



BUILDING RESEARCH NOTE

BRN - 37

IMPROVED METHOD OF MAKING DURABLE AND FIRE RETARDANT THATCH ROOF

Thatch roof is one of the most ancient and commonly used roofing system for the houses constructed by the poor masses in our country and may continue to be so, for many years to come. Its popularity is due to the fact that practically all the materials needed are locally available or can be grown near by. Besides thatching can be usually done with skill available locally and the roof is relatively economical. These roofs keep the house cool in summer and warm in winter seasons.

Thatch roof constructed in traditional manner has certain inherent shortcomings. The material used, being mostly of organic origin, are susceptible to natural weathering and fire hazard. Moreover these are also vulnerable to insects attack causing quick deterioration of roof. A properly laid and well maintained thatch roof may last many years, but needs partial replacement every other year if not every year.

During past two decades, research and development works were carried on to improve the quality of thatch roof as well as to make it fire retardant and water repellent so as to increase its life. A chemical treatment method of making thatch roof fire retardant was developed during earlier stage of R & D, but has not been found suitable due to non-availability and high cost of chemicals. Moreover during field trials it was found that after few years the chemical leaches out (washes away) and thus treatment becomes ineffective. After prolong research and development, studies and field trials, Central Building Research Institute (CBRI), Roorkee has developed a new method of making thatch roof fire retardant by manually pressing thatch panel and making it water

repellent and durable by applying non-erodable mud plaster.

The principle behind developing this new method and technique of manually pressing lies that the basic cause of catching and spreading of fire is due to looseness of thatch grass in traditional type of roofing, whereby air is available between the thatch fibres which helps and exagarate the spread of fire all over the thatch roof within minutes. By manually pressing and tying the thatch roof, the available air gap is reduced to minimum, which retard the rate of spreading of fire and flame.

Preparation of Thatch Panel

Good quality straight bamboos of 50 mm (average) diameter are selected. They are cut to required length and splited in form of 20-30 mm wide strips. Normally 5 to 6 strips are taken out from one bamboo, depending upon its diameter. These strips are tied with 20 SWG GI wire at a spacing of 200 mm centre to centre both ways. Two such cages (mats) are fabricated as per the size of thatch roof. In case the available length of bamboo strips is found short, then these can be tied together with 30 cm overlap, using GI wire to make it of the required length. One such bamboo cage is placed on an even surface at ground. Locally available good quality thatch grass to be used are procured in desired quantity. Small, decayed stems are separated. Thatch grass is spread over the split bamboo cage in uniform thickness of 125 mm along the slope of the roof. Care is to be taken that thatch grass is laid starting from lower edge of panel towards upper edge with overlapping, in one

direction only. It is also to ensure that thatch grass has been laid across the bamboo strips, which are in direct contact with the thatch. When all the required thatch grass in uniform thickness has been laid over the first cage, second similar bamboo strip cage is placed just over it in the manner that the segments and joints almost coincides one above the other. These two cages are tied together at every joint with 20 SWG GI wire, in the following manner.

First the G.I. wires shall be cut in required length for tying the bamboo strip mats loosely fixed in position at every joint/crossings of the bamboo strips. Then thatcher while manually pressing thatch panel applies his body weight and jerk and simultaneously pulls the wire to tighten them. This is repeated at each joint for making the pressed thatch roof. After completing the tightening and tying of wires, it should be ensured that each joint is properly pressed. If any joint is found loose, it should be re-tightened. It will be observed that thickness of thatch has been reduced to about 50% or more after pressing and thatch panel has become very compact. By this method of manual pressing, thatch panel is fabricated, (Fig. 1) which provides fire retardancy and longer life to the roof. This thatch panel is quite rigid, strong in handling and provide much stronger and durable roof, that can safely take normal, incidental, live and dead loads, without any noticeable deflection. Thatch panel is ready for lifting and placing in position over supporting roof structure.

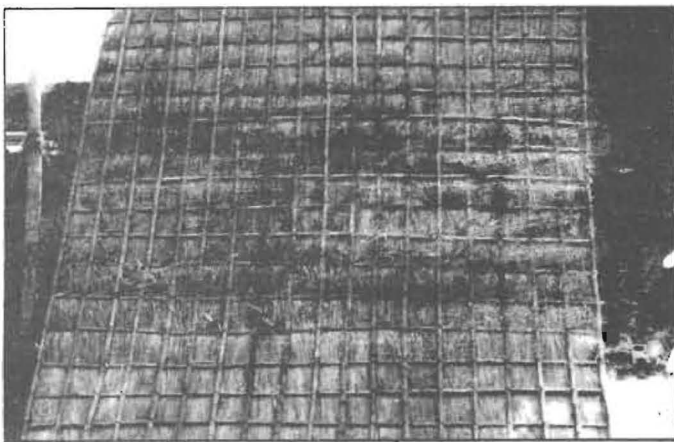


Fig 1 : Manually Pressed Thatch Panel

Preparation of Supporting Roof Structure

Thatch roof constructed with new technique is heavier than the traditional thatch roof due to the mud plaster provided at the top of roof for water proofing and fire retardancy. Hence the supporting roof frame has to be adequately strong and properly designed, so as to bear extra load of mud and the persons working over it, while applying mud plaster and gobi etc.

Eucalyptus or any other locally available balli beams of dia 125-100 mm are properly fixed, one each on highest and the lowest walls/ columns (Ridge and Eve). The balli rafters of minimum dia. 125 mm are fixed at spacing of 1.3 metre c/c on beam with spikes (Gulmaikh - long nail with head) of length 180 mm. Bamboo purlins of minimum 50 mm average diameter are fixed at 600 mm c/c over the balli rafter by nails.

The slope of the roof is 1:4 as recommended from functional and economic point of view. However slope could be increased to 1:3 from aesthetic consideration.

Placing and Fixing of Thatch Roof

Thatch roof panel fabricated with the technique discussed above is lifted from the ground and raised towards roof structure with the help of required labour from the lower edge of the roof. Care should be taken to keep the thatch panels in such a way that the overlapping of thatch is following the slope and not against it. After their properly placing over the supporting roof structure thatch panel is tied with bamboo purlins with 18 SWG GI wire in such a manner that it should not slide down or fly away during wind storm etc.

Water Repellent and Fire-retardant Treatment

Mud plaster is applied in two layers on the top and sides of roof including 50 mm wide on four edges under the thatch roof. The lower layer upto top of bamboo split consists of traditional mud mortar prepared by mixing bhusa (wheat or paddy straw) @ 64 kg/cu.m of soil. The upper layer consists of 12 mm thick non-erodable mud mortar. The non-erodable mud mortar is (for details refer B.R. Note 12) made by adding bitumen cut back @ 63.6 kg/cu.m of soil in the traditional mud mortar as mentioned above. The bitumen cut-back is prepared by mixing 53 kg bitumen 80/100 grade and 10.6 litres of kerosene oil i.e., bitumen and kerosene are mixed in 5:1 ratio. This is sufficient for one cu.m. of dry soil. This cut back is added to mud mortar (having bhusa @ 64 kg per cu.m. of soil) prepared earlier for traditional mud plaster and is thoroughly mixed by pugging and turning. Basic function of these mud plasters, on thatch roof is to make it water repellent; durable and fire-retardant. Bitumenised gobi paste is prepared by mixing cowdung and soil in the ratio of 1:1 and adding to it bitumen cut back @ 64 kg per cu.m. of (soil and cowdung mixture) and water to form a uniform thick paste. Two coats of this paste are applied over dried non-erodable mud plastered

surface and all cracks in the plaster are filled with this paste. Second coat should be applied when first one has dried completely. Generally 1.8 kg bitumen cutback is required for applying 2 coats of gobri wash over 10 sq.m. of plastered surface. Views of the finished thatch roof and ceiling are shown at Fig. 2 and Fig.3 respectively.



Fig. 2 : Finished Thatch Roof

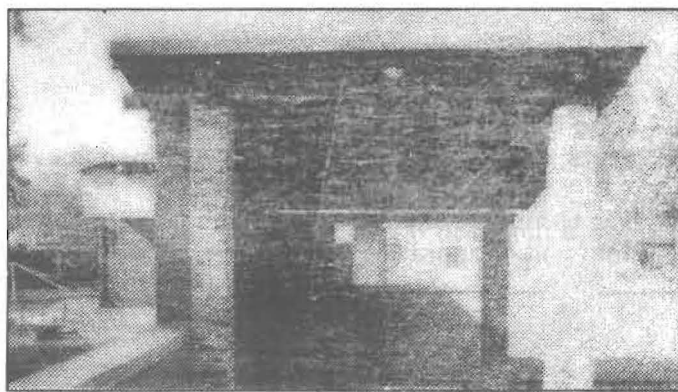


Fig. 3 : A View of Ceiling

Test Conducted

Laboratory tests conducted on various thatch panels for durability against water penetration and fire retardancy.

A small size thatch panel simply supported was tested for a concentrated load equivalent to a man's weight to ensure that the panel did not fail during periodic maintenance and repair (Fig.4). Test result shows that the roof can safely carry load of a person. The deflection was found to be within permissible limit of 1/250 and no distress in the plaster was found. For water proof test, alternate wetting and drying cycle by artificial rain penetration through water spray was conducted. Test results were very satisfactory. A few samples of prefabricated thatch panels of 1500 mm x 1200 mm were subjected to fire penetration. External fire exposure test as per B.S. 476 Part 3

were also conducted as shown in Fig.5. It was found that fire penetration time was more than 1/2 and hour.

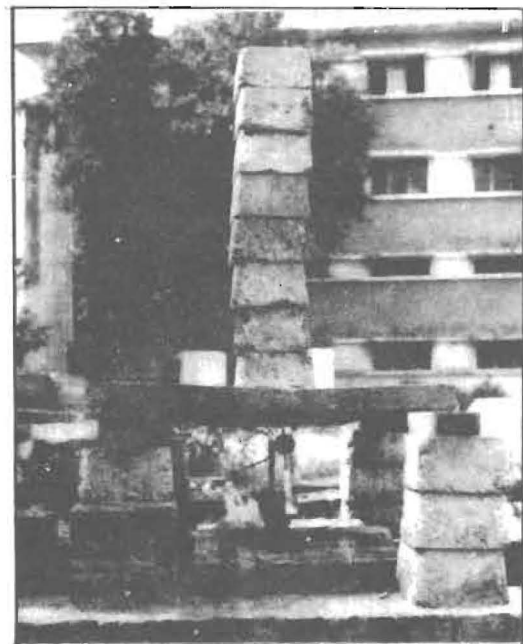


Fig. 4 : Concentrated Load Test on Prefabricated Thatch Panel



Fig. 5 : External Fire Exposure test on Thatch Roof

Field Trial

To study the long term performance of manually pressed large size thatch panel roof, a prototype roof was laid at the test site of RB&E Division of CBRI, in the year 1982. The size of single thatch panel of roof was adopted as 3600 x 3545 mm. The roof was observed for its durability and long term performance for a period of 10 years. The roof has performed satisfactorily. The life of thatch roof is expected to last 12-15 years, if properly maintained.

Cost Economics

Improved technique of making thatch roof fire retardant discussed above required additional

materials like bitumen, kerosene, oil, binding wire and the soil, over the traditional one, which is the extra cost involved in adopting the improved technology. Moreover the technique developed shall be used by villagers only, who provides expenditure or labour component by self help.

As such additional material and labour required for a 10 sq m of roof area have been analysed as per Appendix - I which is based on prevailing rates around Roorkee in Jan. 1995.

The cost of roof with self help considering only additional material requirement is estimated to Rs. 20.50/- per sq m, while including hired labour is estimated to Rs. 34.50/- per sq m (i.e. with labour and material).

Maintenance & Repairs

It is advised to apply one coat of bitumenised gobi rendering before and after every monsoon season for longer life of the roof. The roof is required to be checked periodically for any repair, weed growth or maintenance if needed. In case any crack or weed growth is observed in the roof plaster, repairs should be undertaken in the following steps:

- * Rake the crack to 1.5 cm deep. Wet the joint with mud slurry and filled it with non-erodable mud plaster (NEM). Allow the repairs to dry.

- * If any further crack reappears, repeat the same procedure but do not rake the joint, and just fill non-erodable mud mortar in the joint and press well with karny (trowel).
- * When the surface is completely dry, apply a coat of bitumenised gobi evenly over the entire surface and on edges (projections) of roof.
- * Apply a second coat of bitumenised gobi after the first coat has been dried up completely.

(Note: In case the bitumen in small quantity is not available the cracks can be sealed with a mixer of fresh cowdung and mud. As per the above procedure).

Advantages

- * The technique provides aesthetically better looking and more durable roof.
- * Provides safety on the long run.
- * Reduced maintenance expenditure
- * Long life which is expected to be between 12-15 years, if maintained properly as described above.
- * The technique can usher in an atmosphere of self help and cooperative spirit at the village level.

APPENDIX-I

Improved Fire Retardent Thatch Roof

Additional Material and Labour Requirements for 10 sq m Roof Area.

Material	Unit	Quantity
Soil	M ³	0.35
Paddy or wheat straw	Kg	22.40
Bitumen 80/100 grade	Kg	8.60
Kerosene	Litre	1.70
Cowdung (gobar)	Kg	7.50
Firewood	Kg	10.00
GI wire 18 SWG & 20 SWG	Kg	2.15
Nails	Kg	0.30
Additional Cost* Rs. 20.50 per sq m with self help		
Additional Cost* Rs. 34.50 per sq m with hired labour		

APPENDIX-II

Analysis of Manually Pressed Thatch Panel Roof

A. Fabrication of Thatch Panel (Size 4.41 m x 3.90 m) (17.20 m ²)		Qty.	Unit
1.	Bamboo (4mm & 4.5 mm length and 50 mm dia)		
	4 m length	9	Nos.
	4.5 m length	7	Nos.
2.	Thatch grass - Pullas	90	Pulla
3.	G.I. Wire 20 SWG	3.70	Kg
4.	Labour unskilled	10	Mandays
Rate* per sq metre (with self help) =		Rs. 34.50	
Rate* per sq metre (with lab. + material) =		Rs. 54.75	
B. Preparation and application of 12 mm thick Non-erodable Mud Plaster with two coats of bitumenised gobri rendering over a layer of ordinary mud plaster upto bamboo splits level. Analysis for 10 M ² Roof Area (108 sqft).			
1.	Soil Dry	0.35	M ³
2.	Wheat-straw (Bhusa)	22.4	Kg
3.	Bitumen 80/100 grade	8.5	Kg
4.	Kerosene Oil	1.70	Ltr.
5.	Cow Dung (Gobri)	L.S.	-
6.	Fire wood (off cutting of thatch & bamboo shall be used)	L.S.	-
7.	Labour unskilled	5	Mandays
Rate* per sq. m (with self help) =		Rs. 12.50	
Rate* per sq. m (with labour & Material) =		Rs. 29.80	
C1. Complete Roof (with self help Size 4.41 m x 3.90 m (17.20 m ²))			
1.	Thatch panel (4.41m x 3.90m)	1	Nos.
2.	Bamboos for purlins (4.5m length 50 mm)	8	Nos.
3.	G.I. Wire 18 S.W.G.	0.70	Kg
4.	Nails (75 mm to 100 mm)	0.50	Kg
5.	Application of 12 mm thick non-erodable mud plaster* over a layer of ordinary mud plaster (edges and sides of ceiling included)	19.92	M ²
6.	Eucalyptus bally beam of dia 125-100 mm 4.4m long	2	Nos.
7.	Eucalyptus bally rafters of dia 125 mm 3.8m long	4	Nos.
Rate* per sq.m. Rs. 84/-			

Contd.....

C2. Complete Roof with hired labour and material Size 4.41m x 3.9m (17.20m²).

	Qty.	Unit.
1. Manually pressed hatch panel (4.41m x 3.90m)	1	Nos.
2. Bamboos for Purlins (4.5m length 50mm dia)	8	Nos.
3. GI wire 18 SWG	0.70	Kg
4. Nails (75mm to 100mm)	0.50	Kg
5. Application of 12mm thick non-erodable mud plaster over a player of ordinary mud plaster	19.92	M ²
6. Eucalyptus bally beam of dia 125-100 mm 4.4m long.	2	Nos.
7. Eucalyptus bally rafters of dia 125mm 3.8m long	4	Nos.
8. Labour for fixing purlins, beams, rafters placing of thatch roof panel and tying it with purlins	4	Mandays

Rate* per sq m. = Rs. 132.50

* As per Roorkee January, 1996 market rates.

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V.K. Gupta

S.N. Mehrotra and Y.K. Batra
Central Building Research Institute,
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