

## Engineering and Sustainable Environment

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**Abstract**— India is one of the promising universal business giant with a second fastest fiscal escalation rate (8.9%) and a fourth largest GDP in terms of Purchasing Power Parity (US\$ 3.6 trillion). Every industry faces the threat of failure in business. Construction companies are predominantly susceptible to fiscal risk owing to the nature of the industry, intense rivalry, reasonably low access barrier, soaring uncertainty and risk involved, and fanciful rise and falls in construction volume. We need to encompass a closer perceptive of the correlation involving the two inter-related matters of risk management and funding on construction projects. It is becoming progressively more essential to attain the goals of the patron, the proprietor and the constructor and its supply chain, particularly when the interest in PFI and PPP arrangements are incessantly budding all around globally.

Engineers carry on their shoulders the responsibility of endorsing the principles of sustainable growth. Sustainable development deals with meeting existing individual needs from naturally accessible reserves, while preserving and enhancing the surrounding environmental quality. This paper deals with the various issues involved in the process of engineering while taking in view the environmental considerations for future generations, the prospective responsibility industrial engineers can have in putting a stop to pollution caused by industrialized processes and accentuate how both disciplines can be pooled to craft well-organized and competent resolutions.

**Keywords**— Engineering, Environment, Sustainability, Pollution, Growth, Development, Economy

### INTRODUCTION

Engineering plays a vital role in human life, with respect to economic, social and cultural development. This is necessary in order to achieve United Nation (UN) millennium progressive objectives, principally ecological sustainable growth. Sustainable development confronts to meeting current human needs from naturally available reserves, engineering merchandises, energy, foodstuff, transportation, shelter and efficient ravage management while conserving and enhancing earth's environmental quality. This challenging issue is trying to be met by engineering knowledge and modern expertise. Sustainable development is the need of the hour not only for the current world but also a necessity for the next generation that can be achieved by certified engineers. Engineers ought to make every effort in order to augment the eminence of biophysical and socioeconomic urban environment and also to promote the principles of sustainable development. Engineers have an obligation towards the general public in order to seek the various available opportunities to work for the enrichment of wellbeing, security and the communal welfare of local and global community equally through the practice of sustainable development. In view of the fact that community wellbeing and safety is entirely dependent on engineering judgments, assessments of risk, decisions and practices incorporated into structures, machinery, produce, practices and strategies, engineers have to be conscientious and answerable to their assigned duty. Thus, engineers should follow the rules and regulation imposed by local and global community.

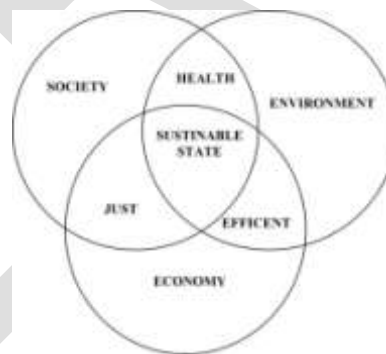
### ENGINEERING AND SUSTAINABILITY:

Engineering is the application of scientific and mathematical principles for practical purposes such as the design, manufacture, operation's of products and processes, at the same time, accounting for constraints invoked by economics, and the environmental and sociological factors. Engineering have brought through many technical. Engineering has always been a significant contributor to economical development, standard of living, well being of the society and its impact on the cultural development and environment. Engineering is constantly evolving as a profession, and engineering education is correspondingly changing continually.

Sustainability is the ability to make development as sustainable by ensuring the needs of the present demands without compromising any power or ability of future generations to meet their own needs. It was also recognized that many of the practices and lifestyles of present social order, predominantly but not entirely developed society, simply cannot be maintained for the foreseeable future without letting up. We are way beyond the competence and potential of the earth to provide many of the resources that we use and to accommodate our emissions, while many of the planets inhabitants cannot meet even their basic needs. Recognizing the needs for living within constraints and ensuring more fairness in access to inadequate resources, are the key predicaments lying at the core of the concepts of sustainability and sustainable development. It is something new in human history that the planet is full and we have no new geographical sphere to shift to. Unswerving with societal, economical and ecological aspects of sustainability, sustainable edifice is one of the speedily growing practices in new construction and development area in the world as the movement of green development has been acquired and adopted by engineers, designers and builders.

Life -cycle analysis shows evidence that sustainable design and building makes good economical sense with regard to environmental impact. It is anticipated that this kind of trend will continue to propel and pick up the pace, owing to the fact that as a rule most of the countries are scheduling to shift to green technology. Furthermore, individual owners are intent upon raising the standards of existing buildings and structures with the green renovation to lift them up to the sustainable state of specifications.

Sustainable development is the process of moving human activities to a pattern that can be sustained in time without end. It is a positive move towards the environmental and growth issues that seek to reconcile human needs with the capacity of the planet to cope with the consequences of human activities. Sustainable development consists of the three broad subject matters of social, ecological and financial responsibility which is said as the Triple Bottom Line concept. It is useful to represent the constraints of the sustainable development, in the form of a simple Venn diagram shown in the figure 1.



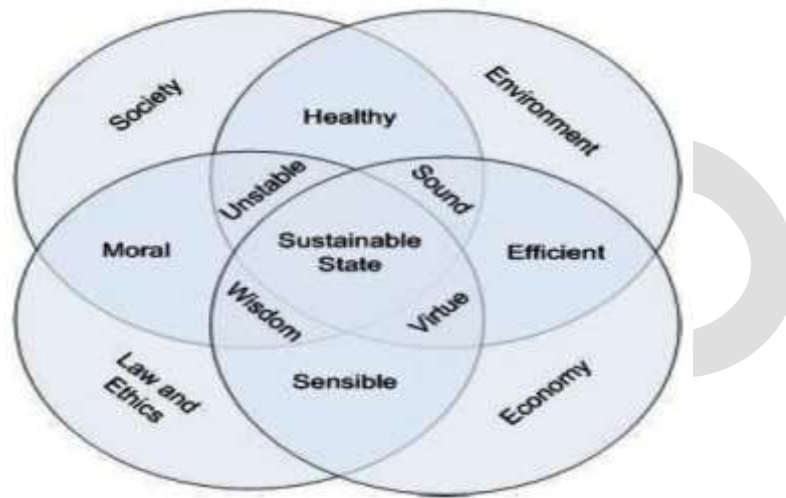
**Figure 1.** Components of a sustainable environment

Society, environment and economy are the three basic essential parts for human beings for survival. In order to lead a vigorous life in the social order fine quality environment is needed. Figure 1 indicates the interrelationship of a vigorous social order, financial system, and environment. It is apparently comprehensible that sustainable state is thriftily well-organized, environmentally fit and justified in social context in all aspects.

Law and Ethics are the fundamental way dealing with the meaningfulness of life. So this term can be included as another component of the sustainable environment. Inspiring with the Triple Bottom Line perception, an innovative thought can be created where the Law and Ethics is considered as another and valuable component of the sustainable environment. This reflection is envisaged through an additional Venn diagram as shown in the Figure 2.

There is no conflict with the state named as Healthy and Efficient as stated in the Triple Bottom Line notion. A civilization can be considered an ethical society only when the ethical values are established and they are more acceptable

and trustworthy. A financial system encompassing the ethical values is prudent which means the state is intellectually and intuitively perceived through sound judgment. The position of a social order having interface with only Environment and their Ethical values can be defined as unstable state because if economy falls down, society will collapse. The capability of performing what is correct and dynamic while avoiding the wrong is the virtue which can be established with the combination of Economy and Ethics having the proper knowledge and understanding to the Environment. Society and their Environment with efficient Economy make a state which can be defined as Sound State. But in a comprehensive matter the Sustainable Environment is a state which is environmentally healthy, economically efficient, socially moral and ethically sensible.



**Figure 2.** Sustainable environment and its relation with four components

## PROFESSIONAL ETHICS OF ENGINEERS

In the discipline of philosophy, moral principles envelop the study of the accomplishments that a responsible individual ought to select, the values that an honourable individual ought to espouse and the character that a virtuous individual must encompass. For example, every person must be candid, reasonable, kind, social, courteous and responsible. Above and beyond these familiar obligations, the skilled professionals have added commitments. These obligations arise from the responsibilities of their professional work and their relationships with employers, patrons, erstwhile professionals and the general community. Owing to the specialization, acquaintance and expertise they are endowed licenses by the public to use their knowledge and skills to affect the lives of their clients significantly.

Codes of ethics for engineers state that they should hold paramount for the wellbeing, healthiness, and benefit of the community, more than other commitments to patrons and employers. Engineering and engineering societies have provided little guidance on prioritizing the community goods, with the exception in intense cases such as whistle-blowing. When an engineer finds an immediate threat to the safety of the community, the engineer ought to give notice to the concerned authorities. If this intimidation is not handled and run through within the concerned association, the engineers are expected either to raise the flag or blow the whistle.

## SOCIAL RESPONSIBILITIES OF ENGINEERS

Engineers are the valuable part of the society. This necessitates them to put together the determined efforts in discovering all of the relevant facts pertaining to the design, development, operation and all achievable outcome of the choices available that may positively and negatively affect the society and the public. Citizens are entirely reliant on their premeditated products and goods that should be robust, safe, reliable, economically feasible and environmentally sustainable. Some principles of Engineering for Sustainable Development are:

- Adopting holistic like, cradle to grave approach.

- Be cautious to the cost reductions that masquerade as value engineering.
- Being creative and innovational.
- Being sure about the knowledge of needs and wants.
- Commitment of risk assessment experts to safety assessments or ethical risk.
- Contributing one's services to worthy, non – profit groups and projects
- Declining work on a particular project or for a particular company.
- Right things been done with the right decisions.
- Valuable and competent, scheduling and administration.
- Engineering school's commitment for educating future engineers about their social and moral responsibilities.
- Commitment of engineers in designing and developing sustainable technologies
- Explicit care and concern about technology's impact on nature and the environment.
- Principles of sustainable development followed, while thinking about any technical and engineering designs.
- Guarantee the safety and wellbeing to the public.
- Guarantee the society's fund and resources concerning technology are well used.
- Honoring the precautionary principles to take any steps in engineering designs
- Individual and organizational apprehension about any engineering projects and its impact on the society.
- Looking for a balanced solution.
- On the lookout for engagement from all stakeholders.
- Participating in democratic procedures for technology decision making and policy management.
- Practicing the engineers preach.
- Promoting the principled development enthusiastically and use of technologies.
- Provide expert advice to non experts.
- Offer security measures for whistleblowers.
- Remonstrate the illegality or wrong-doing.
- Social activities by engineers in public interest.
- Speaking out publicly in disparity to a proposed project.
- Thinking beyond the locality and the immediate future.
- Voluntarily assume the job of education to the public about valuable consequences of different technical and scientific developments.

## **THE ROLE OF ENGINEERS IN SUSTAINABILITY**

The group of people that maintains, enhances, or improves its environmental, social, cultural, and economic resources in such a way that support current and future community members in pursuing the healthy, productive and happy lives can very well be termed as Sustainable Community.

Professional engineers play an important and significant role to meet the sustainability. They work to improve the welfare, health and safety, with the minimal use of natural resources and paying attention with regard to the environment and the sustainability of resources. The sustainability is influenced by the challenges and opportunities. To provide an options and solutions to maximize social value and minimize environmental impacts are to be provided by Engineers.

There are some grave challenges because of the undesirable effects of exhaustion of resources, rapid population growth and damage the ecosystems and environmental pollution. Only an environmentally sociable advancement is not sufficient and increasingly engineers are required to take a wider perspective including societal integrity and local and universal associations and poverty mitigation. Comprehensiveness brings crucial prospects for engineers to promote change through sharing experiences and through good quality practice. The authoritative responsibility and guidance of engineers in achieving sustainability should not be underestimated. Increasingly this will be as part of multidisciplinary teams that include non-engineers and through work that crosses national boundaries.

The main goal of the sustainable development is to enable the people throughout the world to meet and satisfy their basic needs and enjoy an improved and better quality of life without compromising the quality of life for generations to come. Sustainable development has largely being categorized in two perceptions, requirements and precincts imposed by the state of technology and the social organisation on the environment's ability to meet present and future demands. Following principles have been agreed upon to achieve sustainable development

- Living within the environmental goals,
- Ensuring a strong , healthy and justified society,
- Promotion of good governance,
- Achieving a sustainable with an efficient economy, using science responsibly.
- Engineers have a responsibility to maximize the value of their activity to build a sustainable planet. In order perceive attainable goal and recognition of the changes over time and demand of the society.
- Empathies the important potential role for engineering
- Empathies about the environmental limits and finite resources
- Reduce the demand of resources
- Reduction of waste production by using effectively the resources that are used
- Make use of systems and products which reduce embedded carbon, energy and water use, waste and pollution, etc.
- Adoption of full life cycle assessment as normal practice including the supply chain,
- Adopt strategies such as salvaging, reprocessing, decommissioning and discarding of components and materials,
- During Design stage itself minimization of any adverse impacts on sustainability .
- Carrying out a comprehensive risk assessment prior to starting of the project.
- Risk assessment should ensure and includes the potential environmental, economical and societal impacts, way ahead of the natural life of the engineering venture.
- Monitoring systems to measure any environmental, social and economical impacts of engineering projects so it can be identified at an early stage.

#### **ENGINEERS RESPONSIBILITIES TOWARDS ENVIRONMENT:**

Scientific research continues to provide in-format ion about the links between human health and environmental quality. Essential components of life are air, water and food, which provide potential pathways for contaminants to have an effect on our health. Air, water and soil pollutions exposure has been linked to various diseases/disorders to name few cancer, lupus, immune diseases, allergies, and asthma, problems in reproduction and birth defects, allergic reactions, nervous system disorders, hypersensitivity and decreased diseases resistance.

##### **a) AIR POLLUTION**

Air pollution is a great threat to our sustainable environment. Engineers in every country of the world should try to,

- Cut down the release of sulphur dioxide, nitrogen oxide, carbon dioxide and mercury through regulatory programs according to established targets and time frames.
- Involve yourself in national and international initiatives to address trans-boundary air issues.
- Work to meet standards for two primary components of smog(formed mainly above urban centres, is composed mainly of tropospheric ozone (O3) ground level ozone and particulate matter.
- Build up air-shed management plans and team-up with large industrial facilities to monitor transport and deposition from major sources.

##### **b) WATER POLLUTION**

Safe drinking water is another challenge for many developing countries where engineers in the world can contribute a good deal on this issue. So, engineers should do the followings,

- Resolve quality and quantity issues of water for agriculture and fisheries sectors,



- Develop a scaffold for safeguard water resources and aquatic habitat that builds on the drinking water strategy,
- Consult with the Municipal/Public Works Association of relevant region while developing guidelines, standards and regulations for issues related to municipal water and wastewater ,
- Employ a government-wide approach to water problems through the Interdepartmental Drinking Water Management Committee,
- Develop, modify and upgrade the ambient water monitoring system with proper maintenance,
- Team-up with the Department of Health to tackle issues related to contaminants in drinking water,
- Wastewater issues to be addresses by working with municipal and domestic partners,
- Be a support system to municipalities for their water and wastewater infrastructure programs, and for land use planning in water supply areas.

#### **c) LAND POLLUTION**

Hazardous substances in water, air, and soil cause noteworthy health perils. The concerned government is devoted to minimize the environmental impacts of such materials and protecting country's health. In this regards engineers will

- Promote pollution prevention in efficient way,
- Validate risk-based administrative approaches to spotlight efforts where they are most needed,
- Bring up to date existing directives controlling perilous substances and eliminating regulatory duplication,
- Promote effective utilization, storage, handling, and discarding of harmful substances,
- Apply the "polluter pays" principle to users of hazardous substances,
- Encourage stewardship by manufacturers to promote proper lifecycle management of hazardous substances,
- Make joint efforts with other authorities to perk up treatment of contaminated sites and promote sustainable redevelopment,
- Promote early detection and response to land quality issues through legislated requirements for mandatory reporting of site contamination.

### **IMPORTANT AREAS OF SUSTAINABILITY**

#### **i) Construction area**

To make this planet sustainable certain areas should be given highest priority. Development in construction is one such most important issue, as it is related to everyone's daily life. Construction engineers need to be careful while designing a buildings, industries, roads and highways efficiently, considering greening technology. Concept of sustainability to build and construct any structure must focus not only to the limited resources but also to the energy and on the procedure to reduce the impacts on the environment and methodological issues, structural modules, materials, erection technologies and concepts of design related to the energy but and also ethics, values and humanity for the occupants of buildings

#### **ii) Education area**

A novel instructional arrangement for engineers, up-and-coming engineers or general students must be developed introducing sustainable development into the curriculum both for undergraduate and graduate level and also for the professional skill levels.

### **CONCLUSION**

Sustainable development has become as an accepted orthodoxy for the global economic development and environmental protection since the ending of the twentieth century where engineers play an important role for this sustainable development and fortification. Our environment is made up of intermingling systems of air, water, land, organic and inorganic substance and living organisms. Maintaining a healthy environment for current and future generations requires the group effort of the general public, organizations and companies and each and every echelon of government. Using a balanced, coordinated approach, we can protect the health, prosperity, and environmental integrity of our society. Individuals can safeguard energy, opt for environmentally accountable products, and modify their behaviour. Organizations can develop environmental supervision strategies, cut down emissions and squander from their operations,

and adopt environmentally responsible practices. The government can continue to lead by administering legislation, establishing public policy, delivering programs and services, participating in local, countrywide, and worldwide environmental proposals, and managing its own operations conscientiously.

Nevertheless, each and every above mentioned strategy are tackled by different rank of engineers. Engineers and scientists are required to protect our environment in terms of inventing safe elemental substances, sustainable environment, and recyclable and renewable energy resources and so on to ensure a better life for us and our future generation.

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