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Research Article

Delay Pattern Assessment in Concrete Casting

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A B S T R A C T

Urlabari Construction management is mainly concerned with time, cost and quality of a project. Concrete is mostly used construction material and its quality characteristics is important. With poor knowledge in concrete mixing and placing activities though the structures are structurally designed will have a great impact on the compressive strength of the structural elements and the life of the structure as a whole. The main objective of this research was to analyze through Field based observation the delay pattern in concrete casting on selected construction sites of Jhapa district.

During field observation on selected construction sites of Jhapa district, the casting delay was mainly observed in manual mixing and in case of ready mix concrete. Use of plasticizer was noted in case of ready mix concrete which helped to maintain workability even in case of delayed casting but in ordinary works of manual type, more time elapsed cases were observed which resulted in loss of workability and strength.

Keywords: Concrete, Casting delay, Setting Time, Compressive Strength of concrete, M20

Introduction

Construction management is a professional service that oversees the planning, design and construction of a project from start to finish using specific project management techniques. Construction management's goal is to keep a project's time/delivery, cost and quality under control a concept known as the "project management triangle" or "triple constraints" . Concrete is a man-made stone formed by the hardening of a combination of cement, aggregates and water with or without an appropriate admixture. The quality of concrete is of prime concern of construction managers in any civil engineering projects as "quality" parameter is one of the fundamental parts of project management triangle.

Concrete as a building material is used considerably in structures, mainland, roads and heads. Its uses range from structural plays on shafts, columns, footings, crossbeams, to pavements, kerbs, pipes, troughs and so on. The history of the usage of concrete as a building material date back to the Egyptian period but the development of Portland cement in 1824 by Joseph Aspdin marks the climacteric in the development of contemporary day concrete in the history.

Because concrete is the most commonly used construction material in the world (S. & Pravesh, 2019), the quality of the concrete used is an important factor in construction, which is determined primarily by its compressive strength (Muhammad, Uneb, Mohammed, Omar S., & Imran, 2020). The capacity of a material or structure to carry stresses on its surface without cracking or deflection is referred to as compressive strength. Compressive strength is an important parameter in determining the material's performance under service conditions.

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The strength that can be developed by a workable, appropriately placed blend of aggregate, cement and water (under similar conditions of blending, curing and testing) for a given cement and acceptable aggregates is affected by: water-cement (w/c) ratio, cement-aggregate ratio, surface texture, shape, grading, strength and stiffness of aggregates, aggregate maximum size and so on. From the foregoing, it can be deduced that the water/cement (w/c) ratio has a direct impact on concrete strength, whereas other factors have an indirect impact on concrete strength by influencing the water/ cement ratio.

Concrete placement is a critical step in the building process that determines the structure's success and longevity. While placing the concrete, the technical and environmental factors are carefully considered. From the time it comes out of the mixer until it is done, the concrete is permitted to go through a number of phases. The concrete is delivered, poured, vibrated, matured and cured before being removed from the form. Each of these phases must adhere to building procedures that are considered best practices.

In a single bay or pour, all of the concrete must be laid in one continuous process. All impediments, abnormalities in the foundations and the like must be carefully worked around so that all portions are entirely full of compacted concrete with no segregation or honey combing. It must also be worked carefully around and between water stops, reinforcement, embedded steelwork and other similar things that protrude above the finished pour's surface. Delay in concrete placing may have a major impact on the quality of casting, mechanical strength and long-term durability of the construction, depending on the concrete mix. Properties of fresh concrete vary with time. For example, the flow ability of concrete reduces over time, especially after it has set, when it drops significantly. Different mechanisms might be responsible for the change. The hydration of cementations materials with water is one mechanism.

Time elapsed between mixing and placing also effects quality of hardened concrete. Some of the reasons for the surprisingly long delay include improper concrete handling procedures, site organization, work schedule, severe environmental conditions and equipment malfunction. Therefore, certain chemicals can be used to prevent concrete from setting. The setting time test and control of setting time by using chemicals on concrete have been the subject of past investigations but practically in field, the use of retards is found to be used only on specialized works where the technical man powers like engineers are involved. Whereas in general construction works the concrete placing is delayed due to many reasons but no retarders are used. So, the effect of such delay on concrete's compressive strength is worth evaluating especially in Nepalese cement concrete industry, where past experiments are not found enough on such cases.

Research Objectives

The overall objective of this research is to assess the delay pattern in concrete casting on different construction sites of Jhapa district.

Ordinary Portland Cement

Ordinary Portland cement is by far the most common form of cement in general use around the world as it is a basic ingredient of concrete and mortar (Mishra & Chaudhary, 2018). Cement is made by combining calcium, silicon, aluminum, iron and other components in a precise chemical reaction at the controlled temperature (Banstola, Shrestha, Thapa, & Mishra, 2021).

Grade of cement is 28 days compressive strength of cement. In the case where time is constraint, estimation of 28 days compressive strength based on 3 days and 7 days compressive strength can be useful (Mishra, Joshi, & Badagha, 2021). The OPC is classified into three grades based on the strength of the cement at 28 days when tested according to IS 4031-1988: 33 grade, 43 grade and 53 grade. OPC's initial setting time is 30 minutes and the final setting time is 600 minutes, or 10 hours (Shetty, 2000).

The cement is the most expensive construction material and easily deteriorates in terms of quality if delayed in consumption or if not taken proper care in transporting and storing situations (Mishra & Chaudhary, 2018). Although Nepal is not a developed nation, it is undergoing significant growth and the need for cement is increasing on a daily basis, whether for buildings, bridges, roads, or hydropower projects (Mishra & Jha, 2019).

Quality of Concrete

A product's quality is defined as the degree to which all important qualities and attributes of the product correspond to all parts of a customer's requirement, as determined by the price and delivery schedule that he or she will accept (Mishra, Gupta, & Aithal, 2020) . Materials for concrete; workmanship in all phases of batching, mixing, transporting, placement, compaction and curing; and related plant, machinery and equipment should all be performed according to the standard in order for the final structure's qualities to be compatible with the requirements (Aryal & Mishra, 2020).

The compressive strength of concrete is its most essential attribute. After 28 days of curing, concrete specimens are examined for compressive strength in a universal compressive strength test equipment. Aggregate quality, cement strength, water content and water/cement ratio are some of the variables that affect compression strength (Noorzaei, Hakim, Jaafar, & Thanoon, 2007).

Water content, aggregate form and size distribution, cementations composition and degree of hydration all affect

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workability. Furthermore, it can be raised without changing the water-cement ratio by adding chemical admixtures (e.g. plasticizer or superplasticizer). The addition of water or chemical admixtures to a concrete mixture improves the workability of the concrete. Excessive water, on the other hand, causes increased bleeding or segregation of particles, resulting in lower-quality concrete. Because the workability of new concrete declines significantly over time, waiting too long may render the concrete unsuited for placement. This issue is exacerbated by hot weather and the usage of chemical admixtures. Regaining the workability of new concrete by adding water is a bad construction practice. Because the water-cement ratio is inversely proportional to concrete strength, this might result in a change in the water-cement ratio, lowering the strength of the concrete (Mahuz, Bhuiyan, & Oshin, 2020).

A study done by (Mishra, Gupta, & Aithal, 2020) in Gautam Buddha Airport to assess the factors which affect the quality and the standard conformance of cement and coarse aggregates used at the construction site by using the key informant interview, questionnaires survey along laboratory test of coarse aggregates and cement, they discovered that the average concrete cube compressive strength after 3 days, 7 days and 28 days is 18.8N/mm2 (>16N/mm2), 27.20N/mm2 (>22N/mm2) and 39.40 N/mm2 (>33N/mm2), respectively. Cement's typical initial and final setting times are 180 minutes (>45 minutes) and 351 minutes (<600 minutes), respectively and its average soundness is 2.7 millimeters (<10 millimeters). The average Los Angeles Abrasion value of aggregate was 32.8 percent (<40 percent) in the test, while the average crushing value of aggregate was 19.88 percent (<25 percent), the aggregate flakiness index was determined to be 19.85 percent (25 percent) and the gradation of aggregate was found to be within specification, with the absence of competent people, low-quality drawing and specification and poor-quality procedure being the key issues affecting quality.

Concrete Production Practice

After researching 30 practitioners using the questionnaire survey approach, (Aryal & Mishra, 2020) discovered that none of the concrete practitioners were aware of the usage of NBC concrete and that no training relevant to NBC practice had been completed by the respondents. The majority of the practitioners applied their knowledge of concrete production gained through observing concrete operations on the job site.

Mixing of Concrete

Concrete installation success is contingent on precise mixing, the right equipment and appropriate transportation. Concrete mixing is simply defined as "the entire blending of the components required for the manufacture of homogenous concrete" (Young, 267). Hand mixing can differ from machine mixing, with machine mixing being the most prevalent. However, no successful mixture can be achieved unless all materials are properly batched (Vinci).

Transportation of Concrete

The transfer of concrete from blending plant to the site of construction is referred to as transporting the concrete mix. All concrete is blended on the construction site, which may necessitate some travel. This is most commonly seen with ready-mixed concrete. The main goal of transporting concrete is to keep the water-cement ratio, slump or consistency, air content and homogeneity as close to their intended states as possible. There are numerous modes of transportation available, including wheelbarrows or motorized buggy, truck mixers, buckets or steel skips, chutes, belt conveyors, concrete pumps and so on (Vinci).

Placing of Concrete

To prevent rehandling, the concrete should be put as close to its ultimate position as possible. Before the first setting of concrete begins, the concrete should be laid and compacted and it should not be disturbed thereafter. Placement methods should be such that segregation is avoided. It's important to prevent moving the formwork or displacing the reinforcement. As a general rule, the maximum free fall of concrete that is allowable is 1.5 meters (IS 456, 2000).

Freshly mixed concrete is placed, distributed and consolidated in the area where it will harden (often inappropriately referred to as pouring) (Specifications for structural concrete , ACI 301-05, 2005)

To ensure durable concrete, the mortar should be in intimate contact with the coarse aggregate, reinforcement and any neighboring faces to which it is to be attached. Concrete should be deposited as close to its final position as possible. Concrete is placed using buckets, manual or motorized buggies, hoppers, chutes and drop pipes, , pumps, tremies, conveyor belts and paving equipment. The shotcrete method, which involves applying layers of concrete pneumatically, can also be used to put concrete. When formwork is impossible or impracticable, access or location is challenging, or typical casting procedures cannot be employed, the shotcrete process comes in handy (American Concrete Institute).

Pumping is a less labor-intensive way of placement that also speeds up the process. The productivity of pumping labor is nearly double that of crane-and-skip or hoist-and-barrow installation. The crane becomes unavailable for other activities when the crane and skip technique is utilized. Many factors impact the selection, but in a high-labor-cost environment, pumping is advised as the first-choice alternative, even for modest pours, but economic concerns may still prevent it (Anson & Wang, 1998).

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Concreting in Hot Weather

PCA, America Cement Manufacturers, defines hot weather concrete as concrete placed when the temperature is between 77°F and 95°F (25°C to 35°C). As a general rule, a rise of 20°F can cut the time it takes for a concrete mixture to set by up to 50%. For illustration, a concrete mixture which takes three hours to set at 60°F may take as little as 112 hours to set at 80°F. The rate of hydration and the flow of moisture from the concrete's interior and surface are both accelerated by hot weather, which has a substantial influence on all phases of production of concrete and placing operations. It has an impact on long-term strength and durability. The strength of hardened concrete is affected by some characteristics of craftsmanship in the mixing and laying of hardened concrete in hot weather .It has been revealed that extending mixing time and allowing for a reasonable postponement in casting can actually boost the concrete's strength as long as the curing is done appropriately. It was also discovered that the vibration duration should be limited to roughly 10 seconds in order to achieve maximum strength. If such effects were considered when designing the mix, it is unlikely that special measures would be required to lower the fresh mix temperature in hot weather climates (Kayyali, 1984).

Concreting in Cold Weather

Cold weather concrete is defined by ACI when the temperature falls below 40 °F (4.44°C) for more than three days in a row. All hydration and strength growth ceases when concreting below -10°C; however, there may be a considerable loss of long-term strength of up to 50% when placed between -10°C and 4°C depending upon the actual temperature of the curing process. By providing more favorable protection and curing circumstances, concrete that has been frozen for a short length of time at an early age can be recovered to its original design strength (Choi, Reichler, & Neighbors, 2003).

Research Gap

It is well known that when concrete is cast late, its compressive strength decreases. However, it is uncertain how much strength is lost as a result of a specific time delay. This research looked at how compressive strength changed over time after fresh concrete was mixed. Various admixtures were employed in most prior studies to mitigate workability loss due to delay by adding some admixtures, for example, super plasticizer was applied in comparable studies by (Zhang, Sisomhon, Ng, & Sun, 2010) . In most cases, when a delay arises unintentionally or unexpectedly, laborers immediately add water to restore workability. Similar researches by (Mahuz, Bhuiyan, & Oshin, 2020) was done by adding some water after the delays and obtained the alteration in the compressive strength of the concrete. In "no-water addition" case on the same research, the workability and compressive strength of concrete samples (of both OPC and PLC) significantly began to fall after the 1st hour of mixing even very below the target strength. In "water addition" case, the compressive strength of concrete samples (of both OPC and PLC) significantly began to fall after the final setting time (FST). It has been mentioned in clause 13.2 of (IS 456, 2000) that the concrete should be placed and compacted before initial setting of cement commences and should not be subsequently disturbed . As the result of the (Mahuz, Bhuiyan, & Oshin, 2020) is contradictory with the codal instruction to use the concrete within initial setting time, more study is felt to be done. This study is also significant as enough researches has not found done on this topic in the context of Nepalese cement concrete industry. So it may give practical information to different practitioners of concrete technology like contractors and engineers as well as it may be a good reference for researches in future.

Also Nepal Bureau of Standard & Metrology under Government of Nepal has sometimes banned even the well-known Nepalese cement and steel brands for non-compliance issues. So, it could not be fully assumed that foreign studies on cement concrete can fully address the concrete behavior in Nepalese context. That does not necessarily mean Nepalese brands lack quality consistency on production but what is going to be focused is that more researches are needed to be done frequently according to volume production & particularly on each lot to be fully assured on concrete quality.

Table1.Research Matrix

S.No.	Research Objective	Data required	Collection tools	Analysis	Outcomes
1.	To observe the delay pattern in concrete casting on different constructi-on sites of Jhapa district.	Mixing time Final placing time Admixtures Mixing type	Observation was done on different construction sites of Jhapa district and mixing time and final placing time was noted.	Time delay was calculated by the difference between final placing time and mixing time. Time delays of different construction types and mixing type are compared to see the pattern of delay casting.	General pattern of time delays in casting of concrete for different construction types and different mixing types in Jhapa district was given by the observation results.

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So, Despite of above mentioned literature reviews, further research is felt to be accomplished in Nepal. Further, concrete handling behavior in terms of time delay in placing was also needed to be studied to observe actual field practice of concreting in some construction sites of Jhapa district. By this research, one can have general idea on ongoing delay issues on concrete placing on various types of construction works in Jhapa district.

Study Area

The project was done inside Jhapa district (26°32'40"N ,88°05'40"E) which lies in province number 1 of the Nepal. Jhapa is becoming prime destination for the migrated populations from the hilly and mountainous regions of eastern Nepal. There has been a rapid spike in development activities in last few years in this district. The areas like Birtamode and Damak etc are being densely populated with concrete buildings. As Nepal is vulnerable to earthquake, the quality of construction is a very crucial factor to be kept in notice. For the construction of concrete pavement, buildings, bridges and other structures the raw materials like sand, aggregates are obtained from different rivers like Mechi, Ninda, Hadiya, Biring, Kankai, Ratuwa and Mawa rivers. There are also some cement factories like Century cement factory, Gorakhkali cement factory in Jhapa district. The delay casting is the prime concern of ready mix concrete industries too. There are some ready-mix concrete industries in Jhapa like Omkar Ready-mix Concrete Pvt. Ltd., Pashupati RMC etc. The aggregate materials for this research were collected from Biring River and Maruti Cement obtained from nearest hardware was used. The concrete was of M20 grade for the tests as most of the buildings and road structures are usually made on M20 grade of concrete. The field assessment for observing concrete casing delay pattern was done on different construction sites at Mechinagar Municipality, Arjundhara Municipality, Birtamode Municipality, Gauradaha Municipality, Shivasatakchhi Municipality of Jhapa district.

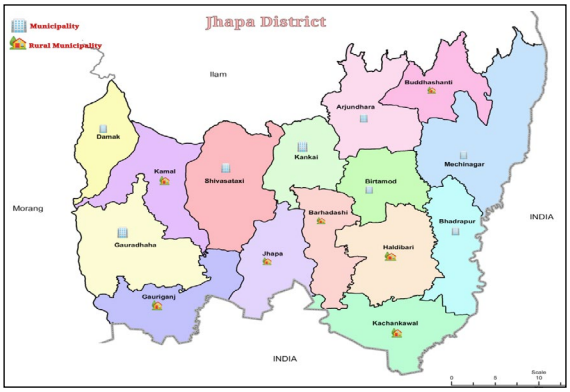

Figure 1.Map showing different municipalities of the Jhapa district

Research Philosophy

It is an empirical field based ex post facto research based on field observation. It is a pragmatic philosophy based research to highlight the concreting practice of local observation. Qualitative approach has dominated the study. This research signifies the origin of several researches in the area.

Research Matrix

The summary of the research process has been outlined as a research matrix in Table 1.

Result and Discussion

Delay Pattern in Casting Concrete

The delay pattern was studied by observing selected construction sites of Jhapa district.

Field Observation

Ten different construction sites were observed for this purpose.

Site 1: The construction work of roadside structure (plum concrete wall) was observed at Mechinagar Municipality, Jhapa. Use of Shivam cement was noted and mixing type was mechanical. The first concrete placing time was noted as 7:15 AM and the last placing time was noted as 10:28 AM. Elapsed time of 173 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Site 2: The construction work of building structure (tie beam) was observed at Arjundhara Municipality, Jhapa. Use of Century cement was noted and mixing type was Mechanical. The first concrete mixing time was noted as 4:28 PM and the last placing time was noted as 4:48 PM. Elapsed time of 20 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 2.Field observation at site 1

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Figure 3.Field observation at site 2

Site 3: The construction work of bed PCC for drain was observed at Mechinagar Municipality, Jhapa. Use of Bhagawati cement was noted and mixing type was manual. The first concrete mixing time was noted as 11:05 AM and the last placing time was noted as 1:14 PM. Elapsed time of 129 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 4.Field observation at site 3

Figure 5.Field observation at site 4

Site 4: The construction work of roadside structure (RCC drain wall) was observed at Birtamode Municipality, Jhapa. Use of Century cement was noted and mixing type was Mechanical. The first concrete mixing time was noted as 8:22 AM and the last placing time was noted as 8:40 AM. Elapsed time of 17 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Site 5: The construction work of Bridge abutment was observed at Gauradaha Municipality, Jhapa. Use of Maruti cement was noted and ready mix concrete was used. The first concrete mixing time at RMC plant was noted as 10:43 AM and the last placing time at field was noted as 12:55 PM. Elapsed time of 132 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was used.

Figure 6.Field observation at site 5

Site 6: The construction work of PCC for footing of building was observed at Arjundhara Municipality, Jhapa. Use of Sarbottam cement was noted and mixing type was manual. The first concrete mixing time was noted as 7:58 AM and the last placing time was noted as 10:02 AM. Elapsed time of 124 minute was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 7.Field observation at site 6

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Site 7: The construction work of RCC raft for industry was observed at Mechinagar Municipality, Jhapa. Use of Jagadamba cement was noted and mixing type was mechanical. The first concrete mixing time was noted as 1:35 PM and the last placing time was noted as 2:09 PM. Elapsed time of 39 minutes was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 8.Field observation at site 7

Site 8: The construction work of RCC slab for building was observed at Arjundhara Municipality, Jhapa. Use of Maruti cement was noted and mixing type was manual. The first concrete mixing time was noted as 8:15 PM and the last placing time was noted as 9:43 PM. Elapsed time of 88 minutes was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 9.Field observation at site 8

Site 9: The construction work of plum concrete wall at riverside was observed at Arjundhara Municipality, Jhapa. Use of Maruti cement was noted and mixing type was manual. The first concrete mixing time was noted as 3:12 PM and the last placing time was noted as 5:30 PM. Elapsed time of 138 minutes was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Site 10: The construction work of piling for bridge was observed at Shivasatakchhi Municpality, Jhapa. Use of Jagadamba cement was noted and mixing type was Mechanical. The first concrete mixing time was noted as 10:40 and the last placing time was noted as 10:47 AM. Elapsed time of 07 minutes was calculated by the difference between first mixing time and last placing time. Use of plasticizer was noted.

Figure 10.Field Observation at site 2

Site 11: The construction work of concrete block casting was observed at Buddhashanti Rural Municipality, Jhapa. Use of Shivam cement was noted and mixing type was Manual. The first concrete mixing time was noted as 10:28 PM and the last placing time was noted as 03:30 PM. Elapsed time of 122 minutes was calculated by the difference between first mixing time and last placing time. Plasticizer was not used.

Figure 11.Field observation at site9

Figure 12.Field observation at site 10

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Table 2.Summary of field observation for casting delay pattern

S. No.	Used at	Cement type	First Mixing time	Last Placing time	Elapsed time (min)	Mixing type	Use of plasticizer	Location
1	Plum concrete wall at road side	Shivam	7:35 AM	10:28 AM	173	Manual	No	Mechinagar Municipality
2	Building beam casting	Century	4:28 PM	4:48 PM	20	Mechanical	No	Arjundhara Municipality
3	Bed pcc for drain	Bhagawati	11:05 AM	1:14 PM	129	Manual	No	Mechinagar Municipality
4	RCC drain wall	Century	8:22 AM	8:40 AM	17	Mechanical	No	Birtamode Municipality
5	Bridge Abutment	Maruti	10:43 AM	12:55 PM	132	Ready mix	Yes	Gauradaha Municipality
6	Building foundation pcc	Sarbottam	7:58 AM	10:02 AM	124	Manual	No	Arjundhara Municipality
7	RCC raft at industry	Jagadamba	1:35 PM	2:09 PM	39	Mechanical	No	Mechinagar Municipality
8	RCC slab of building	Maruti	8:15 AM	9:43 AM	88	Manual	No	Arjundhara Municipality
9	Plum concrete wall at riverside	Maruti	3:12 PM	5:30 PM	138	Manual	No	Arjundhara Municipality
10	Piling for bridge	Jagadamba	10:40 AM	10:47 AM	7	Mechanical	Yes	Shivasatakchhi Municipality
11	Concrete block casting	Shivam	1:28 PM	3:30 PM	122	Manual	No	Buddhashanti Rural Municipality

Discussion

The casting delay was mainly observed in manual mixing and in case of ready mix concrete. Use of plasticizer has been found to be used in case of ready mix concrete which help to maintain even in case of delayed casting but in ordinary works of manual type, more time elapsed cases has been observed which resulted in loss of workability and strength. While accessing the concrete handling behavior in field , use of plasticizer has been found to be used in case of ready mix concrete which helps to maintain workability even in case of delayed casting but in ordinary works of manual type, more time elapsed cases has been observed which results loss of workability and strength.

Conclusion

The casting delay is mainly observed in manual mixing and in case of ready mix concrete. Use of plasticizer has been found to be used in case of ready mix concrete which helps to maintain workability even in case of delayed casting but in ordinary works of manual type, more time elapsed cases has been observed which results loss of workability and strength. Casting should be ensured within initial setting time .use of plasticizer has not been found to be used in case of ready mix concrete which helps to maintain workability even in case of delayed casting but in ordinary works of manual type, more time elapsed cases has been observed which results loss of workability and strength. Since every cement has its unique setting time, it should be determined for each lot of supply before commencement of concrete based construction activities.Mechanical mixing should be preferred to manual mixing for homogeneous mixing as well as to prevent delay in casting. During operation of concrete

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casting, no casting delay is expected. Placing it as soon as feasible is the best practice. If an unanticipated delay occurred, this study attempted to measure the variance in concrete compressive strength.

Recommendations for Further Study

- To identify the optimum time between mixing and placing of concrete to achieve target strength under different condition.
- To study the effect of casting delay on the compressive strength of M20 grade concrete and so on.
- Its recommended to conduct similar research by using retarding chemicals.
- The variation of compressive strength beyond the initial setting time is yet to be studied.
- The study is based on only one type of cement; similar study can be done with different brands of OPC cement as well as PPC cement. Also, experiments in this research were carried out with a fixed mix ratio and fix ingredient properties. On a broader scale, similar research may be undertaken, making the aforementioned criteria variable.

Author Contributions

The first author conducted the experiment under the supervision of second author. The second author wrote the paper and completed the research as per regulatory guidelines of Madan Bhandari Memorial Academy Nepal.

Conflict of Interest

The research team will take overall responsibility of guaranteeing that the dignity, rights to know, decisions of taking part in interview, safety & Security, privacy, confidentiality, right to know the result & wellbeing of the research participants under the guideline of Nepal Tathyanka Act 2015.

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