Spesialiseringsprosjekt i Master Bygg

Tittel:

The material properties of concretecontaining colour pigments

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Introduction, Soscial perspective and theroy

How the material properties of concrete are affected by iron oxides is presented in this report. Concrete is a widely used construction material and by adding pigments, the visual possibilities will be diverse. It can also provide sustainable opportunities by limiting the use of materials in construction, for example having exposed pigmented concrete as the facade. Concrete is a composite material. Inorganic pigments are staining particles, insoluble in water, and the chemical stability is ideal for concrete use.

Research question

How will the addition of colour pigments impact the mechanical properties of the concrete?

- How will the percentage of colour pigment affect the intensity of the coloured concrete in thesurface and inside?
- How will the added colour pigments and water content influence the slump of the concretemixture?
- How will the added colour pigments and water content influence compressive strength after7 and 28 days?
- How will the added colour pigments and water content influence elasticity of concrete after28 days?
- Will the colour be consistent trough the concrete?

Delimitations

- Adding 1%, 5%, and 10% colour pigments by weight of cement into the cement.
- Water content will be consistent through the addition of pigments.

Case and Materials

Kyrö distillery in Finland is a coloured concrete building

Figure 1 Kyrö destillery in Finland

Material used in the experiment:

- Cement
- Concrete aggregate
- Acrylic polymer: Dynamon sx-23
- Pigment: red iron oxide from Sika
- Water

Metod

The report's results are based on a literature study and laboratory experiments. The laboratory experiments conducted; slump test, compressive strength test, density, the elasticity of concrete, with the addition of 1%, 5%, and 10% pigment by weight of cement. 4 sets of tests were cast, in each set, there were between 1-4 mixes. The water-cement ratio was constant within each set so that these samples could be compared. The experiments were carried out in accordance with norwegian standards

Figure 2 a) Slump test of E1, b) Slump test of E10

Result and Discussion

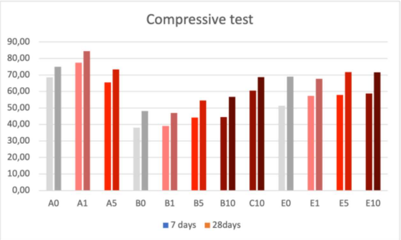

Figure 3 compressive test of all mixes

	Initial E-modulus	Stabilazed E-modulus	unit
A0	35,68	38,77	GPa
A1	40,19	44,30	GPa
C10	35,84	39,89	GPa
E0	34,01	37,32	GPa
E10	33,74	36,94	GPa

Table 1 E-modulus of concrete samples

The slump of the concrete mixture decreases with the increase of pigment content. Indicating that water needs to be added to increase the flow, but this will decrease the compressive strength of the concrete. The literature research is in accordance with the test results and they compensated with water. The results from set A, show that it is possible to increase the compressive strength, but the water content needs to be constant. some of the pigment did not mix properly making the concrete sample spotty.

Figure 4 a) concrete samples, b) overview of the average density of the concrete, c) overview of the average density of the concrete

Conclusion

Both water and pigment content affect the colour of the concrete. There was a difference between 1% and 5% pigments, but not between 5% and 10%. The slump of the concrete mixture decreases with the increase of pigment content. The compressive strength of the concrete will increase with the addition of piments, but only if the water content stays constant. Water weakens the ´glue´ of the concrete, so by adding extra water the e-modulus decreases. When water content stays constant the e-modulus increases to a certain point with an increase in pigment content, see e-modulus E0 and E10.

The colour is stronger and more consistent on the inside compared to the outside. The outside colour is uneven, and some samples show lime efflorescence.