 (4), pp 155-173. <b>(OPTIONAL)</b>
BSO-13-1	Lecture 13 (Gas)	NR Junkison, DR Wills (1960), The Use of Modern Gas Equipment in Flats and Other Large Buildings, R.S.H. 5. <b>(ESSENTIAL)</b>
BSO-13-2		John Venn (2005), Rapid access to modern energy services using LP Gas, Energy Environment, Vol. 16(5), pp. 781-801. <b>(OPTIONAL)</b>
BSO-14-1	Lecture 14 (Electrical Installations)	SL Lyons (1972), Electric lighting for building sites and construction, Lighting Research and Technology, Vol. 4, No. 2, pp 67-79. <b>(ESSENTIAL)</b>
BSO-14-2		VHC Crisp (1978), The light switch in buildings, Lighting Research and Technology, Vol. 10(2), pp. 69-82. <b>(OPTIONAL)</b>
BSO-14-3		F Fouchal, TM 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. <b>(OPTIONAL)</b>
BSO-15-1	Lecture 15 (Room Acoustics)	Gabriel Pérez, Julià Comaa, Camila Barrenechea, Alvaro de Graciac, Miguel Urrestarazu, Silvia Burése, Luisa F. Cabezaa (2016), <i>Acoustic insulation capacity of Vertical Greenery Systems for buildings</i> , Applied Acoustics, Elsevier, Volume 110, September 2016, pages 218-226. <b>(ESSENTIAL)</b>
BSO-15-2		Peter W. Wessels, Tom G.H. Basten (2016), Design aspects of acoustic sensor networks for environmental noise monitoring, Applied Acoustics, Elsevier, Volume 110, September, 2016, pages 227-234. <b>(OPTIONAL)</b>



Reading	Reference	Suggested Literature
BSO-15-3		Cheuk Ming Mak, Zhen Wang (2015), Recent advances in building acoustics: An overview of prediction methods and their applications, Building and Environment, Elsevier, Volume 91, pages 118-126( <b>OPTIONAL</b> )
BSO-16-1		WKChow, LTWong(1998), fire safety codes for Hong Kong: Inadequacy for atrium design, Proceedings of CIBSE A: Building Services Engineering Research and Technology, 19(2), pp.93-99. ( <b>ESSENTIAL</b> )
BSO-16-2	Lecture 16 (Fire Protection)	CMMak, MMMashrae 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. ( <b>OPTIONAL</b> )
BSO-16-3		Juergen H Troitzsch (2016), Fires, statistics, ignition sources, and passive fire protection measures, Journal of Fire Sciences, Vol. 34(3), pp 171-198. ( <b>OPTIONAL</b> )
BSO-17-1	Lecture 17 (Plant and Services Area)	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 and Technology, Vol. 35(6), pp 634-652. ( <b>ESSENTIAL</b> )
BSO-18-1		Richard Peters (2011), The appraisal of lift passenger demand in modern office buildings, Building Services Engineering Research and Technology, 32(2), pp 159-170. ( <b>ESSENTIAL</b> )
BSO-18-2	Lecture 18 (Mechanical Transportation)	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 and Ergonomics society, 40 <sup>th</sup> Annual Meeting-1996, pp. 619-623( <b>OPTIONAL</b> )
BSO-18-3		Albert So, Wai L Chan, Steve KM Tsang (2017), On the total power factor of lift systems, Building Services Engineering Research and Technology, 0(0), pp-1-4, ( <b>OPTIONAL</b> )



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For any query please contact the subject coordinator over phone or email.

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





MASTER OF CONSTRUCTION MANAGEMENT  
ASSAM ENGINEERING COLLEGE  
GUWAHATI-781013

# FUNDAMENTALS OF PROJECT MANAGEMENT

(SUBJECT GUIDE)

(Version-1.0)  
Revised by – Dr. Pradip Baishya



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## 1.0 INTRODUCTION

The application of project management is found to be gaining importance in different fields and provides an organization with tools that enhances its ability to plan, organize and monitor resources for successful completion of project goals and objectives. This subject focuses on the basics of project management and highlights the key aspects of the subject.

## 2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT:

This subject provides a brief overview of the theory of project management by showing and reflecting on how the established set of project management competencies applies to all phases of building projects' life cycle. Through project simulations and structured discussion, students are made aware of the relationship between quantitative data and qualitative decisions in a framework of relative uncertainty, and how this relationship is likely to change depending on project type, technological context and building coalitions. At the end of the subject, students are required to go through a self-assessment process that helps them identify knowledge gaps and own development paths as well as the importance of peer interaction and reflective learning in team environments. In undertaking this subject students will understand the basic principles of project management and the different tools and techniques for implementation of project management. Topics covered 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 students will be equipped with IT enabled project planning, scheduling and monitoring.

## 3.0 LEARNING OUTCOME

To develop a thorough understanding of all key competency areas in Project Management and in socio-cultural management from a built environment perspective

The core objectives:

- Understanding of the range of knowledge areas in Project and Program Management;
- Understanding the processes of project management in each knowledge area;
- Understanding the tools and techniques required for each project management knowledge area;



- Understanding the relevancy and applicability of the project management body of knowledge with respect to the opportunities in the field.

#### 4.0 GENERIC SKILLS

On completion of the subject students should have developed the following skills and capabilities:

- An appreciation of the scope and dimensions of professional roles;
- The ability to function effectively as either a team leader or member within multi-disciplinary and multi-cultural teams;
- A commitment to, and fundamental appreciation of, the concept of successful teamwork and the ability to communicate effectively, clearly and concisely as a team leader or member of the group;
- An ability to communicate ideas, concepts and solutions to both technical and non-technical audiences effectively, clearly and concisely;
- An ability to carry out research and apply fundamental theoretical knowledge to problem solving in relevant disciplines.

#### 5.0 DETAILED SUBJECT SCHEDULE

**Total contact period : 44 hours**

**Duration of Lecture : 1 Hour**

**Duration of tutorial : 3 hours**

**Table 1: Detailed subject schedule**

Week	Lecture	Topic	Learning Activities
1	<b>Lecture 1:</b>	Subject introduction and requirements <ul style="list-style-type: none"><li>• Definition of a Project</li><li>• Need analysis of a project</li><li>• Applications &amp; objectives of a project</li><li>• Different tools &amp; techniques</li></ul>	<b>Reading list:</b> FPM-1-1(Essential)
	<b>Lecture 2:</b>	Project Management overview <ul style="list-style-type: none"><li>• What is Project Management</li><li>• Role of PM for achieving</li></ul>	<b>Reading list:</b> FPM-2-1(Essential)



Week	Lecture	Topic	Learning Activities
1		<p>project success</p> <ul style="list-style-type: none"><li>• Hierarchy of PM team in project management</li><li>• Client's perspective, Tenderer's perspective &amp; Builder's perspective in project management</li></ul>	
	Tutorial 1	<p>Introduction to MS Project</p> <ul style="list-style-type: none"><li>• Briefing about the software</li><li>• Setting up a project using the software</li><li>• Different fields of application of MS project</li></ul>	<p>Discussions/quiz etc. based on the contents of Essential Readings of Lecture 1 &amp; 2.</p> <p>Learning how to use software tools for Project Management</p>
	Lecture 3:	<p>Project life cycle</p> <ul style="list-style-type: none"><li>• Characteristics of Project life cycle</li><li>• Phases of project life cycle</li><li>• Brief description about the different phases project life cycle</li><li>• Project management processes</li></ul>	<p><b>Reading list:</b> FPM-3-1(Essential)</p>
2	Lecture 4:	<p>Expression of Interests (EOI) and tendering process</p> <ul style="list-style-type: none"><li>• Preparation of EOI reports</li><li>• Information to be furnished in a tender document</li><li>• Specification and detailed design for a quality tender document</li><li>• Case study discussion on tender document from the UK</li></ul>	<p><b>Reading list:</b> FPM-4-1(Essential)</p>
	Tutorial 2	<p>Hands on tutorial on MS Project</p> <ul style="list-style-type: none"><li>• Entering of activities, resources etc.</li></ul>	<p>Discussions / quiz etc. based on the contents of Essential Readings of Lecture 3 &amp; 4.</p>



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Setting up predecessor relationship, setting up calendar etc.</li><li>• Entering of time estimates, creation of WBS etc.</li><li>• Scheduling activities, creation of milestone</li></ul>	
3	Lecture 5:	Scope Planning & Management <ul style="list-style-type: none"><li>• Brief description about scope management</li><li>• Planning of Scope Management</li><li>• Collecting requirements from the stakeholder needs</li><li>• Defining scope and detailing of the project</li><li>• Creating Work Breakdown Structure</li><li>• Validation &amp; control of scope</li></ul>	<b>Reading list:</b> FPM-5-1(Essential)
	Lecture 6:	Time Planning & Management <ul style="list-style-type: none"><li>• Planning of schedule management: Inputs, Tools &amp; Techniques &amp; output</li><li>• Defining of activities: Inputs, Tools &amp; Techniques &amp; output</li><li>• Sequencing of activities: Inputs, Tools &amp; Techniques &amp; output</li><li>• Estimating activity resources: Inputs, Tools &amp; Techniques &amp; output</li><li>• Estimating activity durations: Inputs, Tools &amp;</li></ul>	<b>Reading list:</b> FPM-6-1(Essential)



Week	Lecture	Topic	Learning Activities
		<p>Techniques &amp; output</p> <ul style="list-style-type: none"><li>• Developing of schedule: Inputs, Tools &amp; Techniques &amp; output</li><li>• Controlling schedule: Inputs, Tools &amp; Techniques &amp; output</li></ul>	
	<b>Tutorial 3</b>	Worked Examples and Reflections (Lecture 5 & 6)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 5 & 6.
4	<b>Lecture 7:</b>	Resourcing, Direct Cost Estimate <ul style="list-style-type: none"><li>• Introduction to project cost management</li><li>• Planning of cost management</li><li>• Estimation of costs</li><li>• Direct cost estimating using an example of a farm management system</li></ul>	<b>Reading list:</b> FPM-7-1(Essential)
	<b>Lecture 8:</b>	Indirect Costs <ul style="list-style-type: none"><li>• Importance of indirect costing in a project</li><li>• How indirect cost differ from direct cost</li><li>• Defining Activity based costing (ABC) and its importance</li><li>• Implementation of ABC system for allocation of different project cost</li></ul>	<b>Reading list:</b> FPM-8-1(Essential)
	<b>Tutorial 4</b>	Worked Examples and Reflections (Lecture 7 & 8)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 7 & 8.
5	<b>Assignment 1</b>	Fundamentals of Project Management –Draft report due	
	<b>Lecture 9:</b>	Preliminaries and overheads <ul style="list-style-type: none"><li>• Perceptions regarding</li></ul>	<b>Reading list:</b> FPM-9-1(Essential)



Week	Lecture	Topic	Learning Activities
5		<p>project overheads: Contractor's perception</p> <ul style="list-style-type: none"><li>• Reasons for increasing project overhead cost trend</li><li>• Method of controlling and managing overheads</li><li>• Factors affecting the company overhead allocated cost</li></ul>	
	<b>Lecture 10:</b>	<p>Quality Planning &amp; Management</p> <ul style="list-style-type: none"><li>• Planning quality management in project</li><li>• Quality assurance: Tools &amp; techniques</li><li>• Existing measurement on quality performance</li><li>• Controlling quality in project management</li></ul>	<b>Reading list:</b> FPM-10-1(Essential)
	<b>Tutorial 5</b>	Worked Examples and Reflections (Lecture 9 & 10)	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 9 & 10.
6	<b>Lecture 11:</b>	<p>Procurement Management</p> <ul style="list-style-type: none"><li>• Planning of procurement management</li><li>• Conducting procurement for projects: Tools &amp; Techniques</li><li>• Controlling procurement in projects</li><li>• Closing of procurement in projects</li><li>• Discussion on infrastructure procurement by Australian state Governments</li></ul>	<b>Reading list:</b> FPM-11-1(Essential)



Week	Lecture	Topic	Learning Activities
	<b>Lecture 12:</b>	Risks & Contingencies Management <ul style="list-style-type: none"><li>• Identification of different types of risks in projects</li><li>• Performing qualitative &amp; quantitative risk analysis</li><li>• Planning of risk responses in projects</li><li>• Controlling risk and contingency in projects</li></ul>	<b>Reading list:</b> FPM-12-1(Essential)
	<b>Tutorial 6</b>	Individual Presentation on projects using software tools N.B: Details about the project criteria is mentioned below***	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 11 & 12.
7	<b>Lecture 13:</b>	Project Monitoring and Control <ul style="list-style-type: none"><li>• Inputs required for monitoring &amp; Control of projects</li><li>• Tools &amp; techniques used for monitoring &amp; control of projects</li><li>• Strategies adopted for monitoring and control of activities</li><li>• Effectiveness of internal control activities in a project</li></ul>	<b>Reading list:</b> FPM-13-1(Essential)
	<b>Lecture 14:</b>	Human Resources <ul style="list-style-type: none"><li>• Development of human resource plan</li><li>• Acquiring project management team</li><li>• Developing project management team</li><li>• Managing project management team</li></ul>	<b>Reading list:</b> FPM-14-1(Essential)
	<b>Tutorial 7</b>	Feedback session on project	Discussions/quiz etc.



Week	Lecture	Topic	Learning Activities
		presentations and improving of projects	based on the contents of Essential Readings of Lecture 13 & 14.
	<b>Assignment 2</b>	Peer Review of draft report of Assignment 1 (peer review report due)	
8	<b>Lecture 15:</b>	Integration Management <ul style="list-style-type: none"><li>• Developing of project charter</li><li>• Developing Project Management plan</li><li>• Managing project execution</li><li>• Performing integrated change control</li><li>• Closing of project</li></ul>	<b>Reading list:</b> FPM-15-1(Essential)
	<b>Lecture 16:</b>	Communication <ul style="list-style-type: none"><li>• Identification of stakeholders</li><li>• Distribution of information</li><li>• Managing stakeholder expectation</li><li>• Reporting performance of the project</li></ul>	<b>Reading list:</b> FPM-16-1(Essential)
	<b>Tutorial 8</b>	Exercise using role play of a project <ul style="list-style-type: none"><li>• Groups will be formed for different projects</li><li>• In each group it will consist of different members with different role in a project team</li><li>• Each member from each group will present their duties and responsibilities</li></ul>	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 15 & 16.
9	<b>Lecture 17:</b>	Project Management in Construction <ul style="list-style-type: none"><li>• Brief introduction to PM in</li></ul>	<b>Reading list:</b> FPM-17-1(Essential)



Week	Lecture	Topic	Learning Activities
		<p>Construction</p> <ul style="list-style-type: none"><li>• Success factor in construction projects: A case study from UK</li><li>• Issues of infrastructure projects in India</li><li>• Discussion on success cases of projects in India</li></ul>	
	Tutorial 9	Group Presentations on Projects learned from tutorial 7	Discussions/quiz etc. based on the contents of Essential Readings of Lecture 17 & 18.
	Assignment 3	Fundamentals of Project Management – Final Report due.	
10	Group Discussions	Date and Topics TBA later	
	Final Presentations	Date and Topics TBA later	

**N.B.: \*\*\*Tutorial 6:**

Preparation of project using MS Project

- Individual Project preparation incorporating the different features of the software MS Project
- Project topics can cover any field as per your interest
- Project should consist of a minimum of 20 activities
- Project should have a minimum of 10 resources which should consist of material and human resource
- Project should consider at least 3 resources showing fixed cost
- Project should contain at least 4 mile tones

## 6.0 PEDAGOGICAL APPROACH, ACTIVITIES

The pedagogical approach is based on classroom lectures of up to 1 hour duration twice a week during the course. The lectures will involve a range of teaching topics, which will include theoretical background on the basic project management components and tools. The teaching modes apart from classroom lectures will include tutorials on IT based application of project management, various group activities such as, group assignments, site visits, preparation of case studies, and guest presentations from professionals working on live projects to provide both specialist knowledge and the problems faced during management of projects in the real world. Seminars will be held every week so that each student can share their



knowledge, ask questions and dive further in to the subject materials. The timings of the scheduled activities will be provided at the beginning of the course, depending on the annual academic calendar of the college.

## 7.0 ASSESSMENT

Assessment in this subject has both formative and summative aspects to it. The students will have an opportunity to provide formative feedback to their peers and receive constructive feedback in return, as well as from the subject coordinator. This will give them the opportunity to develop and improve on particular skills throughout the course of the subject.

There are five assessment tasks in this subject. The assessment tasks (class participation, assignment 1 to 3 and final presentation) mimic the activities that a student is most likely to undertake in a real situation. This task will be used to demonstrate that the student have developed the skills needed to assess complex Project Management related topics and possible solutions to improving their performance and communicate their findings in a professional context.

The students' main tasks will be to develop a project taking all the components like tendering, scheduling, resource mapping etc. and present it as a professional project report and an oral presentation. A summary of the marking scheme is provided in Table 2. Specific requirements for each task are provided in section 7.1 and 7.2.

### 7.1 Class Participation

The subject involves a range of activities and participation of the student is critical for achieving the learning outcome of the subject.

The assessment for this task will involve a number of in-class discussion, quizzes relating to content and preparation of software based project.

The students will be assessed on their ability to

- Understand and interpret the different components of project management discussed during seminars
- Respond appropriately to questions

### 7.2 Assignment

#### 7.2.1 Fundamentals of Project Management report (draft)

##### Purpose

The purpose of this assignment is to evaluate the extent to which the skills of project management are applied in the appropriate manner for the appropriate task with the appropriate tool(s) in an effective and efficient manner. Improving the skills in the



application of project management software primarily Microsoft Project will also be developed.

## Assignment Details

In this assignment, students are required to consult with other group members and decide upon a project that they will plan and manage. The students have to come up with a project that they are familiar with or have experience in or think is interesting and appropriate. They may even source live projects happening in the nearby area.

Once the project is decided, the group needs to provide following five deliverables:

**Deliverable 1:** Business case, scope statement, inclusions and exclusions, constraints and assumptions.

**Deliverable 2:** Work Breakdown Structure, Activity definition, Effort and Cost Estimation, Resources requirements and allocations, risk assessments, duration and costs

**Deliverable 3:** Activity sequencing, Project Network Diagram, Critical Path, PERT analysis, demonstration of Tracking and monitoring processes (**using MS Project**)

**Deliverable 4:** Development of alternative project planning and schedule compression techniques and revised Project Network Diagram.

**Deliverable 5:** Adequate demonstration of tracking, reporting, monitoring and controlling and progress of activities over implementation phase of projects.

Details of these deliverables in group assignments are as follows:

**Deliverable 1: Business case, scope statement, inclusions and exclusions, constraints and assumptions**

### 1.1 Introduction

The introduction of the business case should also include:

- Identity of the client – that is, the organisation for whom the work is to be done
- Short description of the project – not more than 3 lines.
- Identity of the project authority – the person or persons with the organisation who will have authority over the project's direction.

### 1.2 Background

The background needs to include the following information:

- Relevant information about the organisation's recent history, mission and goals



- Descriptions of existing software and hardware environments
- Circumstances and problems leading to the currently proposed project work already carried out in the area of the proposed project
- Stakeholders in the projects

### **1.3 Business Objectives**

The business objectives must define what is to be achieved with this project and the method of measuring the extent of that achievement. The students should list and prioritize the objectives using a numbered list. The objectives should be written in such a way that, in principle, the client can assess the success or otherwise of the project by testing the achievement of these objectives.

### **1.4 Critical Assumptions and Constraints**

Identify and describe the critical constraints and assumptions of the project. These are conditions that the students expect or need to be in place in order for the project to succeed. These may include:

- externally imposed time scales
- legal requirements
- specific standards
- limitations of the people who can be approached for information

### **Deliverable 2: Work Breakdown Structure, Activity definition, Effort and Cost Estimation, Resources requirements and allocations, risk assessments, 3-point estimates of duration and costs**

Students have to prepare a suitable and professionally presented Work Breakdown Structure (WBS) for their project with at least 20 and at most 30 work packages using a Gantt Chart. One of the key reasons for a WBS is to communicate the breakdown of work into tasks. The students should think of how to achieve this in a professional, neat and presentable way. Too much or too little detail makes management of the project more difficult.

### **Deliverable 3: Activity sequencing, Project Network Diagram, Critical Path, PERT analysis, demonstration of Tracking and Monitoring processes (using MS Project)**

The students should obtain an estimate of the expected effort (in total labour hours) and associated costs for the project. They may use several estimation methods found in the textbook or discussed in the lectures. A clear statement about which method has been decided to use with a brief justification should be given.



Once the sequences of tasks (including predecessors and dependencies) in WBS using MS Project is made, allocation of resources and assigning costs for each task has to be done. A project network showing the critical path and milestones and a corresponding Gantt chart in the project has to be developed.

**Deliverable 4: Development of alternative project planning and schedule compression techniques, revised Project Network Diagram**

This deliverable is based on one or more scenarios (real or hypothetical) selected by the students as appropriate. Examples of scenarios include variation in schedule or cost or a combination of both.

- Adopting a constraint such as 20% reduction of overall project time, demonstrate the steps for achieving necessary schedule compression in the project
- revise the project plan based on the scenario given (e.g. 20% reduction of overall project time) and update the baseline plans
- provide a revised project schedule showing new critical path(s), and a revised time phased project budget based on the proposed solution(s).

**Deliverable 5: Adequate demonstration of tracking, reporting, monitoring and controlling and progress of activities over implementation phase of projects**

This deliverable is based on the new time schedule on the scenarios under considerations. Based on the revised project plan and the new critical path:

- Showing the processes of tracking the project on any assumed date.
- Assumptions relating to the task changes will need to be documented.
- Showing in details the processes of status reporting, monitoring, corrective actions and controlling of the project.

**Report format**

The report should be presented in A4 format with margins of 2.50m in each side and the pages numbered. The line spacing should be 1.50 cm. Both sides of the page should be utilized for printing.

Heading, tables, diagrams are to be used and appropriately numbered. An abstract or executive summary at the beginning of the report is to be included (which will include key findings and recommendations). A 100 word summary by each member reflecting on the individual contributions, overall understanding and development of planning and programming skills in the assignments.



There is no page limit as such for the report, but it should be approximately 5000 words in length (excluding tables, diagrams and references)

Use of references to existing research/literature in order to support the argument of the report is to be included and properly referenced. The Harvard referencing format (i.e. Author (year)) should be used to cite specific references and all the references should be referred to in a ‘References’ section at the end of the report. The students must use consistent and professional formatting styles. They need to have table of contents showing only the first two levels of headings. The appearance of the report must be professional, clean, and consistent from start to end.

The students are advised to refer to online skill development courses provided by [www.coursera.org](http://www.coursera.org) to get a better idea of how to put their ideas to words. The following links may be useful for the students

<https://www.coursera.org/learn/business-writing>

<https://www.coursera.org/specializations/academic-english>

### Submission – Draft Report

The students are required to submit a draft of their report in week 4. The draft report should, as a minimum be structured and formatted as it is planned to present the final report. As a minimum the student should include a table of contents, type of project selected, identification of client, short description of the project, relevant information about the organisation’s recent history, mission and goals, circumstances and problems leading to the currently proposed project work already carried out in the area of the proposed project and stakeholders in the projects.

**The Draft Report should not provide** any identifying details (name, enrolment number etc) that could be used to identify the student, as the peer review process will be anonymous.

Submit your draft report in print form with proper spiral bind.

#### 7.2.2 Peer Review

Students are required to critically review one of their colleagues’ draft Fundamentals of Project Management Draft Reports and provide constructive feedback on how they might be improved. The review should be approximately between 500-1000 words. Primary focus should be on the strengths and weakness of the peer’s draft report and how well they address the requirement of for developing a project.

The peer review should focus on making suggestions to help the peer further develop and improve their report.



### Peer review assessment criteria

The student will be assessed in his ability to:

- Demonstrate an understanding of the broad principles of Fundamentals of Project Managements.
- Apply that understanding to the analysis and critique of the peer's draft report.
- Critically evaluate the work of peer's and provide constructive feedback.
- To use skill and sensitivity in providing formative (constructive) feedback to peers.

The peer feedback of a draft report of a student will be provided to the student after the completion of the process i.e. by Week 8.

### 7.2.3 Submission-final report

The final report should be submitted in printed form after considering and incorporating the suggestions made in the peer review comments (if any).

Reports submitted after the due date will incur a 10 % penalty of the available marks in that section, unless prior application for special consideration has been submitted and approved.

### Final Report Assessment Criteria

The following key points should be noted in this assignment:

1. Use of appropriate scheduling tools primarily MS Project
  - a. Gantt Charts – showing clear WBS and realistic work packages with dependencies
  - b. Clearly shown
  - c. Network diagram
  - d. PERT analysis
  - e. Critical Path
  - f. Resource allocation, listing and levelling
2. Background estimations of time and cost
3. Professionalism
  - a. Correct and consistent usage of templates and styles in final report document
  - b. Gantt Charts clearly and neatly laid out
4. For WBS, ensure tasks are achievable and realistic – e.g. an item that requires 5,000 workers to clear a small construction site in the time and budget allowances is unrealistic.

### 7.2.4 Final Presentation



The student will present the major findings from his/her final report to the panel members (coordinator and invited reviewers). The ideas that have been identified have to be presented.

## Format

The presentation should be addressed to the panel members, as a project proposal for implementation. The student is welcome to present in an own format, but it has to be remembered that the format maximizes the exposure to the content of the presentation.

Presentation : 15 minutes followed by Q&A : 5 minutes

## Assessment Criteria

The presentation will be assessed by the panel members on the way of presentation and communication skills and how well a student is able to convince the panel members and taking care of the different components of the designed project.

**Presentation date:** Week 10.

Students are required to be available for the entire week. The time of presentation will be advised at a later date.

## 7.3 Marking Scheme

Table 2 provides the detailed marking scheme in this subject.

**Table 2: Summary of Assessment Tasks and Marking scheme**

<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to obtain a minimum marks of</b>	
				<b>Out of</b>	
Class participation	Participation in weekly activities and active involvement in class discussion	10	4	8	20



<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to obtain a minimum marks of</b>	
				<b>Out of</b>	
Assignment 1 (Fundamentals of Project Management - Draft)	See Below	10	4	8	20
Assignment 2 (Peer Review)	Review of peer report (1000 words)	10	4	8	20
Assignment 3 (Fundamentals of Project Management- Final)	Professional report outlining as assessment of Fundamentals of Project Managements and suggestions for improvement (5000 words)	10	4	8	20
Final Presentation	Presentation of report findings and recommended improvements	10	4	8	20
End semester exam	Theory based	50	20	40	100
<b>Total</b>	--	<b>100</b>	<b>40</b>	<b>80</b>	<b>200</b>

The students will have to appear in an end semester examination (as per the guidelines of the University under which AEC is affiliated) which will be subjective in nature. A minimum mark of 40% (each assessment category) must be achieved in the examination in order to pass the subject. The assignments/ presentations can be re-submitted in a semester if a student fails to score the requisite pass marks. However, if a student fails to achieve 40 % marks in the theory exam he will be deemed to fail in the subject and will have to clear in the next attempt.

## **8.0 REQUIRED READING**

Students are expected to refer to various building operations and services related topics from various sources, which might include case studies, conferences papers,



library collections, eBooks and eJournals. A list of essential and optional reading is provided in Table – 3, Section 13.

## 9.0 REQUIRED TEXTS

A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 4<sup>th</sup> edition.

## 10.0 ATTENDANCE POLICY

The attendance policy is as per the standard university guidelines (under which AEC is affiliated).

## 11.0 PLAGIARISM, COLLUSION AND CONSEQUENCES

Merriam-Webster's online dictionary explains that **Plagiarism** is the act of stealing and passing off (the ideas or words of another) as one's own; or using another's production without crediting the source; or to commit literary theft i.e. to present as new and original an idea or product derived from an existing source.

**Collusion** is the presentation by a student of an assignment as his or her own which is in fact the result in whole or part of unauthorised collaboration with another person or persons.

In any case where a student has been involved in plagiarism or collusion in an assessable assignment on task the marks awarded for that will be zero, and no substitution of an alternative task will normally be permitted.

## 12.0 READING LIST

The reading list (as provided in Table 3) provides the literature that a student is expected to go through to understand the various state of practice in the field of Fundamentals of Project Managements. The literature marked 'ESSENSTIAL' consists of a published literature which is a must read for the students. However this list is not an extensive one and may be updated and altered as and when necessary. Students are encouraged to come up with suggested literature in this field for discussion in or off the class.

Table 3: Reading List: Fundamentals of Project Management

Reading	Reference	Suggested Literature
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Reading	Reference	Suggested Literature
FPM-1-1	<b>Lecture 1 (Introduction to Project Management)</b>	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 4 <sup>th</sup> edition. Pg (5-13). (ESSENSTIAL)
FPM-2-1	<b>Lecture 2 (Project Management Overview)</b>	A K Munns and B F Bjeirmi (1996) The role of project management in achieving project success. <i>International Journal of Project Management</i> Vol. 14, No. 2, pp. 81-87, 1996. ) (ESSENSTIAL)
FPM-3-1	<b>Lecture 3 (Project Life Cycle)</b>	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 4 <sup>th</sup> edition. Pg (15-33). (ESSENSTIAL)
FPM-4-1	<b>Lecture 4 (Expression of interest (EOI) and tendering process)</b>	Samuel Laryea (2011) Quality of tender documents: case studies from the UK, <i>Construction Management and Economics</i> , 29:3, 275-286, (ESSENSTIAL)
FPM-5-1	<b>Lecture 5 (Scope Planning &amp; Management)</b>	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 4 <sup>th</sup> edition. Pg (103-128) (ESSENSTIAL)
FPM-6-1	<b>Lecture 6 (Time Planning &amp; Management)</b>	A guide to the Project Management Body of Knowledge (PMBOK Guide) published by Project Management Institute, 4 <sup>th</sup> edition. Pg (129-164). (ESSENSTIAL)
FPM-7-1	<b>Lecture 7 (Resourcing, Direct Cost Estimate)</b>	Giacomo Carla, Maurizio Canavari (2013) Introducing Direct Costing and Activity Based Costing in a Farm Management System: a conceptual model. <i>Procedia Technology</i> 8, 2013, (397 – 405) (ESSENSTIAL)
FPM-8-1	<b>Lecture 8 (Indirect Costs)</b>	Herbert Snyder, Elisabeth Davenport, (1997) "What does it really cost? Allocating indirect costs", <i>The Bottom Line</i> , Vol. 10 Issue: 4, pp.158-164,(ESSENSTIAL)
FPM-9-1	<b>Lecture 9 (Preliminaries and overheads)</b>	Adnan Enshassi, Abdul Rashid Abdul Aziz, Ala'a El Karriri, (2008) "Investigating the overhead costs in construction projects in Palestine", <i>Journal of Financial Management of Property and Construction</i> , Vol. 13 Issue: 1, pp.35-47,(ESSENSTIAL)



Reading	Reference	Suggested Literature
FPM-10-1	Lecture 10 (Quality Planning & Management)	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)
FPM-11-1	Lecture 11 (Procurement Management)	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)
FPM-12-1	Lecture 12 (Risks & Contingencies Management)	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)
FPM-13-1	Lecture 13 (Project Monitoring and Control)	Adebayo Agbejule, Annukka Jokipii, (2009) "Strategy, control activities, monitoring and effectiveness", Managerial Auditing Journal, Vol. 24 Issue: 6, pp.500-522, ) (ESSENSTIAL)
FPM-14-1	Lecture 14 (Human Resources)	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)
FPM-15-1	Lecture 15 (Integration Management)	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)
FPM-16-1	Lecture 16 (Communication)	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)
FPM-17-1	Lecture 17 (Project Management in Construction)	Terry Williams <i>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)



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For any query please don't hesitate to contact me over phone or email.

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





MASTER OF CONSTRUCTION MANAGEMENT  
ASSAM ENGINEERING COLLEGE  
GUWAHATI-781013

# CONSTRUCTION METHODS AND EQUIPMENT

(SUBJECT GUIDE)

(Version-1.0)

Revised by - Mr Sasanka Borah



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## 1.0 INTRODUCTION

This document is intended to serve as an information guide to students. It summarizes the objectives of the subject Construction Methods and Equipment and provides details of the lectures and other related information of the subject.

## 2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT

This subject is introduced with the underlying concept that construction of engineered facilities such as buildings, road etc requires the utilization of construction equipment judiciously. This subject provides an overview of the construction methods and equipment that is used in the construction industry. It will guide the students to apply the engineering fundamentals and analyses to the planning, selection and utilization of construction equipment as well as the construction methods.

## 3.0 LEARNING OUTCOMES AND CONCEPTS

This subject will develop the following program learning outcomes.

On successful completion, students should be able to:

- Identify the critical issues that should be addressed in utilizing a particular method as well as construction equipment in a particular construction project.
- Estimate the cost as well as the machine power requirements;
- Identify the issues affecting the construction equipment at a particular site;
- Undertake cost studies of different construction equipment by using cost analysis techniques.
- Learn how to apply engineering fundamentals and analyses to the planning, selection and utilization of construction equipment.
- The total construction process, from inspection of the idea through construction and start-up.
- How construction equipment should be selected and used to produce the intended quality in the most cost-effective manner.

This subject uses concepts from various engineering disciplines:



- Engineering Economics
- Geotechnical Engineering (Soil Mechanics)
- Mechanical Engineering (Construction Equipment)
- Structural Engineering
- Environmental Engineering

#### 4.0 GENERIC SKILLS

On completion of the subject students should have developed the following skills and capabilities:

- Ability to critically analyse the systems needed for selection of sustainable construction equipment keeping in view the various environmental, economic and other aspects in a building project.
- Appropriate use of design terminology.

#### 5.0 DETAILED SUBJECT SCHEDULE

**Total contact period : 55 hours**

**Duration of Lecture : 1 Hour**

**Duration of tutorial : 3 hours**

Week	Lecture	Topic	Learning Activities
1	<b>Lecture 1: (SB)</b>	Introduction to Construction Methods and Equipment <ul style="list-style-type: none"><li>• Introduction</li><li>• The construction industry</li><li>• The construction process</li><li>• Classification of construction equipments</li><li>• Need of construction equipment</li><li>• Factors behind the selection of construction equipment.</li></ul>	Reading list: CM&E-1-1 (Essential) CM&E-1-2 (Optional) CM&E-1-3 (Optional)
	<b>Lecture 2: (SB)</b>	Equipment Economics <ul style="list-style-type: none"><li>• Introduction</li><li>• Time value of Money</li></ul>	Reading list: CM&E-2-1 (Essential) CM&E-2-2 (Optional)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Evaluation of equipment costs by capital costs, operation costs and maintenance costs using the concepts of present value, annual value and future value concepts</li><li>• Equipment rental</li><li>• The rent-lease-buy decision</li></ul>	CM&E-2-3 (Optional)
	<b>Tutorial 1: (SB)</b>	Worked Examples and Reflections (Lecture 1 & 2) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 1 & 2.	
2	<b>Lecture 3: (SB)</b>	Earthwork Construction <ul style="list-style-type: none"><li>• Introduction</li><li>• Earthmoving materials</li><li>• Soil identification and Classification</li><li>• Soil Volume Change Characteristics</li><li>• Spoil Banks</li><li>• Estimating Earthwork Volume</li><li>• Planning of earthwork by use of Mass haul diagram</li><li>• Selection of equipment by haul directions.</li></ul>	Reading list: CM&E-3-1 (Essential) CM&E-3-2 (Optional)
	<b>Lecture 4: (PB)</b>	Machine Power Requirements <ul style="list-style-type: none"><li>• Introduction</li><li>• Site specific</li><li>• Client and project specific</li><li>• Machine power required at different field conditions like slope, pavement, etc.</li></ul>	Reading list: CM&E-4-1 (Essential) CM&E-4-2 (Optional) CM&E-4-3 (Optional)
	<b>Tutorial 2: (SB)</b>	Worked Examples and Reflections (Lecture 3 & 4) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 3 & 4.	
3	<b>Lecture 5: (PB)</b>	Dozers <ul style="list-style-type: none"><li>• Introduction</li></ul>	Reading list: CM&E-5-1 (Essential)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Overview of different types of dozers used in construction</li><li>• Calculation of productivity</li><li>• Cost of activity using dozers</li></ul>	CM&E-5-2 (Optional)
	<b>Lecture 6: (PB)</b>	Scrapers <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of scrapers used in construction.</li><li>• Calculation of productivity</li><li>• Cost of activity using scrapers</li></ul>	Reading list: CM&E-6-1 (Essential) CM&E-6-2 (Optional) CM&E-6-3 (Optional)
	<b>Tutorial 3: (PB)</b>	Worked Examples and Reflections (Lecture 5 & 6) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 5 & 6.	
4	<b>Lecture 7: (PB)</b>	Excavators <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of excavators used in construction</li><li>• Calculation of productivity</li><li>• Cost of activity using excavators</li></ul>	Reading list: CM&E-7-1 (Essential)
	<b>Lecture 8: (PB)</b>	Trucks and Hauling Equipment <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of trucks used in construction</li><li>• Calculation of productivity and cost of activity using trucks with other equipment,</li><li>• Calculation of optimum number of equipment and trucks in a hauling crew</li></ul>	Reading list: CM&E-8-1 (Essential) CM&E-8-2 (Optional) CM&E-8-3 (Optional)
	<b>Tutorial 4: (PB)</b>	Worked Examples and Reflections (Lecture 7 & 8) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 7 & 8.	



Week	Lecture	Topic	Learning Activities
	<b>Assignment 1</b>	Construction Methods and Equipment – Draft report due	
5	<b>Lecture 9: (SB)</b>	Graders <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of graders used in construction</li><li>• Calculation of productivity</li><li>• Cost of activity using graders</li></ul>	Reading list: CM&E-9-1 (Essential)
	<b>Lecture 10: (PB)</b>	Drilling <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different applications</li><li>• Types of drilling</li><li>• Calculation of productivity of drilling operations</li></ul>	Reading list: CM&E-10-1 (Essential) CM&E-10-2 (Optional)
	<b>Tutorial 5: (SB)</b>	Worked Examples and Reflections (Lecture 9 & 10) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 9 & 10.	
6	<b>Lecture 11: (SB)</b>	Tunnelling and Blasting Rock <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different applications and types of tunnelling</li><li>• Tunnel Boring Machines (TBM)</li><li>• Blasting requirements.</li><li>• Calculation of productivity of blasting operations</li><li>• Safety issues related to Blasting.</li></ul>	Reading list: CM&E-11-1 (Essential) CM&E-11-2 (Optional) CM&E-11-3 (Optional)
	<b>Lecture 12: (SB)</b>	Aggregate Production <ul style="list-style-type: none"><li>• Introduction</li><li>• Aggregate types and components</li><li>• Aggregate plants</li><li>• Overview of different components of aggregate</li></ul>	Reading list: CM&E-12-1 (Essential) CM&E-12-2 (Optional) CM&E-12-3 (Optional)



Week	Lecture	Topic	Learning Activities
		production plants	
	<b>Tutorial 6: (SB)</b>	Worked Examples and Reflections (Lecture 11 & 12) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 11 & 12.	
7	<b>Lecture 13: (SB)</b>	Compaction and Stabilization Equipment <ul style="list-style-type: none"><li>• Introduction</li><li>• Principles of compaction</li><li>• Importance of compaction and stabilization, equipment used for compaction,</li><li>• Calculation of productivity of rollers</li><li>• Optimum number of rollers for compaction operations</li></ul>	Reading list: CM&E-13-1(Essential) CM&E-13-2 (Optional) CM&E-13-3 (Optional)
	<b>Lecture 14: (PB)</b>	Cranes <ul style="list-style-type: none"><li>• Introduction</li><li>• Crane Types</li><li>• Overview of different types of cranes used in construction</li><li>• Calculation of productivity and cost of activity using cranes</li></ul>	Reading list: CM&E-14-1(Essential) CM&E-14-2 (Optional)
	<b>Tutorial 7: (SB)</b>	Worked Examples and Reflections (Lecture 13 & 14) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 13 & 14.	
	<b>Assignment 2:</b>	Peer Review of draft report of Assignment 1(peer review report due)	
	<b>Lecture 15: (SB)</b>	Excavation Safety: OSHA safety rules and methods of excavation wall protections	Reading list: CM&E-15-1(Essential) CM&E-15-2 (Optional)
8	<b>Lecture 16: (SB)</b>	Asphalt Mix Production and Placement <ul style="list-style-type: none"><li>• Introduction</li><li>• Different types of asphalt mix production plants and equipment.</li><li>• Requirements for placing</li></ul>	Reading list: CM&E-16-1(Essential) CM&E-16-2 (Optional)



Week	Lecture	Topic	Learning Activities
		asphalt concrete in road construction	
	<b>Tutorial 8: (SB)</b>	Worked Examples and Reflections (Lecture 15 & 16) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 15 & 16.	
9	<b>Lecture 17: (SB)</b>	Concrete and Concrete Equipment <ul style="list-style-type: none"><li>• Introduction</li><li>• Types of concreting equipment</li><li>• Different types of concrete mix designs and equipment for batching, mixing and placing concrete</li></ul>	Reading list: CM&E-17- 1(Essential) CM&E-17-2 (Optional) CM&E-17-3 (Optional)
	<b>Lecture 18: (SB)</b>	Piles and Pile-Driving Equipment <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of piles used in construction</li><li>• Methods of installation</li></ul>	Reading list: CM&E-18-1 (Essential) CM&E-18-2 (Optional) CM&E-18-3 (Optional)
	<b>Tutorial 9:</b>	Worked Examples and Reflections (Lecture 17 & 18) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 17 & 18.	
10	<b>Lecture 19: (PB)</b>	Air Compressors and Pumps <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of air compressors used to operate different tools and pumps</li><li>• Calculation of power requirements</li><li>• Selection of air compressor and pumps</li></ul>	Reading list: CM&E-19-1 (Essential)
	<b>Lecture 20: (SB)</b>	Forming Systems <ul style="list-style-type: none"><li>• Introduction</li><li>• Overview of different types of forming systems used in construction</li><li>• Calculation of formwork</li></ul>	Reading list: CM&E-20-1 (Essential) CM&E-20-2 (Optional) CM&E-20-3 (Optional)



Week	Lecture	Topic	Learning Activities
		requirements <ul style="list-style-type: none"><li>• Selection of formwork system</li><li>• Formwork economics.</li></ul>	
	<b>Tutorial 10: (PB)</b>	Worked Examples and Reflections (Lecture 19 & 20) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 19 & 20.	
11	<b>Lecture: 21 (SB)</b>	Building Construction <ul style="list-style-type: none"><li>• Introduction</li><li>• Preplanning building construction</li><li>• Nuisance control.</li><li>• Safety issues in building construction</li></ul>	Reading list: CM&E-21-1 (Essential) CM&E-21-2 (Optional) CM&E-21-3 (Optional)
	<b>Lecture: 22 (SB)</b>	Building Construction: continued <ul style="list-style-type: none"><li>• Foundations</li><li>• Wood Construction</li><li>• Concrete Construction</li><li>• Concrete form design</li><li>• Masonry Construction</li><li>• Steel construction</li></ul>	
	<b>Tutorial 11: (SB)</b>	Worked Examples and Reflections (Lecture 21 & 22) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 21 & 22.	
	<b>Assignment 3</b>	Construction Methods and Equipments-Final Report due	
12	<b>Group Discussions</b>	Date and Topics TBA later	
	<b>Final Presentations</b>	Date and Topics TBA later	

## 6.0 PEDAGOGICAL APPROACH, ACTIVITIES

The pedagogical approach is based on classroom lectures of up to 1 hour duration twice a week during the course. The lectures will involve a range of teaching topics, which will include theoretical background on basic building services and their operations. The teaching modes apart from classroom lectures will include group various activities such as, group tasks, site visits, preparation of case studies,



evaluation of construction equipments in terms of their performance, and guest presentations from industry professionals on specific topics to provide both specialist knowledge and state of the practice to give an insight to real world issues. Seminars will be held every week so that each student can share their knowledge, ask questions and dive further in to the subject materials.

The timings of the scheduled activities will be provided at the beginning of the course, depending on the annual academic calendar of the college.

## **7.0 ASSESSMENT**

Assessment in this subject has both formative and summative aspects to it. The students will have an opportunity to provide formative feedback to their peers and receive constructive feedback in return, as well as from the subject coordinator. This will give them the opportunity to develop and improve on particular skills throughout the course of the subject.

There are five assessment tasks in this subject. The assessment tasks (class participation, assignment 1 to 3 and final presentation) mimic the activities that a student is most likely to undertake in a real situation. This task will be used to demonstrate that the student have developed the skills needed to assess complex building services and operations related topics and possible solutions to improving their performance and communicate their findings in a professional context.

The students main tasks will be to map, assess and suggest improvements to a buildings (existing or to be constructed) services and operations and present their findings in a professional report and an oral presentation. A summary of the marking scheme is provided in Table 2. Specific requirements for each task are provided in section 7.1 and 7.2.

### **7.1 Class Participation**

The subject involves a range of activities and participation of the student is critical for achieving the learning outcome of the subject.



The assessment for this task will involve a number of in-class discussion and quizzes relating to content covered during tutorials.

The students will be assessed on their ability to

- Understand and interpret themes discussed during seminars
- Respond appropriately to questions.

## 7.2 Assignment

### 7.2.1 Construction Methods and Equipments report (draft)

As a part of an inspection team for a residential/commercial building of Guwahati Municipal Corporation (GMC) the student will be asked to undertake an analysis of the construction equipments used by GMC, which will include identification of ways to increase the performance of the equipments (if required) so that it provides best value in terms of cost, sustainability etc..

The students should primarily focus on the various construction equipments, their advantages and disadvantages under study. The student will propose ways to improve the existing amenities and how they will lead to increased values of the in terms of performance.

The analysis of the current study as well as the recommendations with explanations will have to be submitted to the Chairman, GMC in the form of a report.

The exact structure of the report is up to the student, but the student should attempt to address the following areas:

- Utility of various types of construction methods and equipments.
- Identify and critically assess the pros and cons of the various building construction equipments with a comparison to the present state of practice in Assam.
- Suggest how to improve the performance construction team using the modern construction equipments considering the large labour force available in India.
- Identify what balance etc might be required to sustain the performance of the construction team.
- Quantify potential improvements (quantitatively and qualitatively).
- Suggest (with explanations) and draft a new flowchart for the evaluation of the new equipments in a project that GMC might be involved in.



**Guwahati Municipal Corporation (GMC) is the urban local body responsible for governing, developing and managing Guwahati. It administers an area of 216.79 km<sup>2</sup> of Guwahati city. The entire GMC area is divided into 31 municipal wards and each municipal ward is further divided into 2, 3 or 4 Area Sabhas. Presently, there are 90 Area Sabhas. GMC works under Guwahati Development Department, Assam.**

**The GMC is the creation of the Guwahati Municipal Corporation Act 1971. The corporation was duly constituted in 1974 in the first meeting of the elected councillors as per provision of Sec.45 of this Act.**

**GMC administers through various branches/sections/cells located at its different offices situated mainly at various places of Guwahati city.**

**The municipal services provided by GMC are-**

- **Property assessment/reassessment/mutation**
- **Development and maintenance of roads/drains**
- **Issue and renewal of trade license.**
- **Development and maintenance of municipal markets.**
- **Construction and maintenance of Public Toilets/e-Toilets**
- **Building permission.**
- **Development and allotment of parking slots.**
- **Development and maintenance of parks and ponds.**
- **Hoarding and advertisement.**
- **Issue of Birth/Death certificates.**
- **Installation and maintenance of Street Lights**
- **Cesspool emptier**
- **Construction and maintenance of crematorium.**
- **Implementation of different central/state Government programmes schemes and projects.**
- **Water supply with metered/non-metered connection. etc.**

#### **Report format**

The report should be presented in A4 format with margins of 2.50m in each side and the pages numbered. The line spacing should be 1.50 cm. Both sides of the page should be utilized for printing.

Heading, tables, diagrams are to be used and appropriately numbered. An abstract or executive summary at the beginning of the report is to be included (which will



include key findings and recommendations). There is no page limit as such for the report, but it should be approximately 5000 words in length (excluding tables, diagrams and references)

Use of references to existing research/literature in order to support the argument of the report is to be included and properly referenced. The Harvard referencing format (i.e. Author (year)) should be used to cite specific references and all the references should be referred to in a ‘References’ section at the end of the report.

As the student will be presenting the report and its major findings to the GMC (subject coordinator and invited panel members) during the last week of the semester, the report should be written in a style and format that reflects its intended purpose, considering that the report is being drafted by a member of GMC.

The students are advised to refer to online skill development courses provided by [www.coursera.org](https://www.coursera.org) to get a better idea of how to put their ideas to words. The following links may be useful for the students

<https://www.coursera.org/learn/business-writing>

<https://www.coursera.org/specializations/academic-english>

### **Submission – Draft Report**

The students are required to submit a draft of their report in week 4. The draft report should, as a minimum be structured and formatted as it is planned to present the final report. As a minimum the student should include a table of contents, existing construction equipment and methods used by GMC and an indication of the potential areas for improvement and potential solutions.

**The Draft Report should not provide** any identifying details (name, enrolment number etc) that could be used to identify the student, as the peer review process will be anonymous.

Submit your draft report in print form with proper spiral bind.



## 7.2.2 Peer Review

Students are required to critically review one of their colleagues' draft Construction Methods and Equipment Draft Report and provide constructive feedback on how they might be improved. The review should be approximately between 500-1000 words. Primary focus should be on the strengths and weakness of the peer's draft report and how well they address the requirement of the task across the following criteria.

- Abstract / Executive summary
- Table of contents provided
- Ability to map the existing construction equipment scenario.
- Use of diagrams to effectively illustrate the problem at hand vis-a-vis the cost and labour scenario.
- Indication of potential areas for improvement in the management of the existing construction equipment.
- Suggested solutions.
- Understanding the broad principles of cost and productivity in managing modern construction equipment.
- Presented in a concise, professional and well-structured manner.
- Integration of references to relevant literature.

The peer review should focus on making suggestions to help the peer further develop and improve their report.

### Peer review assessment criteria

The student will be assessed in his ability to:

- Demonstrate an understanding of the broad principles of construction methods and equipments.
- Apply that understanding to the analysis and critique of the peer's draft report.
- Critically evaluate the work of peer's and provide constructive feedback.
- To use skill and sensitivity in providing formative (constructive) feedback to peers.



The peer feedback of a draft report of a student will be provided to the student after the completion of the process i.e. by Week 8.

### **7.2.3 Submission – Final Report**

The final report should be submitted in printed form after considering and incorporating the suggestions made in the peer review comments (if any).

Reports submitted after the due date will incur a 10 % penalty of the available marks in that section, unless prior application for special consideration has been submitted and approved.

### **Final Report Assessment Criteria**

The student will be assessed on their ability to

- Identify and critically analyse the strengths and weakness in the traditional men labour versus modern equipment in efficiency of construction projects delivery.
- Map the construction equipment requirements and related methods.
- Use flowcharts to effectively communicate the advantages and disadvantages of construction machinery.
- Present an argument of the re-design of the traditional system.
- Present the report in concise, professional and well-structured manner.
- Respond to peer review.
- Integrate references to relevant literature.
- Provision of appropriate of literature in references.

### **7.2.4 Final Presentations**

The student will present the major findings from his/her final report to the panel members (co-ordinator and invited reviewers). The ideas that have been identified have to be presented.



## Format

The presentation should be addressed to the panel members, as an employee of GMC. The student is welcome to present in an own format, but it has to be remembered that the format maximises the exposure to the content of the presentation.

Presentation : 15 minutes followed by Q&A : 5 minutes

## Assessment Criteria

The presentation will be assessed by the panel members on the way of presentation and communication skills and how well a student is able to convince the panel members that they should take a different approach to the evaluation to the overall practices followed by GMC.

The student will be assessed on his/her ability to:

- Describe the issues with GMC current practices.
- Describe the suggested changes to GMC.
- Convince the panel members of the need to change the practices and explain the rationale behind it.
- Communicate the findings of the evaluation of the present construction machinery situation in GMC.

**Presentation date:** Week 10.

Students are required to be available for the entire week. The time of presentation will be advised at a later date.



### 7.3 MARKING SCHEME

Table 2 provides the detailed marking scheme in this subject.

**Table 2: Summary of Assessment Tasks and Marking scheme**

Assessment category	Brief Discussion	Weight (%)	Pass (%)	To pass, a student has to	
				obtain a minimum marks of	Out of
Class participation	Participation in weekly activities and active involvement in class discussion	10	4	8	20
Assignment 1 (Construction Methods and Equipments - Draft)	See Below	10	4	8	20
Assignment 2 (Peer Review)	Review of peer report (1000 words)	10	4	8	20
Assignment 3 (Construction Methods and Equipments - Final)	Professional report outlining as assessment of Construction Methods and Equipments and suggestions for improvement. (5000 words)	10	4	8	20
Final Presentation	Presentation of report findings and recommended improvements.	10	4	8	20
End semester exam	Theory based.	50	20	40	100
<b>Total</b>	--	<b>100</b>	<b>40</b>	<b>80</b>	<b>200</b>



The students will have to appear in an end semester examination (as per the guidelines of the University under which AEC is affiliated) which will be subjective in nature. A minimum mark of 40% (each assessment category) must be achieved in the examination in order to pass the subject. The assignments/ presentations can be re-submitted in a semester if a student fails to score the requisite pass marks. However, if a student fails to achieve 40 % marks in the theory exam he will be deemed to fail in the subject and will have to clear in the next attempt.

## **8.0 REQUIRED READING**

Students are expected to refer to various building operations and services related topics from various sources, which might include case studies, conferences papers, library collections, e-Books and e journals.

## **9.0 REQUIRED TEXTS**

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

## **10.0 ATTENDANCE POLICY**

The attendance policy is as per the standard university guidelines (under which AEC is affiliated).

## **11.0 PLAGIARISM, COLLUSION AND CONSEQUENCES**

Merriam-Webster's online dictionary explains that **Plagiarism** is the act of stealing and passing off (the ideas or words of another) as one's own; or using another's production without crediting the source; or to commit literary theft i.e. to present as new and original an idea or product derived from an existing source.



**Collusion** is the presentation by a student of an assignment as his or her own which is in fact the result in whole or part of unauthorised collaboration with another person or persons.

In any case where a student has been involved in plagiarism or collusion in an assessable assignment on task the marks awarded for that will be zero, and no substitution of an alternative task will normally be permitted.

## 12.0 READING LIST

The reading list (as provided in Table 3) provides the literature that a student is expected to go through to understand the various state of practice in the field of Construction Methods and Equipments. The literature marked ‘ESSENSTIAL’ consists of a published literature which is a must read for the students, the literature marked ‘OPTIONAL’ suggests that the student has the option either, to go through or, not to go through the said published literature. However this list is not an extensive one and may be updated and altered as and when necessary. Students are encouraged to come up with suggested literature in this field for discussion in or off the class.

**Table 3: Reading List**

Reading	Reference	Suggested Literature
CM&E-1-1	Lecture 1 (Introduction)	Cliff Schexnayder and Stuart Anderson (2011), Construction Engineering Education: History and Challenge, Journal of Construction Engineering and Management, 137(10), 730-739, ASCE ( <b>ESSENTIAL</b> ).
CM&E-1-2		William R. Haycraft (2011), History of Construction Equipment, Journal of Construction Engineering and Management, 137(10), 720-723, ASCE. ( <b>ESSENTIAL</b> ).
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 ( <b>OPTIONAL</b> ).
CM&E-2-1	Lecture 2 (Equipment)	Govindan Kannan (2011), Field Studies in Construction Equipment, Economics and Productivity, Journal of



Reading	Reference	Suggested Literature
	<b>Economics)</b>	Construction Engineering and Management, 137(10), 823-828, ASCE ( <b>ESSENTIAL</b> ). 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 ( <b>OPTIONAL</b> ).
<b>CM&amp;E-2-2</b>		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 ( <b>OPTIONAL</b> ).
<b>CM&amp;E-2-3</b>		
<b>CM&amp;E-3-1</b>	<b>Lecture 3 (Earthwork Construction)</b>	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 ( <b>ESSENTIAL</b> ).
<b>CM&amp;E-3-2</b>		C. B. Tatum; Michael Vorster; Mac G. Klingler; and Boyd C. Paulson Jr. (2006) Systems Analysis of Technical Advancement in Earthmoving Equipment, Journal of Construction Engineering and Management, 132(9), 976-986,, ASCE ( <b>OPTIONAL</b> ).
<b>CM&amp;E-4-1</b>	<b>Lecture 4 (Machine Power Requirements)</b>	Chan C. M. R. & Harris F. C. (1989) A database/spreadsheet application for equipment selection, Construction Management and Economics, 7:3, 235-247, DOI:10.1080/01446198900000025 ( <b>ESSENTIAL</b> ).
<b>CM&amp;E-4-2</b>		Ali Touran & Khalid A. H. Taher (1988) Optimum fleet size determination by queuing and simulation, Construction Management and Economics, 6:4, 295-306, DOI: 10.1080/01446198800000025 ( <b>OPTIONAL</b> ).
<b>CM&amp;E-4-3</b>		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 ( <b>OPTIONAL</b> ).
<b>CM&amp;E-5-1</b>	<b>Lecture 5 (Dozers)</b>	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 ( <b>ESSENTIAL</b> ).
<b>CM&amp;E-5-2</b>		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, ( <b>OPTIONAL</b> ).



Reading	Reference	Suggested Literature
CM&E-6-1	Lecture 6 (Scrapers)	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 ( <b>ESSENTIAL</b> ).  Marina Marinelli and Sergios Lambropoulos (2013), Algorithmic Method for Scraper Load-Time Optimization, Journal of Construction Engineering and Management, 139 (5), pp. 459-465. DOI: 10.1061/(ASCE)CO.1943-7862.0000624., ASCE. ( <b>OPTIONAL</b> ).  John A. Kuprenas and Teresa Henkhaus(2000), SSSPE – A Tool for Scraper selection and production, Computing in Civil and Building Engineering, 980-987. ( <b>OPTIONAL</b> ).
CM&E-6-2		
CM&E-6-3		
CM&E-7-1	Lecture 7 (Excavators)	Bopanna T. KOlera and Leonhard E. Bernold (2006) Intelligent Utility Locating Tool for Excavators, Journal of Construction Engineering and Management, 132(9), pp. 919-927. ( <b>ESSENTIAL</b> ).
CM&E-8-1	Lecture 8 (Trucks and Hauling Equipment)	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. ( <b>ESSENTIAL</b> ).
CM&E-8-2		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 ( <b>OPTIONAL</b> ).
CM&E-8-3		Cliff Schexnayder, Sandra Weber and Brentwood T. Brooks (1999), Effect of Truck Payload Weight on Production, , 125(1): 1-7. ( <b>OPTIONAL</b> ).
CM&E-9-1	Lecture 9 (Graders)	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. ( <b>ESSENTIAL</b> ).
CM&E-10-1	Lecture 10 (Drilling)	Muhammad Adel and Tarek Zayed (), Productivity Analysis of Horizontal Directional Drilling, Pipelines 2009: Infrastructure's Hidden Assets, ASCE, pp. 835 – 843. ( <b>OPTIONAL</b> ).
CM&E-10-2		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 Mainenance – Doing More with less, ASCE, pp. 857-868 ( <b>OPTIONAL</b> ).



Reading	Reference	Suggested Literature
CM&E-11-1	Lecture 11 (Tunnelling and Blasting Rock)	Joseph Membah & Eric Asa (2015) Estimating cost for transportation tunnel projects: a systematic literature review, International Journal of Construction Management, 15:3, ( <b>ESSENTIAL</b> ). 196-218, DOI: 10.1080/15623599.2015.1067345
CM&E-11-2		Gerhard Girmscheid and Cliff Schexnayder(2002), Drill and Blast Tunnelling Practices, Practice Periodical On Structural Design And Construction, 2002, 7(3): 125-133 ( <b>OPTIONAL</b> ).
CM&E-11-3		Chen Dezhi and Xu Shunxiang (2009), Tunnel Blasting Adjacent fo Existing Tunnel and its safety Technology, International Conference on Transportation Engineering 2009 (ICTE 2009), pp. 3748 – 3753. ( <b>OPTIONAL</b> ).
CM&E-12-1	Lecture 12 (Aggregate Production)	Jonathan Jingsheng Shi (1999), Mathematical models for maximizing aggregate plant production, Journal of Construction Engineering and Management, 125(1), pp 53-60. ( <b>ESSENTIAL</b> ).
CM&E-12-2		Haifang Wen and Kun Zhang (2014), Simulation of Aggregates Heating in Asphalt Plants, Pavement Materials, Structures and Performance, GSP 239, ASCE, pp 19 – 28. ( <b>OPTIONAL</b> ).
CM&E-12-3		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. ( <b>OPTIONAL</b> ).
CM&E-13-1	Lecture 13 (Compaction and Stabilization Equipment)	V. Anjaneyappa1; 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) ( <b>ESSENTIAL</b> ).
CM&E-13-2		Mohamed M. Mekkawy, David J. White, Charles T. Jahren and Muhamnad T. Sulieman (2010), Performance Problems and Stabilization Techniques for Granular Shoulders, Journal of Performance of Constructed Facilities, 24(2), pp. 159-169. ( <b>OPTIONAL</b> ).
CM&E-13-3		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. ( <b>OPTIONAL</b> ).
CM&E-14-1	Lecture 14 (Cranes)	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. ( <b>ESSENTIAL</b> ).



Reading	Reference	Suggested Literature
CM&E-14-2		NORMAN-SPENCER – Type of Cranes. ( <b>ESSENTIAL</b> ).
CM&E-15-1	Lecture 15 (Excavation Safety)	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. ( <b>ESSENTIAL</b> ).
CM&E-15-2		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. ( <b>OPTIONAL</b> ).
CM&E-16-1	Lecture 16 (Asphalt Mix Production and Placement)	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 ( <b>ESSENTIAL</b> ).
CM&E-16-2		Asphalt Mixture Plant Operations.(available from <a href="http://www.in.gov/indot/files/chapter_03(5).pdf">www.in.gov/indot/files/chapter_03(5).pdf</a> ) ( <b>OPTIONAL</b> ).
CM&E-17-1	Lecture 17 (Concrete and Concrete Equipment)	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. ( <b>ESSENTIAL</b> ).
CM&E-17-2		TArek M. Zayed and Issam Minkarah (2004), Resource Allocation for Concrete Batch Plant Operation: Case Study, Journal of Construction Engineering and Management, 130(4), pp. 560-569. ( <b>OPTIONAL</b> ).
CM&E-17-3		Tarek M. Zayed, Daniel Halpin (2001), Simulation of Concrete Batch Plant Production, Journal of Construction Engineering and Management, 127(2), 132-141. ( <b>OPTIONAL</b> ).
CM&E-18-1	Lecture 18 (Piles and Pile-Driving Equipment)	Tarek Zayed and Daniel W. Halpin(2005) Pile Construction Productivity Assessment, Journal of Construction Engineering and Management, 131(6), pp. 705-714. ( <b>ESSENTIAL</b> ).
CM&E-18-2		Tarek Zayed and Daniel W. Halpin(2005), Productivity and Cost Regression Models for Pile Construction, Journal of Construction Engineering and Management, 131(7), pp. 779-789. ( <b>OPTIONAL</b> ).
CM&E-18-3		Garland Llkins, 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.



Reading	Reference	Suggested Literature
		<b>(OPTIONAL).</b>
<b>CM&amp;E-19-1</b>	<b>Lecture 19 (Air Compressors and Pumps)</b>	Robert J. Jenny (1983), Compressed Air Use in Soil Ground Tunnelling, <i>Journal of Construction Engineering and Management</i> , 109(2), 206-213. <b>(ESSENTIAL).</b>
<b>CM&amp;E-20-1</b>		Richard C Ringwald (1985), Formwork Design, <i>Journal of Construction Engineering and Management</i> , 111(4), pp. 391-403. <b>(ESSENTIAL).</b>
<b>CM&amp;E-20-2</b>	<b>Lecture 20 (Forming Systems)</b>	Li Zhang and Robert M. Leight (2015), Automated Rule-Based Constructability Checking: Case Study of Formwork, <i>Journal of Management in Engineering</i> , ASCE, 31(1), pp. A4014004(1-10), <b>(OPTIONAL).</b>
<b>CM&amp;E-20-3</b>		Tariq Abdelhamid, Mohamed El-Gafy and Panagiotis Mitropoulos (2009), Selection of Roof Casting Formwork Systems for the Bird Island Project: Case Study, <i>Practice Periodical on Structural Design and Construction</i> , ASCE, 14(4), pp. 224-241. <b>(OPTIONAL).</b>
<b>CM&amp;E-21-1</b>		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 <b>(ESSENTIAL).</b>
<b>CM&amp;E-21-2</b>	<b>Lecture 21 (Building Construction)</b>	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), <b>(OPTIONAL).</b>
<b>CM&amp;E-21-3</b>		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. <b>(OPTIONAL).</b>

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



MASTER OF CONSTRUCTION MANAGEMENT  
ASSAM ENGINEERING COLLEGE  
GUWAHATI-781013

## CONSTRUCTION WASTE MANAGEMENT

(SUBJECT GUIDE)

(Version-1.0)  
Revised by – Dr. Pradip Baishya



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## 1.0 INTRODUCTION

The field of waste management has been gaining importance due to the scarcity of landfill areas and people moving towards the concept of zero waste management in different parts of 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.

## 2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT

In this subject students will learn about the fundamentals of the solid waste stream with special focus on construction waste in modern as well as rural society. The regulatory aspects of construction waste in other parts of the world as well as in India will be discussed. Emphasis will be placed on the life cycle aspects of waste and the prospect of minimizing waste and maximizing the economic value of waste streams. The generation of different waste streams in construction industry will be considered. The subject is of particular relevance to students wishing to establish a career in construction management, but is also relevant to a range of engineering disciplines where waste management and design for the total life cycle of the product or infrastructure should be considered. 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.

## 3.0 LEARNING OUTCOMES

On completion of this subject the student is expected to:

- Describe the major environmental problems caused by inappropriate production and disposal of construction waste.
- Analyse the role of regulatory systems in solid wastes management and C & D 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.

#### 4.0 GENERIC SKILLS

On completion of the subject students should have developed the following skills and capabilities:

- Ability to undertake problem identification, formulation, and solution
- Understanding of social, cultural, global, and environmental responsibilities and the need to employ principles of sustainable development.
- Capacity for creativity and innovation.
- Understanding of professional and ethical responsibilities, and commitment to them.
- Capacity for lifelong learning and professional development.

#### 5.0 DETAILED SUBJECT SCHEDULE

**Total contact period : 45 hours**

**Duration of Lecture : 1 Hour**

**Duration of tutorial : 3 hours**

Week	Lecture	Topic	Learning Activities
1	<b>Lecture 1:</b>	Introduction to Waste Management <ul style="list-style-type: none"><li>• Introduction</li><li>• Different sources of waste generation</li><li>• Types of solid waste generated</li><li>• Principle of 4R</li></ul>	<b>Reading list:</b> CWM-1-1 (Essential) CWM-1-2 (Optional)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Disposal of solid waste</li></ul>	
	<b>Lecture 2:</b>	Resources and waste in construction sector <ul style="list-style-type: none"><li>• Construction waste as a resource</li><li>• Recycling and reuse of C &amp; D waste</li><li>• Deconstruction vs. demolition of waste</li></ul>	<b>Reading list:</b> CWM-2-1 (Essential) CWM-2-2 (Optional)
	<b>Tutorial 1</b>	Discussion on case study of waste management process practiced in Queen Victoria Market, Melbourne	
2	<b>Lecture 3:</b>	International regulations with respect to disposal of C & D waste <ul style="list-style-type: none"><li>• Construction &amp; demolition waste guide for Australia</li><li>• National waste policy in Australia</li><li>• Regulations for industry, Green Building Council of Australia</li><li>• Standard practice for C&amp;D recycling and re-use</li><li>• Industrial ecology</li></ul>	<b>Reading list:</b> CWM-3-1 (Essential) CWM-3-2 (Optional) CWM-3-3 (Optional)
	<b>Lecture 4:</b>	CPHEEO guidelines for solid waste management in India <ul style="list-style-type: none"><li>• Functional elements of Municipal Solid Waste management</li><li>• Waste generation, waste handling, sorting, storage &amp; processing at source</li><li>• Collection, segregation, processing and transformation of solid waste</li><li>• Transfer &amp; transport and disposal</li></ul>	<b>Reading list:</b> CWM-4-1 (Essential) CWM-4-2 (Optional)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>Environmental impact of solid waste disposal</li></ul>	
	<b>Tutorial 2</b>	Worked Examples and Reflections (Lecture 3 & 4) Discussions / quiz etc. based on the contents of Essential Readings of Lecture 3 & 4.	
3	<b>Lecture 5:</b>	Solid Waste Management (SWM) rules for disposal of C & D waste in India <ul style="list-style-type: none"><li>Swachh Bharat Mission (SBM) Urban guidelines 2016</li><li>Swachh Bharat Mission (SBM) Rural guidelines 2016</li><li>Regulatory framework of waste management in India</li><li>C&amp;D waste recycling &amp; treatment centres</li></ul>	<b>Reading list:</b> CWM-5-1 (Essential) CWM-5-2 (Optional) CWM-5-3 (Optional)
	<b>Lecture 6:</b>	Life cycle assessment of construction waste <ul style="list-style-type: none"><li>Introduction to Life cycle assessment of construction waste and its importance</li><li>Use of C&amp;D waste for road construction instead of virgin materials</li><li>Impact assessment and emission modelling</li><li>Carbonation of concrete waste</li><li>Land filling of C&amp;D waste</li></ul>	<b>Reading list:</b> CWM-6-1 (Essential) CWM-6-2 (Optional)
	<b>Tutorial 3</b>	Worked Examples and Reflections (Lecture 5 & 6) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 5 & 6.	
4	<b>Lecture 7:</b>	Economics of construction waste <ul style="list-style-type: none"><li>Introduction to economic viability of C&amp;D waste</li></ul>	<b>Reading list:</b> CWM-7-1 (Essential) CWM-7-2 (Optional)



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Types of materials recovered during construction projects and their percentage</li><li>• Revenue generated from the different fractions of C&amp;D waste</li></ul>	
	<b>Lecture 8:</b>	Managing municipal waste- An economic perspective <ul style="list-style-type: none"><li>• Introduction to different municipal waste streams</li><li>• Waste segregation &amp; treatment for municipal waste fractions by the stakeholder</li><li>• Economic factors for lack of proper waste management</li><li>• Deriving different percentages of recovered waste for processing</li></ul>	<b>Reading list:</b> CWM-8-1 (Essential)
	<b>Tutorial 4</b>	Worked Examples and Reflections (Lecture 7 & 8) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 7 & 8.	
	<b>Assignment 1</b>	Construction Waste Management-Draft Report Due	
5	<b>Lecture 9:</b>	Environmental impacts of construction waste <ul style="list-style-type: none"><li>• Brief introduction to US EPA guidelines for C&amp;D waste</li><li>• Leaching behaviour of demolition waste</li><li>• Prevention of environmental degradation due to hazardous and toxic waste materials and liquid waste in construction</li></ul>	<b>Reading list:</b> CWM-9-1 (Essential) CWM-9-2 (Optional)
	<b>Lecture 10:</b>	Health & Safety issues in	<b>Reading list:</b>



Week	Lecture	Topic	Learning Activities
		handling construction waste <ul style="list-style-type: none"><li>• Occupational risk of the informal sector in handling of waste</li><li>• Occupational health &amp; safety guidelines for handling of waste</li><li>• Duties of employer in deploying waste handling personal</li><li>• Handling of special waste like asbestos waste</li></ul>	CWM-10-1 (Essential) CWM-10-2 (Optional)
	<b>Tutorial 5</b>	Worked Examples and Reflections (Lecture 9 & 10) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 9 & 10.	
6	<b>Lecture 11:</b>	Types of waste generated in Construction industry <ul style="list-style-type: none"><li>• Introduction to the different types of construction waste generated during construction</li><li>• Quantifying C&amp;D waste generated in construction</li><li>• Quantification method used for quantifying of waste</li><li>• Comparison of the current methodologies of waste quantification</li></ul>	<b>Reading list:</b> CWM-11-1 (Essential)
	<b>Lecture 12:</b>	Segregation methodology of construction waste (on site & off site) <ul style="list-style-type: none"><li>• Planning for segregation of construction waste</li><li>• Waste management during pre-construction phase</li><li>• Special plan for handling of asbestos waste</li><li>• Waste management during</li></ul>	<b>Reading list:</b> CWM-12-1 (Essential)



Week	Lecture	Topic	Learning Activities
		<p>construction phase</p> <ul style="list-style-type: none"><li>• Waste management during post-construction phase</li></ul>	
	<b>Tutorial 6</b>	Field trip to Waste management site at Boragaon Landfill site, Guwahati, Assam under Guwahati Municipal Corporation (GMC)	
7	<b>Lecture 13:</b>	Techniques of recycling of construction waste abroad <ul style="list-style-type: none"><li>• Essence of recycling of C&amp;D waste</li><li>• Process of recycling<ul style="list-style-type: none"><li>- Sharing experiences from C&amp;D waste recyclers in Australia</li><li>- Preparation of recycled aggregate (RA) for construction from demolition waste</li></ul></li><li>• Properties of recycled aggregate (RA)</li><li>• Scope of using such techniques in India</li></ul>	<b>Reading list:</b> CWM-13-1 (Essential)
	<b>Lecture 14:</b>	Techniques of recycling of construction waste in India <ul style="list-style-type: none"><li>• Current uses of construction waste</li><li>• Practice of recycling followed in landfill sites</li><li>• Discussion on a case study on the first plant started in Delhi for recycling of construction waste</li></ul>	<b>Reading list:</b> CWM-14-1 (Essential)
	<b>Tutorial 7</b>	Worked Examples and Reflections (Lecture 13 & 14) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 13 & 14.	
8	<b>Lecture 15:</b>	Prefabrication as an alternative for reducing C&D waste <ul style="list-style-type: none"><li>• Introduction to</li></ul>	<b>Reading list:</b> CWM-15-1 (Essential)



Week	Lecture	Topic	Learning Activities
		Prefabrication <ul style="list-style-type: none"><li>• Factors in minimizing construction waste by using prefabrication</li><li>• Comparing waste levels between on-site production and prefabrication</li></ul>	
	<b>Lecture 16:</b>	Construction & Demotion waste recycling equipments <ul style="list-style-type: none"><li>• Introduction</li><li>• Types of contaminants in C&amp;D waste</li><li>• Type of equipments for recycling of C&amp;D waste</li><li>• Processing phases based on the type of waste</li></ul>	<b>Reading list:</b> CWM-16-1 (Essential)
	<b>Tutorial 8</b>	Worked Examples and Reflections (Lecture 15 & 16) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 15 & 16.	
9	<b>Lecture 17:</b>	Managing concrete waste and other type of wastes <ul style="list-style-type: none"><li>• Introduction to types of waste that can be used for blending with concrete waste</li><li>• Method of Blending of waste concrete with waste glass</li><li>• Brief introduction to utilization of concrete slurry waste</li><li>• Benefits and necessity of recycling concrete slurry waste</li></ul>	<b>Reading list:</b> CWM-17-1 (Essential) CMW-17-2 (Optional)
	<b>Lecture 18:</b>	Good practices in construction waste management <ul style="list-style-type: none"><li>• Introduction to integrated waste management</li></ul>	<b>Reading list:</b> CWM-18-1 (Essential)



Week	Lecture	Topic	Learning Activities
		<p>concepts</p> <ul style="list-style-type: none"><li>• Methodology for best practices</li><li>• Estimated cost of waste management</li><li>• Preparation of Demolition plan</li><li>• Briefing on Waste audit</li></ul>	
	<b>Tutorial 9</b>	Worked Examples and Reflections (Lecture 17 & 18) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 17 & 18.	
	<b>Assignment 3</b>	Construction Waste Management-Final Report due	
10	<b>Group Discussions</b>	Date and Topics TBA later	
	<b>Final Presentations</b>	Date and Topics TBA later	

## 6.0 PEDAGOGICAL APPROACH, ACTIVITIES

The pedagogical approach is based on classroom lectures of up to 1 hour duration twice a week during the course. The lectures will involve a range of teaching topics, which will include theoretical background on solid waste management with a primary focus on construction waste management. The teaching modes apart from classroom lectures will include various group activities such as, group tasks, site visits, preparation of case studies, evaluation of existing waste management system in the locality and guest presentations from industry professionals on specific topics to provide both specialist knowledge and state of the practice to give an insight to real world issues faced due to improper waste management. Seminars will be held every week so that each student can share their knowledge, ask questions and dive further in to the subject materials.

The timings of the scheduled activities will be provided at the beginning of the course, depending on the annual academic calendar of the college.



## 7.0 ASSESSMENT

Assessment in this subject has both formative and summative aspects to it. The students will have an opportunity to provide formative feedback to their peers and receive constructive feedback in return, as well as from the subject coordinator. This will give them the opportunity to develop and improve on particular skills throughout the course of the subject.

There are five assessment tasks in this subject. The assessment tasks (class participation, assignment 1 to 3 and final presentation) mimic the activities that a student is most likely to undertake in a real situation. This task will be used to demonstrate that the student have developed the skills needed to develop waste management systems and suggest possible solutions to improving the waste management scenario and communicate their findings in a professional context.

The students' main tasks will be to map, assess and suggest improvements to a construction waste management plan and present their findings in a professional report and an oral presentation. A summary of the marking scheme is provided in Table 2. Specific requirements for each task are provided in section 7.1 and 7.2.

### 7.1 Class Participation

The subject involves a range of activities and participation of the student is critical for achieving the learning outcome of the subject.

The assessment for this task will involve a number of in-class discussion and quizzes relating to content covered during tutorials.

The students will be assessed on their ability to

- Understand and interpret themes discussed during seminars
- Respond appropriately to questions.



## 7.2 Assignment

### 7.2.1 Construction Waste Management Report (Draft)

The students will be asked to undertake an analysis of the present system of waste management under the Guwahati Municipal Corporation (GMC). They will also see the compliance of GMC under the Guidelines of Waste Management Rules, 2016.

The students should primarily focus on the various waste management components like waste collection, transportation, segregation and disposal into the landfill under study. The students will also find out the different components of waste going to landfills. The students will propose ways to improve the existing waste management system and how they will lead to increasing the recycling percentages and reduction in the amount of waste to be dumped.

The analysis of the current study as well as the recommendations with explanations will have to be submitted to the Commissioner, GMC in the form of a report.

The exact structure of the report is up to the student, but the student should attempt to address the following areas:

- Analyse the existing waste management system
- Identify and critically assess the pros and cons of the existing waste management system with a comparison to the best practices in the country and abroad.
- Suggest how to improve the performance of the waste management system.
- Identify what components of waste management or modification are required for a sustainable and zero waste management strategy.
- Quantify potential improvements (quantitatively and qualitatively).
- Suggest (with explanations) and draft a new flowchart for the improvement of waste management plan with special emphasis on construction waste within GMC administrative area.



## About GMC

*Guwahati Municipal Corporation (GMC) is the urban local body responsible for collection and disposal of waste. It administers an area of 216.79 km<sup>2</sup> of Guwahati city. The entire GMC area is divided into 31 municipal wards and each municipal ward is handed over to each Non Government Organisation (NGO) responsible for door to door collection and disposal of waste into the secondary bins. The Municipal Corporation collects the waste from the secondary collection points and disposes it into the landfill at Boragaon, Guwahati. Presently, around 600 tons per day of waste is disposed into the landfill at Boragaon. There is no separate system of collection of construction waste and is collected as a mixed waste commingled with municipal waste.*

*The GMC is the creation of the Guwahati Municipal Corporation Act 1971. The corporation was duly constituted in 1974 in the first meeting of the elected councillors as per provision of Sec.45 of this Act.*

*GMC administers through various branches/sections/cells located at its different offices situated mainly at various places of Guwahati city.*

*The municipal services provided by GMC are-*

- *Solid waste management from collection to disposal*
- *Maintenance of the landfill for waste disposal*
- *Property assessment/reassessment/mutation*
- *Development and maintenance of roads/drains*
- *Issue and renewal of trade license.*
- *Development and maintenance of municipal markets.*
- *Construction and maintenance of Public Toilets/e-Toilets*
- *Building permission.*
- *Development and allotment of parking slots.*
- *Development and maintenance of parks and ponds.*
- *Installation and maintenance of Street Lights*
- *Cesspool emptier*



- ***Construction and maintenance of crematorium.***
- ***Implementation of different central/state Government programmes schemes and projects.***
- ***Water supply with metered/non-metered connection. etc.***

### **Report format**

The report should be presented in A4 format with margins of 2.50m in each side and the pages numbered. The line spacing should be 1.50 cm. Both sides of the page should be utilized for printing.

Heading, tables, diagrams are to be used and appropriately numbered. An abstract or executive summary at the beginning of the report is to be included (which will include key findings and recommendations). There is no page limit as such for the report, but it should be approximately 5000 words in length (excluding tables, diagrams and references)

Use of references to existing research/literature in order to support the argument of the report is to be included and properly referenced. The Harvard referencing format (i.e. Author (year)) should be used to cite specific references and all the references should be referred to in a ‘References’ section at the end of the report.

As the student will be presenting the report and its major findings to the GMC (subject coordinator and invited panel members) during the last week of the semester, the report should be written in a style and format that reflects its intended purpose, considering that the report is being drafted by a member of GMC.

The students are advised to refer to online skill development courses provided by [www.coursera.org](https://www.coursera.org) to get a better idea of how to put their ideas to words. The following links may be useful for the students

<https://www.coursera.org/learn/business-writing>

<https://www.coursera.org/specializations/academic-english>



## Submission – Draft Report

The students are required to submit a draft of their report in week 4. The draft report should, as a minimum be structured and formatted as it is planned to present the final report. As a minimum the student should include a table of contents, existing waste management system under GMC and an indication of the potential areas for improvement and potential solutions.

**The Draft Report should not provide** any identifying details (name, enrolment number etc) that could be used to identify the student, as the peer review process will be anonymous.

Submit your draft report in print form properly spiral binded.

### 7.2.2 Peer Review

Students are required to critically review one of their colleagues' draft Construction Waste Management Draft Reports and provide constructive feedback on how they might be improved. The review should be approximately between 500-1000 words. Primary focus should be on the strengths and weakness of the peer's draft report and how well they address the requirement of the task across the following criteria.

- Abstract / Executive summary
- Table of contents provided
- Ability to present the waste management system of GMC and compliance to waste management rules.
- Designing a proper waste management system for GMC which can be adopted under the prevailing conditions.
- Indication of potential areas for improvement in the waste management system.
- Indication of construction waste management system adopted by GMC.
- Suggested solutions.
- Understanding the broad principles of waste management.
- Present in a concise, professional and well-structured manner.
- Integration of references to relevant literature.



The peer review should focus on making suggestions to help the peer further develop and improve their report.

### **Peer review assessment criteria**

The student will be assessed in his ability to:

- Demonstrate an understanding of the broad principles of waste management principles and guidelines.
- Apply that understanding to the analysis and critique of the peer's draft report.
- Critically evaluate the work of peer's and provide constructive feedback.
- To use skill and sensitivity in providing formative (constructive) feedback to peers.

The peer feedback of a draft report of a student will be provided to the student after the completion of the process i.e . by Week 8.

### **7.2.3 Submission – Final Report**

The final report should be submitted in printed form after considering and incorporating the suggestions made in the peer review comments (if any).

Reports submitted after the due date will incur a 10 % penalty of the available marks in that section, unless prior application for special consideration has been submitted and approved.

### **Final Report Assessment Criteria**

The student will be assessed on their ability to

- Identify and critically analyse the prevailing waste management system and compliance to waste management rules.
- Design the waste management system under the prevailing rules and regulations with a focus on construction waste management.
- Present an argument of the re-design of the traditional system.
- Present the report in concise, professional and well-structured manner.
- Respond to peer review.
- Integrate references to relevant literature.
- Provision of appropriate of literature in references.



### 7.2.4 Final Presentation

The student will present the major findings from his/her final report to the panel members (co-ordinator and invited reviewers). The ideas that have been identified have to be presented.

#### Format

The presentation should be addressed to the panel members, as an employee of GMC. The student is welcome to present in an own format, but it has to be remembered that the format maximises the exposure to the content of the presentation.

Presentation : 15 minutes followed by Q&A : 5 minutes

#### Assessment Criteria

The presentation will be assessed by the panel members on the way of presentation and communication skills and how well a student is able to convince the panel members that they should take a different approach to the evaluation to the overall practices followed by GMC.

The student will be assessed on his/her ability to:

- Describe the issues with GMC current practices.
- Describe the suggested changes to GMC.
- Convince the panel members of the need to change the practices and explain the rationale behind it.
- Communicate the findings of the evaluation of the present waste management system.

**Presentation date:** Week 10.

Students are required to be available for the entire week. The time of presentation will be advised at a later date.



### 7.3 Marking Scheme

Table 2 provides the detailed marking scheme in this subject.

**Table 2: Summary of Assessment Tasks and Marking scheme**

<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to obtain a minimum marks of</b>	
				<b>Out of</b>	<b>obtain a minimum marks of</b>
Class participation	Participation in weekly activities and active involvement in class discussion	10	4	8	20
Assignment 1 (Construction Waste Management - Draft)	See Below	10	4	8	20
Assignment 2 (Peer Review)	Review of peer report (1000 words)	10	4	8	20
Assignment 3 (Construction Waste Management - Final)	Professional report outlining as assessment of waste management and suggestions for improvement. (5000 words)	10	4	8	20
Final Presentation	Presentation of report findings and recommended improvements.	10	4	8	20
End semester exam	Theory based.	50	20	40	100
<b>Total</b>	--	<b>100</b>	<b>40</b>	<b>80</b>	<b>200</b>



The students will have to appear in an end semester examination (as per the guidelines of the University under which AEC is affiliated) which will be subjective in nature. A minimum mark of 40% (each assessment category) must be achieved in the examination in order to pass the subject. The assignments/ presentations can be re-submitted in a semester if a student fails to score the requisite pass marks. However, if a student fails to achieve 40 % marks in the theory exam he will be deemed to fail in the subject and will have to clear in the next attempt.

## **8.0 REQUIRED READING**

Students are expected to refer 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, Section 12.

## **9.0 REQUIRED TEXTS**

Construction Safety and Waste Management-An Economic Analysis, Rita Yi Man Li, Department of Economics and Finance /Sustainable Real Estate Research Center, Hong Kong Shue Yan University, Hong Kong, China. Springer International Publishing Switzerland 2015.

## **10.0 ATTENDANCE POLICY**

The attendance policy is as per the standard university guidelines (under which AEC is affiliated).

## **11.0 PLAGIARISM, COLLUSION AND CONSEQUENCES**

Merriam-Webster's online dictionary explains that **Plagiarism** is the act of stealing and passing off (the ideas or words of another) as one's own; or using another's production without crediting the source; or to commit literary theft i.e. to present as new and original an idea or product derived from an existing source.



**Collusion** is the presentation by a student of an assignment as his or her own which is in fact the result in whole or part of unauthorised collaboration with another person or persons.

In any case where a student has been involved in plagiarism or collusion in an assessable assignment on task the marks awarded for that will be zero, and no substitution of an alternative task will normally be permitted.

## 12.0 READING LIST

The reading list (as provided in Table 3) provides the literature that a student is expected to go through to understand the various state of practice in the field of Construction Waste Management. The literature marked 'ESSENSTIAL' consists of a published literature which is a must read for the students, the literature marked 'OPTIONAL' suggests that the student has the option either, to go through or, not to go through the said published literature. However this list is not an extensive one and may be updated and altered as and when necessary. Students are encouraged to come up with suggested literature in this field for discussion in or off the class.

**Table 3: Reading List**

Reading	Reference	Suggested Literature
CWM-1-1	Lecture 1 (Introduction to Waste Management)	Handout on Solid Waste Management from Anders Damgaard & Morton A. Barlaz, NC State University, U.S. <b>(Essential)</b>
CWM-1-2		Risks & Choices, Center for Chemistry Education, Miami University (Ohio) <a href="http://www.terrificscience.org">www.terrificscience.org</a> —Permission granted to copy for classroom use only <b>(Optional)</b>
CWM-2-1	Lecture 2 (Resource & waste in construction sector)	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. <b>(Essential)</b>
CWM-2-2		Metropolitan Waste and Resource Recovery Implementation Plan Victoria State Government



Reading	Reference	Suggested Literature
		(Optional)
CWM-3-1		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. <b>(Essential)</b>
CWM-3-2	Lecture 3 <b>(International regulations with respect to disposal of C &amp; D waste)</b>	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 <b>(Optional)</b>
CWM-3-3		Construction & Demolition Waste Reduction Guideline 2016, <i>Sustainable Procurement Guidelines 4.0 C&amp;D Waste Reduction and Procurement</i> , Issue 01 Aug 2016. The University of Queensland, Australia. <b>(Optional)</b>
CWM-4-1		Central Public Health Environmental Engineering Organisation (CPHEEO) guidelines on Solid Waste Management (2000). Chapter 2 Pp (5-30). <b>(Essential)</b>
CWM-4-2	Lecture 4 <b>(CPHEEO guidelines for solid waste management)</b>	Central Public Health Environmental Engineering Organisation (CPHEEO) guidelines on Construction & Demotion Waste (2000). Chapter 4 Pp (57-63). <b>(Optional)</b>
CWM-5-1	Lecture 5 <b>(SWM rules for disposal of C &amp; D waste in India, SBM Rural &amp; Urban guidelines 2016)</b>	Swachh Bharat Mission Manual on Solid Waste Management Guidelines 2016 <b>(Essential)</b>
CWM-5-2		Swachh Bharat Mission Rural Guidelines on Solid Waste Management 2014 <b>(Optional)</b>
CWM-5-3		Swachh Bharat Mission Urban Guidelines on Solid Waste Management 2014 <b>(Optional)</b>
CWM-6-1	Lecture 6 <b>(Life cycle assessment of construction waste)</b>	Stefania Butera, Thomas H. Christensen, Thomas F. Astrup (2015) Life cycle assessment of construction and demolition waste management. <i>Waste Management</i> 44 (2015) 196–205. <b>(Essential)</b>
CWM-6-2		Min Wu, Guangwei Chen, Peter Davis, Willy Sher, John Smolders, Shuo Chen, Zhidan Qin, Zhou Yan



Reading	Reference	Suggested Literature
		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. <b>(Optional)</b>
CWM-7-1	<b>Lecture 7 (Economics of construction waste)</b>	Sandeep Shrivastava and Abdol Chini (2015) Construction Materials and C&D Waste in India. <b>(Essential)</b>
CWM-7-2		Myrrin et al (2015) Construction material from construction and demolition debris and lime Production wastes. Construction and Building Materials 79 (2015) 207–213. <b>(Optional)</b>
CWM-81	<b>Lecture 8 (Managing municipal waste- An economic perspective)</b>	Okumura et al. (2017) Economic growth and selection of municipal waste treatment Options in Bangkok. J Mater Cycles Waste Manag (2017) 19:718–730. <b>(Essential)</b>
CWM-9-1	<b>Lecture 9 (Environment al impacts of construction waste)</b>	United states Environmental Protection Agency, Construction Waste Management, Section 01 74 19, Date of Publication December, 2007. <b>(Essential)</b>
CWM-9-2		Saca et al. (2017) Leaching behavior of some demolition waste. J Mater Cycles Waste Manag (2017) 19:623–630. <b>(Optional)</b>
CWM-10-1	<b>Lecture 10 (Health &amp; Safety issues in handling construction waste)</b>	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. <b>(Essential)</b>
CWM-10-2		Occupational Health and Safety Regulations, Victorian Legislation (2007) Version No. 001, S.R. No. 54/2007, Version as at 1 July 2007. <b>(Optional)</b>
CWM-11-1	<b>Lecture 11 (Types of waste generated in</b>	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. <b>(Essential)</b>



Reading	Reference	Suggested Literature
	<b>Construction industry)</b>	
CWM-12-1	<b>Lecture 12 (Segregation methodology of construction waste- on site &amp; off site)</b>	Construction Waste Management Plan Guidelines a resource for Western Australian local government, developers, property owners and builders. The Western Australian Local Government Association (WALGA). <b>(Essential)</b>
CWM-13-1	<b>Lecture 13 (Techniques of recycling of construction waste abroad)</b>	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. <b>(Essential)</b>
CWM-14-1	<b>Lecture 14 (Techniques of recycling of construction waste in India)</b>	India's first plant that recycles construction waste, newspaper article from 'The Hindu' NEW DELHI: August 29, 2014 10:32 IST. <b>(Essential)</b>
CWM-15-1	<b>Lecture 15 (Prefabrication as an alternative for reducing C&amp;D waste)</b>	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. <b>(Essential)</b>
CWM-16-1	<b>Lecture 16 (Construction &amp; Demolition waste recycling equipment)</b>	CDE Global C&D waste recycling equipment manufacturer. <a href="http://www.cdeglobal.com/applications/cd-waste-recycling">www.cdeglobal.com/applications/cd-waste-recycling</a> <b>(Essential)</b>
CWM-16-2		Construction and Demolition Waste Guide-Recycling and Re-use across the Supply Chain, Department of Sustainability, Environment, Water, Population and Communities. <b>(Optional)</b>
CWM-17-1	<b>Lecture 17 (Managing concrete waste and</b>	Biglarijoo et al (2017) Modelling and optimisation of concrete containing recycled concrete aggregate and waste glass. Magazine of Concrete Research Volume 69 Issue 6. <b>(Essential)</b>



Reading	Reference	Suggested Literature
CWM-17-2	others )	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. <b>(Optional)</b>
CWM-18-1	<b>Lecture 18 (Good practices in construction waste management)</b>	Best Practice Guidelines on the Preparation of Waste Management Plans for Construction & Demolition Projects. ( <a href="http://www.envirocentre.ie/includes/documents/WMConstruction and Demolition">http://www.envirocentre.ie/includes/documents/WMConstruction and Demolition</a> ) <b>(Essential)</b>

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For any query please don't hesitate to contact me over phone or email.

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





MASTER OF CONSTRUCTION MANAGEMENT  
ASSAM ENGINEERING COLLEGE  
GUWAHATI-781013

# SUSTAINABLE SOLUTIONS FOR BUILDINGS

(SUBJECT GUIDE)

(Version-1.0)

Revised by - Mr Sasanka Borah



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## 1.0 INTRODUCTION

This document is intended as an information guide to students. It summarizes the objectives of the subject Sustainable Solutions for Buildings provides details of the lectures and other related information of the subject.

## 2.0 OVERVIEW & OBJECTIVES OF THE SUBJECT:

This subject provides a multi-disciplinary overview of the design of sustainable buildings and considers the design from an architectural, services engineering, facade engineering, environmental engineering and structural engineering, tenants and owners perspective. Topics include: ecological sustainable design, life cycle analysis, planning for sustainable buildings, smart villages and cities, regulatory environment, barriers to green buildings, green building rating tools, material selection, embodied energy, operating energy, indoor environmental quality (noise, light and air), facade systems, ventilation systems, transportation, water treatment systems, water efficiency, building economics, and staff productivity. A number of industry based case study examples will be introduced to complement the lectures.

## 3.0 LEARNING OUTCOMES

This subject will develop the following program learning outcomes.

On successful completion, students should be able to:

- Identify the critical sustainability issues that should be addressed in planning a building or new development;
- Estimate the green star rating of a new building;
- Identify the potential sustainable materials available locally that could be used for construction of building.
- Identify the issues effecting indoor environmental quality;
- Select different heating and cooling ventilation systems and justify the selection;
- Calculate the embodied energy of different structural systems including recycled materials and facade systems;



- Calculate the utilisation energy and greenhouse gas production of different building conceptual designs;
- Carry out conceptual designs for the design of a water supply system for a building with a focus on water conservation and recycling measures and estimate the expected water consumption requirement;
- Undertake cost studies of different green star rated buildings using life cycle cost analysis techniques.

#### **4.0 GENERIC SKILLS**

On completion of the subject students should have developed the following skills and capabilities:

- Ability to critically analyse the systems needed for sustainable solutions for a building.
- Ability to analyse technical, social and cultural contexts of sustainability
- Appropriate use of design terminology.
- Understand the social value in Building Construction Industry
- Able to preserve and keep a balance between the traditional traits of an ethnic house vs. modern building designed to be used by a particular tribe/community/society in Assam whilst providing a modern sustainable infrastructure.

#### **5.0 DETAILED SUBJECT SCHEDULE**

**Total contact period : 50 hours**

**Duration of Lecture : 1 Hour**

**Duration of Tutorial : 3 hours**



**Table 1: Detailed subject schedule**

Week	Lecture	Topic	Learning Activities
1	<b>Lecture 1:</b>	Sustainability - Introduction <ul style="list-style-type: none"><li>• Introduction to Sustainability</li><li>• Objective of Sustainable Development</li><li>• Sustainability aspects of habitat design</li><li>• Sustainable Buildings: Principles, approaches and characteristics.</li><li>• Sustainable development in Gurgaon: historical context, current trends and future direction.</li></ul>	<b>Reading List</b> SSB-1-1(Essential) SSB-1-2(Optional)
	<b>Lecture 2:</b>	Sustainable Design <ul style="list-style-type: none"><li>• Introduction</li><li>• Design areas in sustainably built environments</li><li>• Site Planning</li><li>• Water Management</li><li>• Orientation</li><li>• Solid Waste Management</li><li>• Traditional and Modern concepts</li><li>• Energy efficient materials</li></ul>	<b>Reading List</b> SSB-2-1(Essential) SSB-2-2(Optional) SSB-2-3 (Optional)
	<b>Tutorial 1:</b>	Worked Examples and Reflections (Lecture 1 & 2) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 1 & 2.	
2	<b>Lecture 3:</b>	Drivers of Sustainability in the Built Environment <ul style="list-style-type: none"><li>• Construction and its impacts</li><li>• Sustainable design and construction</li><li>• Benefits of implementing sustainable design and construction</li></ul>	<b>Reading List</b> SSB-3&4-1(Essential) SSB-3&4-2(Optional) SSB-3&4-3(Optional)
	<b>Lecture 4:</b>		



Week	Lecture	Topic	Learning Activities
		<ul style="list-style-type: none"><li>• Life Cycle Analysis of a Building</li><li>• The world in 2020: why sustainability is essential.</li></ul>	
	<b>Tutorial 2:</b>	Worked Examples and Reflections (Lecture 3 & 4) Discussions / quiz etc. based on the contents of Essential Readings of Lecture 3 & 4. Case Study: Torre Titanium La Portada, Santiago, Chile	
3	<b>Lecture 5:</b>	History of Sustainability in the Built Environment <ul style="list-style-type: none"><li>• The birth of the sustainability movement</li><li>• Sustainability initiatives at a national scale</li><li>• Multinational sustainability initiatives</li><li>• Organisations and governance in 2020</li></ul>	<b>Reading List</b> SSB-5&6-1(Essential) SSB-5&6-2(Optional) SSB-5&6-3(Optional)
	<b>Lecture 6:</b>		
	<b>Tutorial 3:</b>	Worked Examples and Reflections (Lecture 5 & 6) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 5 & 6. Case Study: United Nations Office Complex, Nairobi, Kenya	
4	<b>Lecture 7:</b>	Sustainability Policies and Programmes <ul style="list-style-type: none"><li>• The owner's perspective: what does a sustainability policy need to succeed: Sustainability policy options.</li><li>• Components of a sustainability programme for owners of capital projects</li><li>• Sustainable construction policies and programmes: international examples</li><li>• The corporate perspective: how to</li></ul>	<b>Reading List</b> SSB-7&8-1(Essential) SSB-7&8-2(Optional) SSB-7&8-3(Optional)
	<b>Lecture 8:</b>		



Week	Lecture	Topic	Learning Activities
4		<p>transform a construction company to deliver more sustainable projects</p> <ul style="list-style-type: none"><li>• Corporate sustainability policies in construction-related firms</li><li>• Sustainability policies in 2020.</li></ul>	
	<b>Tutorial 4:</b>	<p>Worked Examples and Reflections (Lecture 7 &amp; 8)</p> <p>Discussions/quiz etc. based on the contents of Essential Readings of Lecture 7 &amp; 8.</p> <p>Case study:</p> <ul style="list-style-type: none"><li>• Social Sustainability for Construction</li><li>• Foster + Partners</li><li>• Songdo IBD: South Korea's new sustainable city</li><li>• HOK</li><li>• URS Asia Pacific</li><li>• Hyundai Engineering and Construction</li><li>• Skanska</li><li>• Interface Global</li><li>• Holcim</li></ul>	
	<b>Assignment 1</b>	Sustainable Solutions for Buildings-Draft report due	
5	<b>Lecture 9:</b>	<p>Green Buildings, Green Rating Systems and Sustainable Material Selection.</p> <ul style="list-style-type: none"><li>• Evaluating Material and product sustainability</li><li>• Closing the loop of materials.</li><li>• Building Rating systems</li><li>• Infrastructure, Regional and country rating systems</li><li>• Corporate rating systems, reporting and strategic actions</li><li>• Sustainability evaluation and assessment in 2020.</li></ul>	<b>Reading List</b> SSB-9-1(Essential) SSB-9-2(Optional) SSB-9-3(Optional)
	<b>Lecture 10:</b>		<b>Reading List</b> SSB-10-1(Essential) SSB-10-2(Optional) SSB-10-3(Optional)



Week	Lecture	Topic	Learning Activities
6	<b>Tutorial 5:</b>	Worked Examples and Reflections (Lecture 9 & 10) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 9 & 10. Case study: <ul style="list-style-type: none"><li>• Duke Energy Center's choice of a green building rating</li><li>• London 2012 Olympic and Paralympic Games Venues</li></ul>	
	<b>Lecture 11:</b>	Embodied and Operating Energy <ul style="list-style-type: none"><li>• Induction to Embodied and Operating Energy</li><li>• Factors affecting.</li></ul>	<b>Reading List</b> SSB-11-1(Essential) SSB-11-2(Optional) SSB-11-3(Optional)
	<b>Lecture 12:</b>	Indoor Environment Quality <ul style="list-style-type: none"><li>• The issue of Indoor Environment Quality</li><li>• Integrated IEQ Design</li><li>• Main Components of IEQ Design</li></ul>	<b>Reading List</b> SSB-12-1(Essential) SSB-12-2(Optional) SSB-12-3(Optional)
7	<b>Tutorial 6:</b>	Worked Examples and Reflections (Lecture 11 & 12) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 11 & 12.	
	<b>Lecture 13:</b>	Facade Systems <ul style="list-style-type: none"><li>• Introduction</li><li>• Climate Based Design Approach for Facades</li><li>• Characteristics of Sustainable Facades</li><li>• Design for Comfort</li><li>• Emerging Technologies in Facade Design</li></ul>	<b>Reading List</b> SSB-13-1(Essential) SSB-13-2(Optional) SSB-13-3(Optional)
	<b>Lecture 14:</b>	Ventilation Systems <ul style="list-style-type: none"><li>• Introduction</li><li>• Climate based Design approaches for Ventilations</li><li>• Characteristics of sustainable Facades</li><li>• Design for best IEQ.</li><li>• Emerging Trends</li></ul>	<b>Reading List</b> SSB-14-1(Essential) SSB-14-2(Optional) SSB-14-3(Optional)



Week	Lecture	Topic	Learning Activities
	<b>Tutorial 7:</b>	Worked Examples and Reflections (Lecture 13 & 14) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 13 & 14.	
	<b>Assignment 2</b>	Peer Review of draft report of Assignment 1(peer review report due)	
8	<b>Lecture 15:</b>	Transportation <ul style="list-style-type: none"><li>• Introduction</li><li>• Building Transportation</li><li>• Least energy-maximising productivity.</li></ul>	<b>Reading List</b> SSB-15-1(Essential)
	<b>Lecture 16:</b>	Water Treatment Systems (WTS) <ul style="list-style-type: none"><li>• Introduction</li><li>• Various trends in WTS</li></ul>	<b>Reading List</b> SSB-16-1(Essential) SSB-16-2(Optional)
	<b>Tutorial 8:</b>	Worked Examples and Reflections (Lecture 15 & 16) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 15 & 16.	
9	<b>Lecture 17:</b>	Water Efficiency <ul style="list-style-type: none"><li>• Introduction</li><li>• General Water Conservation strategies</li><li>• Indoor Water Conservation</li><li>• Outdoor Water Conservation</li><li>• Innovative Waste Water Management</li></ul>	<b>Reading List</b> SSB-17-1(Essential) SSB-17-2(Optional) SSB-17-3(Optional)
	<b>Lecture 18:</b>	Building Economics and Staff Productivity <ul style="list-style-type: none"><li>• Introduction</li><li>• Health, Well-being and Productivity</li><li>• Economics Benefits of Good IEQ</li></ul>	<b>Reading List</b> SSB-18-1(Essential) SSB-18-2(Optional)
	<b>Tutorial 9:</b>	Worked Examples and Reflections (Lecture 17 & 18) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 17 & 18.	
10	<b>Lecture 19:</b>	Post-Occupancy Sustainability Opportunities and Best practices	<b>Reading List</b> SSB-19-1(Essential) SSB-19-2(Optional)



Week	Lecture	Topic	Learning Activities
11		<ul style="list-style-type: none"><li>• Post occupancy opportunities<ul style="list-style-type: none"><li>➢ Case Study: Homestead Air Reserve Base Fire Station</li><li>➢ Case Study: Trees Atlanta Kendeda Center</li><li>➢ Case Study: The Empire State Building energy-efficiency retrofit.</li><li>➢ End-of-life-cycle opportunities</li><li>➢ Case study: Trees Atlanta building sustainable end-of-life-cycle strategies</li></ul></li><li>• De-construction best practices</li><li>• Post occupancy sustainability in 2020</li><li>• Summary of sustainable facility practices over the life-cycle<ul style="list-style-type: none"><li>➢ Case Study: One Island East-Island East, Hong Kong.</li></ul></li></ul>	SSB-19-3(Optional)
	<b>Tutorial 10</b>	Worked Examples and Reflections (Lecture 19) Discussions/quiz etc. based on the contents of Essential Readings of Lecture 19.	
	<b>Assignment 3</b>	Sustainable Solutions for Buildings –Final Report due	
11	<b>Group Discussions</b>	Date and Topics TBA later	
	<b>Final Presentations</b>	Date and Topics TBA later	



## 6.0 PEDAGOGICAL APPROACH ACTIVITIES

The pedagogical approach is based on classroom lectures of up to 1 hour duration twice a week during the course. The lectures will involve a range of teaching topics, which will include theoretical background on sustainable solutions for buildings. The teaching modes apart from classroom lectures will include group various activities such as, group tasks, site visits, preparation of case studies, evaluation of existing buildings/infrastructure in terms of their performance, and guest presentations from industry professionals on specific topics to provide both specialist knowledge and state of the practice to give an insight to real world issues. Seminars will be held every week so that each student can share their knowledge, ask questions and dive further in to the subject materials.

The timings of the scheduled activities will be provided at the beginning of the course, depending on the annual academic calendar of the college.

## 7.0 ASSESSMENT

Assessment in this subject has both formative and summative aspects to it. The students will have an opportunity to provide formative feedback to their peers and receive constructive feedback in return, as well as from the subject coordinator. This will give them the opportunity to develop and improve on particular skills throughout the course of the subject.

There are five assessment tasks in this subject. The assessment tasks (class participation, assignment 1 to 3 and final presentation) mimic the activities that a student is most likely to undertake in a real situation. This task will be used to demonstrate that the student have developed the skills needed to assess sustainable solutions related topics and possible solutions to improving their performance and communicate their findings in a professional context.

The students main tasks will be to map, assess and suggest improvements to a buildings (existing or to be constructed) sustainability context and present their findings in a professional report and an oral presentation. A summary of the marking scheme is provided in Table 2. Specific requirements for each task are provided in section 7.1 and 7.2.



## 7.1 Class Participation

The subject involves a range of activities and participation of the student is critical for achieving the learning outcome of the subject.

The assessment for this task will involve a number of in-class discussion and quizzes relating to content covered during tutorials.

The students will be assessed on their ability to

- Understand and interpret themes discussed during seminars
- Respond appropriately to questions.

## 7.2 Assignment

### 7.2.1 Sustainable Solutions for Buildings

As a part of an inspection team for a residential/commercial building of Guwahati Municipal Corporation (GMC) the student will be asked to undertake an analysis of the sustainability of a building in its present condition, which will include identification of ways to increase the performance of the building (if required) so that it provides best value to the residents.

The students should primarily focus on the various building services related topics such as electrical connections, mechanical devices, plant assemblies and integration of the services in the building under study. The sustainability of such existing building services etc has to be evaluated in terms of sustainability. The student will propose ways to improve the existing amenities and how they will lead to increased values of the building in terms of sustainable performance. The students will also be involved in identifying the possible local materials for use in terms of sustainability.

The analysis of the current study as well as the recommendations with explanations will have to be submitted to the Chairman, GMC in the form of a report.

The exact structure of the report is up to the student, but the student should attempt to address the following areas:



- Map and analyse the existing sustainability strategy in the present building in terms of sustainability.
- Identify and critically assess the pros and cons of the existing building services with a comparison to the present state of practice.
- Suggest how to improve the performance of the building.
- Identify what integration of services etc might be required to sustain the performance of the building.
- Quantify potential improvements (quantitatively and qualitatively).
- Suggest (with explanations) and draft a new flowchart for the evaluation of the new buildings in the GMC administrative area.

### About GMC

*Guwahati Municipal Corporation (GMC) is the urban local body responsible for governing, developing and managing Guwahati. It administers an area of 216.79 km<sup>2</sup> of Guwahati city. The entire GMC area is divided into 31 municipal wards and each municipal ward is further divided into 2, 3 or 4 Area Sabhas. Presently, there are 90 Area Sabhas. GMC works under Guwahati Development Department, Assam.*

*The GMC is the creation of the Guwahati Municipal Corporation Act 1971. The corporation was duly constituted in 1974 in the first meeting of the elected councillors as per provision of Sec.45 of this Act.*

*GMC administers through various branches/sections/cells located at its different offices situated mainly at various places of Guwahati city.*

*The municipal services provided by GMC are-*

- *Property assessment/reassessment/mutation*
- *Development and maintenance of roads/drains*
- *Issue and renewal of trade license.*
- *Development and maintenance of municipal markets.*
- *Construction and maintenance of Public Toilets/e-Toilets*
- *Building permission.*



- ***Development and allotment of parking slots.***
- ***Development and maintenance of parks and ponds.***
- ***Hoarding and advertisement.***
- ***Issue of Birth/Death certificates.***
- ***Installation and maintenance of Street Lights***
- ***Cesspool emptier***
- ***Construction and maintenance of crematorium.***
- ***Implementation of different central/state Government programmes schemes and projects.***
- ***Water supply with metered/non-metered connection. etc.***

### **Report format**

The report should be presented in A4 format with margins of 2.50m in each side and the pages numbered. The line spacing should be 1.50 cm. Both sides of the page should be utilized for printing.

Heading, tables, diagrams are to be used and appropriately numbered. An abstract or executive summary at the beginning of the report is to be included (which will include key findings and recommendations). There is no page limit as such for the report, but it should be approximately 5000 words in length (excluding tables, diagrams and references)

Use of references to existing research/literature in order to support the argument of the report is to be included and properly referenced. The Harvard referencing format (i.e. Author (year)) should be used to cite specific references and all the references should be referred to in a 'References' section at the end of the report.

As the student will be presenting the report and its major findings to the GMC (subject coordinator and invited panel members) during the last week of the semester, the report should be written in a style and format that reflects its intended purpose, considering that the report is being drafted by a member of GMC.

The students are advised to refer to online skill development courses provided by [www.coursera.org](https://www.coursera.org) to get a better idea of how to put their ideas to words. The following links may be useful for the students



<https://www.coursera.org/learn/business-writing>

<https://www.coursera.org/specializations/academic-english>

### **Submission – Draft Report**

The students are required to submit a draft of their report in week 4. The draft report should, as a minimum be structured and formatted as it is planned to present the final report. As a minimum the student should include a table of contents, maps of existing building evaluation techniques used by GMC and an indication of the potential areas for improvement and potential solutions.

**The Draft Report should not provide** any identifying details (name, enrolment number etc) that could be used to identify the student, as the peer review process will be anonymous.

Submit your draft report in print form properly spiral binded.

#### **7.2.2 Peer Review**

Students are required to critically review one of their colleagues' draft Sustainable Solutions for Buildings Draft Reports and provide constructive feedback on how they might be improved. The review should be approximately between 500-1000 words. Primary focus should be on the strengths and weakness of the peer's draft report and how well they address the requirement of the task across the following criteria.

- Abstract / Executive summary
- Table of contents provided
- Ability to map the sustainability of existing building.
- Use of diagrams to effectively illustrate the problem at hand.
- Indication of potential areas for improvement in the performance of building services and operations.
- Indication of potential areas for improvement in the building services and operations evaluation methodology used by GMC by taking in to sustainable services etc. in to account.
- Suggested solutions.



- Understanding the broad principles of sustainability in building construction.
- Presented in a concise, professional and well-structured manner.
- Integration of references to relevant literature.

The peer review should focus on making suggestions to help the peer further develop and improve their report.

### **Peer review assessment criteria**

The student will be assessed in his ability to:

- Demonstrate an understanding of the broad principles of building services and operations.
- Apply that understanding to the analysis and critique of the peer's draft report.
- Critically evaluate the work of peer's and provide constructive feedback.
- To use skill and sensitivity in providing formative (constructive) feedback to peers.

The peer feedback of a draft report of a student will be provided to the student after the completion of the process i.e . by Week 8

#### **7.2.3 Submission-final report**

The final report should be submitted in printed form after considering and incorporating the suggestions made in the peer review comments (if any).

Reports submitted after the due date will incur a 10 % penalty of the available marks in that section, unless prior application for special consideration has been submitted and approved.

### **Final Report Assessment Criteria**

The student will be assessed on their ability to

- Identify and critically analyse the strengths and weakness in the domain of traditional building services and operations.
- Map the sustainability of existing building services and operations system.



- Use diagrams to effectively illustrate sustainability of building services and operations related data.
- Present an argument of the re-design of the traditional system.
- Present the report in concise, professional and well-structured manner.
- Respond to peer review.
- Integrate references to relevant literature.

Provision of appropriate of literature in references

#### **7.2.4 Final Presentation**

The student will present the major findings from his/her final report to the panel members (co-ordinator and invited reviewers). The ideas that have been identified have to be presented.

##### **Format**

The presentation should be addressed to the panel members, as an employee of GMC. The student is welcome to present in an own format, but it has to be remembered that the format maximises the exposure to the content of the presentation.

Presentation : 15 minutes followed by Q&A: 5 minutes

##### **Assessment Criteria**

The presentation will be assessed by the panel members on the way of presentation and communication skills and how well a student is able to convince the panel members that they should take a different approach to the evaluation to the overall practices followed by GMC.

The student will be assessed on his/her ability to:

- Describe the issues with GMC current practices.
- Describe the suggested changes to GMC.
- Convince the panel members of the need to change the practices ans explain the rationale behind it.



- Communicate the findings of the evaluation of the present building.

**Presentation date:** Week 10.

Students are required to be available for the entire week. The time of presentation will be advised at a later date

### 7.3 Marking Scheme

Table 2 provides the detailed marking scheme in this subject.

**Table 2: Summary of Assessment Tasks and Marking scheme**

<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to</b>	
				<b>obtain a minimum marks of</b>	<b>Out of</b>
Class participation	Participation in weekly activities and active involvement in class discussion	10	4	8	20
Assignment 1 (Sustainable Solutions for Buildings -Draft)	See Below	10	4	8	20
Assignment 2 (Peer Review)	Review of peer report (1000 words)	10	4	8	20
Assignment 3 (Sustainable Solutions for Buildings -Final)	Professional report outlining as assessment of sustainability of building and suggestions for improvement. (5000 words)	10	4	8	20
Final Presentation	Presentation of report findings and recommended improvements.	10	4	8	20



<b>Assessment category</b>	<b>Brief Discussion</b>	<b>Weight (%)</b>	<b>Pass (%)</b>	<b>To pass, a student has to</b>	
				<b>obtain a minimum marks of</b>	<b>Out of</b>
End semester exam	Theory based.	50	20	40	100
<b>Total</b>	--	<b>100</b>	<b>40</b>	<b>80</b>	<b>200</b>

The students will have to appear in an end semester examination (as per the guidelines of the University under which AEC is affiliated) which will be subjective in nature. A minimum mark of 40% (each assessment category) must be achieved in the examination in order to pass the subject. The assignments/ presentations can be re-submitted in a semester if a student fails to score the requisite pass marks. However, if a student fails to achieve 40 % marks in the theory exam he will be deemed to fail in the subject and will have to clear in the next attempt.

## **8.0 REQUIRED READING**

Students are expected to refer to various building operations and services related topics from various sources, which might include case studies, conferences papers, library collections, eBooks and eJournals. A list of essential and optional reading is provided in Table – 3, Section 13.

## **9.0 REQUIRED TEXTS**

Sustainable Buildings and Infrastructure-Paths to the Future, Annie R. Pearce, Yong Han Ahn and HanmiGlobal, Routledge.

Sustainable Building – Design Manual: sustainable building design practices, The Energy and Resources Institute (TERI), New Delhi India.

Sustainable Buildings in Practice-What the users think, George Baird, Routledge

Building Services Engineering by David V. Chadderton, Routledge



Sustainable Facades: Design Methods for High-Performance Building Envelopes, by Ajila Aksamija, Wiley.

## 10.0 ATTENDANCE POLICY

The attendance policy is as per the standard university guidelines (under which AEC is affiliated).

## 11.0 PLAGIARISM, COLLUSION AND CONSEQUENCES

Merriam-Webster's online dictionary explains that **Plagiarism** is the act of stealing and passing off (the ideas or words of another) as one's own; or using another's production without crediting the source; or to commit literary theft i.e. to present as new and original an idea or product derived from an existing source.

**Collusion** is the presentation by a student of an assignment as his or her own which is in fact the result in whole or part of unauthorised collaboration with another person or persons.

In any case where a student has been involved in plagiarism or collusion in an assessable assignment or task the marks awarded for that will be zero, and no substitution of an alternative task will normally be permitted.

## 12.0 READING LIST

The reading list (as provided in Table 3) provides the literature that a student is expected to go through to understand the various state of practice in the field of Sustainability of buildings. The literature marked 'ESSENTIAL' consists of a published literature which is a must read for the students, the literature marked 'OPTIONAL' suggests that the student has the option either, to go through or, not to go through the said published literature. However this list is not an extensive one and may be updated and altered as and when necessary. Students are encouraged to come up with suggested literature in this field for discussion in or off the class.



Table 3: Reading List

Reading	Reference	Suggested Literature
SSB- 1-1	Lecture 1: (Introduction)	Xiaolong Gan, Jian Zuo, Kunhui Ye, Martin Skitmore, Bo Xiong (2015), Why sustainable construction? Why not? AN owner's perspective, Habitat International, 47, pp. 61 – 68, Elsevier ( <b>ESSENTIAL</b> )
SSB-1-2		Grace K.C Ding (2008), Sustainable construction – The role of Environment assessment tools, Journal of Environmental Management, 86, pp. 451-464, Elsevier. ( <b>OPTIONAL</b> )
SSB- 2-1	Lecture 2: (Sustainable Design)	Nengmou Wang & Hojjat Adeli (2014) Sustainable building design, Journal of Civil Engineering and Management, 20:1, 1-10, DOI: 10.3846/13923730.2013.871330 ( <b>ESSENTIAL</b> )
SSB-2-2		Begum Sertyesilisik (2016): A preliminary study on the regenerative construction project management concept for enhancing sustainability performance of the construction industry, International Journal of Construction Management, DOI:10.1080/15623599.2016.1222665 ( <b>OPTIONAL</b> )
SSB-2-3		Kjell Tryggestad (2013) Sustainable Buildings and Infrastructure: Paths to the Future, Construction Management and Economics, 31:4, 391-394, DOI:10.1080/01446193.2013.770893 ( <b>OPTIONAL</b> )
SSB-3&4-1	Lecture 3&4: (Life Cycle Analysis)	Mohammad Kamali, Kasun Hewage (2016), Life cycle performance of modular buildings: A critical review, Renewable and Sustainable Energy Reviews, 62, pp.1171-1183., Elsevier( <b>ESSENTIAL</b> )
SSB-3&4-2		Donghoon Lee, Sungho Lee, Jeong Tai Kim and Sunkuk Kim (2012), A Lifecycle Health Performance Tree for Sustainable Healthy Buildings, Indoor Built Environment, 21(1), pp. 16-27. ( <b>OPTIONAL</b> )
SSB-3&4-3		Vivian W.Y.Tam, Sepani Senaratne, Khoa N.Le, Li-Yin Shen, Josip Perica, IM. Chethana S, Illankoon (2017), Life-cycle cost analysis of green building implementation using timber applications, Journal of Cleaner Production, 147, pp. 458-469. ( <b>OPTIONAL</b> )



Reading	Reference	Suggested Literature
SSB- 5&6-1		Khalis Md. Bahauddin, Mohammad Mahbubur Rahman and Falad Ahmed (2014), Towards Urban City with Sustainable Buildings: A Model for Dhaka City, Bangladesh, Environment and Urbanization ASIA, 5(1), pp. 119-130. <b>(ESSENTIAL)</b>
SSB- 5&6-2	Lecture 5&6: <b>(Planning for sustainable buildings)</b>	José Amarilio Barbosa, Luís Bragança & Ricardo Mateus (2014) New approach addressing sustainability in urban areas using sustainable city models, International Journal of Sustainable Building Technology and Urban Development, 5:4, 297-305, DOI:10.1080/2093761X.2014.948528 <b>(OPTIONAL)</b>
SSB- 5&6-3		Sumita Chaudhuri (2015) Urban poor, economic opportunities and sustainable development through traditional knowledge and practices, Global Bioethics, 26:2, 86-93, DOI: 10.1080/11287462.2015.1037141 <b>(OPTIONAL)</b>
SSB-7-1		Ashwani Kumar, Pushplata (2017), Problems and prospects of building regulations in Shimla, India – A step towards achieving sustainable development, International Journal of Sustainable Built Environment, Elsevier. <b>(ESSENTIAL)</b>
SSB-7-2	Lecture 7: <b>(Regulatory Environment)</b>	Ashwani Kumar, Pushplata (2015), Approach to formulate setback regulations for Indian hill towns, International Journal of Sustainable Built Environment, 4, pp. 91-99, Elsevier. <b>(OPTIONAL)</b>
SSB-7-3		Ashwani Kumar (2016), Impact of building regulations on Indian hill towns, HBRC (Housing and Building Research Center) Journal, 12, pp. 316-326. <b>(OPTIONAL)</b>
SSB-8&9-1	Lecture 8&9: <b>(Green Buildings)</b>	Susie Ruqun Wu, Peilei Fan and Jiquan Chen (2016), Incorporating Culture Into Sustainable Development: A Cultural Sustainability Index Framework for Green Buildings, Sustainable Development, 24, pp. 64-76. (wileyonlinelibrary.com) <b>(ESSENTIAL)</b>
SSB-8&9-2		Grace K.C Ding (2008), Sustainable construction – The role of Environment assessment tools, Journal of Environmental Management, 86, pp. 451-464, Elsevier. <b>(OPTIONAL)</b>



Reading	Reference	Suggested Literature
<b>SSB-8&amp;9-3</b>		Green Buildings and the Bottom Line (2006), <a href="http://www.BDCnetwork.com">www.BDCnetwork.com</a> ( <b>OPTIONAL</b> )
<b>SSB- 10-1</b>	<b>Lecture 10: (Sustainable Material Selection)</b>	Lennart Y. Ljungberg (2007), Materials selection and design for development of sustainable products, Materials and Design, 28, pp. 466-479, Elsevier. ( <b>ESSENTIAL</b> )
<b>SSB-10-2</b>		Laura Florez, Daniel Castri-Lacouture (2013), Optimization model for sustainable materials selection using objective and subjective factors, Materials and Design, 46, pp. 310-321, Elsevier. ( <b>OPTIONAL</b> )
<b>SSB-10-3</b>		Koichi Yagi, Kohmei Halada (2001), Materials development for a sustainable society, Materials and Design, 22, pp. 143-146. ( <b>OPTIONAL</b> )
<b>SSB- 11-1</b>	<b>Lecture 11: (Embodied and operating Energy)</b>	A.J. Marszal, P. Heiselberg, J.S. Bourrelle, E. Musall, K. Voss, I. Sartori, A. Napolitano (2011), Zero Energy Building-A review of definitions and calculation methodologies, Energy and Buildings, 43, pp. 971-979, Elsevier. ( <b>ESSENTIAL</b> )
<b>SSB- 11-2</b>		Patxi Hernandez, Paul Kenny (2010), From net energy to zero energy buildings: Defining life cycle zero energy buildings(LC-ZEB), 42, pp. 815-821, Elsevier. ( <b>OPTIONAL</b> )
<b>SSB- 11-3</b>		Antonio Martinez-Molina, Isabel Tort-Ausina, Soolyeon Cho, Jose-Luis Vivancos (2016), Energy efficiency and thermal comfort in historic buildings: A review, Renewable and Sustainable Energy Reviews, 61, pp. 70-85, Elsevier. ( <b>OPTIONAL</b> )
<b>SSB- 12-1</b>	<b>Lecture 12: (Indoor environmenta l quality)</b>	K. W. Mui & W. T. Chan (2005) A New Indoor Environmental Quality Equation for Air-Conditioned Buildings, Architectural Science Review, 48:1, 41-46, ( <b>ESSENTIAL</b> )
<b>SSB- 12-2</b>		D. J. Moschandreas , Sung-Hoon Yoon & Darina Demirev (2006) Validation of the indoor environmental quality conceptual model, Building Research & Information, 34:5,483-495, DOI: 10.1080/09613210600908367 ( <b>OPTIONAL</b> )
<b>SSB- 12-3</b>		Yasemin Afacan & Halime Demirkan (2016) The influence of sustainable design features on indoor environmental quality satisfaction in Turkish



Reading	Reference	Suggested Literature
		dwellings, Architectural Science Review, 59:3, 229-238, DOI: 10.1080/00038628.2015.1056768 <b>(OPTIONAL)</b>
SSB- 13-1	Lecture 13: (Façade systems)	Luciana Alves Oliveira & Silvio Burrattino Melhado (2011) Conceptual Model for the Integrated Design of Building Façades, Architectural Engineering and Design Management, 7:3, 190-204, DOI: 10.1080/17452007.2011.594571 <b>(ESSENTIAL)</b>
SSB- 13-2		Ajla Aksamija (2016) Design methods for sustainable, high performance building facades, Advances in Building Energy Research, 10:2, 240-262, <b>(OPTIONAL)</b>
SSB- 13-2		Lars G. F. Tellnes, Lone Ross Gobakken, Per Otto Flæte & Gry Alfredsen (2014) Carbon footprint including effect of carbon storage for selected wooden facade materials, Wood Material Science & Engineering, 9:3, 139-143, <b>(OPTIONAL)</b>
SSB- 14-1	Lecture 14: (Ventilation systems)	Yang Lu, Hiroshi Yoshino, Rie Takaki, Genta Kurihara, Hiroshi Yonekura & Jing Liu (2010) A Study on Ventilation Systems for Removing Indoor House Dust, International Journal of Ventilation, 9:1, 1-10, <b>(ESSENTIAL)</b>
SSB- 14-2		Marian B. Nantka (2005) Airtightness and Natural Ventilation: A Case Study for Dwellings in Poland, International Journal of Ventilation, 4:1, 79-91, DOI: 10.1080/14733315.2005.11683701 <b>(OPTIONAL)</b>
SSB- 14-3		Lars Olander (2010) Do Train Tunnels Need Ventilation Systems?, International Journal of Ventilation, 9:1, 89-92, DOI: 10.1080/14733315.2010.11683871 <b>(OPTIONAL)</b>
SSB- 15-1	Lecture 15: (Transportation)	Chan Chee Hin & M. B. Ullah (1990) An Expert System for the Design of Lifts (Elevators) in Buildings, Architectural Science Review, 33:3, 63-69 <b>(ESSENTIAL)</b>
SSB- 16-1	Lecture 16: (Water Treatment systems)	André Stephan & Robert H. Crawford (2014) A comprehensive life cycle water analysis framework for residential buildings, Building Research & Information, 42:6, 685-695, DOI:10.1080/09613218.2014.921764 <b>(ESSENTIAL)</b>



Reading	Reference	Suggested Literature
SSB- 16-2		Joaquim J. Júdice , A. Silva-Afonso , Carlos P. Baptista & L. M. Fernandes (2008) Economic design of water distribution systems in buildings, <i>Engineering Optimization</i> , 40:8, 749-766, DOI: 10.1080/03052150802054035 ( <b>OPTIONAL</b> )
SSB- 17-1		Silvia Pazzi, Emili Tortosa-Ausina, Meryem Duygun & Simona Zambelli (2016) The cost efficiency of water utilities: when does public ownership matter?, <i>Local Government Studies</i> , 42:6, 980-1003, DOI: 10.1080/03003930.2016.1207630 ( <b>ESSENTIAL</b> )
SSB- 17-2	Lecture 17: (Water efficiency)	Sabino De Gisi, Patrizia Casella, Michele Notarnicola & Roberto Farina (2016) Grey water in buildings: a mini-review of guidelines, technologies and case studies, <i>Civil Engineering and Environmental Systems</i> , 33:1, 35-54, DOI: 10.1080/10286608.2015.1124868 ( <b>OPTIONAL</b> )
SSB- 17-3		J Wilson & N Lam (2006) Earthquake Design of Buildings in Australia Using Velocity and Displacement Principles, <i>Australian Journal of Structural Engineering</i> , 6:2, 103-118 ( <b>OPTIONAL</b> )
SSB- 18-1	Lecture 18: (Building economics and staff productivity.)	John G. Lowe (1987) The measurement of productivity in the construction industry, <i>Construction Management and Economics</i> , 5:2, 101-113, DOI:10.1080/01446198700000010 ( <b>ESSENTIAL</b> )
SSB- 18-2		Adrian Leaman , Fionn Stevenson & Bill Bordass (2010) Building evaluation: practice and principles, <i>Building Research &amp; Information</i> , 38:5, 564-577, DOI:10.1080/09613218.2010.495217 B ( <b>OPTIONAL</b> )
SSB- 19-1		Guide to Post Occupancy Evaluation, University of Westminster ( <b>ESSENTIAL</b> )
SSB- 19-2	Lecture 19: (Post Occupancy Evaluation)	Post Occupancy Evaluation-A Summary, Government of Western Australia, Department of Finance, Office of the Government Architect. ( <b>OPTIONAL</b> )
SSB- 19-3		Post Occupancy Evaluation and Building Performance Evaluation-Primer, RIBA, <a href="http://www.Architecure.com">www.Architecure.com</a> ( <b>OPTIONAL</b> )



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For any query please don't hesitate to contact me over phone or email.

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



**Smart Villages Lab**

Culture • Construction • Capacity • Community



*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*

# Appendix 1

## Tour Diary

### Visitors

Dr Pradip Baishya

Mr Sasanka Borah

### Duration

24 April – 18 June 2017





**Smart Assam Project**  
**Construction Management Programme at Assam Engineering College**

**Tour Diary of Visiting Scholars (Dr. Pradip Baishya and Mr Sasanka Borah) to University of Melbourne, Australia during the period 22<sup>nd</sup> April to 19<sup>th</sup> June, 2017**

Date	Activity	Descriptions
<b>Day 1 : 22<sup>nd</sup> April, 2017, Saturday</b>	En route to Melbourne	<p><b>Travelling:</b></p> <ul style="list-style-type: none"> <li>• Guwahati to Kolkata by Jet airways flight 9W 2840(arrived at 6.00PM)</li> <li>• Marketing and Dinner at Kolkata (Big Bazaar)</li> </ul>
<b>Day 2: 23<sup>rd</sup> April, 2017, Sunday</b>	En route to Melbourne	<p><b>Travelling:</b></p> <ul style="list-style-type: none"> <li>• Kolkata to Hong Kong by Cathay Dragon CX5169 (at 1.15 AM)</li> <li>• arrived Hong Kong at 7.50 AM (Hong Kong local time) Breakfast at Hong Kong</li> <li>• Hong Kong to Melbourne by Cathay Pacific CX163 (at 10.35 AM Hong Kong local time)</li> <li>• arrived Melbourne at 9.30 PM (Melbourne local time)</li> <li>• Melbourne Airport to apartment (unit 903, 253 Franklin Street, Melbourne, 3000)</li> </ul>
<b>Day 3 : 24<sup>th</sup> April 2017, Monday</b>	<b>Went to University of Melbourne (UoM),</b> Melbourne School of Design Building (MSD), Faculty of Architecture, Building and Planning (FABP).	<p><b>Meeting at Room 318, Melbourne School of Design Building:</b></p> <ul style="list-style-type: none"> <li>• Introductory meeting with Dr. Hemanta Doloi (Senior Lecturer in Property and Construction Management and Technology, FABP, UoM).</li> <li>• Dr. David Week (Project Manager, Assam Project &amp; Post Doctoral Research Fellow, FABP, UoM).</li> <li>• Mr. Geoff Kimm (Research Fellow, Assam Project, FABP, UoM).</li> <li>• Mr. Vikram Kumar (Masters Student, FABP, UoM).</li> <li>• Brief introduction about objectives of visit.</li> <li>• Discussion on public participation in Governance with Mr. Vikram Kumar.</li> </ul> <p>Our Staff Identity Cards were issued (ID-126283)-SB &amp; (ID-126281)-PB</p>
<b>Day 4 : 25<sup>th</sup> April, 2017, Tuesday</b>	<b>Local holiday, ANZAC (Australia and New Zealand Army Corps) Day Celebration</b>	<ul style="list-style-type: none"> <li>• Went to Melbourne City Center</li> <li>• Visited HMAR Hall, Yarra River.</li> <li>• Back to Apartment and halt.</li> </ul>
<b>Day 5 : 26<sup>th</sup> April,</b>	<b>Went to Melbourne University</b>	<p><b>Discussion:</b></p> <p>Room 408, MSD (Melbourne School of Design) Building</p>



**Smart Villages Lab**  
Culture • Construction • Capacity • Community



**Smart Assam Project**  
**Construction Management Programme at Assam Engineering College**

Date	Activity	Descriptions
<b>2017 , Wednesday</b>	Introduction to the research team, faculty and discussions,	<p>with</p> <ul style="list-style-type: none"><li>○ Dr. Hemanta Doloi,</li><li>○ Dr. David Week,</li><li>○ Professor Ray Green (Professor in Landscape Architecture and Heritage, FABP, UoM),</li><li>○ Professor Mark Burry (Academic, FABP, UoM)</li><li>○ Mr. Vikram Kumar</li><li>○ Ms. Velyne Katharpi (PhD Student-Assam Project, FABP, UoM)</li><li>○ Mr. Arup Deka (PhD Student-Assam Project, FABP, UoM)</li></ul> <ul style="list-style-type: none"><li>● Overall scope for the construction management program at AEC.</li><li>● Reviewed the draft program already circulated earlier</li><li>● Briefings on Literature Search for developing subject contents for CM program at AEC.</li></ul>
<b>DAY 6: 27<sup>th</sup> April, 2017, Thursday</b>	<b>Went to Melbourne University</b> <ul style="list-style-type: none"><li>● Discussion with Dr. Hemanta Doloi</li><li>● Discussion at Staff Kitchen</li><li>● Visited the MSD Building Library at Ground floor</li><li>● Literature Survey</li></ul>	<p><b>Discussion with Dr Hemanta Doloi</b> Room 309, MSD Building, UoM</p> <ul style="list-style-type: none"><li>● Opportunities for developing collaboration across the university.</li><li>● Guidance for attending courses and seminars within the university.</li></ul> <p><b>Discussion at Staff Kitchen, Level 4, MSD Building with</b></p> <ul style="list-style-type: none"><li>○ Dr Hemanta Doloi ,Dr Dolly Kikon(Lecturer, School of Social and Political Sciences, UoM), Dr David Week, Mr. Geoff Kimm, Miss Velyne Katharpi and Mr. Arup Deka</li></ul> <p><b>Library</b></p> <ul style="list-style-type: none"><li>● Introduction on the access mechanism of UoM library documents and books both online and offline was given wonderfully by the Librarian present.</li></ul> <p><b>Literature Survey</b></p> <p>Online survey of relevant literature in line with the</p>



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Date	Activity	Descriptions
		development of the master's course curriculum of construction management at AEC.
<b>DAY 7:</b> <b>28<sup>th</sup> April, 2017, Friday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"> <li>• Literature Survey</li> <li>• Visited Burnley Campus, UoM.</li> <li>• Met Mr. Ross Payne at Burnley Campus, UoM.</li> </ul>	<p><b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Burnley Campus with:</b> Dr. David, Dr Doloi, Dr. Baishya and Mr. Deka</p> <ul style="list-style-type: none"> <li>• The objective of visit to the Burnley Campus of UoM was to select a suitable site for erection of the prototype elevated shed.</li> <li>• The prototype elevated shed site was selected.</li> <li>• The prototype elevated shed frame and footing systems were reviewed</li> <li>• Applicability in Assamese context has been discussed.</li> </ul>
<b>DAY 8:</b> <b>29<sup>th</sup> April, 2017, Saturday</b>		
<b>DAY 9:</b> <b>30<sup>th</sup> April, 2017, Sunday</b>		<b>Leisure</b>
<b>DAY 10:</b> <b>01<sup>st</sup> May, 2017, Monday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"> <li>• Literature survey</li> </ul>	<p><b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p>
<b>DAY 11:</b> <b>02<sup>nd</sup> May, 2017, Tuesday</b>	<b>Sasanka Borah reported Sick, Pradip Baishya went to UoM and came back to apartment for</b> <ul style="list-style-type: none"> <li>• Meeting with Mr. Vikram Kumar at apartment.</li> <li>• Literature Survey</li> </ul>	<p><b>Discussions</b></p> <ul style="list-style-type: none"> <li>• Selection of Majuli being the site for investigating the participatory planning in Disaster mitigation (e.g. Flood) as part of his Master of Urban Planning thesis.</li> <li>• A brief discussion on the administrative setup in Majuli etc.</li> </ul> <p><b>Literature Survey</b> Online survey of relevant literature in line with the</p>



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Date	Activity	Descriptions
	<ul style="list-style-type: none"><li>Attended Construction Management class by Dr. Hemanta Doloi at Lowe Theatre, Latham Building (<b>attended by PB</b>)</li></ul>	<p>development of the master's course curriculum of construction management at AEC. Done at apartment as being online gives the flexibility to work from home.</p> <p><b>Dr Hemanta Doloi class</b></p> <p>Class started with an introduction to building of the pre-fabricated Demo house at Burnley Campus, University of Melbourne. The students were briefed about light weight steel, Frame cad, and the footing system designed and fabricated by Sure foot and equipped the students with the required technical know how about the installation of the house. The class was then taken over by one of the invited guest faculty Mr. Paul Breslin from Multiplex who is into the management of Occupational Health and Safety (OHS) in the construction sites of Multiplex. He described about the evolution of OHS and applicability of section 28 in all places of Australia. He also described about the penalties and fines imposed due to non-compliance of OHS.</p>
<b>Day 12: 03<sup>rd</sup> May, 2017, Wednesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>Literature Survey</li><li>Discussion on the Smart Assam Project at Australia Indian Institute (All), UoM with Faculty and Staff which included</li><li>Meeting with Geoff Kimm at Staff Canteen.</li></ul>	<p><b>Literature Survey</b></p> <p>Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Discussion at Australia India Institute with:</b></p> <ul style="list-style-type: none"><li>Dr. Haripriya Rangan, Associate Professor &amp; Director, Research and Academic Programs, Australia India Institute, UoM.</li><li>Mr. Trent Brown, Research Assistant, All, UoM.</li><li>Dr. Amy Piedalue, Post-Doctoral Research Fellow, All, UoM</li><li>Jonathan Balls, PhD Student, All, UoM</li><li>Dr. Amanda Gilberston, Lecturer in Youth and Contemporary India, All, UoM.</li><li>Dr. Alexander E. Davis, NGN Research Fellow at All, Latrobe University.</li><li>Dr. Sangeetha Chandra-Shekeran, Lecturer in the School of Geography, Faculty of Science, UoM.</li><li>Dr Dolly Kikon</li><li>Dr. Hemanta Doloi</li></ul>



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Date	Activity	Descriptions
		<ul style="list-style-type: none"><li>○ Dr. David Week</li><li>○ Mr. Geoff Kimm</li><li>○ Mr. Arup Deka</li><li>○ Miss Velyne Katharpi</li><li>● Dr Hemanta Doloi briefed the gathering about the Smart Assam Project and its intended deliveries.</li><li>● Brief introduction of the Assam project members.</li><li>● Dr David Week divulged some technical aspects of the project, outcomes.</li><li>● Possible collaboration with AIU discussed.</li><li>● Dr Haripriya Rangan interacted with the members of the Smart Assam Project Team including the visiting academic scholars.</li></ul> <p><b>Meeting (with Geoff Kimm):</b></p> <ul style="list-style-type: none"><li>● Discussion about the existing governance system in Assam, India.</li><li>● Involvement of Information Technology in governance.</li><li>● The flow of information from the public to the government was discussed briefly, with reference to Public Works Department (PWD) of Assam Government, with a special reference to PMGSY road adoption schemes.</li><li>● Information to PMGSY app was given to Mr. Kimm, however it was found that the mobile app cannot be downloaded outside of India.(probably an initialization to the app will be given when the members come to India for a visit)</li><li>● Some basic background information of Assam discussed.</li></ul>
<b>DAY 13:</b> <b>04<sup>th</sup> May, 2017, Thursday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>● Literature survey</li><li>● Attended Dr. Robert Crawford's (Associate Professor, Construction and</li></ul>	<p><b>Literature Survey:</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Class of Dr Robert Crawford (taken by Dr Toong-Khuan Chan)**(at Alice Hoy Buliding):</b> Dr. Chan delivered a topic on "Understanding the Built Environment: Current and Emerging Trends in technology within the construction industry", where he</p>



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Date	Activity	Descriptions
	<p>Environment Assessment, Faculty of Architecture, Building and Planning, UoM) class taken by Dr. Toong-Khuan Chan (Senior Lecturer for Construction Management and Technology, Faculty of Architecture, Building and Planning, UoM)</p> <ul style="list-style-type: none"><li>• Attended another class of Dr. Toong-Khuan Chan on Hoccoore Technology.</li><li>• Back to MSD Building</li><li>• Literature Survey</li><li>• Back to apartment and halt.</li></ul>	<p>discussed about various progress made in the modern construction industry. Some statistics of how the labour cost varies in the developed to the developing world were also provided. He covered some topic like Transfloor, AFS Wall, Bubble Deck, Mechanization and IT in construction, Rocca Columns, Tilt up Panel Walls, Cross laminated timber, Power Trowel, Laser Screeding, Hoccoore Technology etc. Had a discussion with Dr. Chan, where he invited us to attend another class of longer duration on the topic <b>Hollowcore Technology</b> which he took in the Medical Building lecture hall.</p> <p><b>Class of Toong-Khuan Chan(at Medical Building)</b></p> <p>Attended this class of Dr. Chan where he discussed on the Hollowcore technology. We were provided with the course materials of Dr. Chan. He proposed for a site visit on 11<sup>th</sup> May, 2017 along with his students to Melton to a prefabrication unit and we agreed to it.</p> <p>** Dr Chan took Dr Robert's class as a scheduled invitee to deliver his expertise on a topic. This is an observation that was appreciated by us, since this gives an opportunity to the students to get the proper guidance from the proper faculty.</p>
<b>DAY 14:</b> <b>05<sup>th</sup> May, 2017, Friday</b>	<p><b>Went to University of Melbourne</b></p> <ul style="list-style-type: none"><li>• Literature Survey</li><li>• Attended Class of Dr. Dominique Hes on Living Building Challenges.</li><li>• Site Visit to Rosana, Community</li></ul>	<p><b>Literature Survey:</b></p> <p>Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Class of Dr. Dominique Hes:</b></p> <p>We attended a class of Dr. Dominique Hes on Living Building Challenges version 3.0, where she discussed on sustainable aspects with a reference to the metaphor of the flower-PETAL theory.</p> <p><b>Site Visit to Murundaka Community Housing.</b></p> <p>Dr Dominique took us to a site visit to Murundaka Co-</p>



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Date	Activity	Descriptions
	Housing. • Back apartment to and rest	housing located at Heidelberg Heights, Bamfield Road, Melbourne. Where various aspects of the Murundaka Cohousing community was described to us. More information of the community can be found in their website. <a href="http://www.murundakacohousing.org.au">www.murundakacohousing.org.au</a> .
<b>Day 15: 06<sup>th</sup> May, 2017, Saturday</b>		
<b>Day 16: 07<sup>th</sup> May, 2017, Sunday</b>		<b>Leisure</b>
<b>Day 17: 08<sup>th</sup> May, 2017, Monday</b>	<b>Went to University of Melbourne</b> • Literature survey • Meeting with Dr. David Week at office, progress discussed. • Meeting with Dr. Hemanta Doloi.	<b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC. <b>Meeting with Dr. David Week</b> Discussion on the probable timeline for finishing the assigned jobs of the visiting academic scholars discussed in detail. The deadlines of the deliverables from us were clearly defined and identified. Dr. Week discussed about topic likes Logic Model, Post Occupancy Evaluation (regarding St. Francisco tower), he talked about value engineering, Flipped classroom, online courses for better outcomes of the students at any part of the globe. Various online modules like eDX ( <a href="http://www.edx.org">www.edx.org</a> ), Coursera ( <a href="http://www.coursera.org">www.coursera.org</a> ), Udemy ( <a href="http://www.udemy.com">www.udemy.com</a> ), Lynda ( <a href="http://www.lynda.com">www.lynda.com</a> ), NPTEL etc were discussed and may to be included in the course curriculum of the Construction Management course. <b>Meeting with Dr. Hemanta Doloi</b> Basic discussion on the progress so far. Suggestions to develop the course provided. He was informed about the tour to Melton scheduled on 11 <sup>th</sup> of May, 2017. Dr Doloi invited us to attend his classes regularly on Tuesday evening and then join as a panel member in evaluation of the student's presentation from 6.30pm onwards till 9.00pm.



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Date	Activity	Descriptions
<b>Day 18:</b> <b>09<sup>th</sup> May, 2017, Tuesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"> <li>• Literature survey.</li> <li>• Attended Dr. Hemanat Doloi's class</li> <li>• Attended student presentation.</li> </ul>	<p><b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Dr Doloi's Class (taken by Dr Stephen Kip, Fire Safety Engineer and Building Regulation Consultant)</b> <b>Latham Building, Lowe Theatre.</b> Discussion about construction regulations, Occupational Health and Safety norms in Australia. Topic like acceptable risk, calculated risk, community outrage which are related by "Acceptable Risk = Calculated Risk + Community Outrage" were discussed.</p> <p><b>Students Presentation:</b> Attended the student's presentation as an invited panel member to evaluate the presentations, an exposure to how the presentation were delivered by the students was achieved.</p>
<b>Day 19:</b> <b>10<sup>th</sup> May, 2017, Wednesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"> <li>• Meeting with Dr Robert Crawford</li> <li>• Literature Survey</li> <li>• Meeting with Mr. Christopher Jensen.</li> <li>• Meeting with Dr. Haripriya Rangan at AAI</li> <li>• Meeting with Manager Premier Waste at Queen Victoria Market, Melbourne.</li> </ul>	<p><b>Meeting with Dr Robert Crawford</b> Discussion on the approach to development of the course curriculum of construction management in AEC suggested. Theory of Teaching, Intended Learning Outcomes, Teaching and Learning Activity and Assessment were discussed and suggested to be taken into consideration while developing the course curriculum. It was also suggested to include quizzes etc to involve the students in the process of learning.</p> <p><b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Meeting with Mr. Christopher Jensen</b> Mr Christopher is the subject coordinator of Building Services and Operations, he provided meaningful insight into - what should consist of a good course curriculum of Building Services and Operations. His suggestion were incorporated in the development of the course curriculum.</p> <p><b>Meeting of Dr. Pradip Baishya with Dr. Haripriya Rangan, Director, Australia India Institute (All)</b></p>



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Date	Activity	Descriptions
		<p>Discussion started with a focus on the research activities of Australia India Institute (AII) at Australia and in India. Dr. Rangan briefed about some of the institutes working on sustainability in India. One of them is Centre for Environmental Planning &amp; Technology (CEPT), Ahmedabad working on projects like water and sanitation and playing a lead role on sustainability in India. She introduced to Dr. Meenakshi Arora, Sr. Lecturer, Department of Infrastructure, University of Melbourne working on waste water management. Dr. Rangan also introduced to Dr. Vaibhav Gaikwad, Post-Doctoral Fellow from University of New South Wales, Sydney who is working on e-waste management under the Centre for Sustainable Materials Research &amp; Technology.</p> <p><b>Meeting of Dr Pradip Baishya with the Manager of Premier Waste Mr. Narsai at Queen Victoria Market, Melbourne</b></p> <p>Mr. Narsai the service manager of the waste management unit in Queen Victoria market was very keen and explained about the waste management system followed in the market. He took me around the market and explained the different system of processing of waste collected in the market and the approximate quantity of generation. There are three bins for waste disposal Red for general waste which needs to be sent to the landfill for disposal, Yellow for recyclables, Orange for meat and fat and Green for organic waste. It was a good learning experience about the waste management process followed in markets in Melbourne.</p>
<b>Day 20:</b> <b>11<sup>th</sup> May, 2017, Thursday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Visit to Westkon Prefabrication Plant, Melton, Melbourne</li><li>• Mr Simon showed us around the plant.</li><li>• Literature Survey.</li></ul>	<b>Visit to Westkon Prefabrication Plant, Melton, Melbourne</b> <p>We collected our safety gears (Hard Hat, High-visibility Vest and Industrial Boots) from UoM and proceeded to board the bus in front of Clyde Hotel near UoM, Dr. Chan accompanied us in the bus along with other students of UoM. On reaching the plant Mr. Simon Hughes who is the Business &amp; Project Development Manager of Westkon Precast, briefed us about the profile of Westkon Prefab, we were also explained the safety related issues and the do's and don'ts when inside the plant. More</p>



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Date	Activity	Descriptions
	<ul style="list-style-type: none"><li>Meeting with Dr. Meenakshi Arora, Sr. Lecturer, Department of Infrastructure Engineering (PB)</li></ul>	<p>details of the company is available at its website <a href="http://westkon.com.au/">http://westkon.com.au/</a>. We were shown around the plant of how the prefabrication is done and the different components that leads to prefabrication of the components. We were also shown how the materials required for the production of the prefabricated components were stored and fed in to the plant. It was seen that the worker were all wearing protective gears (like hand gloves, eyeglasses, industrial boots, high visibility vests, gas masks (for painting) and hard hats) as required by the Australian Standards. Safety of the workers were of utmost importance to the company as the Workplace Health and Safety (WH&amp;S)/Occupational Health and Safety (OH&amp;S) norms of Australia is said to be very strictly applied and monitored. More details of the WH&amp;S/OH&amp;S of Australia is available at <a href="http://www.australia.gov.au/information-and-services/jobs-and-workplace/whs-workplace-health-and-safety">http://www.australia.gov.au/information-and-services/jobs-and-workplace/whs-workplace-health-and-safety</a>. We acknowledged the information provided to us by Mr Simon and left the plant and arrived at UoM by the same bus.</p> <p><b>Literature Survey</b></p> <p>Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Meeting of Dr. Pradip Baishya with Dr. Meenakshi Arora, Sr. Lecturer, Department of Infrastructure Engineering</b></p> <p>Met Dr. Meenakshi at Potter Café, UoM and briefed about her research activities at UoM which includes urban water management, designing of rain water harvesting projects, remediation of land and ground water and Life cycle assessment studies. Discussion was primarily on the sustainable aspects with reference to Smart Assam Project focussing on waste management and water management. She also introduced Dr. Graham A. Moore, Professor, Department of Infrastructure Engineering, UoM and suggested me for a meeting with him.</p>
Day 21:	Went to University of	Burnley Campus



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12 <sup>th</sup> May, 2017, Friday	<b>Melbourne</b> <ul style="list-style-type: none"><li>Proceeded to UoM Burnley Campus, Richmond with Mr. James, Dr Pradip Baishya for installation of footing of prototype elevated shed.</li></ul>	This is the second visit of us to the Burnley campus of University of Melbourne where the campus is dedicated to the dissemination of knowledge related to Ecosystem and Forestry Science. More details are available at <a href="http://ecosystemforest.unimelb.edu.au/about/burnley">http://ecosystemforest.unimelb.edu.au/about/burnley</a> <b>Installation of footing of prototype elevated shed (demo house)</b> During the earlier visit to Burnley campus ( <b>28<sup>th</sup> April, 2017</b> ) the site for proposed elevated shed was identified, it was scheduled that during this visit the placing of the footing was to be made and <b>Surefoot Footings</b> ( <a href="http://surefootfootings.com.au/">http://surefootfootings.com.au/</a> ) was contacted by Dr Hemanta Doloi for the job. <b>Surefoot Footings</b> is a company in Australia that provides concrete-less modular foundation systems. It is a screw pile foundation system with many variants, and easy to install without much expertise and with great speed. Two persons from Surefoot Mr. Neil and Mr. Michael came for the installation with the required tools and equipment. They involved the students as well for the installation which was quite a simple process. <b>Also at very less amount of capital cost (approximately 200 AUD for one footing), expertise (only two persons required) and time (two hours in our case) was necessary for the installation of the footing. Also, it seemed that the footing system is sustainable, i.e., it can be reused as and when necessary as it claimed to have a very high lifetime. In line of its usability in Assam, India considering different soil conditions, it may be proposed to carry out a study to validate the feasibility of the proposed footing system in Assam, India. The study may be carried out in the Geotechnical Engineering Division, Department of Civil Engineering, Assam Engineering College.</b>
Day 22: 13 <sup>th</sup> May, 2017, Saturday	Went to Burnley Campus	Burnley Campus for installation of frame of the of prototype elevated shed. After the placing of the footing on 12 <sup>th</sup> May, 2017, today we visited the Burnley Campus of UoM again in order to have a look at the installation of the frame of the elevated shed. The frame of the shed is made up of



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		rolled steel sheet cut into required dimensions as per design and delivered to site by FrameCAD, Information on FrameCAD can be found in the following link <a href="http://framecad.com/en/home">http://framecad.com/en/home</a> . A few students of Melbourne School of Design, UoM led by Dr. Hemanta Doloi and Dr David Week and us together alongwith the association of Mr. Evgeni Viritch erected the shed in around 3(three) hours' time. The erection of the shed was quite fast and required only a few a specialized instruments.
<b>Day 23:</b> <b>14<sup>th</sup> May,</b> <b>2017,</b> <b>Sunday</b>		<b>Leisure</b>
<b>Day 24:</b> <b>15<sup>th</sup> May,</b> <b>2017,</b> <b>Monday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Literature Survey</li><li>• Meeting with Dr. David Week, progress discussed.</li></ul>	<b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC. <b>Meeting with Dr David Week</b> Dr. David provided us some links about institutes offering courses on Construction Management in India like Gujarat Technological University. He also suggested us to go through open source engineering books, army corps engineering manuals, site.mil. construction management manual for reference.
<b>Day 25:</b> <b>16<sup>th</sup> May,</b> <b>2017,</b> <b>Tuesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Meeting with faculty and staff of Architecture, Building and Planning at Staff Canteen, MSD Building.</li><li>• Presentation and discussion on the Assam Project.</li><li>• Literature Survey</li><li>• Met Prof. Blair Gardiner</li></ul>	<b>Meeting with faculty and staff.</b> Dr Hemanta Doloi briefed the gathering on the Assam project. The team members including us were introduced. A presentation on the progress and schedule of scope of work of the project was made by Dr David Week and Mr. Geoff Kimm. The faculty and staff showed interest and wished a very successful completion of the project and eagerly offered to guide and mentor the visiting academic scholar if required. <b>Literature Survey</b> Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC. <b>Discussion with Prof Blair Gardiner</b> Professor Blair Gardiner showed interest in the possible



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Date	Activity	Descriptions
	<ul style="list-style-type: none"><li>Attended Dr. Hemanta Doloi's class (Mr. Med Monger, Regional Quality Manager, MULTIPLEX)</li><li>Attended student's presentation.</li></ul>	<p>labour scenario in India and invited to have discussion with him at a later date.</p> <p><b>Dr Doloi's Class (taken by Mr. Med Monger, Regional Quality Manager, MULTIPLEX) Latham Building, Lowe Theatre.</b></p> <p>He discussed on the principles of quality, quality assurance etc in construction industry. He focussed primarily on two principles i.e., fit for purpose and conformance to requirements. He also described about some of the techniques of monitoring and measurement for non-conformance to quality.</p> <p><b>Students Presentation:</b></p> <p>Attended the student's presentation as an invited panel member to evaluate the presentations.</p>
<b>Day 26: 17<sup>th</sup> May, 2017, Wednesday</b>	<b>Went to UoM</b> <ul style="list-style-type: none"><li>Literature survey</li><li>Went to Alice Hoy Building, Level 3, Room 330 to attend Dr. Robert Crawford's activity class (lego blocks)</li></ul>	<p><b>Literature Survey</b></p> <p>Online survey of relevant literature in line with the development of the master's course curriculum of construction management at AEC.</p> <p><b>Dr Robert Crawford's LEGO class on supply chain management.</b></p> <p>Attended the class of Dr Robert on supply chain management in construction which he took in an innovative way by the use of LEGO block, which was really interesting on our part. It was a new technique of delivering knowledge of the field in the class by involving the students to construct a model house with help of LEGO blocks (which are basically used by children in play). The entire class was divided in to 4(four) groups. Each student group had a architect, supplier, prefabrication unit, logistics, contractor, site manager and workers who worked in tandem to complete the task. In doing this the students showcased their abilities and got a firsthand experience of the construction process in the site. The entire exercise was divided in to equal no of day using necessary conversion to minutes, and the progress for each day was monitored by the faculty.</p>
<b>Day 27: 18<sup>th</sup> May, 2017, Thursday</b>	<b>Went to UoM</b> <ul style="list-style-type: none"><li>Meeting with Dr Hemanta Doloi at Staff Canteen</li></ul>	<p><b>Discussion:</b></p> <p>Dr Doloi took stock of the progress made in the development of course curriculum and suggested measures for proper documentation of the work.</p>



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Date	Activity	Descriptions
<b>Day 28: 19<sup>th</sup> May, 2017, Friday</b>	<b>Went to UoM</b> <ul style="list-style-type: none"><li>Meeting with Dr Hemanta Doloi at Staff Canteen</li><li>Meeting with Dr. Graham A. Moore, Professor, Department of Infrastructure Engineering (PB)</li></ul>	<b>Discussion:</b> Dr Doloi took stock of the progress made in the development of course curriculum and suggested measures for proper documentation of the work. He enquired as to what other facilities can be made available to us for the preparation of the course content. <b>Meeting of Dr. Pradip Baishya with Dr. Graham A. Moore, Professor, Department of Infrastructure Engineering at Level 4 Room D420, Engineering Block D.</b> The meeting started with a brief introduction about my roles and responsibilities in the Smart Assam Project and development of the subjects on Construction Management. Dr. Graham has offered courses on Solid Waste to Sustainable Resources and has organised field trips to waste management plants in Melbourne for the students. As one of my subjects is Construction Waste Management it was really helpful for me to get in touch with him and could gather lot of information about waste management plants. He gave me few contacts of waste management companies who are involved in recycling of construction waste.
<b>Day 29: 20<sup>th</sup> May, 2017, Saturday</b>		
<b>Day 30: 21<sup>st</sup> May, 2017, Sunday</b>		<b>Leisure</b>
<b>Day 31: 22<sup>nd</sup> May, 2017, Monday</b>	<b>Went to UoM</b> <ul style="list-style-type: none"><li>Meeting with Dr Robert Crawford.</li><li>Development of the course curriculum.</li></ul>	<b>Discussion:</b> A follow up meeting of the meeting we had with Dr Robert on 10 <sup>th</sup> May, 2017. Dr Robert enquired about the progress of the work in hand. Discussion related to the admission process of UoM took place. We were briefed about the process of delivery of the knowledge to students that is adopted by him. Dr Robert provided us hard copies of his subject guide. The presentation style, formatting etc. of this subject guide that Dr Robert provided is being used as the bench mark for the



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Date	Activity	Descriptions
		<p>development of the subject guide for each subject.</p> <p><b>Development of the course curriculum</b></p> <p>Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey.</p>
<b>Day 32: 23<sup>rd</sup> May, 2017, Tuesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Development of the course curriculum.</li><li>• Attended Dr. Hemanta Doloi's class.</li><li>• Attended student's presentation.</li></ul>	<p><b>Development of the course curriculum</b></p> <p>Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey.</p> <p><b>Dr Doloi's Class Latham Building, Lowe Theatre</b></p> <p>A presentation on the design and construction management program of the Australia 108 project was made by Project Manager from Multiplex.</p> <p><b>Students Presentation:</b></p> <p>Attended the student's presentation as invited panel members to evaluate the presentations.</p>
<b>Day 33: 24<sup>th</sup> May, 2017, Wednesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Development of the course curriculum</li><li>• Meeting with Dr. Hemanta Doloi.</li></ul>	<p><b>Development of the course curriculum</b></p> <p>Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey.</p>
<b>Day 34: 25<sup>th</sup> May, 2017, Thursday</b>	<b>Sasanka Borah reported Sick.</b> Pradip Baishya Went to University of Melbourne <ul style="list-style-type: none"><li>• Development of the course curriculum</li><li>• 3<sup>rd</sup> Fortnightly operations meeting (Room 408, Hanging Gardens)</li></ul>	Members present were Dr. Hemanta Doloi, Dr. Ray Green, Dr. Dominique Hes, Dr. Pradip Baishya, Mr. Geoff Kim, Mr. Arup Deka, Ms. Velyne Katharpi and Dr. David Week over Skype from Myanmar. Discussion started with Dr. Hemanta briefing about the visit of VIP team from Assam and his discussion with the Principal Secretary, Education, Govt. of Assam about the probable dates to be around November- December. Dr. Hemanta also briefed about the visit of Smart Assam team to Assam from Melbourne. The team will comprise of Dr. Hemanta Doloi, Dr. David Week and Mr. Geoff Kim and is scheduled to reach by 24 <sup>th</sup> June, 2017 and return by 2 <sup>nd</sup> July, 2017 from Assam. Mr. Geoff is supposed to coordinate with Dr. Boeing Singh from IIT Guwahati and develop the database platform. There was also discussion on the website launch of Smart Assam. All of



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Date	Activity	Descriptions
		us were requested to visit the website and suggest for any addition or deletion in the website. Dr. Ray Green suggested open ended questions for the questionnaire for Majuli with a small amendment. Just by adding an option 'others' along with the other options the questionnaire become open ended. The Ph.D scholars Mr. Arup and Ms. Velyne also presented their progress work. I also presented about the progress of our scheduled work and the work yet to be completed.
<b>Day 35: 26<sup>th</sup> May, 2017, Friday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Development of the course curriculum</li><li>• Meeting with Dr. Hemanta Doloi.</li></ul>	<b>Development of the course curriculum</b> Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey.
<b>Day 36: 27<sup>th</sup> May, 2017, Saturday</b>		<b>Leisure</b>
<b>Day 37: 28<sup>th</sup> May, 2017, Sunday</b>		
<b>Day 38: 29<sup>th</sup> May, 2017, Monday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Development of the course curriculum</li><li>• Meeting with Dr. Hemanta Doloi.</li></ul>	<b>Development of the course curriculum</b> Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey.
<b>Day 39: 30<sup>th</sup> May, 2017, Tuesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Development of the course curriculum</li><li>• Learning and Teaching Conference</li></ul>	<b>Development of the course curriculum</b> Development of the course curriculum is in progress with the help of the faculty of UoM and the materials collected through Literature Survey. <b>Learning and Teaching Conference</b> Attended the learning and teaching conference of the UoM where the faculty and staff of the University shard their experience of many new models of teaching that they adopted for maximising the intended learning of the



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Date	Activity	Descriptions
	<ul style="list-style-type: none"><li>Meeting with Dr. David Week.</li><li>Site visit to Waste Converters Recycling at Lynbrook, Dandenong, Melbourne (PB)</li></ul>	<p>students.</p> <p><b>Meeting with Dr Davis Week.</b></p> <p>Regular progress monitoring with Dr. Week of our assignments. Work progress as per schedule.</p> <p><b>Site visit of Dr. Pradip Baishya to Waste Converters Recycling at Lynbrook, Dandenong, Melbourne</b></p> <p>Met Mr. Ward, the Managing Director and the owner of the plant. Mr. Ward who is from an environmental science background has been running this business since last 20 years. It is a family business and has been working with recycling since last 30 years. Mr. Ward explained about the different types of waste recycled by them.</p> <p>The first one was the concrete waste recycling facility where concrete and bricks is converted into smaller size in Jaw Crusher with magnetic roller and large particle size separator. These can be used for underground concreting and pavements. The other waste like plastic, paper etc are collected separately and sent to the landfill for disposal.</p> <p>The second one was Mulch production unit. In this unit tree barks, green waste disposed from different places is shredded into smaller size in large size shredder. It is then fed to a sorting machine which divided it into three fractions depending on the size. The smallest size fraction is mixed with soil. This mulch is even coloured for improving the aesthetics and are sold as ready mulch to be used in gardens, parks and by the side of free ways for plantation.</p> <p>The third one was the pallet recycling unit. The old and broken pallets are collected and are repaired with replacement of the missing components and sold as fresh pallets.</p>
<b>Day 40: 31<sup>st</sup> May, 2017, Wednesday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>Final scrutiny of the Course curriculum developed.</li><li>Meeting with Dr.</li></ul>	<p><b>Final scrutiny of the course curriculum developed</b></p> <p>Scrutiny of the course curriculum developed for the Construction Management program at Assam Engineering College is started at our level for submission to UoM for review.</p> <p><b>Meeting with Dr. Hemanta Doloi.</b></p> <p>Informed about our intended trip to University of New</p>



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Date	Activity	Descriptions
	Hemanta Doloi. <ul style="list-style-type: none"><li>• Departure to Sydney</li></ul>	South Wales. <b>Departure to Sydney</b> Travelling to Sydney
<b>Day 41: 01<sup>st</sup> June, 2017, Thursday</b>	Went to University of New South Wales, Sydney. <ul style="list-style-type: none"><li>• Meeting with Dr. Veena Sahajwala</li><li>• Meeting with Dr. V Gaikwad.</li></ul>	Meeting with Dr. Veena Sahajwala, Director, Scientia Professor, Centre for Sustainable Material Research & Technology (SMaRT), University of New South Wales, Sydney & Dr. Vaibhav Gaikwad, Post Doctoral Fellow, SMaRT, UNSW at Board meeting room 452, Level 4, Hilmer Building, UNSW. Meeting began with a warm welcome by Dr. Veena Sahajwala & Dr. Vaibhav Gaikwad to the board room. Dr. Vaibhav accompanied us to the laboratory and demonstrated the different instruments and equipments used for their research in the centre. There were many sophisticated instruments which could generate a very high temperature and produce photographs as well. The meeting started with Dr. Veena describing about the different research activities at the centre. We briefed about our Smart Assam Project to Dr. Veena and Dr. Vaibhav and they showed their interest in collaborating with us. Dr. Veena told they are already working on sustainable materials for construction which could well fit in to the Assam Project. Dr. Vaibhav who is also working on plastic waste and developing a composite material using plastic and wood could also be used as a construction material.
<b>Day 42: 02<sup>nd</sup> June, 2017, Friday</b>	Departure to Melbourne from Sydney.	Traveling
<b>Day 43: 03<sup>rd</sup> June, 2017, Saturday</b>		
<b>Day 44: 04<sup>th</sup> June, 2017, Sunday</b>		<b>Leisure</b>
<b>Day 45: 05<sup>th</sup> June,</b>	<b>Went to University of Melbourne</b>	<b>Submission of Course Curriculum outline</b> The course curriculum of 5 subjects (i.e. Construction



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Date	Activity	Descriptions
2017, Monday	<ul style="list-style-type: none"> <li>• Submission of Course Curriculum outline</li> <li>• Meeting with Dr. Hemanta Doloi.</li> <li>• Brief discussion with Dr. Ray Green.</li> </ul>	<p>Methods and Equipment, Construction Waste Management, Fundamental of Project Management, Building Services Engineering and Sustainable Solutions for Buildings) to be included in the Construction Management course at Assam Engineering College has been developed and submitted (to Dr Hemanta Doloi, Dr Robert Crawford, Dr. Dominique Hes, Dr David Week, Dr Ray Green) for review.</p> <p><b>Meeting with Dr. Hemanta Doloi.</b> Informed about the formulation of the scope of work we have done in University of Melbourne</p> <p><b>Brief discussion with Dr. Ray Green.</b> Met Dr Ray Green and asked him to review the materials submitted. HE asked for the link of the Dropbox folder, which was mailed to him.</p>
Day 46: 06 <sup>th</sup> June, 2017, Tuesday	<p><b>Went to University of Melbourne</b></p> <ul style="list-style-type: none"> <li>• Back to back meeting with Dr David Week and Dr. Hemanta Doloi.</li> </ul>	<p><b>Meeting with Dr David Week.</b> Discussion on the development stage of the paper for ZEMCH2018. He suggested the use of Triple Bottom Line (TBL) for developing the content of the paper and asked if the paper could include comparison of the use of various available materials in Assam. Discussion on various topic like technology transfer, bamboo as a traditional material, prefabrication process in Assamese construction industry, focus on rural aspects were discussed.</p> <p>Dr Week and Dr. Doloi asked if the duty of the construction of the demo house at Assam can be entrusted to us, to which we asked for some time to arrive at a decision in consultation with the Dr Atul Bora, Principal of Assam Engineering College. We also asked them to officially engage Dr. Bora for the same issue so that the decision can be taken at the institute level.</p>
Day 47: 07 <sup>th</sup> June, 2017, Wednesday	<p><b>Went to University of Melbourne</b></p> <ul style="list-style-type: none"> <li>• ZEMCH Paper writing</li> <li>• Meeting with A/Prof. Masa Noguchi.</li> <li>• <b>Meeting with Dr.</b></li> </ul>	<p><b>ZEMCH Paper writing</b> Draft paper writing in progress</p> <p><b>Meeting with A/Prof. Masa Noguchi</b> Met Dr. Masa Noguchi at Room 316, MSD Building. He is an Associate Professor specializing in Environmental Design at University of Melbourne. He informed us about the zero energy housing philosophy. He talked about the acceptability of a developed technology in rural</p>



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	<b>Hemanta Doloi</b>	<p>perspective, how to educated the masses. A workshop in Guwahati during the month of December, 2017 is proposed. He suggested that the workshop should be a 5 day workshop with the target audience from students fraternity, practicing engineers, architects and Government officials. He advocated the use of some free open source software's like HOT2000, RETSCREEN and GOOGLESKETCH to be used by the trainees. Discussions included topic like compost toilets, linkedin ZEMCH network, Post Occupancy Evaluation in Dubai, Inclusive design etc.</p> <p><b>Meeting with Dr. Hemanta Doloi</b></p> <p>Met Dr Doloi at Staff Canteen, MSD Building. He provided input for the submission of the ZEMCH2018 conference paper.</p>
<b>Day 48: 08<sup>th</sup> June, 2017, Thursday</b>	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Fortnightly Operations Meeting of team members of Assam project.</li><li>• Meeting with Dr. Hemanta Doloi</li></ul>	<p><b>Fortnightly Operation Meeting:</b> Dr Hamanta Doloi, Dr Ray Green, Dr. David Week, Dr Pradip Baishya, Mr Sasanka Borah, Mr Arup Deka, Miss Velyne Katharpi.</p> <p>A general team progress and future scope discussed with individual members giving their inputs. Review of CM programme in progress.</p> <p><b>Meeting with Dr. Hemanta Doloi</b></p> <p>Input regarding preparation of papers provided for ZEMCH2018.</p>
<b>Day 49: 09<sup>th</sup> June, 2017, Friday</b>	Went to Melbourne Central	For repairing Laptop
<b>Day 50: 10<sup>th</sup> June, 2017, Saturday</b>		<b>Leisure</b>
<b>Day 51: 11<sup>th</sup> June, 2017, Sunday</b>		
<b>Day 52:</b>	<b>Mr. Sasanka Borah left</b>	Dr. Pradip Baishya was invited for a lunch with Dr. David



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Date	Activity	Descriptions
12 <sup>th</sup> June, 2017, Monday	for Guwahati due to medical emergency  <b>Local holiday:</b> Due to Queen's birthday	Week and Farida at Lygon street.
Day 53: 13 <sup>th</sup> June, 2017, Tuesday	<b>Went to University of Melbourne</b>  Meeting with Dr. Hemanta Doloi	
Day 54: 14 <sup>th</sup> June, 2017, Wednesday	<b>Went to University of Melbourne</b> <ul style="list-style-type: none"><li>• Meeting with Dr. David Week from 10:00 am</li><li>• Meeting with Dr. Hemanta Doloi, Dr. David Week &amp; Mr. Geoff Kim from 11:00 am</li></ul>	<b>Meeting with Dr. David Week</b> Discussion on CM program outline. The compiled report for the five subjects was handed over to Dr. David Week for any changes before the printing is done. Opening of a gmail and dropbox account to be shared by all the students for sharing the resources and materials for the subjects.  <b>Meeting with Dr. Hemanta Doloi</b> Discussion was primarily on the visit to Assam by the team from Melbourne University Dr. David Week, Dr. Hemanta Doloi and Mr. Geoff Kim.  <b>Attended Lecture at Malaysian Theatre, Melbourne School of Design</b> A lecture session was attended on the topic 'Keywords for India: Development' by Emma Mawdsley a Reader in Human Geography at the University of Cambridge, UK.
Day 55: 15 <sup>th</sup> June, 2017, Thursday	<b>Went to University of Melbourne</b>	<b>Meeting with Dr. David Week</b> Discussion of the course structure and reporting formalities including Tour Diary. Discussed about the source of national and state policies on affordable housing in India.  <b>Meeting with Dr. Hemanta Doloi</b> Discussion and working together for compiling the visitor's report, printing and binding and taking back to Assam for submissions.
Day 56:	<b>Went to University of</b>	<b>Final day wrapping up activities</b>



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16 <sup>th</sup> June, 2017, Friday	Melbourne	<ul style="list-style-type: none"><li>• Returning library books</li><li>• Returning PPE used during construction site visits</li><li>• Progress in the research paper for ZEMCH</li><li>• Cleaning the apartment and readiness for handing it back.</li></ul>
Day 57: 17 <sup>th</sup> June, 2017, Saturday		
Day 58: 18 <sup>th</sup> June, 2017, Sunday		Leisure
Day 59: 19 <sup>th</sup> June, 2017, Monday	Dr. Pradip Baishya left for Guwahati	

