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A Survey Study on Challenges and Factors Affecting in Adopting Sustainable Construction Methods in Indian Construction Industry

Uma Ravi Teja Macherla¹

¹Assistant Professor, Department of Civil Engineering, Sri Venkateswara College of Engineering and Technology, Srikakulam, Andhra Pradesh, India-532410;

Email: ravimacherla007@gmail.com

Abstract

Due to India's growing urbanization, the building industry is experiencing severe environmental challenges. Demand for residential housing is rising, which causes people to use more energy, resources, and raw materials leading to the rise of the carbon footprint. The environment is significantly impacted by the construction sector. It uses up natural resources and energy reserves, and it contributes significantly to the world's CO2 emissions. The production of waste, the use of energy and water inefficiently, as well as several other environmental harms, have all been linked to the building sector. The step towards sustainability is getting a good cause due to the extinction of resources and increase of pollution in the environment. As per the sources, the majority of the carbon footprint is produced from cement and cement-related products (Construction Industry). Green Building practices are showing a good impact in the reduction of carbon footprint in the environment from the construction industry. This study aims to explore the importance of sustainable construction by conducting two surveys, a primary survey and a secondary survey. The primary survey focused on identifying the challenges in adopting sustainable construction practices, while the secondary survey aimed to identify the factors that influence the adoption of sustainable construction practices. The research employed the Relative Importance Index (RII) to identify the major challenges faced in adopting sustainable construction practices. With the help of RII factor, I was easily figured out the main challenges are Limited Awareness and Expensive Products.

Keywords: *Sustainable Construction, Challenges, Factors, Questionnaire Survey, Carbon Foot Print*

1. Introduction

Civil engineering is a branch of engineering that deals with the design, construction, and maintenance of the built environment, including structures such as buildings, bridges, roads, dams, and airports. It also includes the design and management of infrastructure systems, such as water supply and sewage treatment. Civil engineers use principles of physics, mathematics, and materials science to plan, design, and oversee construction projects. They are involved in every stage of a project, from initial concept and feasibility studies to final construction and maintenance. Civil engineers play a crucial role in ensuring that our built environment is safe, efficient, and sustainable. Sustainability in construction refers to the practice of designing, building, and maintaining structures and infrastructure in an environmentally responsible and resource-efficient manner. This includes using materials and methods that minimize negative impacts on the environment and promoting the use of renewable energy sources. It also involves designing buildings and infrastructure that are energy-efficient, reducing the use of non-renewable resources, and promoting the use of sustainable transportation options. Additionally, sustainable construction practices aim to minimize waste, reduce pollution and create healthy, comfortable, and safe indoor environments. Overall, sustainability in construction is about creating a built environment that supports the well-being of current and future generations while preserving natural resources and biodiversity.

Sustainable construction is important for several reasons. Firstly, it helps to reduce the environmental impact of buildings and infrastructure by minimizing the use of non-renewable resources, reducing waste and pollution, and promoting the use of renewable energy sources. This is important because the built environment is responsible for a significant portion of global greenhouse gas emissions, and sustainable construction practices can help to mitigate this impact. Secondly, sustainable construction helps to create buildings and infrastructure that are more energy-efficient and cost-effective to operate. This is beneficial for both the environment and for building owners and occupants, as it can lead to significant cost savings on energy bills. Thirdly, sustainable construction can help to create healthy, comfortable, and safe indoor environments for building occupants. This is important for promoting well-being and productivity, and can also help to attract and retain tenants or residents. Lastly, sustainable construction can also help to promote social sustainability by creating spaces that are accessible to all members of society, and by supporting local economies through the use of locally-sourced materials and labor.

Overall, sustainable construction is important for addressing the pressing environmental challenges of our time, while also providing economic and social benefits. It is a crucial step towards creating a more sustainable built environment that supports the well-being of current and future generations. Awareness alone may not be enough to significantly increase the sustainable construction footprint. While raising awareness about the benefits of sustainable construction and the environmental impact of the built environment can help to encourage more sustainable practices, it is not sufficient on its own. To truly increase the sustainable construction footprint, some other factors also need to be considered and addressed. For example, a lack of regulations and standards for sustainable construction can make it difficult for builders and developers to implement sustainable practices. Additionally, the availability and cost of sustainable materials and technologies can also be a barrier to the wider adoption of sustainable construction. Furthermore, sustainable construction practices can often require a higher initial investment, which can be a barrier for some developers and building owners. To overcome these barriers, incentives, and regulations are required to promote sustainable construction, and to make it more accessible and cost-effective.

1.1 Objectives

- To identify the current level of awareness and knowledge among construction industry professionals regarding sustainable practices
- To identify the barriers and challenges faced by construction professionals adopting sustainable practices
- To propose recommendations for overcoming the barriers and challenges.
- To identify the key factors in adopting sustainable practices

2. Literature Review

Ahmed Abu Hanieh et.al the purpose of the study is to create a sustainable model for the Palestinian residential construction industry by following the industry from conception to completion. The sustainability model will specify each resource input and link it to the outputs of the construction process, which include all dynamic contributors—labor, water, and energy. For a 100 m² residential construction, a model is implemented based on the sustainable supply chain. All relevant expenses have been included to indicate the building's overall cost for the implemented case study. The Value Creation Index for the case under investigation has been estimated and displays the relationship between the profits made by neighborhood construction firms and the costs associated with the building. The substantial resource use highlights the significance and necessity of developing a sustainability model for the industry.

Prithviraj Dilip Mane stated that Sustainable building approaches have become more and more popular in India. Newspaper headlines frequently discuss the growing concern over the negative consequences of construction-related activities and the need to remedy them. For improved environmental and social protection, the Indian government has already taken significant steps to promote the idea of green building. Due to growing environmental concerns, developers should review their current construction methods and implement sustainable construction techniques in their upcoming projects. The degree of awareness, knowledge, and

comprehension of the effects of each activity, however, determines how quickly all the connected developers and builders adopt this part of the construction. To measure the differences in knowledge, awareness, and application of sustainable practices based on the perspectives of the project developers in India, a survey has been organized in the current study that is in line with this purpose. The right steps should be taken to expand this understanding at all development levels to increase the momentum and acceptability of sustainable behavior in the sector.

Kaanchan M. Patil et.al Due to India's growing urbanization, the building industry is experiencing severe environmental issues. Demand for residential housing is rising, which causes people to use more energy, resources, and raw materials, increasing their carbon footprint. Environmental impact problems, such as altered weather patterns and ecological damage, already exist in all urban areas. The use of sustainable technology and materials in development is the answer. Sustainable development satisfies current needs without sacrificing the capacity of future generations to satisfy their own needs. This essay elaborates on the idea of sustainable development, which has gained prominence over the past 20 years. The utilization of environmentally friendly building materials and technologies will enable this progress. The idea acknowledges that nature and human civilization go hand in hand and that for the human community to continue, nature must be conserved and perpetuated. This concept is expressed through designs that demonstrate conservation principles, and sustainable development urges us to apply such principles to our daily lives. A different strategy than the conventional design must be used for sustainable development. The new strategy must take into account how each material and the technological decision will affect local, regional, and global natural and cultural resources.

A O Oluwunmi et. al order to create a sustainable environment, development must embrace the green construction concepts. However, there is relatively little research on its use in educational institutions, and the few studies that are accessible in Nigeria do not prioritize students' viewpoints. Therefore, this study looked into how Covenant University students in Ota, Ogun State, Nigeria, perceived the necessity to adopt green building principles. A response rate of 94% was attained out of 101 surveys distributed to students in the university's departments of architecture, building technology, and estate management. Tables were used to exhibit the data after it had been analyzed using descriptive statistics like percentage, weighted mean, and relative importance index (RII). According to the report, 88.42% of the students are familiar with the idea of green construction. The level of adoption of green building standards at Covenant University is quite low, according to the students. Additionally, according to the students, the university may profit from enhanced indoor air and water quality, less pollution and environmental deterioration, energy efficiency, and water conservation by implementing green building concepts.

Vanderley M. John stated Engineers face a significant opportunity and challenge in the form of sustainable development, which calls for a radical rethinking of the entire industrial sector to reduce the environmental impacts of products' life cycles by a factor of five while simultaneously boosting their economic and social benefits. Without fundamental changes to business practices and the acceptance of innovations across all industrial sectors, this cannot be accomplished [Crul & Diehl 2007; Eppinger & Hopkins 2010]. To achieve global sustainability, the building industry is viewed as a priority. The industry consumes between 40 and 75 percent of the total value of materials harvested and contributes up to 15% of the GDP, making it the sector with the highest intensity of material used in the overall economy. The amount of waste produced along the supply chain is inversely correlated with the overall cost of the resources used. The life cycle assessment of construction items, which mostly consist of buildings and roads, revealed that they account for a sizeable portion of total energy use. About 25% of all CO₂ gas emissions from the production of energy are caused by buildings themselves when they are in the "in-use" phase [Price et al. 2006]. Cement manufacturing accounts for 5% of all anthropogenic carbon emissions.

3. Methodology

A detailed analysis has been carried out, and the results are described in the following Flowchart

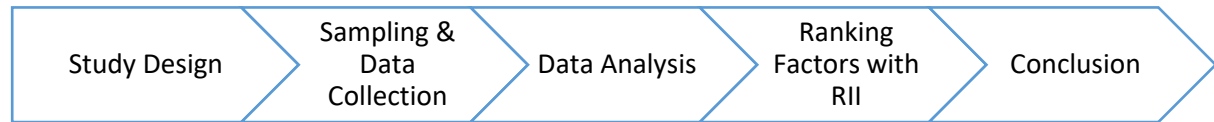


Fig A Methodology Chart

- Study Design
Study design refers to the plan or strategy used to conduct research and collect data for analysis.
- Sampling & Data Collection
Data collection involves gathering information through various methods, such as surveys, interviews, observations, or experiments, for analysis and interpretation.
- Data Analysis
Data analysis is the process of examining and interpreting data to draw conclusions, identify patterns, and test hypotheses.
- Ranking Factors with RII
Ranking factors using RII (Relative Importance Index) involves assigning weights to factors based on their perceived importance in achieving a goal.
- Conclusions

4. Results and Discussions

In this Survey, We mostly encouraged all the participants to know about the importance of Sustainable Construction and allowed them to freely express their interest in Sustainable Construction. All the respondents have a little bit of knowledge of it but mainly all the respondents are saying that this type of structure will be accepted by the High Rise construction people but it will not be accepted by Middle-Class Housing areas due to their initial investment. A few of the Respondents suggested that it should be implemented in the education system to encourage and create awareness of sustainable construction that how it saves the environment even though its initial investment is high but the life of the structure and eco-friendly environment will be a key factor over it. In this survey, I found students showed interest to learn a new concept in the construction industry and they have shown very much interest to know what products will come under Green products or Eco-Friendly Products. This survey data sheet Consists of Respondent Profiles, Challenges to Adopt Sustainable Construction, and Factors Affecting the Acceptance of Sustainable Construction

4.1 Respondent Profile

Respondent profile refers to the characteristics of individuals who participate in a study or survey, such as age, gender, education, income, and other relevant demographic or behavioral factors.

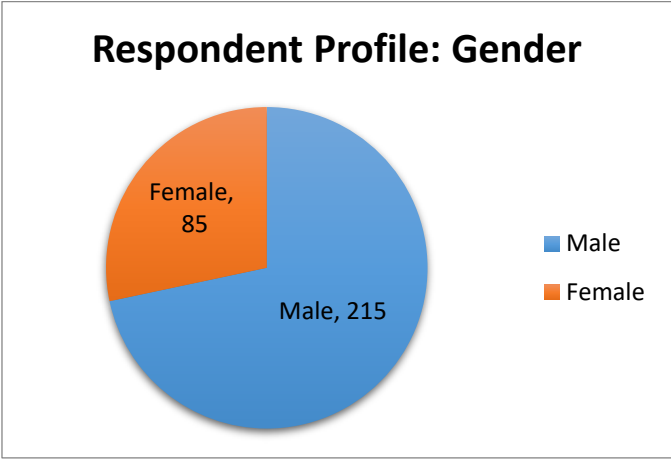


Fig 1 Respondent Profile- Gender

In this survey, the respondent profile was predominantly male, with 215 male participants and 85 female participants.

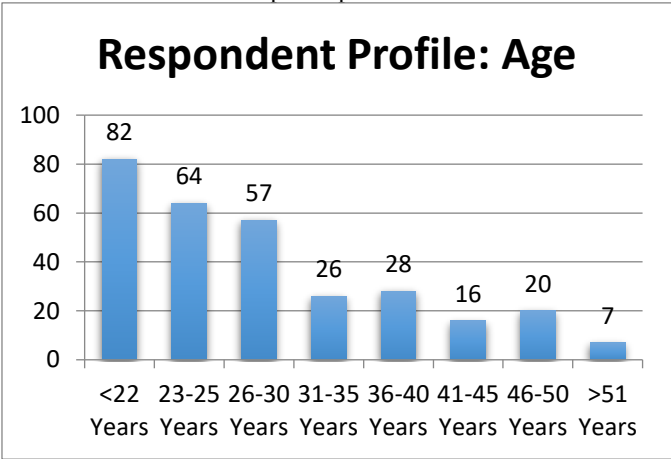


Fig 2 Respondent Profile- Age

The respondent profile in terms of age was diverse, with the majority falling between 23-25 years (64 participants) and <22 years (82 participants), while the age range of 51 years had the lowest participation with only 7 participants.

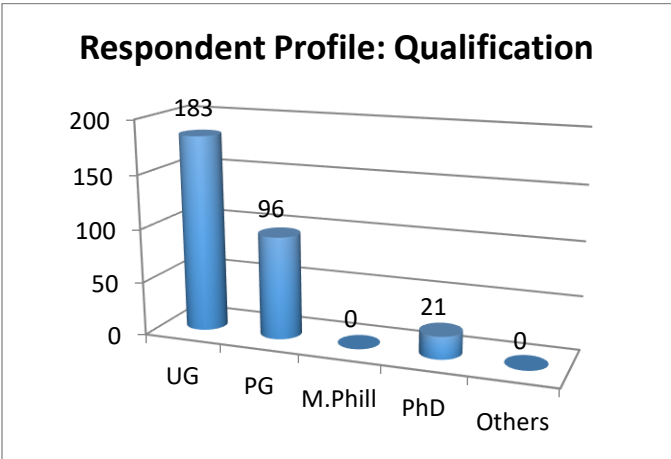


Fig 3Respondent Profile- Qualification

The educational qualification of the respondents varied, with the majority having an undergraduate degree (183 participants), followed by postgraduate degrees (96 participants), while no respondents had a Master of Philosophy degree and only 21 had a Ph.D., with none falling under the "Others" category.

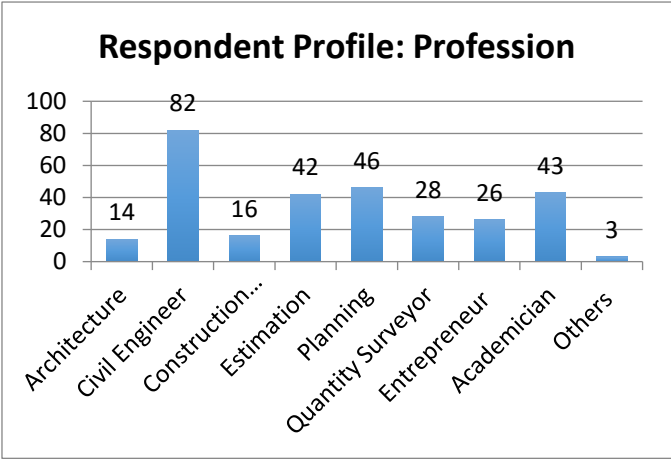


Fig 4Respondent Profile- Qualification

The profession of the respondents was diverse, with civil engineers being the most common (82 participants), followed by architects (14 participants) and entrepreneurs (26 participants). Other professions, such as construction project managers, estimators, planners, quantity surveyors, academicians, and individuals in other fields, were also represented in the respondent profile.

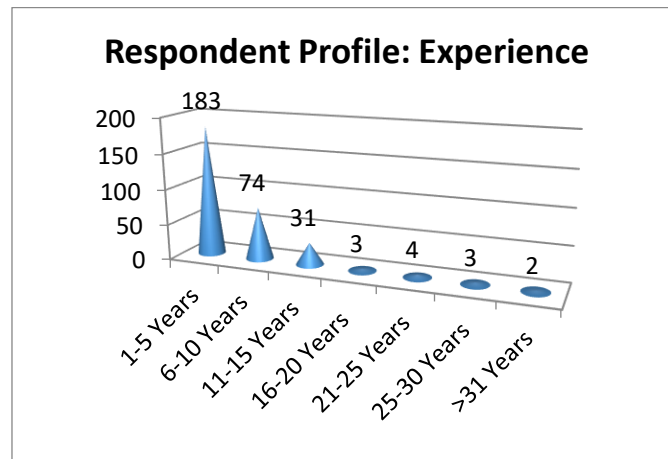


Fig 5 Respondent Profile- Experience

The experience of the respondents in the construction industry varied, with the majority having 1-5 years of experience (183 participants), followed by 6-10 years of experience (74 participants). Only a small number of respondents had more than 15 years of experience, with only 2 having more than 31 years of experience.

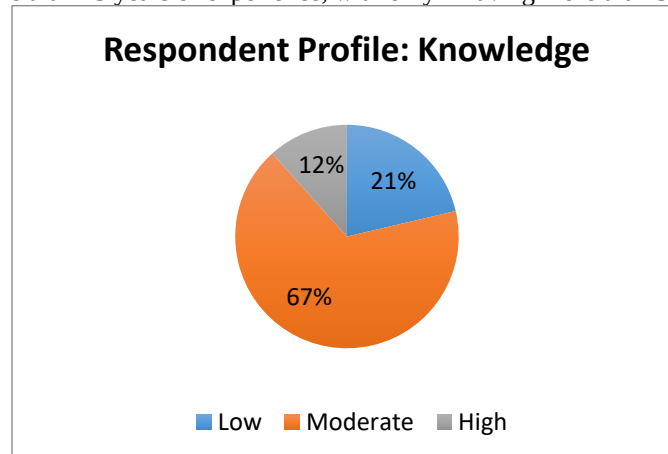


Fig 6 Respondent Profile- Knowledge

The knowledge of respondents on green buildings varied, with the majority having a moderate level of knowledge (201 participants), followed by low knowledge (64 participants) and high knowledge (35 participants).

4.2 Challenges in Adopting Sustainable Construction

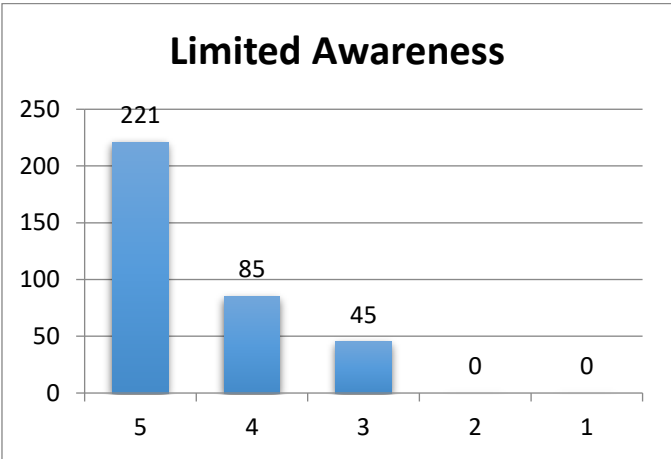


Fig 7Challenges- Limited Awareness

In regards to the limited awareness challenge, the majority of respondents strongly agreed that it was a challenge (221 participants), followed by those who agreed (34 participants). No respondents were neutral, disagreed, or strongly disagreed with this challenge.

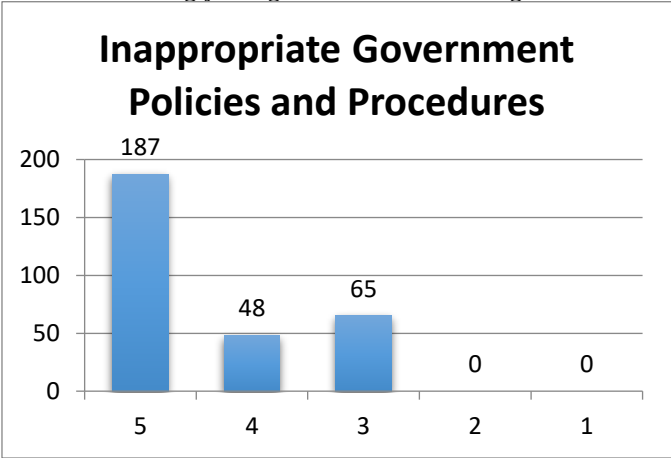


Fig 8 Challenges- Inappropriate Government Policies and Procedures

In regards to the inappropriate government policies and procedures challenge, the majority of respondents strongly agreed that it was a challenge (187 participants), followed by those who agreed (48 participants). A significant number of respondents were neutral about this challenge (65 participants), while none of the respondents disagreed or strongly disagreed with it.

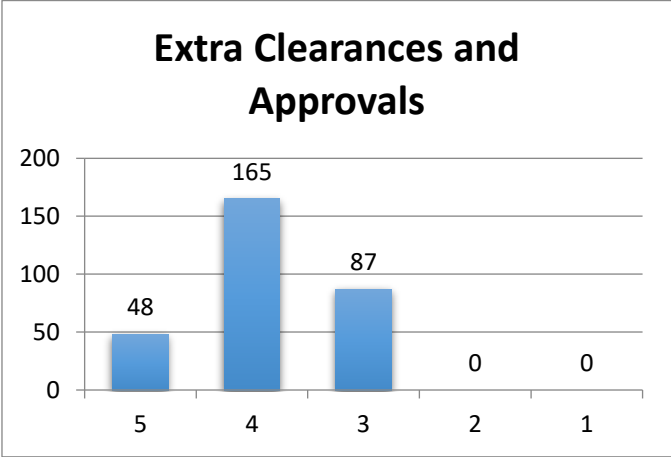


Fig 9 Challenges- Extra Clearances and Approvals

In regards to the extra clearances and approvals challenge, the majority of respondents agreed that it was a challenge (165 participants), followed by those who were neutral about it (87 participants). A smaller number of respondents strongly agreed that it was a challenge (48 participants), while none of the respondents disagreed or strongly disagreed with this challenge.

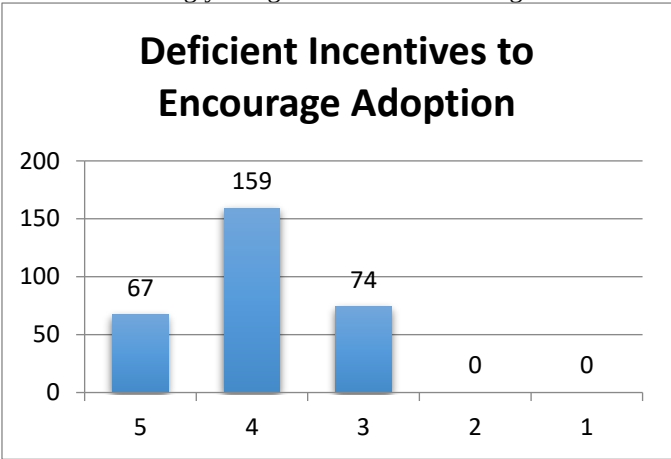


Fig 10 Challenges- Deficient Incentives to Encourage Adoption

In regards to the deficient incentives to encourage adoption challenge, the majority of respondents agreed that it was a challenge (159 participants), followed by those who were neutral about it (74 participants). A smaller number of respondents strongly agreed that it was a challenge (67 participants), while none of the respondents disagreed or strongly disagreed with this challenge.

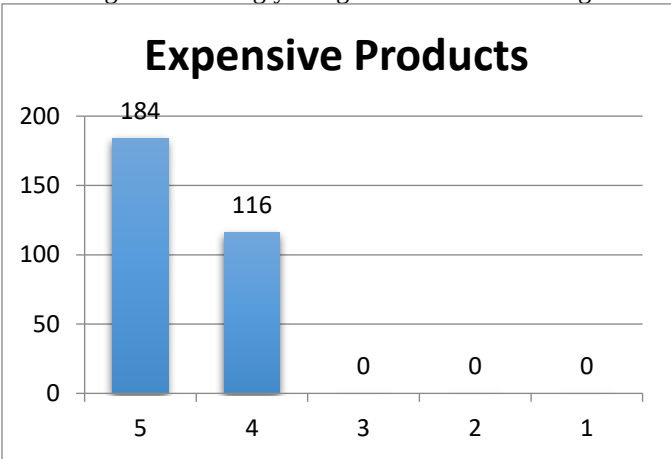


Fig 11 Challenges- Expensive Products

In regards to the expensive products challenge, the majority of respondents strongly agreed that it was a challenge (184 participants), followed by those who agreed (116 participants). None of the respondents were neutral, disagreed, or strongly disagreed with this challenge.

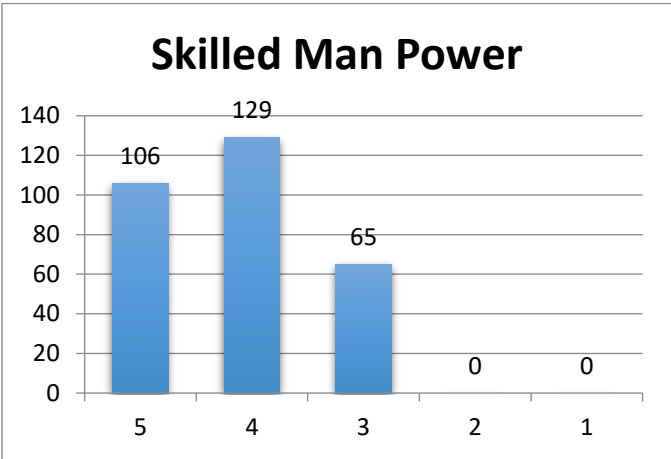


Fig 12Challeneges- Skilled Man Power

In regards to the skilled manpower challenge, the majority of respondents agreed that it was a challenge (129 participants), followed by those who strongly agreed (106 participants). A significant number of respondents were neutral about this challenge (65 participants), while none of the respondents disagreed or strongly disagreed with it.

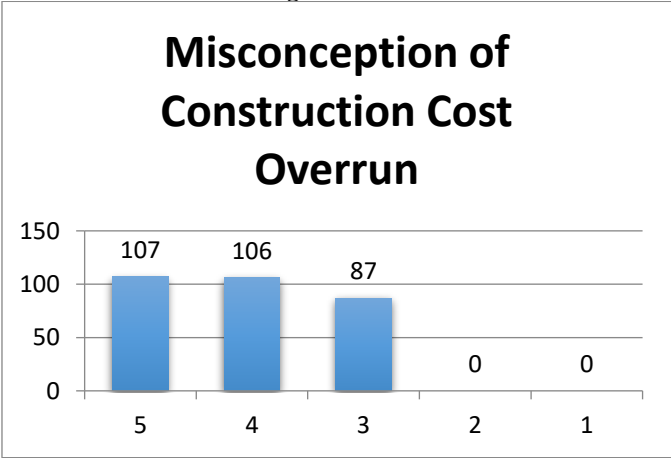


Fig 13Challeneges- Misconception of Construction Cost

In regards to the misconception of construction cost overrun challenge, the majority of respondents either strongly agreed or agreed that it was a challenge (107 and 106 participants, respectively). A significant number of respondents were neutral about this challenge (87 participants), while none of the respondents disagreed or strongly disagreed with it.

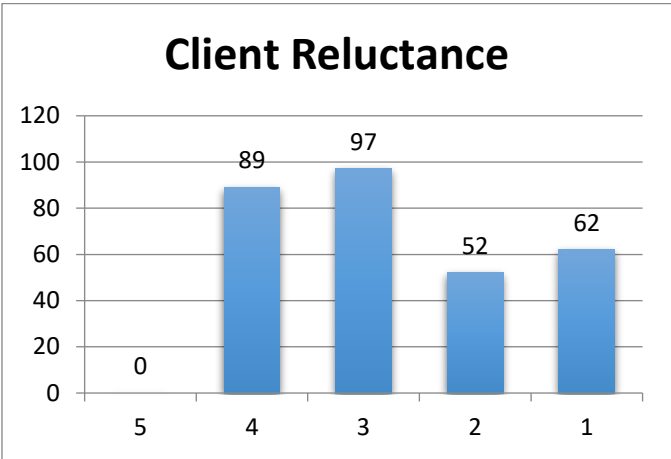


Fig 14Challeneges- Client Reluctance

In regards to the client reluctance challenge, the majority of respondents were either neutral (97 participants) or disagreed (52 participants) that it was a challenge. A significant number of respondents agreed that it was a challenge (89 participants), while none of the respondents strongly agreed with it. However, a considerable number of respondents also strongly disagreed with this challenge (62 participants).

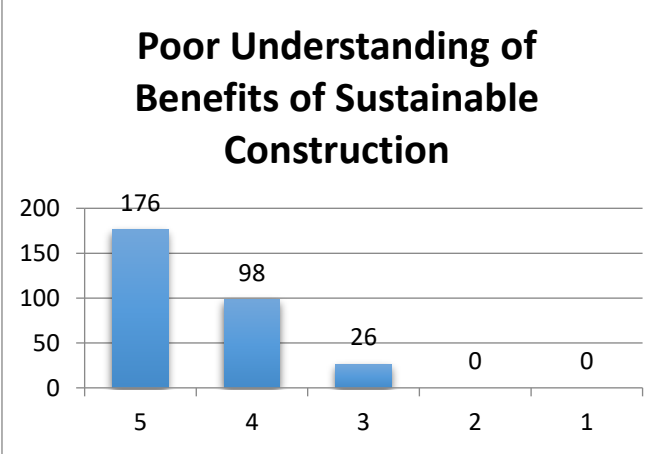


Fig 15Challeneges- Poor Understanding Benefits

According to the survey, a majority of the respondents agreed that the challenge of poor understanding of benefits of sustainable construction exists, with 176 participants strongly agreeing and 98 participants agreeing with this challenge. A small number of respondents were neutral towards this challenge (26 participants), while none of the respondents disagreed or strongly disagreed with it.

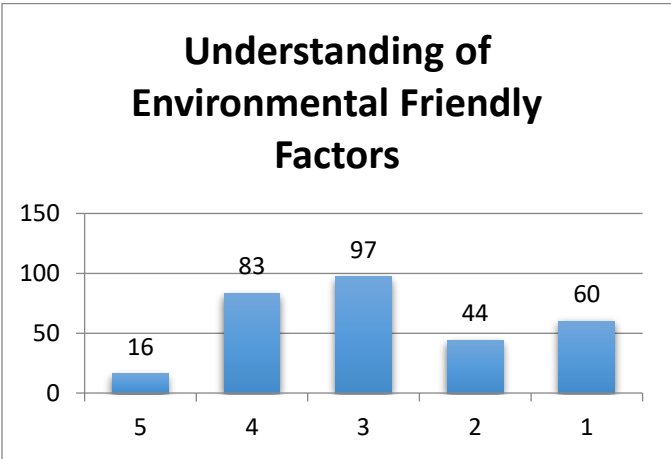


Fig 16Challeneges- Understanding Environmentally Friendly Factors
According to the survey results, for the challenge of Understanding of Environmental Friendly Factors, 16 respondents strongly agreed, 83 agreed, 97 were neutral, 44 disagreed, and 60 strongly disagreed.

4.3 Factors Affecting Acceptance of Sustainable Construction

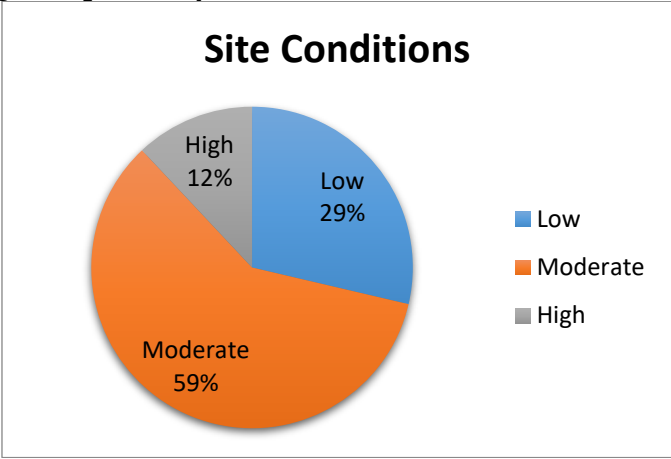


Fig 17Environmental Factors-Site Conditions
In the Environmental Factors, Respondents stated that Site Conditions will be the moderate factor in Accepting Sustainable Construction.

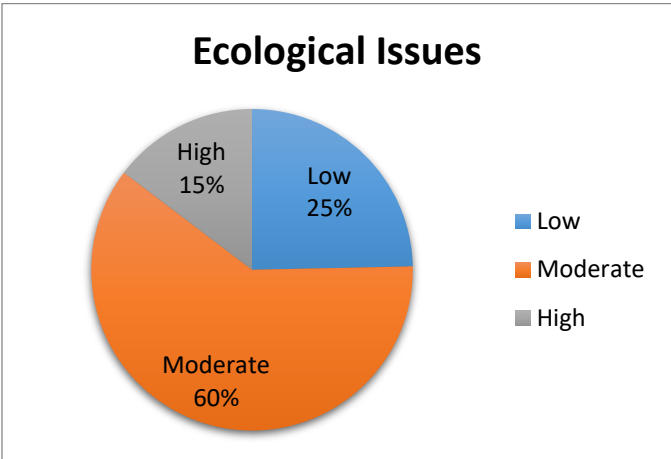


Fig 18Environmental Factors-Ecological Issues
In the Environmental Factors, Respondents stated that Ecological Issues will be the moderate factor in Accepting Sustainable Construction.

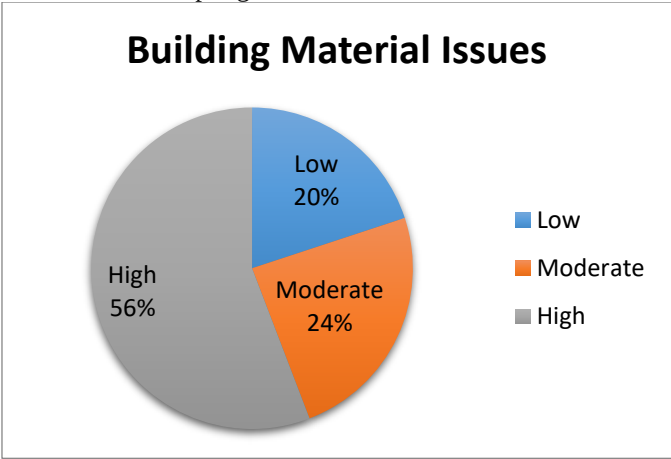


Fig 19Environmental Factors-Building Material Issues
In the Environmental Factors, Respondents stated that Building Material Issues will be the High factor in Accepting Sustainable Construction.

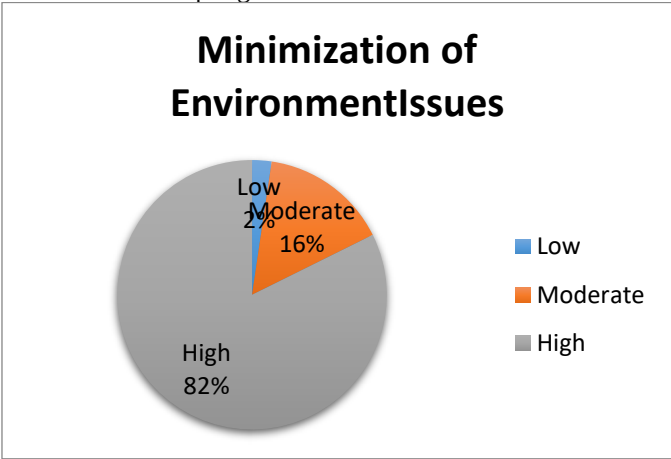


Fig 20Environmental Factors-Minimization of Environment Issues
In the Environmental Factors, Respondents stated that Minimization of Environment Issues will be the High factor in Accepting Sustainable Construction.

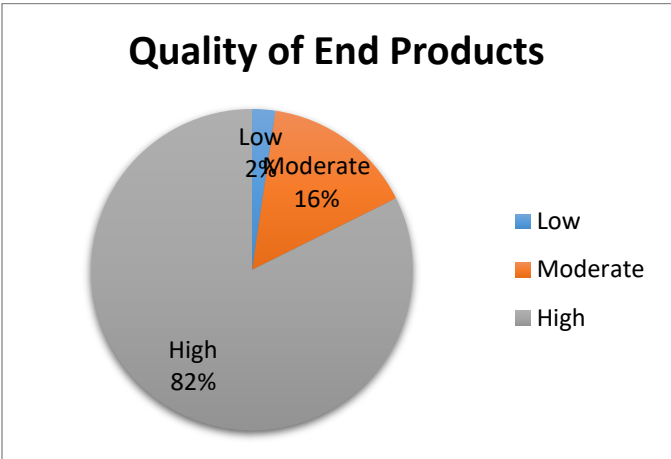


Fig 21Environmental Factors-Quality of End Products
In the Environmental Factors, Respondents stated that the Quality of the End Product will be the High factor in Accepting Sustainable Construction.

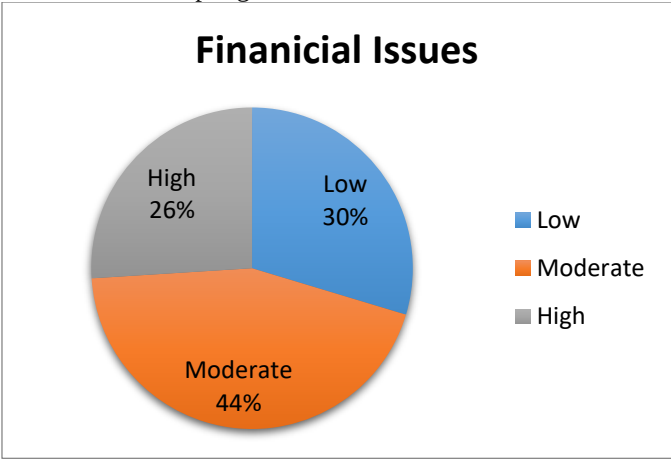


Fig 22 Economical Factors-Financial Issues
In the Economical Factor, Respondents stated that Financial Issues will be the Moderate Factor for Accepting Sustainable Construction.

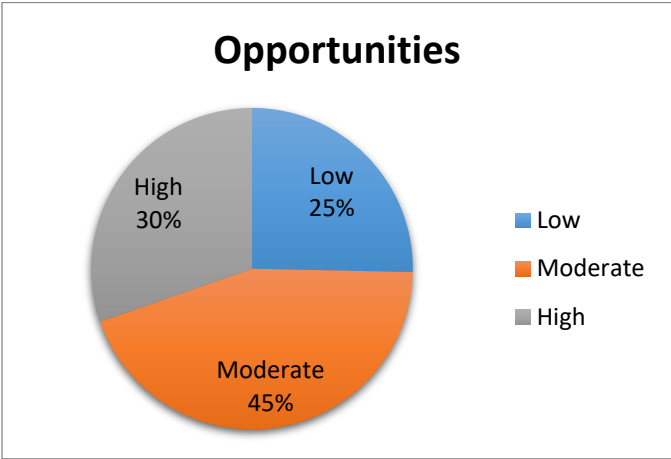


Fig 23Economical Factors-Opportunities
In the Economical Factor, Respondents stated that Opportunities will be the Moderate Factor for Accepting Sustainable Construction.

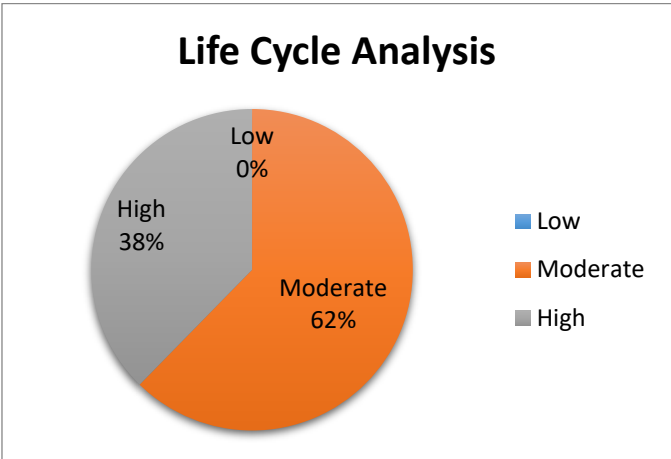


Fig 24Economical Factors-Life Cycle Analysis
In the Economical Factor, Respondents stated that Life Cycle Analysis will be the Moderate Factor for Accepting Sustainable Construction.

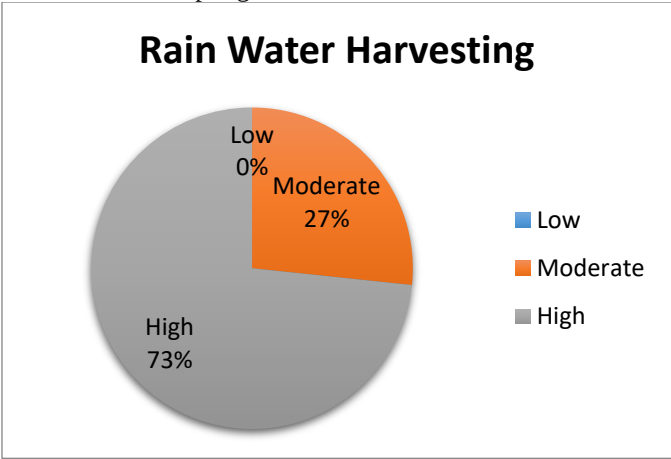


Fig 25Technological Factors-Rain Water Harvesting
In the Technological Factor, Respondents stated that Rain Water Harvesting Techniques will be the High Factor for Accepting sustainable Construction.

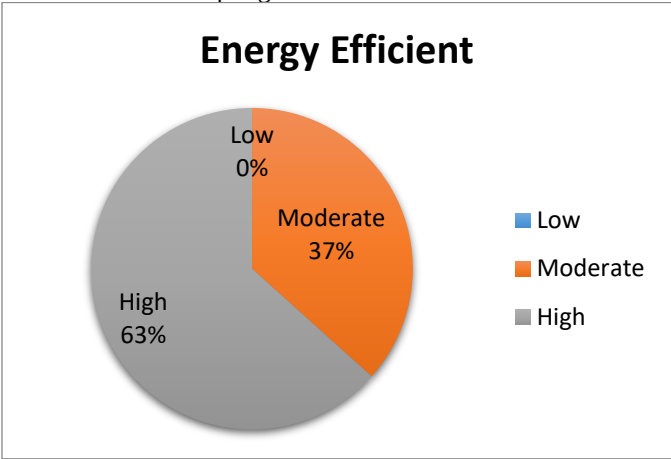


Fig 26Technological Factors-Energy Efficient Techniques
In the Technological Factor, Respondents stated that Energy Efficient Techniques will be the High Factor for Accepting sustainable Construction.

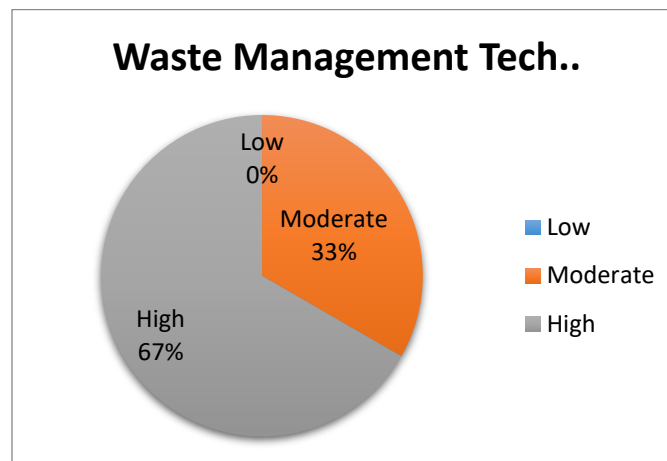


Fig 27Technological Factors-Waste Management Techniques

In the Technological Factor, Respondents stated that Waste Management Techniques will be the High Factor for Accepting sustainable Construction.

4.4 Relative Importance Index(RII):

The Relative Importance Index (RII) is a statistical tool used to measure the importance of various factors in a given study or survey. It is often used in market research and other social sciences to identify the most significant variables or factors that influence a particular outcome.

S.no	Challenges	RII FACTOR	MEAN
1	Limited Awareness	0.92	4.587
2	Inappropriate Government Policies and Procedures	0.88	4.407
3	Extra Clearances and Approvals	0.77	3.870
4	Deficient Incentives to Encourage Adoption	0.80	3.977
5	Expensive Products	0.92	4.613
6	Skilled Man Power	0.83	4.137
7	Misconception of Construction Cost Overrun	0.81	4.067
8	Client Reluctance	0.54	2.710
9	Poor Understanding of Benefits of Sustainable Construction	0.90	4.500
10	Understanding of Environmental Friendly Factors	0.57	2.837

5. Conclusions

The following conclusions are from this study:

1. Due to Less number of people available in our field, I'm unable to reach more people.
2. All the respondents are a little bit aware of Sustainable Construction.
3. In this survey, I found the students aren't aware of this concept. Mainly they should study the concepts of Sustainable Construction or at least they should participate in conferences or project works.
4. Experienced people are good at this type of construction and they are very much interested to adopt this type of Eco-Friendly Construction.
5. In the above study, all the respondents were very much interested to adopt technological factors in their constructions.
6. This survey mainly worked on the concept of finding out the challenges in adopting sustainable constructions and mainly awareness is required.

7. The Cost factor for the products and workmanship plays a major role in adopting sustainable construction
8. Few people n the respondents are not aware of Life Cycle Analysis/ Assessment.
9. Building Materials issues will have a major effect on adopting Sustainable construction
10. Client Approval also is one of the major challenges in adopting sustainable constructions.
11. Respondents Stated that Limited Awareness and Expensive Products are the Main Reason to adopt Sustainable Construction. They have RII factor with 0.92.

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