**Additional Comments on the Joint Expert Memorandum of 18 December 2018**

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The paragraph numbering referred to in my comments below follows that in the Joint Expert Memorandum.

1. General Code Requirements
   - The discussion on the use of ductility couplers was mainly on seismic design of structures. I have raised the point in the meeting that, in general, ductility is a desirable quality of all structures, irrespective of whether a structure is designed for seismic resistance or not.
   - In the design of the works at the Hung Hom Station Extension under the Shatin to Central Link Project, the consultant of MTRCL proposed certain ductility zones within which ductility couplers would be used, including some of the connections between the diaphragm walls and EWL slab for both the top and bottom reinforcing bars. The Buildings Department accepted the design.
   - The *Code of Practice for Structural Use of Concrete 2004* specifies certain detailing requirements for various cases (e.g. clauses in Sections 9.2, 9.3 and 9.9). Even though the strength calculations show that no reinforcement is required at some locations based on certain simplifying assumptions, these detailing rules provide good practice to ensure safety and serviceability of the structure. These detailing rules are mandatory requirements.

2. Role of bottom steel reinforcement in EWL slab near the east diaphragm wall
   - The statement contained in Paragraph 2 of the Joint Expert Memorandum was made in the context of strength requirement only. Apart from strength requirement, there are other requirements in the Code of Practice, e.g. ductility and serviceability, which need to be complied with.

3. Slab-wall joint at eastern diaphragm wall
   - At the meeting, I emphasised that further numerical checking would be necessary before we could come to any conclusion in relation to the second sentence of paragraph 3 of the Joint Expert Memorandum. Hence, the words in brackets (i.e. "subject to a review of the internal stresses at the top-of-wall construction joint relating to the "first change" and its rebar detailing") have been added in paragraph 3 of the Joint Expert Memorandum. However, they are still not clear enough.
   - The first change of the slab-wall joint (i.e. omission of U-bars in some of the joint details) should be checked numerically to ensure that the forces carried by the main

reinforcement outside the joint would be carried and transferred safely within the joint through proper strut-and-tie action.

- The second change of the slab-wall joint involves the replacement of short reinforcing bars with couplers in the diaphragm wall by through reinforcing bars. Theoretically, the through bar can only have an axial strength at most the same as that of an assemblage comprising a few bars of the same material and cross sectional area connected by couplers. First, the performance of this design should be considered in conjunction with the effects caused by the first change. Moreover, the second change also introduces additional construction joints of uncertain profiles within the slab-wall joints. It is necessary to check that the stresses at the construction joints are not excessive; otherwise the slab-wall joint should be properly strengthened. It is premature to jump to any conclusion regarding each slab-wall joint design without proper calculations for verification.

4. Miscellaneous workmanship issues
   - The adverse effects of the honeycombing in the vicinity of lapping reinforcing bars should be considered. Because of the loss of effective bonding between the bars and the surrounding concrete, these bars will become ineffective in transferring axial forces. The adverse effects due to honeycombing should be properly assessed to find out how the applied loading is carried and if any other parts of the structure will be overstressed. Structural repairs should be carried out as soon as possible. Nevertheless, the lapping reinforcing bars affected by honeycombing will only be effective in taking up forces due to future loading, but not the existing loading.
   - The problem of missing shear links (as opposed to misaligned shear links) as exposed at the areas of honeycombing should be investigated. Should the shear strength be considered insufficient, proper strengthening should be carried out.

5. No further comment

6. Opening-up regime for couplers at the east diaphragm wall
   - Whilst the provision of flexural strength for hogging moment at the EWL slab adjacent to the slab-wall joint does not necessarily require bottom reinforcement, provision of bottom reinforcement is a mandatory requirement under the *Code of Practice for Structural Use of Concrete 2004* and it still helps ensure ductility, serviceability, etc. Therefore the proper connection of the bottom reinforcement of the EWL slab to the diaphragm wall by way of mechanical couplers was required and would also serve useful purposes.
   - The need for opening-up should also be considered in the light of the incomplete and/or inconsistent site records in order to restore public confidence. The allegations

of malpractice and poor workmanship in installation of couplers also call for some measures for assessment. The holistic plan submitted by MTRCL has outlined an opening-up regime with random samples to achieve a certain confidence level. If the outcomes are reasonable, further opening-up beyond the quantity proposed in the holistic plan may not be necessary.

- That said, it has been discussed and agreed at the meeting that the sequence of opening-up of concrete for testing of the EWL slab may be reviewed to allow the opening-up of concrete for testing couplers for the top reinforcement to proceed first.
- It is noted from the site visit on 17 December 2018 that the working conditions inside the OTE duct for opening up concrete at the soffit of the EWL slab are quite poor and may cause safety concerns. However, such safety concerns are mainly related to those chosen sample locations inside the OTE duct only. Opening up at locations outside the OTE duct should be comparatively manageable. This is another reason why the opening up process would need to be further reviewed and prioritised.
- To ensure the trustworthiness of the outcomes from random sampling for opening-up, reinforcing bars in the third or fourth have been chosen. However, in view of the practical difficulty, these samples may be replaced by some others in the vicinity to ensure that the sample size is sufficient and meaningful.
- In view of the impracticality of access to the couplers for the bottom reinforcement of the NSL slab, it has been the case that opening-up of these couplers has not been included in MTRCL's holistic proposal. However, to enable a proper assessment or verification of the quality of workmanship of the coupler installations in the NSL slab, the holistic proposal, which had taken into account views of the relevant Government Departments and Government's experts, has included opening-up of concrete to expose the random samples of couplers for the top reinforcement of the NSL slab. In this aspect, I agree that the inclusion of samples from the top reinforcement of the NSL slab is considered essential for serving the purpose.
- Moreover, the top reinforcement in NSL slab near the diaphragm wall may also be required to take tension in the rare case of future dewatering in the vicinity.

Discussions of various issues at the meeting held on 18 December 2018 focused mainly on preliminary broad principles from a qualitative perspective. Further structural calculations should be carried out to justify some of the preliminary views expressed in the Joint Expert Memorandum.

22 December 2018