BUILDING RESEARCH NOTE 70

CONCRETE BLOCK MAKING MACHINE

Introduction

Concrete blocks can be made either by manual method or with a block making machine. In the manual method single block moulds kept in a row are often employed and concrete is compacted in the moulds with a plate vibrator. On the other hand, the block macking machine invariably has a replaceble gang mould system to produce two to eight blocks (or even more) in one operation of casting. The vibrating system in the machine is an integral part of the mould. The machine made blocks are superior in strength and finish due to better control possible during compaction of concrete. The production of blocks becomes much faster with the machine as compared to the manal method.

Indigenous block making machines are available for macking concrete blocks of solid and hollow type. When stone blocks or large aggregate concrete blocks are cast on some of these machines, these blocks are found to be deficient in terms of strength and other qualities. It was observed during trials that these machines were suitable for handling only those concrete mixes in which maximum size of aggregate was limited to about 15 mm. Concrete with bigger aggregates showed segregation and lack of compaction. The stone and solid concrete blocks developed by CBRI are made with concrete having much bigger aggregates 40 mm and above and therefore, the available block making machine could not be effectively utilised for casting these blocks.

In absence of a suitable machine, both the stone blocks and the large aggregate blocks are cast in the field by manual method using sinlge mould and plate vibrator. The method has been found slow for mass production. An altogether new type of block macking machine was therefore, developed by CBRI to promote and popularise its low cost concrete blocks. The machine works on the principle of pressure-vibration technique and is capable of effectively handling concrete mixes with a wide range of consistency. The machine has been successfully used for casting stone blocks, large aggregate concrete blocks and the traditional concrete blocks.

CBRI's Block Making Machine

Design Parameters :

Compaction of concrete in a mould depends on frequency, amplitude and duration of vibration. These in turn depend on the conditions of vibrating system comprising the mould and the concrete in it. For concrete having coarse fraction of aggregate, a lower frequency of vibration and high amplitude are required whereas for concrete containing fine fractions, the high frequency with low amplitude is necessary. Since concerete normally contains

particles of varying sizes, the most satisfactory compaction is obtained by using vibrators with different speed of vibration as in case of poly-frequency vibrators. This, however, makes the vibrating system costly. The vibrators used in practice therefore work only at single frequency suitable for average particle size of the concrete to be compacted. By using increased frequency of vibration it is possible to obtain high values of exciting forces with a much lighter vibrating system, but with increased vibration frequencies, the resistance of wear the vibrator is markedly redcued. The most widely used form of vibrators therefore have vibration frequencies varying from 2800 to 6000 VPM and amplitude of vibrations correpondingly, varying from 1.0 to 0.1 mm.

Besides frequency and amplitude, the acceleration of vibration is also an impoitant factor. For external vibration of concrete (as in case of block making machines in general), the criterion for effective compaction at constant workability and constant time of vibration is acceleration with the provision that at frequency upto 6000 VPM, the acceleration is greater than 1.5 and at frequencies greater than 6000 VPM, amplitude is greater than 0.04 mm. The available block making machine works at higher side of frequency range, 6000 VPM and lower amplitudes and are therefore more suitable for concrete with smaller aggregates. Since the new block marking machine was required to primarily cast the stone blocks and the large aggregate concrete blocks wherein lean mixes of concrete with larger size aggregates are involved, a lower frequency of 3000 VPM and a corresponding higher amplitude of 1.5 mm with and a acceleration of about 7 g were considered desirable in the light of the recommendations of IS : 4656-1968-Specifications for Form Vibrators for Concrete. A top pressure of 30 to 100 gm/cm^2 has been reported to improve the flwoability of concrete during vibration and is particularly helpful in handling stiff mixes. A top pressure of about 50 to 80 gm/cm^2 was found effective in case of stone blocks and large aggregate blocks respectively.

Features :

The CBRI's block macking machine (Fig. 1) comprises a four wheel trolley with front pair of wheel having steering arrangement and a portal frame which on its top carries a horizontal power shaft connected to an electric motor through V-belt and pulleys. A mould block with a number of mould cavities is placed centrally inside the portal frame. Two vertical power screws, one at each end of the mould block, are used to raise or lower down the mould block. The lower end of the power screw after passing though the edge of mould block is supported in a bearing which in turn is supported with the trolley. The top end of power screw is connected with the aforesaid horizontal power shaft through gears, This arragement helps in liffing or lowering down the mould block by motor power.

The mould block has a number of cavities or moulds for casting more than one block at a time. One form vibrator is rigidly fixed with each opposite face of longer side of the mould block. A bridge arranged just above the mould block carries a many number of pressure platens as three are mould cavities in the mould block. The pressure platens kept the concrete pressed in the mould during vibration and latter help during ejection of the newly cast blocks from the moulds. The bridge also carries a system which provides required amount of top pressure through the pressure platens on the concrete in moulds at the time of the compaction of concrete. The vertical upward movement of the bridge is achieved through the mould block when the later is lifted up with the help of two power screws. The connection between the power screws and the mould block is through two lifting pads each fitted on the edge of opposite shorter faces of the mould block. The fitting pads have built-in vibration isolating devices that help in confining the vibrations (during compaction of concrete) only to the mould block. Salient features of the machine are given in the following :

* A portabie egg laying type machine.
* Six blocks of size $30 \times 20 \times 15$ cm cast in one operation.
* Output of 120 to 150 blocks of above size in on hour.
* Better compaction ensured through pressure vibration.

* Two vibrators each of 0.5 KW capacity and frequency 3000 VPM used for consolidation of cocerete.

* Suitable for casting stone blocks, large aggregate concrete blocks, traditional concrete blocks and hollow blocks.

* Operator's access right upto the moulds helps in easy placement of stone spalls in casting stone blocks and screeding of concrete in the moulds while casting large aggregate blocks.

* Power required : 3 KW.

Working and Trials :

The machine is placed on the casting platform which should be a levelled and well finish concrete floor. Waste newspapers or polythene sheets are laid on the platform for easy removal of the block next day. The mould block is first made to rest on the platform by operating the power screws. Concrete prepared in a concrete mixer is received in special trolleys (Fig. 2) and brought to the block making machine and dumped in the moulds. Screeding of concrete is done manually (Fig. 1) to bring the concrete to the same level in all the moulds The operator then allows the bridge to drop freely. This results in a sudden impact which passes through the pressure platens on to the concrete filled in moulds. Vibration of concrete is later carried out by switching on the two form vibrators simultaneously. The vibration is maintained till the full height of the compacted block is achieved. The mould block is then lifted up leaving cast concrete blocks on the platform. During upward moving when the mould block completely clears the cast blocks, the former comes in contact with the bottom face of bridge. From this stage onwards the bridge is also lifted up alongwith the mould block resulting into simultaneous breaking of the contact between all tne pressure platens and the top face of cast blocks. When both the mould block and the bridge are raised to a certain height, their upward movement is automatically stopped with a limit switch. The machine is then moved forward on its wheels to a new position of casting while leaving the newly cast blocks behind on the floor.

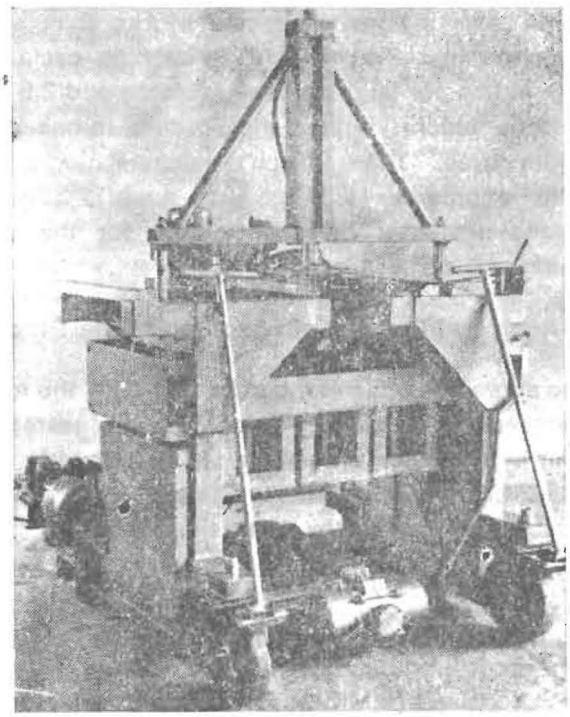

Fig. 1 CBRI Concrete Block Making Machine

The prototype block making machine was extensively tried first in the Institute (Fig. 2) and later at the construction site of Building Centre, Sanganer, Jaipur. Both the stone block and large aggregate concrete block were successfully cast during

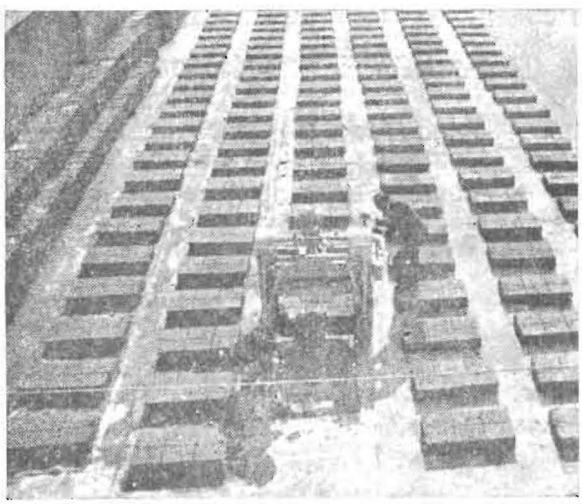

Fig. 2 Mechanised Production of Concrete Blocks

trials. The concrete with stone aggregate as large as 75 mm could be handled effective. Since the screeding of concrete in moulds take little more time in case of large aggregate blocks than stone blocks, the machine recorded an average cycle time of 3 minutes for large aggregate blocks and 2.5 min. for stone blocks, with 6 blocks cast in one cycle in both cases. The traditional concrete blocks with smaller aggregate (1.5 mm and down), however, recorded a shorter cycle of 2 min. for the same number and size of blocks.

Strength and Quality of Machine Made Blocks

Large aggregate concrete blocks cast with the newly developed block making machine were tested for strength and other properties. The following table highlights the test results. The age of the blocks was about thrree Months at the time of testing.

S.No.	Mix. Details	Test Results
Mix. No. 1 Cement		1 Av. Comp. strength –128 Kg/cm^2
	Sand (F.M.3 2)	9 Range Comp. strength –116 to 138 Kg/cm^2
	River Shingles 40mm.	9 No. of blocks tested –21
		Water absorption –4.1%
	W/c	1.1 Density (Av.) –2458/kg./m^3
		Range of Density –2440–2470 kg/m^3
Mix. No. 2 Cement		1 Av. Comp. strength –127 kg/cm^2
	Sand (F.M.3.2.)	10 No. of blocks tested –6
	50mm crushed aggregate	8 Water absorption –4 36%
	W/c	1.25 Density (Av.) –2420 kg/m^3
		Range of Density 2410-2420 kg/m^3

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Economy in Production

It has been observed in the field that the contractors normally employ a gang of about 20 persons to produce 1000 large aggregate concrete blocks of size 30×20×15 cm in one shift of 8 hours with manual method of casting. The gang includes labour for mixing concrete with a 200 litre mixer, conveying and filling of concrete in the moulds, vibrating the concrete with two plate vibrators, demoulding the blocks and preparing moulds for the next filling. Based on the July 1990 rate at construction site at Jaipur, labour cost of production is estimated in the manual method at Rs. 0.50 per block.

An estimate was also prepared for labour charges for making these blocks with the newly developed machine. The operating charges for the machine are Rs. 160.00 per day per shift of eight hours. Considering a production rate of 10000 large aggregate concrete blocks of size 30×20×15cm in one shift and using a concrete mixer of 200 litres capacity with Rs. 80.00 per day labour charges, the total cost of labour was estimated as Rs 0 24 per block which is 50 per cent of the labour cost of manually made blocks. Since in the field, the labour charges are about 20% of the total cost of a block, the mechanised production of blocks brings in substantial savings in labour charges in addition to improving strength and other properties of the block

Commercialisation

At 1990's pricing, the CBRI's Block Making Machine is likely to cost around Rs. 50,000.00. The know-how of the machine is available for commercialisation from National Research Development Corporation, (NRDC), 20-22. Zamroodpur Community Centre, Kailash Colony Extension, New Delhi-110 084.

Prepared by :

J.P. Kaushish, Bhagwan Dass, D.K. Gautam & Mahindra Pal

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