At the „Institut für Massivbau“, concrete mixture designs for building structures with reduced cement content were developed. The ecological advantages were identified, using the environmental performance evaluation. At first the workability as well as the compressing strength of the concretes was tested. A compressive strength of 38 N/mm² (C25/30) was focussed. In addition, the performance regarding the carbonation of the concrete to avoid corrosion of steel rebars was analysed.

Fig. 1: Environmental performance evaluation at the base of five controlling factors related to the DIN reference concrete (normalised and weighted)

Fig. 1 shows, that even concretes with cement content lower than 125 kg/m³ were able to meet the defined strength requirements and the required slump flow of 55 cm. However, a
significant reduction in the water content, as well as addition of inert and reactive powders like limestone powder, fly ash and or a higher cement strength class was necessary to achieve this. Additionally, a higher demand of superplasticizer was required. The optimisation of the clinker volume in the mixture composition has led to a reduction of 50% in environmental impact compared with the DIN reference concrete mixture and even to a reduction of more than 65% using blast furnace cement CEM III/A.

**Fig. 2: Carbonation depth of cement reduced concretes and the DIN reference concrete**

The progress of carbonation was analysed using the accelerated carbonation test (ACC-test method) in which the carbonation depth $x_c$ is determined. The age of the concrete samples is 57 days after 28 days storage in 2% increased CO$_2$ concentration. The results show (see Fig. 2) that the carbonation depth of concretes with app. 150 kg/m³ can be equal or lower than the depth of the DIN reference concretes for exterior structures (exposure class XC4). However with the full probabilistic method, a sufficient durability for a service live of 50 years was found for all concretes with a cement content of 150 kg/m³ assuming different exterior exposure conditions.

**Keywords:** carbonisation, durability, cement reduced concrete, green concrete