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Datum 13.05.2004
Ue/Di-F 807
(f-807-kb-engl-ue.doc)

SHORT REPORT

F 807

Rationalisation Potential by the Application of Self-Compacting Concrete in the Precast Element Plant
Z 6-5.4-01.16/II 13-800101-16

1 AIM OF THE RESEARCH PROJECT

The application of a Self-Compacting Concrete (SCC) in a precast element plant can entail advances regarding the production technique. Building components with a complex geometric structure can be manufactured in one single working process and the concrete quality of the building members no longer depends on the compacting work. The surface of the concrete (exposed concrete) and the quality of the concrete covering layer (density) are generally improved by the application of a SCC. The production process is rationalised because the compacting is no longer necessary. Moreover, the application of SCC decisively reduces the noise level during the production process and the working conditions of the staff are considerably improved. Thus, the application of a SCC enables an efficient manufacturing of precast elements of a high quality. The question, however, remains open to what extent the production of concrete precast elements can be rationalised by the application of a SCC and to what extent this application is economic. A shorter production period, lower costs of the form work, the personnel costs, the energy and the machines are generally opposed to the higher costs of the raw materials for the SCC. Therefore, this research project aims to demonstrate the rationalising potential resulting from the application of a SCC when producing prefabricated elements of reinforced concrete.

2 INVESTIGATIONS

Within the scope of this research project, a comprehensive examination is conducted regarding the rationalising potential of SCC applied in a precast element plant. To this end, the production costs depending on the design of the SCC (powder type, viscosity agent type and combination type) are calculated and compared to the production costs of comparable vibrated concretes. When calculating the cost-reducing potential not only the production process of the building components is of importance. Moreover, the extent to which the hardened concrete properties of a SCC change (as there are the compression strength, the tensile strength, the Young´s modulus, the creep and shrinkage as well as the bond properties) in comparison to vibrated concrete. A change of these characteristics can entail a change of the design of the precast elements, which directly influences the costs. During the entire research project, the above-mentioned aspects were considered integrally.

In order to examine the changed production process, in a precast element plant data was gathered to deduct characteristic values for the production costs. With the resulting data model calculations were conducted to determine a possible cost-reducing potential for special building components in direct comparison of vibrated concrete with SCC.

3 SUMMARY OF THE RESULTS

The references in the literature, which were to be the basis of working on this research project, varied widely. Nearly all of the literature references regarding this subject emphasised the higher material costs when applying a SCC in comparison with vibrated concrete. These additional costs are mostly opposed to the savings due to the lower personnel costs and the reduced production times. At present there is no consideration of the complete influences resulting from the application of SCC. Only single influences are examined and compared. The comparisons relating to certain building components described in the literature clearly show that the influences resulting from the geometry of the building components, the casting method or the mix proportion are too substantial in order not to be taken into consideration when assessing the rationalising potential. Therefore, during this research project a process comparison regarding the building component was conducted between vibrated concrete and SCC.

The results of the characterisation of the hardened concrete properties of the examined SCCs showed no differences to vibrated concretes of the same strength. When applying a SCC of the same strength class instead of a vibrated concrete, no rising costs due to changed durability or changed mechanical properties are to be expected.

In a precast element plant data are collected in order to establish guiding values concerning the working time and subsequently they are valuated by means of a systematic multi- moment survey. A guiding value for the working time needed to cast a flat-spread building component could be determined. To establish a guiding value for a wall-like building component, data for a first approach were collected and evaluated. It became evident that the costs of casting a SCC were, as it was to be expected, considerably lower than those of casting a vibrated concrete.

In order to create a model of assessment, input parameters were determined. The basis of this model is formed by the characterization of the developed SCC designs as well as the data collected in the precast element plant. To this end, the results of the hardened concrete tests of the developed SCC-designs were used to design the model building components. For the indeterminable input parameters of the assessment model estimations were made to enable a comprehensive approach.

To determine the rationalising potentials, case studies were conducted by means of the developed calculation model. The results are saving potentials which depend on different parameters. In this case, the main parameters are the mix proportion and the respective costs of materials. The concrete admixtures applied, especially the superplasticizer, have a substantial effect on the costs of material. A further parameter is the content of reinforcement. The saving potentials always depend on the mix proportions and on the load that has an impact on the building components. Another item which adds to the cost reduction is less making good of the concrete members when a functional SCC is applied. The results of the case studies also demonstrate that a general statement regarding the rationalisation potentials in a precast element plant where SCC is applied cannot be made. A general statement can only be made concerning a special building element.

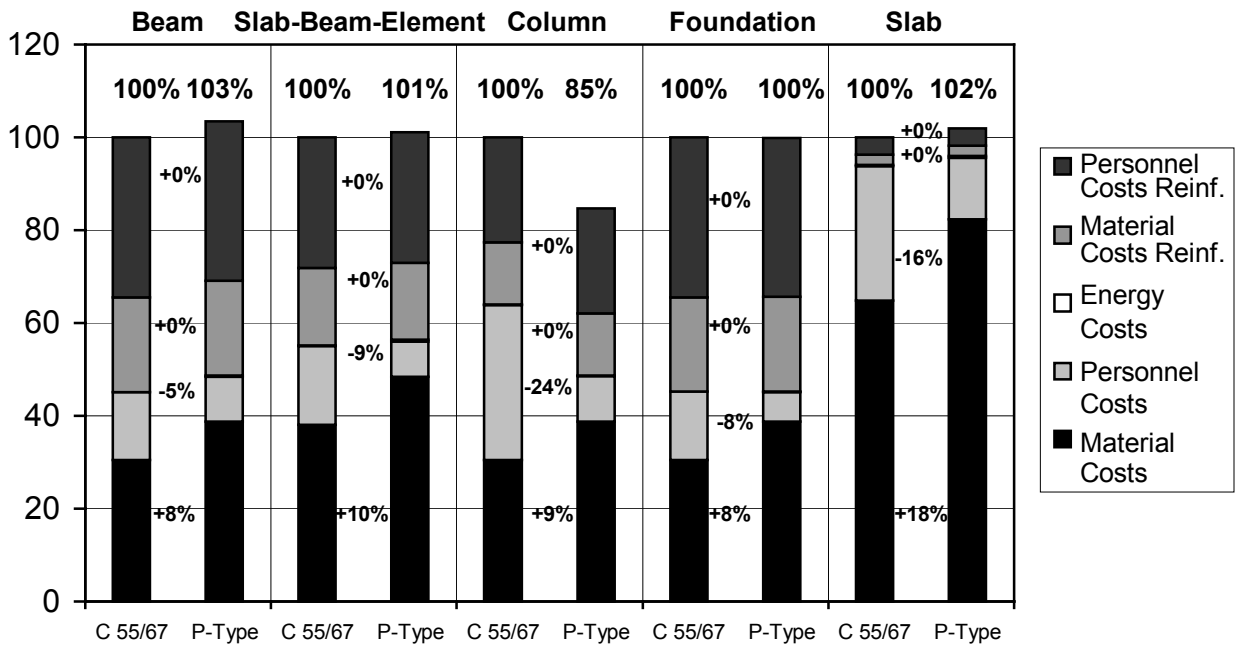

Figure 1: Change of costs in percent by application of a powder type SCC (P-Type) of the strength class C55/67 in relation to a vibrated concrete of the same strength (Reinf.: reinforcement)

It could be proved that there are rationalisation potentials when SCC is applied in a precast element plant. Thus, no higher production costs will occur when a powder type SCC is applied instead of a vibrated concrete of the same strength (see figure 1). The costs for building components requiring more manpower for the casting process could even be reduced in this case.

The so far lacking statement of a comprehensive approach could be remedied with regards to single building elements. In order to yield an optimum efficiency of the existing potentials when applying an SCC in a precast element plant, the applied production techniques as well as the process engineering must be adjusted to the requirements. Only when a precast element plant is completely readjusted, all arising rationalising potentials can be used.