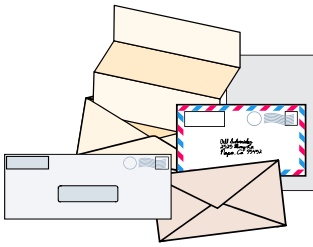

Letters to the Editor

Restoration of hammer foundations in forging industry

This has reference to the a paper "Restoration of hammer foundations in forging industry — a case study" by Mr P. G. Gokhale, Mr G. D. Shanbag and Mr B. V. Bhedasgaonkar. The authors need to be congratulated for presenting an interesting case study on the concrete repair work carried out on three forge hammer foundations which was published in the January 2000 issue of the *Indian Concrete Journal*. It is interesting to note that in the case of the 500-kg hammer foundation, what was originally observed as a uniform settlement at the base before repairs were carried out, resulted in rotation of the foundation block in plan after the repairs. To prevent this rotation of the foundation block, the authors have further fixed a plug of 300 mm depth at the bottom all around in the open space which was originally intended to be a clear air gap for the purpose of avoiding transmission of vibrations. Although it is quite late to seek clarifications from the authors, the present witers would like to seek the following clarifications:

(i) How was the conclusion of uniform settlement of the foundation block arrived at ? Were any measurements taken on the foundation?

(ii) The cross-section shown in *Fig* 2 of the paper does not show the anvil portion of the machine to check how much depth of the foundation block was actually provided beneath the anvil block. Clause 4.4.2 of IS 2974 (Part II) which deals with this class of structures suggests a certain minimum depth of foundation block below the anvil for the hammer foundations in order to avoid structural problems of the kind reported here.

(iii) It is not clear from the text of the paper whether reinforcement was checked and found to be code-compliant.

(iv) Information concerning the nature of soil below the foundation and the expected ground water levels in different seasons of the year would be informative for proper diagnosis of the problem leading to appropriate repair measures to be adopted finally.

(v) The probable causes of cracking in the foundation for 1000-kg hammer were not explained. Clause 6.3 of the IS code mentioned earlier specifies the requirement of a grillage of reinforcement to be provided in the foundation beneath the anvil block. Alternatively, steel fibre reinforcement could be used in this region. This would have given better performance under impact loads.

(vi) The foundation for the 1500-kg hammer was reported to have "tilted" and this tilt was seen to have gradually increased. The plain cement concrete (PCC) layer at the bottom is reported to have been "weathered". The writers feel that the PCC layer, could also have been replaced by a reinforced concrete (RC) slab cast monolithically with the side walls along with the provision of water bars to avoid the ingress of the moisture. Provision of a water-tight RC trough and the RC foundation resting on the base with due compliance to the codal requirements for dimensioning and detailing of steel therein could have saved the cost of extensive repairs, now incurred to lift the heavy foundation block and repairing only the plain concrete layer underneath. The tilting of the foundation block could also have been a result of possible eccentric impacts caused by repeated forging operation.

(vi) The authors have stated that under the repair scheme the rubber pads

used under the anvil were "fixed" with an epoxy bonding agent! The rubber pads provided under the anvil are meant to absorb the impact shocks caused by the forging operations and if these pads are not left free and resilient but get "fixed" and "sealed" as stated, the cracks on the top portion of the foundation block under the anvil of the block are likely to reappear under long-term operations. Rubber pads should be left "free" on the sides to make them perform as elastic elements. It is therefore in the interest of the users of the plant to free these pads on the sides though they can be fixed on their base for position fixing on the concrete surface under the anvil.

(viii) Finally, the writers would like to endorse the importance of publishing the case study of actual failures but would have appreciated if the authors had thrown light on:

- the causes of failure as noted from the investigations carried out
- the remedies adopted based on the scientific analysis of results of investigations, and finally
- the post-repair performances observed both under short and long term operations.

Such contributions give valuable insight into the practical guidelines given in the prevailing codes of practice, especially in such inter disciplinary areas of industrial importance.

Dr P. Srinivasulu Professor, and
Ms T. Ch. Madhavi,
Lecturer, Department of Civil Engineering,
Hindustan College of Engineering
Padur 603103, Chennai

While thanking Dr Srinivaslu and Ms Madhavi for the interest shown by them in the paper, the authors would like to reply as under:

(i) The conclusion about settlement of foundation block was arrived at after due measurement. When the block was lifted physically, it was noticed that there was a clear impression of the block seen on the PCC below. The depth of the impression was measured and was found to be practically uniform.

(ii) The cross-section in *Fig* 2 shows the actual depth of the block below anvil which is 1820 mm. As per IS 2974 (Part II), 1980 – clause 4.4.2, the minimum depth is specified as 1250 mm for 1 tonne to 2 tonne hammers.

It is to be noted that the foundation block itself had no problem, though the PCC below had settled.

(iv) The strata below the PCC was black deccan trap, which was very hard. No ground water was met at this depth during any season of the year.

(v) The 300 mm PCC plug (mentioned by writers in) was in fact provided, with due appreciation of the fact that this will defeat the purpose of cutting the vibrations from being transferred to adjoining area/construction. The likely further rotation of the block was required to be arrested. Provision of heavy springs, etc was thought of, but discarded due to various reasons, including their prohibitive cost. In practice, some compromises are unavoidable. Since the gap sacrificed due to this plug, is a small part of the total depth of the block foundation, probably, no bad effects have been observed.

(vi) The reinforcement in the block for 1000-kg hammer was as per clause 6.3 of the above code. The reinforcement was provided at surfaces, diagonal bars in both directions and two directions in plan below the anvil, as well as mesh of 16 mm Φ at 100 mm on centres at top was provided. As mentioned, the block itself had no problem, except the two right angled cracks. The 1000-kg hammer was in use for nearly 13-14 years. The cracks may be because of wear and tear due to age. The block below was not affected at all. The cracked layer was removed with the breaker and after applying epoxy, adding mesh reinforcement and 5 percent microsilica, new concrete was poured. The performance of this foundation has also been satisfactory for more than nearly 2½ years now.

(vii) The suggestion made by the writers that the PCC layer below the anvil be replaced by an RC slab is noted for future guidance. It is a good suggestion.

(viii) The rubber pad was fixed with an epoxy bonding agent, only at the bottom, with spots of epoxy, to ensure that the rubber pad does not get displaced due to blows of hammer. The sides of the rubber pads were not constrained, allowing the side deflections, resulting in resilience and damping of the vibrations. The suggestion of the writers, is in fact, already incorporated.

The authors trust that the questions raised by writers are adequately explained.

Mr P.G. Gokhale
Consultant Structural Engineer,
'Padmavati' 20, Shirgaonkar Society,
Takala
Kolhapur 416 008.

Mr G. D. Shanbag
Vijay Engineering Services,
10, Siddhivinayak Apt.,
Tarabhai Park,
Kolhapur

Mr B. V. Bhedasgoankar
Consulting Engineer,
210, Bharat Bhavan,
1360, Shukrawar Peth,
Pune 411 002

• • •