

# PEP-SBF Awards 2022

Pro-Enterprise Initiative (PEI) Award - Bronze



## Name of Initiative

Journey to enhance Eurocode 4 for the Design of Composite Columns using high strength materials to improve construction productivity

## Agency

Building and Construction Authority (BCA)



### Could you share briefly on what was the impetus that eventually led to the initiative, and how did you motivate yourself/your team to pursue it?

The use of high strength concrete and steel is already allowed in Eurocode 2 and 3 (EC2 & EC3) for the design of concrete and steel structures respectively. However, Eurocode 4 (EC4) for the design of concrete-steel composite structures covers only normal strength concrete (up to grade C50/60) and steel (up to grade S460). This limitation prevents the industry from using high strength concrete and steel for composite columns, especially in high-rise construction to improve productivity.

Following feedback from the industry about the limitation of the EC4, BCA took a proactive initiative and embarked on a journey to develop a Design Guide to overcome this limitation. The idea was to collaborate with local Institutes of Higher Learning (IHL) and experts in the field of steel-concrete composite structures to enhance EC4 for the Design of Composite Columns using high strength materials instead of waiting for future revision of EC4 which is unlikely to happen anytime soon.

### What were the challenges that you / your team encountered, and how did you / your team overcome them?

Modern design codes on steel-concrete composite members such as the American, Chinese, European, and Japanese codes did not provide guidance on the use of high strength construction materials. Therefore, it was a great challenge to extend the EC4 for the design of steel-concrete composite columns with special considerations for high strength concrete up to 90 N/mm<sup>2</sup> (i.e. characteristic cylinder strength) and high strength steel section with yield strength up to 550 N/mm<sup>2</sup>.

In the course of developing the BC4 Design Guides, more than 2500 test data collected from the available literature on steel-concrete composite members with normal and high strength materials were analysed to formulate the design methods proposed in this guide. Additional tests on high strength composite members were conducted in the Structural Laboratory at NUS based on the research fund supported by the Ministry of National Development (MND) and managed by BCA.

With the latest Design Guide BC4:2021, engineers now can use a unified method for high strength steel-concrete composite columns, with formulas and tables that give immediate solutions to both Concrete Filled Tube (CFT) and Concrete Encased Steel (CES) composite columns using high strength concrete and steel.

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## What was the most memorable moment while working on this project?

One of the most memorable moments was when we introduced the new revision of BC4 Design Guide (BC4:2021) and showcased successful projects adopting the BC4 design guide at the 2nd International Symposium on Advances in Steel and Composite Structures. A key takeaway from the conference was how high-rise projects benefited from using BC4 Design Guides. For example, the Afro Asia project showed how it used high-strength CFT composite columns to make the complex diagrid shape buildable (no falsework, formwork required) while achieving smaller column sizes and thinner steel tubes (more useable floor, less welding & lifting works). Similarly, the Outram Community Hospital projects showed how it used high strength CES composite columns to achieve smaller column sizes to meet the hospital functional requirements while saving significant concrete/rebars/formwork thus improving productivity.

## Supporting Media/ Illustrations



*Afro Asia Building*

*Project team at BCA Townhall Exhibition in Aug 2022, with BC4 Design Guide publication and the prototype model of the Afro Asia Building which benefited from using BC4*

