BUREAU OF INDIAN STANDARD
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भारतीय मानक मसौदा
नहरों में सीमेंट कंक्रीट और पत्थर की स्लैब की लाइनिंग बिछाना — रीति संहिता

(IS 3873 का *तीसरा पुनरीक्षण*)

Draft Indian Standard

LAYING OF CEMENT CONCRETE AND STONE SLABS LINING IN CANALS — CODE OF PRACTICE

(*Third Revision of* IS 3873)

ICS No. 93.160

Canals and Cross Drainage Works Sectional Committee, WRD 13	Last date for Comments: 29/07/2025

FOREWORD
(*Formal Clauses of the foreword will be added later*)

Lining of canals is considered an important feature of irrigation projects as it not only minimizes the loss of water due to seepage but also results in achieving considerable economy in the use of cultivable land which would otherwise be prone to waterlogging due to rise in water table. Further, the water thus saved can be usefully employed for the extension and improvement of irrigation facilities. Lining of water courses in the area irrigated by tube wells assumes special significance as the pumped water supply is relatively costlier.

Lining of canals permits the adoption of high velocities resulting in proportionate savings of the cross-sectional areas of the channel and waterway required with corresponding saving in the cost of excavation and masonry work, which may in certain cases offset completely the extra cost of lining. Also, the lining ensures stability of channel sections thereby reducing the maintenance cost. Lining of canals in erodible soils helps in maintaining the channel regime. Lining prevents rodents and other burrowing animals from digging holes in the embankments and causing canal breaches. The benefits that accrue from lining canals generally justify the initial capital cost and, because of this, there is now better appreciation of the need for lining on canals.

Judicious selection of serviceable and economical lining at the first instance and subsequently proper execution of the work while laying the canal lining reflects considerably in achieving overall economy in the project. Guidance with regard to the selection of canal lining for any particular canal is given in IS 10430 'Criteria for design of lined canals and guidelines for selection of type of lining'. However, having once decided to adopt lining in any particular canal, this standard would give necessary guidance in laying cement concrete (cast *In-situ* and precast) and stone slab lining.

This standard was first published in 1966, and subsequently, revised in 1978 & 1993. In the second revision, the scope of standard was enlarged to laying of precast cement' concrete tiles and stone slabs on earthen canals. This revision (third revision) has been brought out to bring the standard in the latest style and format of the Indian Standards. In addition, the following major changes have been incorporated:

a) The title of the standard has been modified in accordance with the scope of the standard and text;

b) The definition of consolidation has been revised to improve clarity and enhance understanding;

c) The minimum grade of concrete prescribed for lining is M15;

d) The provision regarding the use of a mechanical mixer has been deleted;

e) Reference of standards published on polyethylene films and PVC geo-membranes have been provided;

f) New paragraph has been added in regard to selection of thickness of lining. An upper limit on the maximum size of aggregate to be used in canal lining has been introduced; and

g) The grade of plain cement concrete to be used for steps, as an alternative to safety ladders, has been revised to M15.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1 SCOPE

This standard covers guidelines for lining canals using plain cement concrete *in-situ*/precast and stone slabs.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on these standards are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Compaction

The densification of a soil by means of mechanical manipulation.

3.2 Consolidation

The gradual reduction in volume of a soil mass partly or fully saturated resulting from an increase in and continued application of compressive stress and is due to the expulsion of water from the pores.

3.3 Construction Joint

A joint occurring in a structure composed of homogeneous material, such as earth or concrete, along a plane or surface formed by cessation of placing of material for a time, such as overnight or for several days.

3.4 Expansion Joint

A joint provided in exposed members between fixed points to permit vertical movement where differential settlement is anticipated.

3.5 Lip Cutting

Cutting of the extra width provided at the inner face of the bank under compaction to allow for any lapses in compaction due to the inability of sheep-foot rollers to cover the edge of the bank resulting from the safe limits set by different operators of compaction machinery.

3.6 Slip-Form

A steel plate provided at the leading edge of the slip-form machine, extending across the bottom and up the slopes of the canals to form the finished surface of the lining.

3.7 Subgrade

Specially prepared canal profile for placement of lining.

4 PREPARATION OF SUBGRADE

4.1 Expansive Soils

The detailed for preparation of subgrade in expansive soil are given in IS 9451. If the expansive clay is in thin layers or in small pockets in an otherwise suitable subgrade it should be over-excavated and replaced with a suitable non-expansive soil and compacted suitably.

4.2 Preparation of Subgrade Consisting of Rock

4.2.1 The subgrade in rock should be excavated to the required cross section. Over excavation in rock is generally undesirable and should be minimized by using wedging and barring methods, for final dressing.

4.2.2 Over-excavation in hard strata having side slopes more than 1: 1 beyond the profile line may be backfilled with gravel and aggregate, large aggregate forming the bulk of backfill with smaller aggregate filling the voids and a layer of pea gravel as binding material. The bed may then be compacted with road rollers and sides with rammers to form a firm backing for the lining.

4.2.3 For over excavation in hard strata having side slope less than 1 : 1, beyond the profile, the backfilling may be suitably done with chip masonry or lean concrete. However, for bed the backfilling may be done with properly compacted murum. Over excavation up to 5 cm may be backfilled. If over excavation is up to 10 cm lean concrete may be used. Beyond 10 cm backfilling with chip masonry is preferable.

4.2.4 For slip-form paving, over excavation up to 10 to 15 cm may be required. Such over excavation may be backfilled with selected material and compacted at optimum moisture. The material selected should be machine trimmable and be gravel/stone-free earth.

4.2.5 *Tolerance in Excavation*

Excavated profile provides the final base for the lining, and the tolerance should be comparable to those required for paving.

Departure from established alignment:

± 20 mm on straight section;
± 50 mm on tangents; and
± 100 mm on curves.

Departure from established grade: ± 20 mm.

4.3 Preparation of Subgrade Consisting of Soil

4.3.1 The subgrade should be prepared, dressed and rolled true to level and according to the required cross-section of the canal to form a firm compacted subgrade for the lining.

4.3.2 In other than predominantly sandy reaches where the dry bulk density of the natural soil is not less than 1·8 g/cm^3, initial excavation should be done up to about 30 cm above the final section and the cutting to final shape should be done immediately before lining.

4.3.3 For checking the uniformity of side slopes, sample profiles at an interval of about 20 m, in straight reaches and 10 m in curved reaches should be made. Concrete templates of suitable size should be laid on the sample profiles. To begin with the top and bottom of the side templates should be fixed with reference to the established centre line of the canal and the corresponding design levels. For verifying the slope of the templates representing the sample profiles the diagonals of the cross-section of canal, between the two opposite side templates are checked. After laying the templates to the correct profile a cord should be stretched over the two templates (representing the same profiles) and run along the slope till the surface between the two profiles is properly leveled and dressed from top to bottom.

4.3.4 If at any point material of prepared subgrade has been excavated, beyond the neat lines required to receive lining, the excess excavation should be filled with graded filter material compatible with subgrade material and thoroughly compacted in accordance with **4.3.6** and **4.3.7.**

4.3.4.1 When partial filling of an existing canal is necessary to adequately reduce the cross sectional area to that required for lined canal, the fill should be placed and suitably compacted to avoid its settlement and rupture of the lining.

4.3.5 To cover up any lapses in the compaction of the inner core of the banks near the edges and to allow sufficient width for a labourer to work conveniently a lip cutting width of not less than 50 cm horizontally should be provided. Depending upon the nature of soil and the side slopes of the canal, the lip cutting width may be in the range of 50 to 100 cm. For canals in embankment it should be ensured that one monsoon is passed for proper consolidation before lining is done.

4.3.6 *Compaction of Subgrade in Predominantly Sandy Reaches*

4.3.6.1 *Bed*

The compaction of the bed should be done by over-saturating the bed by flooding it with water before lining is laid.

4.3.6.2 *Sides*

The compaction of sides should be done by over-cutting the subgrade by 15 cm and refilling it with lean mortar with adequate quantities of lime or cement, or by vibro-compactors.

4.3.7 *Compaction of Subgrade in Other than Predominantly Sandy Reaches*

All compaction should be done at optimum moisture content in layers not more than 15 cm thick to obtain a dry bulk density of not less than 95 percent of the density at optimum moisture content obtained in accordance with IS 2720 (Part 7).

4.3.7.1 Where the dry bulk density of the natural soil is equal to or more than 1.8 g/cm^3 , the procedure described in **4.3.2** should be followed.

4.3.7.2 *Bed*

Where the dry bulk density of the natural soil is less than 1.8 g/cm^3, and the subsoil water is near the subgrade, the consolidation should be done by undercutting the bed by 7·5 cm and then ploughing up to 15 cm below the subgrade level. The loosened soil should then be recompacted with sheep foot rollers or other suitable devices. Where the subsoil water is low, requiring no dewatering and the dry bulk density of the natural soil is less than 1.8 g/cm^3 the consolidation should be done by digging the canal up to subgrade level and after loosening the earth below subgrade up to 15 cm by disc harrows, or ploughing and compacting the same to a depth of 11 cm. After that, the second layer of 7 cm of earth should be laid over the compacted layer by taking earth from lip cutting and compacting this to a depth of 11 cm. The compacted layer of 7 cm above the subgrade level should be removed, and the subgrade brought to design profile before laying the lining.

4.3.7.3 *Sides*

Consolidation on sides should be done, by manual labour or suitable compactors to a depth of 30 cm to obtain a minimum dry bulk density of not less than 90 percent of the density at optimum moisture content.

4.4 Underdrainage

For a lined canal where the ground water level is higher or likely to be higher than water level inside the canal so as to cause damaging differential pressure on the linings; or where the subgrade is sufficiently impermeable to prevent free drainage of the underside of lining in case of rapid draw down, underdrainage should be provided in accordance with IS 4558.

4.5 Anti-salt Treatment

4.5.1 Soil in all reaches should be tested for salt content before the lining is started. Where the salt content is over 1·00 percent or sodium sulphate is over 0·36 percent, the subgrade should be first covered with about 2 mm thick layer of bitumen obtained by evenly spraying bitumen at a rate of about 2·35 kg/m^2. To get a good bond between bitumen and soil, crude oil at a rate of 0·5 lit/m^2 should be sprayed over it in advance of spraying bitumen. In case such a situation is encountered only in small packets the replacement of subgrade up to a suitable depth by suitable earth from adjoining reaches should be considered, if economical.

4.5.2 Before spraying crude oil, subgrade should be perfectly dry, clean and free from dirt. And crude oil should be allowed to penetrate the subgrade surface. Bitumen should be heated to a temperature of 175°C and applied to the subgrade by a suitable sprayer. Immediately following the application of bitumen, dry sand should be uniformly spread. Lining should be started 6 to 12 hours after spraying.

5 LAYING OF *IN-SITU* CONCRETE LINING

5.1 The concrete used for lining should be design mix concrete of minimum grade M15 and shall conform to requirements of IS 456.

5.2 Slump

For hand-placing and for placing with light machines where concrete is screeded from bottom to the top of the slope, the consistency should be such that the concrete will barely stay on the slope. A slump of 60 to 70 mm should be generally allowed. For heavier, longitudinally operating slip-form machines, a slump of 50 mm at the laying point should be used. To have close control of consistency and workability of the concrete, the slumps of concrete should not vary more than 20 mm which would, otherwise, interfere with the progress and quality of the work.

5.3 Thickness

The thickness of lining should be fixed depending upon the nature of the canal requirement, namely, hydel channel or irrigation channel, full supply depth and channel capacity. Hydel channel should have a greater thickness than channels meant for irrigation because of drawdown effects and where closure for repairs may not be usual. Deeper channels should have greater thickness than shallow depth channels. Minimum thickness of canal lining based on canal capacities are given in Table 1. For cases where the thickness of lining comes under different depth and discharge criteria, the thickness of lining should be selected based on the higher value derived from either the depth or the discharge.

Table 1 Minimum Thickness of *In-Situ* Concrete Lining

Sl No.	**Capacity of Canal**	**Depth of Water**	**Minimum Thickness of Lining**
(1)	(2)	(3)	(4)
i)	(1)	(2)	(3)
	(cumecs)	m	mm
	0-5	0-1	50-60
	5-50	1-2.5	60-75
	50-200	2.5-4.5	75-100
	200-300	4.5.6.5	90-100
	300-700	6.5-9.0	120-150

NOTE—If surface deterioration in freezing climate is expected, these thicknesses may be increased. The lining will not be subjected to external hydrostatic earth pressures or uplift caused by expansive clays or frost heave.

5.4 Tolerance in Concrete Thickness, Alignment and Grade

a) Departure from established alignment ± 20 mm on straight reaches ± 50 mm on partial curves or tangents;

b) Departure from established grade ± 20 mm on small canals; and

c) Variation in concrete, lining thickness ± 10 mm provided average thickness is not less than the specified minimum thickness.

5.5 Placing

5.5.1 Placing of concrete should not be started until all formwork, installation of parts to be embedded and preparation of surfaces upon which concrete is to be laid have been completed. All absorptive surfaces against which concrete is to be laid should be moistened thoroughly so that moisture will not be withdrawn from freshly placed concrete. The surfaces however, should be free from standing water and mud and 1: 3 cement slurry shall be spread over the moist subgrade before placing concrete to prevent absorption of water from 'concrete making it spongy. A plastic *mem*brane of low density polythene film of suitable thickness may be used below the concrete lining in sides and in beds where the subgrade of the lining is of pervious materials like murum etc so as to

prevent absorption of water in subgrade from green concrete, during placement on the subgrade. The approved film is to be laid on the neatly well-dressed subgrade, and fixed in the subgrade so as to prevent displacement during the placement of the concrete. The use of polythene sheets is for achieving better ultimate imperviousness of the lining as a whole. For laying of PE film, reference shall be made to IS 9698. The PE film shall conform to IS 2508.

NOTE — In case filter material is to be provided over subgrade to take care of differential hydrostatic pressure and draw-down in canals, designs of coarse filter material blanket immediately in contact with lining would be necessary. To make such filter blanket effective and to prevent ingress of concrete into it, before placement of concrete, polythene sheet should be placed over the filter blanket. All concrete should be placed directly in its' final position within 20 minutes of mixing, Concrete should not be dropped from excessive height and free fall should be kept to a minimum to avoid segregation. Construction should be continued until satisfactory construction joint is made. Concrete should not be placed faster than the placing crew can compact it properly.

5.5.2 *Placing of Concrete*

5.5.2.1 Depending upon the construction method and arrangement of concreting, the sequence of placing concrete either on the sides or the bed should be decided. It is preferable to place concrete on the sides first if the concreting equipment and the construction materials like aggregate, sand etc, are kept on the canal bed. This will prevent the bed from getting spoiled by the subsequent concreting operations for the sides. Other things being equal placement for bed first should be preferred.

5.5.2.2 The concreting of the sides and bed should be done in alternate panels. The panel width should vary from 2 to 3 m. In no case should the panel width exceed more than 3 m as wider bays require unwieldy vibrators for compaction. The construction joints should be either parallel or perpendicular to the direction of flow. In case the full supply depth is high, construction joints along the direction of flow to divide the length of the panel should be provided. For this purpose, wooden rafters should be used. The succeeding panels should be laid at an interval of one day. If the sloping length is less than 2·5 to 3 metres, concrete should be placed in one operation over the entire length. In case of deeper canals where the sloping length is more, it should be suitably divided (say for a length of about 2 meters) in each alternate panel to prevent appreciable downward flow of concrete. The bays/panels should be formed by proper formwork of mild steel channels laid all around the bay. The channels should be firmly spiked to the subgrade so that no movement takes place at the time of concreting and vibration. The depth of the. mild steel channels should correspond to the required thickness of concrete lining. The concrete should be dumped in the bay from bottom to top and the n spread all over the bay uniformly and to the required thickness guided by the channels. The spread concrete should then be compacted properly and thoroughly by means of mechanical or screed vibrators. An improvised plate vibrator operated by high horse power engine and a winch for moving the vibrator up the inclined slope should be made use of for proper compaction. When width of panel is less that is up to 2 m manual operation of vibrators is possible and may be permitted. In no case the concrete should be compacted by tamping. The compacted surface should be true to the required side slope. Before reusing the channel forms, they should be thoroughly cleaned and well oiled. Care should be taken, while

placing and vibrating the concrete that, the sub-grade in the adjacent bays does not get spoiled.

5.5.2.3 For bed lining, the procedure for laying the concrete on the canal beds should be same as that for side lining, except the operations specifically required on sloping surfaces. The compaction should be done by means of a heavy screed vibrator moving on the side channels.

5.5.2.4 In order to test the effectiveness of vibration, permeability and strength of concrete cores at suitable places from the side as well as from the bed concrete should be taken.

5.5.2.5 *In-situ* sleepers in case of bed, and precast in case of sides, should be provided under the joints. The sleepers should be 20 cm wide and 15 cm deep. The sleepers should be placed centrally below the joint. Concrete used for sleepers should be of the same grade as for lining. Alternatively, brick sleepers 225 × 150 mm with 1:4 mortar may be used. Concreting near the joints should be done with utmost care so as to avoid segregation and collection of loose pieces of aggregate along the formwork which may later result in honeycombing.

5.5.2.7 Concreting near the junction of the side cast and bed cast should be done such that both should rest firmly against each other to resist any external hydrostatic forces (*see* Fig. 1 and 2). The sketches indicate the procedure for formation or junction of the sides with bed depending upon the sequence of laying concrete i.e. sides first and vice-versa.

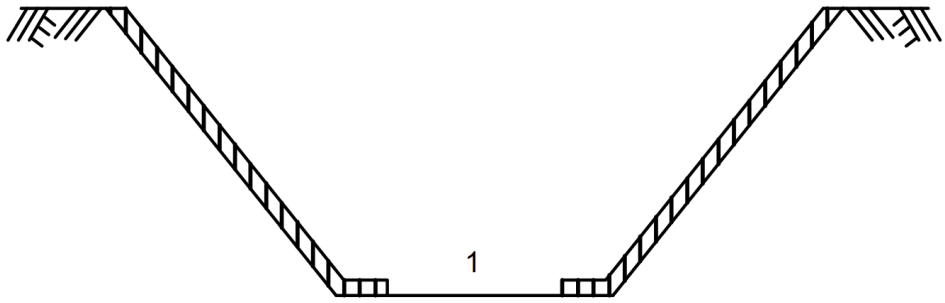


FIG.1 SIDES CAST FIRST

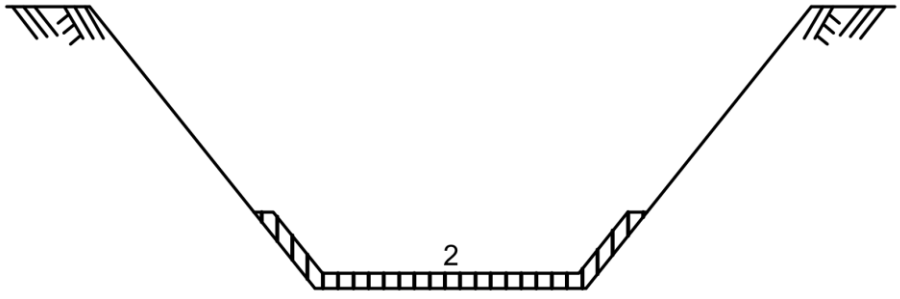


FIG.2 BED CAST FIRST

5.5.3 *Mechanical Placing of Concrete*

Concrete for slip-form should be air entrained to provide a more workable and slippable mix. Percentage of air should be as follows:

Maximum Aggregate Size, mm	*Air, Percent by Volume*
10	8.0
12.5	7.0
20	6.0
25	5.0
40	4.5

NOTE—Air entraining agents should always be used in concrete by means of slip-form paving machine for entraining air.

5.5.3.1 *Subgrade guided slip-form*

This should be used for lining small to moderate size canals. The slip-form should be supported directly on the subgrade and operated longitudinally along it, concrete should be screeded on the bed along the canal and on the sides from bottom to top.

5.5.3.2 *Rail guided slip-form*

They are adopted for larger canals of considering length. Slip-forms supported on rails placed along both berms of the canals should be operated longitudinally. Concrete should be spread uniformly on the bed longitudinally and on the sides from bottom to top.

5.6 Finishing

5.6.1 The Surface of finished concrete against forms should be smooth and should be free from projections, honeycombing and other objectionable defects. Immediately on the removal of forms, all unsightly ridges or lips should be removed and undesirable local bulging on exposed surfaces should be removed by tooling and rubbing. Repairs to concrete surfaces and additions, where required, should be made by cutting regular openings into the concrete and placing fresh concrete to the required lines. 'The chipped openings should be sharp and should not be less than 70 mm in depth. The fresh concrete should be reinforced with wire mesh extending to the full depth of the slab and chipped and trowelled to the surface of the openings. The mortar should be placed in layers not more than 20 mm in thickness after being compacted and each layer should be compacted thoroughly. All exposed concrete surface should be cleaned of impurities, Jumps of mortar or grout and unsightly stains.

5.6.2 The concrete should be finished to an even and smooth surface free from pockets, voids or exposed aggregates. This should be obtained by careful use of a long-handled

steel trowel. Any remaining roughness or rough spots shall be rendered smooth, without any time interval after laying the concrete, with cement mortar of 1: 3 proportion.

5.7 Curing

5.7.1 Subsequent to laying of concrete lining and after a period of 12 hours, the lining should be cured for at least 28 days.

5.7.2 *Bed Lining*

Twelve hours after laying of concrete, small bunds longitudinal and cross-wise consisting of earth materials or lean mortar (1: 15) should be laid for a height of 8 cm for the purpose of curing. Water should be kept always ponded in these bunds for 28 days continuously.

5.7.3 *Side Lining*

The panel on which concreting is done on the previous day should be covered with burlap or empty cement gunny bags.

5.7.4 For the purpose of curing, water tank of 5 000 litres capacity should be placed on a platform at the edge of service road at the rate of one for 500 m length of lining, which should be kept filled with water, with arrangement of outlet and flexible hose of at least 300 m length. Water should be continuously sprinkled on the gunny bags or hessian cloth keeping them wet for 28 days. Sprinkling shall be done during night time also. The curing of side slopes may be done by constructing masonry drains with weep boles or perforated pipes on the coping at the top of lining or by sprinklers.

5.8 Surface Drainage

5.8.1 The top of the side lining concrete should be keyed into the subgrade both in cutting as well as banking by taking it horizontally for a width of about 300 mm. This key would prevent direct entry of surface rain water behind the lining. The top surface of the key should be finished with a downward slope of 1 in 10 or so towards the canal. A day after the completion of concreting of all panels between two templates, concreting of key slab should be done.

5.8.2 Concurrently with the curing operation, surface drainage arrangement of the bank such as construction of keys, bank surface slope away from the lining and construction of longitudinal drain on the outer wedge, shall be completed. This is necessary to prevent surface and subgrade erosion and consequent damage to the lining.

5.9 Joints

5.9.1 *Expansion Joints*

These should not be provided except where a structure intersects the canal. The details are given in relevant Indian Standards covering such structures.

5.9.2 *Construction Joints*

5.9.2.1 Construction joints form a weak link in the lining and deterioration is generally noticed at such joints. Besides joints are also potential seepage points for the canal water. As such, number of joints should be kept to the minimum and great care should be taken to obtain well compacted and smooth concrete surface at joints. To ensure a good surface, the shuttering should be smooth, cleaned, well-oiled and rigidly fixed at the site. Besides different mechanisms for compaction of concrete in lining, tamping with iron bar near the joint surface gives better results.

5.9.2.2 To cater for initial shrinkage and cracks, concreting should be done in alternate panels or bays. The panel size for the bed and slope of the canal should be adopted as given in **5.5**.

5.9.2.3 LDPE film of 25 cm wide and 150 micron thickness should be placed on the top of sleepers, provided to support construction joints. The top of film and side of panel should be applied with primer conforming to IS 3384. This sheet acts as an intercepter for seepage through the joint. In case lining *is* laid by mechanical paver, PVC water stops conforming to IS 15909 are placed at joints along with the concreting. The water stops in such a case should be provided at a spacing not more than 4 metres centre to centre.

6 LAYING OF PRECAST CONCRETE TILES/ STONE SLAB LINING

6.1 The tile shall conform to IS 10646 and stone slab to IS 1128 or IS 3622.

6.2 The lining should be started only when at least 35 m length of canals subgrade is properly dressed to receive lining. The arrangement for mortar and availability of sufficient number of tiles/stone slabs should be ensured before starting the work.

6.3 The subgrade should then be uniformly soaked with water without making it slushy to ensure that water penetrates to a depth of about 300 mm in sandy soil and about 150 mm in other soils. Wetting of subgrade should continue in advance of laying of tiles so that soil does not absorb moisture from the mortar laid on the subgrade on laying the layer of tiles.

6.4 Single tiles/stone slab profile of lining parallel to central line of the canal should be prepared at suitable intervals. Mortar (1:3) should uniformly be spread over subgrade for a minimum thickness of 12 mm, and the tiles should be properly laid in position quickly. It should be ensured that vertical joints are completely filled with mortar. The tiles should be laid in bed with their lengths at right angles to the central line of the canal while on the other side slopes they should be laid parallel to the central line.

6.5 Tiles should be firmly embedded in mortar. Hollows, if any, should be rectified by relaying defective portion with fresh mortar. The tiles should be laid over a minimum of 12mm thick cement mortar and having aggregate less than 6 mm to bring overall fineness modulus less than 2. Hollow the joints should be raked and pointed with the same mortar. The thickness of joint should be 20 to 25.mm.

6.6 Stone slabs should be firmly embedded in mortar. Hollows if any should be rectified by relaying the defective portions with fresh mortar.

6.7 On completion of laying lining should be kept wet by sprinkling water over it to keep the mortar wetted. On the next day, the surface should be kept wet and joints should be carefully wetted. Hollow joints should be raked to a depth of 12 mm, loose mortar removed from sides and top of tiles/ stone slabs and the joints properly refilled. Loose tiles/stone slab should be removed and relaid.

6.8 The complete lining should be checked for level with wooden templates and spirit levels.

7 SAFETY LADDERS

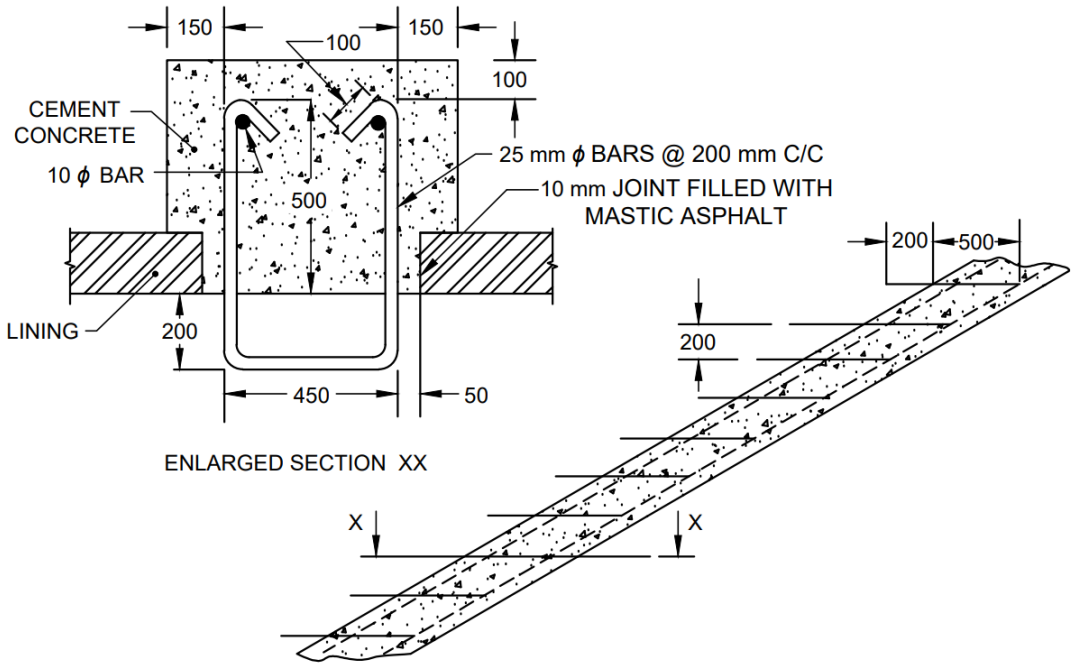
7.1 Safety ladders should be constructed in canal lining as directed by the engineer-in-charge.

7.1.1 Safety ladders consisting of ladder rungs should be constructed in canal lining about 30 m upstream of the point where the canal enters some underground structure. In other reaches safety ladders may be provided at a spacing of about 300 m; the ladders being provided alternatively on either side.

7.1.2 Ladder rungs should be smooth, round mild steel bars, galvanized or coated with coaltar after installation.

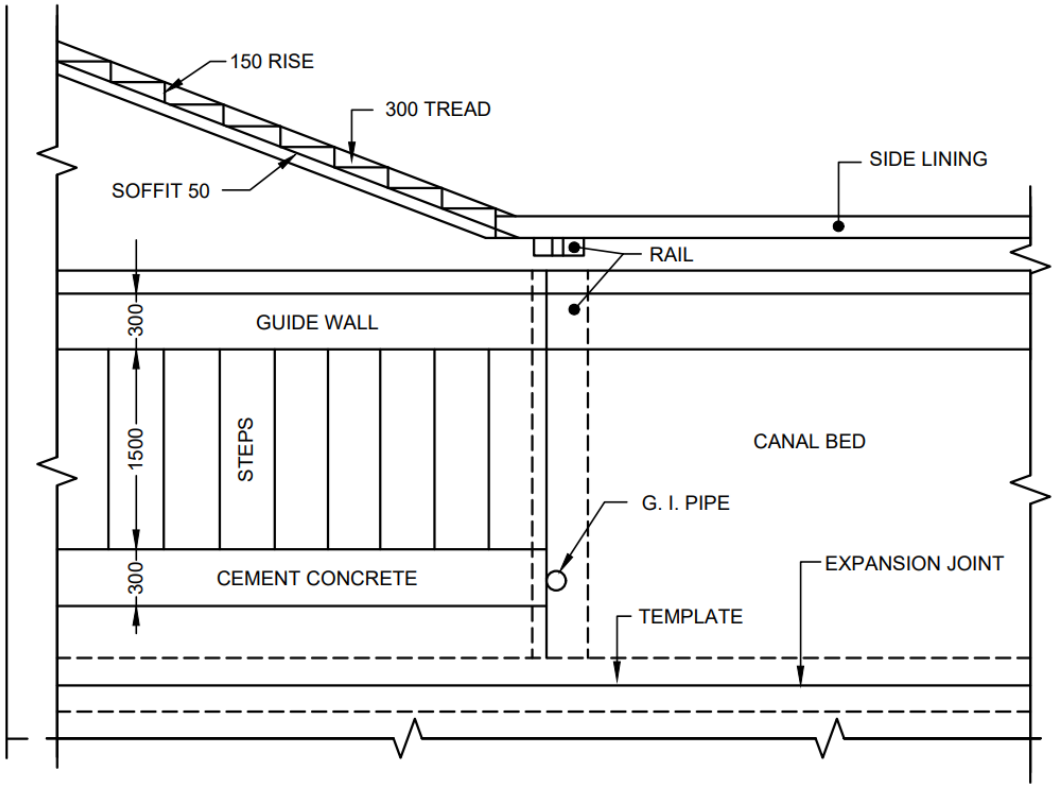
7.2 Typical details of safety ladder are illustrated in Fig. 3.

NOTE—As an alternative to safety ladders steps of rise 150 mm, tread 300 m and 1 500 mm wide may be provided in plain cement concrete of grade M15 at a spacing of 300 m centre to centre (staggered) on either side of canal. Details of the steps are illustrated in Fig. 4.



All dimensions in millimetres.

FIG. 3 DETAILS OF SAFETY LADDERS



All dimensions in millimetres.

FIG. 4 DETAILS OF STEPS

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 456 : 2000	Plain and reinforced concrete — Code of practice (*fourth revision*)
IS 1128 : 1974	Specification for limestone (Slab and Tiles)
IS 2720 (Part 7) : 1980	Methods of test for soils: Part 7 Determination of water content-dry density relation using light compaction (*second revision*)
IS 3384 : 1986	Specification for bitumen primer for use in waterproofing and damp-proofing (*first revision*)
IS 3622 : 1977	Specification for sandstone (slabs and tiles) (*first revision*)
IS 4558 : 1995	Under drainage of Lined canals — Code of Practice (*second revision*)
IS 9451 : 2022	Guidelines for lining of canals in expansive soils (*third revision*)
IS 10430 :2000	Criteria for design of lined canals and guidance for selection of type of lining (*first revision*)
IS 9698 : 1995	Lining of canals with polyethylene film — Code of Practice (*first revision*)
IS 2508 : 2024	Polyethylene films and sheets — Specification (*fourth revision*)
IS 10646 : 1991	Canal linings-Cement concrete tiles — Specification (*first revision*)
IS 10889 : 2004	High density polyethylene films (*first revision*)
IS 15909 : 2020	PVC geomembranes for lining — Specification (*second revision*)