THE HONG KONG HOUSING AUTHORITY

Memorandum for the Building Committee

Follow-up to Findings of the Research on Cost-efficiency of Structural Designs of Standard Domestic Blocks

PURPOSE

To report on the findings of the study by the in-house staff on some of the recommendations made in the research report “Cost-efficiency of Structural Design of Standard Domestic Blocks”.

BACKGROUND

2. A research on cost-efficiency of structural design of standard domestic blocks was conducted by a research team led by the H.K. University of Science and Technology (HKUST) in early 1999 and the research report had been discussed in the meeting held on 22 July 1999 via Paper No. BC 128/99.

3. The findings of this research report mainly covered -

(a) cost analysis of standard blocks versus those of the Housing Society (HS) and Private Sector (PS); and

(b) assessment of standard blocks in respect of design, utilization of materials, testing and construction method.

4. According to Paper No. BC 128/99, some of the recommendations made by the research team in respect of 3(b) above need further study by the in-house staff before implementation. The outcome of the study on these recommendations is summarized below.
ENHANCEMENT OF STRUCTURAL DESIGNS

Procurement of structural optimization software from HKUST

5. In the research conducted by the HKUST, a novel computer-based optimization software has been effectively used to determine the optimum sizes of structural members. This software has been assessed and considered very useful by the in-house standard design team. However, it is developed by the HKUST mainly for research purposes and is not yet available for purchase in the market. Consultancy agreement will therefore be made with the HKUST for the use of this special software if the need arises.

Structural design modifications

6. In accordance with the current layouts of Harmony 1 (H1), Concord 1 (C1) and New Cruciform Block (NCB), HKUST has proposed the following detailed design items which can optimize the structural designs. The findings of the in-house study on the various proposals are as follows -

<table>
<thead>
<tr>
<th>Proposed modification</th>
<th>Block Applicable</th>
<th>Response</th>
<th>Reasons</th>
<th>Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Use of varying wall thickness over the height of the block</td>
<td>C1 NCB</td>
<td>Not supported</td>
<td>In the construction aspect, any change of formwork system will inevitably increase the cycle time of construction and preliminary cost. It will also affect the standardization of precast facade, semi-precast slab and the standard provisions in kitchen &amp; bathroom. The construction cost will eventually be pushed up.</td>
<td>Nil</td>
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<tr>
<td>(b) Replacement of structural partition walls with non-structural panel wall</td>
<td>H1 NCB</td>
<td>Supported except for partition walls between flats and; between flat and common area. The estimated saving is about $1.45M per H1 block and $1.75M per NCB block.</td>
<td>Panel wall between flats and; between flat and common area are undesirable from security point of view because it can be broken through.</td>
<td>The replacement of structural partition walls inside domestic flat is to be adopted at the earliest opportunity for H1 and NCB.</td>
</tr>
<tr>
<td>Proposed modification</td>
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<td>(c) Enlargement of columns &amp; beams at re-entrant of C1 block</td>
<td>C1</td>
<td>Supported. The estimated saving is about $2.2M per block.</td>
<td>The change can provide better structural link between the flat wings and the central core of the block.</td>
<td>This design concept is to be adopted at the earliest opportunity for C1 subject to confirmation on further production of this block type. Currently no C1 Block is scheduled for tender.</td>
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**Omission of rendering on structural walls using large panel formwork construction**

7. From architectural point of view, the off-form concrete formed by the large panel formwork construction does not truly give a smooth unblemished surface on which finishes can be applied directly. Some preparation prior to tiling, particularly at the junction areas, is needed even though omission of rendering is considered feasible.

**Use of more varied precast concrete facade types**

8. The use of more variety of facade types has been actioned and explored. The relevant Paper No. BC 126/99 ‘Enhancement of Identity in Public Housing Estates’ has been discussed by Members in July 1999 and the first batch of facade designs including bay window option is in detailed design stage. Construction of trial panels for precast bay windows is in hand to review buildablity and construction details. Use of coloured glazing and coloured aluminium window frames will also be implemented.

**Adoption of private sector’s podium design approach**

9. Although the HA had extensively used transfer plate designs, the continuation of a central core including the lift wells and lift lobby down from the podium to the ground floor in some individual projects did generate inefficiencies both in terms of layout and cost. HKUST suggested adopting the PS’s design concept by carrying down only the lift wells to the ground floor. Some HA’s projects have already adopted this PS’s podium design approach which has proved more efficient. Relevant design guidelines would be issued to project teams to facilitate their adoption of such approach for podium design.
Use of scissors stairs and more compact central core design

10. As compared to PS’s residential buildings, the standard housing blocks generally provide more spacious lobby and always two separate staircases at the central core area. On the other hand, the PS normally adopts scissors stairs and apparently more efficient central core design. However, it is really qualitative judgement that we should address to. Lift lobbies in HA blocks have been reckoned to be superior in respect of providing better view out, natural lit and with cross-ventilation. The symmetrical core arrangement is the outcome of efficient construction and buildability. When the efficiency of the core and block is compared with PS, it must be recognised that the flat sizes of HA block are much smaller and the efficiency may hence be affected.

USE OF STRUCTURAL COMPONENTS AND MATERIALS

Reduction of cement content in concrete

11. In the research report, the cement content of concrete was found to be relatively high in HA’s specifications as compared with that specified in the Building Regulation. Higher cement content was specified in mid-80’s to enhance durability of the structure and protect against workmanship problems. Due to the consistent improvement in quality of concrete and workmanship over the years, it is considered justified to reduce the cement content in HA’s concrete. Relevant specification will be amended accordingly and it can be applied in the contracts to be tendered out after June 2000. The estimated saving is in the order of $0.45M/block for H1, $0.25M/block for NCB and $0.15M/block for C1.

Reversion to optional use of fabric reinforcement

12. Fabric reinforcement is currently mandatorily used in the walls of all standard blocks with a slightly higher unit rate reported in returned tenders as compared with traditional loose bars. After weighing the benefits of fabric reinforcement such as better control of concrete cover and reinforcement spacing, labour-saving and safety construction against the small cost differences vis-à-vis loose bars ($0.9M/block for H1 and $0.5M/block for C1), the reversion to optional use of fabric reinforcement is considered not justifiable.
MATERIAL TESTING

Reduction of testing requirements for constituent materials of concrete

13. The testing requirements for two types of constituent materials of concrete, namely aggregates and cement have been reviewed. Based on past testing records, the tests on these materials have scarcely failed. To reduce the testing frequency for these materials as recommended in the research report, co-ordinated testing arrangement has already been initiated and implemented by the Department. The approach is basically to centralize the testing by taking samples from the concrete batching plants instead of taking samples from every individual site. Since the samples taken from a batching plant may represent a number of sites, the number of tests required to be carried out on aggregates and cement can be greatly reduced with a significant saving in testing costs.

CONSTRUCTION TIME

Further shortening of construction period of C1 and NCB

14. It was considered technically feasible by the research team to further shorten the standard construction period of C1 & NCB by one to two months. However, due to recent quality concern on public housing developments, the construction period for building contracts will be extended by two months to allow sufficient time for contractors to deliver quality housing under our new initiatives. Therefore, it is considered not appropriate to further pursue such recommendation at this stage.

RECOMMENDATIONS

15. The proposed follow-up actions in response to the aforementioned recommendations in the research report are as follows -

(a) The following recommendations have already been implemented -
(i) The use of more variety of precast concrete facades (with bay windows) vide Paper No. BC 126/99. (paragraph 8)
(ii) The reduction of testing frequencies for aggregates and cement of concrete by coordinated testing arrangement. (paragraph 13)

(b) The following recommendations will be pursued in the future design and construction of standard blocks at the earliest opportunity -

(i) The use of HKUST’s optimization software for structural design. (paragraph 5)
(ii) The replacement of structural partition walls inside domestic unit with non-structural panel walls for H1 and NCB. (paragraph 13)
(iii) The enlargement of columns and beams at re-entrant of C1 subject to confirmation on the further production of this block type. (paragraph 6c)
(iv) Omission of rendering on structural walls using large panel formwork construction. (paragraph 7)
(v) The issue of design guidelines to project team to adopt the private sector’s podium design approach by carrying down only the lift wells to the ground floor. (paragraph 9)
(vi) The reduction of cement content of concrete to accord with prevailing standards. (paragraph 11)

(c) The following recommendations are considered not applicable -

(i) Use of varying wall thicknesses over the height of the block. (paragraph 6a)
(ii) Optional use of fabric reinforcement. (paragraph 12)
(iii) Shortening of construction period of C1 and NCB by one to two months. (paragraph 14)
PRESUMPTION

16. It is not thought that Members will object to the recommendations in paragraph 15 above. If no objection or request for discussion is received by the Committees’ Secretary by noon on 13 June 2000, Members’ approval will be presumed and appropriate action taken.

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