



Work Theme B: Structural engineering on modern steel construction

B1 Effective use of high performance steel materials - Q690 ~ Q960

Project Title:

b) “Advanced Numerical Analyses for Building Structures using High Performance Steel Materials”

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Project Outline:

This project will be aimed to remove the limitations of current design method for structures made of high performance steels which are buckling controlled with higher limitation in ductility. With the success of this project, practical steel structures made of high performance steels can be designed rationally and constructed in practice and this will change the acceptability of steel, especially high performance steel, to industry. Engineers will be provided with an acceptable design method for their economical and safe design of steel structures, instead of using the conventional simplified second-order or linear analysis which is limited to bulky structures not susceptible to buckling as mentioned above and stated in design codes. The design method to be developed will have an advantage in faster speed in designing structures, more economical structures produced and higher reliability in the design process. With these advantages, the impact is tremendous as more steel structures will be used in replacement of reinforced concrete structures when their advantages are realized and utilized. This is further in pace with the concept of smart city using advanced materials for sustainability and environmental reservation since steel can be recycled much easier than concrete.

The main objectives of this project will be on the development of analysis and design method for steel structures made of high strength material of grade 690 or above. Proper material and geometrical imperfections and design against various buckling modes will be considered. As the current codes have no provisions to high performance steel, the approach will not be based on them of which the formulae are only for low grade steel of 345 and 460 while higher steel grades have not been verified. In addition to basic material properties required for the conventional effective length method, only material and geometrical imperfections are required in the new design method which is from the basic principle of structural mechanics. It has no limitations in value of elastic buckling load factor provided that strength, stiffness and ductility of the steel members and the structures are rationally and correctly considered.

The research is planned to be conducted by three stages as (1) identification of imperfection parameters, properties, etc. for high performance steels; (2) incorporation of these parameters to advanced analysis software; and (3) compare and calibrate the results for high performance structures with refined finite element analysis or tests for some bench marked examples.

The four main objectives of this project are (1) to identify the geometrical and material imperfections of high performance members; (2) to propose and verify the uses of a new set of imperfection parameters for high performance steels; (3) to formulate a codified design method for high performance structures which is not yet available in literature and beyond the application of current design codes and; (4) to apply the new method to design of prototype and practical structures and compare the outcomes with results by others or by rigorous finite element analysis which can only be used for calibration exercise but hardly be applied to practical design because of computational inefficiency.