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Behavior of Real Scale Beams Manufactured with Electric Arc Furnace Slag Concrete

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Abstract. We live in a consumer society that generates excessive amounts of waste. Innovative techniques to reduce these volumes of waste are therefore important lines of research in engineering. The Electric Arc Furnace steelmaking industry in the Basque Country produces almost 1% of global electric-arc-steel production. Although driving the economy, it also implies the generation of a huge amounts of waste that has to be managed within a small region. Concrete is an extensively used product, which can absorb notable amounts of Electric Arc Furnace slag but, at the moment, there are only applications for use in unreinforced concrete. In this research work, real scale concrete beams containing electric arc furnace slag concrete are manufactured, in order to study their structural behavior. Our results showed that reinforced concrete elements containing electric arc furnace slag can be safely manufactured using current design standards.

Keywords: Electric arc furnace slag · Real scale beams · Reinforced concretes · Standards

1 Introduction

Sustainability has become a recurrent topic at conferences over the past few years. Since the industrial revolution, ton upon ton of waste has been dumped throughout the world. In response to the pervasive presence of waste, not only in landfills, conceptual changes, such as the circular economy, have been devised to alter industrial practice. In consequence, as researchers and engineers, we would do well to look for solutions in which waste may be recycled rather than solutions that increase the already inevitable production of waste in industrial processes. Imprudent storage of toxic waste has led to a string of disasters, such as the Zaldibar (Basque Country) landslide where two people lost their lives and the Doñana disaster (Andalusia) that contaminated water courses with toxic mine tailings, to name but a few in Spain.

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the effect of shrinkage. Also, the experimental λ value in Table 5 showed a significantly different behavior between the P and the SC beams. It is difficult to try to explain this question by referring to the mechanical behavior of the concretes, because the strength and the elastic moduli of the concretes manufactured with cement, I and cement IV differ. The explanation of this effect could be due to the different microstructure-porosity of the SC concretes compared with the P concretes, due to the higher amount of cementitious matrix in the SC mixes.

5 Conclusions

After the result obtained in the test and its comparison with the analytical results, the following conclusions can be drawn:

- The results obtained in the four-point bending test, for evaluating the flexural behavior of the concretes, were very similar to the analytical ones, in most cases with higher experimental than analytical values.
- In the case of long-term deflection, the experimental results were lower than the analytical values. However, in this case, it was difficult to compare the results, as the beams had been kept in storage in the lab for six months before testing and any deformation due to shrinkage had not been recorded.

Summarizing, the general conclusion of this study, it appears that the design of reinforced concrete elements, manufactured with EAF slag, is possible when applying the procedures described in the EHE-08 standard. In general, safe results were obtained throughout the experimental procedure.

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