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MADRAS RECORD OFFICE.

Government of Madras.

Public (Confl) DEPARTMENT.

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Dated 20-2-	19 44

Not to be folded or roughly handled

Proceedings of the Madras Government, Public Works Department, 22nd February 1867.

No. 447. Read the following letter from the Secretary to the Government of India, Public Works Department, (Civil Works—Communications), to the Agent to the Governor General for Central India, dated Fort William, 25th January 1867, No. 75 C :—

I am directed to acknowledge receipt of your letter No. $\frac{5}{5}\frac{9}{5}$, dated 7th January 1867, submitting a Report on the mile of experimental metaling laid down on the Malwa Division of the Agra and Bombay road, and in reply to state that the Governor General in Council agrees with you in thinking that, owing to the great cost of metaling over moorum in that part of the Agra and Bombay road, the use of metal should be confined to those portions in which it is absolutely essential, and that, where possible, moorum alone should be used.

No. 76 C.

Copy, with transcript of the letter (with enclosures) to which it is a reply, forwarded for information to the Governments of Madras and the North-Western Provinces, in the Public Works Department, to the Chief Commissioner of the Central Provinces, the Commissioners of Mysore and Coorg, and the Resident at Hyderabad.

(Signed) C. H. DICKENS, Lieut.-Colonel, R. A.,
Secretary to the Government of India.

From the Agent to the Governor General for Central India, to the Secretary to Government of India, Public Works Department, dated 7th January 1867, No. 5 C.

1. In forwarding, for submission to His Excellency the Viceroy and Governor General in Council a report from the Superintending Engineer, Rajpootana Circle, on the experimental metaling on the Agra and Bombay Road, I have the honor to state that, having made a careful inspection of this work on two occasions with Major Pollard, I quite concur in the opinions regarding it set forth by him in the enclosure; and that, though the result of the experiment has not been so satisfactory as it might have been, the suitability generally of the mode adopted for laying down the metal appears to have been sufficiently established.

No. $\frac{\text{C. I.}}{1535\text{C}}$ dated 17th ultimo, with annexure.

2. There can, however, it seems to me, be no doubt that the layers of moorum should be thoroughly consolidated throughout before the metal is laid down, and that to ensure this their thickness should be moderate. Moorum so employed and preserved from exposure to the air and the action of water will probably be found to last without further disintegration, if the sub-drainage of the road embankment be duly attended to.

3. The cost of the process being very great, I submit that metaling should only be used for those portions of the road where its use is obviously called for, and that where moorum of a superior quality is procurable, or the soil is firm, as is the case here and there along the line, it will be quite sufficient to make the most of these advantages without having recourse to it.

From the Superintending Engineer, Rajpootana Circle, to the Agent to the Governor General for Central India, dated 17th December 1866, No. C. I.—1,538 C.

1. I have the honor to submit a report by Lieutenant-Colonel Cowper, R. E., on the experimental metaling on the Agra and Bombay Road.

2. The object in view was to gain knowledge of the best way of metaling a road on black soil, the usual material "moorum" being found too soft to withstand the action of heavy traffic, and broken stone metal being swallowed up in the boggy mass into which a black soil embankment turns in the rains. It was determined, therefore, to combine the two materials, using the moorum as a

foundation with an upper layer of good hard metal. At first twelve inches of moorum was given as a substratum, and after *apparent* consolidation the layer of metal (broken trap-rock) was applied six inches thick, and the result is fairly described in Colonel Cowper's report.

3. Although this experiment was by no means a success as an engineering operation, yet the matter at issue may be said to be satisfactorily settled, and that the intervention of the moorum substratum between the soft earth and hard metal prevents the latter being swallowed by the swelling of the saturated black soil, and that a road surface, when thus carefully constructed, will prove hard, firm, smooth, and suitable for any ordinary traffic likely to come upon it.

4. The practical errors committed in the work now under report were—

1st.—Laying down the moorum without due care to preserve the cross and longitudinal sections of road.

2nd.—Insufficiency of water in the operation of consolidating the moorum and metal.

3rd.—Using for this work light stone rollers when heavy iron ones were available. The result was that a mere surface smoothness gave a fictitious appearance of consolidation.

4th.—Omitting to keep the earthen sides of the roadway up to the metal, and so allowing the material to spread laterally under the pressure of the roller and the action of traffic.

Other minor errors there were, but these are the practical mistakes that essentially militated against the success of the experiment.

The first was a mere matter of carelessness. The Overseer took no pains to work the road to its formation level, or even to proof level the distance to be operated on, but commenced throwing down the material on the surface of the old road without even scoring up the old material, or making a level trench; in fact he took no pains to ensure correspondence between the work as executed and the section furnished him for guidance.

The insufficiency of water was simply the result of want of experience, but even after the necessity was pointed out, and its liberal use insisted on, the workers were slow to recognize its value, and never, as far as I was able to see, came up to the proper mark of saturating the material to be consolidated.

Similarly with the heavy rollers. They had always been accustomed to use the light stone ones, and to be satisfied with a surface sufficiently smooth to allow the traffic to pass over the soft moorum, and so completed the work of consolidation. The iron ones were more difficult to manage, and doubtless the cattle owners preferred the lighter weight; finally they were used, but the results were not equal to those in the Mhow Division, where the same rollers on the same metal produce thorough consolidation.

Omitting to pun up the earthen sides was a serious omission, and told greatly against the work by allowing the partially consolidated metal to spread. Had the sides been packed and rammed, it is probable the ruts which Colonel Cowper remarks on would not have been so wide or so deep. It would not have prevented them altogether, but it would certainly have mitigated their extent. It stands to reason that metaling left with the sides all exposed, just as shown by the Executive Engineer in his sectional sketch, must yield.

5. After carefully examining the results of this experiment, I unhesitatingly recommend this system to be adopted in metaling the Agra and Bombay Road.

In black soil the substratum of moorum must be at least nine inches, but in the firmer and less spongy soils a thickness of six inches, and in some cases even four inches will suffice; but I am strongly convinced that the foundation strata should be laid and consolidated for one or even two rainy seasons before the top layer of metal is applied.

From the Executive Engineer, Malwa Division, Bombay and Agra Road, to the Superintending Engineer, Rajpootana Circle, dated 27th October 1866, No. 772.

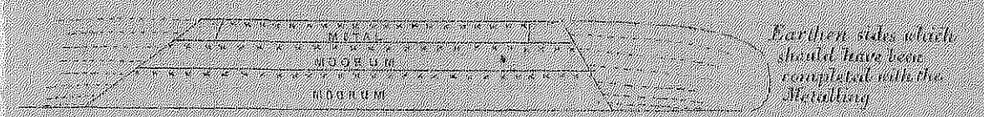
1. In accordance with the instructions contained in your letter No. C. I. 969, dated 6th September 1866, I have the honor to furnish the following report on the mile of experimental metaling at Secah near the Dewas boundary.

Proceedings of the Madras Government, Public Works Department,
22nd February 1867.

2. The foundation of the metaling was formed of moorum sized and screened, and the first portion of the mile was one foot thick, and more in some places where the surface had been worn away, and had to be made good with moorum. This was well watered, and rolled in two layers of about six inches each, and over this was brought the same thickness of metal after a few rollings; this was top-dressed with the "hoggins" or screenings from the moorum, and the rolling then continued. In the latter portion of the experiment, the thickness of the moorum bed was reduced to nine inches rolled in two layers of four and a half inches.

3. The roadway was opened for traffic about the month of January, since which time the passage of the heavy cotton and other carts has done much to consolidate it. At my inspection of this work in July, it was found to have rutted considerably under the traffic, the ruts being on an average about two inches deep and one foot three inches broad. In some places they were three inches deep, or even more; and were just as deep, though hardly so extensive on those parts of the experiment where the specification had been carefully carried out, and the watering had been rather in excess, as in those parts which had not been so carefully done.

4. The condition of the different strata in this experiment is shown in the sketch set down below, where the consolidation of about three inches is shown by shading, leaving blank the remainder of each strata in an unconsolidated state. All these should have been in a compact strata before the superincumbent metal could be in a sound and safe condition, as even after the metal has bound perfectly throughout its depth, it is to be feared that some trouble will be caused in the course of time by the gradual consolidation and sinking of the moorum bed. This moorum is protected from the action of the atmosphere, and it is perhaps impossible to foretel exactly the manner the metal will eventually be affected by the above cause.



18*f* C.P.

5. The rollers we at present employ are filled with stones and drawn by four bullocks or buffaloes abreast. The weight of a roller is about 3,768 lbs., and the stone filling is probably 2,945 lbs., so that the entire weight is 6,713 lbs., or almost exactly three tons. By the aid of these the upper stratum of metal will probably be got into a state of consolidation during the present season.

6. As much correspondence has taken place with reference to this matter, elucidating many points in connection with it, it is hoped that the above remarks will be sufficient for the purpose.

No. 448. ORDER THEREON, 22nd February 1867, No. 540.

CIVIL WORKS, No. 68.

Communicated to the Superintending Engineers.

(True Extract.)

(Signed) CHARLES A. ORR, Colonel, R. E.,
Secretary to Government.

To the Superintending Engineers.

Exd. S. T. Augustin.

Enclosure to Public Works Department Docket No. 76 C of 1867.

No. 5 C, dated 7th January, 1867.

From—Lieut.-Col. R. J. Meade, C. S. I., *Agent to the Govr. Genl. for Central India,*
To—*Secretary to Government of India, P. W. Dept.*

In forwarding for submission to His Excellency the Viceroy and Governor General in Council a report from the Superintending Engineer, Rajpootana Circle, on the experimental metalling on the Agra and Bombay Road, I have the honour to state that, having made a careful inspection of this work on two occasions with Major Pollard, I quite concur in the opinions regarding it set forth by him in the enclosure; and that, though the result of the experiment has not been so satisfactory as it might have been, the suitability generally of the mode adopted for laying down the metal appears to have been sufficiently established.

No. $\frac{\text{C. I.}}{1538\text{C}}$, dated 17th ultimo, with annexure.

2. There can, however, it seems to me, be no doubt that the layers of moorum should be thoroughly consolidated throughout before the metal is laid down, and that to ensure this their thickness should be moderate. Moorum so employed and preserved from exposure to the air and the action of water will probably be found to last without further disintegration, if the sub-drainage of the road embankment be duly attended to.

3. The cost of the process being very great, I submit that metalling should only be used for those portions of the road where its use is obviously called for, and that where moorum of a superior quality is procurable, or the soil is firm, as is the case here and there along the line, it will be quite sufficient to make the most of these advantages without having recourse to it.

No. C. I.—1538 C, dated 17th December, 1866.

From—Major C. Pollard, R. E., *Supdg. Engr., Rajpootana Circle,*
To—*Agent to the Governor General for Central India.*

I have the honour to submit a report by Lieutenant-Colonel Cowper, R. E., on the experimental metalling on the Agra and Bombay Road.

2. The object in view was to gain knowledge of the best way of metalling a road on black soil, the usual material "moorum" being found too soft to withstand the action of heavy traffic, and broken stone metal being swallowed up in the boggy mass into which a black soil embankment turns in the rains. It was determined therefore to combine the two materials using the moorum as a foundation with an upper layer of good hard metal. At first 12 inches of moorum was given as a substratum, and after apparent consolidation the layer of metal (broken trap-rock) was applied 6 inches thick, and the result is fairly described in Colonel Cowper's report.

3. Although this experiment was by no means a success as an engineering operation, yet the matter at issue may be said to be satisfactorily settled, and that the intervention of the moorum substratum between the soft earth and hard metal prevents the latter being swallowed by the swelling of the saturated black soil, and that a road surface when thus carefully constructed will prove hard, firm, smooth, and suitable for any ordinary traffic likely to come upon it.

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3rd.—Using for this work light stone rollers when heavy iron ones were available. The result was that a mere surface smoothness gave a fictitious appearance of consolidation.

4th.—Omitting to keep the earthen sides of the road-way up to the metal, and so allowing the material to spread laterally under the pressure of the roller and the action of traffic.

Other minor errors there were, but these are the practical mistakes that essentially militated against the success of the experiment.

The first was a mere matter of carelessness. The Overseer took no pains to work the road to its formation level, or even to proof level the distance to be operated on, but commenced throwing down the material on the surface of the old road without even scoring up the old material, or making a level trench; in fact he took no pains to ensure correspondence between the work as executed and the section furnished him for guidance.

The insufficiency of water was simply the result of want of experience, but even after the necessity was pointed out, and its liberal use insisted on, the workers were slow to recognize its value, and never, as far as I was able to see, came up to the proper mark of saturating the material to be consolidated.

Similarly with the heavy rollers. They had always been accustomed to use the light stone ones, and to be satisfied with a surface sufficiently smooth to allow the traffic to pass over the soft moorum, and so completed the work of consolidation. The iron ones were more difficult to manage, and doubtless the cattle owners preferred the lighter weight; finally they were used, but the results were not equal to those in the Mhow Division, where the same rollers on the same metal produce thorough consolidation.

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5. After carefully examining the results of this experiment, I unhesitatingly recommend this system to be adopted in metalling the Agra and Bombay Road.

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No. 772, dated 27th October, 1866.

From—Lieut.-Col. A. Cowper, R. E., *Exec. Engr., Malwa Division, Bombay and Agra Road,*

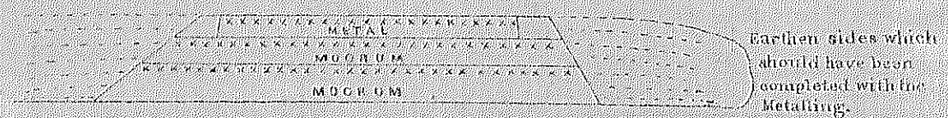
To—*Superintending Engineer, Rajpootana Circle.*

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2. The foundation of the metalling was formed of moorum, sized and screened, and the first portion of the mile was one foot thick, and more in some places where the surface had been worn away, and had to be made good with moorum. This was well watered, and rolled in two layers of about 6 inches each, and over this was brought the same thickness of metal after a few rollings; this was top-dressed with the "hoggins" or screenings from the moorum, and the rolling then continued. In the latter portion of the experiment, the thickness of the moorum bed was reduced to 9 inches rolled in two layers of 4½ inches.

3. The roadway was opened for traffic about the month of January, since which time the passage of the heavy cotton and other carts has done much to consolidate it. At my inspection of this work in July, it was found to have rutted considerably under the traffic, the ruts being on an average about 2 inches deep and 1 foot 3 inches broad. In some places they were 3 inches deep, or even more; and were just as deep, though hardly so extensive on those parts of the experiment where the specification had been carefully carried out, and the watering had been rather in excess, as in those parts which had not been so carefully done.

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(5d) C.P.

the remainder of each strata in an unconsolidated state. All these should have been in a compact strata before the superincumbent metal could be in a sound and safe condition, as even after the metal has bound perfectly throughout its depth, it is to be feared that some trouble will be caused in the course of time by the gradual consolidation and sinking of the moorum bed. This moorum is protected from the action of the atmosphere, and it is perhaps impossible to foretell exactly the manner the metal will eventually be affected by the above cause.

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6. As much correspondence has taken place with reference to this matter elucidating many points in connection with it, it is hoped that the above remarks will be sufficient for the purpose.

No. 75 C.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

CIVIL WORKS.
Communications.

To

THE AGENT TO THE GOVERNOR GENERAL
FOR CENTRAL INDIA.

Fort William, January 25, 1867.

Sir,

I am directed to acknowledge receipt of your letter No. $\frac{6\,C}{001}$, dated 7th January 1867, submitting a Report on the mile of experimental metalling laid down on the Malwa Division of the Agra and Bombay Road, and in reply to state that the Governor General in Council agrees with you in thinking that, owing to the great cost of metalling over moorum in that part of the Agra and Bombay Road, the use of metal should be confined to those portions in which it is absolutely essential, and that, where possible, moorum alone should be used.

I have the honour to be,
Sir,
Your most obedient Servant,
C. H. DICKENS, *Lieut.-Col., R. A.,*
Secy. to the Govt. of India.

No. 76 C.

Copy, with transcript of the letter (with enclosures) to which it is a reply, forwarded for information to the Governments of Madras and the North Western Provinces, in the Public Works Department, to the Chief Commissioner of the Central Provinces, the Commissioners of Mysore and Coorg, and the Resident at Hyderabad.

C. H. Dickens *Lieut.-Col., R. A.,*
Secy. to the Govt. of India.

To
The Secretary to Govt Fort St George
Public Works Department

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

CIVIL WORKS.

To

AGENT TO THE GOVR. GENERAL
FOR CENTRAL INDIA.

No. 75 C.

Dated January 25, 1867.

Received

States that owing to the great cost of metalling over moorum on the Agra and Bombay Road, the use of metal should be confined to those portions in which it is absolutely essential, and that, where possible, moorum alone should be used.