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A comprehensive review of reinforced concrete, steel structures, and composite systems in Bangladeshi building construction

Md. Mohibullah and Saniure Rahman Sheam

Department of Civil Engineering, Bangladesh University of Business & Technology – BUBT, Bangladesh

ABSTRACT

The paper is a comparative evaluation of two main reinforcements materials- steel structures and reinforced concrete in the context of building construction of Bangladesh. Based on the geographical, environmental, and socio-economic peculiarities peculiar to the area, a reasonable choice of the structural material is the key to developing resilient and sustainable infrastructures. This review is a systematic study of the key performance indicators of both steel and RC systems (structural integrity, seismic resistance, cost-effectiveness, construction efficiency, environmental impact and durability under local conditions). Based on the literature on the topic and established tools in the field of engineering, the paper has identified the unique pros and cons of each of the materials. Although steel structures may be advantageous in terms of fast construction, design and its ability to withstand weight, reinforced concrete is a commonly used solution because of the locally available material, resistance to fire and its familiarity in the construction industry. The analysis shows that the analysis indicates that it is crucial to consider the critical factors when a material is chosen and that the best decision to make is based on the requirements of the project being done, the condition of the site and the long term aims of the performance. This comparative evaluation will offer quality information to engineers, developers and policymakers in Bangladesh so that they can make well informed decisions during future building construction.

KEY WORDS

Reinforced concrete structures; Steel structures; Composite structures; Seismic resilience; Environmental impact; Construction efficiency

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Introduction

Proper choice of building materials has been viewed as a key factor in the determination of structural integrity, longevity and economic viability in the construction sector especially in the environment of Bangladesh with its own environmental and socioeconomic setting. In this respect, reinforced concrete and steel constructions become the main rivals which have their own benefits and drawbacks which should be discussed in detail [1]. The present paper will serve as a review of these two most widespread reinforcement materials, examine their performance, design factor, seismic nature, cost-efficiency, and sustainability in the construction sector of Bangladesh [1, 2].Even though reinforced concrete has long been a staple because of its durability and cost-effectiveness, composite structures, which are a combination of steel and concrete, are gaining an increasing popularity now [1]. In this extensive review, the nature, advantages, and uses of reinforced concrete and composite buildings will be explored, providing worthwhile insights into the contribution of individual buildings to the modern Bangladeshi construction behaviors [1]. Through such comparative analysis, the structural performance of these material options, their economic implications, and the environmental impacts will be critically assessed to offer a strong framework of informed decision-making in upcoming construction works [1]. Reinforced concrete can be discussed as being massy and less deflecting, whereas steel structures can be identified as strong in ductility and less weight during seismic earthquakes and heavy winds [2]. Moreover, these materials are characterized by the environmental footprint, such as embodied energy and recyclability, and steel on many occasions is more recyclable than reinforced concrete [1]. The burgeoning need for sustainable and resilient infrastructure necessitates a comprehensive evaluation of the life cycle performance of construction materials, especially in regions prone to seismic activity [3]. In this paper, the modern trends in Bangladeshi construction will therefore be examined in terms of the effect material selection has on structural resilience especially against some of the natural hazards that are common [3]. To also consider during this assessment, there is the composite construction, which combines the benefits of both materials to determine better structural functionality and economic viability, frequently with superior performance to traditional reinforced concrete across medium- to high-rise constructions [2].

The growing use of composite structures can be explained by the fact that they can counter the general limitations of the traditional reinforced concrete, i.e., the large dead load and span restrictions of high-rise construction [2, 4]. Traditionally, there has been caution among the engineers to adopt the use of the steel and concrete composite systems, mainly due to the perceived complexity of analysis and design [5]. However, the modern advancements in the computational analysis tools and design solution models coupled with a greater understanding of material behavior and interaction have significantly increased the feasibility and appeal of composite construction in Bangladesh [6]. Such synergistic integration allows the optimization of structural elements whereby steel members are made to withstand tensile forces, whereas the elements of concrete structure are mainly made to withstand compressive forces. This leads to reduced structural dimensions and high structural efficiency as compared to the traditional reinforced concrete structures [4]. The result of such a combined approach would be structures that possess increased load-bearing capacity,

***Correspondence:** Mr. Md. Mohibullah, Department of Civil Engineering, Bangladesh University of Business & Technology – BUBT, Bangladesh, e-mail: mohibdpi@gmail.com

stiffness, and a better level of durability and would be particularly suitable in high-rise development and infrastructural projects where efficiency and quality is an important factor [7]. Further, the introduction of composite structural systems has potential green benefits, including the reduction of the material use and waste production, and, in turn, agrees with the global sustainability goals in the construction sector. Despite these advantages, applying composite structures wisely requires a thorough knowledge of the structural behavior of composite structures under various loading conditions, and this is emphasized by the ongoing research exploring the seismic behavior and cost-effectiveness of composite structures compared to traditional Structural Systems based on Reinforced Concrete and pure steel [1, 2]. This paper, therefore, provides a comprehensive overview of the relative strengths and weaknesses of steel structures, reinforced concrete and composite structures in the backdrop of the building construction in Bangladesh, focusing particularly on their structural effectiveness, economic viability and their environmental impact. The discussion will also include the analysis of the changing regulatory framework and technological innovation that is affecting the material choice decision in the region. To be more specific, the paper will explore how the developments in seismic design code and the growing availability of enhanced software are affecting the choice among such structural systems, especially in high-rise buildings where composite options can bring significant benefits compared to the traditional reinforced concrete [1].

Literature Review

Reinforcements used in construction (Global/general)

- Briefly explain the history, construction and underlying ideas of reinforced concrete and steel structures.
- Describe their ubiquity and overall strengths/weaknesses in a universal setting and then move specifically to Bangladesh.
- These materials and their overall importance have already been presented in your existing text [1].

Pay attention to Bangladesh: Context and challenges

- Generalize on the literature that talks about the construction landscape in Bangladesh.
- Emphasize the research on the peculiarities of environmental (seismic activity, cyclones, floods), economic, and social factors on the selection of the material and construction methods in the area [3].
- Talk about the increasing need to have environmentally responsible and disaster resilient infrastructure in Bangladesh [3].

A comprehensive study of the reinforced concrete in Bangladesh

- Review the literature about the history, performance, durability, and cost-effectiveness of the use of RC in Bangladeshi construction.
- Admit its long-term reputation of being a staple product because of its durity and low cost [1].

Proper investigation of steel structures in Bangladesh

- Overview the research on the advantages of steel structures (e.g., high quality ductility and reduced seismic weight) [2], design versatility, and robustness) and disadvantages and uses in the Bangladeshi environment.
- Talk about its increased recyclability [1] and possible positive impact on the environment.

Development and benefits of composite structures

- Elaborate on the increasing popularity and immense interest in composite structures [1,2].
- Overview research on the benefits of using composite structures to capitalize on the strengths of both steel and concrete, balancing out the shortcomings of traditional RC, particularly in medium and high-rise structures [2, 4].
- Mention the fact that they can be reduced in terms of dimensions and maximized in terms of structural efficiency [4].
- Explain the developments in the computational analysis and design practices that have enhanced their viability [6]. Such advances allow engineers to better predict the complicated behavior of composite elements in different loading conditions, which gives them more confidence in their use [5].

Literature comparative studies and gaps

- Generalise any comparative studies that had been done so far on steel vs. RC vs. composite in Bangladesh or elsewhere.
- Critically appraise what has been known and more to the point what has not been known or requires further research (e.g. to have an optimal utilisation of composite structures, one requires to have a good understanding of the structural behaviour of composite structures under different loading scenarios as recent research discloses to have on their seismic behaviour and cost-efficiency compared to conventional Reinforced Concrete and steel-only structures [1].
- Moreover, although composite members have taken a lead in terms of cost and construction speed, especially in the medium/high rise buildings [2], the fire-resistance of long-term actions of composite is fragile to test, and this aspect must be taken into consideration especially in industrial buildings that are usually constructed with the idea of strength and durability in mind, as opposed to the intrinsic fire resistance (Industrial Fire Disasters: Structural Evaluation, Damage Assessment, and Retrofitting Approaches in Reinforced Concrete Buildings, 2 As an example, composite slabs that use steel decks can be constructed very fast and provide structural efficiency; moreover, it is vulnerable to the fire conditions that could occur beneath, so compliance with the high standards of fire-safety criteria is crucial [8]. This highlights the need to consider fire safety in its design at the early stages of construction instead of focusing on post-fire recovery efforts, especially in areas where the enforcement of fire-resistant codes is still a problem of concern [9].

Methodology

The paper will critically analyze already available data and compare the structural, economic and environmental performance of reinforced concrete, steel and composite structures in the Bangladeshi construction industry. The approach will entail an extensive literature, including both local and global research to integrate the existing information on material properties, design, and construction practice and

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sustainability measures of each structural system. As the key approaches to measure the environmental implications and financial feasibility of both materials throughout its service life, including the digging out of raw materials and the disposal of its final product, life cycle assessment and life cycle cost analysis will be used [10]. This will enable a more subtle comparison of the long-term consequences of every material option, not just the construction expenses at the very beginning but also the operational performance and environmental impact [10]. Moreover, the analysis will be done based on the seismic and wind load conditions, which are dominant in Bangladesh, and their effect on the design and structural integrity of every material type will be considered [2].

Data collection and analysis

This will also provide how the information about the technical specifications, material cost, labor requirement and the impact of the structures on the environment will be obtained in the Bangladeshi situation of reinforced concrete, steel, and composite structures. It will mean examining the available project reports and industry reports, and scholarly studies to create a solid dataset on comparative analysis [11]. The data gathered will subsequently be subjected to a stringent quantitative and qualitative study to determine the key performance indicators in the areas of structural integrity, economic viability, and environmental sustainability, and pay attention to the particular issues and opportunities in the Bangladesh construction industry [10]. It will help to make an informed evaluation of the aptness of each structural system to different typologies of buildings and local conditions, which will eventually offer a practitioner and policymaker with an opportunity to act [12].

Comparative framework

Systolic comparative framework will be formulated in the effort to analyze the performance features of each material, which includes parameters of structural efficiency, construction speed, embedded energy, operational expenses, and seismic resilience [3, 5]. This framework will employ the methods of multi-criteria decision analysis to balance such parameters, which is a complex process of evaluating the factors that affect the selection of materials in modern building projects. The framework will also incorporate some life cycle assessment and life cycle costing approaches in order to give a comprehensive picture of the environmental and economic impact of a structure throughout its life cycle beyond the initial capital cost and incorporate operational and end-of-life factors [3]. Qualitative aspects that will be considered in the analysis include aesthetics, adaptability, and locality of materials and skilled labor which play a major role in selecting materials in the Bangladeshi market. Lastly, the study will also involve a critical review of national building codes and regulations to make certain that all of the recommendations are compliant and easily implementable within the current Bangladesh regulatory system.

Life cycle assessment and life cycle costing

This step will entail the implementation of available techniques of Life Cycle Assessment and Life Cycle Costing to measure the environmental impacts and economic performance of each of the material options taking into consideration the socio-economic and environmental peculiarities of Bangladesh [10]. It will entail an intense review of the environmental footprint and economic feasibility of both material options, including the purchase of materials to their disposal and making sure that the results are applicable to the local issue and resource constraints in Bangladesh [13, 14].

Case study analysis

To further put the findings into context, specific case studies of recent constructions undertaken in Bangladesh based on the use of reinforced concrete, steel, and composite structures will be examined to prove theoretical comparisons with actual performance data. This will give empirical evidence of construction efficiencies, operational costs and environment impacts when under real circumstances in Bangladesh environment, hence, the theoretical framework will be based on real life application. The strength of reinforced stainless-steel reinforcements will be compared to the strength of the high-yield strength deformed reinforcements especially in concrete structures to establish the strength and durability of the reinforcements in the different loading conditions [15]. The environmental advantages and respective cost of sustainability of utilizing green forms of reinforcement by means of the AshCrete and Glass Fiber Reinforced Polymer will also be analyzed, and the potential of the material to decrease the carbonated emission and the total cost of a project will be considered [16].

Recommendations and policy implications

To address the issue of material selection, design optimization, and policy reforms needed to make the construction of the building more resilient and eco-friendlier, this section will provide recommendations based on the overall analysis [9, 17, 18]. These suggestions will include recommendations on how to encourage the implementation of more environmentally friendly construction technologies, encourage the use of more locally sourced sustainable materials, and incorporate more sophisticated techniques of structural analysis to ensure that the use of materials is optimized and the wastage is minimized [19]. In addition, the research will recommend the structures of integrating new ideas, including the stainless-steel braces into reinforced concrete buildings, to guide more sustainable construction experiences in Bangladesh ([15]). This will entail analysis of the institutional structures and socio-economic processes that affect the material choice and building technologies in the region [20, 21]. The effectiveness of such suggestions will be measured by the possibility to reduce the most common problems, corrosion and seismic vulnerability, and thus provide long-term structural stability and minimized maintenance expenses [15]. The study will also examine the possibility of using recycled steel fibers as concrete reinforcement material, measure their mechanical characteristics and durability in the long-term to support resource conservation in the construction industry [22]. Lastly, the research will also examine the possibility of utilizing other stabilizers, including lime, which is less harmful to the environment than Portland cement in strengthening and lengthening the earthen materials in construction [10].

Results

Reinforcement material characteristics and properties

The basic properties and characteristics of each material will be outlined in this section and this will prepare the way to compare them.

Reinforced concrete

- **Material composition and properties:** Discuss the application of cement, aggregates, water and steel reinforcement.

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- **Advantages:** Prolonged usage, the availability of local materials, fire-resistance, decent compressive strength, economicalness ([1]).
- **Limitations:** Higher dead load, cracking possibilities, reduction of span, more time of construction, reduced recyclability [1,2].

Steel structures

- **Material composition and properties:** Explain the different types of steel materials in building, high strength to weight ratio.
- **Benefits:** It is stronger in tensile strength, its ductility is better and its seismic weight is lower, faster to build, designable, more recyclable [1, 2].
- **Weaknesses:** Prone to corrosion (except in the presence of protection), increased initial cost of material, fire protection.

Composite structures

- **Definition and principles:** Discuss the way that composite structures are made by using steel and concrete to use their strengths [4,7].
- Types of Composite Elements Briefly describe common composite elements (e.g., composite beams, columns, slabs with steel decks).
- **Benefits:** Improved structural efficiency, smaller size, higher load bearing capacity, stronger and more stable, elimination of drawbacks of conventional RC, the possibility of reduced material usage and waste [2, 4, 7].
- **Limitations:** The perceived difficulties in analysis and design, the necessity to gain sufficient knowledge of structural behavior under different loads, or fire performance of some elements [1,5,8].

Comparative analysis of structural performance

This part will be a direct comparison between the behaviors of the materials under different structural demands especially in the context of Bangladesh.

Structural integrity and strength

Compare the ability to carry loads and the general strength of the Rc, steel and composite systems.

- Explain the strength of composite structures compounding in composite structures [4].
- Seismic resilience and dynamic behavior
- Compare ductility and lighter seismic weight of steel and composite buildings with the massiveness of RC in seismic areas [2]
- Talk about technological innovations in the field of seismic design codes and advanced software that affects the choice of materials [1].
- Organize such a comparison with the help of your points on the Comparative Framework and Data Collection and Analysis [3, 5, 11].

Wind load resistance

- Analyze the behavior of each material in the conditions of high winds, which is a topical risk in Bangladesh.
- Comment on structural integrity and design requirements [2].

Durability and service life

- Comparative long-term performance, environmental degradation (e.g. corrosion with steel, and cracking with RC) and maintenance needs [15, 23).
- Take stainless steel reinforcements and other alternatives that are long-lasting into consideration [15].

Fire resistance

- Discuss intrinsic fire resistance of RC and fire protection requirements of steel buildings and detailed elements of composite (composite slabs with steel decks, etc.) [8,9].
- Stress on combined fire safety layout.

Economic viability and construction efficiency

This part will be an analysis of the financial and logistical concerns of making use of both materials.

Cost-effectiveness

- **Initial Construction Costs:** Compare building material prices, and manpower needed, as well as the construction machinery needed in RC, steel and composite structures.
- **Life Cycle Cost Analysis:** You should include your proposed LCA/LCC framework which will compare the efficiency of operation, maintenance costs and cost of disposing the product at the end of the service life [3, 10).
- Discuss the economic viability considering local material availability and skilled labor [10, 13, 14].

Construction speed and efficiency

- Compare the construction schedules, prefabrication possibilities (steel and composite), and on-site assembly difficulties.
- Talk about the benefits of composite structures in terms of construction speed [2].

Environmental impact and sustainability

This part will appraise the ecological footprint of both materials, which is in line with global sustainability targets.

Embodied energy and carbon footprint

- Compare the energy consumed and greenhouse gases emitted during the production of RC and steel [1].
- Discuss the potential of composite structures for reduced material consumption and waste.

Recyclability and waste management

- Compare the rate of recycling of steel and RC, and explain the environmental advantage [1].
- Consider such sustainable options as AshCrete, Glass Fiber Reinforced Polymer, or recycled steel fibers [16, 22).
- Discuss alternative stabilizers like lime for earthen materials to lower environmental impact [10] .

Application-specific considerations and case studies in Bangladesh

This section will conclude the above with real life examples.

Appropriateness to construct typologies

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- Elaborate on the best types of materials to use on the various types of buildings (e.g., residential, commercial, industrial, high-rise, low-rise) in Bangladesh [12].
- Think about problems and prospects of the construction market in Bangladesh [10].

Technological innovations and regulatory environment

- Framing the role of current developments in computational analysis and design approaches in the feasibility and the attractiveness of composite construction [5, 6].
- Examine changing regulatory environment, building regulations and their impact on the choice of materials in Bangladesh [1].
- Look at institutional structures and socio-economic processes [20, 21].

Case study analysis

Combine the particular case studies of recent projects in Bangladesh to check the theoretical comparison of the performance data with real-life data [3]. This is in line with your initial plan of "Case Study Analysis" [15, 16].

Recommendations and policy implications

This part will sum up the core of the paper giving practical advice.

- Identify recommendations to be taken to select the materials in a sustainable way, design them efficiently, and reform the policies in Bangladesh [9,17,18].
- Environmental friendliness promotion strategies, domestic materials, and high-tech structural study [19].
- Offer architectural designs of new ideas such as stainless-steel braces [15].
- Determine effectiveness in reducing such problems as corrosion and seismic susceptibility [15, 23]. By means of incorporating sustainable materials, including natural fiber reinforced concrete, additional reduction in cracking and an improvement in tensile strength may be achieved, not to mention the substantial environmental advantages [24].

Discussion

This is a systematic review, which has compared the performance of reinforced concrete, steel structures, and composite structures regarding the building construction in Bangladesh. The results demonstrate that each material has its own unique benefits and drawbacks on its structural integrity, seismic tolerance, cost efficiency, environmental friendliness, and construction efficiency, and a careful material selection process in the area is required.

Comparison of performance and trade-offs

The discussion highlighted that although the use of Reinforced Concrete has traditionally been the base of the decision in Bangladesh because of its wide application, the availability of local materials, the duration of fire resistance on its own and low costs ([1]), it has several disadvantages since it has been concluded to increase dead loads, cracking behavior, and overall construction duration [1]. Compared to the steel structures, they have high ductility, less seismic weight, fast construction , and high recyclability , which is specifically beneficial around seismic zones and projects that require a timeline acceleration [1, 2]. Nevertheless, they are more prone to corrosion and high initial cost of material is a significant trade-off.

The appearance of composite constructions is one of the possible solutions, which can indeed use the advantages of both the steel and concrete materials. Composite systems have a higher structural efficiency, lower dimensions, and better load-carrying capacity due to the combination of the tensile capacity of steel and compressive strength of concrete [4, 7]. This synergy will be able to counter the constraints of traditional RC, especially on medium to high-rise structures where the efficiency and quality are paramount [2]. The review discovered that the development of computational analysis and design methodology has made composite construction much more viable and attractive, which means that it is more confident in its application, particularly during more complex loading scenarios [5,6]. However, the best use of these structures remains the need to have an in-depth knowledge of their behaviour under different circumstances such as seismic performance and resistance to fire [1,8].

Bangladeshi building construction implications

The lessons that were learned in the comparison of the two have enormous implications to engineering and developers as well as policy makers in Bangladesh. This comes because of the trade-offs inherent with initial investment, long term performance and environmental footprint whereby the selection of materials should be project specific in addition to the conventional likes.

Effective material choosing

Infrastructure of great importance and tall buildings in seismic prone districts of Bangladesh, the high ductility and lesser seismic gravitas of steel and composite structures have significant benefits in seismic endurance compared to the bulkiness of RC [2]. On the contrary, RC could still be more cost-effective in terms of lower-rise or less complicated construction projects where the cost of labor and materials in the area is the determining factor [1]. The holistic frameworks of Life Cycle Cost Analysis and the Life Cycle Assessment outlined in this review play a vital role in making appropriate decisions that may go beyond initial capital outlay to include operation costs, maintenance, and end of life, which is important in sustainable development in Bangladesh [3, 10].

Regional challenges

The study has strengthened the importance of having materials that are resistant to natural hazards common in Bangladesh, including earthquakes and strong winds [2, 3]. The results emphasize the direct influence of material selection on the structural integrity and design consideration in such a situation. Moreover, the theme about long-lasting solutions such as stainless-steel reinforcements and the effectiveness of new ideas such as stainless-steel braces in RC buildings covers such serious problems as corrosion and the long-term structural integrity [15, 23).

Sustainability and environmental policy

The environmental impact is straightforward, namely, steel tend to be more recyclable than RC, and composite structures present the possibility of lower material consumption and waste [1]. This is in line with the fact that Bangladesh needs

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more eco-friendly infrastructure [3]. The introduction of sustainable solutions such as recycled steel fibers [22], natural fiber reinforced concrete [24], and natural fiber substitutes such as lime [10] is offering ways to decrease the amount of carbon footprint and advance the idea of the circular economy in the construction industry. Policy changes and incentives must be used to spur the use of these greener practices and sourcing of sustainable materials in the locations [17, 18, 19].

Technological integration and regulatory advancement

With the growing role of sophisticated computational analysis and advanced design software [1, 5], the problem of design complexities that was a drawback to the use of composite structures is becoming easier to handle. This enables the optimization of the structural systems to the needs of the project. The changing regulatory environment and construction regulations in Bangladesh probably need to change in terms of adaptable new technology and efficient use of all three material systems to ensure safety and efficiency [1, 12].

Limitations

Although this review is comprehensive, its main basis is on literature and theoretical comparisons that exist. Although attempt was made to contextualize the results to Bangladesh, it might be hard to have specific empirical data on all the aspects of comparisons in the Bangladeshi context. These materials may perform and be cost-effective in practice in a very varied way depending on local building customs, quality management, availability of skilled workforce and site circumstances. More so, material science and methods of construction are rapidly evolving and so some of the aspects of this review are subject to change even beyond the scope of this review.

Future Directions

Following the gaps expressed and critical implications generated to Bangladesh, there are a few future research avenues that come out as follows:

- **Localized empirical studies:** More empirical research and case study investigations carried out directly in Bangladesh to confirm theoretical comparisons at the long-term performance of composite connections due to specific seismic and environmental loads in Bangladesh.
- **Socio-economic impact of sustainable materials:** Research to explore the socio-economic impacts and viability of a broader adoption of the sustainable alternatives (e.g., natural fiber concrete, recycled steel fibers) on the local industries, labor, and supply chains in Bangladesh.
- **Policy effectiveness studies:** Determine the effectiveness of existing and proposed regulation systems and policy incentives as a way of encouraging resilient and sustainable construction practice within Bangladesh.
- **Life cycle assessment on local data:** Build more material specific LCA and LCCA models based on Bangladeshi data only on material production, transportation, and waste collection to offer highly precise environmental and economic standards.
- **Post-disaster performance analysis:** This is done to conduct detailed post-disaster performance analyses (e.g., after earthquakes or cyclones) to assess the actual performance of various structural systems in Bangladesh and to make improvements in future designs.

Conclusion

This comprehensive research has considered the comparative performances of the reinforced concrete, steel construction, and composite construction as reinforcing materials in the special context of building construction in Bangladesh. Analysis, including structural performance, economic viability, construction efficiency and environmental impact, notes that the best choice of material is not inherently absolute, but it is rather specific to project demands, current site factors, and future sustainability aims. Even though the reinforced concrete is still the front-binder of the Bangladeshi construction industry, characterized by its high durability and the availability of material locally and fire resistance by its nature, its weaknesses regarding the dead load and construction speed have become more observable, especially in the vigorous high-rise industry. Although reinforced concrete is still one of the key elements of Bangladeshi building, with its strong durability, homogeneous access to local materials, and the absence of the need to protect against fire, its low dead weight and construction rate are becoming more pronounced, especially in the rapidly growing high-rise market. The steel structures are also extremely promising in seismic resistance because they are more ductile and less weighty, as well as they require less time to assemble and recycle. Nevertheless, they must be taken into special account because of their high initial cost and necessity to take special precautions in terms of fire protection. Composite structures are proving to be highly effective solution, which strategically integrates the most effective features of both steel and concrete to attain a better structural efficiency, smaller dimensions and higher load-bearing capacity emerge as a highly effective. Their increased use enhanced by computational analysis and design methodologies makes them a viable and effective alternative regarding mid- to high-rise applications where resource and performance optimization is a primary consideration. Finally, the findings indicate that a holistic approach to decision-making is necessary that goes beyond initial costs and incorporates life cycle assessment and life cycle costing findings would suggest the need to consider both life cycle assessment and life cycle costing. This must be approached to promote the development of sustainable and resilient infrastructure in Bangladesh, which responds to the unique environmental challenges in the region and works towards global sustainability objectives. necessary to promote sustainable and resilient infrastructure development in Bangladesh, one that meets the unique environmental challenges in the region and works towards global sustainability objectives. The review offers practicable information to engineers, developers and policymakers, encouraging choice of material, merging of advanced design methods and popularization of green practices to determine the future of Bangladeshi building. engineers, developers and policymakers.

Disclosure Statement

No potential conflict of interest was reported by the author.

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