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(पहला पुनरीक्षण)

Indian Standard

CONSTRUCTION AND MAINTENANCE OF GUIDE BANKS IN ALLUVIAL RIVERS — GUIDELINES

(First Revision)

UDC 627.18.03 (026)

BUREAU OF INDIAN STANDARDS
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Price Group 3

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the River Training and Control Works Sectional Committee had been approved by the River Valley Division Council.

Guide banks form a very important river training work at the barrages and bridges. It is, therefore, important that construction of the same should be carried out with great care and leaving no room for construction failure to occur.

A good coordination between planning, designing and construction agencies has to be established for a safe and economical structure. The engineer-in-charge should have a knowledge of implications of the provisions in the designs of various components. Any change required to be made on account of site conditions or for any other reasons whatsoever should be made by him after evaluating the implications due to such change(s) in consultation with the designer to find out any other economical and safe alternative thereof. Frequent checks on construction vis-a-vis design provisions and constant quality control should be ensured.

This standard was first published in 1990 under the title 'Construction of guide banks in alluvial rivers — Guidelines'. The revision of this standard has been taken up to update the construction practices being presently followed in the field and also to incorporate the maintenance aspects of guide banks. Planning and design of guide banks in alluvial rivers are covered in IS 10751 : 1994 'Planning and design of guide banks for alluvial rivers — Guidelines (*first revision*)'. Soil classification given in this standard is based on IS 1498 : 1970 'Classification and identification of soils for general engineering purposes (*first revision*)'.

Indian Standard

CONSTRUCTION AND MAINTENANCE OF GUIDE BANKS IN ALLUVIAL RIVERS — GUIDELINES

(First Revision)

1 SCOPE

This standard lays down the guidelines for construction and maintenance of guide banks in alluvial rivers. These are to be deemed as guide to good practice of construction and maintenance of guide banks compatible with the current experience and knowledge on the subject.

2 REFERENCE

IS 10751 : 1994 'Planning and design of guide banks for alluvial rivers—Guidelines (*first revision*)' is a necessary adjunct to this standard.

3 GENERAL CONSIDERATIONS

3.1 The layout of guide bank should be based on hydraulic consideration to streamline the river flow. The height of the bank should be determined from the highest flood level and freeboard requirement. The slope of the bank should be designed considering the engineering properties of the construction material and using conventional slip circle analysis.

3.2 Selection of Materials

The sub-soil investigation should be carried out by excavating trial pits and/or bore holes in borrow areas to know the type of soil and its distribution over the area. The physical properties such as gradation and Atterberg's limits of the soil obtained from borrow areas should be determined to decide upon its suitablity as a construction material. Ideal material for construction of homogeneous embankment is cohesionless material, in the absence of which clay having low plasticity (CL), having liquid limit below 50 and plasticity index below 25 may be used. However, when alluvium material consisting of silts and fine sands (ML) which are highly erodible is to be used, adequate protection against erosion should be provided in addition to compaction control.

For effective quality control of compaction, data of optimum moisture content and maximum dry density obtained from laboratory compaction tests are required. For small embankments, in the absence of such laboratory data, values given in Table 1 may be used.

3.3 The materials for use in construction of guide banks should conform to the specifications. Any deviations in the quality of materials may lead to failure with disastrous results. Wherever filters are indicated in the design, they should be provided without fail since stability of the banks depends on it.

3.4 Sufficient labour, material, equipment and machinery with spare parts, tools and tackles, and trained staff should be arranged well in time to match the construction schedule. Necessary arrangements for lighting for working all 24 hours in a day may be provided, if required.

4 ASPECTS OF CONSTRUCTION OF GUIDE BANKS

4.1 Suitable phasing of various components is essential for successful construction of the project and efficient construction.

4.2 Planning for Construction

For carrying out construction efficiently, modern techniques of management like programme evaluation and review technique (PERT) and critical path method (CPM) of construction scheduling may be employed which may include the following :

a) Sequence of construction of various features;
b) Anticipated constraints in executing different items of construction;
c) List of interdependant items of construction which would facilitate planning for uninterrupted execution;
d) Precautionary measure for protecting the season's work from the ensuing floods; and
e) Special features and provisions for local laws and regulations, if any.

4.3 The following main pre-constructional requirements may be taken care of before starting the actual construction work of guide banks :

Table 1 Approximate Values of Maximum Dry Density and Optimum Moisture Content for Different Types of Soils
(*Clause* 3.2)

Soil Classification	Proctor Compaction	
	Maximum Dry Density g/cm^3	Optimum Moisture Content percent
(1)	(2)	(3)
GW	>1.907	<13.3
GP	>1.762	<12.4
GM	>1.826	<14.5
GC	>1.843	<14.7
SW	1.907 ± 0.08	13.3 ± 2.5
SP	1.762 ± 0.032	12.4 ± 1.0
SM	1.826 ± 0.016	14.5 ± 0.4
SM-SC	1.907 ± 0.016	12.8 ± 0.5
SC	1.842 ± 0.016	14.7 ± 0.4
ML	1.650 ± 0.016	19.2 ± 0.7
CL	1.730 ± 0.016	16.8 ± 0.7
MH	1.314 ± 0.064	36.3 ± 3.2
CH	1.506 ± 0.032	25.5 ± 1.2

NOTE — ± Entry indicates 90 percent confidence limits of the average value.

a) Availability of the approved construction drawings,
b) Provisions of the necessary infrastructure;
c) Rehabilitation;
d) Diversion/closing of the branch channel, where required;
e) Location for stock-piling of construction materials;
f) Foundation and borrow area surveys and investigations; and
g) Availability of construction materials conforming to size and specification prescribed for the work.

4.4 Activity Classifications

For constructions of guide banks the following main operations are involved :

a) Layout and survey for locating the position of guide banks;
b) Stripping of the top soil, weeds, etc;
c) Earthwork for guide banks and approaches;
d) Excavation pit for the apron;
e) Selection and laying of filter;
f) Laying of apron and slope protection; and
g) Drainage arrangements.

5 LAYOUT AND SURVEY FOR LOCATING THE POSITION OF GUIDE BANKS

5.1 From approved construction drawing, layout drawing of guide banks should be prepared showing the bearing of centre line of bunds and base width at different reaches.

5.2 The alignment of the guide banks is to be laid on the ground with the help of theodolite or prismatic compass and tape. The base and apron width lines are to be marked by dug lines on stripped bed/ground level.

6 EARTHWORK FOR GUIDE BANKS AND APPROACHES

6.1 Proper stripping of borrow areas and seat of banks should be ensured before starting the construction. It is preferable to take earth for construction of guide banks from the river side. Borrow pits should be at a safe distance of about 3 H from the toe of launching apron, where H is the height of guide bank. However, this should be checked by carrying out detailed stability analysis for important works.

6.2 Guide banks should be made from locally available material from the river bed, preferably cohesionless material. Good compaction of guide banks is necessary as any slip during the floods might be disastrous. No portion of guide banks should be left unprotected below highest flood level (HFL) including afflux and it should be well protected before onset of monsoon. The top of guide banks should be protected with a layer of gravel, brick soiling, boulder or other locally available suitable material(s) against raincuts.

6.2.1 *Guide Bank Involving Mechanical Compaction*

In case of guide bank involving mechanical compaction, the materials free from all organic matter should be compacted in layers of 15 to 20 cm for full

width of the bank and carried up regularly in accordance with guide bank section. All clods should be broken up to a size having not more than 5 cm diameter. Each layer should be properly watered and compacted. The surface should be well graded and crowned in the centre so that during rain the surface water is carried rapidly to the slopes of the fill.

6.2.2 *Guide Bank Involving Manual Compaction*

In case of guide bank involving manual compaction, the layers not exceeding 15 cm thickness should be placed slightly sloped towards the centre of the crest so that rainfall will consolidate the bank naturally during the construction. The materials should be free from organic matter. The top layer forming the crest of the guide bank should be suitably graded so that rain water does not accumulate and create maintenance problems.

6.2.3 Compaction of each layer of fill materials should proceed in systematic, orderly and continuous manner so as to ensure the specified coverage by the compactors. Sheepfoot roller or tamping type roller is generally accepted as the best available means of ensuring proper compaction for average type guide bank material. The acceptable limit of compaction as compared to the dry density at optimum moisture content would depend on the desired shear strength for the stability of side slopes. For mechanical compaction the minimum compaction should be 90 percent and for manual compaction 85 percent. Adequate quality control and field tests are needed to ensure this.

6.2.4 Proper moisture control of the material is very important in order to ensure proper compaction. Materials may be conditioned to the desired moisture content either at the site of excavation, on the guide banks or under same condition at both the borrow pit and during placement. It is necessary that some rapid and convenient methods be employed to determine whether or not the materials have the desired moisture content as they are placed on guide bank.

6.2.5 The penetration resistance needle, which makes use of the penetration resistance-moisture relation for the material being placed, is very useful for the purpose. It is desirable to establish field laboratories to carry out tests in the field while compaction operation goes on.

6.3 Construction of only a part of the guide banks or only one of the two guide banks in a working season is considered inadvisable. Both the guide banks complete with their curved heads, should preferably be completed simultaneously in one working season. If there is any doubt about completion of the whole guide banks within one working season it should be ensured that the construction of guide bank is started from abutment towards upstream. Where full guide bank could not be constructed in one working season suitable measures to protect it should be taken.

6.4 It is advisable that construction of guide banks should be taken in hand along with abutments.

6.5 It should be ensured that afflux banks are tied to high ground to prevent outflanking of structure.

6.6 If guide banks are required to be constructed inside wide khadir, construction of approach banks should be done along with the guide banks.

7 EXCAVATION OF PIT FOR THE APRON

It is necessary that sufficient length of pit along the guide bank should be ready within one or two months of commencement of work so that pitching of stones in apron and slope can be started at the earliest. Bottom of the apron pit should be excavated as low as permitted by water level.

8 SELECTION AND LAYING OF FILTER

8.1 A well designed filter should be layed on the slope and below the apron. Graded sand filter should have one or two layers depending on gradation of base material and gap between stones/concrete blocks. Filter criteria given below may be used:

a) $\frac{D_{15} \text{ of the filter}}{D_{15} \text{ of base material}}$ = 5 to 40 provided that the filter does not contain more than 5 percent of material finer than 0.074 mm

b) $\frac{D_{15} \text{ of the filter}}{D_{85} \text{ of base material}}$ = 5 or less

c) $\frac{D_{85} \text{ of the filter}}{\text{Maximum gap between stones/concrete blocks}}$ = 2 or more

d) The grain size curve of the filter should be roughly parallel to that of the base material

where D_{15} is the size at which 15 percent of the total soil particles by weight are smaller and D_{85} is the size at which 85 percent of the total soil particles by weight are smaller.

8.2 Laying of filter may start after excavation of pit for apron and proceed along the slope as construction advances. Laying of sand filter on slope under water may pose problem. In such case sand bags (nylon or jute) should be used.

8.2.1 Alternatively, synthetic woven or non-woven filter may be used in place of thick sand filter as given in IS 10751 : 1994.

8.3 Laying of geotextile appears relatively simple but might require sometimes special arrangements particularly in flowing water. However, work could be done in dry season or after diverting flow away by some means. Laying should be done in single stretch from top of bank to toe and suitably anchored and loaded. Sand cushion should be provided below the geotextile. Laying of stones on the geotextile for loading should be done carefully to avoid any rupture. Suitable jointing or overlaping should be adopted ensuring that no gap is left out between two adjoining sheets.

9 LAYING OF APRON AND SLOPE PROTECTION

9.1 Sufficient working time should be made available for laying of apron and for slope protection works. Adequate arrangements should be made for labour and for transport of material to the site of work to ensure uninterrupted progress of work within the time schedule.

9.2 It is not necessary to handpack stones in apron as it is meant to launch.

9.3 On slope, care should be taken in placing the stone/protective units so as to have least voids so that water may not cause any swirling. The gradation of stones should be adhered to. Whenever two layers are used, comparatively smaller stones should be used at the bottom and larger ones at the top.

9.4 When using quarry refuse as soling on the slope under pitching stone, care should be taken to bring only broken spalls and gritty material. Soluble clay should be avoided as it is liable to be washed out with wave action.

9.5 While on river side, stone protection is required up to full height of the guide bank, on rear, this protection is just carried around the mole head beyond which usually good turfing is provided. Where wave action is expected on the rear side at the junction of approach embankments and guide banks, protection up to the minimum 0.6 m above maximum water level should be provided by stone pitching or by suitable local material (s).

10 MAINTENANCE

10.1 General

10.1.1 Completion drawings of guide bank are to be maintained as permanent records for ready reference. The completion drawings should indicate the details of work actually executed.

10.1.2 Pre-monsoon and post-flood inspection of guide banks are to be carried out regularly to ascertain the health of the structure and repairing works, if any, to be done for safety of the guide banks.

10.1.3 Pre-monsoon and post-monsoon surveys should be carried out regularly by taking long sections along centre line of embankment crest and by taking cross-sections at every 30 m along pitched guide bank, and plotted to a fixed scale and on the same sheet in different distinguishing colours to visually bring out the health of the structure before and after monsoon. Cross-sections around armoured mole head of guide banks are to be taken at a spacing of every 15 m. At the zones where flowing channel of the river is adjacent to banks, cross-sections are to be taken by sounding and the length of cross-section should cover the complete width of deep channel or apron width whichever is more.

10.2 Maintenance During Floods

10.2.1 Top of guide bank should be kept clean from bushes, jungles, high grasses, etc, so that inspection and carrying of materials for maintenance during floods may be possible without any hindrance. A register should be maintained to record the health of structure, angle of attack, damage caused and if any action is required to be taken during floods or after floods.

10.2.2 A permanent gauge should be established close to the structure, say on abutment and another well gauge in the backfill of the abutment and daily records of levels are to be maintained during the flood season.

10.2.3 Regular patrolling of guide banks should be done to monitor the behaviour of the structure and to take protective measures where abnormal swirls, eddies or scour is apprehended. During falling flood soundings are to be taken on the apron to ascertain launching damage of apron and if severe scour hole is observed at any location, remedial measures are to be taken by dumping loose stone boulders, boulders in wire netting or cement concrete blocks so that the toe of the embankment is protected from scouring action.

10.2.4 Greater attention in patrolling is necessary during the first flood to detect any weakness in construction.

10.2.5 An adequate stock of boulders, wire netting for preparation of crates, gunny bags, etc, should be maintained close to the guide banks for use in emergency.

10.2.6 Any rain cut or wave out along guide banks should be repaired immediately to avoid their enlargements and consequent damage to the structure. Rain cuts are to be filled up with compacted earth in layers and suitably pitched or turfed.

10.2.7 Any settlement in the bank or bulge or slip in the slope needs immediate remedial measures by way of placement of sand filled gunny bags/stone boulders/crated stones maintained at site, to restore the original section.

10.2.8 If toe erosion is noticed at any reach, boulders in wire crates may be dumped or launched at the site to reach maximum scour depth so as to stop further scouring and the country side of the embankment may be strengthened and widened by sand filled gunny bags.

10.2.9 Stone pitching on river side slope scooped out and swept by swirling current should immediately be replaced by stone boulders underlain by inverted filter. For repair works of such emergent nature, adequate stock of boulders should be available at suitable places to meet any exigency.

10.3 Maintenance After Floods

10.3.1 The health register of the structure (*see* **10.2.1**) should be seen and action taken against each item should be recorded. Even if after examination it is found that no action is required, the reason for taking such a decision should also be recorded.

10.3.2 Annual inspection of all underwater protection works should be carried out by the engineer-in-charge of works after the flood season. Soundings and probings in the upstream apron and in the area upstream of it and in the downstream apron and in the area downstream of it should be taken to assess scour and launching of the aprons in the vicinity of the structures. Any shortfall/damage should be made good before the next flood season.

10.3.3 Surveys as mentioned in **10.1.3** should be carried out meticulously for a detailed analysis of the behaviour of the structure and assessement of remedial measures necessary to restore the structures.

10.3.4 The original design of the structure may be reviewed periodically for the actually observed discharge in the river and behaviour of structure. Raising and strengthening, wherever necessary, should be taken up and completed before the next monsoon.

10.3.5 Development of cracks in the river upstream of the guide banks, adjacent to marginal embankments or parallel flow formation in case of approach banks should be carefully examined and possibility of occurrence of embayment, if any, should be set right by adopting suitable training measures.

10.3.6 During the initial years of service of guide banks, additional structures such as bundling, bed bars, groynes/spurs, etc, as necessary, may be installed before the onset of next monsoon to train the course of the river so that any possible avulsion of the course may be averted.

11 MISCELLANEOUS

Approach roads to the guide banks should be maintained in good condition for smooth and speedy flow of vehicles carrying materials for protective works including emergent works during flood season.

Communication facilities and adequate warning devices like wireless/telephone/telegraph should be provided, if required.

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