Greening an architectural curricula – Integrating environmentally responsive design in the architectural education

1.0 INTRODUCTION

The word ‘Green’ has become a pervasive influence and seemingly ubiquitous presence with architectural education. The scale in which the world has been experiencing damages and fatalities in recent years with the growing pressures of environmental changes such as rising sea levels, fast depleting resources, and climate change, have all contributed to the acknowledgement that green education has a significant role to play in addressing these challenges. The environmental consciousness has begun to spring up worldwide. Around the world, governments, organizations and institutions are considering ways to take better environmental care to improve the existing climate problems and prevent further damage as well as develop sustainable communities. So in fear of the energy and climate crisis, the world is slowly recognizing the importance of sustainable development. Building sector is a major contributor to the environment change and the Building and construction industry can play a vital role towards sustainable development. In order to match up with the challenges of global warming and scarce natural resources, the practice of sustainable construction is necessary. Sustainable construction can be achieved with the application of tools that deal with the assessment of the whole life cycle, site planning and organization, material selection, re-use and recycling of materials, waste and energy minimization. With the growing emphasis on sustainable construction, architects are being forced to act and design the building in more environmentally sustainable ways. While a part of this involves changes in behavior and life style, these changes should begin with our architectural education and how it is built up. Green architecture education is believed to be effective in encouraging the integration of sustainable package in the building industry. As designers of the built environment, architects have a tremendous opportunity to make a positive impact on the lives of the ‘bottom billion’ and can play a vital role in the creation of sustainable built environment and responsive to the needs of a changing world and have a large influence on the building performance of buildings. Today’s architecture students will be tomorrow’s architects and design professionals. The student perspective provides valuable insight and vision to be leveraged into measureable results. However, most of the architects are not aware or have little information on energy efficiency and recycled materials and hence having problems in adopting environmentally friendly built environment. They need to acquire the knowledge needed to address pressing environmental, social, and economic challenges through design, conservation and responsible professional practice. One of the strategies has been to include green design in a curriculum that would ensure to improve the architectural education. Students need a high level of green education if they are going to change the nature and practices of the industry when they enter the professions. The concern is that when the student enters industry they may be swayed by industry practices, and effectively ignore the knowledge that they have acquired about environmental damage caused by construction work. Their attitudes and behaviour may begin to conform to existing industry practices. One of the most important influences on behaviour is attitude that in turn is influenced by education. So idea of green education is to change attitudes that will in turn change behaviour as education is generally perceived to be the most important factor in forming attitudes.

The success of sustainability in design and in the built environment relies on how institutions of education philosophy respond to the ideas generated as a result of widespread interest in sustainable development. If sustainability is to become an essential aspect of society and economical development then it has to become an essential part of education. It provides an ability to do architectural design to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety and sustainability. These courses are essential to link the students to the real world and appreciate the realization of the profession.

Hence, the aim for this paper is to review architectural education and implement green curriculum to enhance the environmental awareness of building construction practices as well as provide basic direction for the building industry to head in the direction of environmental protection and achieve sustainability. The descriptive survey research method was used for the study to examine the level of

awareness and existing curriculum on sustainability and sustainability content in studio project and related courses. It helps to understand to what extent the current education curriculum are oriented towards creating professional and technical skills needed to cater to the growing demand for green architecture and green building construction and operations. In addition, it helps to prepare students to enter the profession of architecture in the 21st century, with broad knowledge of current need of sustainability and recognize the positive impact of design on the environment.

The main objective is to emphasize the inter-relationship between building construction and the environment. The building sector has a large role to play in this campaign as it consumes a significant fraction of materials produced and emit CO2 emissions globally. And in this consumption and emissions rate, architectural education plays the leading role. In order to progress and acknowledge the destructive effects these construction practices have on the natural environment, the development of new curriculum into architectural education comes along as part of the progressive step. The primary purpose to bring sustainable courses in undergraduate programme is to educate students towards a sustainable development in the profession of architecture. An undergraduate program is committed to maintaining diversity of course offerings that allow institutes to undertake courses as per their choice, at a range of scales from art and aesthetic to building technologies. For this, green curriculum need to be introduced to facilitate and encourage students and designers to play a bigger role in ensuring that their buildings are not contributing to the negative effects of globalization with the creation of a sustainable built environment in mind. It encourages the adoption of green building design and technologies to improve buildings energy efficiency and reduce negative environmental impacts like carbon emission.

The study focuses on five themes: Enhancing a curriculum for sustainability, curriculum revision process and procedure, role of the council of architecture, impact of flexibility to the institutions, and current trends and issues. The study is further defined through six etic issues: the driving forces behind curricula revision, COA role, adaptation and creation of sustainable programs, the faculty's role, the role of students and other groups or individuals, barriers to curricula revision. Most themes and issues are apparent in the findings. Current trends and issues – Enhancing a curriculum for sustainability is the single most influential theme of the process. Defining general education and its purpose, emerges as the pivotal issue of the study. The study provides descriptive detail of the development of the general education core curricula.

RESEARCH PROCESS FLOWCHART

STEP- 1

STEP - 2

STEP - 3

STEP - 4

STEP - 5

STEP - 6

STEP- 7

STEP - 8

1.1 The Idea of green architecture education

Recently, the climate changes and global warming have become the most critical global environmental issues affecting all people in the world. These global environmental issues call for urgent and effective actions from individuals, organization and countries to reduce greenhouse gas emissions. The construction industry is one of the most resource-intensive and environmentally damaging industries in the world. The built environment has brought adverse impacts to the environmental surroundings. Deteriorating natural resource profiles, climate changes and global warming that need access to sustainable energy infrastructures make it necessary to review what catalyst measures and policies are needed to further accelerate climate change mitigation measures in India, and in a sustainable manner.
In addition, Construction sector plays an important role in India's economics and GDP. Given that building is a major component for economic growth, it is inevitable that 'greening' of building is a major step to mitigate these adverse effects. Hence, efforts must be put in to embrace better environment towards sustainable construction. Therefore, sustainable construction concept needs to develop to raise the awareness of people involving in a project and aim at a sustainable development.

The construction activities have significant impact on both environmental and economic development of a country. Today, an escalating focus is on sustainability. Emphasis on building energy efficiency and consumption is greater than never before. As such, architectural education enhancement is crucial to further improve on the efficacy of existing curriculum to meet this demand. Sustainable design is no longer just a bonus, but a necessary concern in any education. Yet, sustainable architecture in India is still in its infancy, and is only gradually gaining acceptance and demand amongst students and educators. Green Buildings in the local scene has taken on a relatively slow pace and are not very well-developed or well-received. The level of recognition of the benefits associated with Green Buildings in India is uncertain since research in this area is still in its infancy. Moreover, not many people have the experience in occupying Green Buildings before as the Green concept is a comparatively new trend. Thus, people may be unfamiliar with the potential of this new market segment and are doubtful of the benefits as claimed.

In addition, the urbanisation of the world in the coming several decades will add 3 billion people to urban populations, an amount equal to all city-dwellers today. Therefore, in this context, architectural education needs to move towards incorporating sustainable 'green' curriculum into their system. Given COA's positions as the key driver of architecture education in India need to lead the shift towards sustainable design in India. CoA should targeted teaching and research in the sustainable context for special attention. Several modules should be offered that address the need for educating the architect to be able to deal with the important issues of future buildings including critical resource constraints, the need for energy efficient and humane housing, rapid urbanisation, Land use planning, and land use transformations.

Sustainable appraisals that architects and designers are involved in are mostly restricted to the architectural object (buildings) and its operations. This study is interested in the sustainability of larger and broader territories, with a focus on sustainable built environment in India. It arises from the recognition of the importance of, albeit underdeveloped, stages of methodology for development of curriculum for an architectural education. Sustainability approaches now require more integrated processes across disciplines. Hence, it probes the efficacy of new curriculum in merging multi-disciplinary factors across the different stages of planning, designing, building and monitoring large scale infrastructure projects. It has been observed that there is a gradual but growing demand for green curriculum that leads to green construction in India. So with increasing evidences on global warming and sustainability issues, Architects and designers around the world are calling for green movement in buildings due to its characteristic of having a long life span

In light of the emphasis placed on sustainable design in the built environment in India, the construction architectural education is moving towards the concept of "Green Building". From these rising education shortcomings, we can see the necessity of having a detailed green curriculum to help achieve a ` built

environment. By establishing green curriculum, the result generated will help students to understand the environmental impacts due to different building operations and incorporate green elements in their design. It can help to identify function(s) of the building system and building technologies. With these identifications, they will then be able to derive effective strategies in tackling the design at the root cause. Hence, it is important and crucial to implement green curriculum into India's architecture education.

1.2 Buildings and their impact on the environment

In India, construction industry is growing rapidly at a rate of 10% compared with the world average of 5.2% and has a large and growing resource footprint. It is observed that buildings in India consume about 30% of the total electricity in the country. Electricity consumption for lighting, air conditioners, water heaters and other appliances accounts for 10% of total electricity consumption. Between 45% and 65% of the energy consumption in buildings is for heating, ventilation and air conditioning (HVAC). Also buildings are responsible for 40% energy use, 30% raw material use, 20% water use and 20% land use. Furthermore at the same time it causes 40% carbon emissions, 30% solid waste generation, 20% water effluents. Not only being responsible for greenhouse gas emission, the construction industry is also responsible for various types of pollution caused by its activities in a life cycle process: from planning and design phase, to construction, operation and lastly deconstruction and demolition.
India's construction sector accounts for 10% of global GDP, has direct and indirect impacts on the environment, employing 41 million people, and is poised to become the world's third-largest construction sector by 2018. In terms of monetary value, the equivalent of $370 billion was spent on construction in India in 2013. Over the next five years, the sector is expected to grow by 16-17%.

Building construction and operation have detrimental impacts on the environment. Due to man activities, the nature has been drastically tailored and transformed into cities with buildings of all kinds. This have significantly influence on resource dissipation and biodiversity degradation. Buildings impact on the environment in its life cycle stages account for one-sixth of the world's freshwater withdrawals, one-quarter of its wood harvest, and two-fifths of its material and energy flows (PTI, 1996). According to D. Pearson (1995), structures also impact areas beyond their immediate location, affecting the watersheds, air quality, and transportation patterns of communities. In addition, studies suggest that over 80 percent of greenhouse gas emissions take place during building operational phase to meet the various energy needs such as heating, ventilation, and air-conditioning (HVAC), water heating, lighting, entertainment and telecommunications. Building sector accounts for a significant amount of GHGs. United nation Environmental programme (UNEP) (2009) revealed that buildings are responsible for one third of global GHG emissions, both in developed and developing countries.

According to BEE report, approx. 659 million sq.m built up area was constructed and it is estimated 1900 sq.mt built up area by year 2030. It means 66 % building stock is yet to be constructed. As the buildings have a considerable environmental impact that requires the attention of all key players involving in the building lifecycle. Also as per IGBC, India has now a registered green building base over 2.2 billion sq.ft, which was achieved in about 10 years and now IGBC is aiming to have a registered base of about 10 billion sq.ft by 2022, when India would e 75 years after independence. Generally, buildings have a long life-span as compared to buildings of the past; it is of essence that the developments of buildings have to take into considerations of being sustainable in terms of social, economical and environmental. Environmental issues made many countries to turn to sustainable or green building as the building sector has the most energy consumption as compared to other sectors. The contribution of buildings to the total environmental burden is significant. The environment impact of the buildings on the environment is coupled with the rapid urbanization of the human population and industrialization. Buildings have the potential to use — or conserve — large amounts of energy, water and materials, as well as to produce or minimize waste. In addition, they can teach us about history, art and anthropology. As a result, sustainable architecture and design is important to sustainability not only because green practices can lessen a building's environmental footprint, but also because sustainable buildings can be used to teach those who live, work or study within them about environmental and cultural sustainability. Therefore, there is a need for more environmental-friendly buildings to minimize the impact of buildings on the environment. Adopting green building practices would significantly reduce these environmental and resource impacts. Hence, building construction industry in India has a significant impact on the

environment and resources. This indicates that there is a real opportunity to develop green buildings in the country.

2.0 India initiatives for the sustainable built environment

India has stepped up efforts in the promotion of environmental sustainability and friendliness through various methods. Although there is no consolidated law with respect to green buildings in India, provisions in existing legislation and several policy initiatives recognise the environmental aspects of the construction sector. The 12th Five Year Plan (FYP) aims to hasten the adoption of codes relating to green building through the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and by linking financial devolution to local urban authorities to the implementation of green building codes. The National Action Plan on Climate Change (NAPCC) and the National Mission on Sustainable Habitat address energy efficiency in buildings.

The government promotes the Energy Conservation Building Code (ECBC) as an integral component of urban planning, applicable to buildings with a load of 500 kilowatts (kW) or more. BEE released it as part of a national strategy to ensure that new constructions will meet minimum energy efficiency criteria for commercial buildings. BEE is using standards and labelling to increase awareness and reduce the energy consumed by appliances.

A new chapter on sustainability has been introduced to the National Building Code (NBC). The Indian Bureau of Standards and the Building Materials and Technology Promotion Council are addressing building materials production and standards.

There are policies for water use in buildings at the state and municipal levels. Rainwater harvesting, for example, is mandatory in a number of states and cities. Hyderabad and Delhi have set standards for wastewater management.

Also in most countries the private sector is responsible for much of the construction industry, including building development, management and the supply of appliances and energy. The private sector thus has a vital role in both financing and producing green construction and creating a market. The private sector can also help to promote positive change in green building councils and industry bodies. Examples are Voluntary green building rating systems have become a popular tool to encourage the construction sector to adopt sustainable practices. In India, the two main rating systems are the Green Rating Integrated Habitat Assessment (GRIHA), developed by TERI and the Ministry of New and Renewable Energy, and Leadership in Energy and Environment Design (LEED), operated by the Indian Green Building Council (IGBC). GRIHA uses a set of 34 criteria to assess buildings with a floor area 2,500–150,000 m2, and incorporates all the relevant building codes and standards, including the ECBC, and has been adopted by the government Central Public Works Department. Other rating systems for green buildings in India are the Small Versatile Affordable GRIHA, developed by TERI and Association for Development and Research of Sustainable Habitats (ADaRSH) for small stand-alone buildings; the Eco-Housing rating system developed for Pune; and the Star Rating Programme for Buildings of the Bureau of Energy Efficiency. The IGBC also has rating systems for homes, townships, special economic zones factories and landscapes.

3.0 Sustainable development through sustainable design and construction

The concept of sustainable development evolved through the years. The beginning of the idea can be traced way back, as long ago as the work of Malthus on population growth in the late 1700s. However, the concept really took off during debate in the early 1970s, following a series of key publications drawing the world's attention to over exploitation of the environment. In 1972, the UN Stockholm Conference on the Human Environment marked the first international meeting on how human activities were harming the environment and putting humans at risk. Subsequently, In the year 1987, the 42nd United Nations Congress marked the emergence of an official definition of the concept of sustainable development. This happened with the definition given in the Brundtland‟s Report, which defined the concept as „development which meets the needs of the present without compromising the ability of future generation to meet their own needs‟ (WCED, 1987). The state of sustainable is reached when equilibrium between environmental sustainability, economic sustainability, and sociopolitical sustainability is achieved. Twenty

years have passed and a series of researches on how to conserve energy are carrying on continuously. It is of utmost importance now to implement practical measures to enhance the usage of resources. As one of the measures in curbing climate change, increasing energy efficiency in the surroundings of our lives has become the target of many scientists and engineers who seek to innovate for a more sustainable future. In 1992 Rio Summit Declaration, the sustainable development issue was brought up again with emphasis on more social aspects of development, including mobilizing youths and women, and respect for indigenous culture.

Sustainable development covers a wide spectrum of issues involving economic, social and environmental sustainability. Whilst the developing countries face the toughest challenge of poverty and hunger eradication, the greatest sustainability challenge faced by developed economies may be the mitigation of environmental harm. However, as focusing only on environmental sustainability at the expense of sacrificing continuing economic growth is not going to be a popular option, these countries need to make conscientious efforts to continue and sustain economic and social development in balance with measures to promote environmental sustainability.
Sustainability in the construction sector is one of the many ways to fulfill the progress of all three aspects of sustainable development, namely, economic, social and environmental. While economic progression takes place in developing countries, development of infrastructure and various facilities are being built to cater for more economic and social activities. The construction of these amenities are going to cause pollution to the environment causing huge amount of carbon dioxide and other toxic materials and gases to be released to the atmosphere. Hence, by incorporating sustainable building practices during construction and adopting green building design and technologies, pollution can be minimized.
Furthermore, these amenities once constructed will be in use for a long time, hence incorporating sustainable features in the buildings will reduce potential pollution that will be released during the operation of the building facilities. Therefore sustainable development in built industry will save the environment from pollution and bring about better quality of life by having cleaner environment.
International conventions and agreements like the Rio Earth Submit (1992), the United Nations Framework Convention on Climate Change (1994) and Kyoto Protocol (1997) that deal with sustainable development have had implications on the progression of the built environment in a business as usual scenario. This is because the buildings are responsible for more than one third of total energy use and associated greenhouse gas emissions in the society both in developed and developing countries (UNEP, 2008). Being such a major contributor to global carbon emissions signifies that small changes could potentially have large effects and significantly reduce the harmful impact the building industry has on the environment. According to the Intergovernmental Panel on Climate Change (IPCC), stated in its fourth assessment report that the building sector not only has the largest potential for significantly reducing greenhouse gas emissions, but also that this potential is relatively independent of the cost per ton of CO2 eqv achieved. This is partly due to the fact that most measures aimed at greenhouse gas emission reduction from buildings also result in reduced energy costs over the buildings" life cycle, which over time off-sets increased investment costs (UNEP, 2008). Hence, it is clear that changes in the built environment are needed to monitor and restrict the carbon emissions from its activities.

Sustainable development has turned out to be a global issue as global climate changes have gradually become a serious concern for the future. Anxiety over the impacts of built environment on natural environment, economy, health, and productivity. Therefore, the major goal of sustainable construction is to create a healthy built environment based on efficient use of resources and smart ecological design. Sustainable development, when applied to project development, would involve —the efficient allocation of resources, minimum energy consumption, low embodied energy intensity in building materials, reuse and recycling, and other mechanisms to achieve effective and efficient short- and long-term use of natural resources. Therefore, sustainable construction is about the adoption of building designs, construction methods and materials that are environmentally friendly. Processes of the construction industry have been pushed towards sustainable construction seen 1994.When the concept of sustainable construction was first developed from the First International Conference on Sustainable Construction held in 1994 introduced by Charles J. Kibert. The major aim of the conference is to look into the new concept of ‘sustainable construction’ or ‘green construction’. Kibert (1994) suggests that sustainable construction is defined as *“creating and maintaining a healthy, resource efficient built environment based on ecologically*

principles". Kibert in 1994 has proposed six guiding principles for attaining sustainable construction. They are reduce, reuse, renew/recycle, protect nature, eliminate toxics and attaining good quality. These are incorporated into the Sustainable Construction Framework. The framework was later revised in 2005.

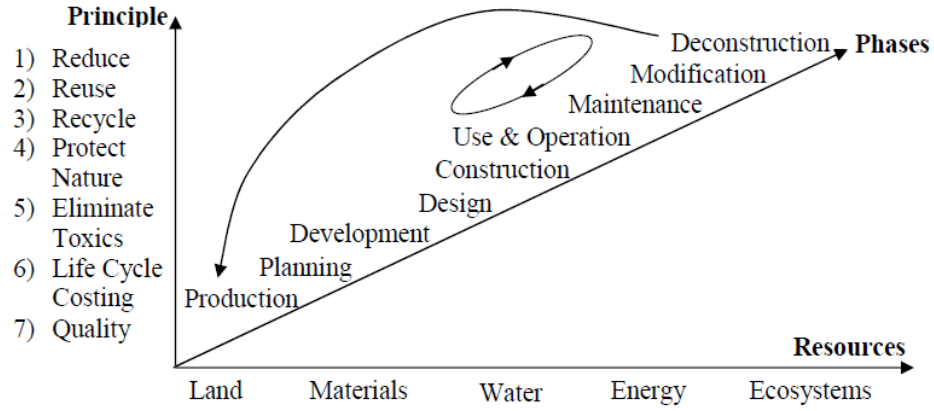

Figure: Sustainable construction framework
Source: Kibert (2005)

Kibert (2005) has added an additional guiding principle, which is the life cycle cost of the building in the sustainable construction framework. During the presentation, he has also highlighted that there are some key concepts which are still undeveloped. They are ecological design, closing material loop and integration with nature. Ecological design is linked to the design of different material that is used in developing the building and would include the use of recycled materials. Hence when the material loop is closed, all the C&D waste which is obtained from demolition should be fully recycled to form new parts of another building. However the development in that area is lagging, thus further development in this area would be required to take the construction industry towards the sustainable construction.

The true bottom line of sustainability has 3 key aspects: economics, environment and social responsibility (GBES, 2009). Similarly, sustainable construction concept also involves that triple bottom line. Sustainable construction applies to the whole project life cycle, starts right at the beginning of a project, from pre-design process, through design, planning, tendering to construction stage, occupancy and deconstruction.

A very common term used for a major focus area in sustainable construction is 'Green Building'. Positive outcomes of green construction can be measured in terms of electricity and water savings, improved health and reduced consumption of resources (Eco Ventures, 2009).

4.0 Green curriculum

Green curriculum could be thought of as the reformation of existing architectural disciplines and practices to those that lead to sustainability. A new paradigm in greening the curriculum has evolved. It is an emerging philosophy which aims to protect environment through the design. Green design has environmental, economic and social elements that benefit all stakeholders, including owners and the occupants. This is achieved through better site development practices, design, construction, operation, maintenance, removal and possible reuse of materials. Greening an architectural curriculum is an important consideration to foster sustainable thinking in graduate architects. The basic principles of green curriculum include life cycle thinking in designing of buildings, minimization of depletion of resources including energy, minimization of waste generation etc. Green curriculum are favorable as buildings are designed to minimize and ultimately eliminate the overall negative impact of the built environment on the health levels of human as well as the natural environment. There is greater emphasis on green buildings to reduce carbon emissions in order to aid in environmental sustainability as well as bring about final savings from the efficient energy building and equipment employed.

The main objective of green curriculum is to prepare students to design, explain, promote and implement strategy for bringing sustainability culture into construction industry.

Importance of green curriculum

Green education as one of the catalyst for sustainable development. The need to introduce issues of sustainability into architectural curricula has become critically important, as the architect play a vital role in the creation of built environment. It is imperative therefore for those students, who are future architects to be aware of how their attitudes, behaviour and actions will impede the future natural environment. The notion of green curriculum has a special relevance to construction and its environment and keeping it sustainable is of utmost importance. Green curriculum plays an important role in achieving environmental sustainability in building due to its wide application and its integrality in driving green building technologies. The concept of green curriculum is a direct response of the construction industry's efforts in achieving sustainability. The promotion of green curriculum in architectural education is a key factor for addressing the challenges that mankind faces in response to finite resource availability, ecological deterioration and climate alteration.

Green curriculum Frameworks

Green curriculum courses incorporate sustainability as a distinct course component or module or concentrate on a single sustainability principle or issue. These courses may cover environmental, social, or economic issues. It provides an ability to design projects that optimize, conserve, or reuse natural and built resources, provide healthful environments for occupants/users, and reduce the environmental impacts of building construction and operations on future generations through means such as carbon neutral design, bioclimatic design, and energy efficiency.

The actual model focuses on 10 main foundation elements for sustainable development.

1. **Environmental systems**

Understanding the principles of environmental systems' design such as embodied energy and embraces macro and micro environment - Macro environment encompasses elements of climate, environmental quality, climate change, ozone depletion etc. Micro climate includes natural environment Vis a vis built environment, thermal comfort, solar radiation, heat flow, air movement, solar geometry, passive design techniques, water conservation etc.

2. Ecology and landscape

Embodies all natural and geophysical systems related to a site and the ecosystem services they provide. The aesthetic value and urban ecology of built landscape is also a consideration and site characteristics such as soil, topography, vegetation, and watershed in the development of a project design.

3. Building physics

A basic coursework touches on energy, climatology and human comfort topics that can influence the shape of buildings.

4. Sustainable architecture and engineering

Understanding of the basic principles involved in the appropriate application of design principles and passive strategies including Solar orientation and building envelope systems and associated assemblies relative to fundamental performance, aesthetics, moisture transfer, durability, and energy, material resources and methods of construction

5. Building services- systems and technologies

Understanding of the basic principles and appropriate application and performance of building service systems in sustainable manner such as plumbing, electrical, vertical transportation, security, and fire protection systems. In addition, it comprises advanced building system technologies such as daylighting and artificial illumination and acoustics; adoption of energy efficient techniques; building energy performance and alternate energy sources.

6. Legislations, codes and policies
Understanding of the architect's responsibility to the public and the client as determined by registration law, building codes and regulations, professional service contracts, zoning and subdivision ordinances, environmental regulation, and historic preservation and accessibility laws. For eg. ECBC, EIA, ASHRAE, NBC, etc.

7. Building materials and assemblies
Understanding of the basic principles utilized in the appropriate selection of construction materials, products, components, and assemblies, based on their inherent characteristics and performance, including their environmental impact and reuse. It includes all the physical components involved in the construction and functioning of the built environment.

8. Waste management
Understanding of solid waste and water waste management.

9. **Assessment methods**
Understanding the use of appropriate performance assessment tools such as green building rating systems, building simulation, life cycle analysis and energy Audit

10. **Integrated building design studio**
Understanding to incorporate design elements that can reduce energy consumption and bring sustainability into the building designs and relates to construction assemblies and the integration of building systems.

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5.0 EDUCATION

5.1 Background

The beginning of formal Technical Education in India can be dated back to the mid 19th century. The major policy initiatives in the pre-independence period included appointment of the Indian Universities Commission in 1902, issue of the Indian Education policy resolution in 1904 and the Governor General's policy statement of 1913 stressing the importance of Technical Education, the establishment of II Sc. in Bangalore, Institution for Sugar, Textile and Leather Technology in Kanpur, N.C.E. in Bengal in 1905 and Industrial schools in several provinces.

Significant developments include:

- Constitution of the Technical Education Committee of the Central Advisory Board of Education (CABE) of 1943;
- Preparation of the Sergeant Report of 1944; and
- Formation of the All India Council for Technical Education (AICTE) in 1945 by the Government of India.

The AICTE was set up in November 1945 based on the recommendations of CABE to stimulate, coordinate and control the provisions of educational facilities and industrial development of the post war period. At that time, mandate of AICTE basically covered only programs in Engineering and Technology. The growth of industries in the Country, just after independence, also demanded the need for qualified in other fields, such as Business Management, Architecture, Hotel Management,Pharmacy etc.

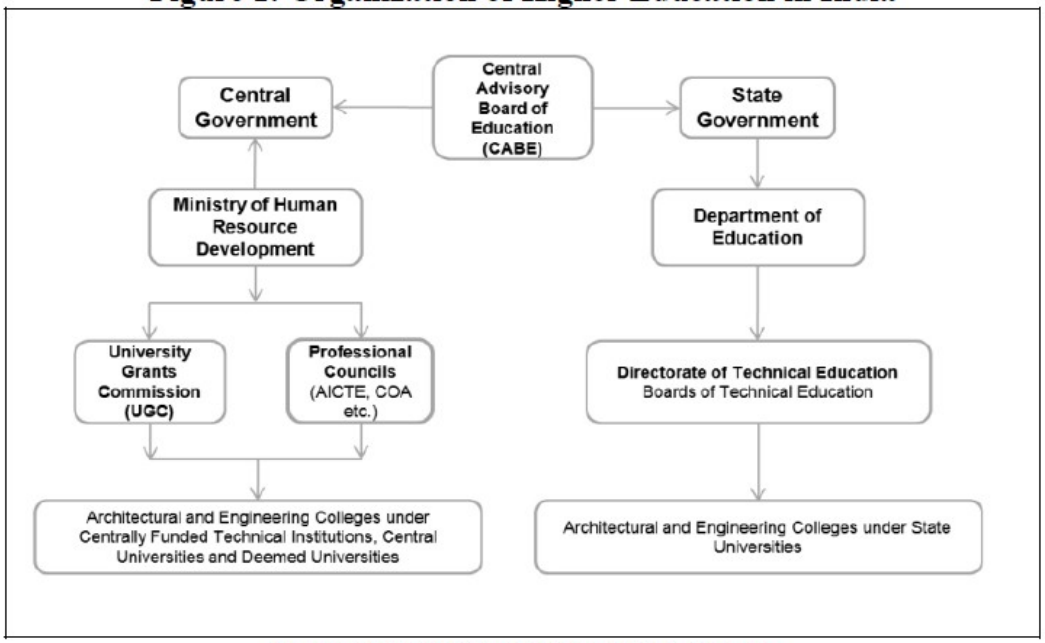
The **AICTE Act, 1987** was passed by the Parliament, to provide for the establishment of the All India Council for Technical Education (AICTE), with a view to ensure the proper planning and coordinated development of Technical Education System throughout the Country. Technical Education in this context includes fields of Engineering and Technology, Architecture, Town Planning, Management, Pharmacy and Applied Arts & Crafts. The growth of Technical Education before independence in the Country has been very slow. The number of Engineering Colleges and Polytechnics (including Pharmacy and Architecture Institutions) in 1947 was 44 and 43 respectively with an intake capacity of 3200 and 3400 respectively. Due to efforts and initiatives taken during successive Five Year Plans and particularly due to policy changes in the eighties to allow participation of Private and Voluntary Organizations in the setting up of Technical Institutions on self-financing basis, the growth of Technical Education has been phenomenal.

Architecture was covered under the Architects' Act, 1972. Parliament passed the Architect's Act in 1972, which set up an independent statutory body, the Council of Architecture (CoA), to regulate the profession and, by extension, architectural education. Subsequently, for better coordination of the Professional Courses, Architecture Education was also placed under the purview of AICTE.

Programs for Technical Education, during the first three Five Year Plans, were devoted to expansion of Technical Education to meet the growing demand for technical personnel at Diploma, Degree and Post-Graduate Levels. From the fourth Five Year Plan onwards, the emphasis was shifted to the improvement of quality and standard of Technical Education. This was done through implementation of the Quality Improvement Program consisting of three major components that provided for M.E. / M. Tech and Ph. D Programs, establishment of Curriculum Design and Development Cells, and Short Term Training Programs.

Meanwhile, expansion of Institutions and intake remained at a low level in the Government, Private aided and University sectors. The policy shift during eighties towards involvement of Private and Voluntary Organizations in the setting up of Technical and Management Institutions on self-financing basis ushered in an era of unprecedented expansion of the Technical Education System, a trend which has continued during successive Five Year Plans. The government of India has given paramount importance on education in its 11^{th} five year plan allocating a five-fold increase in funding for education over the Tenth Plan.

Figure 1: Organization of Higher Education in India



Source: Planning Commission 2009, MHRD

Architecture institutes in India can be divided in two types based on their organizational structure:

- Architecture colleges under centrally funded technical institutions , central universities and Deemed universities
- Architecture colleges under state universities

5.2 Architectural education

Through education, a society hopes to reproduce itself, and through architecture a society reveals its values, aspirations, norms, beliefs and its cultural composition in the built environment. A good holistic architectural education, therefore, is a combination of skills, information, as well as values. It is somewhat unique.

Architecture is an interdisciplinary field that comprises several major components: humanities, social and physical sciences, technology, and the creative arts. As architecture being multidisciplinary in nature, architectural education has always been a complicated issue. Architectural education is available at universities, polytechnics, and academies; the education leading to formal qualifications and permitting professionals to practice in the field of architecture has to be guaranteed to be at university level with architecture as the main subject. The basic goal is to develop the architect as a generalist able to resolve potential contradictions between different requirements, giving form to the society's and the individual's environmental needs. The School of Architecture cultivates an intellectual climate embracing the concept of “making” to achieve design excellence. Experiential learning opportunities are supported by our state of the art facilities. For over number of years of Architecture education has been at the forefront of High Performance Building, leading the way in Advanced Building Systems, Systems Integration, Performance Simulation and Building Diagnostics, based upon the foundation of environmentally–sensitive, regionally-based architectural design.

Architecture education in India is considered as a fundamental corner stone for the advancement of technology and applied sciences, and for being the basic foundation of knowledge and innovation. It had

its origins about 150 years ago, when the colonial government set up art and technical schools to produce draughtsmen and surveyors to assist British engineers who, in those days, 'designed' buildings. So the schools of art and architecture started during the period of British India from mid 19th century to mid 20th century. Being headed by the Englishmen, the conception of the five year diploma course was European in nature. At Independence there was only JJ, and a school in Delhi; today there are more than three hundred schools providing diplomas and degrees in architecture. As new advancements were made in engineering and the formal process of architectural drawings came into being, the necessity of formal architectural education was felt. The Sir J.J School of Architecture (originally called the Government College of Art) in Bombay was the first modern school that start offering courses related to architecture sometime around 1907 and introduce a structured course in architecture. On the path of Sir J.J. school that had a strong technical component, all other schools such as Bengal engineering college at Calcutta, Baroda's Kalabhavan, Delhi's polythecnic followed the lion's share of the curriculum. With this background, the IIT Kharagpur was established in collaboration with the MIT and then the emphasis was tilted in favour of technology.

In 1917, students of J.J. school founded the Architectural students association and in 1929, the Institute o architects (IIA) was formed aimed at promoting the profession in a country. Later, the council of architecture (COA) was established in the early seventies as a statutory body that is responsible for the development and maintenance of architectural education in India under the Architects act, 1972.

The system of controls in architectural education now consists of three formal layers, and some informal ones. First, there are the COA and AICTE. The COA's statutory task is to regulate the profession of architecture by maintaining a register of bonafide architects and thereby, protect the appellation, 'architect'. In order to perform this task it regulates architectural education, a responsibility it shares with AICTE. The COA and AICTE, jointly or separately, inspect/monitor architectural colleges to ensure that (minimum) educational norms and standards are maintained, and that all its other 'conditions of approval' are duly adhered to by the colleges.
Every institution shall be required to follow the "Council of architecture – Minimum standars of architectural education, 2008" which have been prescribed pursuant to section 21 of the Architects Act, 1972 supplementing the council of architecture (Minimum standards of architectural education) regulations, 1983, for imparting the B. Arch course.

The second layer is the university. This is an important medium of control because education in India is a state subject, and state departments of technical education, often operating through state universities, exercise hands-on control over architectural education. They prescribe an 'approved syllabus' and administer the examination system. They also select candidates to be admitted to architectural colleges.

The third layer consists of agencies like the Association of Indian Universities, who certify equivalence between one university and another, and the requirement of the Ministry of Education to obtain a separate certification from them, to enable graduates of architectural colleges to seek 'first-class government jobs'. This layer, though less insidious, also contributes to the imposition of uniformity amongst architectural colleges

There are other informal layers of control – such as the voluntary certifications sought from professional associations like the Indian Institute of Architects and the Commonwealth Institute of Architectural Education – to enable graduates of a particular college to access specific opportunities in India and abroad. But they have no direct bearing on the educational system.

5.3 **Key players of architectural education in India**

Council of Architecture (COA) - The Council of Architecture (COA) was established in the early seventies as a statutory body with a view to oversee both the profession and the education of architects, With the expansion of the profession and proliferation of schools of architecture, a regulatory mechanism was necessary. The Council laid down certain norms of minimum facilities, procedures and courses that each school has to follow and instituted periodic inspection to ensure adherence. Though primarily mandated to oversee and regulate the profession, the Council was also given responsibility to regulate the education at undergraduate level. COA operates under Indian Architects Act and responsible for drives and monitors the education system, curriculum, infrastructure and administration.

AICTE- In early eighties, another statutory body came into being; the All India Council of Technical Education (AICTE**)** with a mandate to regulate all technical education systems in the country. By this time the popular psyche had been conditioned to consider architecture as a technical discipline as opposed to a design discipline and it naturally came under the purview of AICTE. But this created a strange situation with two statutory bodies looking at architecture. Later it was resolved with a Memorandum of Understanding between the two Councils whereby it provided that COA would continue regulating architectural education and the AICTE was assigned the responsibility of issuing the final letter of approval or continual to institutions. Till 2002, both the councils continued to function smoothly as per MoU. However, thereafter, MoU was unilaterally withdrawn by AICTE. Attorney General was then approached by COA for his advice in the matter. His opinion was that even though AICTE Act was a later Act, Architects Act was a special Act dealing with architectural education as well as regulation of profession. Committee's attention was also drawn to complications arising due to both the Councils handling the same subject and a number of cases filed by different entities in various High Courts and the Supreme Court. It was also emphasized that there was no change in the functioning of COA even after the termination of MoU with AICTE.

National Board of Accreditation (NBA) is an autonomous board of AICTE and aims to provide accreditation of architecture programmes in India to achieve quality across the country. So far, National Board of Accreditation has not met with much success as far as accreditation of Architecture Programmes is concerned.

Indian Institute of Architects (IIA) was initially founded in British India as part of Royal Institute of British Architects (RIBA) and now is a part of Commonwealth Association of Architects (CAA) and International Union of Architects (UIA). For the benefit of Indian Architects, any member who is associated with Indian Institute of Architects gets automatic association with Commonwealth Association of Architects and International Union of Architects.

International Union of Architects (UIA) was founded in 1948 and since then, it has been their endeavor to pursue maintenance of high standards in architectural education. In 1996, after a lot of discussion with experts from all over the world, a charter was drafted by UIA.
This charter received great support from UNESCO and is known as UNESCO – UIA Charter of Architectural Education. Professor BV Doshi, a renowned architect and educationist from India was part of the drafting committee of this UNESCO–UIA charter.

6.0 ARCHITECTURAL CURRICULUM

4.1 Curriculum review and development

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.
In India, architectural curriculum is developed and monitored by Council of architecture (COA) and it has been weighed down by the traditions of architectural practice that encompasses the field of art, design and technology. The curriculum is devised to have three main streams of courses including; core/compulsory, optional, and electives courses. The core/compulsory courses are mandatory and have to be taken by all students. The optional courses will be selected by the institution based on their academic strength and focus, while elective courses will be selected by the student based on their professional interests. This will ensure certain minimum standards through the Core courses, the Optional courses will reflect the strength of the institution, and the selection of the Electives will enable the students to pursue his/her interest.

In its curriculum, COA set the minimum standards of architectural education and it states that the architecture course shall be of minimum duration of 5 academic years / 10 semesters of approximately 18 working weeks each inclusive of one year of practical training after the first stage in a professional's office. The 5 years Bachelor's Degree Course in Architecture is a two stage programme. The First stage of the course shall be the first 3 academic years or 6 semesters (each of approximately 18 working weeks) of institutional academic studies. The Second stage of the course shall be of 2 academic years/ 4 semesters including one year of practical training. The main aim of this curriculum to attain a high level of excellence in architectural design.

(a) First stage curriculum

The objective of the first stage is to develop the creative ability of the student, as well as to inculcate a sense of inquiry along with oral, written, visual graphic presentation skills and technical knowledge, creating the basis for application in the design studios.
First year establish the core principles and basic architectural knowledge to develop awareness of, and aptitude to design. Second and third year the focus is on developing basic architectural design skills and advance skill development. During the stage 1, COA has allotted 810 periods (25%of the study periods) by the institution to the subjects of their choice (for specialization) and 75 % as per the modules prescribed under COA. The names and topics for elective are suggestive. COA has given freedom to the Institutions that they may add many more elective and alter the list as per local requirements and resources. An architectural design is the teaching backbone, with a total of minimum 540 periods/hours, but the implementation of sustainable courses is marginal. Climatology and environmental studies is the only course that explicitly addresses sustainability that focusing on passive mode and other low energy design strategies for architecture in the various climates.

(b) Second stage curriculum
The objective of the second stage is resolved as an all-encompassing activity in which all the components are critically analyzed and the student is in a position to undertake an independent project/research culminating in a thesis. Students are encouraged to take up elective subjects within their sphere of interest to assist in their thesis research.

During the stage 2, approx. 86.66 per cent of the total periods of study have been taken into account for the whole stage and the institutions may allot the balance approx. It means COA has given freedom to the institutions to choose 13.33 per cent of the study periods to the subjects/areas of their choice (electives) and students need to select one of the electives offered by institution. Also in this stage each student is required to write a research-based dissertation, prepare for a seminar and present a design thesis as per their choice and interest along with advance level courses and electives. In stage 2 also architectural design is the backbone, with minimum 216 hours.

4.2 Evaluation and opportunities for sustainability in current state of architectural curriculum

The curriculum is designed to develop proficiency in design and conceptualization, enhance skills to communicate ideas through models and graphics, and to gain competence in the artistic, practical and technical aspects of architecture. The program integrates both theoretical and practical approaches to the study with emphasis on the prime development of the students' creative and critical thinking skills. Aside from the essential design, planning, structural conceptualization courses, the curriculum also includes core courses in the sciences, ethics and humanities. These are necessary in appreciating the basic philosophy and concepts of the multi-dimensional aspects of architecture. Computer-aided courses in drafting and design are provided not only to immerse the students in the design culture but also to develop in them the artistic skills and technical competencies in using state-of-the-art technologies. In its

aim to infuse that high sense of intellectual capacity to seek for the truth, experience new fields and endeavor to enhance quality of life.

But existing curriculum do not succeed in contributing towards the systematic promotion and diffusion of environmental sustainability in the design of buildings. This is largely due to focus being put on 'superstructures' or architectural entities, involving visual composition and aesthetic qualities, standardization for technical efficiencies. However, it gives an opportunity to the institutions to enhance the architectural curriculum on their choice for promoting sustainable built environment in India.

COA has incorporated sustainable & energy efficient related modules in its curriculum but in the form of elective and optional. It is totally depends and varies from institution to institution. It has given a freedom to institution and depends upon the mission &educational philosophy of the institution and availability of workforce (expert faculties). Currently, it all is relying heavily upon individual efforts of lecturers that are familiar and inclined towards the subject matter.

Students are free to pick 8% of their courses as per their interest in the form of electives.

The scheme of studies for Bachelors in Architecture is divided into six knowledge areas, namely: design studios/workshops; Allied science and technologies; environmentally sustainable studies; History, theory and planning; Building management & communication tools; and Professional practices & research

Furthermore, curriculum has three main subject streams: Core, optional/electives and student choice streams.

1) Core courses - The course courses are compulsory and have to be taken by every student.
2) Optional/Electives – The optional/Electives will be selected by the institution
3) Student choice – The courses and electives will be selected by the student.

This will ensure certain minimum standards through the Core courses, the Optional courses will reflect the strength of the institution, and the selection of the Electives/courses will enable the students to pursue his/her interest.

FRAMEWORK FOR BACHELOR IN ARCHITECTURE

COURSE STATUS		DESIGN STUDIO/WORKSHOPS	ALLIED SCIENCE & TECHNOLOGIES	ENVIRONMENT SUSTAINABLE STUDIES	HISTORY,THEORY & PLANNING	BUILDING MANAGEMENT AND COMMUNICATION	PRACTICAL TRAINING & REASEARCH
Core courses	Stage1	Architectural Design	Building Construction technology	Climatalogy	History of architecture,arts and culture	Computer application in architecture	
		Architectural Graphic Skill	Structural design and syatem	Environmental studies	Theory of Design	Humanities	
		Basic Design and Visual arts	Building Service and equipments	Landscape	Human settlements	Surveying and leveling	
		Workshop practice & site Exposure	Building Materials and sciences		vernacular architecture	Estimation,Costing and Specifications writing	
						Building bye laws and codes of practice	
	Stage 2	Architectural Design	Building Construction & Material			Professional Practice	
			Advance Service				
			Advance structural design and System				
Optional & Elective course		Interior design	Building System integration	Energy conscious architecture	Housing	construction management	
		Architectural conservation	Intelligent buildings	sustainable architecture	urban design	Disaster management	
		Theatre/Fil set Design		Landscape design	uraban and regional planning	Visual communication	
					Arts architecture	Marketing Skils	
					Architectural Journalism	Expert system advanced Computing	
Students choice course							Project (Thesis)
							Practical tranning
							Research Skills and Project introduction

One remarkable fact is that the curriculum includes theory, planning, design, studio, project thesis, research skills dissertation and practical training. On the other side integrated environmental sustainable studies are weaker, as they have courses in the form of standalone optional or electives. During the third year onwards, current curriculum introduced some optional or elective courses that address sustainability issues; however these courses have fragmented approach. It is required of integration and connection among core, optional and student choice project thesis courses.

Fig: CURRICULUM PRESCRIBED UNDER SECTION 21 OF THE ARCHITECTS ACT, 1972 (COA)

During stage 1, COA has provided an opportunity to choose 25% of the subjects as sustainable modules in the form of electives. In addition, 2% of the subjects relevant to environment have already included in the main stream courses and it's compulsory to all the institutions.

Studies have shown that a complete integration of sustainable development across the curriculum, i.e. in all modules and parts of relevant subjects and activities through all phases is needed in encouraging sustainable practices in B.Arch programmes. The fundamental idea is that when sustainability is to become essential for all activities modules, it cannot remain as an isolated field of expertise but must form mindset for everyone.

Currently, in the architectural education inclusions of sustainability aspects are fragmented relying heavily upon individual efforts of faculty that are familiar and inclined towards the subject matter. There is a need to review the existing curriculum to significantly include the worthy aspects of sustainability in the courses content and delivery mode.

Fig: CURRICULUM PRESCRIBED UNDER SECTION 21 OF THE ARCHITECTS ACT, 1972 (COA)

Similarly during stage 2, apart from giving opportunity for students to pick 8% of their courses as per their interest in the form of electives, it also allow the students to focus on areas and practice domains of their choice during practical training and project (thesis). During practical training, students are free to do training in any course and anywhere in the world with approved architectural offices and during thesis, students undertake individual capstone projects.

5.0 CASE STUDIES

There are 387 architecture schools in India under CoA. In order to understand the educational philosophy & interests of the institution, the study has focused on the gathering of syllabus from the 20 different institutions located in different region of the country. The study provides the educational philosophy transpiring through the weightage and contents given to green and different subjects by different institution.

The objectives of the study focus were:

- To gain insight into present curricular situation concerning the environment & sustainable and to identify principles for greening of curricula.
- To gain an insight into students' concepts and understanding of the environment.
- To gain an understanding of how the architecture institutes has adopted environmental electives and how much importance is placed on weightage of the programme.
- To summarize efforts to review curriculum content
- To provide a possible roadmap of a single institution with regards to pre-requisites, course integration, course creation, and faculty involvement

The selection of the institute is based on the following factors:

- zonal representation
- ranking of schools
- Age of institutes
- Deemed, Central and state universities
- Autonomous, state and central funded

The institutes are:

North zone

a) School of planning and architecture, New Delhi
b) Chandigarh college of architecture, Chandigarh
c) Jamia Milia University, Delhi
d) Panjab Technical university

West & Central zone

a) CEPT university, Ahmadabad
b) J.J. School of architecture, Mumbai
c) NIT, Bhopal

East zone

a) NIT, Raipur
b) NIT, Patna
c) IIT, Kharagpur

d) BIT, Ranchi
e) Biju Patnaik university of technology, Orissa

South zone

a) Anna University
b) Andhra University
c) Kerala University
d) Calicut University
e) NIT, Calicut
f) NIT, Trichy
g) Manipal institute of technology, Manipal
h) J.N. Architecture & fine arts university, Hyderabad

The course curriculum of 20 different institutes has been collected and a thorough review of the curriculum especially electives were undertaken. Here, we analyse the data which has been collected and presented in a graphical form, and the pie chart presentation of the selection of different subjects as an optional/elective. The study conducted an analysis of the state of green course (including course content, course syllabus, delivery methods, assessment criteria,etc.). It gives an idea to understand to what extent the selection of electives are oriented towards creating professional and technical skills needed to cater to the growing demand for green architecture and green building construction and operations.

FINDINGS

Findings have revealed that sustainable architecture has the potential to be an intrinsic part of the whole architecture programme. The promotion of deeper and more integrated architectural education that cultivates not only students' creative approach but also interconnected understanding of subjects and disciplines, self- and other-awareness combined to purposeful, ethical action is to be promoted.

The result of the study highlights the following points:-

- **Institute education philosophy/interest**

It is intended to review the educational approaches taken by all the institutes with regard to environmental issues. Environmentally responsive design and energy efficiency in buildings have been taught at many schools of architecture. 90% of institutes stated that their programme aims had a specific reference to the environment/sustainability, whilst others did not. However student perception of how much environmental content was included in their programme showed no statistically significant difference in the awareness of students to environmental issues if the programme has a specific environmentally focussed learning outcome.
Most of the institutes tending to assume the general view that the environmental aspects of buildings were the role of the engineering or specialist higher education profession lead to provide reasonable content in the current syllabus of environment/sustainable education. Specialist knowledge is generally delivered in post graduate programmes as it's a market driven course.

- **Institutes teaching method on sustainability**

The architecture education at schools is based on problem based and project organized learning and brings sustainability modules in all the streams of curriculum.
Compulsory courses- First two years starts and focus on building physics basics in lecture form and assignments. Content development for courses that can teach the sustainable concepts from the first principles (eg. Building physics, Climataology) during first two years. It helps students in designing low-

energy and green buildings. A basic coursework touches on energy and climatology topics that can influence the shape of buildings

Optional courses - A course related to Sustainable architecture has been introduced for the third year or fourth architectural students as optional subject in the form of mandatory subject or elective depends on school decision . In the third year it is expected that the students are familiar with the needs for sustainable or energy-form relationship and to test their comprehension, it is then introduced in their studio design during fourth year. They are expected to incorporate design elements that can reduce energy consumption into the building designs.

Elective courses - In the fifth and final year students are given the opportunity to test further their comprehension but this time it is a one year studio design thesis and of various building types, unlike in the fourth year where all students will present only one building type. So students are exposed about sustainable and energy-form relationship for four semesters before they graduate. During fifth year they apply the sustainable and energy efficient design ideas in their individual building proposal and also they are tested on their technical and construction details on the sustainable elements.

- **Emphasis on optional courses/electives**

Education of environment/sustainability at Indian architecture institution is done through institution's choice as CoA has given freedom to choose 25% of electives in first stage and 8% of electives in second stage.

Optional courses or electives are classified into three categories: Art & architecture, Design group and Building technology & building service group.

ELECTIVES		
ART & ARCHITECTURE	DESIGN GROUP	BUILDING TECHNOLOGY & BUILDING SERVICES GROUP
Ekistis	Housing	Sustainable building technology
Art & appreciation	Urban design	Computer (3D & animation)
Traditional & contemporary architecture	Site planning & landscape architecture	CAAD & visulaisation
Visual communication	Traffic & Transportation	Valuation & arbitration
Vernacular architecture	Town planning & landscape architecture	Remote sensing & GIS
Rural habitat	Interior design	Hotel services
Islamic architecture	Urban geography	Energy efficient architecture
History of Indian architecture	Environment planning	Construction management
Behaviour studies in architecture	Vaastu Shastra	Disaster management
Futuristic architecture	Urban & regional planning	Language
Industrial architecture	Tourism and environment	Intelligent buildings
architecture as a culture system	Architectural conservation	Building maintenance
Modern architecture	Green & sustainable architecture	Modular coordination & Industrial building
	Earth quake resistant architecture	Building automation & management system
	Hill architecture	Marketing skill
	Design for barrier free environment	Real estate valuation
	Facility planning & specialized building design	Cost effective technology in building construction
	Ergonomics & product design	High rise building
	Environment impact assessment	

An architecture school currently offers a number of courses that will meet the criteria for the Core Electives. Findings have revealed that Interior design is the most important optional/elective followed by urban design and site planning & landscape architecture. The sustainable & energy efficient electives are offered in 72% of the institutes but as a stand-alone and have not integrated well with design studios/workshops and allied science and technologies. Moreover, this study is also revealed that sustainable elective offered under stage 2 in which students are required to choose one of the modules under the institute elective programme. So it's entirely depends on the student interest to pick sustainable modules and it's not compulsory from CoA or Institutes that leads to students deprive of shaping the sustainable built environment and unable to meet the challenges posed by sustainable development.

The fact is acknowledged here that each institution while imparting optional/electives has its own peculiar strength, circumstances and philosophy, and therefore specific emphasis/focus in architectural education is distinct from each other.

Integrated design studio

The School of Architecture views architecture design studios as the core of the undergraduate curriculum in collaboration with six streams: Design Tools, Building Technology, Environmental Science, Architectural History, Critical Practice, and General Studies. Studios serve as laboratories for analytical and creative reasoning, critical inquiry, and most importantly, the integration of multiple knowledge streams. Few schools have attempted to resolve sustainability issues in the curriculum through a mandatory design studio, where greater consideration was demanded as relates to construction assemblies and the integration of building systems and sustainability. Here students can learn the principle of sustainability, both passive and active methods with technology, and simulations which can be practiced in real life. Integrated design studio allows the students to employ digital design processes to simulate building performance impact on building form and configuration as an interactive design process in the development and study of optimal solutions. The first three years of studio sequence consist of required studios that embrace fundamentals, elaboration and integration followed by two years of advanced topic studios, enabling students to pursue one area to develop depth or multiple areas to develop breadth. But in some schools it is that often the faculty overseeing studio work have other agendas, or lack the experience necessary to provide the students with adequate direction regarding issues of construction. Also it does not guarantee for integrated design studio, this is because faculty responsible for teaching sustainable architecture as support courses, generally do not participate in design studio teaching.

COA Course framework

CoA offers courses in the technical, aesthetic and cultural components of design, as well as in environmental history, sustainability, behavioral sciences, resource management and design theory at some extent. After analysis of course framework and education philosophy of different institutes, it revealed that most of institutes put less emphasis on environmental/Sustainable issues. However, one of the institute members commented that there is not enough room in the curriculum to put more environment content in because of all the other topics that need to be covered. Furthermore, it also responded that the accrediting panel had specifically stated that they wanted no more environmental content to be included as it was distracting away from the main theme of the programme.

Architecture course framework need to achieve sustainability as a unified goal and bridge the gap between academic environment and the professional practice. The course framework should be placed uniformly between creative arts and technical sciences, theory and practice, sustainable and environment. Inter-disciplinary collaboration, integrated and holistic approach should be appreciated as the main principles, in the constitution of the syllabus of architecture undergraduate program.

Course content

The course content in sustainable architecture has significant gap and need sustainability is studied in integration with various subject areas Th. e education is only limited to single discipline with isolated topics based on the knowledge and interests of the lecturers. The course content are needed for whole architectural education emphasizing on how buildings are developed and designed, and how interdisciplinary teams can be used to maximize energy efficiency, reduce resource waste, and improve the environmental quality of the buildings being constructed and re-connecting them to the natural environment. But weakness is that the courses related to sustainability are mainly focused on environmental technology and design, especially passive strategies, with less emphasis other important areas of sustainability. For example, students learn about specific building services, although not specifically stated as sustainable issue.

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One would need to learn the integration of the learned sustainable technologies in their own design work, and making sure students graduate with all basic conceptual understanding and engineering and practical skills. Also through this graph, it is clear that there is lack of integration of theory/elective courses with design studios. Structuring of a Design Studio that would encourage the students to use the concepts learned in Climatology, Building Physics, etc. and assists them in incorporating the sustainability principles in the design problem

6.0 CONCLUSION

CoA curriculum model is well balanced between conceptual and theoretical understanding to the application in design studio, providing students with enough conceptual understanding, basic instrumental skills and practice of implementation in design studio, but need of well integrated approach. After analyzing and discussing all data, it becomes clear that the model curriculum approach to sustainability seems fragmented and provides general core-studies in general subjects, without special emphasis in sustainability, while it is in the form of optional or elective courses where more specialized modules in sustainability are offered in the second half of the programme, unfortunately reserved to those students choosing the sustainability electives and where the sustainability they learn in the latter years becomes just another technical course, instead of an integral part of their education and practice

In addition to this, model syllabus prescribes only 75 per cent of the curriculum, leaving individual colleges to determine the balance 25 per cent; all universities play safe in the formulation of their prescribed syllabus and spread the 'minimum' requirements to cover the entire curriculum. No university wants individual schools affiliated with them to have space to deviate and experiment, even within the boundaries permitted by the COA – again, it would make control more difficult.

According to issues about education philosophy it can be said that executing for green education in India is facing six main challenges:

- Lack of educational strategies and appropriate culture of teaching for sustainable architecture education
- Ineffective in integrating sustainable environmental design in the education of school of architecture
- Given emphasis on sustainability courses when it comes to the post graduate level and concentrate on design and building construction methods at the bachelor level
- Lack of expertise in sustainability education and largely depends on guest faculty
- Lack of demand from architectural graduates.
- Lack of communication between industry and academia

CoA is proactively encouraging curriculum greening via provide a freedom to the institutions to choose their electives as per their education philosophy, but progress regarding implementation appears to be slow. Many institutes adopted fragmented approach to teaching environmental issues of the programme. Current courses are often fragmented and alienated to applied coursework so that students are not able to fully engage with an integrated design process. Thus, the primary challenge is for green education to become an integral part of architectural design. One promising approach is to supplement environmentally sustainable focused lecture based course material with increased project based tutoring.

Integrated design and sustainability provides an in-depth understanding on the principles, systems and strategic framework that are enabling essential in an integrated design approach to achieve a sustainable architecture. It is aimed at enabling students to have a holistic insight and forming strategies for managing design information and resources to facilitate an integrated design development.

It is required an intensive and concentrated approach in which the theoretical and practical courses are balanced with sustainability issues so that theoretical understanding, application exercising and design implementation of sustainability principles are carried together. Also the interest of curriculum model

should be embedding the students with the environmental concerns form the very first day, trying to achieve a clear conceptual understanding and apply it right way in the design work.

It was identified that curriculum development involves a number of stakeholders and these could not be excluded from the study. These stakeholders have been identified as the government, the Construction Industry, Institution head, architecture education professional bodies. It is hoped that by involving these parties, that negotiated criteria and concepts for curriculum development can be developed, which could be utilised to inform curricula in order to improve the environmental attitudes of construction professionals of the future. This could have a positive effect on how the construction industry performs, and reduce the damaging impact that construction activity has on the environment.

Way forward

In summary, Council of architecture is the umbrella body and created the room which influences the architecture education system. CoA educational framework is reasonably flexible, so sustainability issues could be increased in the curriculum at some extent. The variables such as lectures, students, studio content, course content, and the time factor are important ingredients to make a successful sustainable architecture education. It is strongly recommended that to keep abreast with rapid changes, curriculum of a subject must be reviewed after every 3 years. Also in pursuance of the current needs, COA should performed curriculum revision in collaboration with top universities. Revision of curriculum should be happened after due consideration of the comments and suggestions received from universities and colleges where the subject under consideration is taught. There is real need of reorienting architectural education towards sustainability so that architects are trained to have a clear understanding of how their role interacts with others to bring about good buildings and designs in many contexts.

Apart from the handbook and course compact, faculties are probably the most important respondents, because they make the ultimate decisions about the content taught to students, time or credit hours, and standards of achievement. It is felt strongly that continual faculty development should be facilitated through orientations and trainings. In addition to this, workshop series need to be organized that would act as platform of different stakeholders and provide knowledge support by creating networking of educators and exchange and bring ideas into theory of sustainable priority. Moreover, scholarships and exchange between institutions in the country and abroad would also be useful.

At last, if the development of an educational methodology for the enhancement of sustainable environmental design in university curricula proves successful, graduates of the near future could significantly contribute towards improving the energy performance of new and existing buildings and, ultimately, contributing to meeting global challenges within the realms of a creative design process.