INVESTIGATING INTEGRATION OF SUSTAINABILITY IDEAS IN DESIGN OF CONSTRUCTION PROJECTS

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ABSTRACT

Sustainable construction design is a concept which reduces the negative impact on the environment, increases durability and comfort for the community. Construction sector is a key to create a healthy, happy and thriving economic climate in the communities. Importance should be given to the future success and a critical role for creating enhanced sustainability in various projects. The important aim for adopting sustainable infrastructure design is to progress, integrate the ideas, information of sustainability with principles implemented into practices used and entirely eradicating adverse environmental impact throughout the lifecycle of any construction projects. Construction clients and governments recognize the significant impact the design, construction and occupation of buildings have on the environment and society. The construction industry and governments have a central role in driving the sustainable development agenda. Good sustainable design can deliver buildings with low running costs-an attribute that is highly attractive to both the society and businesses. The concluding remark for this research is that there is an essential need for accepting and implementing sustainable infrastructure design which will have a positive impact on environment in design phase throughout the lifecycle of construction projects.

Keyword : - *sustainable building , sustainability principles , conceptual framework; resource conservation; technologies*

1. INTRODUCTION

The construction industry is a vital element of an economy and has significant impact on the environment. Sustainable approach has a high potential to make a valuable contribution to sustainable development. The idea of sustainability involves enhancing the quality of life, thus allowing people to live in a healthy environment, with improved social, economic and environmental conditions. Industry practitioners have begun to pay attention to controlling and correcting the environmental damage due to their activities. Architects, designers, engineers and others have a unique opportunity to reduce environmental impact through the implementation of sustainability objectives at the design development stage of a project. While current sustainability initiatives, strategies and processes focus on wider global aspirations and strategic objectives, they are noticeably weak in addressing micro-level i.e., at project specific level. This research therefore compliments existing research in the field of sustainability for implementing sustainability ideas at the project phase-specific level i.e., at the design stage of a project.

1.1 SUSTAINABLE DESIGN

Also called as Environment Responsive Design, it is integration of conceptual and schematic designs delivering services, built environment and materials complying with principles of ecological sustainability. The sole

purpose of adopting sustainable design embodies removal of adverse environmental impact completely, through proficient and sensitive formulation of design specifications.
While designing for environment sustainability, it is imperative that appropriate standards and data is accounted that provides intelligent baseline weighed on similar levels, giving perspective if design is actually sustainable in long run. An expeditious growth of economic activity and human population, depletion of natural resources, damage to ecosystem and loss of biodiversity, sustainable design is prevalent reaction to global environmental crisis.
Primarily, limits of sustainable design implementation allocate to increased complexity of efficiency improvements, secondly drawback of implementing new technologies in societal built around old environment, accounts for rather than just switching to new sustainable design, rather flow of information and invention development should be achieved, adhering to values of sustainability, thus delivering sustainable goal.

1.2 SUSTAINABLE CONSTRUCTION DESIGN

Reintegration, reprocess and optimization of existing infrastructure, consistent with principals of urban sustainability and global sustainable development is what defines sustainable infrastructure design. It provides critical problems solutions, manages risk more efficiently, while working in direction of achieving sustainability goals.
Encompassing infrastructure rehabilitation, infrastructure economic analysis, energy used, reduced infrastructure costs, preserving existing infrastructure from environmental degradation, durable material selection, minimising waste and materials, and remediation of environmentally damaged soil and water, such responsible design balances these social, economic and environmental issues.

With prevailing proficient planning, designing and construction of sustainable infrastructure in developed as well as developing countries evident prime importance is delivering better and more responsible infrastructure. Infrastructure must be sustainable making positive impact in future, precondition for supporting and creating better economic times.
Utilizing a sustainable design, encourages decisions at each phase of the design process that will reduce negative impacts on the environment and health of occupants, without compromising the bottom line. It is an integrated, holistic approach which positively impacts all phases of a project's life-cycle, including design, construction, operation and decommissioning. Therefore, investigating how these sustainability ideas are incorporated in design stage of a project is further proposed in this research

2. RESEARCH PROCESS

This research has chosen both the qualitative and quantitative research strategy to obtain the desired results. The primary data focuses literature survey and case studies and the interpretation of the same is done from 25 papers covering various sustainability ideas incorporated in construction industry. The secondary data, on the other hand, uses questionnaire survey containing both objective and subjective analysis

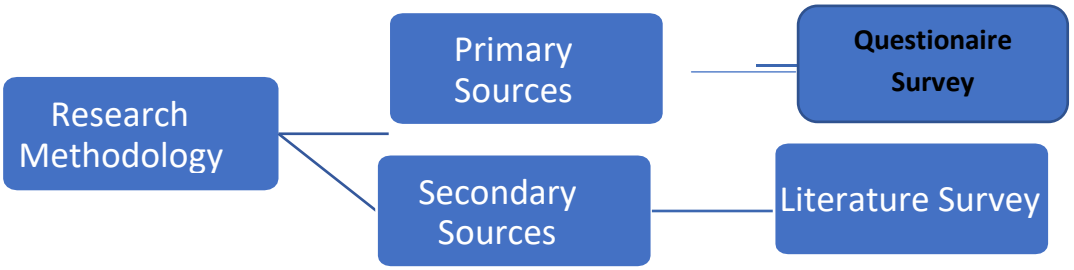


Fig.1 Block Diagram of Research Methodology

3. RESEARCH METHODS AND TOOLS:

- **Questionnaire Section: Sustainability Ideas investigation in Indian Infrastructure Projects**

Serial Number	Impact in terms of cost, time, and scope
1	Non-Conventional technologies & reusing material
2	Rating system to evaluate criteria for design, construction & assessment
3	BIM and Standard performance evaluation
4	LEED, ASHARE and GRIHA Guidelines
5	Infrastructure performance matrix
6	Blended Infrastructure projects
7	Green Credentials improvement
8	Sustainability Performance of Green Space or Green Infrastructure (GI) Projects.
9	Smart Highways
10	Energy efficient generation of electricity
11	Smart Grid Integration working on intelligent M2M communication.
12	Smart Infrastructure for generation, transmission & distribution of Power.
13	Sustainable Water Treatment Plants
14	Design Challenges in Urban Sustainability
15	Design process and sustainable notions necessary for urban public spaces development

➢ IDENTIFICATION OF SUSTAINABLE DESIGN IDEAS THROUGH LITERATURE REVIEW

TABLE 1

Categorization of Sustainability Ideas from Literature Survey

CATEGORY	SUSTAINABLE DESIGN IDEA
1. Material Selection	Sustainable Road Design: Promoting Recycling and Non-Conventional Materials
	An Investigation on Cell-Filled Pavements.
2. Technological consideration	Rating System for Indian Green Highways
	Integration of Rating Systems and Building Information Modelling
	Airport Sustainable Design, Green Technologies & Smart Sustainable Design Airports
	Assessing green infrastructure performance
	Integrated Sustainable Urban Project
3. Design & Project Management Consideration	Role of design in sustainability transitions projects
	Advancing-Performance-Based Sustainable and Resilient Infrastructure Design
	Sustainable Bridge Design
	Sustainable Development- Green Design
	Sustainable safe road design manual
4. Energy consideration	Infrastructure-Integrated Photovoltaic (IIPV
	Smart Highway of the Future: Utilizing Green Energy
	Smart Grid Initiatives in India
	Energy Infrastructure- An Overview
5. Social consideration	Effective Instructions in Design Process of Urban Public Spaces
	Sustainable Redevelopment of Public Spaces in City Centres
6. Water consideration	Design of the future energy-efficient, cost-effective, reliable, resilient, and sustainable full-scale wastewater treatment plants.

	Creating an innovation platform for sustainability- in urban water projects

4. DATA ANALYSIS AND FINDINGS :

➢ COMPARISONS OF IDENTIFIED SUSTAINABILITY IDEAS WITH SUSTAINABLE DEVELOPMENT GOALS

Table 2
Comparative Analysis of Sustainable Design Ideas

SUSTAINABILITY DESIGN IDEAS	IDENTIFIED SUSTAINABLE DESIGNIDEAS	SUSTAINABILITY DEVELOPMENT GOAL ACHIEVED
1. Incorporating Nonconventional Technologies and Reused Materials in design	Material Selection	Responsible consumption and production
2. Cell Filled Pavements		
3. Rating system to evaluate criteria for designand construction	Technological consideration	Industry, innovationand infrastructure
4. Blended Infrastructure Projects		
5. Integration of BIM dataand standard performance evaluation		
6. Sustainable Guidelines adopted in Airport	Design & Project Management Consideration	
7. Performance-Based Approach to Design and Infrastructure Rating System		
8. Integral life-cycle analysis of bridges		
9. Monofunctional Roads		
10. Infrastructure integrated photovoltaic (IIPV)		

11. Integrated networks of green space, or green infrastructure (GI).		
12. Smart highways, Vibration energy, Solar energy, Wind energy, LED lightening	Energy Consideration	Affordable and clean energy
13. Smart Grid Initiatives in India		
14. Green Design in India & LEED Ratings		
15. Energy Infrastructure		
16. Sustainable full-scale WWTPs	Water Considerations	Clean water and sanitation
17. Roles of design in sustainability transitions projects		
18. Integrated water management and sustainable water design		
19. Design Process ofUrban Public Spaces Promoting Sustainable Development	Social Consideration	Sustainable cities
20. Sustainable Redevelopment of Public Spaces in City Centres		

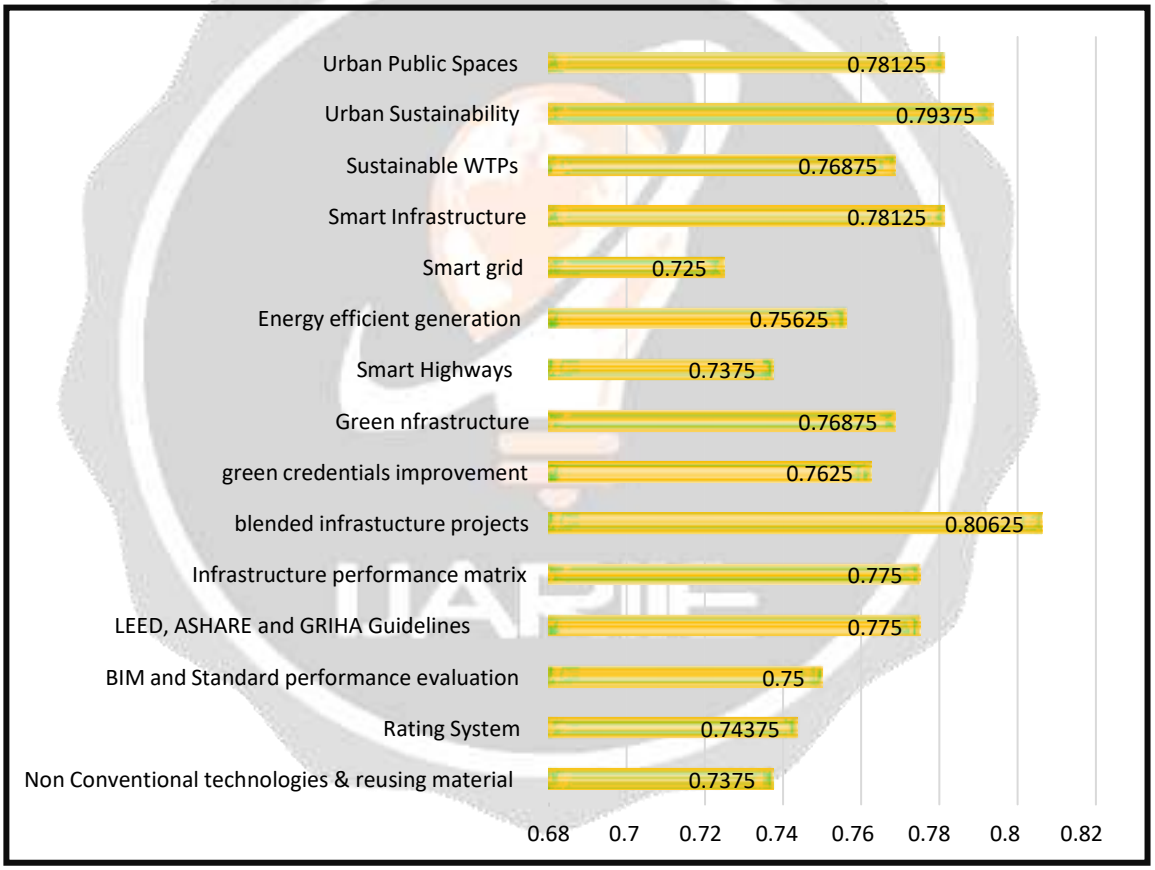
After conducting the systematic literature review, a comparison of type of sustainable design ideas identified in different infrastructure sector with the Sustainable development goals were made, which indicated a similarity of ideas that are incorporated in infrastructure projects, also it proved validation of literature review as sustainable goals are being met.

➢ SUSTAINABLE DESIGN IDEAS CURRENTLY ADOPTED IN INDIAN CONSTRUCTION INDUSTRY

The respondents were required to indicate which were the sustainable design ideas are currently under practise or implemented in Indian Infrastructure projects, and also if the proposed sustainability ideas could be incorporated in future projects to achieve sustainability. The rating was done from a scale of 1 to 5, 5 being Strongly Agreed and

1 being Strongly Disagree. Relative Importance Index and the ranking of the Sustainable design ideas are done .

Fig 1. Trends of which sustainability design ideas are currently adopted in Indian Infrastructure

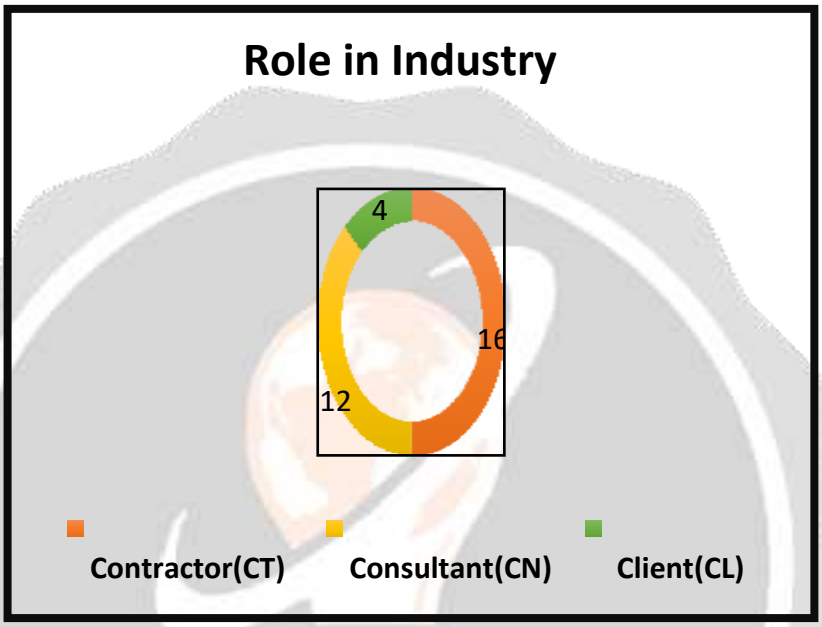


It can be inferred that Blended Infrastructure projects and Urban Sustainability were the major sustainability ideas that were investigated and should be incorporated in future infrastructure projects. The identified ideas will provide an amalgamation of traditional construction practices with simultaneous introduction of sustainability in design phase of the project, bringing an intersection of the socio- cultural (cultural development and experienced city vision) and technological dimensions (smart & intelligent city development in infrastructure projects. A closer look also indicates, the sustainability idea belongs technological consideration which achieves Industry Innovation and Infrastructure sustainability goal, which explains the technical specifications of a project done at the design stage influences the structure to be sustainable.

- **Role in Industry**

Respondents current role in industry was an important factor for analyzingthe responses received, because the current implementation of constructiondesign ideas currently implemented in Indian Infrastructure could be determined based on respondents working in different projects as client, consultant(designer) and contractor.

Fig 2. Role in Industry



- **Work Experience**

There was a total of 32 respondents and the tenure of experience on the field in Infrastructure sector varied from 2 years to a maximum of 10 years. The total years of experience influences the study as the validation of data increases with the experience on construction. The respondents mainly structural and design manager s were from various companies suchas Larsen.

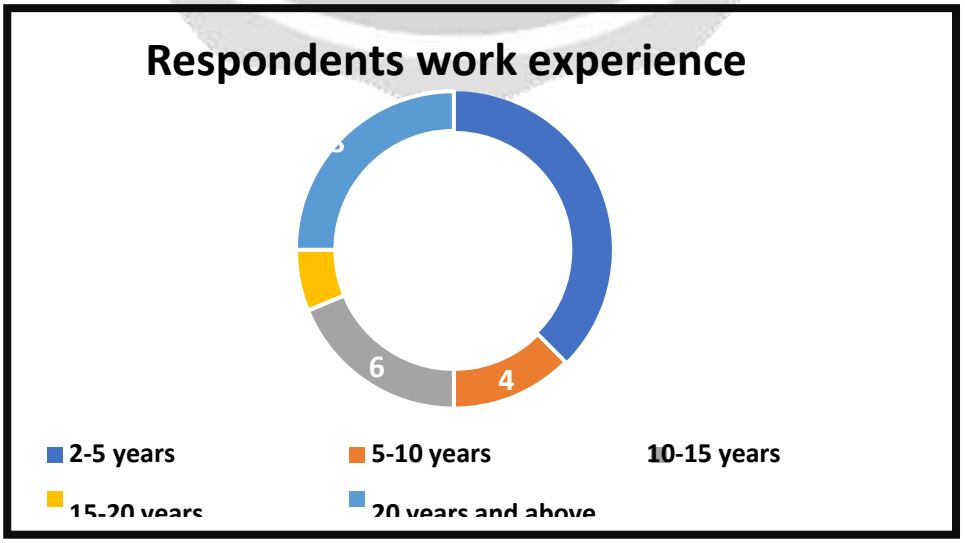
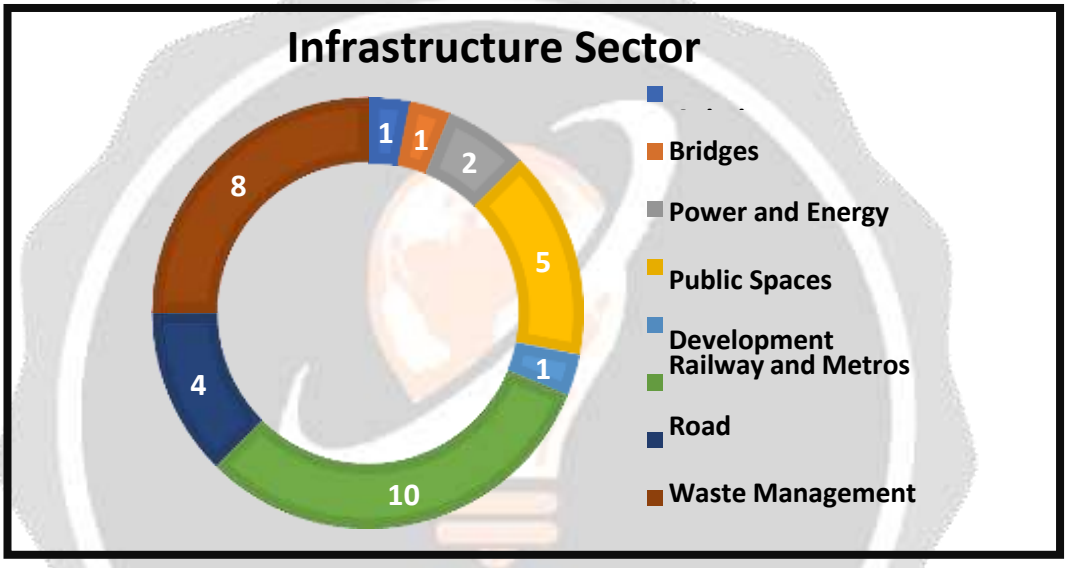


Fig 3. Respondents Work Experience

- **Infrastructure Sector**

Respondents were asked to notify in which type of infrastructure sector they were currently working on, as different sectors contribute to differentprojects which invariably helped in finding out the sustainable design ideaused in that sector providing with the pool of data for comparing with sustainable design goals.

Fig 4. Infrastructure Sector



➢ **MINIMISING COSTS AND MAXIMISING BENEFITS USING SUSTAINABILITY IN CONSTRUCTION**

By taking different project analysis it is found that the life cycle of a construction projects , there is potential to minimise costs and maximise benefits through judicious investments in key processes, including:
• involvement of end-users in initial planning and design is critical in reducing cost premiums and maximising benefits;
• integrated design solutions, particular in respect of whole building energy use, can reduce initial cost by avoiding oversizing and unnecessary complexity;
• design detailing needs to be completed as far as possible prior to construction;
• strong oversight of construction to ensure quality of workmanship and installations;
• full building commissioning to realise the design intent.
quality management, operation and maintenance is a requirement to realise the benefits of good design and commissioning.
• building user awareness that their activities impact on indoor conditions and energy use

4. CONCLUSIONS

From the questionnaire survey analysis in this research, it was demonstrated that sustainability ideas pertaining to design methodology of using blended infrastructure, residential and urban sustainability attained high level of acceptance from Industry professionals, such that they are currently in construction practices in Indian construction sector. The benefits of BIM and Green Rating System as well as Smart grid technology pertainingto productive data storage and data computation are greatly advantageous throughout the design process which also received major acceptance ideas of sustainable development This study complements the current literature such that it provides synchronization of sustainability ideas with survey analysis data, with the perception to designers for adopting these ideas and also achieving sustainability goals through various adoption methods for infrastructure sustainability. The research provides a future scope of incorporating the above stated Sustainability Ideas in conjunction with sustainability goals.

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