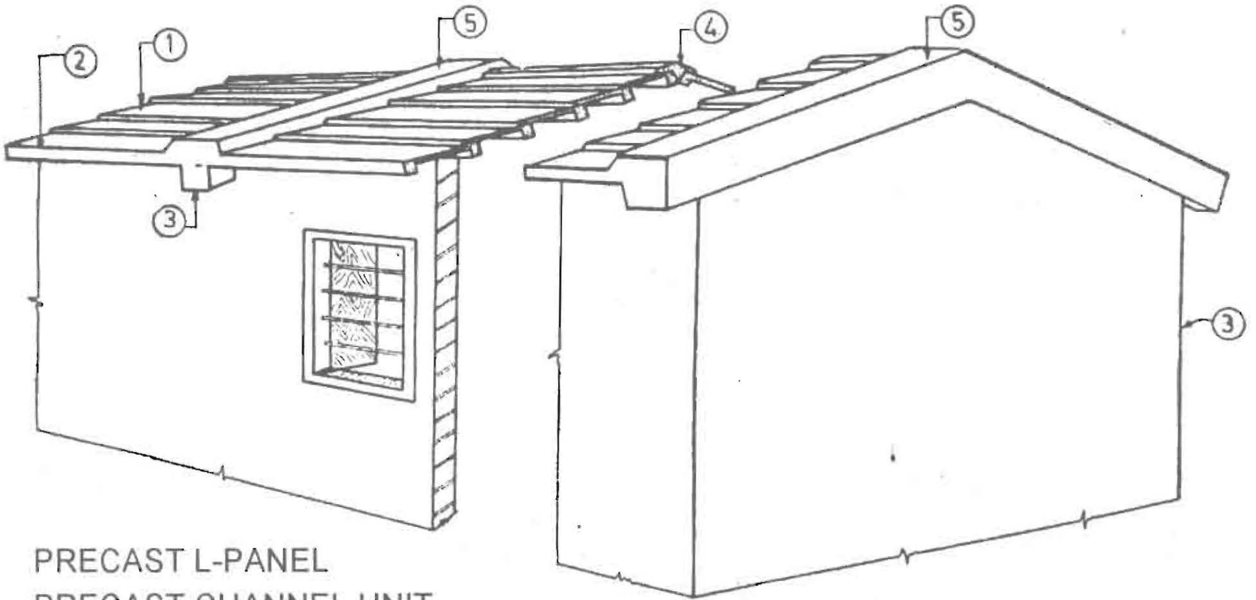
CENTRAL BUILDING RESEARCH INSTITUTE, ROORKEE-247667 (INDIA)

BUILDING RESEARCH NOTE

B.R.N. 61

L-PAN ROOFING

Prefabricated L-Pan roofing mainly consists of full span R.C.C. L-shaped components (Fig. 1) and (Plate-1). Sheeting and purlins or battens, normally used for a conventional sloping roof are monolithically composed into single components in this scheme. The precast panel has its section as 'L'. Its smaller leg functions as rib of an L-beam and the wider leg (flange) as sheeting, besides resisting flexural compressive stresses resulting in an efficient from (Fig. 2). The dimensions are variable but so chosen that they give maximum economy and the units are easy to handle. Full span components are supported on parallel gable walls or trusses with suitable slope. In the transverse direction, the flanges rest on the ribs of adjacent lower panels with overlaps. A special channel unit may be provided at the eave in case of a verandah or where wide facia is desired for aesthetic considerations.



1 PRECAST L-PANEL
2 PRECAST CHANNEL UNIT
3 GABLE WALL/RAFTER
4 INSITU RIDGE
5 INSITU SIDE CONCRETE

Fig. 1
Sectional Perspective View of L-Pan Roofing

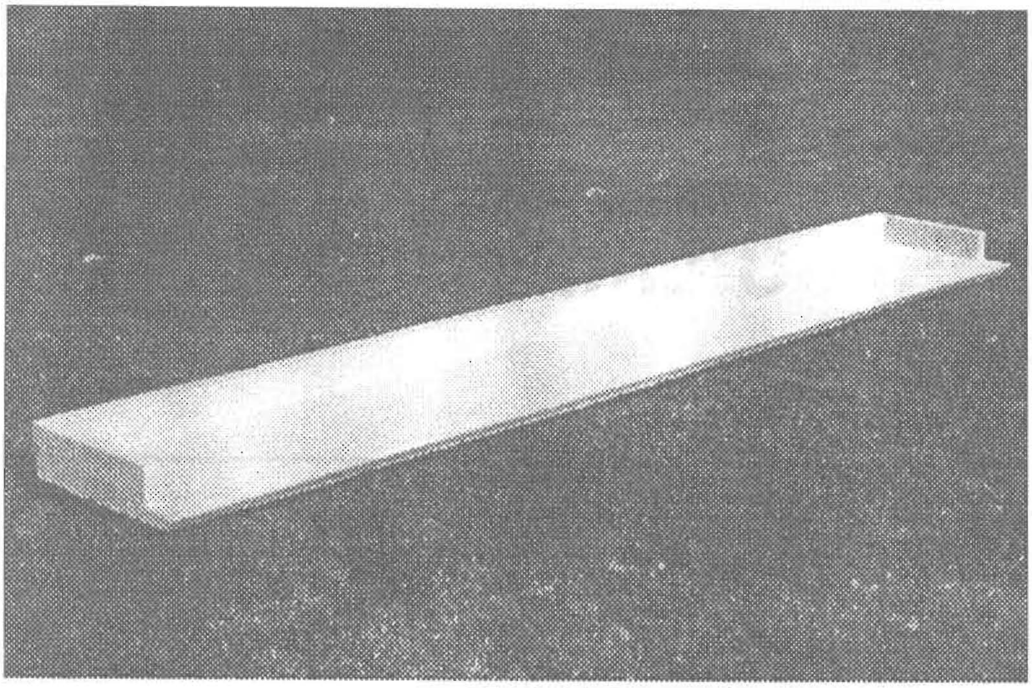


Plate 1 — Precast RC L-Panel

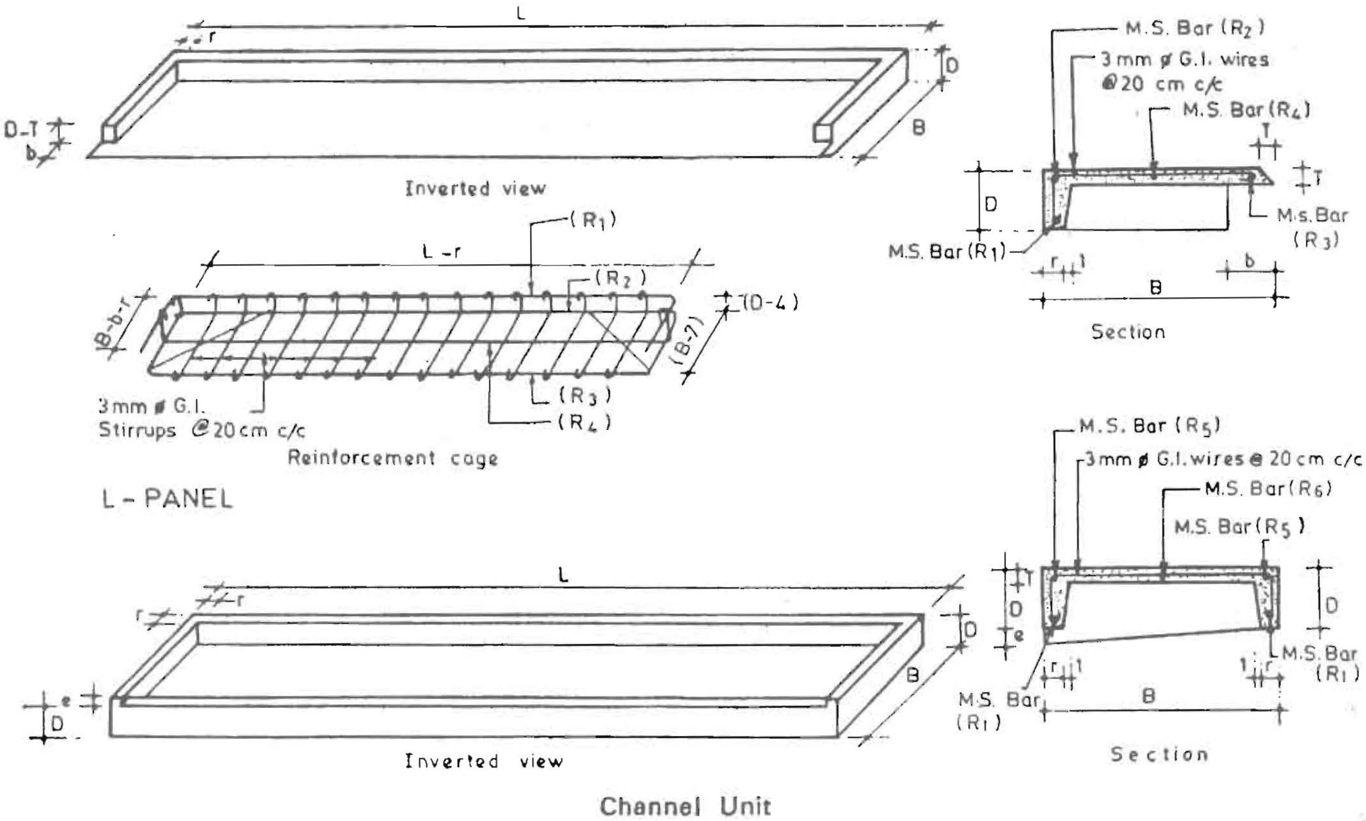


Fig. 2 Details of L-Panel and Channel Unit

DESIGN PROCEDURE

1.	Length of panel	=	L
2.	Width of panel	=	B
3.	Depth of rib	=	D
4.	Width of rib	=	r
5.	Thickness of flange	=	T
6.	Extra depth of slanting side rib of End panel	=	e
7.	Effective depth of rib	=	d
8.	Overlap between two panels	=	b
9.	Slope of gable walls ($\tan\theta_1$)	=	1/n
10.	Outer roof projection	=	p
11.	Outer width of room	=	B_r
12.	Total number of panels (for both the slopes)	=	N
13.	Effective length of panel (span)	=	l
14.	Effective width of flange	=	bf

Size of Components

The length of components depends upon the width of the room and can be upto 4.00 m, though lower size is preferable for ease in handling and erection. Modular calculations for choosing the width and number of components are made as follows :

1. Slope of flange $= \dfrac{1}{n} - \dfrac{T}{B-b}$

$= 1/x \text{ (say)} = \tan\theta_2$

Or- $\theta_2 = \tan^{-1} 1/x$

By putting the chosen values of Br, x, b and D the values of B and N for a double sloped roof can be found by trial solution of the following equation :

$$Br + 2p = N.(B-b).\frac{x}{\sqrt{1+x^2}} + \frac{2.D}{\sqrt{1+x^2}} + 2.b.\frac{x}{\sqrt{1+x^2}}$$

For practical purpose with gable wall slope ranging from 1 : 4 to 1 : 2.5, T ≈ 3 cm, D ≈ 12 cm, B ≈ 50 cms. The equation can be simplified for a doubly sloped roof, as

$$Br + 2.p = N(B-b-2) + \frac{D}{2} + 2b$$

(Dimensions in cms).

Design of L-Panels

Steps :

(i) Dimensions

effective length of each panel (l)

$$= L - 2 \times \frac{\text{bearing}}{2}$$

$$= L - \text{bearing}$$

chosen, slope of gable wall $\theta_1 = \tan^{-1} 1/n$

find slope of flange of panel $= \tan^{-1} 1/x$

(ii) Dead Load

Volume of each panel

$$= [T.B. - \tfrac{1}{2}T^2 + (D-T) \times r] \times L + r(B-b-r) \times (D-T) \times 2 = V \text{ (Say)}$$

∴ Dead weight/panel (Wd) $= V \times 2400$ kg.

(Weight of grout concrete at overlapping joints is neglected).

(iii) Live Load

Horizontal width/panel $= (B-b)\dfrac{x}{\sqrt{1+x^2}} = H$ (Say)

∴ Horizontal area/panle/m $= H \times 1.00 = H$.

Live Load/unit area $= 75-(\theta_1 - 10) \times 2 = (95-2\,\theta_1)$ kg/m². (As per latest code provisions or as per earlier norms).

∴ Live load/panel (Wl) $= (95-2\theta_1)\,1.H.$,

∴ Total load/panel (W) = Wd + Wl.

The panels are designed as simply supported beams. Hence Maximum B.M.

at mid span $= M = \dfrac{W.l}{8}$

∴ B.M. perpendicular to the flange $= M_1$

$= M.\cos\theta_2$

B.M. parallel to the flange $= M_2 = M.\sin\theta_2$

At special occasions, the intermediate joint between two bays may be made continuous by projecting out reinforcement rods at the ends of the panels during casting and connecting the rods preferably by welding before grouting at site

The design B.M. should, however, be taken as

$\frac{W.l}{8}$ at mid span.

Effective width of flange of 'L' beam for taking compressive stresses

$$= bf = \frac{0.5.l}{(l/B+4)} + r$$

Approximate tensile steel area

$$= \frac{M_1}{tp.jd.}$$

Provide single bar of suitable diameter in the rib and actual area of steel = At (Say).

$$\therefore \quad m.At(d-n) = bf.\frac{n2}{2}$$

Where m = modular ratio of the grade of concrete chosen.

tp = Design stress of reinforcement steel
At = Area of tensile steel
n = depth of neutral axis
d = effective depth of the section
= D-Cover of reinforcement
= D-2

Choosing the design stress of steel and putting the values of m, bf, At, d and solving the equation, find n.

The unit is designed like an L-beam. In most situations, the neutral axis will be within or very near to the flange and hence for practical purposes the design can be made as for a rectangular beam. Therefore, the considered amount of tensile steel will be sufficient for taking flexural stresses due to M_1.

Compression in the Flange

Moment of resistance in balanced section = $Mr = R_1 . bf.d^2$. It will, most often, be greater than M_1. Hence single reinforcement is sufficient. Yet for taking handling stresses reinforcement in the flange is essential. M.S. rods of 6 to 10 mm dia shall be provided in the flange which are sufficient for taking stresses due to the other component of bending moment (M_2). Safety against shear force, bond stress etc. is also to be checked as in a traditional design.

Wind Load Analysis

Wind load check should be done in conventional manner with the following steps or as per latest code provisions.

1. Basic wind pressure = P
2. Find co-efficient for $\theta 1 \pm 0.20$ for semi-permeability.

Multiply the above value with a reduction factor of 0.75 for roof height equal to or less than 10 metres.

Net co-efficient = f

Design wind load = f.P. (perpendicular to roof)

Weight of each panel = Wd.

added wt. of end grouts ≈ 10 kg/panel.

$\therefore$ Total D.L./panel = Wd + 10 (vertical)

$$\therefore \quad \text{Total D.L./m}^2 = \frac{Wd+10}{H.L.}$$

$\therefore$ Total D.L./m^2, acting perpendicular to roof surface

$$= \frac{Wd+10}{H.L.} \cos\theta_1$$

If this value exceeds the value of f P. no anchorage is needed. In addition to this, no anchorage is needed upto a basic wind pressure of 150 kg/m^2 (for short duration). Above 150 kg/m^2 anchorage at the ends of panels is recommended. No extra reinforcement in the components is necessary for prevailing wind pressure in India.

At the eave where special channel unit is essential, the same tensile reinforcement is provided in both the ribs, while the width is kept same as for an L-panel. Separate design is, therefore not necessary. For normal conditions M-150 concrete is used in the scheme, while for high rainfall and corrosive environment higher grade of concrete is recommended besides taking other precautions. While choosing mix proportions, strength along with impermeability of concrete should be attained. Damp proofing compounds of standard quality may be mixed with concrete to make it impervious. 10 mm and down crushed stone chips and coarse sand both free of any impurities, should be used as coarse and fine aggregates respectively. Overlap between two adjacent components varies from 8 to 15 cm depending upon the climatic conditions. Thickness of the flange also varies from 3 to 4 cm mainly on the basis of climatic conditions. In coastal areas and in aggressive environment the reinforcement should be protected against corrosion by suitable treatments. Slope of gable wall may vary from 1: 4 to 1: 2 depending upon climatic conditions.

Table 1 can be referred to for getting the m.s. reinforcement for different sizes of units. Detailed calculations can be carried out for rigorous design. It is preferable to keep the size of the units within low range for easy manual handling. Type and grade of concrete, thickness of flange, over lap between two parallel units, slope of gable walls, etc. are designed mainly on the basis of climatic condition and utility of the building. For ready reference, table 2 may help in choosing these parameters.

Supporting Structures

The precast L-panels can be supported over sloping masonry gable walls, trusses, portal frames or sloping beams. Minimum half brick thickness of walls should be used. However, they should be designed properly and laid perfectly in plumb to have appropriate bearing of L-panels, and sound lateral stability. The top two or three courses of bricks should be laid in the same roof slope to improve bearing of roof as well as aesthetics in side view. Anchorage rods, if needed, can be inserted through the mortar joints of the top courses as mentioned above. In case of rafters with projected stirrups at the top, the insitu slanting ridge concrete may act structurally in composition, resulting in more economic design of such structures.

A few innovative composite structures have been developed at the Institute, which may further reduce the cost of construction of such supporting systems.

PRODUCTION OF COMPONENTS

Mould

The mould should be made of well seasoned good quality timber (Plate-2). For mass production a steel mould may be used. The mould is quite simple and consists of two parts. Outer frame of the L-pan mould is composed of 4 separate pieces and the inner one is a single piece.

The dimensions and shape of various parts of the moulds for L-panel as well as channel unit are shown in Fig. 3. Steel moulds can be designed as per necessity. Flexible steel moulds for multiple sizes of components can also be suitably designed.

Casting

Outer pieces of the mould, after lubrication are

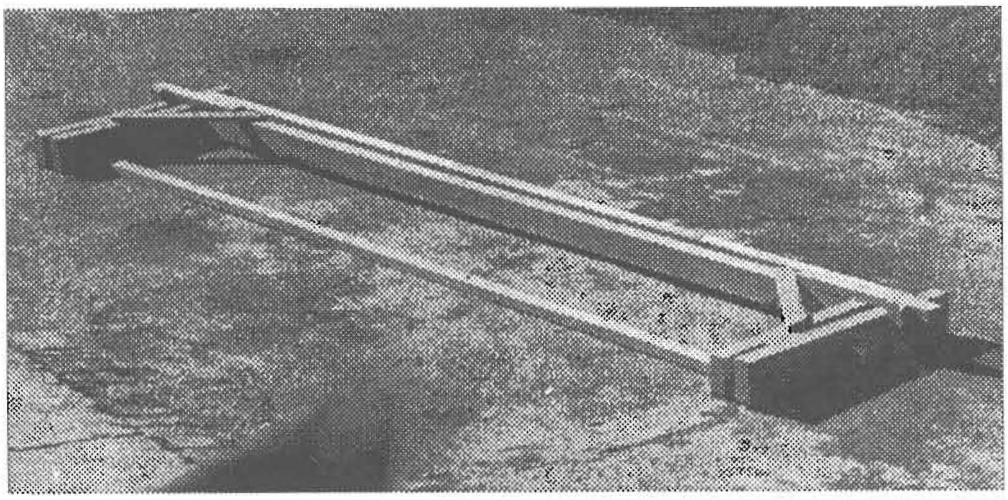


Plate 2 — Simple Timber Mould for Casting L-Panels

Table 1 : Schedule of design of L-Panels and Channel Units

Sl. No.	Length	Reasonable Breadth Ranges	Depth of Rib	Width of Rib	Thickness of flange	Dead weight	Dia of Tension bar (m.s.)		Diameter of bars in flange (Ref. Fig. 2)			
	L (cms)	B (cms)	D (cms)	r (cms)	f (cms)	Wd (kg)	R_1 (mm)	R_2 (mm)	R_3 (mm)	R_4 (mm)	R_5 (mm)	R_6 (mm)
1	2	3	4	5	6	7	8	9	10	11	12	13
1	120	50	8	4	3	52	6	6	6	—	6	—
2	120	60	8	4	3	62	6	6	6	—	6	—
3	120	70	10	5	4	96	6	6	6	6	6	6
4	120	80	10	5	4	110	6	6	6	6	6	6
5	120	90	10	5	4	123	6	6	6	6	6	6
6	150	50	8	4	3	65	6	6	6	6	6	—
7	150	60	8	4	3	77	8	6	6	6	6	—
8	150	70	10	5	4	120	8	6	6	6	6	6
9	150	80	10	5	4	135	8	6	6	6	6	6
10	180	50	10	4	3	82	8	6	6	—	6	—
11	180	60	10	4	3	96	8	6	6	6	6	6
12	180	70	10	5	4	142	8	6	6	6	6	6
13	210	50	10	5	3	100	8	6	6	—	6	—
14	210	55	10	5	3	108	8	6	6	6	6	—
15	210	60	10	5.5	3.5	132	10	6	6	6	6	6
16	210	65	10	5.5	3.5	143	10	8	6	6	6	6
17	240	50	10	5	3	113	10	6	6	6	6	—
18	240	55	10	5	3	122	10	6	6	6	8	6
19	240	60	12	5.5	3.5	154	10	6	6	6	8	6
20	270	45	10	5	3	115	10	8	6	—	6	—
21	270	50	10	5	3	126	10	6	6	6	6	—
22	270	55	12	5.5	3	150	10	8	6	6	8	6
23	300	45	12	6	3	144	8	10	6	—	6	—
24	300	50	12	6	3	156	10	8	6	6	8	—
25	300	55	12	6	3	168	10	8	6	6	8	6
26	315	50	12	6	3	163	10	8	6	6	8	6
27	330	40	12	6	3	145	10	8	6	—	8	—
28	330	45	13	6	3	164	10	8	6	—	8	—
29	360	35	13	6	3	150	10	8	6	—	8	—
30	360	40	14	6.5	3	174	10	10	6	—	10	—
31	390	30	14	6.5	3	157	10	10	6	—	10	—
32	390	35	15	7.0	3	184	10	10	6	—	10	—

Note : Mild steel bars have been used in the above table. For other types of steel including torsteel, suitable conversions can be made.

Table 2 : Utility and Climatic Factors for Design

Deciding Factor		Minimum specifications					
Type of building/utility	Climates	Slope of gable wall (tan θ,)	Overlap between panels (cm)	Thick-ness of flange (cm)	Grade of conc-rete (M)	Admix-tures in conc-rete	Other treat-ments
1	2	3	4	5	6	7	8
School buildings, sheds, garage etc.	Very low rainfall area	1:4	8.0	3.0	150	Nil	—
School buildings, sheds, ordinary storage, community buildings, office buildings, etc.	Low rainfall area	1:4	9.0	3.0	150	Nil	—
School buildings, residential buildings ordinary shops, general stores, etc.	Medium rainfall area	1:3:5	10	3.0	150	Nil	—
Important residential buildings, important shops, important storages, record rooms etc.	High rainfall area	1:3.0	12	3.5	200	D.P.C.	—
Very important shops record rooms, dry storage, etc.	Very high rainfall area	1:2.5	15.0	4.0	250	D.P.C.	—
Any building	Cold and snowfall regions	1:2	10.0	3.5	200	Nil	—
Any Building at coastal area	Aggressive	1:3	12	3.5	200	D.P.C.	Anticorrosive treatments to reinforcement
Chemical factories, industrial buildings dealing with reactive materials etc.	Reactive environment	1:3.5	10	3.5	200	D.P.C.	—Do— and other suitable coatings and admixtures

Note : More critical of columns (1) and (2) will be the deciding factor for design.

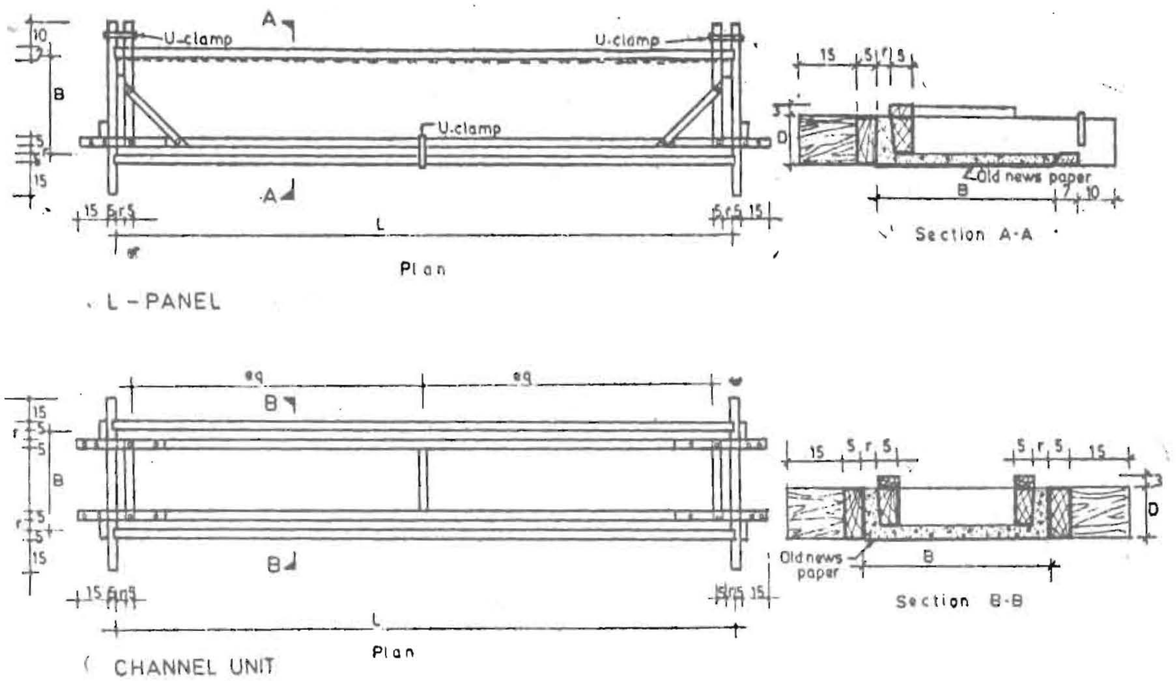


Fig. 3 Details of Timber Moulds for L-Panel and Channel Unit

assembled over old newspapers / alkathene sheet over a smooth and levelled platform. A thin layer of cement-sand, dry/wet mortar (1 : 1) is spread over the paper to a thickness of 3 to 5 mm.

Suitable waterproofing compound can also be mixed with it. Well mixed concrete is then laid over the slurry/mortar to half of the flange thickness and the reinforcement cage followed by the inner piece of mould is placed in position. Remaining concrete is laid to the required thickness/depth and compacted well (Plate 3). For good compaction a plate vibrator of low amplitude of vibration should be used. The top surface is finished with a very thin coat of cement : sand mortar (1 : 3). Inner frame of the mould can be removed within 20 minutes and the outer one can be removed after 30 minutes (depending upon the climate). Exposed surfaces are finished smooth immediately after casting to reduce consumption of labour during final stage of construction.

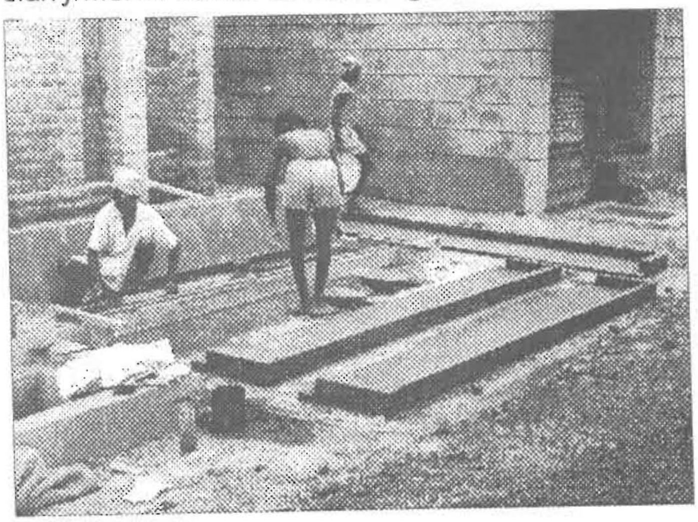


Plate 3 — Casting of L-Panels

Innovative stack method of casting of L-panels one above the other can be applied with minor modifications of the basic shape of L-Panels but with numerous advantages in this casting method. Ferrocement L-panels and casting of the panels in semi-mechanised methods can also be designed as per necessity.

The components can be removed to curing yard after 48 to 60 hours of casting, depending upon the weather. However, lifting clamps as shown in Plate 4 can be used for shifting the units at earlier period. The panels should be used for construction after 20 days

Plate 4 — Safe Lifting of L-Panels from Platform

of proper curing. Old paper sticking to the back of flange should be removed in wet condition of concrete while shifting the units at the production yard, otherwise, it may be difficult to remove it, once it has dried up. In all handling stages the flange of the components should be kept vertical. Gadgets can be used for safer handling (Plate-4). The units should be handled very carefully.

Plate 5 — Innovative winch-Hoist for Erection of L-Panels

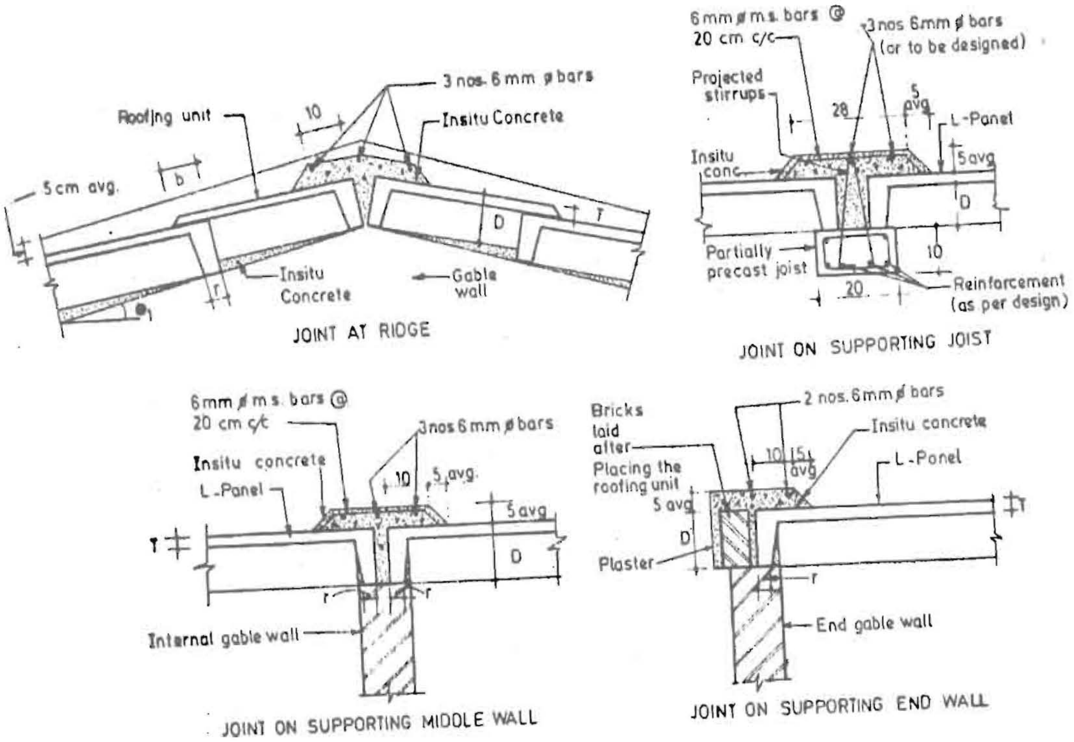


Fig. 4 Joint Details in L-Pan Roofing

TRANSPORTATION OF COMPONENTS AND CONSTRUCTION OF ROOF

The components can be transported by trolley, bullock cart or truck, keeping the flange vertical. For loading in layers, in a truck, intermediate flat timber pieces are to be used in cross direction between the layers.

Erection of Components and Insitu Works

After properly cleaning, components are erected and placed over the truss or gable walls with suitable overlap and side bearing. The units can be erected manually or with the help of a hoist. Manually the components can be erected from inside the room with temporary scaffold or from outside with a scaffold, ram, etc. For larger constructions, simple hoist as developed at this Institute for the scheme (Plate-5) or any other suitable device can be used. During erection of a unit, overloading of any component already placed in position should not be allowed. For gable wall slope of 1:3 or more, or its top surface being slippery temporary anchorage of the lowest component is necessary during erection. The joints are filled up with insitu concrete of suitable grade along with reinforcement where necessary (Fig. 4). Electrical fittings and other fixtures can be provided with proper planning during production or insitu concreting. After curing of the grout concrete, the roof surface is painted with cement slurry containing lime or water-proofing compounds in high rainfall areas.

EXPERIMENTAL AND FIELD CONSTRUCTIONS

Static load test on individual components and on roof assembly for deflection recovery as per IS provisions have been carried out with satisfactory results. Water penetration through components and joints was observed during rainy seasons and no major leakage was observed. Experimental roofs and several buildings with L-Pan roofing have been constructed in CBRI Campus and in large number of low cost housing schemes in many places of India with satisfactory performance. This scheme was

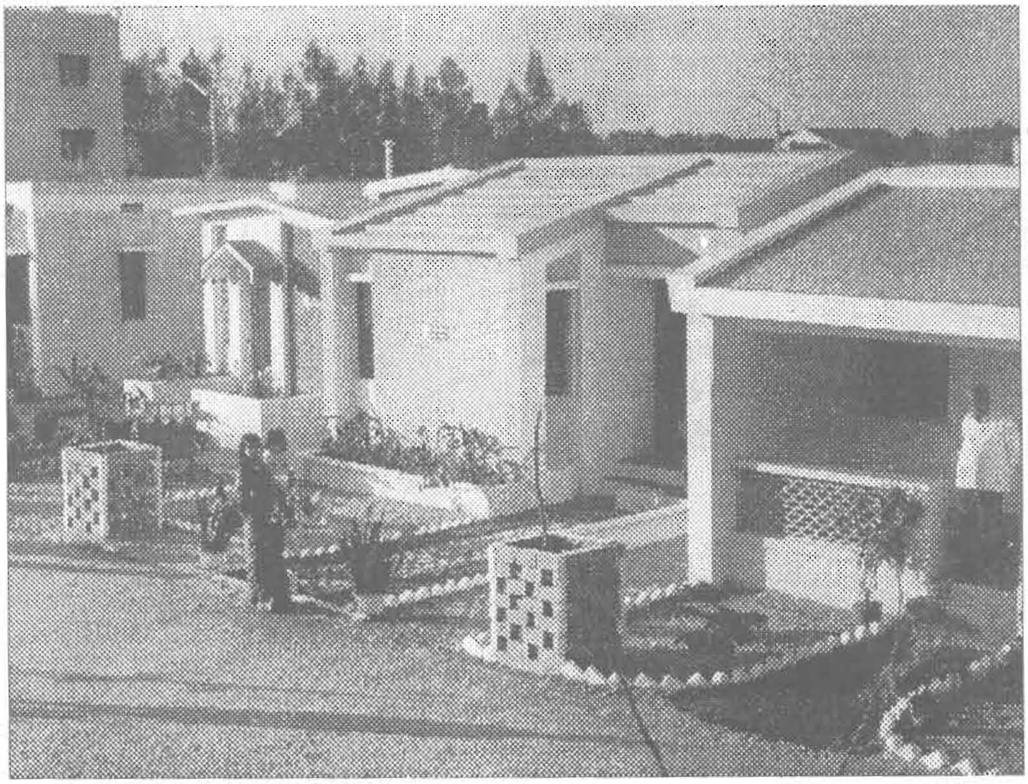


Plate 6 Demonstration Low Cost Building at Madras with L-Pan Roofing

demonstrated in the exhibition in connection with the International Seminar on Low Cost Housing at Madras (Plate - 6). L-Panels with projected rods at the ends with anchorage of roof and other measures against E.Q. Forces, were used by the Himachal Pradesh Housing Board at Parwanoo. Stabilised mud-mortar was used in a building with partial replacement of cement-sand mortar/concrete in joints to further reduce the cost of a low cost building. Special leak-proof overlapping joint was also designed/developed and experimentally tried with success. Precast ridge units have been experimentally tried but insitu ridge concrete with suitable reinforcement is better as well as more economic. The technique has been tried in large scale in roofs for school buildings, residential buildings, sheds, garrages, porch and in many other schemes. Performance of most of the L-pan roofs in numerous sites in many states in India was quite sound.

APPLICATIONS

Precast RC L-Panels were developed mainly for pitched roof of low cost residential buildings, industrial sheds, school buildings etc. The technique was used in large scales at various places in India and abroad under different site conditions for last two decades. The same R.C. panels were also used for many uncommon elements in addition to the normal use in a roof. Various applications of L-panels can be identified as below :

Conventional / Structural uses :

(a) Doubly sloped roof of a building

(b) Singly sloped roof of a verandah / roof

(c) L-Pan roof over masonry gable-walls

(d) L-Pan roof over RC/Steel rafters

(e) L-Pan roof with structural composition with partially precast RC joists/frames.

(f) Porch of a building

(g) Stair-case mumty roof of a building

Unconventional Use of L-Panels :

(a) L-Panels as tread units and stringer beams of a precast stair-case

(b) L-Panels as chajja-cum-lintels

(c) L-Panels as facia in a building (Plate-6)

(d) L-Panels as lofts in a building

(e) L-Panels as cooking platform

(f) L-Panels for flower-guarding - soil bed (Plate - 6)

(g) L-Panels as earth retaining structures, etc.

REPAIR & MAINTENANCE

The L-Panels are connected with non-structural Lap-joints in roof filling the gaps with cement-sand mortar. As measures against any leakage through the cracks of the joints or seepage through the thin flange of L-panels, the cracks can be repaired properly in conventional ways and the surface can be coated regularly with rich cement - sand mortar mixed with DPC.

At special circumstances any weak pocket/location can be covered with ferrocement treatment during repair/maintenance of a roof. In L-pan roof a damaged panel can also be replaced easily with a sound panel.

During production stage, a cracked/damaged L-panel can also be recast after removing the concrete around the cracked locations only. However, the specific repair and maintenance work in L-pan roof highly depend upon the specific site and climatic conditions and many other factors.

GENERAL FEATURES

Provision of a sloping roof avoids waterproofing courses and reduces both live and dead load resulting in an economic design. Reduction of loads also helps in achieving economic design of foundations and other supporting structures. L-pan roof is easy to construct. It is light in weight, pleasing in aesthetics, more durable than A.C. sheet or tile roof and is reusable to suit temporary constructions or re-construction of a roof with re-use of L-panels from a demolished building.

In addition to roofs, the RC L-Units can be used for cooking platform, loft, facia, parapet, tread units, stringer beams, retaining structures, etc. with appropriate detailings and design. These have however, not been tried on large scale.

Cost Dynamics

Relevant data in respect of a residential roof of medium size L-panels is as follows :

Average concrete thickness (including grouting)	= 5.0 to 6.0 cm
Cement consumption (depending upon grade of concrete, slope, overlap, projection etc.)	= 20 to 33 kg/m^2

Steel Consumption

(a) for wind load ≤ 150 kg/m^2	= 4.0 to 6.0 kg/m^2
(b) for wind load > 150 kg/m^2	= 4.25 to 6.25 kg/m^2

Savings

(a) Compared with A.C. sheet roof (Approx.)	= 15 to 20%
(b) Compared with traditional RCC roof (excluding terracing treatments) (Approx.)	= 20 to 30%

Materials and Labour Requirements

L-pan roofing can be made of panels of different sizes. So requirement of labour and materials may vary. To have an idea of the cost of construction, a sample basic data is given below. For other sizes, proportion of concrete and specifications, suitable modification should be made.

Precast R.C.C. L-panels and channel units of size 315 cm × 50 cm × 12 cm and flange thickness of 3 cm, for a mass housing construction, in moderate climate will consume the following materials and labour. Design mix proportions and strength of concrete required may vary from site to site. However 1 : 2 : 4 and 1 : 1½ : 3 mixes have been shown in the calculation with coarse sand as fine aggregate and 8-10 mm stone chips as coarse aggregate.

BASIC DATA :

			L-Panel	Channel Unit
I.	Mould			
	(a)	Material per mould		
		Deodar timber (including wastage)	0.062 m^3	0.094 m^3
		Screws, Nails, Fixtures etc. (L.S.)	Rs. 12.00	Rs. 16.00
	(b)	Labour per mould		
		Carpenter	1 man day	1 man day
		Mazdoor	1man day	1 man day
		Minimum number of uses of one mould (using vibrator).	100	100
		Without using vibrator (not desirable)	150	150
II.	Casting			
	(a)	Material per unit		
		(Volume of concrete)	0.067 m^3	0.085 m^3
		Cement (concrete mix 1 : 2 : 4)	0.46 bag	0.57 bag
		Cement (concrete mix 1 : 1½ : 3)	0.60 bag	0.75 bag
		Coarse sand		
		Coarse aggregate		
		(10 mm & down)	0.060 m^3	0.076 m^3
		Mild steel	5.52 kg.	7.80 kg.
		G.I. wires	0.69 kg.	0.80 kg.
		(3.0 mm dia or 8 gauge)		
		Binding wire	0.06 kg.	0.07 kg.
	(b)	Labour per unit (for all the operations viz. casting, curing, stacking in yard, barbending etc.).		
		Mason	1/7 man day	1/6 man day
		Mazdoor	4/7 man day	2/3 man day
		Barbender	1/14 man day	1/12 man day
		Mazdoor	1/14 man day	1/12 man day
III.	Miscellaneous items per unit			
	Casting platform (L.S.)		Rs. 2.00	Rs. 1.50
	Oil paper etc. (L.S.)		Rs. 1.50	Rs. 1.50
	Vibrator & electricity (L.S.)		Rs. 0.50	Rs. 0..50
	T & P (L.S.)		Rs. 1.00	Rs. 0..50
IV.	Transportation (upto an average lead of 200 m.) per unit :			
	Trolley or cart (L.S.)		Rs. 2.00	Rs. 2.50
	Labour			
	Mazdoor		3/16 man day	1/5 man day

V.	Erection & assembly, per unit :		
	(a) Manual Hoisting Scaffolding (L.S.)	Rs. 2.00	Rs. 2.50
	Labour		
	Mason	1/24 man day	1/20 man day
	Mazdoor	1/3 man day	2/5 man day
	Or,		
	(b) Mechanical Hoisting		
	Scaffolding etc. (L.S.)	Rs. 0.50	Rs. 0.50
	Hoist (L.S.)	Rs. 1.00	Rs. 1.50
	Labour		
	Mason	1/30 man day	1/30 man day
	Mazdoor	1/6 man day	1/6 man day
VI.	Joint filling & Plastering		
	(a) Materials per unit (average consumption)		
	Cement	0.10 bag	0.10 bag
	Coarse sand	0.010 m^3	0.010 m^3
	Coarse aggregate (10 mm & down)	0.010 m^3	0.010 m^3
	Reinforcement through slanting ridge	0.40 kg	0.40 kg
	(b) Labour per unit		
	Mason	1/10 man day	1/10 man day
	Mazdoor	1/10 man day	1/10 man day
VII.	Surface Finish		
	(a) Material/unit :-		
	Outer surface 2 coats of cement-lime (cement : lime - 3 : 1) (L.S.)	Re. 2.50	Re. 2.50
	Inner surface One coat of cement & One coat of Lime (L.S.)	Re. 2.50	Re. 2.50
	(b) Labour per unit :		
	Mason	1/16 man day	1/16 man day
	Mazdoor	1/16 man day	1/16 man day

Note : Alternate surface coating may also be used with the approval of the engineer-in-charge.

Insitu Ridge

Ridge concrete volume = 0.014 m^3/m. run

Mason = 1/20 man day/m. run

Mazdoor = 1/20 man day/m. run

Reinforcement = 1.40 kg/m. run (average)

(reinforcement for fan load should additionally be provided as per design).

Notes :

— In areas of high wind force of 200 kg/m^2 or more anchorage reinforcement should be added at 0.25 kg/unit.

— Water charges, appropriate contigency charges and profit to the contractor may be added extra.

— Specifications and basic data have been prepared for moderate climate and favourable conditions in casting yard/construction site. For other situations exact details may be prepared after studying the site condition.

Special Remarks

(i) L-pan roofing is a sloping roof scheme consisting of prefabricated components of modular size. So special attention should be paid during planning and design stage to suit the scheme without affecting func:.onal requirements of a particular building. Concrete cover to the reinforcement is not high to limit the dead weight of components. Unless the reinforcement is protected with suitable treatment the scheme should be cautiously recommended in aggressive environment as found in coastal areas.

(ii) The units should be cast on smooth platform as their bottom surface during casting forms the exposed top surface of roof. Undulation of roof top surface due to uneven platform, may lead to seepage of water during rains.

(iii) Special precautions should be taken during erection and placement of components over gable walls having a slope of 1:3 or more. Anchorage of components to gable walls is essential in case of steeper slope.

(iv) Two IS-codes as mentioned below have been prepared by Bureau of Indian Standards, which can be referred for more details on L-Panels and L-Pan roofing.

(a) IS-14241 : 1995, Precast Reinforced Concrete L-Panel for Roofing —specifications.

(b) IS-14242 : 1995, Design and construction of Roofs using Precast Reinforced concrete L-Panels — Code of Practice

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