Separating media for concrete battery casting

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The work referred in the paper is a part of the research programme on development of large panel prefabrication system being carried out at the Institute.

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Synopsis :

For on-site production of large concrete panels, Battery Casting in Concrete moulds is a suitable technique. The major problem faced in the use of concrete moulds is in separating the mould panels and the panel cast due to good bond between them. This besides creating difficulty in demoulding the battery also affects the surface finish of the production panel. Investigations have been carried out at the Central Building Research Institute, Roorkee and suitable specifications for the separating medium which ensure easy and clean separation have been formulated.

Introduction :

Among the various casting techniques for prefabricated concrete walls and floor panels, vertical casting in a battery is a most attractive proposition and has been adopted in various countries. The battery moulds are either of steel or concrete. In case of steel moulds, the plates have to be machined to get true plane faces and to get maximum benefit of early stripping and reuses or turnover arrangements for steam curing are generally incorporated. This calls for high initial investment and is more suitable for factory casting. On the other hand, concrete moulds are simple to produce and economical and are therefore preferred for on-site casting.

The principle adopted is that two panels are cast horizontally, referred to as parent panels. They are erected vertically with a gap between them and one of these is fixed against a frame-work. Afterwards stop ends are fixed at both sides of the parent panels and concrete is poured from the top in the gap. The panel thus cast is referred to as battery panel. Requisite number of battery panels are cast using parent panels over and over again. The battery pannels are assemble in between parent panels to form the battery for casting *production panels* (*Fig.* 1). Since the production panels are cast in between the concrete battery panels, there is a need for applying a separating coating on the battery panels to ensure quick and easy release of the production panels. In foreign countries, proprietary release agents for different shuttering materials and concrete moulds are readily available. However, such release agents are not available, in India. Therefore, a detailed investigation was undertaken at the Institute to arrive at suitable specifications for the separating medium for concrete moulds.

The basic requirements for the separating medium are as follows :

(*i*) should be easily applicable;

(*ii*) should ensure easy and clean separation between the panels ;

(*iii*) should not produce stains on the cast pannel ;

(*iv*) should require minimum efforts for cleaning the battery panels for subsequent castings ;

(*v*) should be economical.

Experimental work :

Two types of separating medium viz. lining materials and brushable materials were studied.

Lining materials :

The lining materials which are either flexible or rigid when stuck on to the concrete moulds, generally, require little effort for releasing. Among the flexible linings, building paper, polythylene sheet and rexine-cloth were tried. It was found that these linings are difficult to be laid wrinkel-free and are liable to be damaged during vibration. Therefore, they are not recommended to be used. The rigid linings are free from the above stated drawbacks and the following were tried with a view to find their suitablity :

(*i*) 10 mm shuttering plywood;
(*ii*) 24-gauge G. I. sheet ;
(*iii*) Fibre-glass reinforced plastic sheet.

These linings were stuck on to 1 m X 1 m concrete panels with PVA resin and pressure of about 200 kg/M² was applied on it for about 12 hours. These panels were then made vertical and release agents as per details given in table 1 were applied with a brush. Afterwards they were assembled with a gap of 12.5 cm between two successive panels and 1:2:4 cement concrete was poured and vibrated. After 48 hours of concreting the moulds were separated and surface of cast panel and lining observed for finish and transfer of matrix.

Brushable materials:

Brushable materials are easily applicable but the effort needed to release the panels is of larger magnitude and depends upon the quality of release agent and the degree of smoothness of the battery panels. These two factors also have marked influence on the surface finish or production panels. To study the efficiency of release agents in terms of release force needed for separating the panels, surface finish of cast panels and transfer of matrix on battery panels, a half-size battery of 180 cm X 150 cmkeeping the normal thickness of 12.5 cm for the panels was set up. The parent panels were cast horizontally having 1 cm thick mosaic layer on the bottom face. The panels were turned upside down and the mosaic surface was polished smooth. The parent panels were erected vertically and battery panels 12.5 cm thick were cast against the polished surfaces. The parent panels were used over and over again to cast all the battery panels. The release agents as mentioned in table 2, were then applied on the battery panels and these were assembled into a battery with parent panels

TABLE I—PERFORMANCE OF RIGID LININGS

Sl. No.	Lining	Release Agent	*Observations
1.	Shuttering Plywood	Lubricating oil grade 30	A little transfer, reasonably good surface.
		Lubricating oil grade 140	No transfer. Oil stains on the cast panels, surface not acceptable.
		One kg of protland cement mixed with 1 litre of lubricating oil grade 30	A little transfer, surface rough.
		1 kg portland cement 100 gms of soap with 1 litre of water	No transfer, surface smooth.
		1 kg of hydrated lime 100 gms of soap with 1 litre of water	No transfer, surface smooth
2.	G. I. Sheet, 24-Gauge	Lubricating Oil Grade 30	Lot of transfer, separation difficult.
		1 kg cement 100 gm. soap with 1 litre water	No transfer, separation easy.
		150 gm. Grease mixed with 1 litre of Kerosene Oil	
3.	Fibre-glass reinforced plastic sheet	Light dressing of lubricating oil grade 30	No transfer, surface too smooth to receive white washing

*This means that the matrix of concrete remains sticking the battery panels.

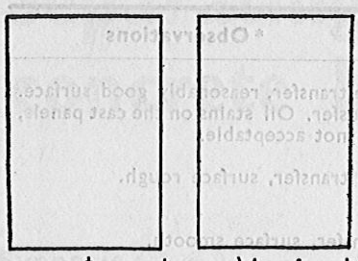
TABLE 2 PERFORMANCE OF BRUSHABLE MATERIALS

A—Release agents applied directly on surface of battery panels.

Sl. No.	Release Agent	Releasing force kg/ m²	Observations
1.	Lubricating oil grade 30	Casting not done	Oil flows down due to low viscosity.
2.	Lubricating oil grade 140	1200 to 1400	A little transfer, reasonably smooth surface.
3.	1 kg of portland cement mixed with 1 litre of lubricating oil grade 30	900 to 1000	Transfer in patches, surface finish not satisfactory
4.	Thin paste of 300 gm of yellow grease in 1 litre of kerosene oil	casting not done	No effective film formed.

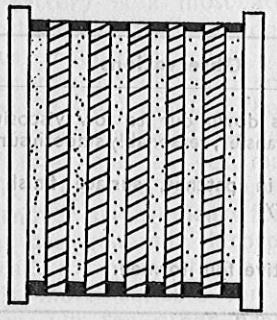
B—Release agents applied on the surface coated battery panels.

Sl. No.	Coating	Release agent	Releasing force kg/m²	Observations
1.	Polyster resin	Not used	600 to 700	Transfer uniform, surface not acceptable.
		1 kg of portland cement mixed uniformly with 1 litre of lubricating oil grade 30	Casting not done	Uniform application of the paste not possible.
		Thin paste of 300 gms of yellow grease in 1 litre of kerosene oil	300 to 350	No transfer, surface smooth.
2.	150 gm of parafin wax dissolved in 1 litre of kerosene oil	Not used	600 to 700	A little transfer, surface not acceptable.
		Lubricating oil grade 140	300 to 350	No transfer, surface smooth, but having oil stains.
		1 kg of portland cement mixed uniformly with 1 litre of lubricating oil grade 30	300 to 350	Application difficult, practically no transfer, surface smooth.
		Thin paste of 300 gms of yellow grese in 1 litre of kersene oil.	300 to 350	Easily applicable, no transfer, surface smooth.



parent panels, cast horizontally
plan

battery panel, cast
between parent panels
plan



complete battery
plan

battery panel ▨
parent panel □
production panel ▣

Figure 1
Principle of Battery Casting.

remaining at the ends. Production panels were cast in the battery by pouring concrete in the gaps and compacting by 4 cm needle vibrator. After 48 hours, the panels were jacked up vertically one by one and the pull required to separate the panels as well as surface finish of the production panels were observed.

Results and Discussions :

Lining Materals—The results are given in Table 1. For shuttering plywood, lime soap emulsion and cement soap emulsion gave best results. Lime has to be slaked or converted into putty before being used for preparing the emulsion. For the G. I. sheet, yellow grease mixed with kerosene oil proved satisfactory. Fibre-glass reinforced plastic sheet being smooth does not require any application of release agent, light dressing of oil does the job.

Brushable materials—The results are presented in Table 2. It may seen that with the release agents applied directly on the battery panels, the released force required to separate the panels ranges from 900 to 1400 kg/m^2 which is about 3 to 5 times the weight of the panel. To reduce the amount of release force, plastic coat and wax coal were tried. The plastic coat consisted of single application of polyster resin, while wax base coat consisted of 3 applications of 150 gm of molten paraffin wax thinned with 1 liter of kerosene oil applied on three consecutive days.

With the polyster resin base, the release force is reduced but the surface finish of cast panel is not good. However, a film of grease thinned with kerosene oil applied over it further reduces the release force and the surface finish is also satisfactory. The plastic film starts scaling off the surface of the battery panels after a few days. With wax base coat, cement-oil emulsion and grease-kerosene oil paste give good results. With these, the release force is almost equal to the weight of the panel.

In view of easy mixing and application, grease-kerosene oil paste is preferred. With the same wax-base coat on the battery panels, 5 castings were tried by applying the grease-kerosene oil paste for each castings. This was observed to give satisfactory surface finish to the cast pannel and also the wax coat on the battery panel remained intact. The wax base coat seals all the surface pores of bartery panels and thus helps in reducing the release force. Greased-kerosene oil applied over it acts as an effective release agent. Trials were also made with 'esso' wax emulsion which is a milky white emulsion of wax uniformly dispersed in water with selected emulsifiers which was applied in place of kerosene wax solution. Two coats of emulsion mixed with equal volume of water were applied on the battery panels at an interval of 3-4 hours. This also gave satisfactory results.

Conclusions :

In view of the high cost of lining materials and the difficulties met with in sticking it to the concrete panel, brushable materials are to be preferred. A suitable specifications for the same consist of a thin film of paste containing 300 gm of grease and 1 litre of kerosene oil applied over a thin wax base coat : For the later, Esso wax emulsion has also been found to be very effective. The base coat is to be applied only after eight ten castings while the film paste is to be applied before each casting. The specifications may be followed on the concrete floor also in case of horizontal castings.

Acknowledgement :

The work referred in the paper is a part of the research programme on development of large panel prefabrication system being carried out at the Central Building Research Institute, Roorkee. The paper is published with the permission of the Director.

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