TECHNICAL APPRECIATION REPORT OF AWHO, CHANDRAKUNJ ARMY TOWERS, SILVER SAND ISLAND, KOCHI

1. **BACKGROUND**. A directive has been issued by Maj Gen Raghu Srinivasan, VSM, Chief Engineer, Southern Command to Chief Engineer (NW) Kochi that there has been a issue regarding premature distress of recently constructed buildings of AWHO, Silver Sand island, Kochi and CE to assess the situation and submit a technical appreciation report.

2. **VISIT**. Based on the instructions received from CESC, a technical team comprised of Shri R Alagarsamy, IDSE, CE, CE (NW) Kochi, Shri SC Somani, IDSE, SE, Director (Design), CE (NW) Kochi, Smt Simmi, JE, Col Jassar SM, CWE (NB) Kochi and Shri Madhukutty Sabastian, Senior Engineer (Projects), FOSROC, Kochi have visited site on 03 Jul 2021. It is submitted that all the team members are technically qualified with post-graduation degrees and sufficient field experience on the subject matter.

3. During the site visit, AWHO welfare committee members have also accompanied the team and shown all critical areas.

4. **SUPPORTING DETAILS FOR REFERENCE**. A report on "Investigation of Distress in First Floor of Tower A, B, C and Basement Floor of Tower B & C of AWHO, Chandrakunj Army Towers at Silver Sand Island, Vytilla, Kochi" dated April 2021 prepared by M/s Bureau Veritas and a report submitted by IIT Madras have been perused to get technical information and inferences arrived based on results of various tests conducted at site.

5. **TECHNICAL ASSESSMENT**.

(a) The distress noticed are more prominent in basement and stilt floors which indicates the deficiencies of quality control, workmanship and structural layout of main structural members viz. column, beam and slabs.

(b) From the M/s Bureau Veritas report, it has been noticed that all established testing procedures such as non-destructive (NDT), semi-destructive and chemical analysis of the structural members have been carried out. The tell-tales of the site tests carried out have also been noticed during the site visit.

(c) Signs of settlement of foundation, which normally manifests at basement / stilt columns/ grade beams, have not been noticed during the visual inspection.

(d) Post construction cracks in buildings could be broadly categorised into two types viz: surface / plaster cracks and structural cracks. While the plaster cracks are mostly repairable and pose no major problems, the structural cracks of beams, columns and slabs are to be taken seriously to keep the structural integrity of the building safe. The cracks observed in structural members of columns, beams and

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at one slab in basement and stair case flight floors in upper floors are all considered to be of structural cracks. The patch repair works carried at various places to arrest the cracks are not sustaining in such locations and further opening up of cracks even after that patch repair, simply proves the fact that the majority of the cracks are structural in nature, and they are not plaster cracks.

(e) Inferences from the various tests results as well as visual inspection during site visit confirms that the quality of ingredients used in the basic concrete manufacturing process has been compromised. High chloride contents shown in the results indicates that brackish water might have been used for concrete making.

(f) The uneven reinforcement bar locations, wherever the cracks have appeared and concrete peeled off, shows that the cover to reinforcement to be provided as per IS has been compromised. This highlights the poor workmanship of form work as well as placing of concrete. → or not catered in design

(g) The plump of columns and uniformity of size of RCC members have been observed satisfactory. The finish of plastered surface has also been observed to be of accepted quality.

(h) The structural layout of columns and beams at few locations in basement areas have been found to be a clumsy arrangement and not as per sound engineering practice. (However, it is a fait-accompli case for which the builder cannot be blamed.) It is felt that though the members may be found structurally safe as per theoretical calculations, but due to a combination of lack of serviceability criteria such as excessive deflection and poor quality of concrete in RCC beams may result in repetitive formation of cracks.

(j) Long span beams with heavy secondary beams have shown cracks in the bottom middle portion, which indicates excessive deflection due to flexural action. The repairs carried out at such locations are not sustaining and further cracks developed in the region. Necessary action to repair the cracked beams and if required to give additional supports wherever obstructions are not there be explored. → should

(k) Bigger size MS pipes for fire fighting have been crossing main beams at tension zones. This is considered as a major weak point and whether such crossings in beam sections had been taken care of at initial structural design calculations is to be ascertained.

(l) In RCC retaining wall, the cracks could be arrested only when appropriate treatment is done at positive side.

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6. **RECOMMENDATIONS**.

(a) The distress of the buildings are being manifested in the form of cracks, peeling of plaster, exposed rusted reinforcement bars which confirms that there are major deficiencies in quality control of green concrete for RCC members and to certain extent poor workmanship like cover to concrete. Timely action to repair the surfaces and strengthening of RCC members may arrest further deterioration and the structural integrity could be maintained to a larger extent.

(b) The repair work shall be carried out in a wholesome manner and not a patch work.

(c) Reputed companies such as M/s FOSROC, M/s BASF, M/s CICA should be engaged with a guarantee clause for a minimum period of 8-10 years from the OEM, and not through the applicator or any sub-contractors.

(d) In addition to the focus on material repair and restoration, deflection check of large span beams may also be observed.