MUNICIPAL DEPARTMENT

STREET CONSTRUCTION FOR MEDIUM TRAFFIC.*

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(Concluded.)

From the point of view of first cost and maintenance, wood paving is more costly than granite From the sanitary point of view it is also inferior to granite, if nervous diseases are not taken into account. It is, however, the quietest pavement, suitable for medium to heavy traffic, of which there is much experience. It gives fairly good foothold to horses, especially in the case of uncreosoted deal. The extension of wood paving is almost invariably asked for by the public wherever it is laid. Excepting in Norwich, the author is unaware of wood pavements having been extensively laid excepting on concrete foundations; in Norwich about 16 miles of streets have been paved with wood during the past 20 years, the greater part of which has no such foundations. When the author first entered upon his duties in that city he was convinced that the construction of wood paving without concrete foundations must end in failure; his experience during the past two years has proved to him that, at any rate in Norwich, the presence or absence of such foundation appears to have little, if any, effect on the wear and life of the pavement, provided that where concrete is not used the pre-existing road is thoroughly sound.

One of the author's predecessors, Mr. Marshall, a former member of our association, in a report to the Norwich Council, dated February, 1888, says: ". . . I have satisfied myself as to the manner of laying down the wood pavement—that is, in regard to the foundation—whether a greater wear of the pavement is occasioned, more or less, by the absence of concrete. Upon a careful examination of the streets, and taking up a course of blocks without disturbing the sand beneath them, I find that the wearing away of the blocks into holes is not occasioned by any settlement in the foundation. In every case I have found the formation undisturbed." The author has made many similar investigations, with in almost all cases similar results to those recorded by Mr. Marshall. The traffic in Norwich, whilst not including many heavy individual loads, is close and continuous, the streets generally being narrow and winding; the traffic is more concentrated and trying to the street surface than the same volume and weight would cause in most towns. Unfortunately, the author has had no opportunity to cause records of the traffic to be made. Uncreosoted deal blocks were generally used for the first 12 years after wood paving was introduced here; they were bedded on sand. After about the seventh year from laying such pavements they became rough; they had to be renewed during the eighth or ninth year. About 10 years since pitch-pine and creosoted deal blocks began to be used; the pitch-pine was not successful, the heartwood wearing better than the surrounding rings, notwithstanding great cost incurred at the time of laying in removing all sap-wood. Creosoted deal paving, laid in 1888 without concrete foundations, but bedded on sand grouted with cement, is still in use, and in good order, excepting as regards slight roughness where it is on a gradient of 1 in 30 and is subject to the climbing and backing actions of horses' feet. No difficulty has arisen in the use of cement grouting for the joints of creosoted deal blocks. Where such paving is opened for sewer, etc., trenches, it is usually found necessary to chip the cement from the blocks. Pitch grouting has been used with creosoted deal with great success as regards imperviousness, but the creosote from the blocks has so altered the temper of pitch as to cause trouble during very hot weather. All wood paving is now laid with close joints, the courses being forced together with the aid of sledge hammers, at about each twelfth course. As far as can be ascertained, no pavements in Norwich are laid on roads passing over clay; in every case the soil is either gravel or chalk. This is a most important feature in the case.

In January last the author made an endeavor to elicit the opinions of borough engineers and others on the subject of tarred macadam, but the replies received to the questions sent out vary so much that it is difficult to make any general statement founded upon them. From his own experience, however, he is of opinion that where the gradients are suitable, and the traffic such as that usually found in suburban streets, tarred macadam forms an economical pavement which is much appreciated by residents. Wherever tar is used, skilled and attentive workmen must be employed to obtain satisfactory results. When such works fail it is usually found to arise from either (1) the use of an excessive quantity of tar; (2) the use of watery or insufficiently boiled tar; (3) the use of pitch to thicken unsuitable tar; (4) the use of flinty or non-absorbent gravel or stone; (5) insufficient consolidation. It is probable that the constant, careful supervision necessary to commence with to obtain good results with tarred work has prevented its general adoption. The author has had very varied experience with his work in this connection, some unsatisfactory, some satisfactory.

A properly constructed tarred macadam is easily cleansed, quiet, easily repaired where opened for connections, etc., economical in maintenance, and, being impervious and offering no lodgement for dirt, it is a good pavement from the sanitary point of view. The material used for tarred macadam, or tarred pavements generally, should be hard, close-grained iron slag, or hard blue mountain limestone, or hard Kentish rag. The tar should be boiled until thick; when allowed to cool, it should be capable of being drawn out into threadlike filaments. Good results are not likely to be obtained by thickening tar with pitch. The stone should be heated to such an extent only as to drive off all moisture, and, whilst warm, the boiling tar applied. Each particle of stone should be completely covered as thinly as possible with tar. Where the bottom is thoroughly good, a coating of tarred macadam 3in. thick is sufficient for the class of traffic for which such pavement has been described as suited. The material for the first coat to consolidate to 3in. thick should be broken to 1½in. gauge, and after thorough consolidation with a steam roller it should be faced with tarred ½in. material, to fill up and seal the surface and be re-rolled. The top should be dusted with dust of the stone used and ground lime in equal quantities, and a hand roller passed over to press the dust in and prevent it from blowing about.

Cost per Superficial Yard for Constructing and Maintaining Street Carriageways in Norwich.

Description of road	A. s. d.	B. s. d.	C. s. d.	D. s. d.
*Syenite Granite Macadam, including gravel foundation	4 6 0	9 0	10 1	7
*Uncreosoted deal paving, 5in deep, on sand bedding and jointed with sand	5 6	1 0	5 1	6
*Pitch pine, 5 in. deep, laid as last.	7 0	1 3	0 5	1 8
*Creosoted deal, 5in. deep, on sand bed grouted with cement	8 0	0 10	0 4	1 2
†3in. by 5in. syenite granite paving on sand bed, joints grouted with pitch. This supposed pavement will have a life of 25 years; it allows for taking up and repaving twice during that period, and for small repairs	8 0	0 3¼	0 3	0 6¼
‡Tarred macadam, including gravel foundation (Foundation 2s., tarred macadam 4s)	6 0	0 6	0 3	0 9

A. First cost. B. Maintenance. C. Cleansing. D. Total annual cost excluding capital charges. *Note.—None of this pavement has required renewal up to the present It is assumed that with slight repairs it will last four years longer, making 12 years in all. †Note.—Very little of this material has required repairs during the time it has been in the author's charge. He has assumed that once in five years it will require re-facing, that with this attention it will have a life of 20 years in the class of streets where it is suitable. Note.—In the last three cases the costs of maintenance are partly estimates.

The author has seen tarred macadam which after 12 years' use required very little repairs. He has constructed crossings in macadamized and gravel streets which have outlived two renewals of the surrounding surfaces. In preparing existing macadam for repairs, or for taking it up to make way for paving, a suitable macadam scarifier is of the greatest assistance where power is available to drive it. If the works of a town are of sufficient magnitude to make it worth while having a scarifier, it enables several of the men usually employed in lifting macadam to be employed in other work, leaving the scarifier to lift the macadam more expeditiously and effectually than is possible at reasonable cost by manual labour. The paper on the subject of macadam scarifiers which I had the honour of reading before you in 1894 states my views on the subject. I will not amplify them now, excepting to say that my further experience increases my conviction of the utility of these machines. The city of Norwich possesses a most efficient scarifier made by Messrs. Manlove & Alliot, of Nottingham; it is pulled and pushed by a 15-ton compound engine steam roller, of Messrs. Aveling & Porter's construction. Ordinary macadam forms one of the most expensive street surfaces known to the author, as regards maintenance and cleansing. Accounts which have been kept in Norwich show that syenitic granite macadam in the city streets costs 6d. to 1s. per superficial yard per annum for maintenance, and from 8d. to 1s. a yard for cleansing; taking the average at 9d. and 10d. respectively, the total average amounts to 1s. 7d. per yard.

* Paper read before the Association of Municipal and County Engineers, London, Eng.