

INTEGRATING BIM AND AI TO ENHANCE FORMWORK DESIGN, REINFORCEMENT PRACTICES, AND CONCRETE PERFORMANCE IN MODERN CONSTRUCTION

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Abstract

This study examines the practical and technical challenges associated with concrete formwork, reinforcement installation, and concrete pouring in cast-in-place construction. Drawing from both literature and interviews with five experienced construction professionals, the research highlights critical factors influencing structural performance, safety, and construction efficiency. The findings show that formwork integrity depends heavily on engineered design, proper material selection, and adherence to installation standards, while failures often result from excessive concrete pressure, insufficient bracing, poor supervision, and premature formwork removal. Reinforcement design must balance structural requirements with constructability and safety, as bar size, spacing, concrete strength, and consolidation significantly affect steel-concrete bonding and long-term durability. The study emphasizes the essential role of proper curing, noting that inadequate hydration, extreme temperatures, or mismanagement of admixtures can compromise compressive strength. Modern digital technologies—specifically BIM, Buildots, and Tegal.AI—were found to greatly enhance planning accuracy, real-time quality assurance, and productivity by automating formwork layout optimization, monitoring site progress, and improving material estimation. However, human factors such as worker competence, communication, training, and physical well-being remain central to successful execution. Safety risks, including falls, rebar injuries, equipment hazards, and concrete burns, underscore the need for rigorous protective measures and task-specific

planning. Overall, the study concludes that effective concrete construction requires an integrated approach that combines engineered design, technological support, experienced human judgment, and continuous monitoring to improve structural integrity, efficiency, and worker safety.

Keywords: *Formwork Design; Reinforcement Placement; Concrete Strength Development; Building Information Modeling (BIM); Construction Safety; Artificial Intelligence (AI) in Construction*

1. Introduction

The design and execution of formwork are essential in the construction process, especially in cast-in-place concrete projects. Hyun et al. (2018) assert that formwork is not simply a temporary mold but an engineered structure designed to endure the cumulative effects of fresh concrete, reinforcing, building materials, equipment, labor, impacts, and environmental forces, such as wind. The structural integrity of the formwork directly influences the quality, safety, and efficiency of concrete placing. Inadequate design and construction of formwork can result in disastrous occurrences, material loss, project delays, and safety risks for construction personnel. The design of formwork necessitates meticulous attention to structural loads and functional requirements, ensuring the system can sufficiently withstand all expected loads without significant deflection or failure (Jha & Sinha, 2017).

The emergence of Building Information Modeling (BIM) has revolutionized the building sector by facilitating more accurate and efficient formwork design. BIM enables engineers and contractors to automate the creation of ideal formwork layouts, taking into account essential characteristics such as lateral concrete pressure, bending, deflection, and horizontal shear stresses (Hyun et al., 2018; Mei et al., 2022). BIM facilitates comprehensive simulations of formwork performance before to on-site execution, thereby minimizing error risk and enhancing cost prediction and schedule precision. Hyun et al. (2018) illustrated this in a hospital project in Seoul, where BIM automation facilitated precise cost assessment and construction timeline estimation, establishing a framework for improved project management. Hanna and Senouci (1999) emphasized that refining slab formwork design, especially through the modification of joist spacing, can lead to substantial cost savings, demonstrating that meticulous planning guarantees both safety and economic efficiency. For instance, decreasing joist spacing by 0.1 meters significantly reduces expenses, although a spacing of 0.4 meters provides the most economical option for slab formwork.

Notwithstanding progress in formwork technology and BIM-driven design automation, failures persist. Jha and Sinha (2017) highlighted that excessive loads, early formwork removal, design flaws, and human error—often stemming from haste or inexperience—are prevalent causes of structural failure. Material deterioration and improper selection of formwork materials largely lead to failures. Autengruber et al. (2021) noted that moisture exposure can markedly diminish the load-bearing capacity of hardwood formwork due to warping and distortion, hence jeopardizing structural integrity. Li and Yin (2021) examined permanent textile-reinforced concrete (TRC) formwork, observing that failures frequently arise from textile rupture when the formwork length approaches 150 mm, as bond strength exceeds the tensile capacity of the textile reinforcement. These examples demonstrate the intricate relationship among material selection, environmental conditions, and design integrity in attaining safe and effective formwork systems.

The removal of formwork subsequent to concrete placement presents more complications. Jha & Sinha (2017) recognized formwork stripping as one of the most perilous activities in concrete construction, chiefly owing to the dangers of falling objects, partial collapses, and ergonomic stress. The initial phases of concrete curing are very vital, as newly poured concrete progressively increases in strength over time. Robinson (2017) observes that concrete generally necessitates

about 28 days to attain its complete design strength under regular curing circumstances. In numerous instances, a duration of 5–7 days may suffice for the material to withstand backfill loads, contingent upon thorough strength verification. Premature loading of newly poured concrete, whether from formwork removal or the imposition of construction loads, can result in cracking, spalling, or total structural failure.

A notable issue in reinforced concrete construction is reinforcement corrosion, which can undermine long-term durability, especially in coastal or high-humidity settings (Castañeda et al., 2017; Chen et al., 2021). Steel reinforcement is essential for concrete structural performance, offering tensile strength that enhances the compressive strength of concrete. Castañeda et al. (2017) investigated a concrete structure along the coast of Havana City and determined that efflorescence was a key factor in rebar corrosion. The buildup of corrosion products induces tensile stresses in the concrete, resulting in cracking and spalling. Chen et al. (2021) validated these findings, illustrating that corrosion incrementally elevates tensile stress in the concrete and compressive strain in the implanted steel, persisting until visible cracking manifests.

The adhesion between rebar and concrete is a crucial element influencing structural integrity. Mousavi et al. (2020) indicated that bond strength is contingent upon rebar diameter and concrete compressive strength. Alharbi et al. (2021) discovered that diminishing concrete strength from 35 MPa to 20 MPa resulted in a 39% reduction in bond strength, whereas replacing 16 mm rebars with 12 mm rebars enhanced bond strength by around 20%. The concrete consolidation process significantly affects bond performance; self-compacting concrete (SCC), owing to its enhanced flowability, generally attains superior steel–concrete bonding relative to normally vibrated concrete (NVC) (Zhu et al., 2004). Kanellopoulos et al. (2020) emphasized that vibration sensitivity should be regarded in deep structural components, as insufficient consolidation can adversely impact the contact between steel and concrete.

This study seeks to investigate practical views from industry specialists about three key aspects of contemporary concrete construction: concrete pouring, reinforcing installation, and formwork methods. Due to the intricacy of these methods, it is essential to comprehend the viewpoints of seasoned professionals. Noncompliance with project specifications, building codes, and standards may result in construction failures both during and subsequent to the process. Thus, the study examines professionals' perspectives on formwork design, rebar spacing and dimensions, failure mechanisms, concrete strength progression, steel-concrete bonding behavior, and safe work practices. A thorough comprehension of these elements is crucial for averting structural problems linked to substandard design, inappropriate reinforcement installation, insufficient curing, and hazardous work practices.

2. Importance of the Study

This study offers an extensive examination of concrete formwork, reinforcing, and casting methodologies, integrating technical literature with practical views from seasoned construction experts. Formwork is an essential part in cast-in-place concrete construction, since it determines the shape, structural integrity, and safety of concrete components throughout the initial stages of construction. Well-engineered formwork guarantees that structural components function as designed, endure imposed loads, and uphold the safety of construction workers. The study underscores the imperative of meticulously designed formwork systems to enhance construction safety and structural efficacy, noting that even slight discrepancies in design, material choice, or installation can yield substantial repercussions.

Reinforcement design is essential for maintaining structural stability. The dimensions, spacing, and configuration of rebar directly affect the load-bearing capability, longevity, and overall

efficacy of concrete components. Proper reinforcement placement enables workers to efficiently consolidate, position, and examine concrete, whereas inadequate spacing or dimensions may jeopardize bond strength and structural integrity. The selection of rebar influences constructability, as workers often traverse reinforcing cages during concrete laying, which raises safety issues if spacing is insufficient. Thus, the study underscores that reinforcement design must reconcile structural necessities with practical feasibility. The analysis highlights the significance of choosing suitable concrete strengths for particular structural components.

Concrete must attain enough strength at each phase of construction, especially during initial loading and the removal of formwork. Inadequate strength compliance may lead to cracking, spalling, or structural failure. Safety is essential throughout all phases of concrete construction, including formwork installation, reinforcement placement, concrete pouring, and curing. The study emphasizes the necessity for rigorous compliance with safety measures, encompassing the implementation of guardrails, personal protection equipment, and appropriate scaffolding to alleviate hazards linked to working at elevated levels, below ground, and in confined areas.

The study seeks to offer insights beneficial to both practitioners and academics by amalgamating technical knowledge with the practical experience of building workers. Comprehending the interaction of formwork design, reinforcement arrangement, concrete strength, and safety protocols is crucial for elevating construction quality, augmenting worker safety, and optimizing project efficiency. This research enhances comprehension of practical concrete construction methods, connecting theoretical concepts with real-world applications.

3. Research Goals and Approaches

3.1. Goals

One of the key objectives of this research was to investigate a number of fundamental features of concrete construction, specifically those that have an impact on the quality, safety, and structural performance of the structure. The purpose of this study was to determine the factors that influence the development of concrete strength after casting, to analyze the functional differences that exist between different levels of concrete strength, and to evaluate how these strengths are utilized in actual construction projects. Another purpose was to examine design concerns linked to reinforcement and formwork, including the common modes of formwork failure that were observed in practice along the course of the investigation. In addition, the purpose of the study was to identify safe work practices that can be utilized to prevent hazards and minimize risks during the stages of concrete construction that include pouring, reinforcing, and forming. In conjunction with one another, these objectives were designed to offer a full grasp of the practical and technical challenges that are experienced in the field.

3.2. Research Method

The researchers decided to take a qualitative method, which consisted of conducting interviews with experts working in the business, in order to accomplish these goals. It has been demonstrated that interviews are a reliable method for gaining insights into practitioner experience and the realities of the business (Galvin, 2015; Dietsch & Tannert, 2015). Because of this, interviews are extensively utilized in research that is relevant to construction. They are also considered to be an efficient method of obtaining precise professional information, particularly in research that is associated with construction procedures (Fox, 2009; Makvandia & Safiuddin, 2021). For the purpose of this inquiry, five seasoned individuals who are employed in the construction industry were chosen. Their significant participation in concrete formwork, reinforcing, placement, and finishing was the primary factor that led to their selection. A variety of senior and supervisory positions, including owner, field coordinator, superintendent, assistant superintendent,

and general manager, were held by the participants when they participated in the event. The participants represented three separate construction companies. Due to the need to protect the confidentiality of the interviewees and their respective organizations, the names of those who were interviewed are not given in this study.

Between the months of November 2021 and March 2022, the interviews were successfully carried out. Due to the limits imposed by COVID-19, four of the interviews were carried out over the phone, while the remaining one was carried out by email. In addition, additional correspondence and explanations were managed through the use of email communication. A structured questionnaire that consisted of ten open-ended questions was used to guide each interview. These questions were created to fit with the aims of the research and for the purpose of gathering thorough insights from the participants. The interviewees' combined experience spanned from more than three years to more than three decades, with the majority of them having direct involvement in concrete-related construction activities for fifteen to thirty-three years.

4. Results and Analysis

The study's findings are organized according to the comments of the interviewed construction experts, categorized by the themes and questions addressed during the interviews. The results underscore the practical realities, technical obstacles, and safety issues faced in concrete construction, especially during formwork installation, reinforcement placement, and concrete pouring. Each component examines critical insights, elucidations, and suggestions offered by participants, substantiated by pertinent literature.

4.1 Challenges Associated with Formwork Installation and Human Factors

The installation of formwork is a pivotal phase in concrete construction that directly affects the quality, durability, and safety of the structure. Interviewees indicate that prevalent concerns with formwork stem from non-adherence to project standards, insufficient planning, environmental factors, and expedited timelines. Accurate recording and validation of engineering directives are essential to avert deviations that could jeopardize safety or functionality.

Technology-Assisted Solutions

The emergence of Building Information Modeling (BIM) and Artificial Intelligence (AI) has revolutionized concrete construction. BIM enables engineers and contractors to automate the creation of ideal formwork layouts, accounting for lateral concrete pressure, bending, deflection, and horizontal shear stresses (Hyun et al., 2018; Mei et al., 2022). AI further enhances project efficiency by predicting scheduling conflicts, monitoring equipment, and optimizing material use.

Integration of Buildots and Togonal.AI in Concrete Construction

In addition to BIM- and AI-driven planning systems, several advanced digital tools are now being adopted on construction sites to enhance accuracy, productivity, and real-time decision-making. **Buildots**, an AI-powered progress-tracking platform, utilizes 360° cameras worn by site personnel to automatically compare site conditions with the BIM model. This technology enables real-time monitoring of formwork installation, rebar placement, and concrete pour sequencing. By detecting deviations early—such as misaligned formwork, missing reinforcement, or schedule slippage—Buildots significantly reduces rework, strengthens quality assurance, and improves coordination between design and field teams. The automation of progress reporting also reduces administrative workload and enhances transparency across project stakeholders.

Another emerging tool is **Togonal.AI**, which automates quantity takeoffs and material measurement using AI-driven plan analysis. For concrete construction, Togonal.AI accelerates the estimation of formwork areas, concrete volumes, and reinforcement quantities by converting 2D plans into accurate digital quantities within seconds. This helps contractors refine bids, minimize manual

measurement errors, and improve cost forecasting. By rapidly analyzing multiple design revisions, Togonal.AI ensures that material orders and construction schedules are accurately aligned with the latest drawings, reducing delays, material waste, and budgeting risks.

These technologies, when combined with BIM platforms, elevate construction planning by offering continuous verification between design intent and field execution. Their integration demonstrates how modern AI systems—beyond traditional modeling—contribute to safer operations, higher productivity, and more reliable outcomes in concrete formwork, reinforcement, and pouring activities.

Table 1: AI Applications Enhancing Profitability and Efficiency in Concrete Construction

Profitability Area	AI Application	Key Benefits
Cost & Error Control	AI detects clashes in BIM and predicts scheduling conflicts	Keeps projects on time and budget; reduces idle labor
Material Use & Waste	AI predicts material needs, optimizes delivery, and cutting patterns	Minimizes excess inventory and material waste
Equipment Efficiency	AI monitors equipment for predictive maintenance	Reduces downtime, repairs, and rental costs
Labor Productivity	AI schedules tasks based on crew efficiency; automates reporting	Increases output per labor hour; reduces idle time
Risk & Contingency	AI analyzes real-time data to flag risks	Lowers contingency costs; reduces accidents and insurance claims
Project Delivery	AI forecasts schedules and optimizes supply chains	Shortens timelines; improves cash flow and project turnover
Bidding & Estimation	AI refines cost estimates using historical and market data	More accurate bids; improves win rates
Sustainability	AI recommends low-carbon materials and optimised mixes	Reduces carbon emissions; meets green building standards

These technological tools streamline planning, prevent errors, and improve overall project productivity, demonstrating that integrating AI and BIM is crucial for modern construction operations.

Human Factors and Operational Challenges

Despite technological advancements, human-related factors remain a significant source of delays, errors, and safety risks during formwork installation. Workers' competence, attitude, communication, and well-being can profoundly impact both quality and safety. For instance, fatigue or inadequate training may result in improper installation, while poor communication can lead to accidents and material wastage.

Table 2: Human Factors Affecting Concrete Pouring

Category	Specific Factors	Role in Concrete Pouring
Individual Competence Skill	Knowledge, & experience, making ability	training, Experienced workers better judge distances, decision-operate equipment, and identify issues, leading to higher productivity and fewer errors.

Category	Specific Factors	Role in Concrete Pouring
Attitude & Motivation	Commitment, negligence, violation of rules, motivation	Inadequate training can cause critical mistakes in scaffolding or formwork. Worker attitude affects performance and safety. Negligence or deliberate protocol violations can result in accidents and poor-quality work.
Physical & Mental Well-being	Fatigue, physical health, mental health	Fatigue from long shifts reduces attention and increases errors. Physical fitness is crucial for operating machinery safely.
Communication & Information Flow	Communication quality, information availability	Effective communication between crane operators, managers, and concrete gang ensures smooth concrete flow and prevents accidents.
Supervision & Quality Assurance	Degree of supervision, inspection protocols	Proper supervision ensures correct placement of formwork and reinforcement. Quality control checks prevent defects.
Jobsite Layout & Planning	Planning/scheduling, equipment availability, crew size	Human planning determines optimal equipment and material locations. Poor layout or insufficient crew size can cause delays.
Environmental Conditions	Weather conditions, physical environment (noise, light)	Extreme temperatures and site conditions affect worker performance and concrete properties, requiring proper management.

This highlights that **technology alone cannot guarantee success**; human expertise, coordination, and supervision remain critical to achieving quality, safety, and efficiency on-site.

Integrated Approach

Interviewees emphasized that the **best results emerge from a combination of technology and human oversight**. BIM and AI can enhance precision, detect potential errors, and optimize workflow, but trained and motivated personnel are required to execute plans safely and effectively. Coordination between AI-assisted planning and human execution ensures that concrete pouring, formwork installation, and reinforcement placement occur efficiently while minimizing risks.

4.2 Concrete Failures Attributable to Formwork and the Curing or Cured Concrete

Concrete failures may arise from formwork collapse, inadequate curing, or premature loading of the building. A primary reason leading to formwork collapse is the hydrostatic pressure exerted by fresh concrete. The pressure escalates with the depth of the formwork and is additionally intensified by vibration during consolidation. Inadequate bracing or support may lead to the detachment of sheeting at the base, leading in structural failure, injuries, and considerable material loss. The potential for failure also encompasses permanent formwork systems. Li and Yin (2013) examined textile-reinforced concrete (TRC) formwork and discovered that high loading can result in material slippage within the matrix, generating weak areas at the matrix-textile interface. The premature removal of formwork constitutes a considerable hazard, as newly poured concrete may lack the requisite strength to bear imposed loads. Jha and Sinha (2011) advised that formwork should remain in place until the concrete attains a stress level at least double that anticipated before removal, hence assuring stability and safety.

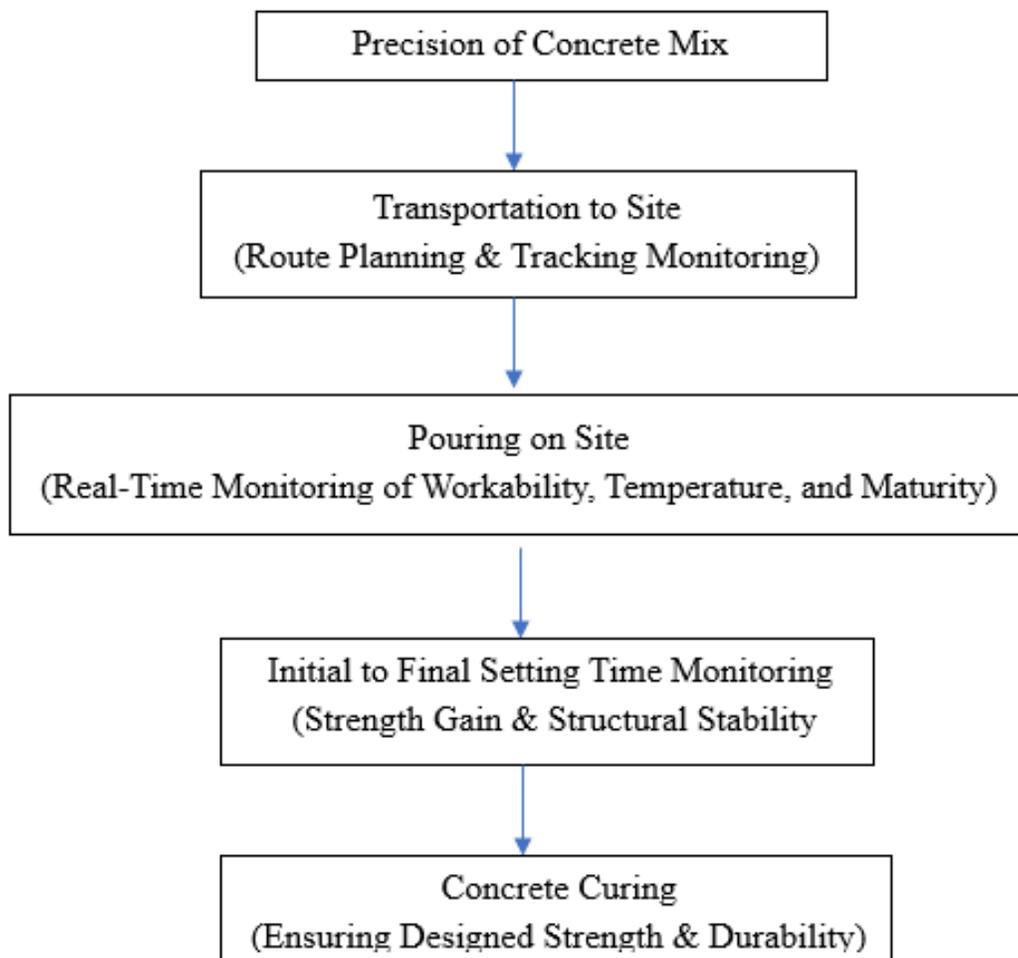
Multiple supplementary factors intensify the likelihood of concrete failure:

Inadequate inspection and supervision of formwork installation.

- Deficient engineering designs that fail to include dynamic construction loads.
- Inferior reinforcement materials, particularly from overseas vendors.
- Severe climatic circumstances, encompassing periods of freezing and thawing.

Corrosion of rebar is a persistent issue that can result in structural degradation years post-construction. High-quality concrete may nonetheless fail to inhibit corrosion in maritime or high-humidity settings, leading to steel degradation, loss of cross-sectional area, and the formation of expansive reaction products that result in cracking and spalling (Chen et al., 2013). Chen et al. (2015) elucidated that compressive strain on embedded steel and tensile strain on adjacent concrete both escalate prior to observable cracking, underscoring the necessity of monitoring and preventive strategies to prolong structural longevity. Pragmatic Suggestions: Appropriate top, bottom, and lateral coverings for rebar mitigate the risk of corrosion. Timely inspections of formwork and curing conditions facilitate the early detection of faults. The application of protective coatings and corrosion-resistant rebar in adverse situations prolongs service life. These findings emphasize that concrete failures are multifaceted, encompassing both transient formwork factors and enduring material resilience.

Fig 1. Concrete Production and Placement Process Flow



4.3 Critical Factors in the Design of Concrete Reinforcement

Reinforcement design is contingent upon structural function, load specifications, and span dimensions. High-rise buildings or structures with extensive column-to-column spans necessitate supplementary or larger rebars to accommodate increased loads. Likewise, industrial edifices with expansive open areas demand broader spans, hence requiring substantial reinforcement systems. Superimposed dead loads, such as heavy equipment or storage shelves, must be integrated into rebar design to avert overloading. Environmental factors like as seismic activity and frost heave additionally affect reinforcement requirements. The spacing of rebar is a crucial element influencing structural performance and worker safety. Increased spacing, typically linked to thicker rebars, may present safety hazards during concrete placement, since workers would have to traverse reinforcement cages. Interviewees said that spacing should be less than the minimum boot size to avert slips and falls. Mousavi et al. (2020) indicated that the bond strength between concrete and steel is influenced by rebar diameter and concrete strength. Alharbi et al. (2021) noted a 39% decline in bond strength as concrete strength diminished from 35 MPa to 20 MPa, but smaller rebars enhanced bond performance by almost 20%. Furthermore, concrete consolidation is crucial; self-compacting concrete (SCC) attains enhanced steel–concrete adhesion relative to conventionally vibrated concrete (Zhu et al., 2004). Vibration sensitivity in deep elements must be mitigated to guarantee reliable bonding (Kanellopoulos et al., 2020). These factors underscore the relationship between structural design, material choice, and construction safety, indicating that rebar dimensions and spacing significantly influence the long-term durability and structural integrity of concrete components.

4.4 Standard Concrete Compressive Strength Classifications and Their Applications

The necessary compressive strength of concrete fluctuates based on structural requirements. Low- to mid-rise structures often necessitate concrete with a strength of 25–35 MPa for footings, foundations, and slabs. Specific residential developments may permit 20 MPa, contingent upon approval from the structural engineer to minimize expenses. Air-entrained concrete designed for freeze-thaw durability typically possesses a strength of approximately 32 MPa in Canada. Foundations exposed to substantial loads, such as tower crane bases, necessitate elevated strengths, often approximately 35 MPa.

High-rise structures necessitate robust concrete, generally ranging from 45 to 80 MPa, for their foundations, piers, and columns. Core walls typically exhibit compressive strengths between 60 and 80 MPa, although upper-level walls may have reduced strength specifications. Slab-on-grade and suspended slabs generally vary from 25 to 35 MPa (Dieter, 2017). These data demonstrate the correlation between applied structural loads and the necessary concrete strength.

Excessive cement content due to over-design escalates building costs and diminishes contractor profit margins (Dufferin Concrete, 2017). Utilizing accelerated mixtures to attain 75% strength within 24 hours raises expenses by 42–53 CAD per cubic meter (Dufferin Concrete, 2019). Nonetheless, productivity enhancements may counterbalance these expenses.

4.5 Specifications for the Determination of Compressive Strength and Curing

The curing of concrete is essential for attaining the desired strength. Effective curing necessitates sustaining the concrete temperature above 10°C to ensure enough hydration. Curing is ineffective at temperatures below 5°C (Neville, 2012). In frigid climates, tarping and heating systems facilitate accelerated curing, hence facilitating uninterrupted construction cycles. Insufficient compaction, especially in areas with high rebar density such as beam-column joints, can diminish strength. Embedded sensors and strength-indicating plugs provide real-time assessment of concrete strength. Laboratory cylinder tests are performed at seven and twenty-eight days to verify

strength development. Miscommunication about admixtures, particularly plasticizers, can diminish strength and augment porosity, absorption, and permeability, underscoring the necessity for meticulous quality assurance.

4.6 Safety Considerations

Concrete construction presents numerous hazards. Falls from elevation and below-grade activities pose significant hazards. Insufficient scaffolding, exposed jagged rebar, concrete spillage, cement burns, and heavy lifting lead to injuries. Constrained mobility in foundational structures and heavy machinery operation elevates dangers. Appropriate guardrails, personal protective equipment, and regulated access alleviate these hazards. Preliminary risk evaluations tailored to the task are required prior to commencing concrete work.

5. Conclusion

Throughout the course of this study project, a number of various topics were studied, including the design of formwork, the performance of the structure, and the stability of the construction process. The performance of concrete pouring, reinforcing, and forming at building sites that were experiencing a high level of activity garnered a great amount of attention. This concentration was focused to the performance of these actions. The following discoveries, in addition to the ones listed below, are among the most important ones: In order to assess the strength of the concrete, the quantity of reinforcing bar (rebar), and the spacing between the bars, the most essential aspects that are taken into consideration are the loads that are applied and the usage that is envisaged. These criteria, in turn, are responsible for deciding the structural design of the structures that are connected to the project. Concrete is capable of progressively obtaining its strength over the course of time; it generally takes between five and seven days for it to reach its entire design strength, and it takes roughly twenty-eight days for it to reach its total design strength (Robinson, 2017). Concrete is able to accomplish its strength and strength progressively throughout time. Concrete is capable of gradually gaining its strength all the way through the procedure. It is suggested that the time it takes to take down formwork be cut down to three to four days instead of the current five days. Using real-time surveillance has several benefits, such as making decisions better and making people safer. Failures in the formwork, inadequate placement of reinforcement, corrosion, and insufficient curing are some of the causes that contribute to the loss of materials, the excess of the budget, and the acceleration of the project. All of these challenges develop as a result of a number of various complications that are brought about collectively. Providing safety, which is of the utmost relevance, can be accomplished by the employment of a range of approaches, including the deployment of personal protection equipment, guardrails, and design that is adapted to the individual activity that is being performed. These safeguards are being put into place with the purpose of reducing incidents that entail falls and burns that are brought on by cement. To build a concrete structure that works, you need a strong design, continual monitoring of the materials, and strong safety measures. It is vital to have all of these things. As a consequence of the findings of this research, it has been determined that the combination of technical preparation, practical knowledge, and continuous monitoring leads to an increase in the efficiency of construction, as well as an increase in the integrity of the structure and the safety of the workers. From the outcomes of this inquiry, one can derive this conclusion. This is the conclusion that can be drawn.

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