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CODE OF PRACTICE FOR USE OF SCREED BOARD CONCRETE VIBRATORS

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CODE OF PRACTICE FOR USE OF SCREED BOARD CONCRETE VIBRATORS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 27 March 1987, after the draft finalized by the Construction Plant and Machinery Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The introduction of the concept of compaction of concrete by vibration has made it possible to use low slump, stiff mixes for production of high quality concrete with required strength and impermeability. The use of vibration is essential for the production of good quality concrete, when hand compaction methods fail to eliminate the voids. Insufficient compaction results in formation of voids in concrete, which in turn reduce the strength. If, the void content is 10 percent, the strength may be reduced by as much as 50 percent. Where the exposed surface is large, and thickness of layer is relatively small as in the case of concrete slabs, for road and airfield pavements, building roofs, etc, screed board type vibrators play a very important role in improving the compaction and strength of concrete. Results of research in many countries and at Central Road Research Institute, New Delhi has established that reasonably high amplitude of vibration corresponding to a matching frequency is of primary importance for sufficient compaction, while using screed vibrators.

0.3 IS : 2506-1985* stipulates that the amplitude of vibration of such vibrators shall not be less than 1·5 mm under 'operation in air' condition for sufficient compaction. As against this, several major user departments in the country have reported that the indigenously available screed board vibrators exhibit rather low amplitude of vibrations of the order of 0·4 to 0·5 mm. While such low amplitude screed vibrators may be adequate for surface finishing operations only, they are unable to do satisfactory compaction beyond the top 10 cm or so. Cases of honey-combing at lower layers of thicker slabs have been reported in the case of airfields.

*General requirements for concrete vibrators, screed board type (*first revision*).

0.3.1 The Central Road Research Institute, New Delhi has developed an improved high amplitude screed vibrator indigenously which is now under commercial exploitation. The high amplitude screed vibrator is reported to provide amplitude of vibration in the range of 1·5 to 2 0 mm for matching frequencies of 3200-3800 revolutions per minute when operated in air, corresponding amplitude and matching frequency range under 'loaded' condition that is under actual operation on green concrete being 0 8 to 1·8 mm and 3300-3600 cycles per minute respectively. Comparative tests on a series of full size concrete slabs of thicknesses varying from 15 to 25 cm have shown that the high amplitude screed vibrators with an amplitude of vibration of 2 mm when 'operated in air' condition may compact up to 25 cm thick slabs with a minimum of 97 percent efficiency (3 percent voids) at the lower layers as against only 90 percent efficiency that is 10 percent voids in case of commonly available screed vibrators having 0·4 to 0 5 mm, as amplitude of vibration when 'operated in air conditions'.

1. SCOPE

1.1 This standard deals with the use of screed board vibrators for the compaction of concrete, the maintenance of the screed vibrators in proper running order and the safety requirements for their use and gives recommendations regarding placing of concrete and its compaction by vibration.

2. TERMINOLOGY

2.0 For the purpose of this standard, the definitions given in IS : 2505-1980* and IS : 2506-1985† shall apply.

3. GENERAL CONSIDERATIONS

3.1 Suitability of Screed Board Vibrations

3.1.1 Screed board vibrators may be satisfactorily used for compaction of plain as well as reinforced concrete slabs of highway and airfield pavements, building roofs, etc. The size of the vibrators shall be in accordance with IS : 2506-1985†.

3.2 Power Unit

3.2.1 The screed board vibrator shall be powered by a suitable integral power unit, that is, an electric motor or an internal combustion engine. The electric motors and internal combustion engines shall conform to IS : 996-1979‡ and IS : 10 000-1980§. Suitable arrangement

*General requirements for concrete vibrators, immersion type (*second revision*).
†General requirements for concrete vibrators, screed board type (*first revision*).
‡Single phase small ac and universal electric motor (*second revision*).
§Method of tests for internal combustion engine.

may be provided for adjusting the vibration characteristics of the vibrating unit and the efficiency of the device provided for this purpose may be such that constantly uniform performance of the vibrator is assured under the entire range of operating conditions.

3.2.2 Where reliable supply of electricity is available, the electric motor is generally the most satisfactory and economical power unit as the speed is relatively constant and cables used are light to handle.

3.2.3 The type of power unit and rating in terms of kilowatts shall be specified by the manufacturer of the vibrator.

4. HANDLING

4.1 The vibrators operate under heavy stresses and, therefore, require regular maintenance to keep them under proper working conditions. After use, the vibrators shall be thoroughly cleaned and stored in clean and dry place. All repairs shall be carried out under careful supervision and in accordance with manufacturer's instructions. Stand by units shall also be provided. There is also a tendency for bearings to wear out because of centrifugal force and the resultant impact. Worn-out parts shall be replaced in time to avoid premature damage to the whole machine.

4.2 Overloading of Driving Unit — Proper precautions shall be taken in selecting the driving unit to avoid over heating of motor, when the concrete is very stiff the vibrator will usually be over loaded and the electric motor or petrol engine may get excessively heated. The motor shall be provided with a suitable automatic cut-off device.

4.3 Operational and Safety Requirements

4.3.1 The moving parts shall be suitably enclosed to guard against accident.

4.3.2 Suitable earthing and safety arrangements shall be provided for electric motors so as to effectively protect the operator from shock which may be fatal. The protective device shall be checked everyday before the vibrators are used. The components of the motor shall be in accordance with the relevant Indian Standards.

5. CONCRETE MIX

5.1 Correct design of concrete mix and an effective control in the preparation of concrete during the different phases, that is, selection of constituent materials, their proportioning, mixing and placing are essential to obtain maximum benefits from screed vibration. For best results, the concrete to be vibrated shall be of the stiffest possible consistency compatible to the compacting efficiency of the vibrator, generally within a range of 0·75 to 0·85 compacting factor and shall conform to very low

range of workability as specified in IS : 456-1978*. Screed vibration of concrete of very high workability may not increase its strength, it may, on the contrary, cause segregation, if continued for usual length of time. Formation of watery grout on the surface of concrete soon after screed vibration is an indication that the concrete is too workable and unsuitable for vibration, a close textured layer of viscous grout may, however, be allowed. It has been proved that the best compaction is achieved at resonant conditions.

6. DESIGN OF FORMWORK

6.1 For vibrated concrete used for airfield and highway pavements, the formwork shall be well designed necessary for hand-compacted concrete and greater care shall be exercised in its assembly. It should be designed to take up the increased pressure of concrete due to the screed vibrator. The design of formwork depends upon the experience and judgement and the type of work. Generally, steel channels supported by stakes driven into subgrade or subbase are used except in curves where wooden formwork may be used. In the latter case, it should be capped with 50 mm angle iron along the inner side and kept flush with the face. The joints of the formwork shall be tight and close enough to prevent the squeezing out of grout or sucking in of air during vibration. Absence of this precaution may cause honey-combing at the end surface of concrete.

6.2 The amount of mortar leakage or the permissible gap between channels will depend on the desired final appearance of the work but normally gaps larger than 1·5 mm between the channels shall not be permitted. The number of joints should be made as small as possible by the use of long lengths of channel sections adequately supported. Application of grease or oil on the formwork to prevent the adhesion of concrete should be very thin as otherwise they may mix with the concrete under the effect of vibration.

7. VIBRATION OF CONCRETE

7.1 The concrete to be vibrated shall be placed in position in level layer or layers (in case of multi layered construction) of suitable thickness and the concrete at the surface shall be distributed as horizontally as possible, since the concrete flows in slopes while being vibrated and may segregate. The screed vibrator shall rest on side forms and shall be lowered vertically on to the concrete surface, evenly spread to the required level above the base, making due allowance for compaction by providing adequate surcharge. The vibrator is allowed to

*Code of practice for plain and reinforced concrete (*third revision*).

remain in position for a few seconds until compaction is complete, then lifted vertically and lowered on to the adjacent strip of uncompacted concrete with an overlap of about half the width of the screed board keeping in view that there shall not be any segregation. After the length of concrete already placed is compacted, the screed shall again be taken to its original position and allowed to move slowly over the surface sliding with its axis slightly tilted away from the dioection of sliding and the operation repeated until the required dense, close knit textured surface is obtained. Slabs of thicknesses up to 20 cm may be compacted in single layer using screed vibrator, in all cases immersion vibrators are required to be used in addition for compacting the corners and edges of the slabs. For thicknesses greater than 20 cm, multi-layered construction may be resorted to.

7.2 The surcharge during compaction is the additional height to which the concrete is spread above the level of the form work. When the surcharge is lower than the optimum which the vibrator may compact efficiently, the force on the concrete is inadequate resulting in insufficient compaction of concrete. The relation between surcharge and compactive effort is affected by changes in the characteristics of the vibration and in the workability of concrete. For the same surcharge, when the vibration is not very powerful, the concrete is not compacted in depth, so that there is a surplus of concrete which is pushed in front of the beam. On the other hand, when the vibration is powerful the use of too low surcharge results in complete compaction.

7.3 Compaction by screed vibrator shall be carried on till the mortar in the mix just works up to the surface. Care shall, however, be exercised and the operation so controlled as to prevent over vibration leading to bleeding, that is, appearance of excess of mortar and/or water at the top. Generally, with properly designed mixes, extended vibration will only be waste of effort.

7.4 If the concrete is too workable or the quantity of mortar is in excess of the volume of voids in coarse aggregates or grading of aggregates is unsatisfactory, over vibration will encourage segregation, causing migration to the surface of tighter and smaller constituents of the mix and so producing a layer of mortar on the surface and leakage of mortar through defective joints in the formwork.

8. PERFORMANCE OF SCREED BOARD VIBRATOR

8.1 The screed board vibrators shall be tested in accordance with IS : 6923-1973*.

*Methods of test for performance of screed board concrete vibrator.

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