**SATHYABAMA**
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
Accredited with "A" grade by NAAC
Jeppiaar Nagar, Rajiv Gandhi Salai, Chennai - 600 119
www.sathyabama.ac.in

DNV·GL ISO 9001:2008

## SCHOOL OF BUILDING & ENVIRONMENT

### Department of Architecture

Board of Studies meeting for M.Arch. (Sustainabe Architecture) held on 01-07-2020

Venue: Virtual meet in ZOOM platform

Time: 10.30 AM – 1:00 PM

**Members present:**

| External Members | Internal Members | Signature |
|---|---|---|
| **Ar. ANUPAMA MOHANRAM,**<br>Co-Founder & Head - Architecture - Green Evolution<br>Chennai | **DR. DEVYANI GANGOPHAHY**<br>Dean & Head<br>Department of Architecture<br>School of Building & Environment | |
| **Signature** | **AR. ARULMALAR RAMRAJ**<br>Associate Professor | |
| | **AR. SHEETAL AMRAOTKAR**<br>Associate Professor | |
| | **AR. SANGHAVI**<br>Associate Professor | |

**Special invitees present:**

| S.No | Name and Designation | Signature |
|---|---|---|
| 1. | **AR. CATHERINE**<br>Assistant Professor | |
| 2. | **AR. KAVITHA**<br>Assistant Professor | |

The proposed curriculum and syllabus 2020 for M.Arch. (Sustainable Architecture) was accepted with the suggestions made by the external member as given below in the minutes of meeting

## Minutes of the Board of Studies 2020 meeting

---

**A Board of Studies meeting was held as Virtual mode in ZOOM platform on 1st July 2020 with the following agenda:**

1. Welcome address, Opening remarks on the proposal to introduce REGULATION 2020 and the methodology adopted.
2. Comparative analysis of existing R 2015 and proposed R 2020 curriculum structure, R 2020 curriculum structure and Salient Features of Regulation 2020.
3. Detailed discussions on the proposed syllabus (from semester 1 to semester 4) and proposed Regulation 2020.
4. Any other matter with the permission of Chair.

At the onset, theDeanwelcomed the members to the meeting of BOS and placed the agenda for deliberation of the members. The following deliberations were made as per the items of the agenda:

Dr. Devyani Gangopadhyay: explained the Retrospective outline of 2015 Regulations and scope for improvement.Then gave an overview about the concept for Regulation 2020 based on four focus areas being Energy conscious approach, Research Oriented, Flow of knowledge, User friendly and culturally responsive approach and how it is integrated with each semesterwas highlighted.

Followed by the Dean's initiation, the Syllabus Coordinator, Ar. Sheetal Amraotkar explained the following:

1. **Methodology** for framing the Syllabus which was based on inputs from the subject faculties, Students and the Professionals. The feedback consolidation from all were explained and this gave rise to the approach and requirements for broad changes in the curriculum. Further to this, comparative case study on five different syllabus was explained in brief, which enabled a cross verificationwith the current syllabus.
2. Ar. Sheetal Amraotkar then started explaining the subjects semester wise,

   **In Semester I**:Quantitative technique to be removed as it cannot be correlated without basic knowledge of Research methodologies instead it can be included in Semester 2 to quantify the research,

   Introduced new subject - SARA 5132 Building Energy & Environmental codes and standard, SARA 6131 Building Performance Analysis Studio I

   SARA 8201 Research Methodologies in Built Environment to be included as a core subject in the first semester to form the foundation for research approach.

   **Semester II**: SMTA5241 Quantitative Technique is been included which will be used to validate the research component.

   **Elective component** is not offered in first two semesters Ar. Sheetal told, as we wanted to develop core competencies of the students in the initial semesters, to which Ar.Anupama completely agreed.

3. **In Semester III**: In regulation 2015, Design Studio III is been provided, now in regulation 2020 it is been removed and instead Dissertation is been introduced, to enhance the area of research and Elective I & Elective II was discussed
4. **In Semester IV**: EIA.Elective 3 and Thesis is been offered
5. Following Ar. Sheetal Amraotkar explanation, Ar. Anupama Mohanram appreciated the introduction of Building Perforamnce Analysis Studio is great idea as it would keep the students up to date in new softwares ,she also encouraged site visits for SARA 5133 Climate and Architecture in Tropics and EIA .
6. Followed by Ar,Anupama Mohanram', suggestion, Ar.Sheetal Amraotkar explained the Agenda II: The Conceptual Framework , Agenda III (A): Proposed changes to the curriculum in a nutshell & Agenda III (B):Semester wise discussion along with the credits
7. Ar, Anupama Mohanram enquired whether the Research Methodologies in Built Environment offered in Semester I is the basics of research, Ar Sheetal explained the various units in the subjects and it was accepted and appreciated by the expert.
8. Ar Anupama Mohanram also appreciated the incorporation of Dissertation in Semester III as it would provoke the research interest among the students. She also insisted to be specific about the topic that needs to discussed in the built environment eg: Energy, water management etc.
9. Followed by Ar Anupama Monhanram's Suggestions, Ar Sanghavi explained the Subject SARA 5132 Building energy codes and Standards: where unit 1 & unit II covers the ECBC codes and unit III & unit IV discussed about SP14, which was also appreciated by the expert
10. Semester 1 subjects and studio were finalized byAr. Anupama Mohanram
11. Followed by Ar Sanghavi' explanation ,Ar .Sheetal explained the Semester II subjects and the Studio in detail ,where she mentioned that the Design Studio would be divided into two projects, where the project 1: to be a medium sized project with all sustainable practices to be incorporated and Project 2: Retrofitting project
12. Followed by Ar Sheetal's explanation, Ar. Anupama suggested the project to be small, so the students can understand the various aspects of sustainability clearly and for the project 2: she said Retrofitting project was a good idea and can be picked anything within the campus. She said that the subjects and the studio's offered in semester II were fine.
13. Followed by Ar Anupama inputs, Ar Sheetal explained the Semester III Subjects, Electives, Training, Dissertation and Prethesis. Ar Anupama asked to rethink of Elective: SARA 7333 Sustainable Building Practices as it looks generic and can be more focused and suggested to think of another elective or keep a case study itself as an elective, the students can identify the case study based on what aspect they wanted to do the study. This suggestion was cherished by the members in the meeting. Ar Sheetal suggested an open ended elective.
14. Ar Anupama also suggested to have Green Building rating systems as core subject in Semester III instead of being offered as an Elective. The students can pick any rating system and address only the

mandatory requirements to their particular project in Thesis, so that they learn sustainability in a holistic way.

Ar. Sheetal conveyed that Green Building Rating Workshop was conducted in the semester where hands on calculations were given to students and they practiced simple calculations in the workshop. Ar. Anupama liked this concept.

15. Ar Anupama highlighted about the Practical training, since the time frame given for Practical training is limited to 30 days, she suggested the students go to site and learn as they can compare the material or even do a post occupancy study during their training period.
16. Ar Anupama advised that the Practical Training and the Dissertation can be linked.
17. Followed by Anupama Mohanram's Suggestion, Dean requested for consultancy projects, as the department is equipped with good climatology lab and their projects can be validated. Followed by Dean's request, Ar Anupama agreed to look into the area of consultancy
18. Followed by Ar Anupama's approval, Ar Sheetal explained about Semester IV Subjects, elective and Thesis and Environmental Impact Assessment is mandatory subject and that the new syllabus now included site visit also which was appreciated by Ar Anupama.
19. Ar Sheetal explained the Thesis subject, which is culmination of all the Subjects, and Studio. Where the students can continue the Dissertation for their thesis orless it can completely be a new topic.
20. Followed by Ar Sheetal's explanation, Ar Anupama concluded that the curriculum was comprehensive and was pleased with the overall flow and subjects incorporated with just few corrections and appreciated the team for the process.
21. The meeting came to an end with Dean thanking note.

Minutes approved by

| External Members | Internal Members | Signature |
|---|---|---|
| **Ar. ANUPAMA MOHANRAM,**<br>Co-Founder & Head - Architecture - Green Evolution<br>Chennai<br>**Signature** | **DR. DEVYANI GANGOPHAHY**<br>Dean & Head<br>Department of Architecture<br>School of Building & Environment | |
| | **AR. ARULMALAR RAMRAJ**<br>Associate Professor | |
| | **AR. SHEETAL AMRAOTKAR**<br>Associate Professor | |
| | **AR. SANGHAVI**<br>Associate Professor | |

| SARA6131 | BUILDING PERFORMANCE ANALYSIS STUDIO | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 | 100 |

**COURSE OBJECTIVE:**

- To introduce Simulation software like EQuest, Sefaira, Design Builder, IES VE and Envi Met and upcoming software to learn the techniques and substantiate the design.
- To understand the various simulation strategies and applications related to building sensitivity analysis, i.e. understanding the impact of equipment load in the building.
- To determine the building performance through parameters like thermal comfort of spaces, daylighting analysis, wind analysis, energy optimization and quantification.

**STUDIO BRIEF**

**PART 1**

To understand the basics of Software through Hands-on experience and introductory parameters and their studies like Climatic analysis, Shadow analysis, volumetric zoning, mutual shading, building sensitivity analysis and material selection.

- To comprehensively study the behavior of building components through simulation strategies for better performance.
- To understand the climate responsive design strategies through daylighting analysis, solar radiation analysis, wind analysis, volumetric zoning of spaces and through performing iterations for one particular design.
- To perform Calculations and derive inferences for day lighting, ventilation and solar heat gain and loss with its analysis.
- Understanding the impact of design through multiple strategies & their behaviour from multiple results to determine the optimum design solutions
- Understanding the Behaviour of Building Components-through simulation
- To determine the behaviour of building in the aspects of Energy, $CO_2$ footprint, resources footprint, etc.

**PART 2**

- Understanding of Thermal Behaviour of Spaces, Calculations for thermal comfort of spaces, for various climate and conditions and its associated parameters like heat gains-losses, temperature profiles, fabric gains-losses, Ventilation etc
- Learning the Life Cycle of the Built environment through software like OpenLCA, Revit, etc.
- Add on software and Hands-on with allied and compatible software like Radiance, PMV, Solar Tool etc

**COMPREHENSIVE LEARNING**

Report with individual exercises for various parameters of the taught software as per break-up of module.

**COURSE OUTCOME:**

**CO1** Ability to investigate the performance of buildings through calculations
**CO2** Understand the basics of simulation software to analyse building performance
**CO3** Demonstrate skills and techniques for substantiating design through various analysis – daylighting, wind, solar radiation
**CO4** Critically analyse and perform calculations, prepare graphs and analyse the thermal performance
**CO5** Applying various software tools to analyse sustainability in the built environment.
**CO6** Acquired knowledge on calculations for thermal comfort, Ventilation, modelling for energy performance

**TEXT/ REFERENCES BOOKS**

1. Help Manuals
2. Video Tutorials
3. Trainers or Expert's Guest Lectures

| SARA5233 | PERFORMANCE ANALYSIS OF BUILDINGS | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 2 | 0 | 1 | 3 | 100 |

**COURSE OBJECTIVES:**

- To introduce the need for performance analysis of buildings and the emergent outcomes.
- To comprehend the fundamentals of shading devices and the tools for shading analysis.
- To analyze energy use through open source software.

**UNIT 1 PERFORMANCE OF BUILDINGS 9 Hrs.**

Need for performance analysis of buildings - Soft Computation - Investigation and assessment, energy audit procedures - Design investigations- Energy conservation measure calculations - Modelling systems: cognitive, empirical and analytical assessment of buildings – Parametric and empirical building simulations.

**UNIT 2 WHOLE BUILDING ENERGY SIMULATION 12 Hrs.**

Modelling the Building form - Parametric and empirical building simulation - Factors affecting accuracy of energy model- Thermal performance criteria of buildings- Envelope considerations, climatic analysis, weather data- Heating and cooling systems modelling, ventilation systems modelling. Computing energy required for heating/ cooling needs through open source software's.

**UNIT 3 DAYLIGHTING AND SHADING SIMULATIONS 12 Hrs.**

Shading simulations- Principles of shading design- Tools for shading analysis- Tools for shading design - Shading design exercises using open source shading software - Day lighting simulation models- Day lighting simulation criteria- Factors affecting accuracy of day lighting model - Day lighting simulation exercises using daylight modelling tools - BIM Integration.

**UNIT 4 ANALYSIS OF BUILDING PERFORMANCE 6 Hrs.**

Metering systems - Analysis of collected data from existing buildings - Economic aspects of energy simulation results: LCA, payback analysis, break even analysis, benefit cost analysis, present worth analysis, etc. - Selection of appropriate ECM from modelling results-Recalibration of the model from actual performance data.

**UNIT 5 COMPREHENSIVE LEARNING 6 Hrs.**

Based on understanding of above Units the students are expected to perform Whole building computation of a small project emphasizing on the material selection.

**Max.45 Hours**

**COURSE OUTCOME:**

**CO1** Ability to investigate the performance of buildings through calculations
**CO2** Acquired knowledge on whole building energy simulation.
**CO3** Comprehensive understanding of the parametric and empirical building simulation.
**CO4** Skills to develop building models for shading analysis and understand thermal performance of built forms.
**CO5** Evaluate the various factors which influence energy modeling of buildings.
**CO6** Understanding the various parameters to assess the building performance.

**TEXT / REFERENCE BOOKS**


1. ASHRAE. (2006). *The ASHRAE Green GuidE.* Butterworth- Heinemann: ASHRAE Press.
2. Clarke, J. (2007). *Energy Simulation in Building Design.* Routledge: Architectural Press.
3. GiulianoDall'O'. (2013). *Green Energy Audit of Buildings: A guide for a sustainable energy audit of buildings.* New York: Springer.
4. Power, M. o. (2007). *Energy Conservation Building Code of India, User manual.* New Delhi: Ministry of Power.
5. Waltz, J. P. (1997). *Computerized Building Energy Simulation Handbook.* Fairmont: Fairmont PR.

Wilson, P. T. (2011). *Daylighting: Architecture and Lighting Design,.* London: Routledge.

| SARA5132 | BUILDING ENERGY CODES AND STANDARDS | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 2 | 1 | 0 | 3 | 100 |

**COURSE OBJECTIVES:**

- To understand the importance and basics of ECBC and SP41.
- To devise the applicability of the methodologies prescribed in the codes
- To comprehend the compliance approaches

**UNIT 1 INTRODUCTION 6 Hrs.**

National policies on sustainable and energy efficient development, The Energy Conservation (Amendment) Act, 2010, National policies on sustainable and energy efficient development. Introduction and Guidelines of ECBC – Energy Efficiency Performance levels, Energy Performance Index, Compliance approaches – prescriptive method, whole building performance method (Energy simulation), Compliance requirements, Building Envelope – Fenestration, opaque construction, Daylighting, building envelope sealing, Roof - Skylights, Building envelope trade off method.

**UNIT 2 ECBC – COMFORT SYSTEMS AND CONTROLS 12 Hrs.**

Ventilation - Minimum Space Conditioning Equipment Efficiencies -Unitary, Split, Packaged Air-Conditioners, Variable Refrigerant Flow, Air Conditioning and Condensing Units Serving Computer Rooms. Controls – Temperature control, air conditioning control, occupancy control, fan controls. Piping and duct work. System Balancing. Condensers, Service water heating, cooling towers, Economizers, Variable Flow Hydronic Systems, Energy recovery. Low-energy Comfort Systems. Lighting and controls, electrical and renewable energy systems. Calculation of energy requirements of a proposed and standard design

Suggestive Assignment – Manual calculation – lighting, fenestration efficiency calculation and lighting power allowance calculation.

**UNIT 3 FUNCTIONAL EFFICIENCY OF BUILDINGS – HEAT INSULATION AND VENTILATION 12 Hrs.**

SP41 – Climate, Thermal comfort, Shading devices, energy requirement for cooling and heating. Heat Insulation - introduction, terminology, requirements, heat transmission through building sections, thermal performance of building sections, orientation of buildings, building characteristics for various climates, thermal design of buildings, influence of design parameters, mechanical controls. Ventilation - introduction, terminology, ventilation requirements, minimum standards for ventilation, ventilation design, energy conservation in ventilating systems.

**UNIT 4 FUNCTIONAL EFFICIENCY OF BUILDINGS - LIGHTING 9 Hrs.**

Lighting –standards, general, illumination requirement, day lighting analysis, supplementary artificial lighting design, artificial lighting design, energy conservation.

Suggestive Assignment – Work out examples on thermal insulation, method of calculating solar load on vertical surfaces of different orientation, orientation on the basis of solar road

**UNIT 5 COMPREHENSIVE LEARNING 6 Hrs.**

Arriving at Comfort band and passive strategies for a particular city using Mahoney table, calculating overheated period and deriving the shadow mask for fenestrations

**Max. 45 Hours**

**COURSE OUTCOME:**

**CO1** Explore about the national policies on sustainable and energy efficient development
**CO2** Understand the prescriptive method and whole building performance method.
**CO3** Analyse the available comfort systems and controls.
**CO4** Categorise the various parameters in heat insulation and ventilation.
**CO5** Acquire knowledge about the lighting requirement.
**CO6** Integrate the aspects learnt in the codes for effective application in design

**TEXT / REFERENCE BOOKS**


1. Bureau of Energy Efficiency, G. o. (2017). Energy Conservation Building Code. New Delhi: Bureau of Energy Efficiency.
   Standards, B. o. (1987). SP.41 Handbook on Functional requirements of buildings. New Delhi: Bureau of Indian Standards.
2. Standards, B. o. (2016). National Building Code . India: ureau of Indian Standards.

| SARA5232 | TECHNOLOGY FOR ENERGY EFFICIENT BUILDINGS | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES:**

- To understand the influence of HVAC technology on energy efficient buildings.
- To give a comprehensive introduction and the principles of natural and artificial lighting.
- To explore the fundamentals of integrating services in buildings.

**UNIT 1 HVAC TECHNOLOGIES 9 Hrs.**

Factors affecting HVAC Design - Types of Cooling systems air cooled, water cooled, chilled beams, chilled slabs, pre-cooling, free-cooling, VFD drives, etc.- ducting design, Individual controls and VAV boxes - Natural refrigerants,-types of air conditioning- combined heat power systems- Types of heating systems, radiant heating, solar heating -Conservatory design.

**UNIT 2 DAYLIGHTING & ARTIFICIAL LIGHTING 12 Hrs.**

Principles of day lighting design - Day lighting requirements, daylight protractor, day lighting sensors - Glare reduction systems and devices – Daylight harnessing systems -Daylight system with shading design - Artificial lighting - Principles of lighting systems, lighting design systems - Occupancy sensors - Glare reduction techniques.

**UNIT 3 VENTILATION TECHNIQUES 9 Hrs.**

Requirements of ventilation as per ASHRAE/ECBC - Natural ventilation: stack effect, courtyard effect, air changes, ventilation requirement calculations, cross ventilation - Artificial ventilation techniques: forced ventilation, fresh air systems, pre-cooling of fresh air - Heat recovery through economizers and desiccant wheels - Humidity control systems, demand controlled ventilation.

**UNIT 4 BUILDING SERVICES INTEGRATION 9 Hrs.**

Integration of various building systems - Building automation systems and intelligent building systems - Integration of HVAC systems with water supply and treatment systems - Occupant responsive buildings - Building information modelling- Case studies explaining various building systems.

**UNIT 5 COMPREHENSIVE LEARNING 6 Hrs.**

Exercise to work out cooling load, dehumidifying and heat load estimate. Comparative cost analysis (Capital investment vs maintenance/operating costs) against green buildings and ordinary buildings.

**Max.45 Hours**

**COURSE OUTCOME:**

**CO1** Comprehend the various types of air conditioning
**CO2** Understanding the principles of day lighting systems.
**CO3** Acquire knowledge on adopting the various daylight harnessing systems.
**CO4** Ability to categorize the ventilation requirements as per ASHRAE/ECBC.
**CO5** Evaluate the various methods to integrate automation of building systems in buildings.
**CO6** Develop the strategies to integrate services adopted in buildings through case studies.

**TEXT / REFERENCE BOOKS**


1. Allard, F. (1998). *Natural Ventilation in Buildings: A Design Handbook (BEST (Buildings Energy and Solar Technology)).* London: Routledge.
2. ASHRAE. (2007). *ASHRAE 90.1 user manual.* Atlanta: ASHRAE.
3. Brian Atkin. (1988). *Intelligent Buildings: Applications of IT and Building Automation to High Technology Construction Projects.* London: Kogan page limited.
4. David Egan, l. (1975). *Concepts in Thermal comfort.* Prentice: Prentice Hall.
5. Evans, M. (1980). *Housing, Climate and comfort.* London: Architectural Press.
6. Power, M. o. (2007). *Energy Conservation Building Code of India, User manual.* New Delhi: Ministry of Power.
7. standard, B. o. (1987). *Handbook of functional requirements of Buildings.* New Delhi: Bureau of Indian standard.
8. Wilson, P. T. (2011). *Daylighting: Architecture and Lighting Design,.* London: Routledge.

| SARA5234 | SUSTAINABLE WATER MANAGEMENT | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 | 100 |

**COURSE OBJECTIVES:**

- To understand the traditional knowledge of managing water in various contexts.
- To familiarize the fundamentals of technology for effective water management.
- To comprehend the strategies to reduce water consumption in buildings.

**UNIT 1 WATER MANAGEMENT – HISTORICAL PERSPECTIVE 9 Hrs.**

Traditional community wisdom regarding water management from different climatic zones of the world - Traditional Architecture of wells in Rajasthan, Gujarat, Tamil Nadu– Stepped Wells, Baoris, Tankas, etc.

**UNIT 2 WATER MANAGEMENT – MACRO LEVEL 12 Hrs.**

Management of the water cycle as a single system - Management of water supply, sanitation and drainage - Social imperatives, environmental considerations and economic challenges - Technological options for water management, recycling, reuse, conservation and treatment - Planning of settlements and large campuses based on principles of sustainable watershed development with water as a priority resource.

**UNIT 3 WATER MANAGEMENT – MICRO LEVEL 9 Hrs.**

Design for water conservation – Building and products - Designing building services, plumbing and sanitary design for effective water reuse, recycling, and recharge - Strategies for water pricing and its regulation - Rain water harvesting techniques – Basic Concepts, piping techniques and pit design for groundwater recharge wells.

**UNIT 4 STRATEGIES TO REDUCE WATER CONSUMPTION IN BUILDINGS 9 Hrs.**

Low flow plumbing fixtures for water efficient appliances - Rain water harvesting - Reuse of grey water for non-potable uses - Wetlands for natural waste water treatment, use of wetlands for natural storm water and vegetated roof tops, (natural) renewable power source such as photo voltaic, solar hot water fuel cells etc.

**UNIT 5 COMPREHENSIVE LEARNING 6 Hrs.**

Submission of reports by interviewing those involved in rainwater harvesting and water management system. Critically analyse water management strategy adopted in any particular case study.

**Max.45 Hours**

**COURSE OUTCOME:**

**CO1** Understand the basic concepts on the ways to manage water in different climatic zones specific to Indian context.
**CO2** Summarize the importance of water management from the social, environmental and economic perspectives.
**CO3** Construct knowledge of incorporating sustainable principles of watershed development in large campuses.
**CO4** Ability to analyze the various methods to reduce, recycle and recharge water at the building level.
**CO5** Criticize the fundamentals of renewable power sources.
**CO6** Develop a strategy that can be achieved from practical knowledge in the water management system.

**TEXT / REFERENCE BOOKS**


1. (Ed.), K. N. (2006). *Water Resources Management: Realities and Challenges, .,2006.* India: Eastern Book Corpn.
2. Athavale, R. (2003). *Water Harvesting And Sustainable Supply In India.* India: Rawat Publication.
3. Dr B C Punmia, A. K. (2011). *Water Supply Engineering, Water safety in buildings.* Geneva: World Health Organization,.
4. Honore(Ed.), G. (2002). *Principles and Practices of Integrated Watershed Management in India,.* -: Indo-German Bilateral Project.
5. Iyer, R. R. (2009). *Water and the laws in India.* Chennai: Sage Publications India Pvt. Ltd,.
6. Jain, S. K. (2007). *Hydrology and Water Resources of India, Water Science and Technology Library, Vol. 57, .* New York: Springer.
7. John Briscoe, R. M. (2007). *Handbook of Water Resources in India: Development, Management, and Strategies .* Chennai : )Oxford University Press.
8. Singh, P. (2008). *Rainwater Harvesting: Low cost indigenous and innovative technologies.* India: Macmillan Publishers.

| SARA9131 | SUSTAINABLE DESIGN STUDIO I | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 12 | 6 | 300 |
| Continuous Assessment | | University Viva | | | Min Pass Marks | |
| 200 | | 100 | | | 150 | |

**COURSE OBJECTIVE:**

- To identify contemporary relevance of sustainable principles in vernacular buildings and to compare/ contrast the same with recent buildings.
- To understand the difference in the sustainable principles adapted in vernacular buildings against contemporary buildings and the significance of passive techniques
- To understand and apply the climate responsive passive strategies on a small-scale building design

**STUDIO BRIEF 01**

CASE STUDY 1

To identify and document a building or a group of buildings from a pre-industrial, vernacular, traditional settlement in India and

- To comprehensively study the building in terms of it layout, use of materials, spatial and environmental concepts, user comfort, ambience, distinct features etc.,
- Understand its climate responsive design strategies, sustainable practices and their contemporary relevance.

CASE STUDY 2

To identify a modern building or a group of buildings built within the last decade and

- document and analyze their layouts, use of materials, spatial and environment concepts, ambience, user comfort etc.,

COMPARISON OF CASE STUDIES 1 AND 2

- To compare and contrast case studies 1 and 2 to understand the shift in societal values and their subsequent effect on sustainability

PROPOSAL

Propose changes or modifications (Façade modifications / passive strategy application) to the 'lesser performing case' and prove its enhanced climate responsiveness.

**DELIVERABLES**

Students shall submit case study documentation sheets with requisite sketches, photographs, models, cognitive analysis diagrams, empirical documentation, detailed narrativesand proposal for modification and enhancement of one of the cases based on the analysis.

**STUDIO BRIEF 02**

1. The students shall design a residential building which shall function as per ECBC guidelines
2. Students shall select any one climatic zone from ECBC's climatic zone classification.
3. They shall select any city from a zone and research local bye laws and regulations.
4. They shall analyse site fit and program brief
5. They shall evaluate cultural, environmental factors and inspirations for environmental design from local vernaculararchitectureand nature.
6. The building should highlight at least one local material and one material which has low embodied energy as compared to conventional technology.

**DELIVERABLES**

1. Study report on climatic and microclimatic parameters that will guide environmental site development.
2. Study report and story board incorporating site fit, zoning and program brief, contextual adaptations from vernacular/ nature responses, conceptual design.
3. Residential typology precedent analysis and Preliminary energy analysis
4. Architectural documentation including 2D drawings and 3D models
5. Detailing and modelling of green building features emphasizing passive design features.
6. Detailed calculations as per ECBC standards.

**COURSE OUTCOME:**

**CO1** Understand and document the sustainable principles and practices, and passive design strategies in a built environment.

**CO2** Demonstrate a heightened awareness of sustainability as a multidimensional concept and awareness of the environmental factors influencing the built environment and vice versa.

**CO3** Critically analyze, evaluate and make informed judgment on the working of sustainable design strategies in vernacular

and contemporary buildings

**CO4** Develop design strategies that optimize and conserve resources and provide comfortable environment for the occupants in a buildingin a particular climate

**CO5** Ability to use software tools to analyze sustainability in the built environment.

**CO6** Applying Passive strategies and finding solution for development of sustainable practices in a small-scale building.

**TEXT / REFERENCE BOOKS**


1. Deulgaonkar, A. (2015 ). *Laurie Baker, Truth in Architecture.* New Delhi: Jyotsna Prakashan.
2. Kainth, G. S. (2011). *Climate Change, Sustainable Development and India.* New Delhi: LAP Lambert.
3. Lengen, J. V. (2007). *The Barefoot Architect: A Handbook for Green Building.* California, USA: Shelter Publication.
4. Spiegel, R. (2010). *Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition.* -: John Wiley & Sons.
5. TERI. (2004). *Sustainable Building - Design Manual Pt 1 & 2.* New Delhi: Teri Press, The Energy And Resources Institute.


| SARA9231 | SUSTAINABLE DESIGN STUDIO II | L | T | P | Credits | Total Marks |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 14 | 8 | 300 |
| Continuous Assessment | | University Viva | | | Min Pass Marks | |
| 200 | | 100 | | | 150 | |

**COURSE OBJECTIVES:**

- To incorporate the sustainable principles and approaches to the identified typology in the site, built form and the environment.
- To develop the design skills with respect to larger scale project
- To gain and apply knowledge for detailed calculations on energy and water saving.

**STUDIO BRIEF 01**

1. The student shall select a Campus type: Example
   Residential/ Commercial/ Institutional/ Industrial-manufacturing/Corporate/ Healthcare/ Hospitality
2. Students shall select any one climatic zone from ECBC's climatic zone classification.
3. They shall select any city from a zone and research local bye laws and regulations.
4. They shall analyse site fit and program brief
5. They shall evaluate cultural, environmental factors and inspirations for environmental design from local vernacular and nature.
5. They shall design buildings which shall function as per GRIHA and ECBC guidelines
6. The building should highlight material which has low embodied energy as compared to conventional technology and at least one sustainable building service technology in HVAC
7. The student shall design an energy model using an open source software such as eQUEST, IESVE, which gives comprehensive energy use analysis of the building.

**DELIVERABLES**

1. Detailed description of building typology selected and reasons for the same.
2. Climatic analysis and microclimatic analysis of the site.
3. A case study of a similar building in a similar climatic zone with respect to sustainability features, etc.
4. Study report on climatic and microclimatic parameters that will guide environmental site development.
5. Study report and story board incorporating site fit, zoning and program brief, contextual adaptations from vernacular/ nature responses, conceptual design.
6. Preliminary energy analysis and Architectural documentation including 2D drawings and 3D models
7. Detailing and modelling of green building features including passive design features, hybrid features, active features, etc.
8. Detailed calculations to show energy and water savings and daylight calculations
9. Detailed embodied energy calculation
10. Final energy analysis

**STUIDO BRIEF 02**

Retrofitting of building – Any Building type – Focus on building Envelope design

1. To understand Building and Climatic variables through field study analysis- measurements on-site, photos etc
2. The students will make a team andare to discover a single design strategy that will meet multiple design objectives.
3. Examine the elements in a building that mediate between the interior and exterior environment
4. To initiate energy conservation retrofits to reduce energy consumption and explore the building performance
5. To improve indoor environmental quality, decreasing moisture penetration, and reducing moldfor occupant health and productivity.
6. The design major renovations and retrofits for existing buildings should include sustainability to reduce operation costs and environmental impacts, and can increase building adaptability, durability, and resiliency.
7. They shall follow the ECBC guidelines

**DELIVERABLES**

1. Detailed description of building typology selected and reasons for the same.
2. Climatic analysis and microclimatic analysis of the site.
3. Case studies to understand envelope design, various measures to retrofit with respect to sustainability features, etc
4. Alternative strategies for improving thermal comfort.
5. Base case and Design case analysis
6. Final Design with details and simulations
7. Summary of detailed energy, water savings, daylight and embodied energy calculations and conclusions.
8. Report of the entire exercise as group work to be submitted.

**COURSE OUTCOME:**

**CO1** Explore the sustainable principles relevant to the design typology and the context
**CO2** Ability to incorporate the sustainable principles and practices, and passive design strategies and analyze the same in the identified typology.
**CO3** Acquired knowledge on Energy models and calculations
**CO4** Develop design strategies that optimize and conserve resources and provide comfortable environment for the occupants in a building
**CO5** Simulating by use software tools to analyze the incorporated sustainable ideals in the emergent outcome.
**CO6** Critically analyse, evaluate and make informed judgment on the working of sustainable design strategies in design.

**TEXT / REFERENCE BOOKS**


1. ArvindKrishen, N. B. (1999). *Climate responsive architecture: A design handbook for energy efficient buildings.* New Delhi: McGraw Hill Education ( India) Pvt. Ltd,.
2. B.V Venkatarama Reddy and K.S Jagadish, s. ,. (2003). *Embodied energy of common and alternative building materials and technologie.* Vol. 35 (pp129-137): Energy and Buildings.
3. Egan, D. (1975). *Concepts in Thermal comfort.* Prentice: Prentice Hall.
4. Lengen, J. v. (2007). *The Barefoot Architect: A Handbook for Green Building .* UK: Shelter Publication.
5. Power, M. o. (2007). *Energy Conservation Building Code of India, User manual.* New Delhi: Ministry of Power.
6. Willie Weber, S. (. (2002). *Lessons from Vernacular Architecture.* -: Routledge.