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CONSIDERATIONS REGARDING THE EVOLUTION OF THE CONCRETE'S QUALITY IN THE PREPARATION, TRANSPORT AND PLACEMENT COMPLEX PROCESS

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Abstract: *In this paper were analysed the realization of the concrete mixture and of the concrete elements by conditions variability that are contributing to the final quality of the studied material (physico – mechanical characteristics of the hardened concrete. The aim is to analyse, in the future and by statistical databases, the proportions of the main factors that are negatively influencing the final quality of the hardened concrete and of the structural elements from the reinforced concrete engineering buildings main structures, function on the methods of fresh concrete's preparation, transport, placement and treatment after casting. It have to certificated which is the maxim negative influence that the specified factors can have on the restrictions imposed at the age of days on the concrete.*

Key words: *quality, concrete, variability, samples, preparation.*

1. Introduction

In the present paper is analysed the quality of the fresh concrete mixture and concrete elements realization is analysed basing on the conditions that are concurring to the final quality of the studied material (physico – mechanical characteristics of the hardened concrete). See: [11]. The study is starting from the realization in the laboratory of the concrete mixture and then it is compared with the physico – mechanical characteristics of the hardened concrete realized in concrete plants, respectively on the construction site (in situ), in different conditions of transport, placement and treatment of the fresh material.

In the picture bellow (Figure 1) is presented a scheme where we try to highlight the most important factors that can lead to the decrease of the hardened concrete's quality in the preparation, transport, placing and treatment of the fresh material steps.

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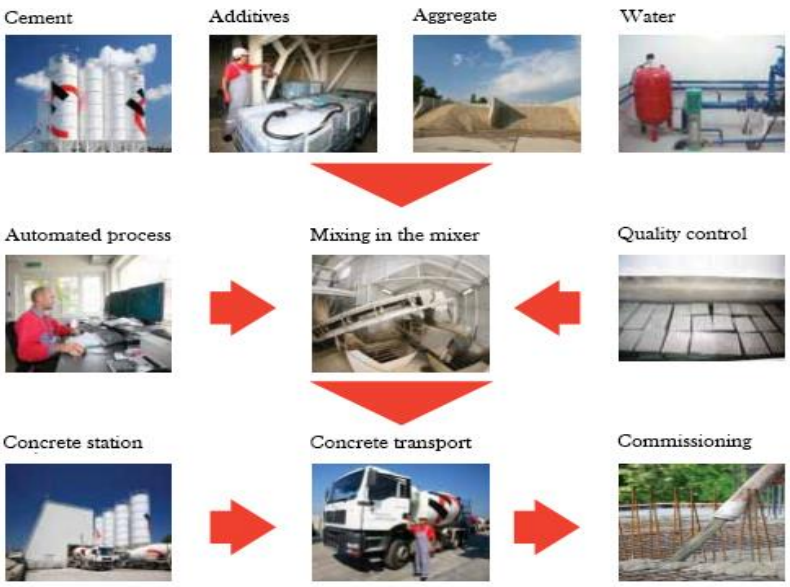

Fig. 1. *Preparation in concrete plants, transport to construction site*

2. Research Methodology

For each researched step „Errors" will be highlighted that can be made and that must be avoided, all the involved factors in the production process must be known. Consciousness of the human factor on the importance of respecting the quality / precision of the obtaining process of a „conform concrete", is long-lasting, according to some procedures that have to be as „clear". See: [5].

2.1. Concrete's Preparation

The concrete is produced in centralized plants, in most of the cases, based on the receipts drafted by a specialized laboratory, certificated and respecting the quality requirements.

In order to establish the receipts the requirements of the NE 012/2012 are respected, the specific granularity curves of the aggregates of the concrete plant, task books drafted by the designer of a theme and the results of the preliminary testing on samples preserved in standard conditions. For concrete preparation in plants are used: cement and aggregates delivered by the certificated provider, each transport being accompanied by the quality certificate of the material. For each concrete plant a responsible person must be named, who has the necessary qualification for the concrete production control, has to know the specific requirements and can prove this issue.

The employed personnel for concrete production control must be involved in a continuous specialized training program, must have knowledge about the control and concrete testing ("the training must be done not more at three years or any time is considered to be necessary") (see Figure2).

Fig. 2. *Aggregates for concretes*

The components for concrete preparation must be verified: the aggregates have nor to contain impurities, the chosen granularity curve to be according to the required concrete class, the humidity periodically must be verified function of the meteorological conditions, the cement must have quality certificates from the producer, to be stored separately function of the quality, the water must be clean from the public resources, not from other unverified sources. The involved personnel must be made aware on the produced material's importance that are ensuring the strengths of the future structures. The manufacturing procedures must be clear, sure, easy to apply by all the involved factors.

The laboratory personnel from the concrete plants must collect probes from the fresh concrete, with the necessary frequency, function on the delivered concrete amount, prepared classes and component materials amount (especially: cement, aggregate, additives).

Actions must be taken to ensure the concrete's temperature according to the Standard and the Task book for the cold or warm season. The amount of the mixing water must periodically corrected, as well, function of the influence of the aggregates humidity.

2.2. Concrete's Transport

From all the plants, the concrete is transported with auto concrete mixers that will mix continuously the concrete, from the moment of the charging to discharging, in the construction sites, in tippers of the crane or in the bunker of the concrete pumps. The transport duration will be of maxim 60 minutes for an environment temperature of 15-30°C and 90 minutes at a maxim temperature of 15°C. The transport is accompanied by a standard form, transportation vouchers that must have all the identification dates for the concrete class, producing hour, if it contains or not additives, number of the charge.

2.3. Concrete's Casting

At casting the concrete has to fulfil the following conditions:

- To preserve its homogeneity, to not present segregation;
- The concrete's temperature to be between +5°C and +25°C. In some special cases the temperature can be up to maxim 30°C with the designer's written agreement for elements having widths lower than 1.5 m;
- The concrete's workability S3/S4 (5-11 cm slump)

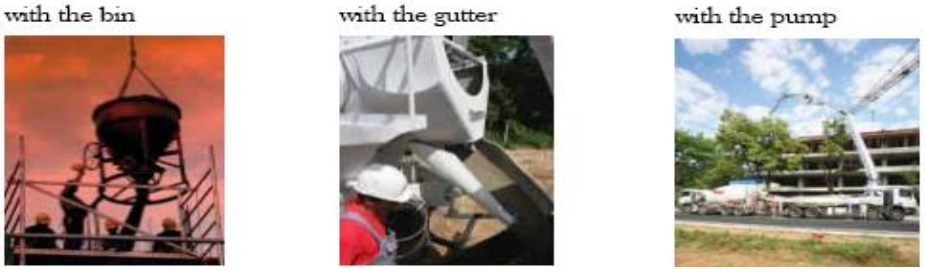

Fig. 3. *Casting methods*

In Figure 3. some concretes casting methods are illustrated.

If the concrete that is brought to the casting place does not fulfil these conditions will be refused. Only the improvement of the workability by using of a superplasticizer additive is allowed according to the NE 012/2014, V3.2 annex and the Task books (Table 1).

Maxim auto concrete mixers transport duration Table 1

Concrete mixture's temperature (^{0}C)	Maxim transport duration (minutes)	
	Cement class 32.5	Cement class 42.5
$10^0C < t^0C < 30^0C$	50	35
$T < 10\ ^0C$	70	50

Generally is recommended that the fresh concrete's temperature, before casting, to be between (5-30) °C.

In the cases of concretes presenting temperatures greater than 30°C, supplementary measures are necessary for using of an appropriate technology for preparation, transport, placing and concrete treatment by using of some setting delayer additives etc.

In the case of transport with auto concrete mixers, the duration is reduced, in case of great temperatures, with 15 minutes from the limits presented in table 1.

During the entire casting the concrete laboratory staff will perform testing and determinations on the fresh concrete at the preparation place and at the placing place, as well, and will collect probes for hardened concrete testing according to NE 012/2014 and the Task books, where the probes frequency is specified.

The dates must be registered in the concretes recording book, events book and in the case when on the construction site different additives are used, the amount, mixing time and additive type must be specified as well. It is strongly recommended to avoid such of situations.

2.4. Concrete Probes

The probes that are collected in the concrete plants directly from the mean of transportation (auto mixing machine) after its complete charging, by discharging of an amount of concrete at least equal to three times the probes volume. They are preserved in standard conditions and tested at 3, 7 or 28 days. Through these probes the concrete's conformity for charging in the mean of transport is verified. The samples collected at the

placing point of the concrete after discharging from the auto mixing machine from three different points or from discharging from the auto mixing machine, from the flood that is flowing on the gutter, at three different intervals (beginning, middle and end of the discharging) or from three different points (but at least one collection from each dipper) in the case when the discharging is performed in dippers. They are preserved in standard conditions at the casting place, if required conditions exist, or in the construction site laboratory. The sampling by collecting and the concrete's conformity criterions are constituting probes are used for determination of the concrete's strength class from the building. These probes are tested at 3, 7 or 28 days, as well. The compression strength is determined by applying of an uniform increasing load on cubic and cylindrical samples or on prism end, cores resulted from the bending tensile strength testing. For testing mechanical or hydraulic testing machines are used having 1% accuracy, who's maxim adopted operating force have to be at most eight times the fracture force of the samples that are subjected to testing. The load transmission is performed by two metallic platens meaning to transmit uniform and centric the load. The probes that are collected in different execution steps (called phase control probes) are preserved in building conditions and tested at the required terms for each case. an example is the determination of the aging degree of the concrete at a certain moment, to know if it can be demoulded, or in the case of prestressed concrete to realize the prestressing transmission on the concrete, or if it is exposed to frost (if it fulfils the frost condition). See: [9].

The vibration compacting of the samples can be realize in construction site laboratories or specialized laboratories by vibration tables or by with pervibrators. The vibration compacting of the samples can be performed only on concretes having a T0, T1, T2 workability. The operation is considered finished when the concrete's surface becomes horizontal and the fine mortar comes at the surface and air bubbles don't go out.

2.5. Concrete's Treatment after Casting

The concrete's after casting is important and is in function of the atmospheric conditions and exposure conditions of the element where the casting was performed. It is important to be transmitted from the concrete plant to the construction site if additives are used, to know the concrete's temperatures and other factors to be taken into account at casting, See: [6].

The treatment methods on cold conditions: the heat conservation method consists in protection of the concrete elements with thermal isolation materials up to the concrete exceeds the critical strength, warm air heating method, preserving of the casted elements in heated spaces method etc.

3. Main Findings and Interpretation

3.1. Errors in Concrete's Preparation

The using of the aggregates from feldspatic or shisteous rocks in concretes preparation represents an execution error being contraindicated because these don't have the necessary strength and may unbind or disaggregate when subjected to different loads, See: [2].

The use of the aggregates that present strongly variable humidity (especially at sand) without correcting of the water amount in concretes receipts is leading to a decrease of the final strength of the hardened concrete. Any sand excess, especially of imperfect

granularity (too fine) is requiring the increase of the water / cement ratio, is reducing the apparent density of the fresh concrete and is increasing the drying shrinkage, so of the cracking tendency, See: [2].

The using at concrete mixing of the water that contains greater amounts of sulphates and chlorides than those are required in the Standards and the use of the water that contains impurities leads to consequences that favour the corrosion of the steel reinforcements, phenomenons of concrete's corrosion and are reducing the adhesion of the cement milk on the aggregates. For example: the use of sea water, pumped from the rivers water, lakes etc.

The altered cement that is stored for a longer period, that due to the physical and chemical instability, is reacting as easy with water and the carbon dioxide from the air as it is finer milled. The cement granules adhere to each other and are beginning to form agglomerations and if the storage is delayed in unfavourable conditions the agglomerations get hardening.

The utilization of other cement classes or cements with admixtures leads to modifications of the final characteristics of the hardened concrete.

The concrete's preparation error, to great water / cement ratio – that consists in the increase of the water amount. In this case, the mixing water excess is moving to the exterior and is leading to open capillarity towards the concrete's surface, so obtaining an inappropriate compactness, See: [3]. As well, a reduced concrete consistency in the case of unsealed frameworks, leads to the loose of the fine part of the aggregate, so to segregation and microcracking.

3.2. Errors in Concrete's Transportation

The exceeding of the maxim transportation durations with auto mixing machines, auto dumper and the stop of the dumps spinning leads to the modification of the fresh concrete's composition. The preserve directly on the sun rays, in summer, at very high temperatures can lead to an inappropriate concrete.

3.3. Errors in Concrete's Casting

The air that remains in the concrete, the false air, as a consequence of an inappropriate compacting leads to a uniform structure of the hardened concrete. To prevent this negative phenomenon, in the fresh concrete's mass, is recommended, next to a good compacting the use of some air entraining additives.

The placing of the concrete with the shovel or casting from great heights represents a wrong way for the concrete's placing. The concrete's segregation is an aggregate agglomeration; in some places these remain unbounded on the cement stone. The segregated concrete is no more homogeneous and from this reason its strength is significantly affected. More, in the segregation zones the reinforcement is not protected and will be subjected to corrosion. The segregations that are not deep can be relative easy to repair. The affected zone is removed with the granulating hammer and a cement mortar plastering will be realized. If the segregation is extended in deep, the affected concrete will be removed with the drill and, in certain conditions, the demolition and realization again of the concrete elements can be necessary, See: [4]

"The concrete is to virtuous nd is not flowing. We add more water!" unfortunately often used expression by the workers on the construction site and represents an usually error

and that has a major influence on the strength which the concrete from buildings can reach.

The concrete's hardening, in fact of the cement paste represents a chemical reaction, any supplementary water amount cannot be used in this reaction but will be part in the concrete's mass. The excess water that is added, without to measure the excess, will lead to a porous concrete having lower strengths than was required and taken into account to the entire building's strength, strength that is computed by the designer.

The incorrect or no vibration of the concrete - the vibration has an important role in reaching of some appropriate strengths of the hardened concrete. By vibration, the existing air the concrete's mass is eliminated, producing the separation of the cement paste from the aggregates and finally, leading to segregations, See: [7],[10]

Most of the times, the quality of the casted and finished concrete depends on the workers qualification, their seriousness, experience and, not at least the leak of the specific equipment for casting.

3.4. Errors for Concrete Probes

The incorrect collecting of the probe, the incorrect manual vibration, their preserving in inappropriate conditions and incorrect transport (impact of the probes, throwing from heights etc.) can lead to unconformity results. See: [8].

3.5. Errors in Treatment of the Concrete after Casting

At placing of the concrete without an application of some protection measures and treatment for heat weather, the error is the leak of treatment by aspersion with water of the fresh casted element's surface that leads to the loss of the concrete's water, having negative consequences on the concrete's quality (cracks are appearing), See: [1]. For cold weather the existing and released heat at casting must be conserved, that leads the concrete's frost, process that has great negative consequences for quality.

4. Conclusions and Contributions

This study propose to analyse in the future and by statistic base the share of the main factors that are negatively influencing the final quality of the hardened concrete, respectively of the structural elements from the reinforced concrete main structure of the engineering buildings, function of the preparation mode, transport, placing and treatment after fresh concrete's casting.

By the results from this study we wish to attract the attention to those involve in the execution process of the concrete elements, of the buildings and engineering buildings, which are the most important factors that need more attention, significant impact factors on the mechanical characteristics of the hardened concrete.

For further research will be studied the influence of the following factors:

- The influence of the different humidity of the aggregates used for concretes preparation;
- The transport duration (for 60 minutes and 150 minutes, at 20^0C);
- The influence of the leak of fresh cast concrete's treatment in summer, at temperatures above 30^0C, directly in the sun rays.

Will be analysed for two concrete classes, C16/20 and C40/50 and more types of construction elements (columns, beams, foundations having the cross section of 100 x 100 cm, two thin surface elements – plates having 12 cm width, the influence of the three factors, beside the standard final strength of the cast elements with the two certain classes.

At the end of the research a map of the control of process and influence on the hardened concrete will be obtained.

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