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ROOF COVERINGS.

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Among the many portions of a building not the least important is the roof, and the success both in appearance as well as in effect depends in a great measure upon the consideration given by the engineer or architect to the circumstances and conditions existing. Climate, locality, the various materials at hand, and the kind of building, are all factors in the determination of the covering; and it is with a view of directing attention to these matters that the preparation of this paper has been proceeded with.

The successful resistance of the material to the action of water, heat, and cold, together with the insensibility to acidulous action may be taken as characteristic of a good covering. Unfortunately the combination of these qualities, embraces such a multitude of features (some by their excess even tending to be antagonistic), that the happy union is not often met with, and we must be content to take the average percentage of water absorption (*i.e.*) in the non-metallic substances, is a point, in more ways than one, indicative of the durability of a material exposed, such as that of a roof covering. A slate or tile with a large porosity per centage is very liable to disintegration if used in a frosty climate, and the climate of New South Wales is not, if late experience be taken into account, entirely free from this qualification. Moreover, crumbling or "fretting" of the tile or slate substance is consequent upon the oxidation of any iron pyrites which may

be present, a process much accelerated by water saturation. Again, the weight of the covering is most inconveniently increased by that of the water absorbed. If these defects be considered, together with the fact that a material liable to absorb water in any marked degree, usually presents a porous or cracked surface for the accumulation of dust or filth, it will be evident that resistance to water is a feature to be looked for when we are selecting our roof material. The effects of violent climatic changes are disastrous, in a more or less degree, to all but very loosely formed material, and it is the frequent cause of collapse in an otherwise durable tile or slate. Instances during the hot seasons are not scarce where a violently hot morning is followed by a chilly rain storm in the afternoon, and an effect on the slate somewhat akin to that of pouring ice water on a sheet of heated glass. It is this peculiarity of our climate which acts so prejudicially on lead by causing the cracks and bulges which appear with such annoying rapidity in our lead gutters and flats.

The deadly action of the acidulous fumes contaminating the atmospheres of cities and manufacturing towns are fatal to such metallic substances as zinc, used in roofing. Zinc is a material the use of which has greatly increased of late years in New South Wales, and, unless in some way protected from the ill effects of vitiated air, must fail as a lasting and durable covering. No doubt its use as an ornamental medium, both externally and internally is convenient, and indeed may be permissible, but, however much depended under this head, no amount of assertion can constitute it as a good lasting material for external coverings of roofs exposed to the atmosphere of cities, more especially if the zinc is accompanied with impurities. It is well known that the presence of lead, iron, or other metals in zinc is a most fruitful cause of rapid decay, owing to the setting up of galvanic action in the presence of moisture, and, unless the zinc is of the very best quality, these impurities are most likely to exist.

Thin sheet iron, corrugated and galvanised, has become so generally used, that it is seldom we see a building that has not some portion of it covered with this material. Except for manufacturing, and such buildings of an engineering and strictly utilitarian nature, it is not to be recommended. Thin sheet iron is not by any means as durable as a good tile or slate, for, despite the galvanic treatment which it is subjected to, corrosion takes place after a few years. This corrosion, or oxidation is also most likely, and does occur at the joints where the sheets lap, owing to the moisture accumulating and being held in suspense between the two sheets. Æsthetically considered, this custom of roofing with galvanized iron is the most abominable abuse that has crept into colonial architecture. It is, however, as was before noted, a good and suitable covering for large sheds, workshops, and such buildings, for though a very rapid conductor of heat, it is light, and if well secured and bolted together, acts in some small degree as a bracing system; in short, on such buildings is its most legitimate use, but not on a public or domestic building of any permanence or importance.

Recent years have been also noted for a great increase in the use of terra-cotta tiles of both foreign and colonial make, and the practice is to be commended for a properly made and burnt tile as far as durability is concerned, meets in a practical manner the many conditions laid down, and at the same time has much to offer where appearance is important. In the southern parts of Europe, where the climate is somewhat similar to our own, their use has been general for centuries, and to those who can admire the charming villa and street architecture of these countries, laudation of the tiled roof is hardly necessary, but in passing it may be offered as an opinion that if for nothing else than its beauty the terra-cotta tile has a future in our land of the Sunny South. In a good roof tile the chief consideration is lightness as far as is consistent with homogeneity of substance, for it is to be remembered that to

prevent the soakage of water, a fine grained compact, almost vitrified body, free from impurities, must be produced. This result is only obtained by judicious selection, and sufficient weathering of suitable clays, thorough grinding and kneading, and what is equally important, careful burning. Those of the foreign make give evidence of plenty of weathering and working, but, at the same time, are not as a whole very compact, being filled with elongated crevices, between what might be called layers or fibres. The layers are very distinct, and indicate a very tough clay. The colour is very uniform, while the design is undoubtedly ingenious, and admits of most effective fixing and security against the inroads of the weather The appended table, which has been prepared by the author, shows the results of some experiments as to the water soakage of these, as well as other tiles, compared with slates. Several varieties of English made tiles are to be obtained, and some which have been brought under the notice of the author attain to the standard of a good average. The best, though certainly not of a pleasing red colour, are at the same time possessed of an extremely compact body, uniformly burnt, and capable of very effective resistance to water. It is to be feared, however, that these tiles, while almost perfect in other directions, are liable to crack under the process of rapidly changing temperature. The colonial manufacture are much heavier and show absence of clay weathering as well as the presence of a full supply of impurities, though it may be remarked they do not attain to such a large water absorption as some of the imported tiles. There is, nevertheless, a much larger soakage than can be good, especially as the impurities present are most likely to be acted on by the water to the destruction of the tile. The colonial tiles would, it might be suggested, be the better if of less thickness, and a greater degree of burning. Exceptionally good raw materials are to be found for tile making, and it only needs some encouragement for the production of better tiles. Some of the tiles produced in years gone by were very

carelessly made, and the results by using them so disappointing that the manufacture and extended use was grievously retarded. The entry of the imported article, together with the improvement of our buildings, has awakened and given fresh life to the industry, and we are likely to have a vastly better article from our own manufacturers.

Amongst all the materials, which we are accustomed to use in covering our buildings, none can excel a good slate, possessing, as it does, in such an eminent degree all the chief qualifications to fit it for the purpose. It is almost proof against water; it is not influenced in a great degree by contaminated atmosphere; stands change of temperature as well as most other materials; and while obtained in abundance, is easily manipulated by the workman, and looks well on the roof. It is of course to be marked that a good slate is so described, for in common with all other things there are varieties in quality, and we have only to look at some of the roofs around us to find slates, the quality of which is evidently very bad. Cases have passed under the notice of the author, where slates perhaps not more than 10 or 12 years in use have decayed to a state little better than brown paper. The source of such rottenness may be found in the large per centage of iron sulphide, the weathering of which has tended to utterly disintegrate the substance of the slate. If such slates were examined prior to being placed in exposure they would be found to be full of such impurities. Again a slate, which is soft and clayey, can no more endure than a piece of rotten sandstone—each will quickly crumble and collapse when subjected to the effects of the weather.

The inferior kinds are found among those known as the common blue slate obtained from America. A peculiar feature connected with the American slates is the want of uniformity in any one lot, and whether examined prior to fixing, or after a few years use the great difference is most evident. Some weather well, others discolor, soften, and crack, and in a short time the slated surface is both unsightly, and insecure. Whether

this result is due to injudicious mixing of different qualities in commercial manipulation, or owing to great variety in the slate rock, is not clear.

The same unfortunate trouble, during the practice of the author, has arisen when using what is looked upon as a better quality of American slate. Those from the Welsh quarries, are, it is pleasing to note, almost entirely free from such defective qualities, and if properly laid, only the greatest satisfaction can accrue from their use.

The purple variety, though not more compact in the grain than the blue, find the most favor, and if the evidence of experience can be taken into account, are certainly the best.

Any iron present has been almost completely oxidized, thereby preventing troubles from this source; while the color permits in most cases the arrangement of harmony in the effect of the structure.

Many of the old Colonial buildings were roofed with these slates, and on those which have survived, the slates will be found as good as the day they were put on. Colonial slate does not seem to offer much opposition to the imported article, indeed, it would be rather difficult to obtain any Colonial roofing slates at the present time.

That there is good slate for the purpose in this, as in the other Colonies, has been amply demonstrated, and there is enough to justify the opinion, that if the quarries were properly developed our buildings might have more Colonial slate on them than they have at the present time.

TABLE SHOWING ABSORPTION OF WATER

BY DIFFERENT VARIETIES OF ROOFING TILES AND SLATES USED IN SYDNEY.

Specimens thoroughly dried prior to immersion. Time of immersion 24 hours.

No. of Specimen.	Description.	Size.	Weight dry in lbs. and oz.	Weight wet in lbs. and oz.	Absorbed in oz.	Per cent. of porosity.	Weight p r square wet. in lb.	Remarks.
			lb. oz.	lb. oz.	oz.			
1	Foreign terra cotta corrugated tiles.	in. ft. in. in. 9¾ x 1-4¾ x 7-16	4 10	5 9	15	20.27	751	Completely saturated at expiration of immersion. Light red color.
2			4 14	5 12½	14½	18.58		
3			5 2	6 0¼	14¼	17·37		
4			4 9	5 8	15	20.54		
5			5 2½	6 1	14½	17.57		
6			5 3½	6 0	12½	14.97		
7	Colonial terra cotta cor'ugat'd tiles same pattern as Foreign manufacture.	in. ft. in. in. 9¾ x 1-4¼ x 11-16	6 14	7 10	12	10.90	1063	Completely saturated. Full red color.
8			7 3½	8 1	13½	11.68		
9			7 3½	8 1	13½	11.68		
10			7 12½	8 11	14	11.24		
11	English made tiles.	in. in. in. 10½ x 6⅝ x ½	2 10	2 13½	3½	8.33	1405	Hard, close grain, partially vitrified. Dark red color.
12			2 6	2 9	3	7.89		
13			2 9	2 13	4	9.75		
14			2 9	2 11½	2½	6.09		
15			2 8½	2 10	1½	3.70		
16			2 12¾	2 14	3½	8.23		
17	English made tiles.	in. in. in. 10¼ x 6¼ x 7-16	2 5	2 6	1	2.70	1254	Very hard, vitrified, dark red or brown in color. Section showed after immersion very little water penetration.*
18			2 4	2 4½	½	2.08		
19			2 3	2 4	1	2.85		
20			2 4	2 4½	½	1.38		
21			2 4½	2 6½	2	5.47		
22			2 2	2 2½	½	1.47		
23	Bangor purple slates.	in. in. 20 x 10	2 14	2 15½	½	1.06	580	Very close grained and compact; slate completely dried in 45 minutes in a temperature of 65°
24			3 4	3 4½	½	.48		
25			3 1	3 1½	½	1.02		
26			3 12	3 12½	½	1.25		
27			3 0	3 0½	½	1.04		
28								
29	Common American Slates.	in. in. 20 x 10	4 0½	4 1½	1¼	1.94	653	
30			3 15½	4 0½	1	1.56		
31			4 1½	4 3	1½	2.29		
32			4 4½	4 5	½	1·09		
33			3 3½	3 5½	2	3.88		
34			4 3½	4 4¼	¾	1.16		

* Brown coloured tiles showed smallest absorption.