



## Research Trip Summary Report

### Task 2. Foreign mobility of WUST doctoral students

#### I. Data of the doctoral student

1. Full name: ADRIAN CHAJEC
2. Year of studies: 4
3. Educational discipline: Civil Engineering, Geodesy and Transport

#### II. Foreign research trip (research visit)

1. Research institute in which the foreign research was implemented: Technical University of Delft (TU Delft)
2. Name and surname of the host person (mentor): prof. Branko Savija
3. Dates of the research trip: 1 April – 30 June 2023
4. Title and date of a seminar delivered during the research trip: Possibilities of using granite powder waste in 3D-printed cementitious composites, 13.06.2023
5. Description of work carried out during the research trip:

Thanks to the doctoral trip, the student had the opportunity to explore the possibilities of using granite powder waste in cementitious composites manufactured with the use of 3D printing method. In particular, the following tasks were performed:

- 1) Analysis of literature related to this topic.
- 2) Experimental tests were performed.
- 3) Correlations between partial replacement of cement in the mix with the addition of granite powder and its bulk density, consistency and rheology properties were checked.
- 4) Specimens were prepared and their properties (physical, mechanical and adhesive) were determined.
- 5) Samples for microstructural studies were prepared.
6. Description of the main results obtained:

The conducted experimental plan allowed to obtain satisfactory test results. In addition, the analysis of the literature led to the improvement of the previously formulated hypotheses and the refinement of the research plan. It also allowed to get acquainted with the latest trends in the technology of cement composites produced by the additive method. The results of experimental research, in turn, allowed to confirm the earlier thesis that it is possible to partially replace cement in cement composites with the use of granite powder waste in such a way that no significant decrease in the mechanical properties of the composite is observed (replacing up to 30% of cement in the mix), however, for this purpose, it is necessary to properly design the mixture and optimize its properties such as bulk density,

consistency and rheology properties. The tested solution allowed to draw conclusions that the use of granite powder waste in cementitious composites produced by the additive method allows to reduce their porosity, increase their bulk density and ensure similar mechanical and adhesive properties. The possible replacement of part of the cement with the addition of granite powder waste is considered particularly important due to the positive environmental effect of the solution used. It may allow to reduce the deposits of granite waste, while reducing the amount of cement used. Nevertheless, such use requires detailed research on the properties of the cement mix, including the optimization of its rheological properties.

7. Future collaborations (if applicable):

As part of future cooperation, one can mention the willingness to prepare a joint publication between the doctoral student and prof. Branko Savija. In addition, it is planned that next year the doctoral student (after defending his doctorate) will apply for a scholarship for Postdoctoral Fellowships in Sklodowska's Marie Curie program, where the place of research will be TU Delft.

8. Title and date of a seminar presenting the results of the trip delivered at Wrocław University of Science and Technology after returning from the research trip: Possibilities of using granite powder waste in 3D-printed cementitious composites, 13.07.2023 15:00

**III. Doctoral student's signature**

10.07.2023  
(Date)

.....  
(doctoral student's signature)

**IV. Confirmation and information from the host**

1. Confirmation of compliance of the information contained in the report: I CONFIRM / ~~DO NOT CONFIRM~~. (In justified cases, the confirmation of the host may be sent by e-mail to the Dean's Office of the Doctoral School email: [interdocschool@pwr.edu.pl](mailto:interdocschool@pwr.edu.pl))

2. Additional information and comments

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(Date)

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(signature(s) of Host)