European Commission

Research & Innovation
Research Fund for Coal and Steel

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TECHNICAL ANNEX

Project acronym:	**NEWREBAR**
Project title:	***NEW dual-phase steel Reinforcing Bars for enhancing capacity and durability of anti-seismic moment resisting frames***
Grant Agreement N°:	RFSR-CT-2015-00023

B2-1 *PROJECT OBJECTIVES*

The main objective of this project is the development of new and innovative dual-phase (DP) steel reinforcing rebars, allowing enhanced seismic capacity and durability performance at least at the same cost of actually used reinforcing steel products.

In particular, DP steel grades will be developed taking into account two main objectives:

- Objective A) (short-term) DP steel grades fulfilling actual production and design standardsat European level will be developed and optimized from the points of view of seismic performance and structural durability. Such reinforcing steelswill be so directly used as reinforcing elements for constructions using the present European standards and codes;
- Objective B) (medium-term) DP steel grades, able to maximize the global seismic performanceand structural durability by capitalizing the peculiar mechanical properties of DP steels themselves, will be developed even if they will not fulfill actual design and production standards at European levels. In order to allow the introduction in the market of such enhanced steel grades, appropriate production and design rules will be developed in the research project.

To these purposes, the project aims to achieve the following additional objectives:

- ***The complete characterization (mechanical and microstructural properties and corrosion resistance) of DP steel reinforcing bars for concrete.***

The limited existing literature on the subject have shown that DP steel bars offer a combination of mechanical properties (strength, ductility and work hardening ratio) very promising to be used as reinforcements for concrete structures. Moreover, the existing few published results have shown that they present better corrosion resistance in aggressive environments (chloride exposition and carbonation) than Tempcore conventional bars. The characterization of corrosion resistance will allow a thorough analysis of the possible durability of buildings with the new DP bars. Moreover, the complete characterization of mechanical properties of the DP steel bars can provide useful data (such as the cyclic constitutive law) for the specific design of earthquake-resistant structures.

- ***The development of appropriate design rules for structural elements reinforced with DP bars.***

Limits foreseen in actual design and production standards for reinforcing steels, written for different types of steels, can surely limit the possibilities offered by DP steel. So if Objectives A), more incremental, assures an immediate use of DP steels in the framework of actual regulations, Objective B), really breakthrough, foresees the use of DP steels that for their peculiar mechanical properties (such as continuous yield point and higher work hardening ratio) can't be used in the framework of the existing production and design rules but exploit the full potential of DP steels in terms of mechanical performance and durability.

To these purposes tailored design rules of for concrete structures reinforced with DP steels will be developed.

- ***The construction of prediction models of the final microstructure and mechanical properties of DP steels in function of their chemical compositions and thermomechanical process parameters***

The construction of prediction models is a critical step in the simulation and design of industrial processes. They are able to reduce costs, risks, and time associated with the use of empirical methods and they allow the

development of new materials and the easy transfer from laboratory to industrial processes. Thus, the development of a new class of DP steels that can be successfully used as reinforcing bars, requires a thorough knowledge of the austenite transformation kinetics and the relationship between mechanical properties and chemical composition and microstructural features. Prediction models of microstructure and mechanical properties will be essential for the analysis of the industrial feasibility of such products, as well as they will have general validity for the base knowledge of the metallurgy of this class of steels.

- ***The industrial feasibility analysis of DP reinforcing bars***

Historically, technology has always played an important role in the steel industry allowing improvements in production processes. The present project aims to design an optimal thermomechanical cycle for the production of DP bars with the desired properties (microstructural and mechanical features and corrosion resistance). However, thermal cycles for the production of DP reinforcing bars are probably different from those of conventional ones and thus they are not directly transferable. Therefore, the project aims, through a careful analysis of the potentialities of the existing facilities, to verify the possibility to produce DP bars.