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A Study On Climate-Resilient Construction In Bangladesh: Building A Safer Future

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ABSTRACT

Bangladesh is one of the most climate-vulnerable countries in the world, frequently exposed to floods, cyclones, storm surges, riverbank erosion, and rising temperatures. These climate-induced hazards pose serious threats to the built environment, particularly to housing and critical infrastructure. This study examines the concept and practice of climate-resilient construction in Bangladesh with the aim of identifying effective strategies for building a safer and more sustainable future. The research analyzes existing construction practices, climate-related risks, and policy frameworks, alongside case studies of resilient housing and infrastructure projects implemented in vulnerable regions. Emphasis is given to the use of locally available materials, innovative design techniques, elevated structures, flood-resistant foundations, wind-resistant roofing systems, and environmentally sustainable construction methods. The study also explores the role of government regulations, community participation, and capacity building in promoting climate resilience. Findings indicate that integrating climate-responsive design, appropriate technology, and strong institutional support can significantly reduce disaster-related losses and enhance long-term sustainability. The study concludes that climate-resilient construction is not only a technical necessity but also a socio-economic imperative for Bangladesh, requiring coordinated efforts among policymakers, engineers, planners, and local communities to ensure safe, affordable, and adaptive infrastructure development.

Keywords: Climate-resilient construction, Bangladesh, disaster risk reduction, sustainable infrastructure, resilient housing, cyclone-resistant structures.

INTRODUCTION

Bangladesh is globally recognized as one of the country's most vulnerable to the impacts of climate change due to its low-lying deltaic geography, high population density, and heavy dependence on climate-sensitive sectors. The country frequently experiences natural hazards such as floods, cyclones, storm surges, riverbank erosion, heatwaves, and salinity intrusion, all of which pose significant threats to human life, livelihoods, and the built environment. Rapid urbanization and unplanned construction have further intensified these risks, making infrastructure and housing increasingly susceptible to climate-induced disasters.

The construction sector in Bangladesh plays a crucial role in national development, providing housing, transportation networks, and public infrastructure. However, conventional construction practices often fail to adequately consider long-term climate risks, leading to repeated damage, economic losses, and social disruption. Climate-resilient construction has therefore emerged as a vital approach to reducing vulnerability

by integrating adaptive design, durable materials, and disaster-resistant technologies into the planning, design, and construction processes.

Climate-resilient construction refers to the ability of buildings and infrastructure to withstand, adapt to, and rapidly recover from climate-related hazards while maintaining their essential functions. In the context of Bangladesh, this includes flood-resistant foundations, elevated structures, cyclone- and wind-resistant design, improved drainage systems, and the use of locally appropriate and sustainable materials. Additionally, resilience involves institutional frameworks, building codes, community participation, and policy support to ensure widespread adoption of adaptive construction practices.

This study aims to explore the current status, challenges, and opportunities of climate-resilient construction in Bangladesh. By analyzing climate risks, existing construction practices, policy initiatives, and selected case studies, the research seeks to highlight effective strategies for strengthening resilience in the built environment. Ultimately, the study emphasizes that promoting climate-resilient construction is essential for safeguarding lives, protecting investments, and ensuring sustainable development in Bangladesh in the face of growing climate uncertainties.

OBJECTIVES OF THE STUDY

The main objectives of this study are as follows:

1. To identify the major climate-related hazards affecting the construction sector in Bangladesh.
2. To examine existing construction practices and assess their vulnerability to climate change impacts.
3. To explore climate-resilient construction techniques and materials suitable for Bangladesh's environmental and socio-economic context.
4. To analyze current policies, building codes, and institutional frameworks supporting climate-resilient construction in Bangladesh.
5. To review selected case studies of climate-resilient housing and infrastructure projects implemented in vulnerable areas.
6. To identify challenges and barriers to the adoption of climate-resilient construction practices.
7. To propose recommendations for promoting sustainable, safe, and climate-resilient construction to support long-term development in Bangladesh.

LITERATURE REVIEW

Climate-resilient construction has gained increasing attention in both global and national research due to the growing impacts of climate change on the built environment. Existing literature highlights that developing countries, particularly low-lying coastal and deltaic nations like Bangladesh, face disproportionate risks from climate-induced disasters such as floods, cyclones, sea-level rise, and extreme weather events (IPCC, 2022). These hazards directly affect infrastructure durability, housing safety, and overall urban and rural resilience.

Several studies emphasize that traditional construction practices in Bangladesh are often inadequate to withstand recurring climate stresses. Ahmed and Rahman (2018) note that poor material quality, lack of compliance with building codes, and limited technical knowledge contribute to structural vulnerability, especially in rural and informal settlements. Research by Alam et al. (2020) further suggests that unplanned urban growth and encroachment on floodplains increase exposure to flood and waterlogging risks, intensifying infrastructure damage during extreme rainfall events.

The literature also highlights various climate-resilient construction strategies relevant to Bangladesh. Elevated plinth levels, reinforced concrete frames, wind-resistant roofing, and improved drainage systems are commonly recommended measures for flood- and cyclone-prone areas (UNDP, 2019). Studies by Hasan et al. (2021) demonstrate that the use of locally available and sustainable materials, such as treated bamboo, stabilized soil blocks, and coir-based products, can enhance structural resilience while reducing construction costs and environmental impacts.

Policy and institutional frameworks play a critical role in promoting climate-resilient construction. Researchers have examined the effectiveness of the Bangladesh National Building Code (BNBC) and national adaptation policies, noting improvements in hazard-resistant design guidelines but also identifying gaps in enforcement and implementation (Khan & Islam, 2019). Community-based approaches are widely recognized in the literature as essential for ensuring long-term resilience, as local participation enhances

acceptance, maintenance, and contextual suitability of resilient construction solutions (World Bank, 2020). Case studies documented in academic and development literature provide practical insights into successful climate-resilient construction initiatives. Cyclone-resilient housing projects in coastal regions, flood-resilient schools, and raised road infrastructure have shown significant reductions in damage and faster post-disaster recovery (ADB, 2021). However, scholars also highlight challenges such as higher initial costs, limited access to finance, lack of skilled labor, and low awareness among stakeholders as major barriers to widespread adoption.

Overall, the literature indicates that climate-resilient construction is a multidimensional concept encompassing technical, environmental, social, and institutional aspects. While Bangladesh has made notable progress in developing resilient infrastructure, existing research underscores the need for stronger policy enforcement, increased capacity building, and greater integration of climate resilience into mainstream construction practices to ensure sustainable development in the face of ongoing climate change.

RESEARCH METHODOLOGY

This study adopts a qualitative and descriptive research methodology to examine climate-resilient construction practices in Bangladesh. The methodology is designed to analyze existing knowledge, policies, and practical applications related to climate resilience in the construction sector, with a focus on understanding challenges, opportunities, and effective strategies.

Research Design

The research follows a descriptive and analytical design, combining literature-based analysis with case study review. This approach enables an in-depth understanding of climate-related risks and resilience measures within the context of Bangladesh's construction industry.

Data Sources

Both primary and secondary data sources are utilized in this study. Secondary data form the core of the research and are collected from academic journals, government reports, policy documents, development agency publications, and international organization reports related to climate change, disaster risk reduction, and construction practices. Relevant documents include the Bangladesh National Building Code (BNBC), national climate adaptation plans, and reports from organizations such as IPCC, UNDP, World Bank, and ADB.

Primary data are limited and exploratory in nature, obtained through informal discussions with engineers, builders, and local stakeholders involved in construction activities in climate-vulnerable areas. These discussions provide practical insights into on-ground challenges and adaptive practices.

Case Study Approach

Selected case studies of climate-resilient housing and infrastructure projects in flood-prone, cyclone-prone, and coastal regions of Bangladesh are reviewed. These case studies help illustrate the application of resilient design principles, materials, and technologies, and allow comparison between conventional and climate-resilient construction practices.

Data Analysis Method

The collected data are analyzed using qualitative content analysis. Key themes such as climate risks, construction techniques, policy support, community participation, and implementation challenges are identified and systematically reviewed. Comparative analysis is used to evaluate the effectiveness of different resilience strategies.

Limitations of the Study

The study is subject to certain limitations, including reliance on secondary data and a limited number of case studies due to time and resource constraints. Additionally, the absence of extensive quantitative analysis may limit the generalizability of findings. However, the qualitative approach provides valuable insights into the current state of climate-resilient construction in Bangladesh.

Overall, the chosen methodology allows for a comprehensive assessment of climate-resilient construction practices and provides a foundation for policy recommendations and future research.

RESULTS AND DISCSSION

This section integrates the survey findings with literature and contextual analysis to provide a comprehensive understanding of climate-resilient construction in Bangladesh. The discussion highlights key trends, challenges, and opportunities identified through both primary (survey) and secondary (literature) data.

Table 1: Respondent Profile (Survey Participants)

Category	Frequency (n=120)	Percentage (%)
Engineers	35	29.16%
Contractors/ Builders	27	22.50%
Architects/ Planners	14	11.67%
Local Residents	32	26.67%
Policy/ NGO Officials	12	10.00%

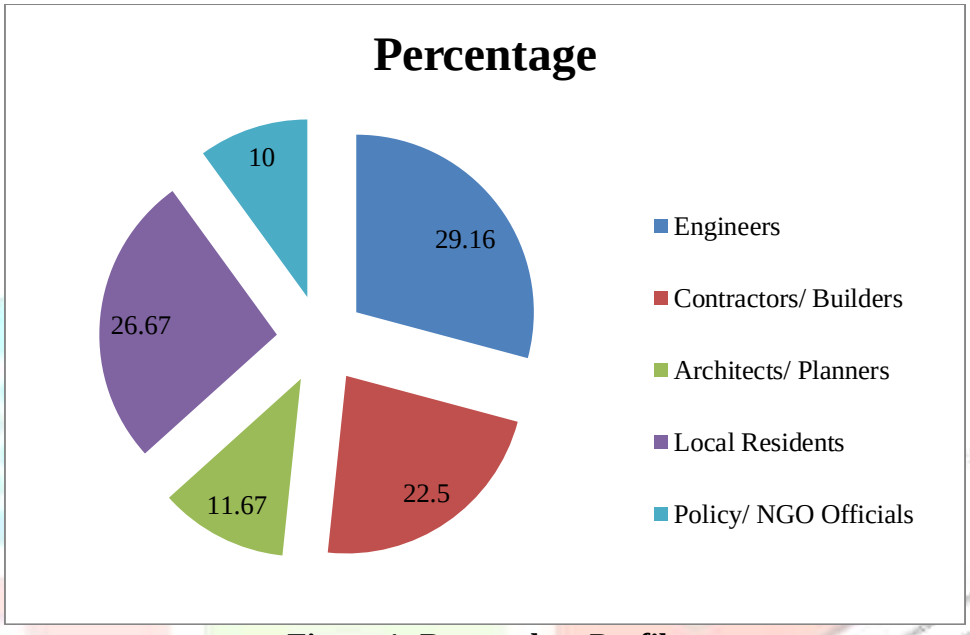

Figure 1: Respondent Profile

Table 1 presents the demographic and professional distribution of the survey respondents involved in this study. A total of 120 participants were selected to ensure a diverse and representative understanding of climate-resilient construction practices in Bangladesh. The respondents included engineers (29.16%), contractors/ builders (22.50%), architects and planners (11.67%), local residents from climate-vulnerable areas (26.67%), and policy makers or NGO officials (10%).

The inclusion of professionals such as engineers, architects, and contractors provides technical insights into construction practices and design considerations, while local residents contribute practical, experience-based perspectives on climate impacts and housing resilience. Policy and NGO officials offer an institutional and policy-oriented viewpoint regarding climate adaptation initiatives. This balanced respondent profile strengthens the reliability of the survey findings by incorporating technical, community, and policy-level perspectives relevant to climate-resilient construction in Bangladesh.

Table 2: Awareness of Climate-Resilient Construction

Awareness Level	Number of Respondents	Percentage (%)
Highly aware	34	28%
Moderately aware	50	42%
Slightly aware	24	20%
Not aware	12	10%

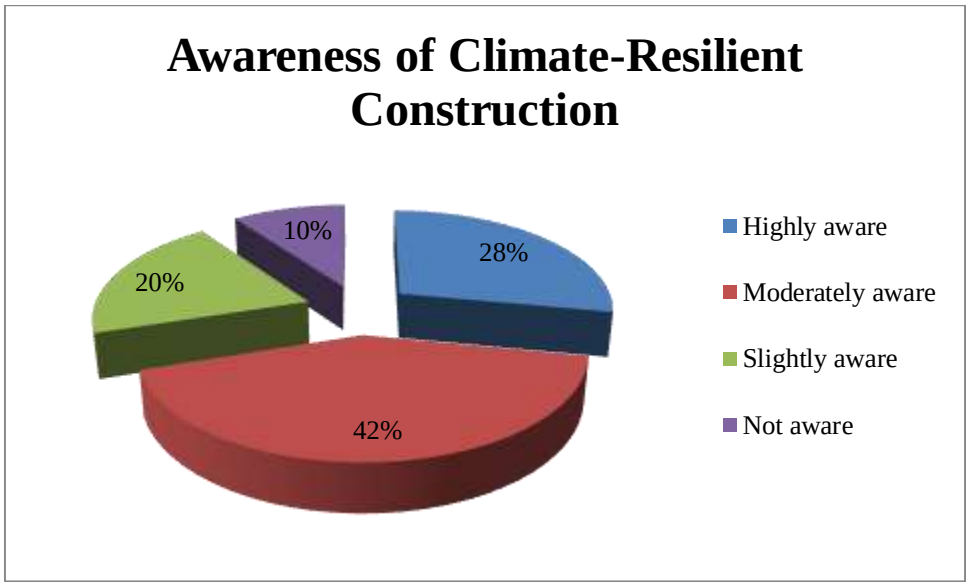

Figure 2: Awareness of Climate-Resilient Construction

Table 2 illustrates the level of awareness of climate-resilient construction among the survey respondents. The results show that a significant proportion of participants possess a reasonable understanding of climate-resilient construction concepts. About 28% of respondents reported being highly aware, while 42% indicated a moderate level of awareness. This suggests that a majority of respondents (70%) have at least a basic to good understanding of climate-resilient construction practices.

However, the table also reveals that awareness is not yet universal. Approximately 20% of respondents are only slightly aware, and 10% reported no awareness at all. These findings highlight existing knowledge gaps, particularly among non-technical stakeholders, and emphasize the need for greater awareness-building initiatives, training programs, and information dissemination to promote wider adoption of climate-resilient construction practices in Bangladesh.

Table 3: Perceived Major Climate Risks to Construction

Climate Risk	Respondents (%)
Flooding	78%
Cyclones	65%
Waterlogging	54%
Riverbank erosion	40%
Heat stress	32%

Table 3 presents the survey respondents' perceptions of the major climate-related risks affecting the construction sector in Bangladesh. Flooding emerged as the most significant threat, identified by 78% of respondents, reflecting the country's frequent exposure to riverine and flash floods. Cyclones were perceived as the second most critical risk, reported by 65% of respondents, particularly relevant to coastal and near-coastal regions.

Other notable risks include waterlogging (54%), which is especially problematic in urban and low-lying areas, and riverbank erosion (40%), leading to the loss of land and structures in river-adjacent communities. Heat stress was identified by 32% of respondents, indicating growing concern over rising temperatures and their impact on construction materials and indoor comfort. Overall, the findings demonstrate that respondents recognize multiple, overlapping climate risks, underscoring the necessity of adopting comprehensive climate-resilient construction strategies in Bangladesh.

Table 4: Adoption of Climate-Resilient Construction Practices

Practice	Yes (%)	No (%)
Raised plinth/foundation	62	38
Reinforced concrete frame	70	30
Cyclone-resistant roofing	48	52
Improved drainage system	55	45
Use of local sustainable materials	46	54

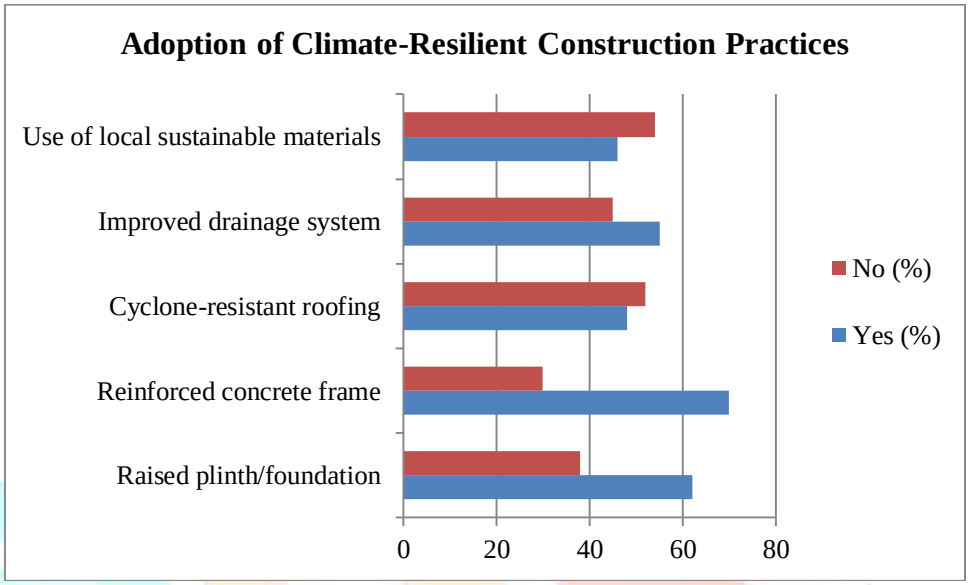

Figure 3: Adoption of Climate-Resilient Construction Practices

Table 4 highlights the extent to which survey respondents have implemented or observed the use of climate-resilient construction practices in Bangladesh. The data indicate that certain measures, such as reinforced concrete frames (70%) and raised plinths or foundations (62%), are more widely adopted, particularly in urban and cyclone- or flood-prone areas.

Other practices, such as improved drainage systems (55%) and cyclone-resistant roofing (48%), show moderate adoption, reflecting partial integration of resilience measures in existing construction projects. The use of local and sustainable materials, such as treated bamboo, coir-based products, or stabilized soil blocks, is the least adopted practice at 46%, suggesting challenges in material availability, cost, or technical knowledge.

Overall, the table illustrates that while awareness and partial adoption of climate-resilient construction exist, significant gaps remain. Wider dissemination of technical knowledge, incentives for resilient construction, and support for sustainable material use are necessary to improve overall adoption rates across Bangladesh.

Table 5: Perceived Effectiveness of Climate-Resilient Measures

Effectiveness Level	Frequency	Percentage (%)
Very effective	43	36%
Effective	53	44%
Neutral	14	12%
Ineffective	10	8%

Table 5 presents the survey respondents' assessment of the effectiveness of various climate-resilient construction measures in reducing disaster-related damage and enhancing building durability. According to the data, 36% of respondents consider these measures to be "very effective," while 44% perceive them as "effective," indicating that a majority (80%) of participants recognize the positive impact of climate-resilient practices.

A smaller portion of respondents 12% remain neutral, reflecting uncertainty or limited firsthand experience with such construction methods. Only 8% consider these measures to be ineffective, possibly due to cost constraints, lack of technical knowledge, or substandard implementation in practice.

Overall, the findings suggest that climate-resilient measures are largely regarded as beneficial by stakeholders, reinforcing the importance of promoting these practices through policy support, training, and awareness campaigns to enhance resilience across Bangladesh's construction sector.

Table 6: Key Barriers to Climate-Resilient Construction (Survey Findings)

Barrier	Respondents (%)
High construction cost	72%
Lack of skilled labor	58%
Weak enforcement of codes	60%
Limited access to finance	55%
Lack of awareness	47%

Table 6 summarizes the primary obstacles to adopting climate-resilient construction practices, as reported by survey respondents. High construction costs emerged as the most frequently cited barrier (72%), indicating that financial constraints significantly hinder the widespread implementation of resilient design and materials.

Other major barriers include weak enforcement of building codes (60%) and lack of skilled labor (58%), highlighting institutional and technical challenges in ensuring quality and disaster-resistant construction. Limited access to finance (55%) further restricts both builders and homeowners from investing in resilience measures. Additionally, lack of awareness (47%) among stakeholders, particularly local residents and small-scale contractors, reduces the adoption of climate-adaptive practices.

These findings reveal that promoting climate-resilient construction in Bangladesh requires a multifaceted approach that addresses financial, technical, institutional, and educational challenges. Strengthening policy enforcement, providing capacity-building programs, and offering financial incentives are essential to overcoming these barriers and ensuring broader adoption of resilient construction practices.

Table 7: Willingness to Adopt Climate-Resilient Construction in Future

Response	Frequency	Percentage (%)
Very willing	48	40%
Willing	46	38%
Not sure	18	15%
Not willing	8	7%

Table 7 illustrates the respondents' willingness to implement or support climate-resilient construction practices in the future. The data show a generally positive outlook, with 40% of respondents indicating they are "very willing" and 38% expressing that they are "willing" to adopt such measures. This demonstrates that a significant majority (78%) of participants are receptive to integrating resilience into construction practices.

Meanwhile, 15% of respondents reported being "not sure," reflecting uncertainty due to factors such as cost, technical knowledge, or accessibility of materials. Only 7% stated they are "not willing," which may be influenced by financial limitations or lack of perceived immediate benefits.

Overall, these findings suggest strong potential for future adoption of climate-resilient construction in Bangladesh, provided that supportive policies, incentives, technical guidance, and awareness programs are in place to address the concerns of hesitant stakeholders.

FINDINGS

Based on the survey data and analysis presented in Tables 1–7, the key findings of this study on climate-resilient construction in Bangladesh are summarized as follows:

1. **Diverse Stakeholder Participation:** The survey included engineers, contractors, architects, local residents, and policy/ NGO officials, providing a balanced perspective from technical, community, and institutional viewpoints. This diversity ensures that findings reflect both practical and policy-level insights.

2. **Awareness Levels:** While a majority of respondents (70%) have at least moderate awareness of climate-resilient construction, there remains a significant knowledge gap among 30% of participants, particularly local residents and small-scale builders, indicating a need for targeted awareness and training programs.

3. **Perceived Climate Risks:** Flooding (78%) and cyclones (65%) were identified as the most critical climate hazards affecting construction in Bangladesh, followed by waterlogging (54%), riverbank erosion (40%), and heat stress (32%). This underscores the importance of integrating multiple hazard considerations into construction planning.

4. **Adoption of Resilient Practices:** Adoption of climate-resilient construction techniques varies, with reinforced concrete frames (70%) and raised plinths (62%) being more commonly implemented. Other measures, such as cyclone-resistant roofing (48%) and use of local sustainable materials (46%), show moderate adoption, indicating room for improvement.

5. **Effectiveness Perception:** Most respondents (80%) perceive climate-resilient measures as effective or very effective in mitigating disaster-related damage. This reflects strong stakeholder confidence in the technical benefits of resilient construction practices.

6. **Barriers to Adoption:** The main challenges hindering widespread adoption include high construction costs (72%), weak enforcement of building codes (60%), lack of skilled labor (58%), limited access to finance (55%), and insufficient awareness (47%). Addressing these barriers is essential for scaling up resilience initiatives.

7. **Future Willingness:** A large majority of respondents (78%) expressed willingness to adopt climate-resilient construction in the future, indicating strong potential for growth if financial, technical, and policy support mechanisms are strengthened.

CONCLUSION

Climate-resilient construction is essential for safeguarding lives, infrastructure, and economic assets in Bangladesh, a country highly vulnerable to climate-related hazards such as floods, cyclones, riverbank erosion, and extreme heat. This study highlights that while awareness and partial adoption of resilient construction practices exist, significant gaps remain in implementation due to financial constraints, lack of skilled labor, weak enforcement of building codes, and limited access to resources.

Survey findings indicate that a majority of stakeholders recognize the effectiveness of climate-resilient measures and are willing to adopt them in the future. However, for these practices to become widespread, there is a pressing need for policy support, capacity building, technical training, and financial incentives. Integrating climate-resilient design, sustainable materials, and disaster-resistant techniques into both rural and urban construction is not only a technical requirement but also a socio-economic imperative.

In conclusion, promoting climate-resilient construction in Bangladesh requires coordinated efforts among government agencies, private sector actors, NGOs, engineers, builders, and local communities. By addressing existing barriers and fostering awareness, the country can develop a safer, more adaptive, and sustainable built environment, capable of withstanding the increasing challenges posed by climate change.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed to enhance climate-resilient construction in Bangladesh:

1. **Strengthen Policy and Regulatory Frameworks:**
   - Ensure strict enforcement of the Bangladesh National Building Code (BNBC) with updated guidelines for climate-resilient design.
   - Integrate climate risk assessment into all stages of construction planning and approval processes.

2. **Financial Incentives and Support:**
   - Provide subsidies, low-interest loans, or tax incentives for adopting resilient construction techniques, especially for low-income households and small-scale builders.
   - Encourage public-private partnerships to fund large-scale resilient infrastructure projects.

3. **Capacity Building and Training:**
   - Organize training programs for engineers, architects, builders, and masons on resilient design, durable materials, and hazard-resistant construction techniques.
   - Include climate-resilient construction modules in technical and vocational education curricula.

4. **Promote Use of Sustainable and Local Materials:**
   - Encourage the use of locally available, environmentally friendly materials such as treated bamboo, coir-based products, stabilized soil blocks, and flood-resistant bricks.
   - Support research and development of affordable, climate-resilient building materials suited for different regions of Bangladesh.

5. **Community Awareness and Participation:**
   - Conduct awareness campaigns targeting local communities to highlight the importance of climate-resilient housing and infrastructure.
   - Engage communities in planning and maintaining resilient structures to ensure long-term sustainability.

6. **Monitoring and Evaluation:**
   - Establish a monitoring system to evaluate the performance of climate-resilient structures during and after extreme weather events.
   - Document successful case studies to serve as models for replication in other vulnerable areas.

7. **Integration with Disaster Risk Reduction (DRR) Programs:**
   - Align construction initiatives with national DRR strategies to ensure coordinated efforts in minimizing climate-related risks.
   - Promote multi-stakeholder collaboration among government agencies, NGOs, engineers, and local communities.

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