

MANUAL FOR MAINTENANCE OF EMBANKMENTS

(MANUAL OF FLOOD OPERATION)

Introduction :-

Assam which covers an area of heaviest rainfall, used to experience periodical floods. Particularly after the great earthquake of 1950, frequent visit of floods has been severely disturbing the riverine system.

River Brahmaputra along with its tributaries and innumerable subtributaries have been causing floods of various magnitude in the basin.

For the purpose of effective flood protection and release of drainage congestion, a vast net work of embankments/drainage system has so far been constructed as below :-

1. Effective length of embankments along Brahmaputra on both banks. 759 K.M.S.
2. Effective length of embankments along tributaries. 2354 K.M.S.
3. Drainage channels. 464 K.M.S.
4. Town protection works.
 - a. Major town 5 Nos.
 - b. Small town 27 Nos.

These embankments and town protection works suffer damage to great extent almost in every year due to various reasons such as :-

- a. Due to overtopping.
- b. Due to Seepage/percolation piping through embankment.
- c. Slumping down of side slopes.

Besides these, bank erosion is also one of the major factor causing great damage to embankment as well as habitated town and villages.

To maintain properly, the embankment and other protection works, against annual devastation, an organised net work has been set up throughout the State of Assam, by the Flood Control Department.

1. Flood Warning System :-

In order to keep all concerned well informed about the time to time flood situation in the State, the following flood warning system operates, in the State.

1-1. Central Control Room :-

Central Flood Forecasting circle of Central Water Commission at Gauhati, will send to Control Room of Flood Control Department, the water levels twice daily for river Brahmaputra and Barak and their tributaries. The Forecast report will indicate water level of Brahmaputra, Barak, and major tributaries from fifteenth May, of the year to fifteenth October, or as soon as the water level attains level of one metre below danger level.

The forecasting stations from which the forecast of water level will be available are given below :-

RIVER GAUGE SITES

River	Location of Gauge	Danger level	H. F. L. Recorded
Brahmaputra.	Dibrugarh	342.00 ft.	347.60 ft.
		104.24 M.	105.95 M.
Brahmaputra.	Neamati	279.00 ft.	284.90 ft.
		85.04 M.	86.84 M.

River	Location of Gauge .	Danger level	H. F. L. Recorded (Year
do	Tezpur	<u>214.00 ft.</u> 65.38 M.	<u>218.70 ft.</u> 65.66 M.
-do-	Gauhati	<u>163.00 ft.</u> 49.68 M.	<u>167.46 ft.</u> 51.04 M.
-do-	Pandu	<u>160.00 ft.</u> 48.77 M.	<u>162.88 ft.</u> 49.66 M.
-do-	Dhubri	<u>94.00 ft.</u> 28.65 M.	<u>97.84 ft.</u> 29.83 M.
-do-	Goalpara	<u>119.00 ft.</u> 36.27 M.	<u>121.00 ft.</u> 36.88 M.
Lohit	Tezu	<u>643.00 ft.</u> 195.99 M.	<u>645.80 ft.</u> 196.84 M.
	Dholla	<u>430.83 ft.</u> 128.27 M.	<u>424.72 ft.</u> 129.49 M.
Siang	Pasighat	<u>505.11 ft.</u> 153.96 M.	<u>508.95 ft.</u> 155.17 M.
Buredehing.	Khowang.	<u>335.00 ft.</u> 102.11 M.	<u>339.60 ft.</u> 103.51 M.
-do-	Naharkatia.	<u>395.00 ft.</u> 120.40 M.	<u>401.52 ft.</u> 122.40 M.
Kopili	Dharamtul	<u>184.75 ft.</u> 56.31 M.	<u>186.76 ft.</u> 56.94 M.
-do-	Kampur	<u>198.49 ft.</u> 60.50 M.	<u>207.41 ft.</u> 61.37 M.
Dhansiri (s)	Golaghat.	<u>292.63 ft.</u> 89.50 M.	<u>297.47 ft.</u> 90.68 M.
Pagladiya	N. T. Road.	<u>173.05 ft.</u> 52.75 M.	<u>181.19 ft.</u> 55.23 M.
Subansiri	Chowaldhowa-ghat	<u>329.45 ft.</u> 100.43 M.	<u>329.88 ft.</u> 100.76 M.
Puthimari	N. T. Road.	<u>170.00 ft.</u> 51.82 M.	<u>178.07 ft.</u> 54.20 M.
Manas	-do-	<u>156.00 ft.</u> 47.55 M.	<u>161.74 ft.</u> 49.30 M.
Beki	Rly Bridge.	<u>146.90 ft.</u> 44.38 M.	<u>150.43 fs.</u> 45.85 M.
Borak	Annapurnaghat	<u>65.06 ft.</u> 19.83 M.	<u>69.15 ft.</u> 21.08 M.

Note :—These danger levels, should be varified once every 3 years to examine. Whether any change have occured/required. If so, detailed report should be submitted with proper data for examination and reconciliation.

1-2. Departmental Control Room :—

From 15th May till end of the flood season a Control Room will be set up at the Head Quarter of F. C. Deptt., at Gauhati. All informations regarding the flood situation will be received and notified to concerned authorities as specified under special circular.

This Control Room also collects from field Officers by Telephone, Telegram, Police Wireless system, the flood information and other information regarding erosion problem, inundation and similiar cases if any, day to day and keep whole organisation well informed and in total alertness.

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The Executive Engineer, of the Flood Control Deptt., in charge of the division will send to the Control Room of Flood Control Department, at Gauhati, and to the Deputy Commissioner, Sub-Divisional Officer, (Civil) of the respective Districts and Sub-Divisions, informations as follows:—

1. Daily information regarding the water levels at different Stations of the rivers.
2. Crossing of danger level by any river.
3. Other informations regarding damage, breaches, in embankments, erosion cases etc. promptly.
4. The Flood Control Deptt., will publish from its Control room at Gauhati a bulletin twice daily and circulate to the concerning authorities as specified under circular issued from time to time.

The Flood Control Department, if the situation so warrants will inform to the D.C./S.D.O. and police authorities while communicating the flood warning to make necessary arrangement for evacuation of people from particular area.

Immediately after flood, flood damage data are to be collected by field officer in collaboration with Revenue Deptt., in order to ascertain the accuracy, of data collected for the purpose of preparation of Annual Flood Report and other future projects.

These damage data should be collected separately, for flood protected area and unprotected area as per guideline prescribed by the Govt. of India.

1.3 ISSUE OF FLOOD BULLETIN/FLOOD NEWS LETTER :

Issue of Flood Bulletin/Flood News Letters during Flood time particularly from June to Oct. is found unavoidable as to keep all concerned well informed about day to day flood situation in the State.

Central Water Commission, New Delhi also proposes for issue such Bulletins, and as such insisting for giving them flood news whenever water level of a river reaches within 0.5 metre of the danger level, in prescribed proforma (Annexure I) giving there in particulars as below :

- i) Water level of river in floods.
- ii) Rainfall in the catchment area (in C.M.S.)
- iii) Any emergent measures taken etc., to meet the flood situation.

Such messages are to be despatched by "Flood Immediate" Telegram/by telex.

In addition, a weekly report may also be issued giving a review of damage experienced during the week, as well as, the over all flood situation in as much details as possible every week.

A note on the hints for guidance in reporting Daily and weekly Flood situation is as per Annexure I. It may be added that merely giving water levels would not be adequate for the purpose of issuing "Flood Bulletin" unless sufficient in formations indicating whether any area has been actually flooded by these river levels, whether any damage to engineering structures and whether disruption of traffic has occurred should also be indicated as per proforma (Annexure-II).

The Flood Bulletins, will be issued normally once a week but the frequency may be increased as and when necessary depending on flood situation in the State. It is therefore necessary to send reports on flood situation, in detail immediately after their occurrence.

It is further added, that the Executive Engineer, Hydrology Division, Flood Control Department, Chandmari, Gauhati-3, with telephone No. 26130 (Office) dealing with flood messages for the entire State through a Control Room, established in Head Quarter, will act as co-ordinating Officer.

Details of the Office/Officer are to be specified as per proforma (Annexure-III).

2) Maintenance of Embankments :

Proper maintenance of embankment is extremely important and essential. Any breach through the embankment can be disastrous and can cause even greater damage than

the inundation by the Floods, from rivers where no embankment is existing. The maintenance of embankment can be divided into two parts.

During premonsoon period.

During Monsoon period.

2.1 Per-monsoon Maintenance :—

2.1.1 Levelling of Embankment crest and Slope.

Existing embankments have to be reconditioned or repaired well in advance so that these can safely with-stand pressure of the likely highest flood level against them in coming monsoon. It is therefore important to bring the embankment to the proper grade level and standard section. To achieve this required free board designed for higher flood level (in case there had been higher levels attained subsequent to the preparation of design) should be maintained by taking cross sections at regular intervals. Such Cross-Section should cover the river cross section also. Having thus determined the available free board according to the record, the correct free board available at site has to found by levelling.

The Officer-in-charge, of the embankment will submit a certificate annually that he has satisfied himself with regards to the correctness of the level of the top and the side slope (including berm level) of the main embankment as well as the lower or retired embankment. True and accurate data should be kept at the annual levelling done, showing the name of the Officer, doing levelling and incase of check levelling of the checking Officer, together with the data in details.

Such data should be readily available for inspection in a separate register with cross reference to actual field books in which the original levelling record is entered and should form important record which should be preserved. Preferably one Register for one continuous embankment system should be maintained so that these data could be utilised conveniently for future programme.

From this data a graph (Long. Section) should be drawn to compare in each K.M. The actual top level and ground level with the highest flood level of the previous year/years and of the other high flood years.

2.1.2 Installation of flood gauge, bench mark pillars and erection of timber profile of embankments :

Importance of installation of flood gauge and bench mark pillars etc. need not be emphasised again in view of foregoing paras.

However, arrangement should be made for fixing the gauge, bench mark and timber profile well in advance as specified below.

- (a) Flood gauges should be fixed at one K.M. apart or at closer spacing at obligatory points.
- (b) Bench mark pillars should be fixed at 250 metres apart along the country side.
- (c) The bench marks should be w.r.f. G.T.S. only.
- (d) Timber profiles should be fixed at 250 metres apart.

2.1.3 ASSESSMENT OF VULNERABLE REACHES OF EMBANKMENTS :

A careful study of the revised statement of high flood levels at the embankment gauge and also the graph (long section) of actual top level and ground level of embankment available will show at a glance whether the required free-board of any embankment is available.

Besides, these during the normal course of inspection the Divisional Officer, should particularly see whether in any particular reach there is any impending danger which might affect the safety of embankment and assess total vulnerability of the embankment system made in the Division and keep among recorded. This record should by all means be completed before 30th April each year and made available to all concerned and take up steps for effective measures.

Advance action should be taken at specific vulnerable reach of embankment for construction of dowel bund and for restoration of embankment section by earth work

to prevent future failure against overtopping and seepage. Execution of such earth work in advance should be carried out to allow proper settlement. This would be cheaper and economical in the long run and there by profuse use of empty cement bags and other flood fighting materials during flood time can be avoided.

Taking such advance action extra expenditure incurred for execution of earth work by boat carriage/truck carriage and wanton use of empty cement bags boulders, bushy trees etc. particularly when these have to be done at peak of flood time can also be minimised.

2.1.4 Petty Annual Repair :

All rain cuts, pot holes, depression in the embankment section etc. must be made up by earth work after cleaning the site of all loose particles and vegetations when the top of embankment is dusty or sandy a layer of basic materials should be placed on the top and rammed or rolled properly.

All leaks, sites should be opened out in the full width of the embankment with particular care to trace out its extend to the end, and refilled by fresh earth laid in 15 cm layers, duly watered and rammed to proper compaction.

Rodents and other borroughing animals make holes, cavities and tunnels through and under an embankment. These are source of danger as these cause leaks, excessive seepage and even breaches during flood period. All openings in embankment must be plugged well in advance.

Arrangement should also be completed well in advance to ensure that :

1. The site materials are stacked in proper place to be made available at short notice.
2. Passages of all cross drainage works are cleared, free of obstructions to allow easy flow of flood water.
3. All the structures (like sluices, bridges, culverts are to be repaired, painted, oiled, greazed as necessary all the gates, flaps etc. are to be repaired to bring them to proper functioning.

All gauges, Kilometre posts, bench mark pillars repainted as necessary where old graduations are worn out.

All machinaries, tools plants are in good and running condition.

Country side slopes of all embankment and bunds, beyond the toe are cleared up of all trees and other growth, of vegetation except short grass and thick bushes.

2.1.5 Plantation :

The Planting of trees on embankment are not allowable because there roots tend to loosen the structure of the embankment, when shaken by wind, storm and these encourage cracks and development of leaks, which because of the existence of the root, are difficult to close. When trees are removed, it is necessary to remove the roots thoroughly because if the roots are left in, when the organic matters dies and decays and crumbles, it leaves dangerous hollows which cause settlement and lead to further trouble. On the otherhand short grass growing on the embankment (Dubri, Ulu, kalma, Khagari etc.) is good for protection against erosion and wave wash. It is therefore specified that the removal of growth on embankments should be done as under.

The side slopes of all embankment and land beyond the toe upto 30m on the country side and 10m on the river side should be kept clear of all trees and growths except short grass. Existing well established avenues within these limit need not be removed if the tree there-in are safe. Such avenues should be maintained but greatest care must be taken to uproot and remove all trees which are dead or which show by tendency to fall/dry up. After clearing away such trees, care must be taken up to have roots thoroughly removed and embankment or ground properly made up. reaches
e readily

2.1.6 Maintenance of other structures :

Works of general maintenance (other than the items as specified under sub-ent, required

repair works" prepage) and repair of timber spurs/boulder spurs/bridges/building/sluices/culverts etc. and also alike structures should also be taken up well ahead after due assesment of extent of damages, and should be completed before adyent of flood, so that no repairs work is left to be done during flood season.

2.1.7 Inspection of river course and progress of work :

The Executive Engineer, incharge of embankment should inspect the river course in their charge immediately after monsoon period and formulate progress of works required to be done during the next non-monsoon period for the safety of the embankment in the next flood season.

In doing so the Executive Engineer should keep in view any change which have taken place in the course of the river during the previous monsoon season.

Reaches where the river is eroding banks and likely to cut through a way particularly upstream of the embankment should be inspected as much higher levels may be expected below it in the event of cut off. Any likely change it is anticepated that the river may come nearer the embankment a full report together with suitable proposal should be forwarded to higher authority.

2.1.8 Filling up of Borrow Pits :

Normally there should not be any borrowpit on the country side within margin of 30^m from toe of embankment. If, however, this is made in an emergent situation during flood season near the toe, this may cause extensive seepage and form source of saturation alongwith, the superincumbent materials may slide or slump, endanger the stability of the embankment. This should be properly filled up later on during the monsoon period without allowing the embankment to probable profuse leakage seepage, slumping etc.

2.1.9 Formation of vigilant party with co-ordination with local leaders and Public :

The Executive Engineer, at site should examine the possibility of formation of local vigilant body constituted with the local leaders for obtaining necessary advice for proper up-keep of the embankment as well as to avail of requisit help and co-operation against probable sabotage by miscreants during flood times.

2.1.10 W/C Personnel duty. :

To utilize the services of W/C personnels under the charge of each sectional officer a working groups of 5 to 6 W/C personnels should be formed headed by a section assistant with day to day duty like petty repair works of dyke, patrolling of dyke, flood gauges, B.M. Pillars, timber profile etc.

1. Up keep of E/M on the top of E/M.
2. Repairs to embankments, cross tunnels longitudinal tunnels near villages.
3. Removal of all unwanted growth on slope and top.
4. Attending to Plantation.

2.2 Maintenance During Monsoon :

Very careful maintenance of the embankment is necessary during high flood. Frequent inspection and constant attendance by all concerned are essential. The establishment required for porper up-keep and maintenance of an embankment will vary according to its importance as also the behaviour and discharge of the river.

2.2.1 Classification of river :

The embankment through the state of Assam, under Flood Control Department, are classified for the purpose of their maintenance into 4 (four) different categories, according to the behaviour of the river as follows :

The embankment along the following river be calssified as :

be con- up steps category 'A'

Advanc- River Brahmaputra (2) River Subansiri
construction River Buredehing (4) River Pagladiya.

(ii) Category 'B'

1. Simen, 2. Jiadhal, 3. Ranganadi, 4. Dikrong, 5. Jiabharali, 6. Puthimari,
7. Gangadhar, 8. Desang, 9. Dikhow, 10. Kopili, 11. Manas, 12. Beki, 13. Gabru,
14. Saralbhangha, 15. Noa-dehing, 16. Kollong.

(iii) Category 'C'

1. Dirak, 2. Jhanji, 3. Dhansiri, (South Bank) 4. Bhogdoi, 5. Digaru 6. Aie,
7. Baralia, 8. Rupahi, 9. Pahumara, 10. Nonai, 11. Bargang, 12. Gainadi 13. Nona,
14. Dhansiri, (North Bank) 15. Morachowalkhowa, 16. Belsiri, 17. Moridhal,
18. Noa-nadi, 19. Pabha, 20. Barnadi, 21. Boginadi, 22. Durpang, 23. Solengi,
24. Singra.

(iv) Category 'D'

1. River Brahmajan, 2. Balijan, 3. Sundri, 4. Hatilong, 5. Bordikrai, 6. Kalu,
7. Dikhow, 8. Kaldia, 9. Morapagladiya. 10. Champamati, 11. Darika 12. Depota,
18. Champara, 14. Karha, 15. Namti, 16. Bhellengi 17. Bissaunalla 18. Mitong,
19. Rakhaldonga, 20. Dirgha 21. Dighalighaijan, 22. Modertala, 23. Hajosuti,
24. Chiladhari, 25. Kalioni, 26. Nadla, 27. Koki, 28. Gaijan, 29. Kakajan,
30. Satrong, 31. Pichala.

The Yardstick for maintenance of embankment under different categories were arrived at in the tune of following analysis.

2.2.2 YARDSTICK PER K. M. OF EMBANKMENT (UNIT RATES AS ON..)

Articles	A	B	C	D
1. Empty Cement Bags.	750 No.	725 No.	600 No.	250 No.
2. Bamboo	75 Nos.	70 Nos.	50 Nos.	40 Nos.
3. Watch tower	1 No. at 6 K. M. apart of all category of embankment.			
4. Patroller	1 No. at 6 K. M. apart of all category of embankment.			
5. M. Roll labour for 90 days	1.5 Nos. per K.M.	1.25 Nos./K.M.	1 No./K.M.	1 No./K.M.
6. Patrollers cum casual labourers for 4 months.	2 Nos /K.M.	1.5 Nos./K.M.	1 No./K.M.	$\frac{3}{4}$ No./K.M.
7. Other miscellaneous items.				
1. Lantern	$\frac{1}{2}$	per K. M. of all category embankment.		
2. Torch	1			
3. Wicks	1 ft.			
4. Kodali	3			
5. Japi	3			
6. Tokri	3			
7. K. Oil etc.	1 tin.			

A lumpsum expenditure @ Rs. 500/- per K. M. of drainage project for maintenance is also allowed as general case, for maintenance.

While assessing total requirement of flood fighting materials :—the surplus quantity of previous years should be fully assessed and utilized during the year under maintenance.

The Executive Engineer, will store flood fighting materials at vulnerable reaches and will organise the set up in such a way that materials and working staff are readily available in short notice.

The Executive Engineer, will assess properly requirement of establishment, required

for proper up keep and maintenance of an embankment (according to classification of the river).

2.2.3 Patrolling -

(a) Patrolling should commence as soon as water comes against embankment and should continue until water finally leaves the embankment. During this period all the establishment engaged on Patrolling must be present on the reach of embankment within the specified jurisdiction. Executive Engineer, in charge must be present on the embankment (at pre-determined vulnerable reach) when water is rising or when situation so demands.

(b) On a falling river, the presence of the Executive Engineer, is not obligatory, provided upper gauge show that no rise of water level is to be anticipated.

(c) It will be incumbent on Executive Engineer, to watch the Upper gauge and to satisfy himself by personal inspection before the flood arrives that all necessary arrangement have been made to meet flood condition through out the whole length of the embankment.

(d) The Executive Engineer, who suspects that abnormal condition may occur, must keep the Superintending Engineer, informed. In turn the Superintending Engineer, will inform his higher authority, that immediate attention may be concentrated on remedial measure.

(e) The Superintending Engineer, should decide the reach or reaches likely to give troubles on account of erosion direct attack or heavy pressure of water and should take special step to see that adequate arrangement have been made for keeping him informed as well as to face the situation at all time.

(f) When the river is in flood, the embankment requires close and constant watching and unremitting supervision both by day and night by adequate staff and materials. Timely warning and timely action with efficient and unremitting Patrolling alone can provide, will save a dangerous situation while complicity born out of false senses of security due to low river stage may lead to disaster. Continuous vigilance in patrolling every where is there-for enjoined on all the staff particularly during the night and in the early hours of the morning when slackening of supervision is likely to occur.

(g) Temporary Head Quarter of supervisory staff, should as far as possible be located near the dangerous and important reaches of the embankment, town. Protection works in their charge.

(h) There should be shift system in patrolling establishment. Duration of each shift should be left to the discretion of the local officer.

2.2.4 (iv) Protective measure normally adopted for checking erosion :-

Since erosion is also a major factor causing great devastation, some measures are to be taken to check the erosion as done in past were under active use. Those measures can be divided into two categories.

(i) Temporary measures, which are more or less intended to give immediate result and reduce the rate of erosion but which are not expected to held on for all limit of time.

(ii) Permanent measures which are intended to affectively check erosion and protect the bank.

2.2.5 (1) Other Protective Works Generally used,

(i) Providing double bamboo pallisading 1.50 m wide 76mm to 100mm dia with Jati bamboo stakes driven 1.20 m to 1.50 m below ground level and 1.80 m to 2.40 m above ground level at 76.00 mm apart tied with double half bamboo horizontals at 0.45 m apart and strengthening with two rows of whole bhaluka bamboo struts and two rows of whole Jati bamboo struts and two rows of whole Jati bamboo cross tied at 1.50 m apart between the two pallisading all works tied with 8 g. wire etc. complete as directed.

(ii) Providing single bamboo pallsiding with 75 mm to 100 mm dia whole bamboo stakes driven 0.9 m below ground and upto 1.2 m above ground at 75 mm apart strengthened with double half jati bamboo horizontals at 0.45 m apart tied with 16 g/18 g wire complete with bhaluka bamboo struts at 1.5 m apart, complete as directed.

(iii) Providing single bamboo pallsiding with 75 mm to 100 mm dia whole bamboo stakes driven 0.9m to 1.2 m below ground and 1.2 m to 1.8 m above ground at 75 mm apart strengthened with double half jati bamboo horizontals at 0.45 apart with 16 g/18 g wire complete with bhaluka bamboo struts at 1.0 m apart, complete as directed.

(a) With bhaluka bamboo stakes.

(b) With Jati bamboo stakes.

(iv) Providing single bamboo pallsiding with 72 mm to 100 mm dia whole bamboo stakes driven 0.91 m to 1.2 m below ground level 1.8 m to 2.4 m above ground at 75 mm apart strengthened with double half jati bamboo horizontals at 0.45 m apart tied with 16g/18g wire complete with bhaluka bamboo struts at 1.0m apart, complete as directed.

(a) With bhaluka bamboo stakes.

(b) With jati bamboo stakes.

(v) Construction of bamboo mohari by two lines of bhaluka bamboo pallsiding placed at 1.5 m apart with matured bhaluka bamboo stakes of 75 mm to 100 mm dia closely placed together at 75 mm apart and tied with wire/cane and bhaluka bamboo horizontals at every 0.45 m apart and bhaluka bamboo struts at 1.2 m to 1.5 m apart providing single turza-mat lining inside the mohari including whole bhaluka bamboo crossed struts at 1.5 m below ground and 2 m above ground including filling inside properly with earth etc. complete as directed.

(vi) Providing half bamboo pallsiding made for 75 mm to 100 mm dia whole bamboo stakes driven 0.90 m to 1.20 m below ground and upto 30 m above ground at 75 mm apart strengthening with half jati bamboo horizontals at 0.45 m tied with 16g/18g galv. wire etc. complete, with bhaluka bamboo struts at 1.50 m apart, as directed.

(a) With Jati bamboo stakes.

(b) With bhaluka bamboo stakes.

(vii) Providing single bamboo pallsiding with 75 mm to 100 mm dia whole bamboo stakes driven 0.91 m to 1.20 m below ground upto 0.90 m above ground at 75 mm apart strengthening with half jati bamboo horizontals at 0.45 m apart tied with 16g/18g galv. wire etc., completed.

(a) With jati bamboo stakes.

(b) With bhaluka bamboo stakes.

(viii) Supplying filling fixing jati bamboo chattai diagonally woven fixed with strong bamboo pegs in half bamboo battens placed at 0.90 m apart in edge of the slope of river bank embankment etc., complete as directed.

(ix) Supplying fitting fixing straight woven jati bamboo chattai inside the pallsiding to rest the earth fixed with half Jati bamboo battens placed at 0.91 m apart etc., complete as directed.

(x) Single "A" type spur with 75 mm to 100 mm dia bhaluka bamboo stakes placed closely at vertex driven 0.91 m to 1.20 m and 1.80 m to 2.4 m above ground with double half jati bamboo horizontals at 9.30 m apart whole jati bamboo at vertex with 16g/18g wire etc. complete as directed.

(xi) Providing bamboo raft made of matured jati bamboo 0.90m C/C both ways and whole jati bamboo diagonals two nos. and double bamboo on longer side and all crossing point being securely tied wires or canes and tying tree branches of minimum length of 2.40m hung with tailage down wards from every crossing points of the bamboo anchoring on bank with three nos. of 8g wire of minimum length of 15m each including supplying of all materials handling and launching in water, complete as directed.

(xii) Supplying of bamboo cage of 18m dia constructed from circular ring made with 3 nos. of split jati bamboo kamies of minimum 75mm width placed at 0.45m apart to the whole jati bamboo kamies of minimum 75mm width placed at 0.45m apart to the whole jati bamboo longitudinals placed 22 cm c/c around the inside of the circularing strengthening by one set of 3 nos jati bamboo struts placed at 0.45m apart. inline of split bamboo kamis tied with 16g/18g wire including inside filled with green brass wood etc. including launching to the eroded bank of the river including anchoring with 2nos of galv. wire of $\frac{3}{8}$ " dia wire rope of minimum 15 m long fixed with Bhaluka bamboo post driven 1.5 m below ground at bank of safe place, complete as directed.

- (a) With Jati bamboo stakes.
- (b) With bhaluka bamboo stakes.

(xiii) Providing triangular bamboo cage of 4.00m equilateral side frame of whole bhaluka bamboo to be placed at 1m apart with bhaluka bamboo king post tied with half jati bamboo horizontals rafter placed at 15 cm clear gap and whole bhaluka bamboo longitudinals at vertex and all joint being tied with 10 cm to 15 cm long iron nails and 16g wire each bhaluka bamboo frame being tied with diagonally placed half jati bamboo horizontal strip to hold the materials like trees branches inside the cage and placed at the eroded bank fixed two nos. of whole bhaluka bamboo post driven at 1.5 m below ground level tied and anchored with 2 nos. of $\frac{3}{8}$ " dia wire rope of 15m long etc. all complete as directed.

(xiv) Construction and launching percupines of size 2mX2m made of whole bhaluka stakes of 75mm to 100mm dia placing and fixing with iron spikes to stakes at 0.80m apart keeping projection upto 0.60m on either sides of each whole bamboo legs and providing half jati bamboo vertically between the two stakes at 0.10m apart and half jati bamboo diagonals cross-wise at each faces with necessary required projection and tied with 14g/16g galv. wire including weighing inside the percupines with 0.15 cm of man size boulder filled in cement bags and tied with 14g/16g wire and launching properly from the boat if and when necessary in the river bed and anchoring with 8g wire 2 nos. of 20m long etc. complete as directed.

(xv) Supplying and launching of whole trees at eroded river bank with spreaded branches and green leaves, anchoring the same on the river bank with 8g galv. wire 2 to 3 nos. tied to a piece of 15 cm to 20 cm dia and 1.2m long hard jungle woodlog of 1.0m to 1.5m long burried at least 0.9 m to 1.2m below ground at a safe distance to the site of work with elephant or as necessary including payment of compensation of any forest royalty etc. as necessary for the trees and logs etc., complete as directed.

(a) Trees above 1 m girth to 2.00 m girth and 6.0 m minm. length and when placed on ground at the broadest point 3m and upwards.

(xvi) Labour for laying cement bags filled with sand/earth including laying fixing in position as directed completed with supply of bags sutlies etc. all complete as directed.

- a) Cement bags.
 - i) Sand filled.
 - ii) Earth filled.
- b) Gunny bags 1 md. capacity.
 - i) Sand filled.
 - ii) Earth filled.
- c) Gunny bags 2md capacity.
 - i) Sand filled.
 - ii) Earth filled.

(xvii) Supplying of matured bamboo stakes 75mm to 100mm size including cutting into pieces leaving knots at bottom end of the bamboo and champhering the upper and proper as directed.

- a) Stakes of 1.5m long.

- i) Jati bamboo stakes.
- ii) Bhaluka bamboo stakes.
- b) Stakes above 1.5m to 2.5m long.
 - i) Jati bamboo stakes.
 - ii) Bhaluka bamboo stakes.
- c) Stakes above 2.5m to 3.5m long.
 - i) Jati bamboo stakes.
 - ii) Bhaluka bamboo stakes.
- d) Stakes above 3.5m to 4.5m long.
 - i) Jati bamboo stakes.
 - ii) Bhaluka bamboo stakes.

(xviii) Construction of leet fencing 7.5m to 10cm dia jati bamboo placed 15cm. Clear apart 1.2m to 1.80m above ground 1 to 1.20m below G.L. fixed with half bamboo kamies 30cm. apart including whole bamboo struts 1.2 to 1.50m apart fixed. complete as directed.

2.2.6 Allocation of duties and responsibility of different Officers / Staff during flood season.

EXECUTIVE ENGINEER :

Executive Engineer, in charge of dyke should inspect the river course during premonsoon, drawing up the programme quite ahead so that any work that might be necessary strengthen the dykes in vulnerable and weak places may be carried out timely. During the course of inspection he should particularly see whether in any particular reach there is impending danger which effect the safety of dykes. He should also make it a point to have look at a particular place where there is any danger of developing a natural cut off which might create a disastrous, situation down below. In respect of fixing the flood free board gauge at every one K.M. apart the Executive Engineer, bears special responsibility. He should also enforce necessary steps so that the flood water levels are recorded by its beat Section Assistant's and record keeper of all the readings of flood free board gauge from 15th May to 15th October, every year.

In premonsoon period necessary steps are to be taken to the Executive Engineer, to get the level section of each important dyke in his division completed not later than 15th May. These level section should be submitted to Superintending Engineer with necessary certificate that the dyke has adequate free board against the design flood levels as well as cross section at different places to withstand the impact of flood. In case a particular reach of flood embankment is not strong in section and also does not have adequate free board, the Executive Engineer, should take the steps to make the particular reach strong enough to stand fury of flood.

(a) The inspection of the dyke the river course within the division by the Executive Engineer are to be reckoned as a part of his duty. It is also to be borne in mind clearly that the Executive Engineer carries a high degree of responsibility in strengthening the different vulnerable and weak places of various dykes under his division within limitation of fund so that the occurrence of breaches during the flood may be avoided. The Executive Engineer, should also make frequent inspection of dykes during flood season in order to see that arrangement made for flood fighting are adequate and satisfactory.

(b) Before the flood season the Executive Engineer, will cause an extensive inspection and assess the vulnerable reaches which are likely to get water logged in flood and is to keep reserve stock of earth by head load in advance on the country side slope of the embankment, by making adjustment in slope so that the same is handy to fight the floods.

SUB-DIVISIONAL OFFICERS. :

The Sub-Divisional Officer will be in charge of the Sectional Officers and will be responsible for everything that occurs in his jurisdiction. He should evience keen interest in flood levels likely to obtain against the embankments in his jurisdiction. The

Sub-Divisional Officer/Assistant Engineer/should visit the embankments at odd hours by day and night and see that the establishment is on the alert and is well. It is his duty to inform the Executive Engineer of all the happenings daily and to make suggestions for the efficient conduct of the work. He will arrange for proper distribution of the establishment and for due discharge of the duties of concentrated strength in dangerous section. He should remain in contact with the Overseer at least once a day and keep himself in touch with up-to-date condition of the embankment and the rivers in his charge.

If the high stage of a river where there is flood bank protecting a prosperous area of a town, the stability of the dyke is threatened then the Sub-Divisional Officer, should spend if necessary more time to see that effective flood fighting works are carried out ceaselessly to hold the dyke safely. Leaving of the site under such situation shall make him liable to disciplinary action. The vigilance of the Sub-Divisional Officer and Assistant Engineer should begin as soon as the water level is just below danger level, of the particular river.

SUBORDINATE ENGINEER :

The Sectional Officer (Sub-ordinate-Engineer/Overseer) is required to pay visit, to the embankment to see all banks wave wash etc. are properly attended to and that all establishment of staff are busy with the work allotted to them. He would pay close attention to have daily gauge reading of E.B. gauges from different sites. He should take steps to meet any immediate danger to embankment or other E & D structures, without waiting for orders. In case additional labour forces are required to cope with an emergent situation, then he can requisition the same from the S.D.C. of the area in case S.D.O. E & D does not happen to camp there.

SECTION ASSISTANT :

The Section Assistant should constantly keep himself in touch with the patrollers and the gang of labourers and should know at once everything that is happening in his beat. He must maintain the materials in his charge such as Kerosine Oil, Bamboo, Gunny Bags etc. and daily check the Muster Rolls. He should daily visit the entire length of his beat and inspect dangerous portion, more often. He should take reading of the gauge daily at lower stages and at least twice daily during high flood and report the same to his Overseer. He is responsible for the proper custody of the flood fighting materials, stacked at various places in his beat and had to arrange for proper burning of fires and lamps after sun-set and for night patrol large fires alternatively in the side edge on the top of embankment are most useful in lightening up the embankment and showing acute vigilance. There should be two such fires one on each side within a fur-long. The fire should be substantial in size as to be visible from a long distance and so as to light up at least 100 ft. of embankment on either side of or alternatively. Patromax may be used for such purpose. He should maintain a register indicating the location of leakage due to rat holes or other reasons.

As soon as flood water comes against the embankment petrolling should commence. Patrollers should work in pairs in shift duty from 8 to 10 hours. It is the duty of the Patrollers to move along the river side embankment slope keeping close watch and pressing the embankment slope with their feet, also examining the embankment immediately above water level for rat-holes or whirls. They should complete the circuit by returning along the other slope of embankment looking all the while for leaks. If a whirlpool is observed in the front, the patrollers should find out whether water is oozing out of the back slope, if he finds this is so he must at once attempt to close the leak. He should close all rat-holes found on the upstream face, similarly while patrolling along the back slope if he notices turbid water coming through embankment carrying silt with it indicating a leak, he must at once try to find a whirlpool at the water line in the front slope and take all necessary steps for closing the leak. At the same time he should inform the Sectional Assistant through the messenger. The later in turn should inform the Overseer, Sub-Divisional Officer, and Executive Engineer, Petroller should carry Kodali all times and at night must carry lamps as well.

HINTS FOR GUIDANCE IN REPORTING DAILY AND
WEEKLY FLOOD SITUATION DURING 1979.

1. Indicate the general trend of rainfall in the last 24 hours.
2. Give the names of rivers and the levels observed at key stations where the levels is less than 0.5 metres below the danger level. Also indicate if the level is rising or falling. The danger level and the maximum level ever reached (with date) on the station under report may also be indicated in the first report.
3. Give names of engineering works like flood embankments, banks protection works, spurs, roads, canals, railways etc. damaged and the approximate value of damage if possible.
4. Describe disruption to communications like highways, railways telegraphs lines etc.
5. Describe measures taken to repair the damage.
6. Remarks on any press news with the State Chief Engineer, may like to contradict on support.
7. Map of Flooded areas.

II. Weekly Reports :—

The Weekly report which should reach this commission by Thursday every week is required to be in the form of a review, and should give a summarised account of the Flood Engineering work affected during the whole week. All important events may be described. Area saved as a result of flood Central Works already executed, and future work's proposed as a result of experience gained during the floods may also be covered.

SPECIMEN

Immediate Telegram
Flood Control CWC New Delhi

Flood Report July Fifth (.)

Wire Spread Havy Rainfall Eastern Region (.) 15 Centimetres Imphal 17 Centimetres Agartala (.) Heavy Rain Continuous (.) Rivers Levels Nearing Danger (.) Dibrugarh Level 104.00 Metres Rising Discharge 200 Cumess (.) Dyke Digaru To Sonarigaon Overtopped 7 To 8 KMS. Near Kashinagath (.) Stone Spur Dibrugarh Slumped 2 Metres Near Nose (.) Digaru Ciratrip Under 1.5 Metres Water (.) Not Fit For Landing (.) Dibrugarh Jorhat Road Closed Vehicular Traffic Since... .. Repairs Of Above Works Started (.)

STATEMENT OF FLOOD DURING

ANNEXURE-II.

Sl. No.	Area affected in lakhs Hectares.	Population affected in lakhs numbers	Damage of Crops		Damage House		Cattle lost.	humane lives Lost. Nos.	Damage to public utilities Rs. lakhs	Total damage to crop houses & Public utilities (Col. 5+7+10) in lakhs.	REMARKS
			Area in Lakhs Hectres	Vulnerable Rs. Lakhs.	No.	Vuln erable Rs. L.					
1	2	3	4	5	6	7	8	9	10	11	12

OFFICERS WORKING IN ABSENCE OF CO-ORDINATING OFFICERS,
DEALING WITH THE FLOODS IN THE STATE DURING

Station.	Name of Co-ordinating Officer/ Officers working in absence of the Co-ordinating Officer.	Designation	Office Address	Residential Address	Telegraphic Address Telex No.	Telephone Office	No. residence
1	2	3	4	5	6	7	8