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MICROSTRUCTURE IN MORTAR

a summary of a new project of research

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BACKGROUND

Research and development within the field of render and masonry is based in principal on emperical studies. With todays fast development, foremost concerning the technique in rendering and bricklaying is this not satisfactory.

One current example is the use of new mechanical equipment which gives an extension of the "working-season" to in principal a whole year. The new mechanical equipment place a totaly different demand on the quality of the mortar in fresh condition. As example on new demands can be mentioned that the mixing-time in some cases are down to 10 seconds and that the mortar should be pumped for a long distance. In order to handle these demands modifies the mortar for instance through different additives. Problems of today can be solved this way. But what are the consequences in a long view? Which are the long-term effects of for example a large additive of air-entraining substances, which only partially has developed airpores during the mixture? How will the aircontent be affected of different subsections during the work? Will a concentration of airpores occur in the adhesive-zon or at the surface? Will an unfavourable shape and distribution occur of the airpores?

Through direct measures of certain qualities, for example adhesive and strenght, can some studies be done on the effect. These measures will not give any answers on the question WHY? A certain aircontent in the fresh mortar can give totaly different consequences depending on how the airpores indicates and how they are distributed. In order to answer the question why, and consequently simplify the procedure of development, the structure of the mortar must be studied.

The same procedure is applied for when different phenomenon and damages shall be explained. In a previous project of research it was indicated that the abilety of suction in the background had a vital importance for the quality of the rendering. Within this project was a great variety of measures done. Studies on the structure should most probably brought an essential smaller inset of work, at the same time as considerable more conclusions would have appeared.

Even in the case of surface coating and degradation of surfaces, both concerning the surface coating itself as well as the material just below the surface, studies of the structure will be necessary. How will the structure be influenced by for example frost and salts during the degradation? Where will potential salts be enriched?

OBJECT

The aim of the project is to study how different FACTORS influences the STRUCTURE and how the structure influences the QUALITIES of material and combinations of material within the field of render and masonry. The basic thought is to with basis of the structure analysis be able to forsee the different qualities and consequences, especially effects in a long view.

By qualification of a certain quality of a material, for example frost-resistant, is an indirect parameter often studied, for example suctionrate. Structure analysis provide in many cases a possibility to study the parameter, for example poreshape, which decide directly a certain quality. This is a great assistance in developments of new material or adjustment of old material to new environments. Time-demanding measures of different qualities would partly be unnecessary. Further an amount of "negative emperical experience" most probably can be avoided.

APPLICATION AREA OF USE

A wide future application area of use for structure analysis could be found in the renovation area. Methods of reparation are today often chosen by routine.
An interesting framing of the question is if structure analysis of existing rendering can give an excellent ground of judgement when choises of suitable surfaces are done in connection with a renovation.

Lately has questions of durability been brought to focus. Analysis of service-life has been introduced increasingly also within the construction industry. It is necessary to be familiar with how different factors influences the quality of the material to be able to calculate the service-life of the material.

A third application area of use are analysis of damages. If the connection between factors and qualities are familiar, could a structure analysis on the damaged material give valuable information of which factors are "the villain of the piece".

METHOD OF WORK

The project ground itself solely on microscope studies. With todays modern image analysis equipment there are great possibilities for very extensive analysis. The only limitaion is the preparation of the samples. Thin-sections will prevadingly be used at microanalysis.

The project will be carried through gradually. During the first stage will microscope, image analysis equipment and preparation equipment be obtained.In connection with this will basic general education concerning service and operation also take place. This stage is almost carried through. Image analysis methodology as well as groundface and thin-section technology has already been used within other projects. Further has contacts with other researchers been bound within the field of micro analysis, partly through participation in seminaries and partly through personal contacts.

The second stage imply a specialization within the field of structure analysis on masonry material. The analysis will in principal concern system of air-entraining agents in mortar. The aim in this stage is to build competence on preparation of samples, interpretation of microscope images and administration of image analysis equipment. Experience from other Nordic laboratories shall be gathered at the same time as any possible future cooperation will be discussed. The own analysis will be carried through using specimens that are considered having "good" or "bad" pore-structures.
This will be used on both old "well-documented" material and newly produced samples. The old samples can be decended from cases of damage and previous project of research. The new samples will be produced so that they have essential different pore-structures.

The third stage commences with systematic studies of how different factors influences the structure and how it influences different qualities.
The "structure influencing" factors which mainly shall be studied are:

- air-entraining agents in mortar
- suction in the background at the moment of rendering/bricklaying
- frost-load on mortar and brick

The "structure dependant" qualities which mainly shall be determind are:

- frost-resistant
- strenght
- adhesion

By proceeding from a basic mortar without additives and then add different types of air-entraining agents should a multiplicity of pore-structures be obtained.

Tests on aircontent and poresizedistribution condition are done on every newly mixed mortars. When the specimens has hardened (4-5 weeks) accomplishes a test of strength and a test of frost-resistance. At last will thin-sections be produced which will be analysed in a microscope with automatic image analysis.

With consideration to that the project partly has the character "search and find" will further detail planning not be meaningfull. Most probably will new approaches and extensions appear. Decision about detail accomplishment of the various stages and eventuell adjustments of the aiming will be decided by time with coordination with a to the project tide reference-group.