M.R.O. 1—77,006—8-6-37.

(1) Number of pages_____

(2) Date of repair_____

(3) Initials of the Referencer_____

MADRAS RECORD OFFICE.

Government of Madras.

Public works DEPARTMENT.

G.O. No. 2093 Press ~~Mis.~~

612-13

Dated 28—6— 1869.

Not to be folded or roughly handled

No. 612. Read the following Memorandum from the Acting Chief Engineer for Irrigation, to the Secretary to Government, Public Works Department, dated Fort Saint George, 4th June 1869, No. 203 :—

Lake St. Lawrence, Neilgherries.

THE following particulars give the state and prospects, on the 20th May, of the work under construction by Mr. McIvor, in accordance with the sanction given in Proceedings Madras Government, No. 2,271, dated 16th July 1868, for the formation of a tank on a tributary of the Bhowany by the silting process advocated by that gentleman.

2. The site of the bund is on the new line of road from Ootacamund to Melkunda, which is intended to cross the river on the bund at a level of about 150 feet above the bed of the river. The direction of the crossing is nearly due north and south, and the length of the bund at top will be about 772 feet, and at base, on the average, about 100 feet. The contents of the earth-work of the bund have been estimated at cubic yards 473,000.

3. The first work which had to be done was, the construction of a culvert or sluice tunnel to carry off the ordinary discharge of the river in the dry season, and some small accessions of flood-water from slight falls of rain, and, after the completion of the works, to regulate the flow of water in the river below. Of this culvert, a length of 206 feet has been completed and covered in ; a further length of 28 feet westwards to the position for the valve well, where the low-level culvert will terminate, was about one-third done; and thence 78 feet of the high-level culvert have been nearly finished, with the exception of the covering stones, and 79 feet more have been completed and covered in.

The masonry has been constructed with stone of compact texture. That of the lower culvert is dressed on the face and joints, while that of the upper culvert corresponds to coursed rubble. The masonry work is being carefully constructed. It has occupied a much longer time than was anticipated ; but this is not surprising, as the workmen had to be obtained from Trichinopoly, and they have to be hutted and fed on the site of the work. These arrangements necessarily occupied a considerable time. The cost also of the masonry has much exceeded the estimate, Rupees 13,250. The design of the culvert has been somewhat modified with advantage ; it is being constructed according to the arrangement shown in figure 2 of Mr. McIvor's plan of April 1868, the tunnel being continued under the inner slope, nearly up to the point where it would cut this slope ; and the valve rods will work in a well passing up from the sluice, chamber to the top of the embankment. Probably the cost of the masonry work will not fall much short of 20,000 Rupees.

4. The base of the bund over the 206-feet length of completed culvert has been carried across the river, and had reached a height of 20½ feet above the water-level in the river in the dry season, or 10 feet above the soffit of the lower culvert. One stream only was being used for silting, and this had been brought by a channel from a source to the eastward, and thence over the north hill to the spot where it was being employed—first to excavate the soil, and then to carry it by channels with very steep gradients to the bund. The discharge from the north-east channel, the one in use at the time, was carried by a trough 19⅓ feet in length over a

temporary roadway required for the cartage of stone for the culvert; and this arrangement enabled a rough calculation of the quantity of material deposited to be made. The average velocity in the trough was just under 6½ feet a second, and the discharge 0·95 of a cubic foot a second, or 3,040 cubic yards a-day. This discharge includes earth and water, and the proportions are considered by Mr. McIvor to be three of the former to one of the latter; and, as far as could be judged from the difference between the stream passing on to, and that leaving the bund, the silting stream was carrying at least 2 cubic yards of soil to every 3 of water and soil combined. If so, about 2,000, or perhaps more, cubic yards of embankment were being deposited per diem; and this would suffice to raise the portion* of bund under construction at the time half a yard a-day.

* 206 feet or 72 yards east and west; about 180 feet or 60 yards north and south.

5. One of the most remarkable circumstances was, the clearness of the water leaving the bund after deposit of the soil held in suspension. The distance from the point of entrance of the loaded to the point of exit of the unloaded stream is not more than 220 or 230 feet; and yet the water had been able in passing slowly over this distance to deposit the whole of its burden. This shows the great density of the soil which is being used for; were there any light material, it would require a much longer time for its deposit. All that Mr McIvor, in the present case, finds it necessary to do is, to raise a small earthen bund at the up and down stream edges of the part of the bund under construction, and to turn the silting stream in at one corner, leaving the water to run off into the river at the opposite corner. As the central area becomes raised, the retaining bunds on the edges are added to by a few coolies, and so the work progresses.

6. Although, except for a few minutes on the afternoon of the 20th May, there was only one stream on the north side at work, there is a larger quantity of water on the south side in readiness, and the channels for utilizing it are all in order; so that Mr. McIvor anticipates a much more rapid rate of progress in the future than he had been able to obtain earlier in the season.

7. The bed of the river on the north side along the south side of the unfinished portion of the culvert has been silted for a part of the width; and this not being under water, the character of the deposit could be more readily understood. The surface was still moist, but had cracked somewhat; and where the stream in the river had, at its west end, impinged against it at a high velocity, there was a slightly eroded surface, which appeared to be but in a small degree affected by the current. The silt had formed a very compact mass of greasy moist clay, which indeed resembled the "Stuff" prepared for pottery more than anything else which can be suggested.

8. At the time referred to, the heavier portion of the material brought by the silting stream was being deposited at a slope of one in fifteen or sixteen, and the lighter at about one in twenty. The velocity in the supply-channels regulates the degree of density of the material which the water is capable of transporting; and on this velocity being checked, the plane of deposition will vary in gradient with the density of the soil brought by the silting stream.

9. The legitimate conclusions from the work which had been done appear to be—

Proceedings of the Madras Government, Public Works Department,
28th June 1869.

1*st*,—That the silting process affords a very rapid and economical mean of constructing earthen bunds or embankments, where suitable soil and water on a proper level are obtainable.

2*nd*,—That a very small supply of water, favourably situated for use, will suffice for the transport and deposition of a quantity of soil equal to, perhaps, three times the volume of the water-supply as the extreme limit. The transporting power depends upon the density of the soil and upon the fall and distance betweent the place of excavation and the point of deposit; or in other words, upon the gradient at which the silting stream can be run. The significance of this fact will, perhaps, be the better appreciated, when it is mentioned that a cubic foot per second is equivalent to 3,200 cubic yards per diem; and that this quantity of water, carrying three times its volume of earth, would be capable of depositing 9,600 cubic yards of soil in embankment every day.

3*rd*,—That the applicability of the process is limited to situations where the length of bund to be formed is comparatively short. This follows from the gradient of the plane of deposition. As this becomes flattened out, the material deposited will become less and less dense; until at length it will no longer be suitable for the formation of an embankment intended to retain water. At present data are not available for determining what will be the safe limit of flatness of gradient; but supposing one in fifty to be that limit, and that silting streams were obtainable at either end of a bund intended to be 100 feet high, taking the highest water line at 80 feet, the embankment could be formed entirely by silting up to the 80 feet level, were the bund not more than 2,000 feet in length on the water-line; and by raising the ends 20 feet above their intended level, the full height in the centre could be obtained; or, of course, half the difference might be formed by the agency of the water, and the other half by manual labour. It would be much better, however, to construct the bund right across alternately from either side, so as to obtain a more uniform distribution of lighter and denser material, and then 1,000 feet would be the limit of distance at this gradient. The great mass of the bund near the base would, however, be capable of formation by silting, even had the upper part to be constructed in the ordinary manner, and therefore the process would be more or less applicable to embankments of much greater length than that above referred to. On the other hand, it seems at present to be tolerably evident that the process is not suited to the construction of embankments in other than hilly or mountainous regions.

10. In this country the use of silting streams for the formation of bunds on a large scale is now being tried for the first time. Much will be learnt from the experimental work now in progress, and when that shall have been completed, is may be expected that very valuable data will have been obtained. Mr. McIvor has been asked to note and record all details of interest, among which the principal are—

1*st*,—The volume of water employed;

2*nd*,—The corresponding rate of deposit of soil in the bund;

3*rd*,—The number of coolies engaged in—

(*a.*)—The regulation of the water.

(*b.*)—In controlling the excavation and in loading the water by mixing up the soil with it.

(c.)—The distances from which the streams are brought, and the gradients at which the water-supply channels are carried before reaching the site of the excavations.

(d.)—The gradients of the several silting channels between the pits and the bund.

The Superintending Engineer of the division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels, their slopes, &c., should Mr. McIvor be unable to do this.

11. The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face; but it is equally certain that material in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure; and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the work at Lake St. Lawrence, but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities, and having varying proportions of water in combination, after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also, with which it would be safe to run up an embankment; and probably also it may be found that admixtures of gravelly or stony soil, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given, it will be seen that the bund cannot be completed before the south-west monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape-channel; and it will not be easy to make a really efficient arrangement. On the south side of the river it will probably be possible to carry a channel from the bund to a point where the discharge at the lower end would be down a rocky scarp into the bed of the river; and it was intended to excavate such a channel as rapidly as possible, the cutting, where not in rock, to be effected by the agency of the water, and the material to be carried by the same means to the bund. Mr. McIvor is or was under the impression that even were a flood to pass over the unfinished bund, the damage sustained might not be serious; but the risk of the whole season's work being swept away would be, to say the least, very serious; and he is fully convinced of the necessity for preventing, if possible, the flood-waters rising above the earth-works.

13. The site selected for the permanent escape is close to the line of the Melkunda road about three-quarters of a mile from the bund; and it is very well suited for a waste weir. At present it is divided from the basin of the tank by an intervening ridge; but it is anticipated that a cut through this ridge may be

excavated by water, and if rock be not met with, this anticipation may be realised. The level of the spot chosen for the escape is stated to be within a few feet of the intended full-water level of the tank.

14. Mr. McIvor has been furnished with a memorandum in which some of the points which will need attention have been explained; and he has been recommended to substitute six openings of 1 foot diameter each, for one of 4 feet diameter in the sluice, to reduce the top width of the bund from 100 to 36 feet, and to avoid excavating soil within the planes of the front and rear slopes of the bund produced. As regards the latter point, it would be advantageous to leave a margin of a couple of hundred feet, so long as the pits are at all near the bund site. Some of the excavation already made will require to be filled in again.

15. Mr. McIvor's arrangements evince much aptitude for the work which he has undertaken. It is no disparagement, however, to him to say that there are many details connected with a work of this kind, which it would be advisable for him to determine with the aid of professional Officers, who may from experience be acquainted with the requirements of water in considerable volumes and under high pressure.

No. 613. ORDER THEREON, 28th June 1869, No. 2,093.

IRRIGATION, No. 25.

COMMUNICATED to the Superintending Engineer of the 7th Division, who will be requested to arrange for affording the assistance in surveying and levelling referred to in paragraph 10, should such be required by Mr. McIvor.

(True Extract.)

Colonel, R.E.,
Secretary to Government.

To the Superintending Engineer, 7th Division.
,, Revenue Department.

Exd. S. T. Augustin.

Govt. of H.C.O.T. Madras

PUBLIC WORKS.

To

THE SUPERINTENDING ENGINEER,

7TH DIVISION

&c., &c.,

Dated June, 28th.

Recd. Encl.

G. O., 28th June 1869, No. 2,093.

JUNE.

Nos. 612-613

Tank on a tributary of the Bhowany
Memorandum from the Chief Engineer Irrigation relative to the state and p pects, on the 20th May 1869, of the w under construction by Mr. McIvor for formation of a tank on a tributary of Bhowany, Coimbatore District, by the sil process advocated by that gentleman, c municated to the Officer concerned v instructions.

N° 203.

Memorandum

Lake St Lawrence, Neilgherries.

The following particulars give the state and prospects, on the 20th May, of the work under construction by Mr Mc Ivor, in accordance with the sanction given in Proceedings Madras Government, N°=2271 dated 16 July 1868, for the formation of a Tank on a tributary of the Bowany, by the silting process advocated by that gentleman.

2. The site of the bund is on the new line of road from Ootacamund to Melkunda, which is intended to cross the river on the bund, at a level of about 150 feet above the bed of the river. The direction of the crossing is nearly due North and South, and the length of the bund at top will be about 772 feet, and at base on the average about 100 feet. The contents of the earthwork of the bund have been estimated at cubic yards

473,000.

3 The first works which had to be done was the construction of a culvert or sluice tunnel, to carry off the ordinary discharge of the river in the dry season and some small accesions of floodwater from slight falls of rain and, after the completion of the works, to regulate the flow of water in the river below. Of this culvert a length of 206 feet has been completed and covered in, a further length of 28 feet Westwards to the position for the valve well, where the low level culvert will terminate, was about one-third done, and thence 78 feet of the high level culvert have been nearly finished with the exception of the covering stones, and 79 feet more have been completed and covered in.

The masonry has been constructed with stone of compact texture. That of the lower culvert is dressed on the face and joints, while that of the upper culvert corresponds to coursed rubble.

The

The masonry work is being carefully constructed: it has occupied much longer time than was anticipated, but this is not surprising, as the workmen had to be obtained from Srichinopoly, and they have to be hutted and fed on the site of the work. These arrangements necessarily occupied a considerable time. The cost also of the masonry has much exceeded the estimate Rupees 13,250 : the design of the culvert has ~~originally~~ somewhat modified with advantage; ~~originally it was intended to terminate the tunnel with a vertical face wall on the line of the front top edge of the bund; now this is being constructed according to the arrangement shown in figure 2 of Mr McLeod's plan of April 1868 the~~ tunnel being continued under the inner slope, nearly up to the point where it would cut this slope, and the valve rods will work in a well rising up from the sluice chamber to the top of the embankment. Probably the cost of the masonry work will not fall much short of 20,000 Rupees.

4. The base of the bund over the 206 feet

473,000.

3 The first works which had to be done was the construction of a culvert or sluice tunnel, to carry off the ordinary discharge of the river in the dry season and some small accesions of floodwater from slight falls of rain and, after the completion of the works, to regulate the flow of water in the river below. Of this culvert a length of 206 feet has been completed and covered in, a further length of 28 feet Westwards to the position for the valve well, where the low level culvert will terminate, was about one-third done, and thence 78 feet of the high level culvert have been nearly finished with the exception of the covering stones, and 79 feet more have been completed and covered in.

The masonry has been constructed with stone of compact texture. That of the lower culvert is dressed on the face and joints, while that of the upper culvert corresponds to coursed rubble.

The masonry work is being carefully constructed: it has occupied a much longer time than was anticipated, but this is not surprising, as the workmen had to be obtained from Srichinopoly, and they have to be hutted and fed on the site of the work. These arrangements necessarily occupied a considerable time. The cost also of the masonry has much exceeded the estimate Rupees 13,250 : the design of the culvert has somewhat been ~~considerably~~ modified with advantage; ~~originally it was intended to terminate the tunnel with a vertical face wall on the line of the front top edge of the bund; now this it is being constructed according to the arrangement shown in figure 2 of Mr McLeod's plan of April 1868 the~~ tunnel being continued under the inner slope, nearly up to the point where it would cut this slope, and the valve rods will work in a well rising up from the sluice chamber to the top of the embankment. Probably the cost of the masonry work will not fall much short of 20,000 Rupees.

4. The base of the bund over the 206 feet

feet length of completed culvert has been carried
acros the river, and had reached a height of
20½ feet above the water level in the river in
the dry season; or 10 feet above the soffit of the
lower culvert. One stream only was being used
for silting, and this had been brought by a
channel from a source to the Eastward, and
thence over the north hills to the spot where it
was being employed, first to excavate the soil,
and then to carry it by channels with very
steep gradients to the bund. The discharge
from the N. & channel, the one in use at the
time, was carried by a trough 19½ feet in
length over a temporary roadway required
for the cartage of stone for the culvert, and
this arrangement enabled a rough calcula-
tion, of the quantity of material deposited,
to be made. The average velocity in the trough
was just under 6½ feet a second, and the
discharge 0.95 of a cubic foot a second, or 3040
cubic yards a day. This discharge included

earth

earth and water, and the proportions are con-
sidered by Mr Mc Ivor to be 3 of the former to 1
of the latter, and, as far as could be judged
from the difference between the stream paping
on to and that leaving the bund, the silting
stream was carrying at least 2 cubic yards
of soil to every 3 of water and soil combined.
If so about 2000, or perhaps more, cubic yards
of embankment were being deposited per diem,
and this would suffice to raise the portion of
bund under construction at the time half a
yard a day.

× 206 feet or 72 yards
East & West about 180
feet or 60 yards north
& south.

5 One of the most remarkable circum-
stances was the clearness of the water leav-
ing the bund after deposit of the soil held
in suspension. The distance from the point of
entrance of the loaded, to the point of exit of
the unloaded, stream is not more than 220
or 230 feet, and yet the water had been able,
in paping slowly over this distance, to deposit
the whole of its burden. This shows the great den-
sity of the soil which is being used for, were

there

there any light material, it would require a much longer time for its deposit. All that Mr Ince Hor, in the present case, finds it necessary to do, is to raise a small earthen bund at the up and down stream edges of the part of the bund under construction, and to turn the silting stream in at one corner, leaving the water to run off into the river at the opposite corner: as the central area becomes raised the retaining bunds on the edges are added to by a few coolies, and so the work progresses.

6. Although, except for a few minutes on the afternoon of the 20th May, there was only one stream on the north side at work, there is a larger quantity of water on the south side in readiness, and the channels for utilizing it are all in order, so that Mr Ince Hor anticipates a much more rapid rate of progress in the future, than he had been able to obtain earlier in the season.

7. The bed of the river on the north side, along the south side of the unfinished portion of the culvert has been silted for a part of the width, and this not being under water the character of the deposit could be more readily understood. The surface was still moist but had cracked somewhat and, where the stream in the river had, at its west end, impinged against it at a high velocity, there was a slightly eroded surface, which appeared to be but in a small degree affected by the current. The silt had formed a very compact mass of greasy moist clay, which indeed resembled the "stuff" prepared for pottery more than anything else which can be suggested.

At the time referred to the heavier portion of the material brought by the silting stream was being deposited at a slope of 1 in 15 or 16, and the lighter at about 1 in 20. The velocity in the supply channels regulates the degree of density of the material which the water is capable of transporting; and, on this velocity being checked, the plane of deposition will vary, in gradient, with the density of the soil brought by the silting stream.

there any light material, it would require a much longer time for its deposit. All that Mr. Ingleson, in the present case, finds it necessary to do, is to raise a small earthen bund at the up and down stream edges of the part of the bund under construction, and to turn the silting stream in at one corner, leaving the water to run off into the river at the opposite corner: as the central area becomes raised, the retaining bunds on the edges are added to by a few coolies, and so the work progresses.

6. Although, except for a few minutes on the afternoon of the 20th May, there was only one stream on the north side at work, there is a larger quantity of water on the south side in readiness, and the channels for utilizing it are all in order, so that Mr. Ingleson anticipates a much more rapid rate of progress in the future, than he had been able to obtain earlier in the season.

7. The bed of the river on the north side, along the south side of the unfinished portion of the culvert has been silted for a part of

of the width, and this not being under water the character of the deposit could be more readily understood. The surface was still moist but had cracked somewhat and, where the stream in the river had, at its west end, impinged against it at a high velocity, there was a slightly eroded surface, which appeared to be but in a small degree affected by the current. The silt had formed a very compact mass of greasy moist clay, which indeed resembled the "stuff" prepared for potters more than anything else which can be suggested.

At the time referred to the heavier portion of the material brought by the silting stream was being deposited at a slope of 1 in 15 or 16, and the lighter at about 1 in 20. The velocity in the supply channels regulates the degree of density of the material which the water is capable of transporting; and, on this velocity being checked, the plane of deposition will vary, in gradient, with the density of the soil brought by the silting stream.

9. The legitimate conclusions from the work which had been done appear to be 1st that the silting process affords a very rapid and economical means of constructing earthen bunds or embankments, where suitable soil, and water on a proper level, are obtainable;

2nd that a very small supply of water, favourably situated for use, will suffice for the transport and deposition of a quantity of soil equal to perhaps 3 times the volume of the water supply as the extreme limit. The transporting power depends upon the density of the soil and upon the fall and distance between the place of excavation and the point of deposit, or in other words upon the gradient at which the silting stream can be run. The significance of this fact will perhaps be the better appreciated when it is mentioned that a cubic foot per second is equivalent to 3200 cubic yards per diem and that this quantity of water carrying 3 times its volume of earth would be capable of depositing 9,600 cubic yards of soil in embankment every day.

3rd That the applicability of the process is limited to situations where the length of bund to be formed is comparatively short. This follows from the gradient of the plane of deposition: as this becomes flattened out, the material deposited will become less and less dense, until at length it will no longer be suitable for the formation of an embankment intended to retain water. At present data are not available for determining what will be the safe limit of flatness of gradient, ~~or in other words of distance from the end of the bund~~, but supposing 1 in 50 to be that limit, and that silting streams were obtainable at either end of a bund intended to be 100 feet high, taking the highest water line at 80 feet, the embankment could be formed entirely by silting up to the 80 feet level were the bund not more than 2000 feet in length on the water-line, and by raising

raising) the ends 20 feet above their intended level the full height in the centre could be obtained; as of course half the difference might be formed by the agency of the water, and the other half by manual labour. It would be much better however to construct the bund right across alternately from either side, so as to obtain a more uniform distribution of lighter and denser materials, and then 1000 feet would be the limit of distance at this gradient. The great mass of the bund near the base would however be capable of formation by silting. ~~even had the upper part to be constructed in~~ ~~the ordinary manner, and therefore the pro-~~ cess would be more or less applicable to embankments of much greater length than that above referred to. On the other hand it seems at present to be tolerably evident that the process is not suited to the construction of embankments in other than hilly or mountainous regions

10 In this country the use of silting streams for the formation of bunds on a large scale is now being tried for the first time. Much will be learnt from the experimental work now in progress, and when that shall have been completed it may be expected that very valuable data will have been obtained. Mr McDow has been asked to note and record all details of interest among which the principal are.

1st the volume of water employed

2nd the corresponding rate of deposit of soil in the bund

3rd the number of coolies engaged in

a- the regulation of the water

b- in controlling the excavation, and in loading the water by mixing up the soil with it

c- the distances from which the streams are brought + the gradients at which the water supply channels are carried before reaching the pits of the excavations

d- the gradients of the several silting channels between the pits and the bunds

&c

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c., should Mr. McIvor be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that material, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities having varying proportions of water

in

10 cc

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soils, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c, should Mr. McIvor be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that material, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 cc 17

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soils, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South

side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c, should Mr. McIvor be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that materials, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 ci 17

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soils, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c., should Mr. McIver be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that material, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities having varying proportions of water

in

10 cir

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soil, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c., should Mr. McIvor be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that materials, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 cc 17

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soils, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the Soul to

pedo

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c, should Mr. McIver be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that material, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 cc

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soil, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. monsoon floods of the current year. The safety of the work already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South

side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c., should Mr. McIver be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that material, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 cc

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soil, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the works already done, or likely to be finished before the first heavy fresh in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South side

The Superintending Engineer of the Division might be asked to arrange for assistance being rendered in surveying and levelling, so as to place on record the arrangement of the channels their slopes &c, should Mr McIvor be unable to do this.

11 The slope at which embankments formed in this manner will stand has yet to be determined. It is clear that for some height the silt will stand with a vertical or nearly vertical face, but it is equally certain that materials, in which a considerable quantity of water will necessarily be retained, will possess a greater or less degree of mobility under pressure, and the tendency to move of the part under greater pressure must be resisted by other parts where the pressure is less. There is much that will require careful observation in connection with this point, not only as regards the works at Lake St Lawrence but also with a view to obtain data from which to deduce what would be safe arrangements with soils of different densities & having varying proportions of water

in

10 cc

in combination after all that could be parted with in the first instance had been drained off. Upon information so derived would depend the degree of rapidity also with which it would be safe to run up an embankment, and probably also it may be found that admixtures of gravelly or stony soil, in moderate proportions, may afford advantages, as regards stability of form, which ordinary clayey soils may not possess. Again it may prove to be advisable to allow successive layers some little time to become comparatively dry before proceeding to superimpose additional material, and there would be no great difficulty in carrying out such an arrangement.

12. From the particulars above given it will be seen that the bund cannot be completed before the S.W. Monsoon floods of the current year. The safety of the works already done, or likely to be finished before the first heavy freshes in the river, will depend upon the completion in time of a sufficiently capacious escape channel, and it will not be easy to make a really efficient arrangement. On the South side

side of the river it will probably be possible to carry a channel from the bund to a point where the discharge at the lower end would be down a rocky scarp into the bed of the river, and it was intended to excavate such a channel as rapidly as possible, the cutting, where not in rock, to be effected by the agency of the water, and the material to be carried by the same means to the bund. Mr McIvor is, or was, under the impression that even were a flood to pass over the unfinished bund the damage sustained might not be serious, but the risk of the whole season's work being swept away would be, to say the least, very serious; and he is fully convinced of the necessity for preventing, if possible, the flood waters rising above the earthworks

13 The site selected for the permanent escape is close to the line of the Mekunda road, about 3/4 of a mile from the bund, and it

it is very well suited for a waste weir. At present it is divided from the basin of the Sanko by an intervening ridge, but it is anticipated that a cut through this ridge may be excavated by water, and if rock be not met with this anticipation may be realized. The level of the spot chosen for the escape is stated to be within a few feet of the intended full water level of the Sanko.

14. Mr McIvor has been furnished with a memorandum in which some of the points which will need attention have been explained, and he has been recommended to substitute 6 openings, of 1 foot diameter each, for one of 4 feet diameter, in the sluice; to reduce the top width of the bund from 100 to 36 feet; and to avoid excavating soil within the planes of the front and rear slopes of the bund produced. As regards the latter point it would be advantageous to leave a margin of a couple of hundred

hundred feet, so long as the pits are at all near the band pits. Some of the excavation already made will require to be filled in again.

15 The Works arrangements evince much aptitude for the work which he has undertaken. It is no disparagement, however, to him to say that there are many details connected with a work of this kind, which it would be advisable for him to determine with the aid of professional officers, who may from experience be acquainted with the requirements of water in considerable volumes and under high pressure

Fort St George
4th June 1869.

I have the honor to be
Sir
Your most obedient servant
(Signed) Colin Campbell Major R.E.
Acting Chief Engineer for Irrigation

To
The Secretary to Government P.W.D.

12a

Pub Works Deptt

No 2093 2093 13 a

Proceedings of the Madras Government

Under date the 28th June 1869

Read the following

From the Actg Chief Engr for Irrigation & T E No 203 dt 4th June 1869

Memorandum descriptive of the state & prospects of the works on the 20th May 1869 in connection with the Lake St. Lawrence, Nilgherries.

Communicated to the Superintending Engr of the 7th Dn. who will be requested to arrange for affording the assistance in surveying and levelling referred to in para 10, should such be required by Mr. McIvor.

1804

S. Engr 7 Dn
Chief Engr for Irrig
Rec 29/6/69
Resp 29/6/69

50

Chief Engr for Irrigation
No 2358
From
The Actg Chief Engineer
for Irrigation.
To
The Secretary
to Govt P.W.D.

Dated 4th June 1869
Recd 5th do 1869

No 203

Memorandum descriptive of the state & prospects of the works on the 20th May 1869 in connection with the Lake St. Lawrence, Nilgherries.

No 2093. 28th June 1869

4/6/2

Rc. 12th June/69 Dd. 14th
Rc. 8th June/69 R. 11th

Ac. 12th June/69 Pr. 14th
C. 8th June/69 Pr. 11th

Rec 2358

Govt. of {1869} Madras.

PUBLIC WORKS.

To The Superintending Engr.
1st Division

Dated

Recd. Encl.

G. O. 28th June 1869, No. 2093.

N.os. 612 - 613

Tank on a tributary of the Bowany

Memo. from the Chief Engr. for Irrigation relative to the state and prospects on the 20th May 69, of the works under construction by him viz. Tank for the formation of a Tank on a tributary of the Bowany, Coimbatore Dt., by the sitting process & vested by that Gentleman and the Dist. concerned with in. Instructions.