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The effect of the addition of granite powder on the adhesion subsurface properties of cementitious floors

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Introduction

The production of cement itself, as the basic component of concretes and mortars, also has an undesirable impact on the environment. During the production of 1 tonne of this material approx. Therefore, partial replacement of cement with another component may contribute to reduction of CO^2 emission into the atmosphere. Therefore, actions are being taken to reduce this emission. The simplest way may seem to reduce the amount of cement in composites, but it is necessary to replace the cement defect with another restorative material. This treatment is being used extensively with materials such as fly ash, silica dust, slag or lime powder.
Researchers are also working on expanding the range of additives to include a wide range of industrial waste materials, such as carpet waste fibers, palm oil fuel ash, rice husk ash, banana fibers, wood ash, crushed glass or granite powder.
Such solutions make it possible not only to limit CO^2 emissions by reducing the cement content in the mixes, but also to find a use for industrial waste, the disposal of which is often costly and labor-intensive. In order to test the validity of replacing cement with it, floor mortars were made with different contents of granite powder. The cement floor mortars themselves should meet two essential conditions. The condition of pull-off strength of the surface layer f_h min. 1,0 MPa, and compressive strength f_c minimum 20,0MPa. Thus, the pull-off adhesion strength and Schmidt hammer compression strength were tested on the samples made.

Study description

Study on the effect of granite powder addition to cementitious floor mortars:

I. Cement mortar underlays with different amounts of granite powder addition were prepared.
II. A criterion of curing the specimens under air-dry conditions and under humid conditions for 28 days was introduced. The specifications of the conditions are shown in Table 1.
III. Pull-off strength of the subsurface layer, ultrasonic tests, and Schmidt hammer compressive strength tests were performed.
IV. Tests were performed after 56 days.

Four specimens of cement mortar cured in air and four specimens cured in humid curing conditions were tested.

Table 1. Curing conditions used for research series.

Curing conditions	Temperature (°C)	Humidity (%)
air-dry (AIR)	18 ± 3	50 ± 5
humid (WET)	23 ± 3	85 ± 5

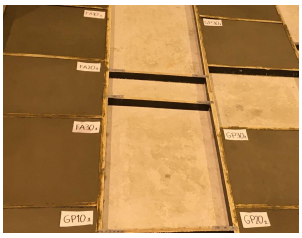

Fig.1 Prepared samples.

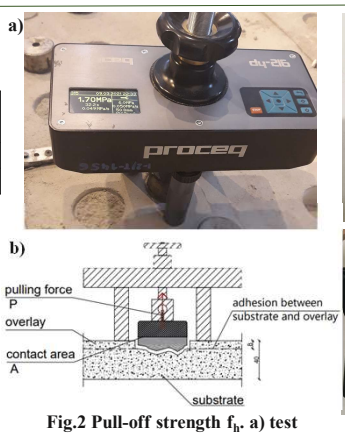

Fig.2 Pull-off strength f_h. a) test device, b) test in cross-section

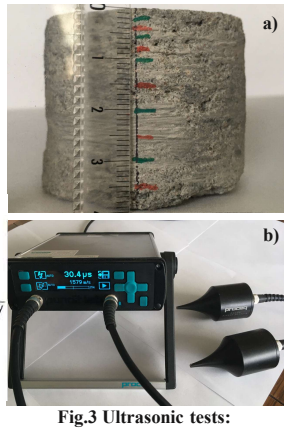

Fig.3 Ultrasonic tests: a) test sample, b) test device.

Results

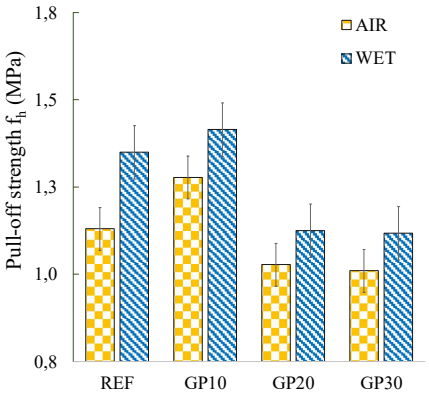

Fig.4 Average pull-off strength f_h of the subsurface layer.

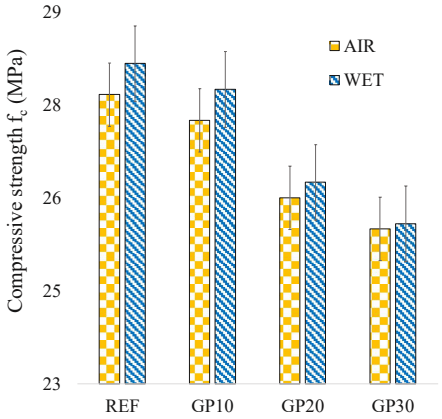

Fig.5 Average compressive strength f_c of the subsurface layer.

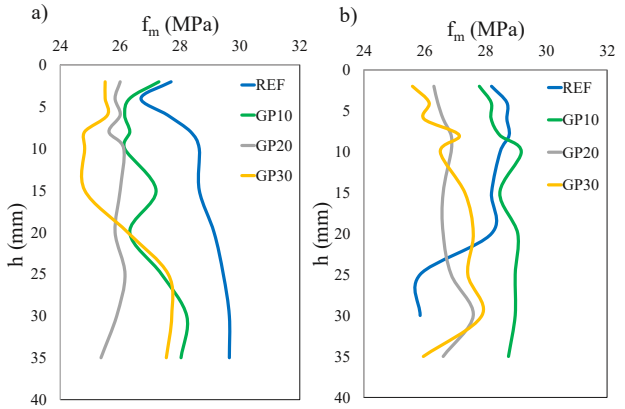

Fig.6 Calculated Compressive strength relative to sample height for mortar: a) air-cured overlays, b) humid-cured overlays

Conclusions

- The results obtained indicate that it is possible to replace 10% of the cement in the overlays with granite powder, thus improving the pull-off strength by about 13%.
- The environmental impact of the building sector can be reduced by reducing the amount of cement used.
- By changing the curing conditions of cementitious primers from air-dry to wet, the pull-off strength of the surface layer can be increased (up to 42% for sample GP20).
- Replacing cement with up to 30% granite powder ensures that the requirements for cementitious overlay are complied with. (minimum f_h = 1,0MPa; minimum f_c = 20,0MPa).
- The granite powder SCM provides significant cost and environmental benefits while maintaining the required mechanical properties of the subfloor

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