



नेपाल गुणस्तर
NEPAL STANDARD

Method of Physical Test for Hydraulic Cement
PART 6 DETERMINATION OF COMPRESSIVE STRENGTH OF
HYDRAULIC CEMENT OTHER THAN MASONRY CEMENT



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1. SCOPE

1.1 This standard (Part 6) covers the procedure for determining the strength of cement as represented by compressive strength tests on mortar cubes compacted by means of standard vibration machine.

2. SAMPLING AND SELECTION OF TEST SPECIMEN

2.1 The samples of the cement shall be taken in accordance with the requirements of NS 386 and the relevant standard specification for the type of cement being tested. The representative sample of the cement selected as above shall be thoroughly mixed before testing,

3. TEMPERATURE AND HUMIDITY

3.1 The temperature of moulding room, dry materials and water shall be maintained at $27 \pm 2^\circ\text{C}$. The relative humidity of the laboratory shall be 65 ± 5 percent.

3.2 The moist closet or moist room shall be maintained at $27 \pm 2^\circ\text{C}$ and at a relative humidity of not less than 90 percent.

4. GENERAL

4.1 Standard Sand - The standard sand to be used in the test shall conform to NS 51.

5. APPARATUS

5.1 Vibration Machine - Vibration machine conforming to Annex A.

5.2 Poking Rod - Poking rod conforming to Annex A.

5.3 Cube Mould- The mould shall be of 70.6 mm size conforming to Annex B.

5.4 Gauging Trowel - Gauging trowel shall have a steel blade 100 to 150 mm in length with straight edges weighing 210 ± 10 g.

5.5 Balance - The balance shall conform to the following requirements:

On balance in use, the permissible variation at a load of 1000 g shall be ± 1.0 g. The permissible variation on new balance shall be one-half of this value. The sensibility reciprocal shall be not greater than twice the permissible variation.

NOTE 1 - The sensibility reciprocal is generally defined as the change in load required to change the position of rest of the indicating element or elements at a non-automatic indicating scale a definite amount of any load.

NOTE 2 - Self-indicating balance with equivalent accuracy may also be used.

5.6 Standard Weights - The permissible variation on weights in use in weighing the cement shall be as prescribed in Table 1.

TABLE 1 PERMISSIBLE VARIATION ON WEIGHTS

WEIGHT	PERMISSIBLE VARIATION ON WEIGHTS IN USE
g (1)	g (2)
500	±0.35
300	±0.30
250	±0.25
200	±0.20
100	±0.15
50	±0.10
20	±0.05
10	±0.04
5	±0.03
2	±0.02
1	±0.01

5.7 Graduated Glass Cylinders - Graduated glass cylinders of 150 to 200 ml capacity. The permissible variation on these cylinders shall be ± 1 ml. The main graduation lines of the cylinders shall be in circles and shall be numbered. The least graduations shall extend at least one seventh of the way around, and, intermediate graduations shall extend at least one-fifth of the way around the cylinder. The graduation lines may be omitted for the lowest 5 ml.

6. PREPARATION OF TEST SPECIMENS

6.1 Mix Proportions and Mixing

6.1.1 Clean appliances shall be used for mixing and the temperature of water and that of the test room at the time when the above operations are being performed shall be $27 \pm 2^\circ\text{C}$. Potable /distilled water shall be used in preparing the cubes.

6.1.2 The material for each cube shall be mixed separately and the quantity of cement, standard sand and water shall be as follows:

Cement	200g
Standard Sand	600g
Water	$\left(\frac{P}{4} + 3.0\right)$ percent of combined mass of cement and sand, where P is the percentage of water required to produce a paste of standard consistency determined as described in NS:123 (Part 4)

6.1.3 Place on a nonporous plate, a mixture of cement and standard sand, Mix it dry with a trowel for one minute and then with water until the mixture is of uniform colour. The quantity of water to be used shall be as specified in **6.1.2**. The time of mixing in any event shall not be less than 3 min and should the time taken to obtain a uniform colour exceed 4 min, the mixture shall be rejected and the operation repeated with a fresh quantity of cement, sand and water.

6.2 Moulding Specimens

6.2.1 In assembling the moulds ready for use, cover the joints between the halves of the mould with a thin film of petroleum jelly and apply a similar coating of petroleum jelly between the contact surfaces of the bottom of the mould and its base plate in order to ensure that no water escapes during vibration. Treat the interior faces of the mould with a thin coating of mould oil.

6.2.2 Place the assembled mould on the table of the vibration machine and hold it firmly in position by means of a suitable clamp. Attach a hopper of suitable size and shape securely at the top of the mould to facilitate filling and this hopper shall not be removed until the completion of the vibration period.

6.2.3 Immediately after mixing the mortar in accordance with **6.1**, place the mortar in the cube mould and prod with the rod specified in **5.2**. The mortar shall be prodded 20 times in about 8s to ensure elimination of entrained air and honey combing. Place the remaining quantity of mortar in the hopper of the cube mould and prod again as specified for the first layer and then compact the mortar by vibration.

6.2.4 The period of vibration shall be two minutes at the specified speed of 12000 ± 400 vibration per minute.

6.2.5 At the end of vibration, remove the mould together with the base plate from the machine and finish the top surface of the cube in the mould by smoothing the surface with the blade of a trowel.

6.3 Curing Specimens - Keep the filled moulds in moist closet or moist room for 24 hours after completion of vibration. At the end of that period, remove them from the moulds and immediately submerge in clean fresh water and keep there until taken out just prior to breaking. The water in which the cubes are submerged shall be renewed every 7 days and shall be maintained at a temperature of $27 \pm 2^\circ\text{C}$. After they have been taken out and until they are broken, the cubes shall not be allowed to become dry.

7. TESTING

7.1 Test three cubes for compressive strength for each period of curing mentioned under the relevant specifications for different hydraulic cements, the periods being reckoned from the completion of vibration.

7.1.1 The cubes shall be tested on their sides without any packing between the cube and the steel plattens of the testing machine. One of the plattens shall be carried on a base and shall be self-adjusting, and the load shall be steadily and uniformly applied, starting from zero at a rate of $35 \text{ N/mm}^2/\text{min}$.

8. CALCULATION

8.1 The measured compressive strength of the cubes shall be calculated by dividing the maximum load applied to the cubes during the test by the cross-sectional area, calculated from the mean dimensions of the section and shall be expressed to the nearest 0.5 N/mm^2 . In determining the compressive strength, do not consider specimens that are manifestly faulty, or that give strengths differing by more than 10 percent from the average value of all the test specimens. After discarding specimens or strength values, if less than two strength values are left for determining the compressive strength at any given period, a retest shall be made.

ANNEX A

Vibration Machine - Specification

A.1. MATERIALS

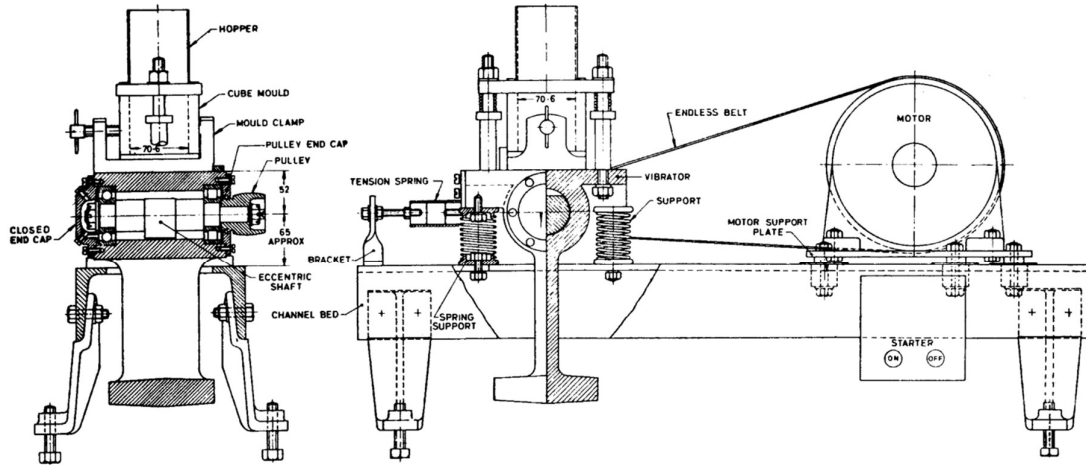
A.1.1 Materials of construction of different components of the vibration machine shall be as given in Table A.1.

TABLE A.1 MATERIALS OF CONSTRUCTION OF DIFFERENT COMPONENTS OF VIBRATION MACHINE

S. No.	PART	MATERIAL	SPECIFIC REQUIREMENTS AND RECOMMENDED NEPAL STANDARD SPECIFICATION
i)	Bed	Light Channel 200	-
ii)	Vibrator	Cast iron Smooth surface	Smooth Surface, NS ***
iii)	Eccentric shaft	Mild steel	NS ***
iv)	Pulley	Mild steel	NS ***
v)	Support spring	Spring steel	-
vi)	Tension spring	Spring steel	-
vii)	Hopper	Brass	-
viii)	Drive pulley	Cast iron	Smooth Surface, NS ***
ix)	Belt	Cotton/Nylon	Woven, endless belt
x)	Motor	-	3/4 hp, 2800 rpm
xi)	Motor support	Mild steel	NS ***
xii)	Mould	Cast iron/Mild steel	NS ***

A.2. CONSTRUCTION

A.2.1 Vibration machine shall be constructed generally as shown in Fig. 1 and shall consist of a vibrator, housing revolving shaft with eccentric supported on four springs, which assembly is mounted over a bed of channel. A motor (3/4 hp, 2800 rpm) carrying a pulley shall be coupled to the vibrator revolving shaft through an endless belt. A belt guard shall be provided. The machine may be fitted with time switch.



All dimensions in millimetres.

FIG. A.1 TYPICAL VIBRATION MACHINE

A.2.1.1 The vibrator shall be constructed to comply with the following essential requirements:

a) Mass of vibrator on its supporting springs (excluding solid eccentric and cube hut, including mass of mould, mould clamp and hopper)	29 ± 0.5 kg
b) Out of balance moment of eccentric shaft	0.0016 kgm
c) Normal running speed of eccentric shaft	12000 ± 400 rpm

A.2.1.2 The centre of gravity of the vibrator, including the cube and the mould, shall be either to the centre of the eccentric shaft or within a distance of 25 mm below it. For this purpose, a mild steel plate may be fixed to the vibrator.

A.2.2 Bed - The bed of the vibration machine shall be made of steel channel and shall be provided with four cast iron feet. It shall be provided with four levelling bolts. Four support springs shall be fitted for positioning the coiled springs. A bracket shall be provided for fixing one end of a tension spring.

A.2.3 Vibrator

A.2.3.1 The vibrator shall be mounted over four coiled springs.

A.2.3.2 The vibrator platform shall be provided with two guide pieces for positioning a cast iron mould clamp which carries a cube mould of size 70.6 mm. A suitable arrangement for mounting a hopper shall be provided and a tension spring shall be fitted as shown in Fig. A.1.

A.2.3.3 A brass hopper fitted on to a mild steel frame with projecting lugs shall be positioned over the mould as shown in Fig. A.1.

A.2.3.4 The vibrator shall house a revolving shaft with an accurately machined eccentric. A pulley shall be fitted to the shaft.

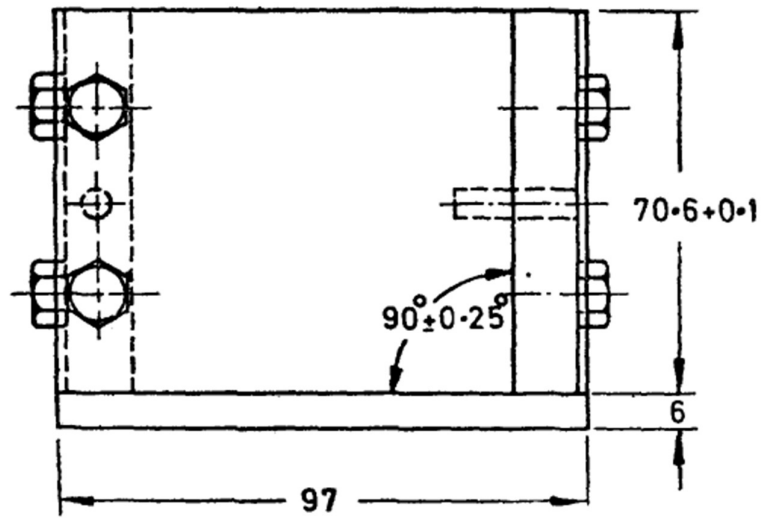
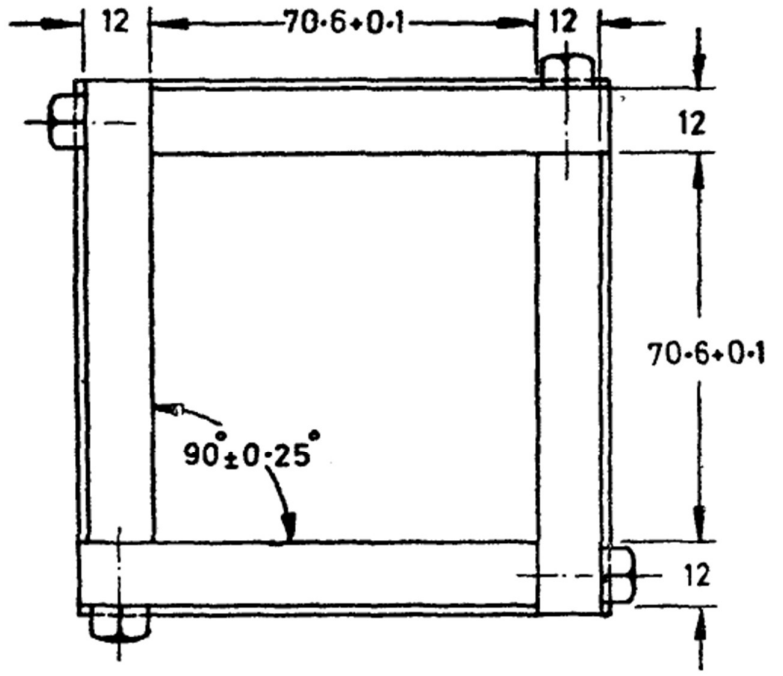
A.2.3.5 Springs - The springs shall be as shown in Fig. 1. The stiffness of the spring shall be such that the natural frequency of the machine mounted on it is well below its minimum running speed.

A.2.3.6 Drive - The drive should be by an endless belt running on a pulley on the motor and a pulley on the vibrator.

A.2.4 Mould - The mould shall be of 70.6 mm size and shall be constructed generally in accordance with Fig. 2. The dimensions of the mould with tolerances shall be as specified in Table A.2.

TABLE A.2 DIMENSIONS AND TOLERANCES OF MOULD

S. No.	Description	Dimension
(1)	(2)	(3)
i)	Distance between opposite faces, mm	70.6 ± 0.1
ii)	Height of mould, mm	70.6 ± 0.1
iii)	Thickness of wall plate, mm	12
iv)	Angle between adjacent interior faces and between interior faces and top and bottom planes of mould	$90 \pm 0.5^\circ$
v)	Length of base plate, mm	97
vi)	Width of base plate, mm	97
vii)	Thickness of base plate, mm	6
viii)	Permissible variation in the planeness of interior faces, mm	
	for new moulds	0.03
	for moulds in use	0.05
ix)	Permissible variation in the planeness of base plate, mm	0.15



All dimensions in millimetres.

FIG. A.2 TYPICAL CUBE MOULD

A.2.4.1 The cube mould shall be constructed in such a manner as to facilitate separation into two parts. The mass of the mould together with the base plate shall be 2.8 ± 0.2 kg. Other requirements of the mould shall be as laid down in NS***