BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE INDIA

REINFORCED CONCRETE FRAMES FOR DOORS & WINDOWS

Introduction

R.C.C. frames for doors and windows have been tried out in the past with varying success. The chief objection for their extensive use lies in the difficulty in obtaining a suitable fixing arrangement for the shutters and lack of good finish. The increasing scarcity and cost of timber has revived the interest in R.C.C. frames which provide a durable and economical alternative. This digest describes reinforced concrete door, frame evolved at the CBRI*, for use in openings upto 7 ft., which covers most of the requirements in normal buildings.

Concrete mix, size and Reinforcement

The mix of concrete recommended is 1 : 2 : 4 with 3/8″ graded aggregate. Section of $3\frac{1}{2}$″ X $2\frac{1}{2}$″ reinforced with 3 bars 1/4″ dia. is recommended for adoption for all openings upto 7 ft. This size has been evolved as a result of tests under simulated conditions of use.

Mould

The mould may be of timber or steel. When timber is used, it is advisable to line it with G.I. sheets for longer life and better finish of the product. Lining also helps in reducing undue distortion of the mould due to wraping and shrinkage. For large scale production, steel moulds (Fig. 1) are preferable. The mould can also be used for producing smaller frames, provided adequate time is available for their production to fit in with the erection programme. Provision is made in the mould to accommodate the fixing devices and holdfasts. If required, a rebate may also be provided to act as a plaster groove.

Fixing of Shutters

Various methods of fixing the hinges to R.C.C. frames are in vogue. For example "Plate and Tube" fixture (Fig. 2A) has been found satisfactory, but this type of fixture proves to be elaborate and costly. Two cheap alternatives evolved in this Institute are described below ;

(a) **Aluminium Pipe Fixture** (Fig. 2 B)

The first alternative consists of a 3/16″ dia. aluminium tube sleeve having internal threading to suit 3/16″ screw. The rear end is pressed flat. The threading can be readily done at site by holding the tube in a vice. The fittings are inserted in the mould from the inner side and flattened ends of adjacent fixtures kept facing in different directions for better bond. The screws are inserted in the tubes from outside of the mould to keep the fitting in position during pouring of concrete as also to prevent concrete from getting into the fixture.

(b) **Wire fixture**

The second alternative consists of a helically wound wire of 22 S.W.G. on a wood screw. The screw is held in a vice and the wire wound around it, till it covers the screw and trails out by about $\frac{1}{2}$″ as shown in Fig. 2 C.

Both the types of fixing arrangements have been tested for their grip in the frames by means of pull-out tests and the results (table 1) indicate that both the fixtures are adequately strong.

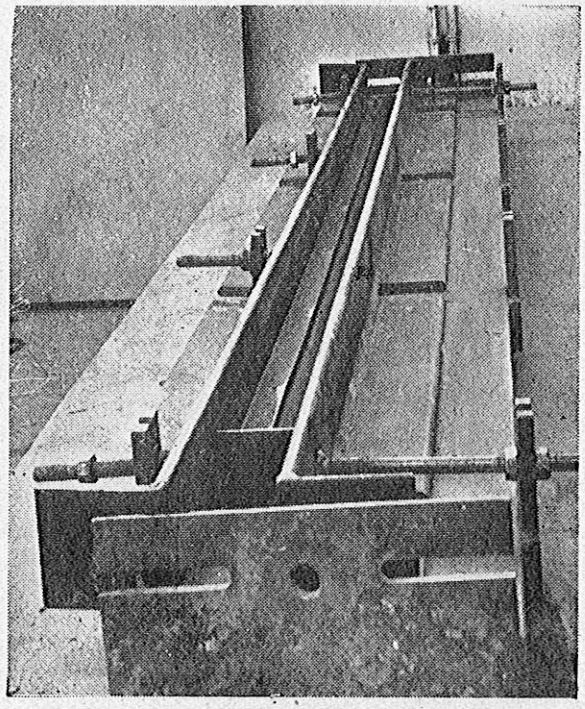

Fig. 1. Adjustable steel mould for R.C.C. frames.

* Full report of the experimental work is published separately in "Cement & Concrete" July-September 1963.

TABLE I

(Showing results of Pull-out test)

Sl. N.	Particulars	Individual load taken in ton at failure				Average	Remarks
		1st	2nd	3rd	4th		
1.	Hinge fixed to first class soft wood 6″ cube.	0.42	0.44	0.42	0.42	0.42	Screws came out of the block.
2.	Hinge fixed to first class hard wood 6″ cube	0.52	0.50	0 48	0.52	0.50	Hinge failed by tearing at the holes while the screw remained in the frame.
3.	Hinge fixed to aluminium tubes (Fig. 2 B) cast in 1 : 2 : 4 Concrete 6″ cube.	0 50	0.54	0.52	0.52	0.52	The fixture remained intact while the hinge failed at the holes.
4.	Hinge fixed to 22 S.W.G. spiral fixture (Fig. 2 C) Cast in 1 : 2 : 4 C-Concrete 6″ cube.	0.48	0.54	0.40	0.52	0.52	The hinge failed at the holes and the fixture along with the screws remained intact.

TABLE II

Showing basic production cost details of fixtures for a single pair of hinge of 4″ size

Sl. No.	Item	Quantity	Rate Rs.	Unit		Cost Rs.
1.	**Aluminium Pipe fixture**					
	Metal tubes Aluminium (4 nos. each 1¾″ long)	7/12 Rft.	0.36	Rft.		0.21
	Fitter	1/16 day	4.00	day		0.25
					Total	0.46
	Overheads @ 10%					0.05
					Total	0.51
2.	**Wire fixture**					
	Wire S.W.G. 22	4 Rft.	0.02	Rft.		0.08
	Fitter	1/25 day	4.00	day		0.16
					Total	0.24
	Overhead charges @ 10%					0.02
					Total	0.26

TABLE III

Showing costs of R.C.C. and timber frames for openings 3′ 6″ × 7′ in size

Sl. No.	Type of frame	Cost Rs. nP.	Saving in Cost	Remarks
1.	First class hard wood (teak)	35.00	—	
2.	Second class hard wood (sal)	28.00	—	
3.	First Class soft Wood (Deodar)	25.00		
4.	R.C.C. frame reinforced with 3 nos. ¼″ dia. bars and aluminium pipe fixtures for fixing hinge	16.00	54% 43% 36%	as compared to Sl. No. 1 -do- No. 2 -do- No. 3
5.	R.C.C. frames reinforced with 3 nos. ¼″ dia. bars and having wire fixture of 22 SWG, for fixing hinge.	15.00	57% 46% 40%	-do- No. 1 -do- No. 2 -do- No. 3

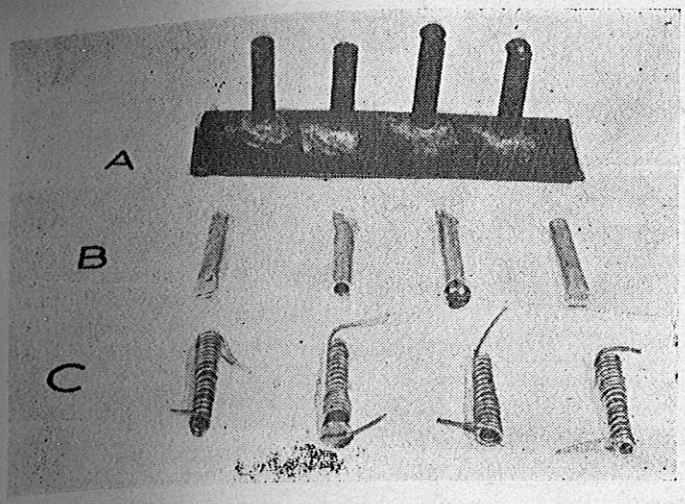

Fig. 2. Fixing devices

The range of variation for spiral fixture indicate that some care is necessary to ensure a uniform bond with concrete. The costs of fabrication of these type of fixtures based on prevalent rates for material and labour at Roorkee are given in Table 2.

Casting

The frame may be fully precast element or assembled at site out of precast members. The former has the advantage of reducing work at site but introduces difficulties in transporting and handling. Since damage to even one member can result in rejection of the whole frame, the latter method is relatively more suitable and economic. When cast in separate parts, one of the reinforcing bars of the vertical members of the frame is kept projecting so as to tenon into corresponding holes in the horizontal members as shown in Fig. 3. The holes in the horizontal members should be some-what larger to facilitate easy insertion of the projecting bars. It is advisable to use a vibrating table for compacting the members or alternatively a shutter vibrator may be used. Hand compaction can provide the required strength but the finish is likely to suffer.

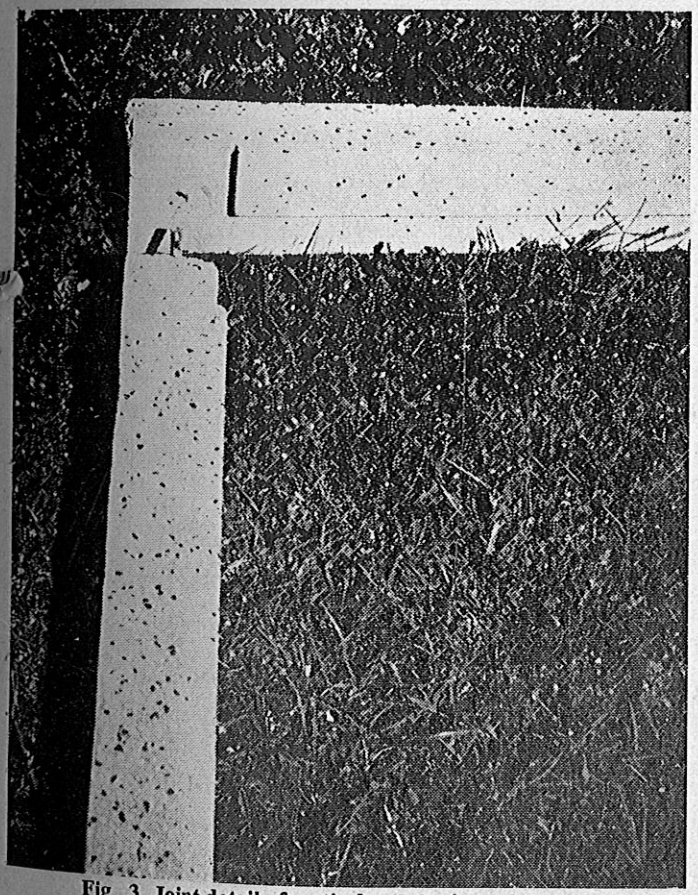

Fig. 3. Joint detail of vertical and horizontal members

Removal of members and curing

The cast products should be removed from the mould after about 24 hours. They should then be allowed to cure in a water tank for a fortnight. Finally they should be removed to a covered place and preferably stored for a month before use.

Finish

A good finish can be obtained by employing smooth surfaced mould and vibration. The defects, if any can be readily made good by rubbing the frame with carborandum stone before erection. Plastering or touching up should not be permitted as far as possible.

In high class of works, various decorative treatments can be given to members, such as painting and terrazzo finish. When terrazzo finish is to be given, the mix used should be of 1 Cement : 2 chips laid on the three exposed faces of the members while casting the frame. Some care is necessary to ensure that the inner edges do not suffer damage.

The paints used should normally be cement paint of an approved brand. When an oil paint finish is desired it should be done in three stages.

(a) Priming coat—2 coats of alkali fast primer should be applied.

(b) Under coat should consist of synthetic resin paint conforming to IS 520-1954.

(c) Finishing coat should consist of 2 coats of synthetic enamel paint conformiug to IS 520-1954 (colour as per choice)

Erection

The R.C.C. frames may be assembled and erected as in case of timber frames. They however require some care in handling, as they are heavier and the joints are liable to give way if not handled carefully. Alternatively vertical members may be held in position and the top member placed over the vertical members. The whole frame is then plumbed and supported temporarily till the hold fasts are embedded in jambs. Cement sand slurry of mix 1 : 3 should be used in grouting the joints between the vertical and top members. In cases where four members are used such as in window or doors having sills, the bottom

members are first placed in position and the others erected on this base as described above.

Economics

For comparison of costs, an average door size of 3'6" × 7' with a section of $3\frac{1}{2}'' \times 2\frac{1}{2}''$ has been choosen and cost analysis prepared for different types of frames on the basis of prevailing prices at Roorkee (Base March 1963), The costs of various types of frames are given in table 3. This shows that R.C.C. frame offers substantial economy as compared to timber frames and may cost only half as much as hard wood (teak) frames.

Conclusion

The foregoing clearly shows that the difficulties normally met with in use of R.C.C. frames can be readily overcome. Such frames will not only be cheaper in initial and recurring costs, but can also assist in overcoming the shortage of timber. Use of concrete offers possibilities of various type of forms and finishes to satisfy functional and aesthetic requirements at economical costs.

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need this Institute is bring out a series of Building Digests from time to time and the present one is the nineteenth in the series.

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