PhD in Civil and Environmental Engineering

Research Title: Development of products and systems for construction and infrastructure through the use of geopolymeric-type products obtained from MPS and / or extra fine waste from Construction & Demolition and stone quarries

SESSION: SUMMER 2019

Funded by	Politecnico di Torino - DISEG

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Context of the research activity	**The UN has implemented Sustainable Development Goals (SDGs) and the Paris Agreement on Climate Change**, which every Member State in the EU has fully committed to and must now fulfil. For this reason, **nearly 1 billion from Horizon 2020's final Work Programme (2018-2020) will be invested into research, innovation** and financing of projects and initiatives **that will support european circular economy ambitions.** **Construction & Demolition Waste (CDW), when measured in volume, is the largest waste stream in the EU**. Even though a vast majority of CDW is recyclable, one common hurdle to recycling and re-using C&D waste in the EU is the lack of confidence in the quality of C&D recycled materials. This guideline is aligned with European strategies for Construction sector and waste management. **On September 2018**, the European Commission published

Construction and Demolition Waste Protocol and Guidelines.
The guideline is aligned with the objectives of the Waste Framework Directive 2008/98/EC which establishes a target of 70% of CDW to be recycled by 2020. The guideline is also aligned with the Construction 2020 strategy, and the Communication on **Resource Efficiency Opportunities in the Building Sector**. **In addition**, **it forms part of the more recent and ambitious Circular Economy Package** presented by the European Commission in 20153 that includes revised legislative proposals on waste to encourage the EU's transition towards a circular economy. **In this** Circular Economy Package, **Construction and Demolition Waste is identified as a key aspect and the preliminary assessment is an essential part of construction and demolition waste management**.

On 4 March 2019, the European Commission adopted a comprehensive report on the implementation of the Circular Economy Action Plan. The report presents the main achievements under the Action Plan and sketches out future challenges to shaping our economy and paving the way towards a climate-neutral, circular economy where pressure on natural and freshwater resources as well as ecosystems is minimised.

The report identifies strategic actions and related sectors: whitin these we find **a specific area for Construction and Demolition**. The third action is related to Core indicators for the assessment of the lifecycle environmental performance of a building, and incentives for their use. The test phase, dedicated to test the usefulness and robustness of the different parts of the framework, is now ongoing and will last until summer 2019. A public consultation is foreseen early 2020.More details in:
http://ec.europa.eu/environment/circular-economy/
https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1551871245356&uri=CELEX:52019SC0090

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Similarly, the European commission has worked for the development of a **guidance document on best practices in the Extractive Waste Management, also related to citedPlans Circular Economy Action.** The guidelines are divided **into chapters, including:** 4.5 Practice 5: **Effective usage of excavated materials** .5.2 Construction minerals as marketable materials from extractive wastes
The Relevance for Circular Economy is defined as below:
Using extracted by-product or waste as construction minerals – as far as it is technically
feasible and environmentally sound – **leads to less extractive waste being generated and offsets primary production of**

	construction minerals elsewhere. *In this context the present research line proposes a training course based on consolidated synergy* ***between the high level scientific experimental Laboratories at Politecnico di Torino****: Building Systems Laboratory, Mastr.Lab,. In the general theme of The specific topic proposed according to the tutor uses the contribution of the whole research group, to the advantage of a multidisciplinary approach :* ***the role of each scientific sector is not only complementary, but is central and strongly characterizing.*** *The importance of this training growth opportunity is recognized and valid for subsequent experiences: many new graduates are now responsible for the sections Development research in high-level companies, e.g..)* **The working research group is composed, as said, of several researchers and professors of the Polytechnic, involved in similar research programs.** **In particular, several results of the research project "***RIPIETRA - PRODOTTI SOSTENIBILI PER L'EFFICIENZA ENERGETICA DEGLI EDIFICI ATTRAVERSO IL RECUPERO DI SCARTI DEL SISTEMA PRODUTTIVO LOCALE",* has filed an **international patent for the reuse of sawing sludge from the stone supply chain: (PI n° EP168015998) (PI n° 2015IT-TO04006)** The framework outlined feeds the **interest of the private partnership,** with particular reference to the construction industry and to the local stone extractive fields**. This is evidenced by the interest of specific companies in supporting the strategic research actions, like this one.**

Objectives	Within the framework outlined, **the aim of the present research program is to develop the formulation of innovative materials deriving from the reuse of secondary raw materials and extra fine waste from building debris**, for the production

	of prefabricated and / or serial building components. It may also supports chooses for GPP in contracts of Public Institutions; **The goal is aimed to recovering the existing building heritage, and to improve energy behavior, by LCA innovative materials**. The products designed will be prototyped on a laboratory scale, developed with regard to the installation systems tested for their mechanical and performance properties in general. The project is characterized by the **interest shown by some companies to participate in research actions** aimed at industrial production; these companies are particularly sensitive to the reuse of MPS and / or extra fine waste from building debris and are currently interested in investing in the circular economy. The training course, therefore, can be profiled with great relevance to the practical reality and to the relationship with the productive world. **The proposal has the aim of developing laboratory formulation of new and innovative materials, supporting and supported by a partner company,** with: - definition of the mix design; - study of the granulometric curves, for example. Development of the product will be supported in progress by parallel results of laboratory tests in order to well definition of: - mechanical characteristics; - compatibility in work; - behavior over time, through aging tests. **The research activity will take place both at the laboratories of the Politecnico and at the laboratories of the partner project Company, in order to gain the high app.** http://www.gruppomarazzato.com Starting from extra fine waste from building demolition, the main expected result is **to develop formulation of innovative materials:** **compatible and sustainable**; - useful in architectural building and in civil infrastructures construction; - suitable for production in different formulations (pre-fabricated panels, but also traditional on-site mixing); - with high mechanical characteristics; and **to obtain international patent**.
Skills and competencies for the development of the activity	**<u>General Skills:</u>** PhD students must know how to orient themselves independently to develop certain aspects of applied research. They must have good theoretical and technical preparation and ability to apply themselves in the use of laboratory instruments and equipment.

	Specific competencies: The candidate must be familiar with the laboratory procedures regarding the mixing of aggregates, additives, added solutions and reagents. He must also know the criteria for selecting and drawing the aggregate grading curves, have a clear overview of the national and international reference standards; must be able to apply, to the aforementioned areas, different formulation criteria also through IT tools such as MatLab or similar.