ADHESION GYPSUM PLASTER TO THE SURFACE OF PREFABRICATED CONCRETE ELEMENTS LIGHTWEIGHT AGGREGATE

Albina Eletchih

Technical University of Moldova

SUMMARY
Introduction. The problem delamination of plaster of concrete surfaces. Picture of damage and especially lightweight concrete elements. Consideration of possible factors affecting the adhesive properties of the plaster on the surface of light concrete element. The research results. Studies by electron microscopy. X-ray analysis. Chemical analysis. Drying process. Conclusion.

Keywords: *Gypsum plaster, prefabricated concrete elements, adhesion, lightweight aggregate, delamination of plaster, linear deformations, loss of weight, X-ray diffraction.*

1. Introduction

Interior plaster walls and ceilings of the premises carried out under production finishing of buildings and structures in order to provide thermal insulation, hygienic and aesthetic requirements. Thus gypsum plaster compared to possess numerous other advantages. A significant advantage is their ability, because of their physical properties, regulate temperature and humidity conditions of premises and thus providing them a comfortable atmosphere. Plaster on the basis of gypsum binders have good workability, quickly harden and dry. Furthermore, they contribute to improving the fire resistance of structures.

Gypsum plaster can be applied to almost all surfaces (substrate):

- concrete;
- masonry ceramic and silicate bricks, porous concrete;
- lightweight building board of wood wool;
- slab of hard foam.

With 60s plastering produced mainly by machine using dry plaster mixtures. Smooth concrete surface, no doubt, considered the most difficult to carry out plastering work. To prevent the formation of defects and to achieve the best adhesion of the adhesive to the substrate for approximately 20 years in the construction of the special polymer is used for surface primer.

Despite the rich experience of many years of painting and decorating, and to this day is often the peel gypsum plasters from concrete surfaces. It is particularly difficult and problematic are surface precast lightweight aggregate, which are used in the construction industry for over 10 years. Expanded porous fillers to slow the drying of concrete and thereby cause high residual moisture content (about 15%) finished lightweight concrete elements. Recently (about 5 years), there is a slight increase in the accident rate facilities built with the use of such building elements. Based on the foregoing within the work presented here, the goal was set - to find out what can be caused by damage to the plaster layer of this kind.

2. Painting damage and features lightweight concrete elements

Flaking plaster is usually after 2-6 months after application. In this hollow space formed between the surface of the concrete and plaster layer thickness up to 80 mm. Width of the wall is 3-6 meters. Finished concrete elements for lightweight aggregate do not dry out completely over the years. Their residual humidity of 3 years after production is about 10% (an initial moisture of 15-20%). Thus there is a significant moisture gradient between the interior and exterior of the concrete elements that almost does not depend on the nature of the wall surface (rough or smooth).

Fundamentally possible factors affecting the adhesion of gypsum plaster on the surface of light concrete elements:

• Humidity
shrinkage of lightweight concrete;
transfer of alkalis;
recrystallization of gypsum (decreased adhesion);
formation of ettringite;
formation of syngenite;
later hydration of anhydrite II.

• The surface roughness production technology carbonization

• The alkalinity of cement recrystallization of gypsum needles later hydration of anhydrite II formation of syngenite.

Since different manufacturers plaster mixtures and polymer coats faced with the above problem, it must be assumed that the reason lies not only in the quality of materials. Moreover, this problem is also referred to the cement, and different suppliers for the production of concrete elements.

A valid reason can not be, and surface roughness, as damaging as are found on smooth and rough on the concrete elements.

Obviously, the thickness of the plaster, too, plays a minor role. Damage to occur as a thick (12 mm) and thin layer (3 mm) of the plaster.

Also follow facing plaster surface can not have a significant effect on the formation of these defects. The lesions were marked as after facing (wallpaper, disperse dyes), and the unlined gypsum plaster.

3. Research results

During the study, a total set of samples was studied plaster, loose particles from the surface of lightweight concrete elements.

Studies by electron microscopy

Research results of the sample of plaster thickness of 3 mm by electron microscopy (ESEM) suggests changes in the crystal structure of calcium sulfate dihydrate. In the area close to the concrete matrix plaster changed (Fig. 1).

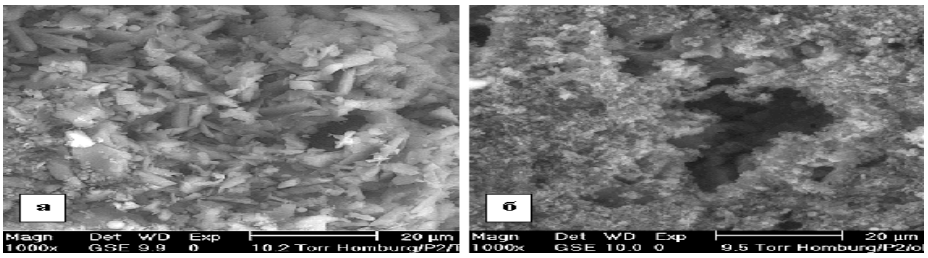

Fig. 1 Results of studies by electron microscopy (ESEM):
a) gypsum plaster (no change)
b) the gypsum plaster in the region close to the concrete

The results of electron microbeam analysis (ESMA) indicate significant accumulation of alkali in contact with the concrete zone (K-peak), the concentration of which decreases exponentially with distance from the border with concrete towards the outer surface of the plaster (Fig. 2).

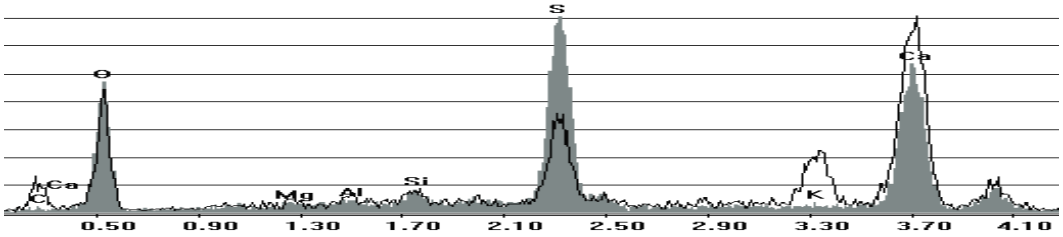

Fig. 2 Results electron microbeam analysis (ESMA):
gray area – gypsum plaster (no change);
limited black area - gypsum plaster in contact with the concrete area.

X-ray diffraction analysis

Results of the analysis of 3 various samples of plaster showed absence ettringite and syngenite. Anhydrite II was observed in 2 cases. The content of anhydrite II above in plaster in a zone close to the concrete (Fig. 3).

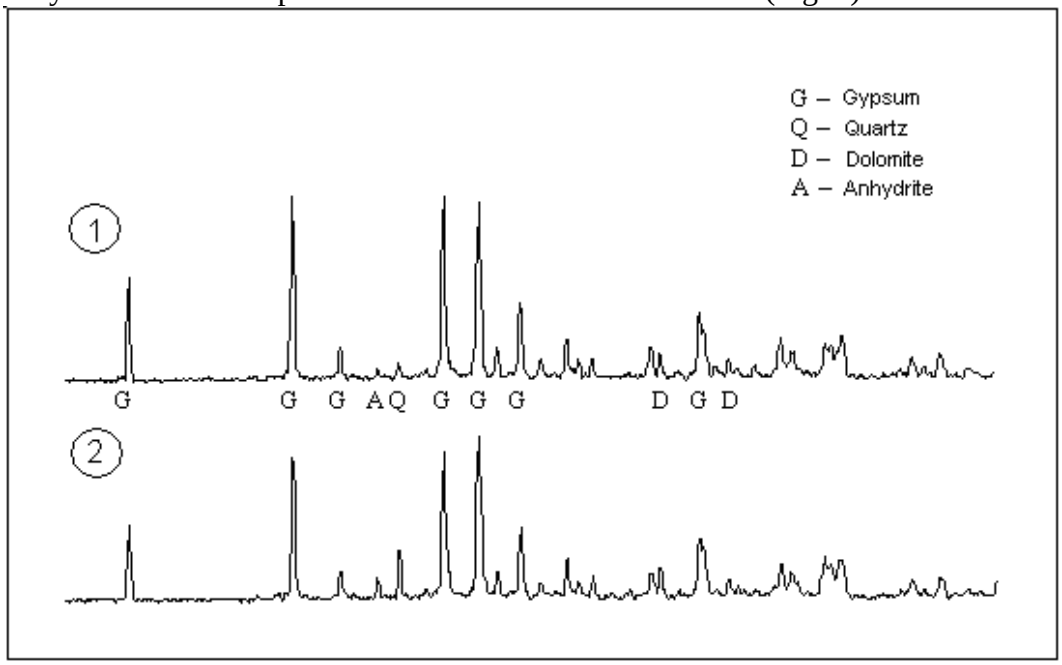

Fig. 3 Results of X-ray analysis:
1) upper curve - the outer side of plaster;
2) lower curve - the inner side of plaster (near concrete).

Chemical analysis

Chemical analysis of the components of the concrete gives the following information about the alkali content, (%):

	K_2O [%]
Liapor (1995)	0,01 ... 0,03
Liapor (2000)	0,04 ... 0,06
cement 1 (Saarland)	0,26
cement 2 (B.-W.)	0,98
sand (B.-W.)	0,00
surface of cement stone in concrete elements (without lining)	0,80
surface of cement stone in concrete elements (contact area with flaking stucco)	2,06

Drying Process

In the measurement of linear deformations of the concrete beam was set in a substantial shrinkage of the drying phase. Differences linear deformations in the cross section of the concrete member (from the outer to the inner surface) can lead to the bending surface and internal stresses in the layer interface with plaster (Fig.4).

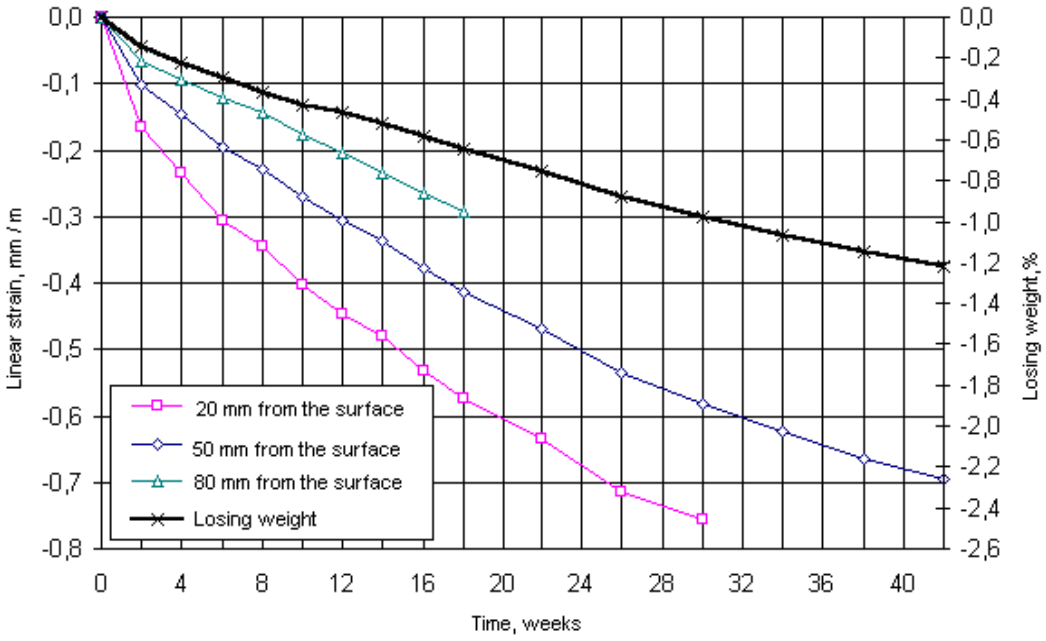

Fig. 4 Development linear deformations (measured at various distances from the surface) of the beam and loss of weight during the drying process (at 20°C and 65% relative humidity)

4. Conclusion

Concrete elements for the manufacture of lightweight aggregate after different high humidity. The drying process lasts for years, leading to a significant decrease in volume (shrinkage) of concrete elements and bending of the surface. For this reason, the boundary of the concrete plaster having a relatively high internal stresses.

On the other hand, the transition of water from the concrete in gypsum stucco plaster promotes recrystallization, which may adversely affect the adhesive bond strength. Furthermore, as a result of accumulation of moisture transfer occurs at the interface between the alkali-gypsum concrete. It also causes

recrystallization. Local increase in the rate of hydration of anhydrite plaster component (expansion process) has been detected.

Consequently, reducing the adhesion of plaster to a concrete surface due to many factors. Under unfavorable combination thereof resulting force will exceed the adhesive bond that leads to the destruction of the plaster layer.

Danger of this kind can be reduced, especially by reducing the moisture content of the concrete. Further studies should provide an answer to the question of whether to increase the adhesion of plaster to concrete by increasing the roughness of the concrete surface, reducing the alkali content and changing the composition of gypsum plaster.

Bibliography

1. C28/C28M-10 - Standard Specification for Gypsum Plasters
2. http://www.lkmportal.com/enc/adgeziya
3. http://xn----7sbavvbytmdcfed3e.com/article/tekhnologiya-shtukaturki-sten.html
4. http://sekretgipsa.com/
5. http://share.sekretgipsa.com/knigi-ebook/knigi-gips/
6. http://www.bca.gov.sg/publications/enhancementseries/others/chapter5.pdf
7. http://www.nrmca.org/aboutconcrete/cips/36p.pdf
8. http://en.wikipedia.org/wiki/Precast_concrete
9. http://www.heberger.com/en/services/precast-concrete-elements/index.html