Recenzja spełnia wymogi formalne

Przewodniczący Rady Dyscypliny
Inżynieria Lądowa, Geodezja i Transport
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Review

of the doctoral dissertation of Jyoti Rashmi Nayak, M.Sc. Eng. "Analysis of impact of selected natural waste fibers and ashes on properties of mortars".

1. Formal basis for preparing the review

The basis for the preparation of the review are:

- a letter from the Dean of the Faculty of Civil Engineering of the Silesian University of Technology informing that the Council of the Discipline of Civil Engineering, Geodesy and Transport of the Silesian University of Technology appointed me as a reviewer of the doctoral thesis of Ms Jyoti Rashmi Nayak, M.Sc. Eng., entitled. "Analysis of impact of selected natural waste fibers and ashes on properties of mortars".

- Doctoral dissertation entitled: "Analysis of impact of selected natural waste fibers and ashes on properties of mortars" - Silesian University of Technology, Faculty of Civil Engineering, Department of Building Processes and Building Physics - Gliwice 2023.

2. Evaluation of the doctoral dissertation

The topic undertaken by the doctoral student is part of the current issues aimed at mitigating climate degradation. In the dissertation, the doctoral student stated that the cement industry is one of the economic branches with high energy consumption per unit of production and, consequently, with a potentially high rate of gas emissions: NO_x , SO_2 , CO_2 , CO as well as dust and heavy metals into the atmosphere. Reducing greenhouse gas emissions in the cement production process is one of the most important tasks of the cement industry.

The topic taken up by the doctoral student concerning the use of natural fibers from waste materials, such as jute and sisal, and polypropylene, as additives to biomass ash, such as rice husk ash, sugarcane bagasse ash and lime powder.

The dissertation theorised that the optimal content of these additives could have a beneficial effect on some properties. [Natural waste fibers and ashes influence on properties of mortars, both mechanical and physical, including structural features].

The dissertation is divided into two main parts: the study part and the research part, which are divided into 11 chapters containing: literature studies, presentation, analysis and discussion of results and conclusions. The first three chapters cover the

introduction, requirements for plaster and masonry mortars and literature studies. The literature studies relate to a review of published research papers on the effects of the waste additives used in the dissertation, on the physical and mechanical properties, including mortar shrinkage. Summarising the review of the current literature, the PhD student concluded that more research is needed to generate properties of natural fibers and Supplementary Cementitious Material in cement-based composites, which was the motivation for the dissertation topic.

Chapter 4 defined the aim, scope of the work and the thesis. The thesis assumed that natural waste fibers (jute and sisal) and ashes (of rice husk and sugarcane bagasse) influence on properties of mortars, both mechanical and physical, including microstructural features.[Natural waste fibers (jute and sisal) and ashes (of rice husk and sugarcane bagasse) influence on properties of mortars, both mechanical and physical, including structural features. Moreover, the optimal content of these additives may have a beneficial effect on some properties.] The author then discusses the research methods used and the materials used in the study. In the following chapters, the results and analysis of the properties of mortars with different composition modifications are provided.

In the research section, the doctoral student presented the results of the study of the effect of fibers on the properties of fresh mortar and hardened mortar. For fresh mortar, she determined changes in consistency, air content, while for hardened mortar these were changes in compressive and flexural strength and shrinkage. The study was enriched by the results of a pore structure analysis carried out on a mercury porosimeter. To obtain a characterisation of the microstructure, studies using scanning electron microscopy are included in the paper. In the next section, the PhD student presented an evaluation of the effects of replacing part of the cement with natural materials such as rice husk ash, sugarcane bagasse ash and lime powder in order to reduce the maximum cement consumption. Here, the scope of the study was similar to the previous case.

Chapter 10 draws detailed conclusions from the research carried out, in a way summarising the results obtained. All the conclusions in this chapter are fully justified in terms of content, show the essence of the investigations carried out and fully reflect the final results. In the case of investigating the impact of fibers in terms of mechanical strength, promising results were obtained with the use of jute fibers. The use of biomass ash also resulted in a beneficial effect on these properties.

The dissertation concludes with a chapter providing guidelines for further research needed to assess the suitability of natural additives that have a beneficial effect on mortar properties and can reduce cement consumption.

The doctoral student made use of 181 items of literature, the vast majority of which are no more than 10 years old, which made it possible to enrich the reviewed work with many current interesting themes.

Evaluation of the work

The literature section is thoughtful, the illustrative material has been appropriately selected.

The reviewer has no objections to this part of the work.

In the research part, the doctoral student presented the results of interesting studies, from which she drew accurate conclusions encouraging further research on the use of biomass ash and natural fibers in shaping the properties of mortars.

Comments on this part of the thesis:

In the reviewer's opinion, the properties of the additives and fibers used were not discussed sufficiently. They were mostly limited to general information that inaccurately characterised the materials used in the study. In the case of fibers, the doctoral student was limited to providing only properties such as density, elongation, Young's modulus and tensile strength. Information on fiber length was only included in section 8.1 when discussing the effect of fibers on mortar consistency.

In the literature review, the PhD student included the results of studies determining the effect of fiber geometry, i.e. its length and cross-section (research : Seongwoo Gowns [20], Sagar and Parikh [58], or S.Singh [55]) on the change of consistency or mechanical properties. In section 3.2.2.1, the author includes the statement ... In general, the surface area, length, and surface shape of the fiber influence the workability of fiber-reinforced mortar.... . In Chapter 6 there is no information on the shape, absorbability or form of these materials.

In the thesis statement (Chapter 4), the PhD student reports that she will be investigating the influence of natural waste fibers. It is the reviewer's understanding that waste fibers are textile waste and discards generated primarily in households. The reviewer, however, found no information regarding the origin of the fibers used in the study. It was not made clear whether the impact of recycled or newly sourced fibers was investigated. If they were waste fibers, how they were prepared. The lack of this information greatly limits the ability to reproduce the research.

The methods of preparing the samples for the study were very sparsely discussed. The reviewer found no information on how the mortars from which the samples were made were prepared. Chapter 7 contains only one subsection 7.1 Mix compositions of mortars. There is no information on how the fibers were introduced into the mortar. Were they previously treated in any way? Shredded? What was the method of mixing, compacting the samples, etc.? In addition, Figure 10 is included, which shows a device for mixing the materials - there is no reference to this figure in the text.

The theses made use of test methods commonly applied in mortar technology. However, a narrow scope of in-house testing using appropriate test methods was carried out. The test procedures used to assess the properties of the modified mortars do not include tests for ageing, water penetration, frost resistance, depth of carbonation, etc. The paper does not specify whether the fibers used are recycled or newly sourced fibers. Thus, the claim made in Chapter 4 that .... Natural waste

fibersand ashes influence on properties of mortars, both mechanical and physical, including structural features.... appears to be too general and the realised scope of the research does not provide a basis for its generalisation .

As the final point in the conclusions, the doctoral student has outlined a direction for further research.

The reviewer notes that the PhD student uses the terms 'waste products' and 'by-products'interchangeably. The thesis refers to waste fibers (page 36....Natural waste fibers (jute andsisal) and ashes (of rice husk and sugarcane bagasse....,), while Chapter 11 in section 2 refers to agricultural byproducts:.....agriculturalby products.... Insofar as ash from biomass combustion is a waste, is jute fiber an agricultural by-product? A byproduct is considered to be an object or substance that results from a production process, the creation of which is not the purpose of the process.

In the reviewer's opinion, the recommendations in Future perspectives, Chapter 11, should be complemented by the need to study not only the impact of newly harvested natural fibers, but also those that constitute textile waste. Studies on mechanical textile recycling processes have shown that recycled secondary fibers have deteriorated physical properties, are shortened and there is a relatively low amount of elementary fiber.

The reviewer draws attention to numerous slips of the tongue and incorrect language:

- page 1..... Faulty of Civil Engineering.....

- page 113 line 7 ....The presencepf large-diameter holes ranging from 1 to 60 m in a mortar ....,

- page 73 line 2 ....Cylinder samples with dimensions of 40x40x160mm were used for flexural test.

Unfortunate wording of chapters:

Chapter 8.5 Results on shrinkage effect of fibers - while the chapter was about "testing the effect of fiber addition on mortar shrinkage".

To quantify size, the doctoral student consistently uses the noun 'value'. Rather, the noun is used to refer to an 'amount'." The amount of money that can be received for something"

- page 93 ...the consistency value....

- page 124 .... The consistency value...., ...cement-lime samples flow values....,

- page 116 ....values of densities translate into porosity values..... (the reviewer did not understand this statement)

In mercury porosimetry, the radius of curvature of the mercury meniscus is related to the pore size. In doing so, specific pore structures are assumed. As these do not reflect the actual shape of the pores, these sizes are therefore referred to as "equivalent". The determined pore sizes are not strictly geometrical parameters as in direct methods.

3. Final conclusions

The peer-reviewed work of JyotiRashmiNayak,M.Sc. Eng., undoubtedly brings interesting and important - both from a scientific and practical point of view - information, while at the same time making a valuable contribution to the Discipline of Civil Engineering, Geodesy and Transport through the development and production of environmentally friendly and sustainable building materials without compromising important material properties.

The assessed work is an original research paper, fulfilling all the conditions for doctoral dissertations. Therefore, I request the Council of the Discipline of Civil Engineering, Geodesy and Transport at the Silesian University of Technology to admit JyotiRashmiNayak, M.Sc. Eng., to the further stage of her doctoral dissertation, which isa public defence of the thesis.

The dissertation meets the requirements of the Law of July 20, 2018. Law on Higher Education and Science (Journal of Laws 2023, item 742, as amended).

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8 march 2024 r.