SHORT TERM SCIENTIFIC MISSION (STSM)
SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: ECOST-STSM-Request-CA17107-47492
STSM title: Efficiency of improved Flax Textile Reinforced Mortar (Flax TRM) composite systems
STSM start and end date: 16/11/2020 **to** 13/12/2020
Grantee name: Ferrara Giuseppe

PURPOSE OF THE STSM:

The research program of the STSM is the continuation of a larger study, object of the grantee Ph.D. theses, concerning the use of flax based TRM composites (FlaxTRM) as reinforcement of masonry elements.
Specifically, the STSM represents a great chance to advance further on this research allowing to analyse innovative techniques to improve the FlaxTRM composite system. On the basis of encouraging results obtained during the Ph.D. program by investigating innovative techniques to improve the mechanical behaviour of the proposed composite systems, the mobility aims at creating an opportunity to analyse these results. Therefore, the purpose of the research, is to quantify the efficiency of the innovative improving techniques adopted. In addition, the overall aim of the STSM is to promote the dissemination of the research outcomes by the drafting of a scientific article to be submitted to an indexed journal.
Finally the STSM also aims at pursuing the cooperation between the two involved institutions (DICIV at UNISA and LMC2 at UCBL1), and at contributing to the professional growth of the grantee by strengthening his network of researchers, a fundamental aspect in view of future collaborations.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

The STSM was carried out in line with the proposed Workplan. It comprised four steps: selection of the data; analysis of the results; analysis of the results with respect to related works from literature; drafting of a scientific article.
At first available data from experimental campaigns carried out during the grantee Ph.D. program were collected. Notably, stress and strain values were taken for the plotting of the curves concerning the tensile behaviour of Flax TRMs (the sustainable composite object of study). In addition, a detailed selection of images captured during the tests were extracted and processed by means of a digital image correlation (DIC) analysis. This analysis provided information about the crack pattern of the specimens during the tests.
Secondly, a detailed analysis of the results was conducted. Several significant parameters were considered including: tensile strength, maximum tensile strain, stiffness, energy dissipated during the test, cracks' width and their distribution through the specimens' length.
The results were compared with related studies from literature. This comparison highlighted the importance of the current study, emphasizing the efficiency of the adopted improving technique.
Finally, the draft of a scientific article was prepared. It comprises un introduction with a short state of the art on the use of plant fibres in cementitious composites, emphasizing the recent scientific advancement in this field. Materials and methods adopted in the research study were shown as well. Then, the results were presented in terms of stress-strain curves representing the tensile behaviour of the studied composite system. A accurate analysis of the results was reported as well comprising: a description of the mechanical

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behaviour of the composite with respect to the presented curves; an analysis of the beneficial effect of the improving thecnique adopted, consisting in the use of short curaua fibres within the mix design of the matrix constituting the composite; the adoption of an analitical model for the evaluation of the crack opening and its cmparison with the DIC analysis; the investigation of the crack pattern and its influence on the overall composite efficiency. Finally, the main outcomes of the work were listed in the conclusion section including future perspective of the work.
A scientific journal of interest in the field of innovative construction materials in civil engineering was chosen for the publication of the article. The draft was organized according to the publication requirements of the journal, ready to get submitted.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

As expected the STSM provided interesting results concerning the use of plant fibres in cementitious composites for construction materials in civil engineering. In addition, the improving technique adopted in the study showed itself as a possible way to even improve the performance of such promising sustainalble systems. The results of the study can be summerised in three main points.
Firstly, it was showed that the use of impregnated flax textile in hydraulic lime mortar provides a TRM composite system correctly behaving as a composite material and with a mechanical response far more similar to the conventional TRM system with respect to what shown by previous related studies in which the absence of the impregnation caused a weaker tensile response.
Secondly, the addition of short curaua fibre within the matrix mortar mix design conferred to the system several beneficial aspects: a higher mean tensile stress during the cracked phase of the tensile response, a denser crack pattern, lower values of the crack openings, and a higher value of the dissipated energy during the cracked phase.
Finally, the crack pattern was investigated by adopting a simplified analytical model proposed by the researchers involved in the study. The comparison of this analysis with the Digital Image Correlation analysis confirmed the high reliability of the proposed analytical formulation for the assessment of the crack width of TRM composites subkected to tensile test.
All the results were reported and accurately discussed in a scientific article draft prepared for the submission to a prominent indexed scientific journal in the field.

FUTURE COLLABORATIONS (if applicable)

Future collaborations between the grantee and the research group at DICIV of University of Salerno are planned with respect to the study of innovative sustainable composite materials including plant fibres. Notably, the cooperation will concern the experimental investigation of the durability plant based cementitious composites, in the framework of an international RILEM commeettee specifically established with this purpose.