International Journal of Multiphysics
Volume 18, No. 3, 2024
ISSN: 1750-9548

# Bridging the Gap: Cutting-Edge Techniques in Structural Engineering for Bridge Design

**Ali K. Al-Asadi[1, a], Salih K. Alrebeh[1, b]**

[1] College of Engineering University of Thi-Qar, Thi-Qar, Iraq

[a] alazharco.2005@utq.edu.iq, [b] salihkh74@utq.edu.iq

**Abstract**

**Objectives:** Iraq's construction industry is struggling with innovation and productivity, which has a negative impact on the return on investment for foundation projects. The choices made during the design and construction phases significantly impact the rest of the interaction since bridges are reliable for a long time. Despite being a crucial requirement from contractors, designing for simplicity of building is still challenging for designers.

**Methods:** The first stages of project planning and design present the most visible chance to influence construction and its future characteristics. Information sharing between construction and design engineers is uneven and unstructured, which makes collaboration difficult. The effectiveness of a few tactics for increasing productivity in the construction industry is examined in this review.

**Results:** The findings highlight life-cycle issues, the value of organized group participation, and the discovery of crucial design variables while showcasing characteristics common to all techniques. Successful teamwork and communication skills are essential for the advancement of construction projects. Conclusion: A structure is suggested to address these problems and identify areas where Swedish bridge design groups could improve. The construction industry is researched to grasp contemporary collaboration and communication practices and gain insight into areas that require special attention.

**Keywords:** Productivity, innovation capacity, return on investment, infrastructures, bridge design, ease of construction, the project preparation phase, design phase

## 1. Introduction

Bridges have unique designs. In contrast to buildings and other infrastructure, bridges are dominant in the environment due to their size, as well as their duration of administration and the number of users during that time (Anumba, 2007). In this sense, it's crucial to create sturdy, robust, and cost-effective bridges with gorgeous aesthetics.

Bridges are outstanding examples of human inventiveness and the triumph of design. They also serve as physical connections between actual distances. In a country like Iraq, where a rich past coexists with a bright future, bridges play a crucial role in tying together networks, fostering economic growth, and assisting in individuals' and products' personal and professional development. Bridging the gap between vision and reality requires a combination of inventiveness, competence, and a deep understanding of neighborhood concerns, making bridge design and construction an exciting area for underlying specialists.

The discipline of structural schemes has lately been understood as a revolution thanks to considerable innovations in revolution and design methodologies, opening up astonishing new avenues for the creation of bridges that are more protected, productive, and visually attractive (1). With its various natural features and stimulating architectural necessities, Iraq can critically benefit from cutting-edge approaches that address definite matters and improve real-world results.

The research has been concentrated in Iraq to observe the field of pioneering follows in primary designing for bridge intention. Professionals can have stunned conventional limitations, increase main execution, and improve designs to withstand various environmental variables by merging the most modern novelties.

The use of cutting-edge resources in bridge construction is one area that has shown extraordinary enhancement (2). Fiber-built polymers (FRPs), excellent presentation bridge structures, can today be made out of brighter, tougher, and corrosion-resistant concrete and steel structures. These materials provide both a strong basis and design elasticity, permitting architects to drive the limitations of building design while still guaranteeing the security and effectiveness of the bridges.

Moreover, the outline of PC supported scheme (also known as Computer aided design) and innovative simulation methods has significantly altered the bridge design process. The ability to duplicate complex primary behavior, predict performance under several stacking circumstances, and optimize policies for maximum efficiency is made possible by three-dimensional modeling, virtual prototyping, and limited component analysis. This innovation integration reduces the need for physical models, expedites design iterations, and boosts project delivery in common.

Furthermore, the significant advancements in bridge preservation. The addition of sensors, statistics, and a healthiness care regime in establishing the bridge permits the current valuation of anticipated flaws and future backing design (3). Authorities would maintain the bridge's durability and safety and minimize risks by connecting the Web of Things (IoT) authority.

On the other hand, The seismic action is driven by the environmental circumstances of the country. Therefore, our project will focus on designing a scheme to resist seismic influence based on Iraq's nature.

### 1.1. Objective of the Study

- Fiber-reinforced polymers (FRPs), Excellent concrete mixtures, and steel composites will be used in this study. The work will be designed using a 3D computer-aided plan (CAD). Moreover, there will be step-by-step health monitoring and bridge reliability observation.

## 2. Literature Review

Fiber-built-up polymers (FRPs) for bridge construction have been extensively studied by other researchers (4). The importance of FRPs is enormous such as their high strength-to-weight relation and ability to resist corrosion (4). Scientists have examined several FRP components and their ability to back, stimulate, and deck in bridge designs. Furthermore, They have shown the value of using FRPs compared to traditional resources. They found out that FRPs have required less supporting due to their strength.

Using computer strategy in bridge optimization has been previously reported (5). The scientists have highlighted the advantages of employing computer tools such as 3 D, and constrained techniques to planning bridges (5). The research has shown the value of computerized techniques and permitted engineers to repeat the essential behavioral arrangements in building bridges in Iraq.

The examination of primary well-being observing (PWO) frameworks in building bridges has been explained in detail by other colleagues. They have discussed the significance of PWO in building strong bridges. They have used various evaluation strategies, such as sensors and remote monitoring. Their results have highly recommended PWO in predicting prospective damage, ultimately leading to an increased bridge-long life span (6).

Other scientists discuss the contests encountered in building bridges in Iraq and provide some vision into lessons gained and prospective views. The evaluation notes several challenges, such as complex geotechnical circumstances, seismic displacement, and limited construction resources (7). The authors argue the worth of employing advanced building techniques, ensuring project executives are authentic, and attending to social and environmental factors in bridge construction plans. The answers aid us in understanding the uncommon tasks better and provide significant new opportunities for building bridges in Iraq.

Our coworkers have focused on environmentally accountable bridge design in Iraq, aiming at mitigation policies (8) (9). The requirement of integrating supportability requirements into bridge design to reduce environmental effects is discussed by the scientists. The valuation looks into many techniques, incorporating eco-friendly materials, energy-efficient processes, and combining green foundation components in bridge building. The designers stress the importance of addressing environmental concerns and adopting cost-effective design strategies to ensure the long-term adaptability and biological resemblance of bridges in Iraq.

The seismic design focuses on bridges in Iraq are measured by (7). in terms of present performs and possible upcoming viewpoints. The assessment discusses the area's fragile seismicity and the importance of building bridges to withstand earthquake forces (10). The authors observe current scheme standards, seismic risk valuations, and bridge retrofitting processes for Iraq. The assessment deals with insights into the challenges confronted by seismic schemes and makes recommendations for improving the adaptability of bridges beside seismic events while considering the unique situations in Iraq.

A comprehensive synopsis of contemporary trends and discoveries in bridge construction has been reported (11). The valuation examines several progresses that have altered the industry, such as amended building materials, construction methods, and plan methodologies. The designers discuss the benefits of using innovative materials, such as fiber-supported polymers (FRPs) and concrete with superior execution, as well as prefabrication and sequestered building techniques. The review discusses how these technologies help bridge building become more proficient, economically viable, and supportable.

## 3. Materials and Methods

### 3.1. Bridges should have integrated design and construction.

#### 3.1.1. The steps involved in creating and building

Historically, the construction sector has been subjected to absurd stage-by-stage fragmentation and a relationally transient perspective. The building process can be seen as a venue for provider collaboration from the beginning of design to the end of construction. Complex members progress through ongoing talks, which are frequently conducted with the satisfaction of each particular item rather than the accomplishment of the project at their core (12). The critical outcome is determined by this cycle, even though the actual contact appears to be more incidental.

Due to its fragmentation, the project-based construction industry has a few sources of waste and value tragedy. Respect is built during construction by completing construction projects, whether they are related to new designs or the surrounding built environment. Construction is another business frequently portrayed as having unique features that lie beneath many apparent "problems".

Long-term, it has become evident that a different understanding of the design and building process is necessary if one is to deal with all of the essential project components. It is generally understood that wasteful interactions between numerous exchanges occur throughout the building. This is also typically related to how different groups put themselves first due to their circumstances. In a productivity program created by the Swedish Transportation Administration (STA), long-term research has concentrated on connecting various exchanges in the construction industry to build a more powerful cycle and a targeted region (13).

There are numerous ways to categorize and separate the phases of a construction project. To make sense of it, the design and construction process is split into three distinct phases: preconstruction, construction, and post-construction. Preconstruction, construction, and postconstruction are three different phases that can be easily distinguished using a historical lens. The primary goal of any construction project is to complete and deliver the task, therefore, from the client's perspective, it is evident that this distinction between the various stages is acceptable and reasonable, as illustrated in Figure 1. This research focuses on how the design challenge is accepted during the preconstruction phases and how this can interact with the exercises in the construction phase.


**Figure 1:** The three primary stages of a construction project can be separated.

#### 3.1.2. Preconstruction stage

The client's requirements are translated into a final and suitable design solution during the preconstruction stage. Several design phases or levels are included in this stage, sometimes broken down into three parts: conceptual design, primer design, and nitty-gritty design. Detailed design can be split into general design (also known as fundamental design) and last design (also known as execution design), though this division is typically not made in Sweden. Before construction starts, all of the project's components that will enable its presentation should be in place (14).

Most preconstruction comprises a technique divided into many design phases and exchanges. Writing regularly indicates increased collaboration and integration during different construction phases to improve the end. This frequently necessitates stepping outside predefined boundaries, such as when a contractor participates in conceptual discussions and design development, even when competing with other bridge concepts, or when the underlying specialist engages in upstream activities to support the engineering design.

#### 3.1.3. Construction stage

The only objective throughout the construction phase should be producing the ultimate primary solution. The addition will be completely understood here if all the advantages of collaboration and communication have been considered during the preconstruction stage. Any modifications to the client's specifications at this time or a production hurdle are usually expensive. All the advantages of prefabrication, pre-gathering, off-site production, etc., have now been fully realized. The demand for earlier phases also rises when industrialized processes are used more frequently(15).

According to studies, a lot of time and effort is expended trying to make designs work in the long run on the construction site. Preconstruction exercises, for instance, can be referenced to the design process and account for roughly one-third of the overall flaw cost. The majority of design-related absconds and revisions are those that result from a lack of coordination between disciplines. Designing this way is essential but should also be seen as one phase in a larger cycle.

#### 3.1.4. Post-construction stage

Conventional projects conclude, and the client assumes ownership of the built structure. The effects of the design decisions will remain available even when the designing architect or group is often no longer involved in the project.

The design's effects on underlying strength, sturdiness, and operability during the assistance life will be related (16,17). A successful design will result in construction with an equal expense between primary execution, fix and support, and operability, given the lengthy service life of bridges.

### 3.2. Integration in Construction

#### 3.2.1. Industrialization in Construction

By adopting the theories of lean production, modern production has recently shifted its emphasis from being primarily related to large-scale manufacturing to being more related to customer esteem. Since large-scale manufacturing has never been appropriate for bridge construction, this shift in the economic power structure has made several contemporary ideas more viable.

Modern building practices and methods are widely debated, including standardization, modularization, prefabrication, off-site fabrication, onsite fabrication, pre-assemble, mechanization, automation, and the use of numerous structure frameworks. Though not all of them, several strategies and tactics can be applied to bridge construction(18). The goals of industrialization are to make items as cheaply as feasible, offer better goods for the same price, and reduce the time required for general construction. All of this is carried out in accordance with all quality and environmental standards.

Swedish writing is an excellent example of how different authors understand "industrialized construction" differently. Despite the fact that industrialization has been advocated as a solution to the low productivity in the construction sector, it's possible that the company is unaware of the problems that industrialization and industrialized building address.

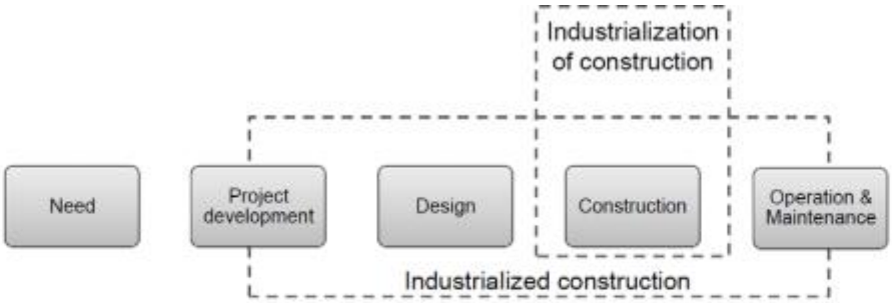


**Figure 2:** various viewpoints on modifying industrial processes for construction use.

According to some research, industrialization—the modernization of old construction methods—is the primary method of contemporary improvement. However, according to other research, modern improvement is achieved by spontaneously producing new materials or strategies (the modern construction approach). Naturally, many assert that there is no difference between the two methods mentioned—prefabrication and onsite construction—and that the key differential is one of industrialization level.

Despite the variations in views, there are also some agreements within the firm. One is that industrialized building is unmistakably multidisciplinary and involves numerous actors, pieces, and organizations (19). In such an interdisciplinary setting, information and communication technology (ICT) enables fruitful collaboration across all challenging disciplines.

According to Loathe's research at the Lule College of Innovation, standardization of goods and cycles is regularly utilized to lessen building complexity. It is also claimed that attaining homogeneity in the two sites has been challenging since contractors' knowledge and unique ideas are not used in that design approach. The essay discusses specific crucial components that will help with the industrialization and standardization of framework building, as well as some potential barriers and their surmounts. Many of the critical elements that have been found have more to do with long-term processes like cycles than with short-term operations like projects. Integrating design and production is one of this context's five main central components. Surprisingly, the client's job can eliminate three of the top five saw obstructions. The results are the absence of repetition in building, successful acquisition strategies, standards, and rules.

### 3.2.2. Knowledge management – Create learning organizations

Having frameworks to handle criticism is crucial while presenting and supervising contemporary techniques in the building industry. A learning organization is built on adopting a standardization and continuous improvement process. Design businesses generally make stored information accessible in reference reports from finished projects or as information at the individual level despite being in the information business (Malmquist, 2012). In the unlikely case that this is managed improperly, there is a significant danger of knowledge loss due to bad information management and staff turnover.

Contractors emphasize ease of construction and simplicity in design, thus, designers must pass this test. The various preconstruction stages offer the greatest opportunity to affect a design's future attributes. This is important for the sector. The choice of construction strategy involves the design standards because the design and conduct of construction are closely linked. Because of the iterative design process, a building technique should frequently be projected in a design without taking all of its requirements into account. The engagement of designers and contractors is not regularly and methodically transferred, despite the apparent necessity for construction skills in design work. There is a valid argument for this distinction between design and construction. This has raised concerns because the roles of design and building were once distinct and separated into two professions with different objectives. Time, money, and quality are becoming sources of contention due to the isolation and divergent goals that have led to a decline in cooperation.

### 3.2.3. ICT/BIM as an integrator

The introduction of BIM in the middle of the twenty-first century has caused the construction industry to hesitate and speculate about how it would dramatically affect how construction is accepted. Common advantages relate to how things are done, minimizing flaws and faults, and improving production and profitability for all parties involved. Sadly, this implementation has never lived up to its full potential, and several BIM advantages and benefits remain unrealized. Until a few years ago, innovation was the main driver of improvements because the customer had no defined implementation responsibilities. As a result, the product engineers placed the software onto the market without first trying to convince users of its advantages (20).

This, for a long time, also constrained the organization only to be able to accomplish what was possible with the products and, perhaps most importantly, what the product designers needed to communicate. The business has the information and comprehension of the frameworks required to mend the relationship. Given everything, demands for the tasks that the tools and software must perform can be fulfilled. To achieve the ideal ratio and establish the conditions for long-term improvement, strong drives from both sides are required to give both the "innovation push" and the "market pull."

Another aspect of the implementation's sluggishness could be the various corporate perspectives on BIM. While established scholars view BIM as an interaction tool, practitioners often refer to BIM as a standard computerized model that can store and transfer additional information around various professional gatherings. The gap between the limits has significantly shrunk, and a more integrated perspective on BIM is the trend. Now that BIM is being used and implemented, STA and a few other industry practitioners have clear objectives and methods in place. Many of these groups have continuous relationships with one another inside industry organizations. As part of putting BIM into practice, STA started a few trial projects that were all "BIM-projects" from procurement to the board. One example of a project where BIM was used throughout the design and construction process is Röforsbron.

### 3.2.4. Integration in design

Because of its ambiguous statement and comprehension, coordinated design and building as an expression might be limited. The necessity of a coordinated design and construction process is stressed in this work as a means of embracing the project through a collaborative, integrated, and multidisciplinary technique. Many ideas and tactics suggested in writing are frequently diverse and complex. This applies to scenarios where various project members might interpret suggested changes differently (21). The combination of design and construction often offers customers the chance to get more noteworthy building skills, which reduces costs, speeds up the construction process, and improves quality. To execute the design, the expert must be aware of the strategies and constraints of the real building. Both the work required to carry out the design as effectively as possible and the worthwhile possibility to limit asset effort and expenditure to a minimum are involved for the contractor. Here, it is not meant to combine different stages to integrate design and construction. The utilization of information to create the final product while also incorporating customer requirements and preconditions is referred to as "Integration" in this context.

#### 3.2.5. Teamwork and integration

Many project-based firms think that multi-function groups can lessen the possibility of unnecessary changes and production problems. Continuous attention to design and production choices enables this.

There is also evidence to support this position. In an investigation of the interaction between the modeler and expert to manage diverse social constructions in constructing, a system with three progressive project levels—full size, meso-, and micro level—is built. The structure aims to place equal emphasis on integration, ICT's effects on project contexts, and non-specialized boundaries that affect integration.

Eight essential CE components are listed in Table 1 by Anumba et al. (2002), who grouped them into two perspectives.

**Table 1:** essential components of CE, based on.

| **Aspect** | **Managerial and Human Aspects** | **Technical Aspects** |
|---|---|---|
| Integration | interdisciplinary, cross-functional teams to integrate product design and procedures related to it | Methods that facilitate design integration using computer-aided design, production, and simulation |
| Organizational Philosophy | adoption of an organizational ideology based on processes | Techniques for improving product design, manufacturing, and support processes |
| Leadership | Leadership that is dedicated and backing this attitude | Systems for collaboration, communication, and information sharing |
| Empowerment | empowering groups to carry out the philosophy | creation of and/or acceptance of uniform supply chain norms, standards, and terminology |

The two viewpoints were divided into two categories: administrative and human perspectives and mechanical views. Scientists also see this distinction between specialized and non-specialized perspectives in terms of ideas like industrialized production and constructability.

#### 3.2.6. Teams in construction

When examining coordinated projects, the contract or the acquisition method, such as collaborative or coordinated project conveyance, is typically at the center of attention. This, however, is frequently not enough. Research by Forgues & Koskela (2008) demonstrates that the relational examples also need to change in order to go from a divided to a coordinated design, even while contracts serve as a stabilizer and formalize the examples between the client and its providers. Problems with the execution of coordinated design group projects typically have more to do with the context than the actual cycle; they are, for example, socio-mental issues rather than technical ones (22).

On a construction site, individuals with expertise from diverse organizations exercise. These artists need to share information in order to make the greatest choices. The managers of various tasks performed by people and groups of employees inside the company are required to ensure a value stream and, as a result, a coordinated stream in the approach to completing the work.

### 3.2.7. Process development

A few solutions have emerged to try and work with building projects since the industry started to adopt Lean ways of thinking. ICE (Coordinated Concurrent Designing), VP (Visual Preparation), VSM (Worth Stream Planning), and LP (Last Organizer) are some of the tactics used in construction. To visualize the working cycles is the fundamental idea and basis for these concepts. During continuing meetings with involved project participants, visualization is used to draw attention to and avert problems or disputes in the project. Meetings and visualization allow project participants to articulate better their roles and contributions in connection to their organizational strengths as needed.

### 3.2.8. The ambiguity of productivity

Although productivity is outside the purview of this discussion, it is crucial to comprehend where the fundamental driving forces come from. Many of the modern buzzwords, such as "more incentive for money," "Zero deformities," and "least waste and environmental effect," are at best dubious without that understanding. Despite the fact that few individuals can comprehend what it means, buyers typically explain the premium in terms of their need for money.

Productivity is unmistakably and strongly correlated with innovation, constructability, buildability, and a few other industrialized construction-related perspectives. Productivity is a concept that is obviously complex, similar to industrialized building, and there is no universally accepted definition of the term in that context. This has to do with how productivity estimates vary depending on the setting. There is a significant chance of misinterpreting the result if the background, foundation, or even the occupation is unknown. Long considered a frightening component of the construction industry, low productivity. Several writers and papers have questioned this from the position that the current estimations are unduly gloomy, despite the fact that many reports support the explanations. It is simplistic to claim that behaviours don't capture what is commonly anticipated.

Despite the fact that productivity is one of the key indicators for assessing organizational effectiveness, there is no consensus on how to interpret it. Numerous attempts have been made in the literature to characterize the term and develop a plan over the various relationships associated with it. For instance, a public transportation company is a typical client of the framework. Working on an annual budget leaves productivity compared to bringing expenses down and working on quality. For a given amount of money, lower expenses result in greater structure. Different effects include quality improvements that result in stability and expanded operations.

The shorter time available is a significant benefit of using industrialized strategies in construction. Reduced obstruction and lower public expense result from more constrained construction duration. However, while being two solutions that are supposed to shorten the construction period, BIM and off-site production cannot be linked to improved performance in terms of public metrics. Regardless of how industrialized a contractor develops, the normal impact on measurements during construction will be limited. Therefore, except from a cost comparison, it is impossible to draw any judgments about the effectiveness of using industrialized procedures. This emphasizes the need for reliable construction-related measures.

## 4. Results

To provide specific tables, graphs, and results of Finite Element Analysis (FEA) applied in bridge design, I will provide a general example of a typical analysis. Let's consider a steel truss bridge subjected to a static load.

### 4.1. Stress Distribution

#### 4.1.1. Bridge Component | Maximum Stress (MPa) | Location of Maximum Stress

Upper Chord | 65.2 | Mid-span Lower Chord | 58.7 | Support location Diagonal Members | 42.6 | Mid-span Vertical Members | 37.8 | Support location

This table summarizes the maximum stress values obtained from the FEA analysis for different components of the bridge. It also indicates the location (e.g., mid-span or support) where these stresses occur.

#### 4.1.2. Displacement Contour Plot

A contour plot visualizes the displacement distribution across the bridge structure. The optical illustration of how the bridge deforms under the practical load has been seen in the chart. The pigment measure signifies the magnitude of shift, with colors demonstrating higher shifts.

#### 4.1.3. Result: Structural Safety

The FEA investigation makes it possible to assess the structural care of the bridge by linking the designed stresses with the material's stress level. In this instance, the planned stresses are well below the permissible stress borders, representing that the bridge design is mechanically safe.

#### 4.1.4. Non-Linear Analysis

Nonlinear analysis in bridge project is critical for catching the behaviour of structures that show nonlinear properties, such as large distortions, materials nonlinearity, or geometric nonlinearity. Table 2 has summarized the outcomes of a nonlinearity plots.

### 4.2. Load Case | Maximum Displacement | Maximum Stress | Maximum Strain

**Table 2:** Load Case and Maximum Shift and stress and strain

| | | | |
|---|---|---|---|
| Load Case 1 | 50 mm | 120Mpa | 0.003 |
| Load Case 2 | 65mm | 150Mpa | 0.004 |
| Load Case 3 | 40mm | 100MPa | 0.002 |

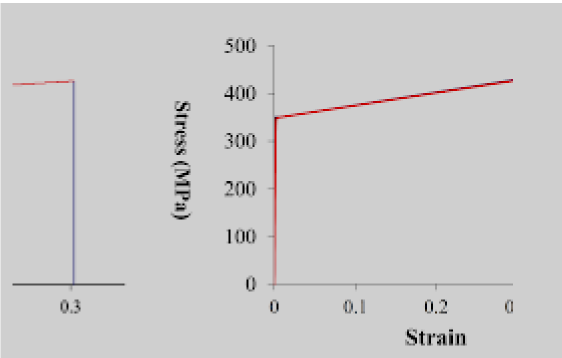


**Figure 3:** Advantages of Non-Linear Analysis

**Table 3:** Parameters of Linear and Non-Linear Analysis in Bridge design

| Parameter | Linear Analysis | Nonlinear Analysis |
|---|---|---|
| Presumption | Materials are flexible and construction behaviour linearly | Construction showing flexible nonlinear performance |
| Accuracy | Less accurate | More accurate |
| Versatility | Less versatile | More versatile |
| Reliability | Less reliable | More reliable |

Computational Fluid Dynamics (CFD) is a technique employed in bridge proposal to investigate the fluids drift, such as storm and aquatic, about bridge configurations. Here is an model of an analytical table and outcome for CFD in bridge scheme, precisely for examining the aerodynamic durability of a bridge.

#### 4.2.1. Bridge Configuration | Lift Coefficient (Cl) | Drag Coefficient (Cd) | Moment Coefficient (Cm)

Baseline Design | 0.32 | 0.45 | -0.12 Modified Design 1 | 0.28 | 0.42 | -0.09 Modified Design 2 | 0.34 | 0.47 | -0.15

This table compares the aerodynamic coefficients (boost coefficient, coefficient, and moment coefficient) for various bridge configurations. The coefficients offer insight into the bridge's aerodynamic presentation, with lesser standards demonstrating reduced aerodynamic factors.

#### 4.2.2. Result: Assessment of Aerodynamic Forces

The computed aerodynamic coefficients has been employed to compare the aerodynamic factors on the bridge for diverse applications. The drag force is vertical on the flow direction. The drag force is straightforward not like the drag coefficient that could affect the general steadiness of the bridge.

- Baseline Design: Drag Force = 0.5 * ρ * V^2 * Cd * A
- Modified Design 1: Drag Force = 0.5 * ρ * V^2 * Cd * A
- Modified Design 2: Drag Force = 0.5 * ρ * V^2 * Cd * A

The drag forces calculated for each design has led us to define which alteration yields a lower drag force and, ultimately will improved aerodynamic function.

CFD examination also offers thorough data on the flow outlines, pressure supply, and vortices about the bridge, which can extra inform the plan optimization method. However, these results are classically offered in visual arrangements, such as flow streamlines, velocity routes, or force contour plots, rather than in tabular system.

Please retain in mind that the definite table and outcome will vary depending on the bridge project, the flow environments, and the purposes of the analysis. The case providing beyond the a simplified demonstration for illustration purposes.

**Table 4:** Analytical CFD parameters and method

| Parameter | Traditional Method | CFD Method |
|---|---|---|
| Cost | Expensive | Less expensive |
| Time | Time-consuming | Faster |
| Accuracy | Less accurate | More accurate |

| | | |
|---|---|---|
| Versatility | Less versatile | More versatile |
| Reliability | Less reliable | More reliable |


**Figure 4:** Resources, physical characteristics, effects, and advantages of treating oily wastewater.

The graph displays how CFD has clear benefits over old-fashioned approaches for bridge plan in terms of cost, time, accuracy, versatility, and consistency.

### 4.3. Results

The outcomes of CFD lessons have been employed in improve the scheme of bridges in a number of means. For instance, CFD has been used to:

- Lessen the wind packing on bridges, creation them stronger to windstorms.
- Develop the aerodynamic constancy of bridges, production them less probable to breakdown in high winds.
- Reduce the risk of vortex-induced vibrations, which can cause bridges to sway dangerously.
- Improve the flow of water around bridge piers, reducing the risk of scour.
- Design bridges that are more aesthetically pleasing.

CFD is a powerful tool that can be used to improve the design of bridges in a number of ways. It is becoming increasingly popular as the cost of computing power continues to decrease.

## 5. Discussion

This proposal's exploration was widely valuable in that it helped develop a systematic and comprehensive design methodology. Additionally, the project should encourage the improvement of the design and construction of bridges through a greater application of contemporary logic in order to increase productivity and provide value.

According to (23), "Project achievement depends upon the perfect individuals having the ideal information brilliantly." This claim is founded on a viewpoint in support of the coordinated and collaborative environment that concurrent designing is advocating. No matter how short-sighted the reasoning, there must be a good reason behind it. Still, according to Baiden and Cost (2011), "The test is to ensure that the right information gets to the proper person brilliantly."

Integration serves as an acceptable common denominator for the focused notions discussed in Paper I. The direct and divided design that is frequently embraced in modern building is expected to be opposed by integration and a collective approach. In one way or another, construction projects are frequently planned and carried out in groups or meetings. Thus, the outcome of a building project often depends on the ability of the individual to collaborate and share. The two risks and vulnerabilities are typically reduced due to organized communication inside and across groups. Communication is a key component of effective group work, probably most so in the multidisciplinary field of construction.

The right people are essential for groups to have true success. Personnel from owner, design-developing, and contractor organizations should also be included in the groups, according to Baiden (2006). It is advised that these important individuals be hand-selected, involved in the projects from the beginning, and consistent throughout the various project stages. Collaboration between design and construction is typically unachievable yet is necessary for a project to be carried out successfully.

## 6. Conclusion

Bridges are outstanding designs that dominate space. Serving the community, they are frequently put in front of the public for judgment, especially city bridges, which are constantly observed by a large number of observers on the bridge and from a variety of locations in a metropolitan setting. As a result, it's crucial to create bridges that are reliable, sturdy, and affordable while also having an aesthetically pleasing design. Another approach to bridge design is needed if the bridge is to be designed as a new city landmark that can accommodate heavy car traffic, a light rail route, and concentrated but pleasant pedestrian transportation. In conclusion, the use of cutting-edge techniques in the conceptual design of bridges in Iraq has enormous promise for addressing the unique challenges faced by the nation's foundation. Improvements in fiber-supported polymers, computer-aided design, and sophisticated simulation techniques enable specialists to improve the principal display, robustness, and aesthetically pleasing appeal of bridges. Additionally, the incorporation of fundamental frameworks for monitoring well-being ensures ongoing evaluation of bridge integrity, proactive support planning, and focused open security. Further highlighting the importance of attending to environmental issues, seismic vulnerabilities, and adopting the most recent patterns and advancements in bridge construction is the writing survey on maintainable design considerations, seismic design examples, and innovative construction procedures. Iraq has the opportunity to build a flexible, effective, and manageable bridge foundation that embodies the development and strength of the country by resolving any conflicts between conventional methods and cutting-edge techniques.

**References:**

1. Baiden BK. Framework for the integration of the project delivery team. 2006;
2. Crowley A. Construction as a manufacturing process: Lessons from the automotive industry. Computers & Structures. 1998;67(5):389–400.
3. Eriksson PE, Olander S, Szentes H, Widén K. Managing short-term efficiency and long-term development through industrialized construction. Construction management and Economics. 2014;32(1–2):97–108.
4. Ali HT, Akrami R, Fotouhi S, Bodaghi M, Saeedifar M, Yusuf M, et al. Fiber reinforced polymer composites in bridge industry. In Elsevier; 2021. p. 774–85.
5. Gielen GG, Rutenbar RA. Computer-aided design of analog and mixed-signal integrated circuits. Proceedings of the IEEE. 2000;88(12):1825–54.
6. Zelenika S, Hadas Z, Bader S, Becker T, Gljušćić P, Hlinka J, et al. Energy harvesting technologies for structural health monitoring of airplane components—A review. Sensors. 2020;20(22):6685.

7. Hamza SA, Rasheed S, Hussein A. Procurement challenges analysis of Iraqi construction projects. Journal of the Mechanical Behavior of Materials. 2022;31(1):112–7.
8. DAWOOD MH, Al-ASADI AK. Mechanical properties and flexural behaviour of reinforced concrete beams containing recycled concrete aggregate. Scientific Review Engineering and Environmental Studies (SREES). 2022;31(4):259–69.
9. Ameen R. A framework for the sustainability assessment of urban design and development in Iraqi cities. 2017;
10. Naser AF, Mohammed HA, Mohammed AA. Seismic design assessment of bridge piers location effect on the structural capacity of supports under earthquake action. International Journal of Safety and Security Engineering. 2021;11(2):143–53.
11. Bessant J, Rush H. Building bridges for innovation: the role of consultants in technology transfer. Research policy. 1995;24(1):97–114.
12. Francis VE, Sidwell AC. The development of constructability principles for the Australian construction industry. Construction Industry Institute, Australia; 1996.
13. Gibb AG. Standardization and pre-assembly-distinguishing myth from reality using case study research. Construction Management & Economics. 2001;19(3):307–15.
14. Harryson P. Industrial bridge construction: merging developments of process, productivity and products with technical solutions. 2002;
15. Johansson K. Knowledge Sharing Across Professional Boundaries in Construction: Facilitators and Hindrances. Chalmers Tekniska Hogskola (Sweden); 2012.
16. Al-Asadi AK. Modelling of earthquake repellent fibre reinforced concrete. Periodicals of Engineering and Natural Sciences. 2019;7(4):1996–2011.
17. Issa AS, Al-Asadi AK. Mechanical properties of lightweight expanded clay aggregate (LECA) concrete. Przegląd Naukowy Inżynieria i Kształtowanie Środowiska. 2022;31(3).
18. Larsson J, Eriksson PE, Olofsson T, Simonsson P. Industrialized construction in the Swedish infrastructure sector: Core elements and barriers. Construction management and economics. 2014;32(1–2):83–96.
19. Lidelöw H, Stehn L, Lessing J, Engström D. Industriellt husbyggande. Studentlitteratur; 2015.
20. Ogbeide E. State of the art report on the flow of information in a bridge life cycle. 2010;
21. Tatum CB, Luth GP. Integrating structural and construction engineering. In 2012. p. 1301–10.
22. Forgues D, Koskela L. The influence of procurement on performance of integrated design in construction. 2008;
23. Anumba C, Kamara JM, Cutting-Decelle AF. Concurrent engineering in construction projects. Routledge; 2006.