Available online at www.sciencedirect.com

ScienceDirect

Procedia Technology 22 (2016) 133 – 138

Procedia Technology

9th International Conference Interdisciplinarity in Engineering, INTER-ENG 2015, 8-9 October 2015, Tirgu-Mures, Romania

Assessment of the Mechanical Strengths of the Concretes from the Joints Between the Precasted Wall Panels Subjected on Dissolving – Levigation Corrosion

Livia Ingrid Diaconu[a,*], Diana Plian[a]

[a]"Gheorghe Asachi" Technical University of Iaşi, Faculty of Civil Engineering and Building Services, Bd. Prof. dr. doc. Dimitrie Mangeron 1, 700050 Iaşi, Romania

Abstract

The proposed testing technology joins the advanced research technologies and allows the development of the concretes technologies for other working conditions. The assessment of the mechanical characteristics of the concrete from the joints cannot be realized by usual procedures (ultrasounds, recoil etc.). The mechanical strengths from the concrete wall panels' joints represents an important issue for the experts. In the concrete from the panels joints the type I corrosion process is occurring as a consequence of the sweat because the most of the times the joints represent thermal bridges. The corrosion process represents the single responsible for the concrete's from the joints structural modifications, removing the gelivity degradation idea because the necessary optimal humidity of this process is not realized.

Peer-review under responsibility of the "Petru Maior" University of Tirgu Mures, Faculty of Engineering

Keywords: precasted wall panel; structure; joints; corrosion; dissolving – levigation.

1. Motivation

During the review period the of the precasted concrete wall panels joints behaviour from a block of flats, action determined by cold weather electro thermal treatment of the concrete from the ground floor, a modification of some

* Corresponding author. Tel.: +4-072-370-6898;
E-mail address: liviagroll@yahoo.com

Peer-review under responsibility of the "Petru Maior" University of Tirgu Mures, Faculty of Engineering
doi:10.1016/j.protcy.2016.01.021

concrete's physical characteristics can be observed. The modifications are related to pH, water absorption at normal temperature and pressure, apparent porosity respectively.

The evolution of the concrete's mechanical characteristics from the joints can not be achieved with custom procedures (ultrasonic, recoil etc.). Mechanical strengths of the joints between the precasted wall panels is important for buildings technical expertise [1, 2, 3].

The paper aim is to perform researches regarding the assessment of the evolution in time of the hardened concrete's mechanical strengths.

2. Research methodology

Under similar conditions, determinations of the concrete's characteristics from the joints were performed with the ones obtained in the laboratory on accelerated treated samples [4, 5].

Evolution of water absorption at normal temperature and pressure on samples from the joints and the on samples obtained in the laboratory allows a comparison in time of the structure and the characteristics of the two types of concrete. For the same water absorption, the age of the concrete from the laboratory is specified and the of the joints concrete is estimated. Having the equivalent age, the cubic strength obtained in the laboratory will be accepted for this. The results obtained by mathematical processing allows the assessment in time, during the entire life of the mechanical strengths [6].

Observations on the concrete from joints allow to conclude the followings:

- The humidity from the outer joints is greater than the normal one (equilibrium) and can be explained by the condensed water vapours.
- The modification in the entire volume of the pH is due to a corrosion process with softened water, resulted from the condensed water vapours.
- The possible mechanical strengths evaluated in the laboratory can be explained by the calcium hydroxide's dissolving by the unhardened water [7, 8].
- The possible mechanical strengths of the concrete from joints are not explained by the gelivity because the water saturation is not reached [9].

3. Determination realizing

3.1. Determination on the concrete from joints

Determinations were carried out on probes taken at intervals of years from the thermal untreated joints concrete. The following characteristics were determined [10, 11, 12]: volumic mass in dry state, water absorption at normal temperature and pressure, the apparent porosity was computed and the time evolution of the water absorption.

Based on these results was computed the percentual increase of the water absorption that is presented in the tables and the figure below and represents the main determination criterion of the possible age of the joints concrete instead the known age of the concrete from the samples subjected to corrosion.

3.2. Laboratory determinations on the concrete mixture

A concrete mixture similar with the studied concrete from the joints was designed [13].

Utilized materials

The concrete mixture was realized according to the actual Standards respecting the quality requirements for the component materials [14, 15, 16, 17].

- Cement - CEM I 42,5 R type cement similar with the concrete that was used at the joints was used.
- Mineral aggregates - washed and sorted pit aggregate was used.
- No additives were used for the concrete's preparation.
- The water introduced in the mixture is potable.

Table1. Concrete receipt for $1m^3$

Mixture	Cement	Water	Aggregate 1982 kg						
			0-0,25	0,25-0,5	0,5-1	1-2	2-4	4-8	8-16
A_0	260	130	160	240	240	201	279	392	470

Table 2. Fresh concrete characteristics

Volumic mass Kg/mc	Slump cm
2380	S3

Table 3. Hardened concrete characteristics

Volumic mass Kg/m^3	Permeability (mm)	Compression strength N/mm^2
2350	P_6^{10}	25,4

3.3. Samples testing method

Cubic samples having a 14,2 cm side were realized that were preserved up to 28 days in mixed conditions, 7 days in water and up to 28 days in laboratory conditions.

After the age of 28 days the samples were preserved in the tanks from the wet chamber that allows maintaining a 20^0C temperature and an 80% relative humidity. The samples were immersed to be 1 cm covered with distilled water.

Monthly the distilled water was changed studying its pH, so the corrosion conditions to be constant.

At equal three months multiple time intervals, the following determinations were effectuated:

- Volumic mass for a equilibrium humidity of 4-5% similar with the joints concrete;
- On the samples used for the volumic mass's determination the compression strength;
- On the cubic fragments that were obtained by splitting test the water absorption at normal temperature and pressure was determined to obtain an average value from the concrete sample volume and with this will be computed the percentual variation of the water absorption.

Table 4.

Samples age (months)	0	3	6	9	12	15	18	21	24
Volumic mass (kg/m^3)	2350	2350	2347	2344	2340	2337	2332	2330	2327
Compression strength (N/mm^2)	25,4	24,90	24,4	24,0	23,5	23,04	22,51	22,14	22,0

The results are presented in the Table 5 and in the plot from fig.1.

Table 5. Water absorbtion variation

Age (months)	Water absorbtion variation (%)
0	0
3	0,89
6	2,24
9	4
12	5,05
15	5,64
18	5,8
21	5,92
24	6,06

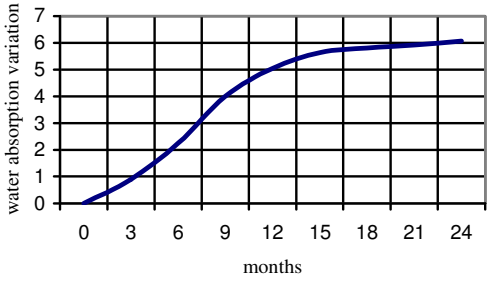


Fig. 1. Percentual increase in time (month) of the water absorption on samples

4. Experimental results processing

Based on the percentual variation curve of the water absorption (Fig. 1 and Fig.2) the equivalent age of the joints concrete was determined for known ages on laboratory samples.

The equivalent age was determined according to the water absorption's variation in the two types of concretes for known intervals on laboratory concrete samples.

Having the equivalent age of the joints concrete was considered that the strength obtained on cubes is the same with the joints concrete because the same structural modifications were occur.

The variation curve of the mechanical strengths in time was plotted by mathematical processing and their evolution up to 70 years (Fig.4).

Table 6. Water absorption variation

Age (years)	Water absorption variation (%)
0	0
2	0
4	2,37
6	3,89
8	4,73
10	5
12	5,1
15	5,2

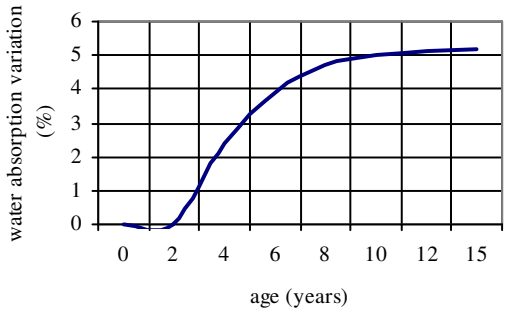
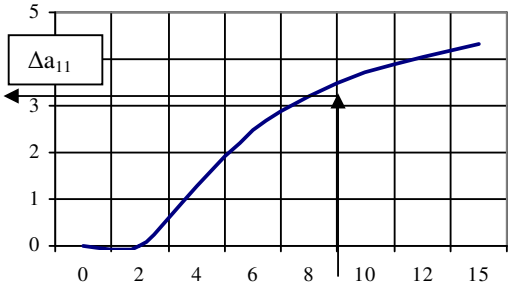
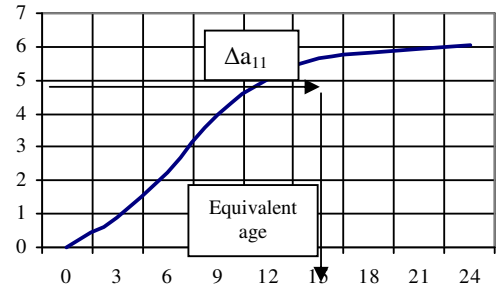


Fig. 2. Percentual increase in time (month) of the water absorbtion in joints



Determination of the percentual increse of the water absorption (Δa_{11}) for a knownage on samples



Determination of the equivalent age of the concrete from joints for the same percentual increase of the water absorption (Δa_{11})

Fig. 3. Determination of the age equivalence between the concrete from samples and the concrete from joints

It was considered that the concrete strength determined on samples is the same with the concrete from joints at the equivalent age. The results are presented in the following table:

Table 7. Determined concrete strength

Concrete's age determined on samples (months)	Compression strength (N/mm^2)	Water absorption variation on samples (%)	Equivalent age for the water absorption variation for the same value of the water absorption determined on samples (years)	Probable compression strength for the equivalent age (N/mm^2)
0	25.4	0	0	25.4
3	24.90	0.89	2.8	24.90
6	24.4	2.24	4.9	24.4
9	24.0	4	6.80	24.0
12	23.5	5.05	8.94	23.5
15	23.04	5.64	10.92	23.04
18	22.51	5.8	12.84	22.51
21	22.14	5.92	15.30	22.14
24	22.00	6.06	-	22.00

The diagram of the compression strength variation for the ages of the concrete from laboratory samples was plotted and the strengths variation of the concrete from joints was estimated for the same water absorption and equivalent age.

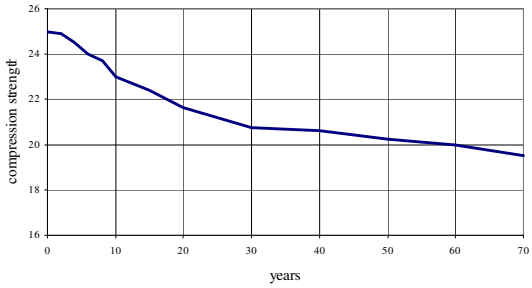


Fig. 4. The diagram of the compression strength variation for the ages of the concrete from joints

5. Conclusions

- Design of a methodology for the modifications determination on the entire life time of the concretes from the panels (70 years) by laboratory testing in an acceptable period.
- By mathematical processing of the experimental results was plotted a modification curve of the panels joints concrete's compression strength.
- The obtained experimental results can be used for tacking decisions regarding the behavior of the realized panel structures.
- The methodology can be extended for other types of concretes for the construction elements where the usual procedures can't be applied.

References

[1] *** Contract nr.4150 din 14.05.2013-Expertiză tehnică , Blocul G4, Intrarea Bârsei nr.7, sector 3 București. Cod proiect 4150-140513-RET 1949
[2] *** Contract nr.4150 din 14.05.2013-Expertiză tehnică , Blocul 8,str. Gura Ialomiței nr.7, sector 3 București. Cod proiect 4150-140513-RET 1931
[3]*** Contract nr.4150 din 14.05.2013-Expertiză tehnică , Blocul M12, Intrarea Bârsei nr.2, sector 3 București. Cod proiect 4150-140513-RET 1923
[4] Diaconu L. I., Plian D., Methodology regarding the assesment in time of some concretes mechanical characteristics supposed on dissolving – levigation corrosion , Buletinul Institutului Politehnic Iași, Tomul LXI (LXV), Fasc.1, Secția Construcții și Arhitectură 2015.
[5] Plian D., Diaconu L. I., Acceleration process of concrete's disolving – levigation corrosion , Buletinul Institutului Politehnic Iași, Tomul LXI (LXV), Fasc.1, ISSN 2068-4762, 2015, Secția Construcții și Arhitectură.
[6] Lepadatu D., Barbuță M. , Judele L., Mitroi R., Ilas A. Mechanical characteristic prediction on polymer concrete with silica fume using artificial neural network, pp: 235-242, Proceedings of 14th SGEM GeoConference on Nano, Bio And Green – Technologies For A Sustainable Future, June 19-25, Vol. 2, 2014.
[7] Neville A. M., Proprietățile betonului - București : Editura Tehnică, 2003. - Vol. IV
[8] Oneț T., Durabilitatea betonului armat, Editura Tehnică, București, 1994
[9] Popescu P., Degradarea construcțiilor [Carte]. - [s.l.] : Editura Fundației Românie de Mâine, 2002.
[10] ***SR EN 12390-1:2002, SR EN 12390-1:2002/AC:2006 Încercare pe beton întărit. Partea1: Formă, dimensiuni și alte condiții pentru epruvete și tipare.
[11]***SR EN 12390-2:2009 Încercare pe beton întărit. Partea 2: Pregătirea și păstrarea epruvetelor pentru încercări de rezistență.
[12] ***SR EN 12390-3: 2009 Încercare pe beton întărit. Partea 3: Rezistența la compresiune a epruvetelor.
[13] Ionescu I. și Ispas T., Proprietățile și tehnologia betoanelor . - București : Editura Tehnică, 1997
[14] *** NE 012/2-2010 Normativ pentru producerea și executarea lucrărilor din beton, beton armat și beton precomprimat-Partea 2: Executarea lucrărilor din beton.
[15] ***SR EN 197-1:2002, SR EN 197-1/A1:2004, SR EN 197-1/A3:2007 ciment, Partea 1: Compoziție, specificații și criterii de conformitate ale cimenturilor uzuale.
[16] ***SR EN 206-1:2002 Beton. Partea 1: Specificație, performanță, producție și conformitate.
[17] ***SR 13510:2006 Beton. Partea 1: Specificație, performanță, producție și conformitate. Document național de aplicare a SR EN 206-1.
[18] ***SR EN 12350-2:2003 Încercare pe beton proaspăt. Partea 2: Încercarea de tasare.