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Building Engineering Group (#05-00)

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Dear Sir/Madam

ROBUSTNESS OF BUILDINGS

BCA has observed an increasing number of buildings being built with complex structural layout and systems, such as inclined or curve columns, and cantilevered or multiple levels of transfer structures. Such complex structural layout could have substantial impact on the building robustness and may lead to disproportionate collapse (i.e. collapse of a small area leading to collapse of major parts of the structure). In addition, such complex structures are also more difficult to build and pose higher safety risks during construction. To enhance the robustness of buildings, we would like to highlight some design requirements in the building codes and provide guidelines on the use of transfer structures.

Robustness Requirements

2 Several robustness requirements are spelt out in the standards for concrete and steel designs. In the Singapore Standard CP 65: Part 1 (Code of Practice for Structural Use of Concrete), clause 2.2.2.2 states that structures should be planned and designed so that they are robust and not unreasonably susceptible to effects of accidents. In particular, situations should be avoided where damage to a small area of a structure or failure of single elements may lead to collapse of major parts of the structure. In general, a careful check has to be made to ensure that there is no inherent weakness in the structural layout for the safe transfer of building loads. Effective horizontal and vertical ties should be provided to maintain the integrity of the building so as to prevent the major collapse of building if localised failure occurs. Other robustness requirements also include the consideration for the notional removal of vertical structural elements, design of key and bridging elements. **We, therefore, would like to remind structural Qualified Persons (QPs) and Accredited Checkers to give due considerations to the robustness requirements in their designs to ensure that buildings are robust and stable so that, in the event of misuse or accident, disproportionate or progressive collapse can be avoided.**

Transfer Structures

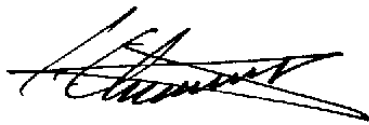
3 While conventional transfer beams and slab systems have an impact on the robustness of the building, the more complex cantilevered or multiple levels of transfer structures would pose an even greater risk to the robustness of the building. Failure of these structures can be catastrophic as they are likely to result in disproportionate collapse. **Therefore, the use of cantilevered or multiple level transfer structures in buildings should be avoided wherever possible.** A simple structural system with direct load path not only enhances

building robustness, it is also highly buildable. To avoid the use of transfer structures, QPs should be involved early in the discussion with the architect and developer during the conceptual design stage of the building.

4 We also like to remind project parties that safety must and continue to be the top priority in the design of any building.

5 I would appreciate it if you could bring to the attention of your members the contents of this circular. Please contact Mr Lim Beng Kwee at Tel 63257787 or email: lim_beng_kwee@bca.gov.sg if you need further clarification. Thank you.

Yours faithfully

A handwritten signature in black ink, appearing to read 'Chew Keat Chuan', with a long horizontal stroke extending to the right.

CHEW KEAT CHUAN
GROUP DIRECTOR
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for COMMISSIONER OF BUILDING CONTROL

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