Public Works (1898) Department.

G.O., No 45-4½ I

DATED 18 Jany 98 ~~December 97~~

[Despatch Abstract.]

Kistna Anicut: Communicating to Officers concerned with remarks Note by the Chief Engr for Irrign on Govt of India letter sanctioning with remarks an estimate of Rs. 58,770 for fitting shutters to the Crest of the — and directing that a copy of the Pros: be forwarded to the Govt of India.

Kistna Anicut: forwarding copy of Pros: Comtg: to Officers concerned with remarks Note by the Chief Engr for Irrign on Govt of India letter sanctioning with remarks an estimate of Rs. 58,770 for fitting shutters to the Crest of the —.

P.W. 96

Indexed

BACK PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

FURTHER PAPERS.

G.O.	No.	Department.	Date.	G.O.	No.	Department.	Date.

CHIEF ENGINEER
FOR IRRIGATION.
2 FEB. 1898
No. 170

IRRIGATION.
ACCOUNT.

Government {1898} of Madras.

PUBLIC WORKS.

Recd. } 1898. *Enclosures*

Regd. } *Spare copies*

G.O., No. 45 I., 18th January 1898.

JANUARY.

Kistna Anicut

Communicating to officers concerned, with remarks, note by the Chief Engineer for Irrigation on Government of India letter sanctioning with remarks an estimate of Rs. 58,770 for fitting shutters to the crest of the —, and directing that a copy of the Proceedings be forwarded to the Government of India.

GOVERNMENT OF MADRAS.

PUBLIC WORKS DEPARTMENT.

Irrigation.
Account.

Read—the following papers:—

From N. F. MACKENZIE, Esq., Under Secretary to the Government of India, Public Works Department (Civil Works—Irrigation), to the Joint Secretary to the Government of Madras, Public Works Department, Irrigation Branch, dated Simla, 8th November 1897, No. 292 I.

In continuation of Public Works Department telegram No. 289 I., dated the 5th November 1897, repeated on the margin, I am directed to communicate the sanction of the Government of India to the estimate forwarded with the Proceedings of the Madras Government, No. 786 I., dated the 26th August 1897, amounting to Rs. 58,770, including establishment and tools and plant charges, of the cost of fitting shutters to the crest of the Kistna anicut, chargeable against the Capital Account of the Kistna delta system under 49.

"Your 904 I., October 11th. Estimate for Kistna weir shutters sanctioned, but postpone construction of 100 out of 287 shutters pending consideration of note by Inspector-General. Letter follows."

2. I am to invite consideration of the attached note by the Inspector-General of Irrigation, and to say that if His Excellency the Governor in Council concurs in the suggestions made therein, arrangements should be made for constructing shutters for a length of 1,000 feet so that they can be released by hand.

3. From the detailed quantities for the estimate forwarded, it appears that it is proposed to erect on the Kistna anicut 287 shutters of 10 feet in length, making a total length of 2,870 feet. The plans submitted show the length of the level portion of the anicut to be 3,263 feet, and the difference between this length and that upon which it is proposed to erect shutters has not been explained, but it appears certain that the length proposed to be fitted with shutters is only 2,870 feet. Unless there are special reasons for this, another 400 feet of shutters will be required, which may be of the self-falling type, in which case a revised or supplementary estimate may be prepared and submitted for the orders of the Government of India.

4. The sanction accorded in paragraph 1 has been registered as No. 26 I. of 1897–98, and the plans and estimate forwarded with Madras Government Proceedings, No. 786 I., dated the 26th August 1897, are returned herewith.

Enclosure.

Note by the Inspector-General of Irrigation on the falling shutters proposed for the Kistna anicut.

An estimate amounting to Rs. 5,020 for fitting experimental shutters on a length of 200 feet of the Kistna aqueduct was sanctioned by the Government of India in their letter, No. 214 I., dated 14th August 1897, in paragraph 2 of which it was remarked that it would be as well to try also the type of shutter in use on the headworks of the Lower Ganges, the Agra, the Sirhind and the Chenab canals, and it was suggested that Colonel Smart, who recently had visited all these headworks, should be consulted on the point. Before that letter was received, the Madras Government had forwarded with their endorsement, No. 787 I., dated 26th August 1897, a complete estimate for making all the shutters required on the type which was the most approved of those adopted in the previous experiments. The papers forwarded with this endorsement were not received in Simla until the 8th October, and contained no reference to the suggestions of the Government of India, but a note on the subject by the Chief Engineer for Irrigation has since been submitted by the Madras Government with their letter, No. 904 I., dated 11th October 1897.

2. In this note the Chief Engineer deprecates the use of the type of shutter which has been adopted in Northern India on the large river weirs in the Madras Presidency, on the ground that "even the largest rivers rise very rapidly in floods, and there would be very little time to release the shutters. In case of a flood coming at night men could not without danger get to the middle of the anicut if there were more than a few inches of water going over the shutters. It would be a very serious matter if the shutters were up during a flood as the apron is not built to stand an overfall."

On these grounds the Chief Engineer advocates the use of shutters that will fall automatically as a flood rises, instead of the Northern India type, in which the shutters have to be released by hand, and the Local Government have stated that they concur in the views of the Chief Engineer.

3. The apprehensions expressed by the Chief Engineer are I think groundless. From the detailed quantities for the estimate under consideration I find that it is proposed to erect on the Kistna anicut 287 shutters of 10 feet in length, making a total length of 2,870 feet. The plans submitted show the length of the level portion of the anicut to be 3,263 feet, and the difference between this length and that upon which it is proposed to erect shutters has not been explained, but it appears certain that the latter length is only 2,870 feet. The weirs or anicuts at Khanki, Narora and Rupar are approximately 4,000, 3,500 and 2,400 feet in length respectively. We may leave the Khanki weir out of consideration, as it is divided into 8 bays of 500 feet by seven towers to which access can be gained at all times by an overhead wire tramway. But at Narora and Rupar men must go out from the sides to get at the central shutters. The length of shutters at Rupar falls short of that proposed for the Kistna by less than 500 feet, but the shutters are 6 feet high, the length being also 6 feet, and they are worked almost all the year round. During the cold weather indeed, or from 1st November to about 15th April, they generally remain up, and it is only on the occasion of a stronger freshet than can be passed through the undersluices that it is ever necessary to let the shutters down. But the conditions at Rupar differ from those on any other headworks, in that it is necessary to work the shutters almost all through the flood season and the shutters seldom remain down all along the weir for more than one month in the year, generally August, when the river is in high and continuous flood. And yet under such conditions as these there is never the slightest risk of the shutters being caught up in a flood. As soon as they are nearly topped a man goes out from each side, and the two central shutters are released by them. Each then works back from the centre to the side, releasing as many shutters as required. If there are signs of a strong flood they may be ordered to release the whole number, about 400, but this can be done without difficulty by two or four men in an hour. I have seen one man let down the shutters over half the weir at the rate of six per minute, and however suddenly a flood may rise no anxiety has ever been felt during the last eleven years as regards the possibility of getting all shutters down in time. I understand that at Bezwada the readings of the Pagatur gauge, 250 miles up the river, are received by telegram daily, but at Rupar there are no arrangements for telegraphic intimation of upstream river gauges. If therefore it were desirable for other reasons to erect hand-released shutters along the whole length of the Kistna anicut, I am of opinion that there would not be the slightest risk in doing so. The relative advantages of self-falling and hand-released shutters may therefore be considered without reference to this point.

4. The great difference between the Kistna headworks and those in Northern India lies in the fact that in the former the undersluices are of very little value for lowering the depth of water over the weir It is on this account that Captain Ellis has designed the shutters so that up to a certain point surplus water may be passed over them. In the absence of more undersluice power the raising of shutters which have once fallen will be so difficult that it is proposed that they shall fall only on the occasion of very strong freshets. It may be assumed, for the sake of simplicity, that the quantity of water passing over a foot run the anicut or the shutters may be approximately indicated by the formula $\frac{1}{3}^{0}$ h. $\sqrt{}$ h, when h equal the height of water over the crest of anicut or top of shutter, as the case may be. Captain Ellis has arranged that the central 700 feet of shutters shall fall when the depth of water over the shutters is 1 foot. The surplus over the whole length of 2,870 feet of shutters would then amount to $\frac{1}{3}^{0}$ of 2,870 = 9,567 cusecs, and this would be passed through the 700 feet gap at a depth of about 2·55 feet over the crest of the anicut. Allowing for the simultaneous reduction in the depth of surplus over the flank walls and undersluices the depth of water over the crest would probably not be much below the full 3 feet required. The next fall of shutters will occur when the surface of the water has risen to 1·25 feet above the tops of the shutters still standing, or to 4·25 feet above the central gap, when another 1,400 lineal feet of shutters will fall. The quantity of surplus will then be—

$\frac{1}{3}^{0} \times 2{,}170 \times (1{\cdot}25)\ \frac{3}{2} =$	... ...	10,126
plus $\frac{1}{3}^{0} \times 700 \times (4{\cdot}25)\ \frac{3}{2} =$	... ...	20,416
	Total ...	31,542

The last 770 feet of shutters will fall when 1·5 feet are passing over them, and the surplus, excluding that over side-walls and through undersluices, will then be—

$\frac{1.0}{3} \times 770 \times (1.5)\frac{3}{2} =$ 4,721
$\frac{1.0}{3} \times 2{,}100 \times (4.5)\frac{3}{2} =$ 66,822

Total ... 71,543

Excluding the surplus over side-walls and through undersluices the shutters will therefore fall as below:—

		Surplus.
700	lineal feet will fall with	9,567 cusecs
1,400	" " "	31,542 "
770	" " "	71,543 "

5. The suitability of the arrangement proposed, which has been very carefully worked out, appears to depend upon the range of variation in the supply during the season in which regulation by means of shutters is necessary, and also upon the degree of difficulty that may be anticipated in raising the shutters. On the former point there is no information before me. If the surplus to be passed over the shutters is never likely to exceed 10,000 cusecs during the working season, the shutters will never fall, and we have only to consider the question of first raising them when the depth of water over crest of the anicut first falls below 3 feet. If, however, freshets which will give surpluses of 10,000, 32,000 or 72,000 cusecs several times during the season may be anticipated, and if such freshets as the last are likely to be followed by a fall in the surplus supply to below 49,000 cusecs (which will pass over the 2,870 feet of anicut at a depth of 3 feet), the shutters will frequently fall and will have to be raised again, and the suitability of the design will depend upon the facility with which this raising can be accomplished, the condition being that the supply shall never be allowed to fall much below 3 feet above crest of anicut except for the day or two that may be necessary for re-erecting the shutters.

6. It is proposed to raise the shutters, either by levers from below, or by a windlass attached to a punt from above. As regards the former method it is said that 16 men have been able to lift a 16-foot shutter against 1·5 feet of water, so that 10 men should be able to lift a 10-foot shutter against the same head. It is very doubtful however whether any number of men could lift a 10-foot shutter against a much greater head than 1·5 feet. It is not so much a question of the load as of the force of the current in which the men would have to stand, and even if they could lift the shutters against a head of 2 feet the work would be very tedious and dangerous.

The alternative of a punt working upstream has often been suggested, but I do not know of any case in which it has been actually adopted. On the Sone, Narora and Okla weirs the water passing over the weir can be reduced to a workable depth for hand lifting by means of the powerful undersluices, and this is true also at present for the Chenab headworks. At Rupar where the water has often to be held up 6 feet, the undersluices are not powerful enough, and the shutters are lifted by means of two cranes mounted on trollies, one on each bank, which can be run out along the crest of the weir on the downstream side of the shutters, where a tramway has been laid down. I have seen a 6 foot by 6 foot shutter lifted by this means against nearly 6 feet of water, though with very great difficulty, but with undersluices open the usual head is not more than 3 feet, and the shutters though 6 feet in height can be easily lifted against this head. On none of these works, therefore, has it been necessary to use a punt. Captain Ellis says that shutters have been raised by this means without difficulty against a 2 feet head. I have no doubt that this can be done, but it is nevertheless a question whether this will be a safe and sufficiently expeditious method, especially when the depth of water exceeds 2 feet. Experiments, though of great value, are not conclusive on such a point as this, and it is only by long practical experience under all conditions that a confident opinion can be formed. I think that the system will be found quite practicable, but that it will be inconvenient to apply it whenever it is necessary to put up some shutters, and that the operation will probably be tedious even if not attended with some degree of risk.

7. If there are great fluctuations in the supply during the season in which it will be necessary to work the shutters, I would suggest for consideration that the best arrangement might be a combination of the self-falling and hand-released systems. I would propose to erect 500 lineal feet of hand-released shutters (each 6 feet long) on each side of the anicut, laying a good wide tramway on the crest downstream of the shutters, for this length of 500 feet, upon which a crane could be run out. The cranes would ordinarily lie behind the side-walls that it is proposed to build on the flanks of the shutters, and could be run up the sloping ends of the anicut to the banks before the advent of the flood season, though small floods over them would do no harm, especially if the jibs were first lowered.

Next to these 500 feet of hand-released shutters, I would put a length of 200 feet of self-falling shutters pivoted to fall with 0·5 foot over the top of shutter. Next to these on both sides would be 390 feet of shutters pivoted to fall with 1 foot going over them, and in the centre of the anicut would be 690 feet pivoted to fall with 1·5 feet of water passing over them.

8. The manner of working would then be as follows. Suppose in the first place that there is no surplus, and all the shutters are up, and the undersluices closed. As the river rises the undersluices would first be opened. If the rise continued two or three inches of water might be allowed to spill over the shutters, but, as soon as this limit was exceeded, the men should go out to the far end of the hand-released shutters, *i.e.*, 500 feet from the side, and let down one or more shutters as may be necessary. As the river rises more shutters will be released, working always from the centre to the flanks, but the water need never be allowed to fall below the level of tops of shutters. If a fall occurs before all these shutters are down the cranes would be run out, and as many shutters put up as necessary, working from the sides to the centres. If however the rise continues, the whole of these hand-released shutters will eventually be let down, and the surplus passing over 1,000 feet of the crest, with a depth of 3 feet will amount to about 17,000 cusecs. The water may now continue to rise until it stands at 3·5 above the crest, when 400 feet only of the self-falling shutters will go down, the surplus then amounting to about 24,000 cusecs, which will be passed over the 1,400 feet of open weir with a depth of 3 feet. If the water falls after this it will be possible to maintain the 3 feet level by first closing the undersluices, and afterwards lifting more of the side-shutters, working as before from the sides to the middle. If when all these are up the level falls below 3 feet, that is the discharge through the 400 feet of open weir is less than 6,800 cusecs, it would only be necessary to open the undersluices to reduce the level to a depth at which the 400 feet of shutters could be again raised, and everything would be as at first. If however the water continued to rise after the 1,400 feet of shutters were down, the next line of shutters, pivoted to fall with 1·00 going over them and extending over 780 feet of the anicut will eventually go down the surplus then amounting to about 42,000 cusecs. Finally the central 690 feet of shutters would go down, when water was standing 4·5 above crest of anicut, the surplus then amounting to 73,600 cusecs or a little more than under the arrangement proposed by Captain Ellis.

9. Let it now be supposed that the river falls steadily to below 49,000 cusecs after a flood of 74,000 cusecs has passed, and all shutters are down. With a surplus of 49,000 cusecs the height over crest will be 3 feet and the effect of opening the undersluices would be to reduce the surplus over the crest to 43,000, or to a height of 2·75 above crest. It would be very difficult to raise the shutters against such a head as this. But under the arrangement now proposed the level of 3 feet would be maintained if the river continued to fall by first closing the undersluices and then gradually erecting the side-shutters. When all these shutters were up the open length of anicut would be reduced to 1,870-feet, and the 3 foot level would be maintained until the surplus fell to less than 32,400 cusecs. By opening the undersluices alone at this stage the quantity passing over the anicut would be reduced to 26,400 cusecs, and the depth would fall from 3 feet to 2·6 feet. If the self-falling shutters could not be conveniently raised against this head the side-shutters might all be dropped, and the depth of surplus over the anicut would then be less than 2 feet. The next step would be to raise as many of the self-falling shutters as possible, and then to close the undersluices and lift as many side-shutters as necessary to maintain the 3-foot level.

10. Many other cases may be assumed, but the principle of working under the system proposed would be the same in all. The self-acting shutters will never fall until as much relief as possible has been given by opening the undersluices and dropping the side-shutters, and by relifting the latter it will be possible after each fall of the self-acting shutters to maintain the 3-foot level without interruption for some time after the river falls, the only necessary interruption being in the case assumed in the preceding paragraph, when after a flood of over 73,000 cusecs all the self-acting shutters have fallen, and the surplus has subsequently been reduced to less than 32,000 cusecs. In such a case it may be necessary to reduce the depth over the anicut temporarily to 2 feet while the self-acting shutters are being raised, but ordinarily the whole of the regulation can be done by means of the side-shutters and undersluices without at any time allowing the depth of water above crest of anicut to be less than 3 feet, or R. L. 50·25. Under Captain Ellis' proposals it would often be necessary to accept a level of 49·25 for days together, unless indeed it is found that the shutters can be raised without difficulty against a head of 2·75 feet.

11. The arrangement now proposed may, I think, be commended to the consideration of the Madras Government though I would not propose to press its adoption. If the conditions are such that after the shutters have once been erected at the commencement of the low river season there is no reason to anticipate that the surplus will exceed 10,000 cusecs (when the central 700 feet of shutters will go down) until the end of the low river season, and that after each length of shutters has once fallen it will be unnecessary to raise them again until the advent of the next low river season, the plan which has been submitted for sanction will answer the purpose very well, and may be approved as it stands. But if the supply, or rather the surplus, is liable to great fluctuations throughout the cold weather season, and it is likely to be eventually a matter of importance to maintain a continuous head of 3 feet over the crest of the anicut, I venture to think that the introduction of side-shutters, which can be dropped or raised at pleasure, will greatly facilitate the working, and that they will be found to make a great extent for the want of power in the undersluices. It is true that the regulating establishment will be required to drop

or set up a few of these shutters almost daily, with every slight fluctuation in the quantity of the surplus, whereas with the self-falling shutters they would have nothing to do until the surplus exceeded 10,000 cusecs. It will not, however, be altogether a disadvantage that they should be almost daily employed in manipulating a few shutters, while the occasions on which they will have to erect the self-falling shutters will be reduced to a minimum.

12. As regards cost I do not think that the side-shutters will cost any more than the shutters which have been designed, and the estimate submitted will therefore cover their cost. A supplementary estimate will however be required to provide for the tramway on each side, and for the two cranes that will be required for lifting the shutters.

13. The details of the design submitted do not call for much remark. I apprehend, however, that some trouble may be experienced with the projecting angle iron at bottom of the shutter. If stones or even silt lodge under any portion of this angle iron the shutter will not be free to fall, and will be subjected to a very violent action, while the age of an angle iron will not form a very tight joint against leakage, though this is not of great importance. It would, perhaps, be better to let the uprights of the shutter rest on a bevel, the plate forming a vertical butt joint with the cill. The slide bars will still be necessary for the purpose of supporting the verticals of the shutter while in the act of falling. I put up a sketch which will indicate what is intended. It is also not apparent why the crest on which the shutter will lie is built at a lower level than the up-stream crest.

26th October 1897. (Signed) T. HIGHAM,
Inspector-General of Irrigation.

From the Superintending Engineer, II Circle, dated 15th November 1897, No. 2253 K.N.

No. 283 I.

Note by the Chief Engineer for Irrigation.

With reference to the Inspector-General's note on the Kistna anicut shutters received with the Government of India letter, No. 292 I., dated 8th November 1897, I regret not to have explained more fully in my previous notes the reasons for preferring the pattern of shutter provided for in the estimates. The following information was needed to supplement that on which the Inspector-General based his note.

2. Information is regularly furnished of the level of the Kistna at Pagatur and of the Tungabadra at Sunkesala, 250 to 300 miles from Bezwada, the object of this being to warn the establishment at Bezwada of the approach of high floods, but between these places and Bezwada the Kistna has a large drainage basin and receives several important affluents. Even though there should be but a slight discharge at Pagatur and Sunkesala there might be a fresh from the country below these places sufficiently sharp and sudden to allow very little time for releasing hand-worked shutters. On examining the river diagrams I find there have been occasions on which the river at Bezwada has risen from below the anicut crest to 6 to 8 feet above it in one day. This indicates an increase in the rate of discharge from hour to hour of 6,000 to 7,000 cubic feet per second. With the aid of the undersluices which are much more powerful than the Inspector-General has assumed any short failure of watchfulness might be remedied and the combination of automatic and hand-released shutters which has been suggested is practically free from danger so long as a sufficient staff of men is kept ready for lowering the crest shutters and opening the scouring sluices. The latter is not by any means a quick or easy operation during the day. It has not been tried at night. The question is narrowed down to whether the use of the hinged shutters at the flanks affords such advantages as to make it worth while to impose on the establishment the anxiety and trouble of keeping watch to see that they are released in time. Probably the result would be a demand for the reconstruction in good masonry of the apron in rear of the shutters so that if they were not released no harm would result. I do not see in what way the substitution of shutters hinged at bottom would facilitate the keeping up of the water-level. The arrangements proposed by the Inspector-General involve the use of a crane and rails but, if these have to be provided, they can be used with just as much facility for raising pivoted

shutters. In fact we do not at present want to keep the water higher than 2 feet above crest but 3 feet shutters have been provided in view to possible extension of irrigation. A crane and rails are not required now. If it is found very tedious and troublesome to raise the shutters against 2 feet of water it will not hurt to wait until the water falls a few inches, and we can then by opening the undersluices lower the water on the crest and raise the shutters without trouble. The easiest and best means of raising the shutters must be decided by experience. The Superintending Engineer has had rings fitted on the upper side of the Gódávari shutters and by putting long levers through these he finds the shutters can be raised with facility against $1\frac{1}{2}$ feet of water. It does not however appear certain that the rings will not be occasionally knocked off by floating trees, &c. A number of the strong cast iron posts now on the anicut are broken away every year.

Discharge of anicut with $1\frac{1}{2}'$ depth in round figures $3 \times 3{,}400 \times 1{\cdot}75^{\frac{3}{2}}$ =	23,616
Capacity of undersluices with water at $1\frac{1}{2}'$ above crest level.	
Bezwada $15 \times 6 \times 9 \times 6 \times \sqrt{6{\cdot}5}$ =	12,386
Seetanagaram $15 \times 6 \times 7{\cdot}2 \times 6 \times \sqrt{7{\cdot}65}$ =	10,750
	23,136

3. From the setting in of the monsoon in June until the end of the season of freshes the Kistna keeps with singular constancy above the level required to give full supply in the canals. It would not be worth the trouble until the north-east monsoon rain is nearly over, say at end of November, to put up the shutters unless water fell unusually low. It would of course depend on the demand. If it be assumed that there is no need during the season of freshes to raise the shutters unless water falls to 1 foot on the anicut, the shutters would have to be lifted wholly or partly only once in every alternate year on an average. Then there is the raising after the freshes making an average—derived from the diagrams of 22 years—of $1\frac{1}{2}$ times a year. There thus exists the condition under which the Inspector-General (see paragraph 11 of his note) assents to the sanction of the design as it stands. With reference to paragraph 13 of the note it was and is still considered that there are strong objections to have the shutters lying above the crest. The crest in front of them is therefore raised and for the same reason it was decided not to have the angle irons on the upstream face. As designed the shutters will present no obstacle to the passage over the anicut of trees or other floating objects. Another objection to the general design shown in the Inspector-General's tracing is that the recess under the upstream part of the shutter (when down) would get filled with sand. It would be a great improvement if the shutters were rested on a level, but it was not easy to do this when the idea of having the angles on the upstream face was rejected. It would have required much heavier angle irons and more work in construction. It seemed very necessary to aim at economy of material work, and time and the design is therefore such as to involve a minimum of labour and the use only of market sizes and shapes of iron. We are much bound by our contract with Messrs. Burn & Co., and I fear cannot introduce any improvements in the design furnished them without invalidating the contract and affording sufficient excuse for delay in completing the work. I shall however have the shutters reserved for construction at the Bezwada Workshops made with a levelled plate at bottom if it is possible to get this done there. The difference in length between the level portion of the anicut and the shutters provided for in the estimate is due to about 200 feet of shutters having been made on the estimate for experimental shutters and to the provision of a wall for some distance at the ends, with its top level the same as the shutters, to allow of a punt to lie alongside it in safety prior to lifting the first shutters. These walls are referred to in Captain Ellis' report which accompanied the estimate.

KURNOOL, 28th November 1897. (Signed) W. HUGHES,
Chief Engineer for Irrigation.

To the Joint Secretary to Government,
Public Works Department, Irrigation Branch.

ORDER—No. 45 I., dated 18th January 1898.

Communicated to the officers concerned in continuation of G.O., No. 987 I., dated 8th November 1897.

2. The sanction accorded by the Government of India is registered as No. 152 I. of 1897–98.

3. The Government concurs in the opinion expressed by the Chief Engineer for Irrigation in the foregoing note and in the circumstances reported in the penultimate paragraph thereof his proposal regarding the shutters reserved for construction at the Bezwada Workshops is approved.

4. Ordered that a copy of these Proceedings be forwarded to the Government of India with reference to paragraphs 2 and 3 of its letter, No. 292 I., dated 8th November 1897.

[Here enter No. 46 I., dated 18th January 1898.]

(True Extract.)

(Signed) W. HUGHES,
Joint Secy. to Government,
Irrigation Branch.

To the Chief Engineer for Irrigation.
„ the Superintending Engineer, II Circle, with plan and estimate.
„ the Examiner, Public Works Accounts.
„ G. T. Walch, Esq.

Exd. Md. Pahilvan.

Public Works (1897) Department.

CURRENT No.

Order

From The Chief Engineer for Irrn

No. 283 I

Dated 28-12-97

Received 7-12-97

Enclosures

Spare copies

SUBJECT.

Kistna Ancut Shutters — Note furnishing the information needed to supplement that on which the Inspector General based his notes on the —

BACK PAPERS.

No.	Date.

FURTHER PAPERS.

No.	Date.

His Excellency the Governo

PUBLIC WORKS DEPARTMENT,
IRRIGATION BRANCH.

PROCEEDINGS OF THE MADRAS GOVERNMENT.

UNDER date the

READ the following

From the Government of India (H.E.NO:292.I dated 8th November 1897)
From the Supg:Engr,II Circle (- " -2253.KN. " 15th DO)
Note by the Chief Engineer
for Irrigation-- (283 .I. 28th DO)

No 145 Ig 18-1-98

Communicated to the officers concerned in continuation of G.O.NO: 987.I.dated 8th November 1897.

2. The sanction accorded by the Government of India is registered as NO: 152 .I.of 1897-98.

3. The Government concurs in the opinion expressed by the Chief Engr: for Irrigation in the foregoing note and in the circumstances reported in the penultimate para thereof his pro-posal regarding the shutters reserved for construction at the Bezwada Workshops is approved.

4. Ordered that a copy of these Proceedings be forwarded to the Government of India with reference to para: 2 and 3 of its letter, NO:292.I. dated

dated 8th November 1897.

Endorsement No. 46 I (8-1-98)

Forwarded.

J. H.
4/12/97

W. H.
4.12.97

Regd 18/1/98

To

D. 7. C. I
17.12.97
Recd 18/1/98
Sd 18/1/98

The Chief Engr: for Irrigation

" Supg: Engineer, II circle.
with plan & estimate

" Examiner, P.W. Accounts.

" G. T. Walch Esq. 31/1/98

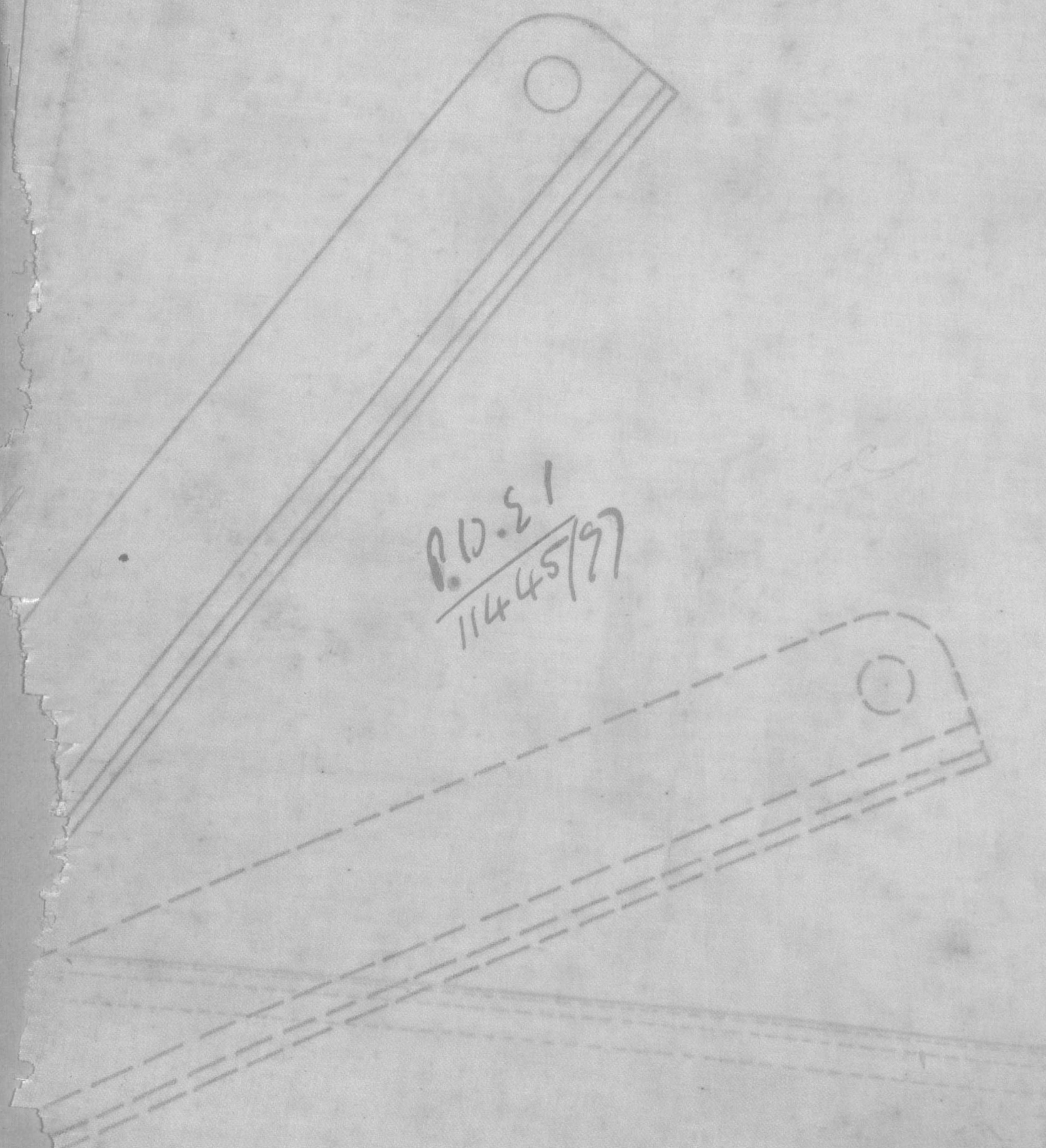
E. I. Form No. 1—1,000—27-11-95.

No 283 I

Note by the Chief Engineer for Irrigation.

5 P

With reference to the Inspector General's note on



P.W.D. I
1145/97

dated 8th November 1897.



No 283 I

Note by the Chief Engineer for Irrigation.

With reference to the Inspector General's note on the Kistna anicut shutters received with the Government of India letter NO:292.I.dated 8th November 1897 I regret not to have explained more fully in my previous notes the reasons for preferring the pattern of shutter, provided for in the estimates. The following information was needed to supplement that on which the Inspector General based his note.

2. Information is regularly furnished of the level of the Kistna at Pagatur and of the Tungabudra at Sunkesala 250 to 300 miles from Bezwada, the object of this being to warn the establishment at Bezwada of the approach of high floods, but between these places and Bezwada the Kistna has a large drainage basin and receives several important affluents. Even though there should be but a slight discharge at Pagatur and Sunkesala there might be a fresh from the country below these places sufficiently sharp and sudden to allow very little time for releasing hand-worked shutters. On examining the river diagrams I find there have been occasions on which the river at Bezwada has risen from below the anicut crest to 6 to 8 ft above it in one day. This indicates an increase in the rate of discharge from hour to hour of 6000 to 7000 c.ft per second. With the aid of the undersluices which are much more powerful than the Inspector General has assumed

any

E.1.

any short failure of watchfulness might be remedied and the combination of automatic and hand-released shutters which has been suggested is practically free from danger so long as a sufficient staff of men is kept ready for lowering the crest shutters and opening the scouring sluices. The latter is not by any means a quick or easy operation during the day. It has not been tried at night. The question is narrowed down to whether the use of the hinged shutters at the flanks affords such advantages as to make it worth while to impose on the establishment the anxiety and trouble of keeping watch to see that they are released in time. Probably the result would be a demand for the reconstruction in good masonry of the apron in rear of the shutters so that if they were not released no harm would result. I do not see in what way the substitution of shutters hinged at bottom would facilitate the keeping up of the water level. The arrangements proposed by the Inspector General involve the use of a crane and rails but if these have to be provided they can be used with just as much facility for raising pivoted shutters. In fact we do not at present want to keep the water higher than 2 ft: above crest but 3 ft: shutters have been provided in view to possible extension of irrigation. A crane and rails are not required now. If it is found very tedious and troublesome to raise the shutters against 2 ft: of water

water it will not hurt to wait until the water falls a few inches and we can then by opening the under sluices lower the water on the crest and raise the shutters without trouble. The easiest and best means of raising the shutters must be decided by experience.

Discharge of anicut with $1\frac{1}{2}$' depth in round figures $3 \times 3400 \times 1.75^{\frac{3}{2}} = 23616$.

Capacity of Undersluices with water at $1\frac{1}{2}$' above crest level.

Bezwada	$15 \times 6 \times 9 \times 6 \times \sqrt{6.5}$	= 12386
Seetanagaram	$15 \times 6 \times 7.2 \times 6 \times \sqrt{7.65}$	= 10,750
		23136

The Superintending Engineer has had rings fitted on the upper side of the Godavari shutters and by putting long levers through these he finds the shutters can be raised with facility against $1\frac{1}{2}$ feet of water. It does not however appear certain that the rings will not be occasionally knocked off by floating trees &c. A number of the strong cast iron posts now on the anicut are broken away every year.

3. From the setting in of the monsoon in June until the end of the season of freshes the Kistna keeps with singular constancy above the level required to give full supply in the canals. It would not be worth the trouble until the north-east monsoon rain is nearly over, say at end of November, to put up the shutters unless water fell unusually low. It would of course depend on the demand. If it be assumed that there is no need during the season of freshes to raise the shutters unless water falls to 1 foot on the anicut, the shutters would have to be lifted wholly or partly only once in every alternate year

year on an average. Then there is the raising after the freshes making an average - derived from the diagarams of 22 years- of 1½ times a year. There thus exists the condition under which the Inspector General (see para 11 of his note) assents to the sanction of the design as it stands. With reference to para 13 of the note it was and is still considered that there are strong objections to have the shutters lying above the crest. The crest in front of them is therefore raised and for the same reason it was decided not to have the angle irons on the upstream face. As designed the shutters will present no obstacle to the passage over the anicut of trees or other floating objects. Another objection to the general design shewn in the Inspector Genl's tracing is that the recess under the upstream part of the shutter (when down) would get filled with sand. It would be a great improvement if the shutters were rested on a level but it was not easy to do this when the idea of having the angles on the upstream face was rejected. It would have required much heavier angle irons and more work in construction. It seemed very necessary to aim at economy of material, work, and time and the design is therefore such as to involve a minimum of labour and the use only of market sizes and shapes of iron. We are much bound by our contrat with Messrs: Burn and CO: and I fear cannot introduce any improvements in the design furnished them without

invalidating the contract and affording sufficient excuse for delay in completing the work. I shall however have the shutters reserved for construction at the Bezwada Workshops made with a levelled plate at bottom if it is possible to get this done there. The difference in length between the level portion of the anicut and the shutters provided for in the estimate is due to about 200 feet of shutters having been made on the estimate for experimental shutters and to the provision of a wall for some distance at the ends, with its top level the same as the shutters, to allow of a punt to lie alongside it in safety prior to lifting the first shutters. These walls are referred to in Captain Ellis' report which accompanied the estimate.

W. Hyde.

Chief Engineer for Irrigation.

Camp Kurnool

28th November 1897.

To

The Joint Secretary to Government

Public Works Department

Irrigation Branch.

Public Works (1897) Department.

CURRENT No. 354 K.S.

Order

From The Supdg: Engr. [illegible] Circle.

No. 2253 K.W.

Dated 15 November 1897

Received 18 — Do —

Registered

Enclosures

Spare copies

SUBJECT.

Falling Shutters for the Kistna Anicut – Informs that the stopping of – will lay the Govt. for many claims – Forwards for orders copy of a letter from E.E. K.W. do —

D.E.J.

[illegible]
18/11/97

E.1.

BACK PAPERS.

No.	Date.

FURTHER PAPERS.

No.	Date.

Urgent

Letter from Capt. W. M. Ellis R.E. Executive Engineer, Kistna Northern Division, to the Superintending Engr., 2nd Circle No. 523 E., dated 8.11.97.

Referred

My deffered telegram this date regarding the order to postpone construction of 100 Shutters for Kistna Anicut.

I would most strongly urge that the work given to Messrs Burn & Co. be in no way altered or interfered with. At a cheap rate a contract with most stringent time limit clause has been entered into. Any such change as is proposed will vitiate the time limit clauses and also lay the Government open to many claims for compensation, in any case any material alteration in the type of shutters is ordered.

I know Messrs Burn & Co. ordered materials specially from England for the work.

I would further point out that

that even if the type proposed for ~~oth hundred~~ shutters by the Inspector-General is the most perfect possible, they will not, in practice, be any improvement on the work as some 200 shutters will remain of the original proposed type. I would ~~most~~ strongly urge that the construction of the shutters to the construction of which I am not yet fully committed in Bezwada workshop (some 20 in number) only be stopped. For purposes of experiment 20 shutters would be quite sufficient.

CHIEF ENGINEER FOR IRRIGATION. 18 NOV. 1897 354 K.S

No. 2253 K.N / 15-11-97

Forwarded to the Chief Engineer for Irrigation for favour of orders.

J. Wroth Wilson
15/11/97
Executive Engr.
for Supg: Engr.

H Circle

13/11/97

Public Works (1897) Department.

CURRENT No. 11445

Order

From the Govt. of India

No. 292 I

Dated 8th November 1897

Received 18 — " —

Enclosures 10 (5 plans)

Spare copies 6 to Enclos 6

Please see list of Encls to Govt of India
Only 4 plans were returned with it
M.h

SUBJECT.

Shutters to the crest of the Kistna Anicut, Kistna Delta System.

Sanctioning, with remarks, the cost of fitting —.

P. W. 29.
1,000—22-4-97.

BACK PAPERS.

No.	Date.
R 2548	15-11-97
I 2831	28-11-97
G.O. 987 I	8-11-97
G.O. 903 I	11-10-97
G.O. 904 I	11-10-97
G.O. 792 I	30-8-97
Orgl G.O. 786-7 I	26-8-97

FURTHER PAPERS.

No.	Date.

2 S.P.

Note by the Inspector-General of Irrigation on the Falling Shutters proposed for the Kistna Anicut.

An estimate amounting to Rs. 5,020 for fitting experimental shutters on a length of 200 feet of the Kistna aqueduct was sanctioned by the Government of India in their letter No. 214-I., dated 14th August 1897, in paragraph 2 of which it was remarked that it would be as well to try also the type of shutter in use on the headworks of the Lower Ganges, the Agra, the Sirhind and the Chenab Canals, and it was suggested that Colonel Smart, who recently had visited all these headworks, should be consulted on the point. Before that letter was received the Madras Government had forwarded with their endorsement No. 787-I., dated 26th August 1897, a complete estimate for making all the shutters required on the type which was the most approved of those adopted in the previous experiments. The papers forwarded with this endorsement were not received in Simla until the 8th October, and contained no reference to the suggestions of the Government of India, but a note on the subject by the Chief Engineer for Irrigation has since been submitted by the Madras Government with their letter No. 904-I., dated 11th October 1897.

2. In this note the Chief Engineer deprecates the use of the type of shutter which has been adopted in Northern India on the large river weirs in the Madras Presidency, on the ground that "even the largest rivers rise very rapidly in floods, and there would be very little time to release the shutters. In case of a flood coming at night men could not without danger get to the middle of the anicut if there were more than a few inches of water going over the shutters. It would be a very serious matter if the shutters were up during a flood as the apron is not built to stand an overfall." B

On these grounds the Chief Engineer advocates the use of shutters that will fall automatically as a flood rises, instead of the Northern India type, in which the shutters have to be released by hand, and the Local Government have stated that they concur in the views of the Chief Engineer. A

3. The apprehensions expressed by the Chief Engineer are I think groundless. From the detailed quantities for the estimate under consideration I find that it is proposed to erect on the Kistna anicut 287 shutters of 10 feet in length, making a total length of 2,870 feet. The plans submitted show the length of the level portion of the anicut to be 3,263 feet, and the difference between this length and that upon which it is proposed to erect shutters has not been explained, but it appears certain that the latter length is only 2,870 feet. The weirs or anicuts at Khanki, Narora and Rupar are approximately 4,000, 3,500 and 2,400 feet in length respectively. We may leave the Khanki weir out of consideration, as it is divided into 8 bays of 500 feet by seven towers to which access can be gained at all times by an overhead wire tramway. But at Narora and Rupar men must go out from the sides to get at the central shutters. The length of shutters at Rupar falls short of that proposed for the Kistna by less than 500 feet, but the shutters are 6 feet high, the length being also 6 feet, and they are worked almost all the year round. During the cold weather indeed, or from 1st November to about 15th April, they generally remain up, and it is only on the occasion of a stronger freshet than can be passed through the undersluices that it is ever necessary to let the shutters down. But the conditions at Rupar differ from those on any other headworks, in that it is necessary to work the shutters almost all through the flood season and the shutters seldom remain down all along the weir for more than one month in the year, generally August, when the river is in high and continuous flood. And yet under such conditions as these there is never the slightest risk of the shutters being caught up in a flood. As soon as they are nearly topped a man goes out from each side, and the two central shutters are released by them. Each then works back from the centre to the side, releasing as many shutters as required. If there are signs of a strong flood they may be ordered to release the whole number, about 400, but this can

be done without difficulty by two or four men in an hour. I have seen one man let down the shutters over half the weir at the rate of six per minute, and however suddenly a flood may rise no anxiety has ever been felt during the last eleven years as regards the possibility of getting all shutters down in time. I understand that at Bezwada the readings of the Pagatur gauge, 250 miles up the river, are received by telegram daily, but at Rupar there are no arrangements for telegraphic intimation of upstream river gauges. If therefore it were desirable for other reasons to erect hand-released shutters along the whole length of the Kistna anicut, I am of opinion that there would not be the slightest risk in doing so. The relative advantages of self-falling and hand-released shutters may therefore be considered without reference to this point.

4. The great difference between the Kistna headworks and those in Northern India lies in the fact that in the former the undersluices are of very little value for lowering the depth of water over the weir. It is on this account that Captain Ellis has designed the shutters so that up to a certain point surplus water may be passed over them. In the absence of more undersluice power the raising of shutters which have once fallen will be so difficult that it is proposed that they shall fall only on the occasion of very strong freshets. It may be assumed, for the sake of simplicity, that the quantity of water passing over a foot run the anicut or the shutters may be approximately indicated by the formula $\frac{10}{3}$ h. $\sqrt{h}$, when h equal the height of water over the crest of anicut or top of shutter, as the case may be. Captain Ellis has arranged that the central 700 feet of shutters shall fall when the depth of water over the shutters is 1 foot. The surplus over the whole length of 2,870 feet of shutters would then amount to $\frac{10}{3}$ of 2,870 = 9,567 cusecs, and this would be passed through the 700 feet gap at a depth of about 2·55 feet over the crest of the anicut. Allowing for the simultaneous reduction in the depth of surplus over the flank walls and undersluices the depth of water over the crest would probably not be much below the full 3 feet required. The next fall of shutters will occur when the surface of the water has risen to 1·25 feet above the tops of the shutters still standing, or to 4·25 feet above the central gap, when another 1400 lineal feet of shutters will fall. The quantity of surplus will then be—

$\frac{10}{3}$ × 2,170 × $(1{\cdot}25)^{\frac{3}{2}}$ =	...	10,126
plus $\frac{10}{3}$ × 700 × $(4{\cdot}25)^{\frac{3}{2}}$ =	...	20,416
Total	...	31,542

The last 770 feet of shutters will fall when 1·5 feet are passing over them, and the surplus, excluding that over side-walls and through undersluices, will then be—

$\frac{10}{3}$ × 770 × $(1{\cdot}5)^{\frac{3}{2}}$ =	...	4,721
$\frac{10}{3}$ × 2,100 × $(4{\cdot}5)^{\frac{3}{2}}$ =	...	66,822
Total	...	71,543

Excluding the surplus over side-walls and through undersluices the shutters will therefore fall as below:

		surplus.
700 lineal feet will fall with		9,567 cusecs
1,400 "	" "	31,542 "
770 "	" "	71,543 "

5. The suitability of the arrangement proposed, which has been very carefully worked out, appears to depend upon the range of variation in the supply during the season in which regulation by means of shutters is necessary, and also upon the degree of difficulty that may be anticipated in raising the shutters. On the former point there is no information before me. If the surplus to be passed over the shutters is never likely to exceed 10,000 cusecs during the working season the shutters will never fall, and we have only to consider the question of first raising

them when the depth of water over crest of the anicut first falls below 3 feet. If, however, freshets which will give surpluses of 10,000, 32 000, or 72,000 cusecs several times during the season may be anticipated, and if such freshets as the last are likely to be followed by a fall in the surplus supply to below 49,000 cusecs (which will pass over the 2,870 feet of anicut at a depth of 3 feet,) the shutters will frequently fall and will have to be raised again, and the suitability of the design will depend upon the facility with which this raising can be accomplished, the condition being that the supply shall never be allowed to fall much below 3 feet above crest of anicut except for the day or two that may be necessary for re-erecting the shutters.

6. It is proposed to raise the shutters, either by levers from below, or by a windlass attached to a punt from above. As regards the former method it is said that 16 men have been able to lift a 16-foot shutter against 1·5 feet of water, so that 10 men should be able to lift a 10-foot shutter against the same head. It is very doubtful however whether any number of men could lift a 10-foot shutter against a much greater head than 1·5-feet. It is not so much a question of the load as of the force of the current in which the men would have to stand, and even if they could lift the shutters against a head of 2 feet the work would be very tedious and dangerous.

The alternative of a punt working upstream has often been suggested, but I do not know of any case in which it has been actually adopted. On the Sone, Narora and Okla weirs the water passing over the weir can be reduced to a workable depth for hand lifting by means of the powerful undersluices, and this is true also at present for the Chenab headworks. At Rupar where the water has often to be held up 6 feet, the undersluices are not powerful enough, and the shutters are lifted by means of two cranes mounted on trollies, one on each bank, which can be run out along the crest of the weir on the downstream side of the shutters, where a tramway has been laid down. I have seen a 6 foot by 6 foot shutter lifted by this means against nearly 6 feet of water, though with very great difficulty, but with undersluices open the usual head is not more than 3 feet, and the shutters though 6 feet in height can be easily lifted against this head. On none of these works, therefore, has it been necessary to use a punt. Captain Ellis says that shutters have been raised by this means without difficulty against a 2 feet head. I have no doubt that this can be done, but it is nevertheless a question whether this will be a safe and sufficiently expeditious method, especially when the depth of water exceeds 2 feet. Experiments, though of great value, are not conclusive on such a point as this, and it is only by long practical experience under all conditions that a confident opinion can be formed. I think that the system will be found quite practicable, but that it will be inconvenient to apply it whenever it is necessary to put up some shutters, and that the operation will probably be tedious even if not attended with some degree of risk.

7. If there are great fluctuations in the supply during the season in which it will be necessary to work the shutters, I would suggest for consideration that the best arrangement might be a combination of the self-falling and hand-released systems. I would propose to erect 500 lineal feet of hand-released shutters (each 6 feet long) on each side of the anicut, laying a good wide tramway on the crest downstream of the shutters, for this length of 500 feet, upon which a crane could be run out. The cranes would ordinarily lie behind the side-walls that it is proposed to build on the flanks of the shutters, and could be run up the sloping ends of the anicut to the banks before the advent of the flood season, though small floods over them would do no harm, especially if the jibs were first lowered.

Next to these 500 feet of hand-released shutters, I would put a length of 200 feet of self-falling shutters pivoted to fall with 0·5 foot over the top of shutter. Next to these on both sides would be 390 feet of shutters pivoted to fall with 1 foot going over them, and in the centre of the anicut would be 690 feet pivoted to fall with 1·5 feet of water passing over them.

8. The manner of working would then be as follows. Suppose in the first place that there is no surplus, and all the shutters are up, and the undersluices closed.

As the river rises the undersluices would first be opened. If the rise continued two or three inches of water might be allowed to spill over the shutters, but, as soon as this limit was exceeded, the men should go out to the far end of the hand-released shutters, *i. e.*, 500 feet from the side, and let down one or more shutters as may be necessary. As the river rises more shutters will be released, working always from the centre to the flanks, but the water need never be allowed to fall below the level of tops of shutters. If a fall occurs before all these shutters are down the cranes would be run out, and as many shutters put up as necessary, working from the sides to the centres. If however the rise continues, the whole of these hand-released shutters will eventually be let down, and the surplus passing over 1,000 feet of the crest, with a depth of 3 feet will amount to about 17,000 cusecs. The water may now continue to rise until it stands at 3·5 above the crest, when 400 feet only of the self-falling shutters will go down, the surplus then amounting to about 24,000 cusecs, which will be passed over the 1,400 feet of open weir with a depth of 3 feet. If the water falls after this it will be possible to maintain the 3 feet level by first closing the undersluices, and afterwards lifting more of the side-shutters, working as before from the sides to the middle. If when all these are up the level falls below 3 feet, that is the discharge through the 400 feet of open weir is less than 6,800 cusecs, it would only be necessary to open the undersluices to reduce the level to a depth at which the 400 feet of shutters could be again raised, and everything would be as at first. If however the water continued to rise after the 1,400 feet of shutters were down, the next line of shutters, pivoted to fall with 1·00 going over them and extending over 780 feet of the anicut will eventually go down the surplus then amounting to about 42,000 cusecs. Finally the central 690 feet of shutters would go down, when water was standing 4·5 above crest of anicut, the surplus then amounting to 73,600 cusecs or a little more than under the arrangement proposed by Captain Ellis.

9. Let it now be supposed that the river falls steadily to below 49,000 cusecs after a flood of 74,000 cusecs has passed, and all shutters are down. With a surplus of 49,000 cusecs the height over crest will be 3 feet and the effect of opening the undersluices would be to reduce the surplus over the crest to 43,000, or to a height of 2·75 above crest. It would be very difficult to raise the shutters against such a head as this. But under the arrangement now proposed the level of 3 feet would be maintained if the river continued to fall by first closing the undersluices and then gradually erecting the side-shutters. When all these shutters were up the open length of anicut would be reduced to 1,870 feet, and the 3 foot level would be maintained until the surplus fell to less them 32,400 cusecs. By opening the undersluices alone at this stage the quantity passing over the anicut would be reduced to 26,400 cusecs, and the depth would fall from 3 feet to 2·6 feet. If the self-falling shutters could not be conveniently raised against this head the side-shutters might all be dropped, and the depth of surplus over the anicut would then be less than 2 feet. The next step would be to raise as many of the self-falling shutters as possible, and then to close the undersluices and lift as many side-shutters as necessary to maintain the 3 foot level.

10. Many other cases may be assumed, but the principle of working under the system proposed would be the same in all. The self-acting shutters will never fall until as much relief as possible has been given by opening the undersluices and dropping the side-shutters, and by relifting the latter it will be possible after each fall of the self-acting shutters to maintain the 3 foot level without interruption for some time after the river falls, the only necessary interruption being in the case assumed in the preceding paragraph, when after a flood of over 73,000 cusecs all the self-acting shutters have fallen, and the surplus has subsequently been reduced to less than 32,000 cusecs. In such a case it may be necessary to reduce the depth over the anicut temporarily to 2 feet while the self-acting shutters are being raised, but ordinarily the whole of the regulation can be done by means of the side-shutters and undersluices without at any time allowing the depth of water above crest of anicut to be less than 3 feet, or R. L. 50·25. Under Captain Ellis' proposals it would often be necessary to accept a level of 49·25 for days together, unless indeed it is found that the shutters can be raised without difficulty against a head of 2·75 feet.

4. S.P

11. The arrangement now proposed may, I think, be commended to the consideration of the Madras Government though I would not propose to press its adoption. If the conditions are such that after the shutters have once been erected at the commencement of the low river season there is no reason to anticipate that the surplus will exceed 10,000 cusecs (when the central 700 feet of shutters will go down) until the end of the low river season, and that after each length of shutters has once fallen it will be unnecessary to raise them again until the advent of the next low river season, the plan which has been submitted for sanction will answer the purpose very well, and may be approved as it stands. But if the supply, or rather the surplus, is liable to great fluctuations throughout the cold weather season, and it is likely to be eventually a matter of importance to maintain a continuous head of 3 feet over the crest of the anicut, I venture to think that the introduction of side-shutters, which can be dropped or raised at pleasure, will greatly facilitate the working, and that they will be found to make up a great extent for the want of power in the undersluices. It is true that the regulating establishment will be required to drop or set up a few of these shutters almost daily, with every slight fluctuation in the quantity of the surplus, whereas with the self-falling shutters they would have nothing to do until the surplus exceeded 10,000 cusecs. It will not, however, be altogether a disadvantage that they should be almost daily employed in manipulating a few shutters, while the occasions on which they will have to erect the self-falling shutters will be reduced to a minimum.

12. As regards cost I do not think that the side-shutters will cost any more than the shutters which have been designed, and the estimate submitted will therefore cover their cost. A supplementary estimate will however be required to provide for the tramway on each side, and for the two cranes that will be required for lifting the shutters.

13. The details of the design submitted do not call for much remark. I apprehend, however, that some trouble may be experienced with the projecting angle iron at bottom of the shutter. If stones or even silt lodge under any portion of this angle iron the shutter will not be free to fall, and will be subjected to a very violent action, while the edge of an angle iron will not form a very tight joint against leakage, though this is not of great importance. It would, perhaps, be better to let the uprights of the shutter rest on a bevel, the plate forming a vertical butt joint with the cill. The slide bars will still be necessary for the purpose of supporting the verticals of the shutter while in the act of falling. I put up a sketch which will indicate what is intended. It is also not apparent why the crest on which the shutter will lie is built at a lower level than the up-stream crest.

26th October 1897.

(Sd) T. Higham,

Inspector General of Irrigation.

G. C. Press, Simla.—No. 1234 P W. D.—10-11-97—60.

P.W.S.6
1145/97

No. 292 I.

GOVERNMENT OF INDIA.

PUBLIC WORKS DEPARTMENT.

CIVIL WORKS.
Irrigation.

All communications should be addressed to the Secretary.

To

The Secretary to the Government of Madras,

Public Works Department.

Simla, the 8th November 1897.

Sir,

In continuation of Public Works Department telegram No.289 I., dated the 5th November 1897, repeated on the margin, I am directed to communicate the sanction of the Government of India to the estimate forwarded with the Proceedings of the Madras Government, No.786, I., dated the 26th August 1897, amounting to Rs.58,770, including Establishment and Tools and Plant charges, of the cost of fitting shutters to the crest of the Kistna Anicut, chargeable against the Capital Account of the Kistna Delta System under 49.

"Your 904 I., October 11th. Estimate for Kistna Weir shutters sanctioned but postpone construction of 100 out of 287 shutters pending consideration of note by Inspector General. Letter follows."

2. I am to invite consideration of the attached note by the Inspector General of Irrigation, and to say that if His Excellency the Governor in Council concurs in the suggestions made therein, arrangements should be made for constructing shutters for a length of 1,000 feet so that they can be released by hand.

3.

3. From the detailed quantities for the estimate forwarded, it appears that it is proposed to erect on the Kistna Anicut 287 shutters of 10 feet in length, making a total length of 2,870 feet. The plans submitted show the length of the level portion of the Anicut to be 3,263 feet, and the difference between this length and that upon which it is proposed to erect shutters has not been explained, but it appears certain that the length proposed to be fitted with shutters is only 2,870 feet. Unless there are special reasons for this, another 400 feet of shutters will be required, which may be of the self-falling type, in which case a revised or supplementary estimate may be prepared and submitted for the orders of the Government of India.

4. The sanction accorded in paragraph 1 has been registered as No. 26 I, of 1897-98, and the plans and estimate forwarded with Madras Government Proceedings No. 786 I., dated the 26th August 1897, are returned herewith.

I have the honour to be,

Sir,

Your most obedient servant,

N. F. Mackenzie

Under Secretary to the Government of India.

ND

Documents accompanying :-

(1) Inspector General's note. with book-copies.

(2) Estimate. & note by Ex. Engr.

(3) Four plans. sent by parcel post.

S.s.S.