Review Paper on Effect of Retempering on Concerete

Swanand S Durgade
Department of Civil Engineering
JSPM's Rajarshi Shahu College of Engineering, Tathawadae Pune, Maharashtra, India

Pruthvi G Gayki
Department of Civil Engineering
JSPM's Rajarshi Shahu College of Engineering, Tathawadae Pune, Maharashtra, India

Gaurav L Kasbe
Department of Civil Engineering
JSPM's Rajarshi Shahu College of Engineering, Tathawadae Pune, Maharashtra, India

Kartik D Salunkhe
Department of Civil Engineering
JSPM's Rajarshi Shahu College of Engineering, Tathawadae Pune, Maharashtra, India

Amrutraj D. Patil
Assistant Prof., Department of Civil Engineering
JSPM's Rajarshi Shahu College of Engineering, Tathawadae Pune, Maharashtra, India

Abstract - Retempering is the process of changing the consistency of a concrete mixture by adding water and remixing. As it is common to send the concrete to the placement site with slightly less water than the maximum that may be used, it is expected that a specified amount of water can be added if necessary. The contractor may add the water because the mixture arrives at the site in a condition that would make placement and finishing difficult.

Keywords: Retempering, Remixing

I. INTRODUCTION

Retempering is defined by ACI 116 as "Addition of water and remixing of concrete or mortar which has lost enough workability to become unplaceable or unsaleable". Concrete industries and, especially, ready-mixed concrete industries, are faced with a common problem known as casting delay, which usually results in a considerable loss of workability, so that concrete may be unworkable. Delay in the production and delivery of ready-mixed concrete is inevitable, which is influenced by the location of construction sites in relation to the central batching plant and traffic conditions on the route. On the other hand, improper methods of handling, lack of site organization, work scheduling and breakdown of equipment are some other causes of unexpected long delays. Retempering of concrete with water, superplasticizers or a combination of both, are the most common variants for resolving slump loss of concrete. However it is well-known that retempering with water alone results in a substantial strength loss, since extra water increases the water to cement ratio of the concrete mixture. Concrete often arrives on site more than half an hour after initial mixing. Placement operations can take anywhere from 10 to 60 minutes, depending on the field conditions and the size of the load. When the slump decreases to an unacceptable level during the operations, water is added to the mix and, very often, experienced field inspectors will tolerate what can be termed 'reasonable' retempering, i.e., enough to increase slump by 50 or 60 mm.

The main objective of this study is to provide the resident engineer with guidelines for retempering practices for concrete used in construction applications. These recommendations are meant to supplement presently used guidelines and specifications for the placement of concrete. The research presented is intended to address the most commonly observed properties of concrete which determine its quality, including fresh and hardened states.

II. LITERATURE REVIEW

Effect of Retempering on Compressive Strength of ready- mixed concrete in Hot-dry Environment.

Author: A.M. Alhozaimy

A.M. Alhozaimy studied the effect of retempering on the workability and strength of ready-mixed concrete (RMC) in hot-dry environments was investigated. This study covered 12 construction sites with concrete delivered by 11 different RMC suppliers. The results indicate that the reduction in strength due to water addition is proportional to the associated increase in slump. In cases where water was added to restore the slump to the specification's limits (100 ± 25 mm), the reduction of strength was below 10%.However, when water was added to increase slump beyond these limits, the reduction of strength may be as high as 35%. The study shows the change in slump can be used to predict reduction of strength due to jobsite water additions when practical considerations preclude accurate determination of the w/c ratio. The objective of this study was to examine the adverse effects of adding water to the RMC at construction sites during the hot-dry summer months and its impact on the compressive strength. Physical properties of fresh concrete (slump and temperature), along with the 28-day compressive strength of hardened concrete, are measured for samples taken from the delivery truck immediately upon arrival to the construction site and later during the discharging operation. The addition of water, if any, is documented.

Effects of retempering methods on the compressive strength and water permeability of concrete.

Author: J. Sobhani, M. Najimi, A.R. Pourkhorshidi

J. Sobhani et al studied the effects of retempering with melamine sulphonate naphthalene-based superplasticizer (RS)water (RW) and withhold water (RWW) on the compressive strength and water permeability (WP) of concrete, are experimentally investigated. The results of this study indicated that the compressive strength of concrete retempered with superplasticizer and withhold water, enhanced by increasing the delay in casting, while retempering with water, resulted in a substantial decrease.

Retempering of concrete with water, superplasticizers or a combination of both, are the most common variants for resolving slump loss of concrete. However it is well-known that retempering with water alone results in a substantial strength loss, since extra water increases the water to cement ratio of the concrete mixture. In the case of readymixed concrete, when concrete is observed at the delivery point to have a lower-than-specified workability, there may be one or more of three possible reasons (a) Insufficient water batched initially; (b) a higher rate of evaporation (or absorption by aggregate) than anticipated; and (c) a higher rate of hydration than expected. Based on established research, the retempering water added to offset reduction in workability, due to reasons (a) or (b), will not result in strength reduction, whereas extra water to combat (c) will result in a lower strength, due to some increase in the water to cement ratio. On the other hand, retempering with a superplasticizer would be beneficial in terms of the strength loss experienced Although the research work of Kirca et al showed less loss of strength compared with untempered concrete mixtures, the Erdogdu experimentation showed some development in compressive strength by retempering with superplasticizers. In addition to the aforementioned methods, retempering with withhold water is a promising method that is rarely investigated.

Fundamental properties of concrete with cement dispersing agent for retempering.

Author: K. Tokuhashi, M. Shoya, M. Aba, T. Kamata, D. Mito

K. Tokuhashi et al studied the properties of freshly mixed concrete with CDA were examined by the slump test, air content test, bleeding test and test correspondingly applied by using vibrating table-type consistency meter. Then, the mechanical properties, the micro structure, compressive strength and the resistance to the frost action of hardened concrete with CDA were also investigated to examine the applicability of CDA.

In recent years, the various types of chemical admixture have been developed, with emphasis on
making the high performance concrete such as high strength concrete, highly durable concrete and self-compacting concrete. There has been strong concern about enhancing factors to lower the durability of many existing concrete

structures. Especially in Japan, one of the reasons is believed to be due to the insufficient practice in placing and compaction of fleshly mixed concrete. Therefore, the technique to improve the workability of concrete will be very important to secure the performance in service life of concrete structures.
The authors have developed one kind of cement dispersing agent for retempering of concrete, denoted as "CDA" with a new concept that this type of agent has the function not only to improve the performance on vibrating compaction of fresh concrete, but also to increase the resistance of segregation of concrete, due to the dispersion of cement particles and the reduction of bleeding of concrete by the addition. The CDA is negative ion type cement dispersing agent having main component of Polyester fiber. The efficacy of CDA is attracted by the dosage of a bit of agent (0.5g ～1.0g/m3).
In this study, the properties of freshly mixed concrete with CDA were examined by the slump test, air content test, bleeding test and test correspondingly applied by using vibrating table-type consistency meter. Then, the mechanical properties, the micro structure, compressive strength and the resistance to the frost action of hardened concrete with CDA were also investigated to examine the applicability of CDA.
Experimental study on the behavior of retempered concrete.

Author: K. Uma Shankar, K. Arun Prakash, M. Harshavardana Balaji, S. Pradeep Kumar
K.U. Shankar , K.A Prakash , M. Harshavardhana studied behavior of retempered concrete and concluded an important finding about water absorption and sorptivity property of retempered concrete and obtained a relationship between sorptivity and time , depending upon the depth of cube immersed in water. The main objective of this research work is to study the behaviour and quality of retempered concrete and making it acceptable in concrete industry which would otherwise go as waste, thus saving the man hours, money and material. To achieve the above objective the workability, near surface characteristics and strength properties of retempered concrete at different time intervals such as, after 15 min, 30 min, 45 min, 60 min, 75 min, 90 min, 105 min and 120 min are found. Concrete industries and, especially, ready-mixed concrete industries, are faced with a common problem known as casting delay, which usually results in a considerable loss of workability, so that concrete may be unworkable. Delay in the production and delivery of ready-mixed concrete is inevitable, which is influenced by the location of construction sites in relation to the central batching plant and traffic conditions on the route. On the other hand, improper methods of handling, lack of site organization, work scheduling and breakdown of equipment are some other causes of unexpected long delays. The practice of retempering is frequently performed to restore the initial slump and keep concrete workable at construction sites in order to cope with the need for expediting casting operations and reducing consolidation efforts. Retempering of concrete with water, superplasticizers or a combination of both, are the most common variants for resolving slump loss of concrete. However it is well-known that retempering with water alone results in a substantial strength loss, since extra water increases the water to cement ratio of the concrete mixture.
It has been shown that there exists a relation of the form,
$S = I/T0.5$
Where, s = sorptivity in mm/min0.5.
I = depth of water level increased by capillary action, expressed in mm.
T = time measured in minutes at which the depth determined
Retempering of Fresh concrete and its Effect on Concrete Strength.

Author: Ziad H. Abo Mustafa, Dr. Ali. S. Zregh
This paper is designed to present the results of a comprehensive investigation to study the effect of using water and super plasticizer as retempering agents on workability and compressive strength for plain and super plasticizer concrete. Experimentation showed some development in compressive strength by retempering with super plasticizers. Ziad H. Abo Mustafa et al studied the effects of using water and superplasticizer as a retempering plasticizer agent on enhancing workability and compressive strength for both plain and super plasticizer concrete. Trial sets of concrete mixes were conducted with the variations of water content, super plasticizer, and measuring their initial slumps. With passing of time for both water or super plasticizer were added and their slump were recorded. This process is repeated each 15 minutes interval upto 90 minutes. A set of cubes was taken at each time to figure out the effect of the added water or the super plasticizer on the strength. From this paper the site engineer can estimate the amount of superplasticizer that he needs to enhance his concrete workability, and he can estimate and expect the strength for his case.

Effect of Withholding mixing water and Retempering on properties of concrete.

Author: Scott M. Anderson and Ramon L. Carrasquillo
Anderson and Carrasquillo with held some portion of the initial mixing water for retempering at the job site, and examined its effects on the properties of concrete. Tests were performed to determine the effects of the amount of water withheld, the age of concrete when retempered, and the cement content on the slump, air content, unit weight, compressive strength, flexural strength, abrasion resistance, and freeze/thaw resistance of concrete. The results of this study indicated that, although strength was not affected when water was withheld, the durability indexes were adversely affected.
Compressive strength was determined using 6 in. by 12-in. cylinders tested using a 600-kip testing machine. Unbonded enoprene caps were used in lieu of the conventional sulfur mortar caps. Tests were conducted on three companion specimens at both 7 and 28 days. All cylinders were tested in accordance with ASTM C 39-81, "Standard Test Method for
Compressive Strength of Cylindrical Concrete Specimens" and Texas SDHPT procedure TEX 418-A, "Compressive Strength of Molded Concrete Cylinders".

III. CONCLUSION

Following conclusions can be drawn based on the experimentations conducted on the retempered concrete.

- Workability goes on decreasing as the retempering time increase.
- Near surface characteristics such as water absorption and sorptivity goes on increasing as the retempering time increase.
- The development of compressive strength and resistance to frost action of concrete with CDA could be judged as almost the same as those of concrete without CDA.
- The final amount of bleeding of concrete using CDA showed the decrease when water-cement ratio increased.
- Due to the inappropriate effects of retempering with water on the strength and permeability properties of concrete, it is recommended to avoid this method.
- Slump loss approximately control mix initial slump of retempered concrete versus time was the same as that of the corresponding Slump loss was found to be dependent upon level.

REFERENCES

[1] Effect of Retempering on Compressive Strength of ready- mixed concrete in Hot-dry Environment: Department of Civil Engineering, King Saud University, P.O. Box 800, Riyadh 11421, Saudi Arabia
[2] Effects of retempering methods on the compressive strength and water permeability of concrete: Building and Housing Research Center, Tehran, 13145-1696, Iran
[3] Fundamental properties of concrete with cement dispersing agent for retempering: K. Tokuhashi, Tsuruga Cement Co. Ltd., Japan M. Shoya, Hachinohe Institute of Technology, Japan M. Aba*, Hachinohe Institute of Technology, Japan T. Kamata, Taiheiyo Soil Corporation, Japan D. Mito, MM Shokai, Japan
[4] Experimental study on the behavior of retempered concrete: Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Kakkapalayam, Salem – 637 504, Tamil Nadu, India Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Kakkapalayam, Salem – 637 504, Tamil Nadu, India Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Kakkapalayam, Salem – 637 504, Tamil Nadu, India Assistant Professor, Department of Civil Engineering, Knowledge Institute of Technology, Kakkapalayam, Salem – 637 504, Tamil Nadu, India