| Material	Shape & Size	Q'ty	Unit	Remarks
Miscanthus stubbles	30cm in stem length, 1m binding by straw rope.	1	bundle	Miscanthus or weeds stubbles.
Straws	Dried long paddy straws	15	kg	To be used as required.
Fertilizer	High quality compound fertilizer N14, P17, K13			6.6g per each sod.

(1) Terracing work with sods is mainly used for devastated land with poor soil conditions, particularly the hard ground. Main advantages of this work are the creation of growing area for planted trees, the dispersion of storm water by terraces, and the prevention of slope erosion by reducing the speed of runoff of the storm water.

(2) Depending upon the number of sods used, the work is called 3 pieces, 4 pieces or 5 pieces terracing work with sods. 3 pieces work should be used for gentle hillside slope and 5 pieces work for steep hillside slope.

(3) The spacing measured vertically between the terraces should be about 1.0m for 3 pieces terracing work and about 1.5m for 5 pieces terracing work. The standard width of terrace shall be 40cm for 3 pieces and 60cm for 5 pieces terracing work.

(4) Standard amount of filling straws should be about 1.5kg/m, but excessive amount of straws is not desirable since it may cause excessive drying.

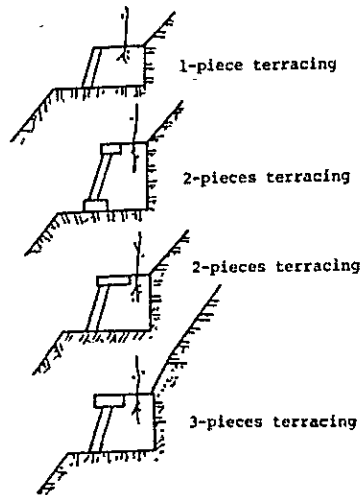(5) In a special case, only 1 or 2 sods are used.
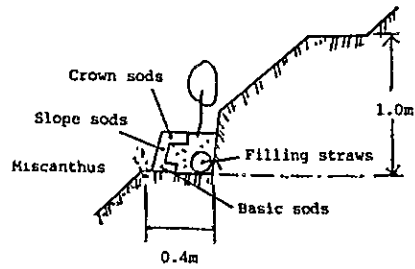
Crown sods
Slope sods
Miscanthus
Filling straws
Basic sods
1.0m
0.4m

3 pieces Terracing Work with Sods

1.5m
0.6m

4 pieces Terracing Work with Sods

0.5m
1.5m

5 pieces Terracing Work with Sods
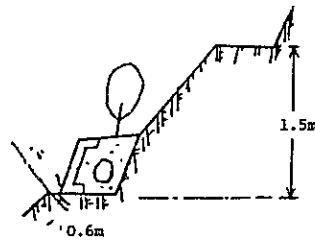
1-piece terracing

2-pieces terracing
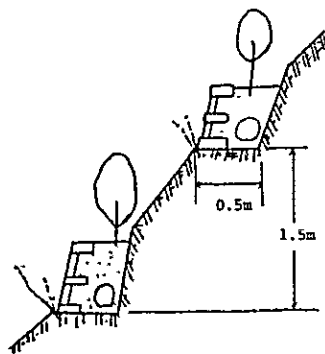
2-pieces terracing

3-pieces terracing

Special Case

(b) Step terracing with sods

Quality and specifications for the materials should conform to the points described for the Terracing Work with Sods. The following precautions should be taken when carrying out the work for the step terracing:

a. Since this work is performed where sediment occurs, work should be conducted after the sediment is loosened by rainfall or the like.

b. Width of steps should be made as wide as possible, and the slope of sod should be as gentle as possible.

c. Line connecting crowns of all terraces when finished must be a straight line or concaved line.

d. Method for placing, tamping and finishing the sods and miscanthus should approximately conform to the requirements for the Terracing Work with Sods.

Standard Quantities of Materials Used for Step Terracing with Sods (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Sods	33cm long, 20cm wide, 6cm thick	90		When sods are used.
Vegetation blocks	25cm long, 20cm wide, 3cm thick	120		When using vetetation blocks in lieu of sods.
Pegs	Green stems, wire or bamboo	180 ~240		Two per sod or vegetation block.
Fertilizer	High compound fertilizer N14-P17 -K13	600	g	100g per 1m^2 of step terracing work.

(1) Step terracing work with sods should be mainly used for fixing and stabilizing relatively a small amount of floated sand caused by slope or terrace cutting.

(2) Cost for this work is considerably high since the step terracing work is continuously done throughout the hillside slope.

(3) It is dangerous to start this work while the sediment is loose since the work is mainly performed on the sediment. Height of this work should not be too high since the sediment may be slided due to water seepage to saturation during rainfall.

(4) For the purpose of stabilizing the sediment, line connecting crowns of all terraces of this work should be a straight line or a concaved line.

(5) If a sloped ground face is provided between terraces, such slope should be covered with straws and seeded.
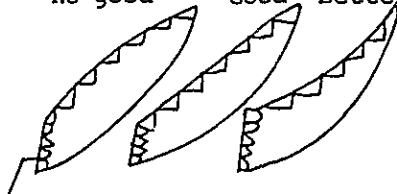
(1) Section

Terracing earth

(2) Front view

Terracing earth
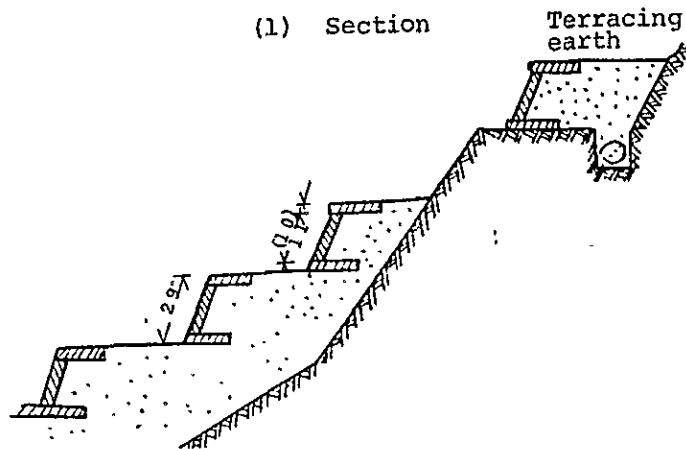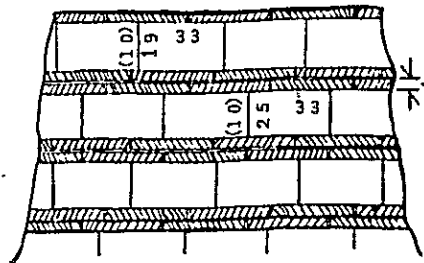
Step Terracing with Sods

No good   Good Better

Work of Step Terracing

(3) Simple terracing work

   (a) Stone simple terracing work

      Materials and work of stone simple terracing should
conform to the following items:

1. Unless specifically prescribed in working drawings or
    specifications, materials should conform to the following:

   a. Stones for masonry shall have the staying length of
       20cm minimum as standard, and should be of a shape
       that does not easily cause collapsing.

   b. Standard size of gravel must be less than 7cm.

2. The following precautions must be taken during work:

   a. Work of simple terracing should begin from top and
       move to lower portion.

   b. Grading work for the slope begin from the top, each
       terrace should be smoothly leveled, and obstacles such
       as stumps must be removed.

   c. Terrace should be cut to 50 to 60cm wide, about 10cm
       wide berm should be made, stones must be stacked to
       about 50cm height with 1:0.3 slope, and back portion
       should be backfilled with earth and tamped with foot.

   d. Miscanthus or weeds stubbles will be planted below
       and above the basic stone.

Standard Quantities of Materials Used for Stone Simple Terracing (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Stones	Quarry stone with staying length of 20cm min.	5.0	m^2	50cm stacking height.
Gravel	7cm dia. max.	0.5	m^2	50cm stacking height.
Miscanthus stubbles	30cm stem length, 1m binding by straw rope.	1.0	bundle	Miscanthus or weeds stubbles.
Straws	Dried long paddy straws	9.0	kg	To be used as required.

(1) This work should be used when there are many stones and gravel on hillside slope and rearrangement of such stones or gravel is needed.

(2) Stone used should be hard and not easily weathered, and the staying length of stone should be as large as possible since better stability is obtained if the staying length is longer.

(3) The maximum height of the simple terracing work should be approximately 50cm.

(4) Sloped face provided between terraces should be protected by seeding, and straws or weed stumps should be embedded on the bottom of terrace for protecting it.
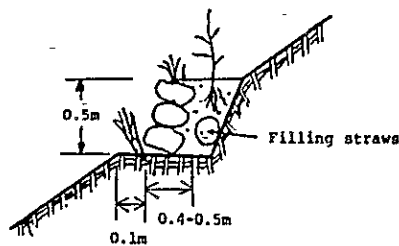
Stone Simple Terracing Work

(b) Miscanthus simple terracing work

> Special precautions should be given to the following points during work of the miscanthus simple terracing:
>
> a. Grading of slope and sequence of work should conform to the points described for the Stone Simple Terracing Work.
>
> b. Vertical distance between terraces is 1.0 to 1.5m, each terrace is 40cm wide, and about 10 to 20cm berm should be provided. Then miscanthus stubbles are laid, and terrace is backfilled with earth and tamped with foot for finishing.
>
> c. Vertical distance between two lines of simple terracing work when terraces are not provided is 50cm as a standard.

Standard Quantities of Materials Used for
Miscanthus Simple Terracing (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Miscanthus stubbles	30cm in stem length, 1m binding by straw ropes.	3.0	bundle	
Straws	Dried long paddy straws	9.0	kg	To be used as required.
Fertilizer	High compound fertilizer N14-P17-K13	100.0	g	10g per 1m of miscanthus simple terracing.

(1) Miscanthus simple terracing work is suited to places where soil conditions are relatively good such as sediment on top of walls or at the foot of hillside, or to places with good soil conditions on a steep slope into which cutting of wide terraces is very difficult.

(2) If use of miscanthus simple terracing work alone is not
     desirable because of soil and meteorological conditions,
     it must be used together with other method.

(3) Vertical height between terraces when only the miscanthus
     simple terracing work is adopted should not be too large
     since a large vertical height may create a long slope whose
     covering does not grow easily. However, larger vertical
     height may be used if other type of work is combined together
     with the miscanthus simple terracing for the slope. For
     the slope with poor soil conditions, terrace surface should
     be excavated to about 30cm depth to help the root swelling
     and to create the good environment for the planted trees.

(4) In the area where the sediment is well fertilized, the
     miscanthus may grow well even though it is merely planted
     in a row without providing terrace. Planted trees can also
     grow well in such area.

Construction (1)

1.0-1.2m

Filling straws where
the soil is slightly hard.

0.3m.

o.4m

Construction (2)

Where the soil is soft and swollen.

0.5m
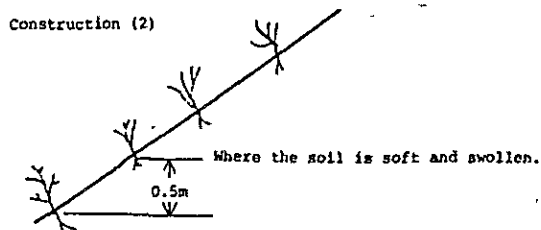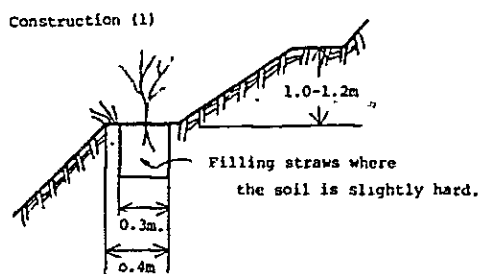
Miscanthus Simple Terracing

(c) Brush simple terracing

> Brush simple terracing work should be carried out by taking account of the following points:
>
> a. Grading of slope and work sequence of the brush simple terracing should conform to the points for the Stone Simple Terracing Work.
>
> b. Terraces should be so cut as to provide 80cm width and 1.5m vertical height between terraces as a standard. Then bundles of brush should be laid flat on terrace perpendicularly to terrace edge line at 10cm on centers, earth covering should be made over these bundles. Afterwords another layer of bundles is laid again with earth covering over the first layer, and the back portion should be backfilled for finishing.
>
> c. Miscanthus stubbles, weeds stubbles or cuttings should be planted between the brush to quicken early fixing of the brush.

Standard Quantities of Materials Used for
Brush Simple Terracing (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Bundles of brush	40cm long, 10cm in dia., bound with wire.	100.0	bundle	40cm of stacking height (2 layers)
Fixed stakes	50cm long, 3cm min. in top end dia., 55 stakes per bundle.	0.4	bundle	50cm spacing between stakes.
Straws	Dried, long paddy straws.	9.0	kg	To be used as required.
Miscanthus stubbles	30cm stem length, 1m binding by straw ropes.	1.0	bundle	Miscanthus, weeds, tree stubbles or cuttings.

(1) Brush simple terracing is the work which will have the
     backfilled earth behind the brush to provide the area for
     growing the planted trees as same as the terracing work
     with sods and the stone simple terracing work.

(2) This work is used in lieu of the terracing work with sods
     in the area where brush is richly available and is suited
     to the area where the slope is gentle and the rainfall is
     small without concentration of storm water.

(3) Since brush is mainly used and it is rotten within 2 to 3
     years, it is required to plant miscanthus or weeds stubbles
     between the bundles of brush to create quick vegetation
     and permanent functioning.
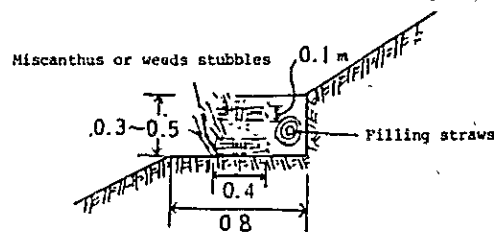
Brush Simple Terracing

(d) Fascine brush simple terracing

     Materials and work of the fascine brush simple terracing
should conform to the following items:

 1. Unless specifically prescribed in working drawings or
     special specifications, the quality and sizes of materials
     should conform to the following points:

   a. Brush must have 1.2m minimum length and 2cm minimum
       base diameter, and 1m binding by the straw ropes
       should be made.

b. Fixed stakes shall have 60cm length and 3cm minimum top end diameter as standard.

c. Iron wire shall be galvanized and have the size between #12 to #18.

2. The following precautions must be taken when carrying out the work:

a. Grading of slope, work sequence and planting of miscanthus stubbles and others should conform to the points for the Brush Simple Terracing.

b. Terrace is 60cm wide and the vertical distance between terraces is 1.5m as a standard.

c. Brush should be bundled to about 20cm diameter and bound with wire at 33cm on centers, bundles of brush should be stacked in two layers in parallel to terrace edge line. Then they are going to be fixed to fixed stakes driven at about 50cm on centers, and the portion behind them should be backfilled with earth for finishing.

Standard Quantities of Materials Used for
Fascine Brush Simple Terracing Work (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Brush	1.2m long min., 1m binding by straw ropes.	6.0	bundle	20cm bundle dia., stacked in 2 layers.
Fixed stakes	66cm long, 3cm min. top end dia., 55 stakes per bundle.	0.4	bundle	50cm spacing between stakes.

Material	Shape & Size	Q'ty	Unit	Remarks
Iron wire	Galvanized, #12 to #18.	0.8	kg	For binding brush at 33cm on centers with 2 turns at each point.
Miscanthus stubble	30cm stem length, 1m binding by straw ropes.	1.0	bundle	Miscanthus, weeds or tree stubbles, or cuttings.
Straws	Dried, long paddy straws.	9.0	kg	To be used as required.

(1) This work is used for stabilizing the floating earth on
     the face of gentle slope, and quick vegetation is required
     for this work since the brush rots very quickly, as same
     as the Brush Simple Terracing.

(2) Straws may be used instead of fascine brush to make straw
     simple terracing.

(1) Section

- 168 -
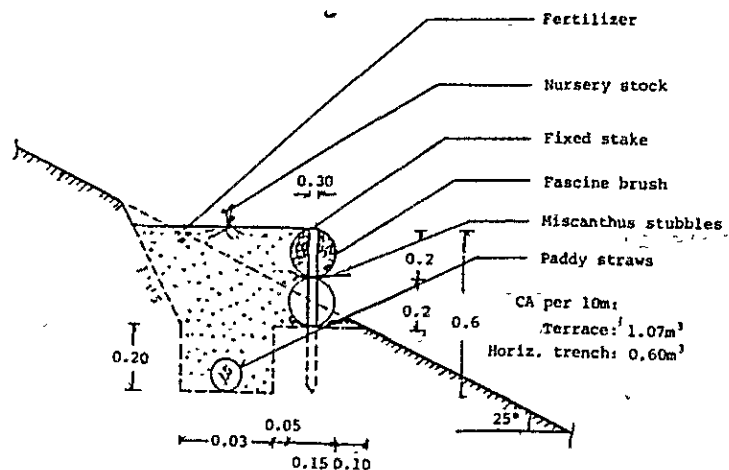
(2) Front view

Fascine brush
Nursery stock
Binding wire
Fixed stake
Miscanthus stubbles

|← 0.50 →|

0.01

0.2

0.2

|←—0.33—→|←—— |←—0.33—→|

|←— 0.50 —→|←— 0.50 —→|
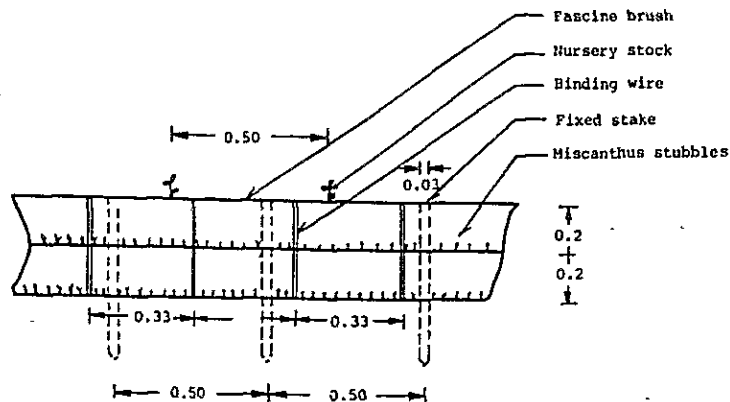
Fascine Brush Simple Terracing Work

(e) Log simple terracing

> Materials and work of the log simple terracing should conform to the following items:
>
> 1. Unless specifically prescribed in working drawings or specifications, materials should conform to the following points:
>
>   a. Piling log is approximately 60cm long and 10cm in top end diameter as a standard.
>
>   b. Lateral log is approximately 2m long and 10cm diameter at center of log as a standard.
>
> 2. The following points must be taken into account when carryign out the work:
>
>   a. Terrace should be cut to 50 to 60cm wide, piling logs should be driven at 70 to 100cm on centers, and logs are going to be stacked in a row behind the piling logs. Then the portion behind them should be back-filled with earth for finishing. Log stacking height should be about 30cm.

b. Quick fixing by vegetation should be made by planting weeds stubbles or scions in the gaps between logs.

c. As an alternative method, logs may be stacked in 2 layers together with crop logs, but foregoing points should be observed even though this method is adopted.

Standard Quantities of Materials Used for
Log Simple Terracing (per 10m)

Material	Shape & Size	Q'ty Unit	Remarks
Piling logs	60cm long, 10cm in top end dia.	15.0	70cm spacing between logs.
Lateral logs	2m long, 10cm dia. at center of log.	15.0	30cm high above terrace surface.
Miscanthus stubbles	30cm stem length, 1m binding by straw ropes.	1.0 bundle	Miscanthus stubbles, weeds stubbles, or tree stubbles.

(1) This work is used in areas where logs are easily available to strengthen poor soil and to stabilize the grading earth.

(2) Instead of stacking the logs, they may be stacked up together with crop logs such as log piling as shown in Construction (2) in the figure indicated below.

Construction (1)   Construction (2)
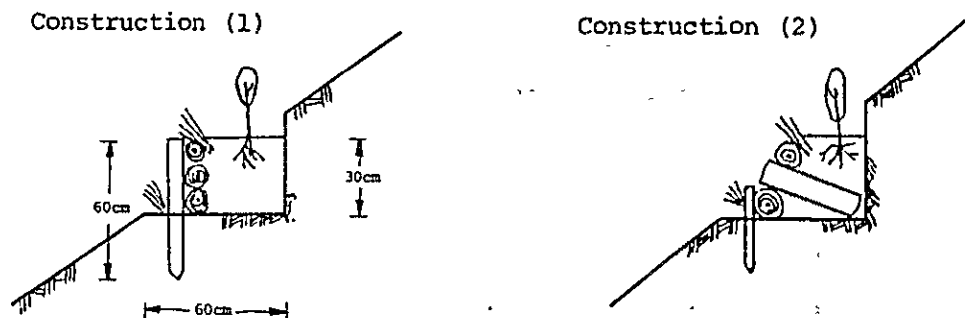
Log Simple Terracing

(f) Sod simple terracing

Sod simple terracing work should be carried out by taking account of the following points:

a. Terrace is 40cm wide with 1.0 to 1.5m vertical distance between terraces and 10 to 20cm berm should be provided. Sods should be laid immediately behind the berm, and then earth should be backfilled and tamped by feet for finishing.

b. The vertical distance between rows of sods, when terraces are not made, should be 50cm as standard, shallow grooves with size capable to hold sods should be made in the form of contour lines and sods should be laid flat in each groove. Earth must be backfilled and tamped between sods and in grooves, and the work should be finished in such a manner that all sod surfaces will become flush with adjacent ground surface uniformly.

c. About two-thirds of length of each peg must be inserted.

Standard Quantities of Materials Used for
Sod Simple Terracing (per 10m)

Material	Shape & Size	Q'ty	Unit	Remarks
Sods	33cm long, 20cm wide, 6cm thick.	30.0		
Pegs	Green tree trunks, bamboo or wire.	60.0		Two pegs per sod.
Fertilizer	High compound fertilizer N14-P17 -K13.	200.0	g	100g per 1m^2.

(1) In this sod simple terracing work, sods will be used in lieu of miscanthus used in the case of Miscanthus Simple Terracing Work. Thus, these sods should be used only when sods are easily available and the work can be done more economically compared to the miscanthus.

(2) As same as miscanthus simple terracing, the sod simple terracing is suited to area where the slope is relatively gentle or to area where the slope is steep and cutting of wide terraces is difficult. However, if the ground is hard, terraces must be excavated and cultivated to create the ground suited to planting.

(3) Since the slope between terraces becomes much steeper after cutting the terraces on a steep land, such steep slope must be protected by means of simple terracing having the effects of covering or soil dressing.

(4) Terrace is not necessary in the sedimentary area where the slope is gentle, earth layer is deep and soil conditions are good, and sods directly planted on the face of slope will be able to grow quuickly in such area.

(1) Sod simple terracing with cutting of terraces

(2) Sod simple terracing without terraces

Sods

Filling straws
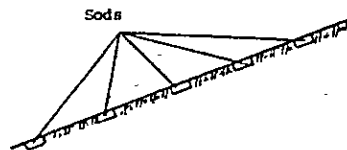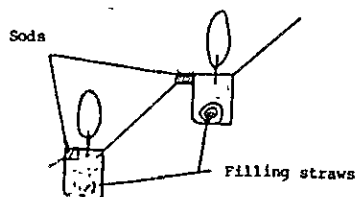
Sods

Sod Simple Terracing

(g) Vegetation block simple terracing

Materials, production of vegetation blocks and work of the vegetation block simple terracing should conform to the following items:

1. Unless specifically prescribed in working drawings or special specifications, the quality of materials and specification of the vegetation block simple terracing should conform to the provisions for materials of Seeding Work and Simple Terracing.

2. Vegetation blocks should be produced in accordance with the following procedure:

   Materials such as earth, fertilizer and straws must be mixed in a mixer without adding water, and then water should be added and mixed for more than one minute. The hardness of earth after mixing should be such that a slight amount of water may drip when some amount of earth is squeezed by hand. Earth must be then thoroughly pressed with RYOKKAH and molded to the size of 25cm length, 20cm width and 3cm thickness. If strips of straws are going to be used, such straws must be added before molding. Seeds should be placed in small holes of these molded blocks and they must be covered with paper. However, pressing may be performed after placing of seeds and covering of paper.

3. The following precautions must be taken during the execution of the work:

   a. Work should start from higher location to lower location.

   b. Face of slope should be graded to eliminate extreme unevenness, and any stones or stumps that may obstruct the work must be removed.

c. Cut 21cm wide by 3cm deep groove on the face of slope with bottom surface of groove parallel to the face of slope, lay the vegetation blocks closely to each other, and fix each vegetation block with two pegs.

d. Fill earth around blocks and between block and bed surface without leaving any air gaps, tamp the earth and blocks, and finish the surface so as to have the faces of vegetation blocks flush with the surrounding ground surface.

e. The quantity of vegetation blocks to be laid should be eight per 1 square meter, and standard distance between centers of upper and lower grooves should be 50cm.

Standard Quantities of Materials Used for
Vegetation Block Simple Terracing (8 blocks per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	To be determined per Para. 3.1.1.
Fertilizer	Compost (fully ripen)	600	g	Weight when it is wet.
	N14-P17-K13	120	g	High compound fertilizer.
Mixing earth	Good humus soil	0.02	m³	
Covering paper	Newspapers, toilet paper, etc.	16		Half of each block to be covered (for 8 blocks).
Pegs	Willow or bamboo, 20cm long, 0.7 to 1.3cm dia.	16		

Material	Shape & Size	Q'ty	Unit	Remarks
Straw strips	21 × 16cm	8		To be used as required.
Cut straws	Paddy straws cut to 3 to 6cm length.	0.12	kg	
Water		1.6	ℓ	

(1) Standard quantities of materials shown above are for eight vegetation blocks. Since spacing between centers of blocks is 50cm and standard size of each block is 25cm long by 20cm wide (3cm thick), 8 vegetation blocks will be needed per 1 square meter and actually sodded area will be 0.4m^2.

(2) Kind of species of sods should be determined basing upon the weather, soil conditions and work method in the work area, and the amount of seeds should be determined by taking account of species of sods and other special conditions.

(3) When introducing seeds of trees also, it is preferable to produce separately the blocks having only the seeds of trees and properly laid on the slope in the staggered or straight pattern of layout between the blocks having only grass seeds on the slope.

(4) Though the compost is listed in the above table as organic fertilizer, bark compost (about 0.6kg per 8 blocks) or chicken feces may be used in lieu of the compost depending upon the supply conditions. If good mixing earth is not available, soil improvement material such as bentonite should be used.

(5) Spacing between rows of vegetation blocks should be so determined as to assure the covering of all ground surface with vegetation at least within one year after the work.

(6) If the number of blocks used per unit area is different from that shown in the table above, the amount of seeds used should be adjusted accordingly. Unit for determining the quantities should be properly adjusted in response to actual material or method shown in the design documents.

Vegetation Block Simple Terracing

(h) HIDOGEN Vegetation block simple terracing

Materials and work method for HIDOGEN vegetation block simple terracing should conform to the following items:

1. Unless specifically prescribed in working drawings or specifications, the quantity and specification of the materials should conform to the provisions for the Vegetation Block Simple Terracing, except for materials for producing vegetation blocks.

2. Method of work should conform to the items for the Vegetation Block Simple Terracing.
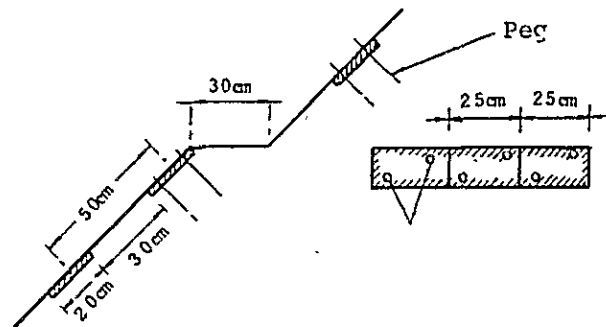
Standard Quantities of Materials Used for HIDOGEN Vegetation Block Simple Terracing (8 blocks per $1m^2$)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds				To be determined per Para. 3.1.1.
HIDOGEN vegetation blocks	25cm long, 20cm wide, 1.8cm thick.	6		Secondary products.
Covering earth	Clay	2.0	kg	2.5kg per 10 blocks for mud.
Water		0.8	ℓ	1ℓ per 10 blocks for mud.

(1) Grading of slope, laying method, number of blocks and amount of seeding should conform to those shown for the vegetation block simple terracing work.

(2) Other kinds of HIDOGEN vegetation blocks different from the table shown above are also available (some has 10cm width though the length and thickness remain the same.)

(3) Use of big pegs may cause cracks in the blocks.

(i) Vegetation sack simple terracing

Materials, sack production and work of the vegetation sack simple terracing should conform to each of the following items:

1. Unless specifically prescribed in the working drawings or special specifications, the quantity and specification of materials such as seeds, fertilizer and mixed earth should conform to the items for the Vegetation Block Simple Terracing Work.

a. Vegetation sack must be polyethylene, cotton or TEBIRON sack with about 2.5mm mesh.

b. Standard peg must be 15cm long and made of iron nail, iron wire or hard vinylchloride with head portion of each peg bent in U-shape.

2. Vegetation sack should be produced in the following manner:

a. In mixing the materials, add fertilizer and seeds to the earth and fully mix them together. Standard moisture content of earth should be 20%.

b. Fill up the sack with mixed materials, and close the sack with wire. Standard finishing size of sack should be 33cm long, 15cm wide and 4cm thick.

3. The following points should be taken into account during work:

a. Work sequence, grading of slope and finishing should conform to the items for the Vegetation Block Simple Terracing Work.

b. Cut about 16cm wide and 4cm deep groove with its bottom face parallel to the face of slope, lay the sacks in the grooves without leaving any gaps between them, and fix the sacks to the ground by using two pegs per each sack.

c. Three vegetation sacks should be laid per one linear meter of groove, and the distance between centers of upper and lower grooves should be 50cm as standard.

Standard Quantities of Materials Used for Vegetation Sack Simple Terracing (6 sacks per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	To be determined per Para. 3.1.1.
Fertilizer	Compost (fully ripen)	600	g	Weight when wet.
	High compound fertilizer N14-P17-K13	120	g	20g per sack.
Mixing earth	Good humus soil	0.02	m²	
Vegetation sacks		6		Including retainer for sack opening.
Pegs	Iron nail or hard vinylchloride	12		

(1) Standard quantities of materials shown in the above table are for 6 vegetation sacks. Since the spacing between rows of vegetation sacks when laid on the slope is 50cm and each sack has 33cm length and 15cm width, six sacks will be needed per 1 square meter and real area of the sacks is 0.30m². However, since the size of sacks varies depending upon the sack manufacturer, it is required to check the actual size of sack. If the size is different from the above, quantities of seeds, fertilizer and soil dressing must be calculated basing upon the values shown in the table above.

(2) Earth must be sufficiently filled in the sack without causing separation between earth and sack surface, otherwise buds of dicotyledon such as white clover may occasionally not be able to come out of the sack.

(3) Other items concerning the vegetation sack simple terracing should conform to the items for the vegetation block simple terracing.
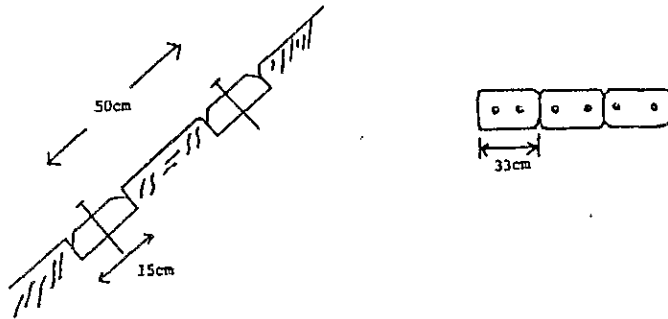
Vegetation Sack Simple Terracing

(j) Simple terracing using other secondary products

The following points should be taken into account when
performing the simple terracing work using other secondary
products:

a. Products containing fertilized earth and seeds in sack-
like containers should be prepared and placed in ac-
cordance with items described for the vegetation sack
simple terracing.

b. Products consisting of seeds and fertilizer attached to
paper or non-woven cloth shall be prepared and placed
approximately in accordance with the covering work if
seeds and fertilizer are attached to whole surfaces,
or with the miscanthus simple terracing if seeds and
fertilizer are attached only to edges of surfaces.

(1) Many different kinds of secondary products other than the
vegetation blocks and vegetation sacks are also available.
And these secondary products will be used when supply and
transport of sacks and blocks are difficult, or for the
purpose of treating grading earth or where the filled earth
exists.

(2) If saving in labor is required during work, use of these secondary products is very effective. However, most of these secondary products have to be ordered specially after considering which species and quantities of seeds to be used.

(3) Since these secondary products greatly vary in characteristics, size, kind of seed and condition of fertilizer contained, a proper type of products must be selected by fully taking account of the purpose of use.

(4) Depending upon the materials used, these products can be generally classified into the products mainly for soil dressing effect and the products mainly for seeding purpose. The products made mainly for soil dressing will consist of peaty or fertilized earth or organic fiber material as base material on which seeds having good sprout ability are bonded or mixed to accelerate vegetation after germination for the purpose of quick seeding and planting on hillside. Since organic materials are used in these products, the permanent effect of fertilizer can be expected for assuring the permanent growing of vegetation.

(5) Secondary products having no soil dressing effect are of improved type for assuring safe and sure effect in lieu of the strip seeding work. Though some fertilizer is attached to the base material of these products, the amount of this fertilizer is insufficient for facilitating the permanent growth of vegetation.

(6) The spacing between rows or strips should be so determined as to assure the full covering of a slope by taking account of slope conditions, economy in work and covering functions. Generally, a vertical distance of about 50cm is selected as spacing.
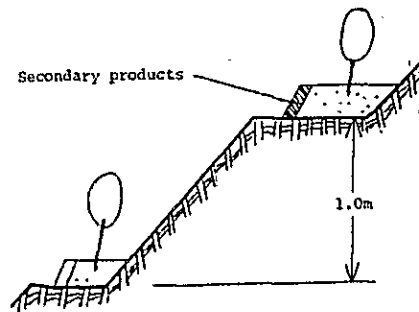
Work in Cut Slope
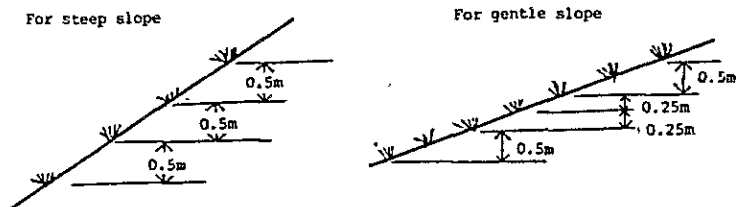
Work in Sedimentary Area

(4) Seeding work

 (a) Strip seeding

      The following points should be met when performing the
strip seeding work:

a. Work should be started from upper portion to lower portion.
    Terraces, each having 10 to 15cm wide, should be cut on
    the slope, and a groove having 7 to 10cm wide and 2 to
    3cm deep should be made on each terrace.

b. Treatment for accelerating germination for the seeds of
    trees should be performed in advance if required.

---

c. Seeds and fertilizer should be mixed to the soil dressing, and then this should be spread to a thickness of about 0.5 to 1.0cm.

d. After seeding, earth should be fully tamped, paddy straws should be laid flat without stacking over the surface, and stones or earth should be placed at several points on straws to prevent them from being moved.

Standard Quantities of Materials Used for
Strip Seeding (per 1m)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	
Fertilizer	Basic fertilizer N14-P17-K13	15	g	Organic compost such as chicken feces may be used.
Soil dressing	Good quality humus soil	0.001	m³	
Straws	Dried long paddy straws	30	g	

(1) This work is mainly performed on sloped portions between terraces on relatively gently sloped hillside.

Seeding   Straw covering

10-15cm

Occasionally sods are planted here.

Groove for seeding:
Width: 7 to 10cm
Depth: 2 to 3cm
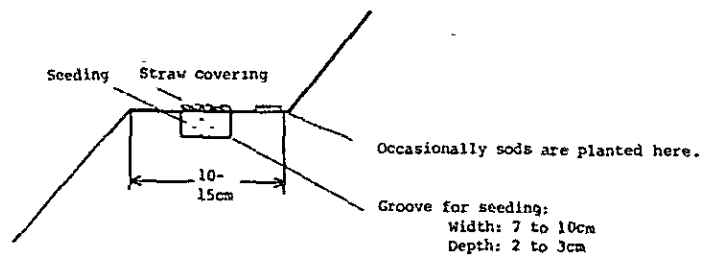
Strip Seeding

(b) Vegetation digging

    Materials and work of the vegetation digging should
conform to the following items:

1. Unless specifically prescribed in working drawings or
    specifications, the materials, quality and size should
    conform to the following:

  a. Standard solid fertilizer should have a total of 37%
      fertilizer component; 16% for nitrogen, 14% for
      phosphoric acid, and 7% for potassium.

  b. Seed paper consists of seeds sandwiched between two
      Japanese papers (about 600cm^2) glued together, and
      this paper should be equally divided into 18 pieces
      for the work.

2. The following precautions must be taken during work:

  a. Hillside slope should be graded to eliminate excessive
      unevenness, and stumps or stones obstructive to the
      work must be removed.

  b. By using an electric drill with auger, 18 holes should
      be drilled per 1 square meter in the staggered pattern
      (standard spacing of 28cm longitudinally and 20cm
      transversely) on the hillside slope, each having 6 to
      10cm diameter and 15cm depth.

  c. One solid fertilizer should be placed to the bottom
      of each hole, required amount of soil dressing prepared
      in advance by mixing soil conditioner to earth should
      be densely filled into hole, and then seed paper should
      be placed in the hole and soil covering should be
      placed until the top of covering becomes almost flush
      with ground surface.

  d. Film-curing method should conform to the items in
      described in Seeds Spray A.

Standard Quantities of Materials Used for Vegetation Digging (per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seed papers	5cm×5.5cm (with seeds)	18	sheet	Seeds of seed paper (600cm²) to be determined per Para. 3.1.1.
Fertilizer	High compound fertilizer (N14-P17-K13)	55	g	For soil dressing.
	Solid fertilizer (N16-P14-K17)	18	pieces	For filling.
Soil dressing	Good quality soil	0.015	m³	
Additives	Silicate magnesia lime	223	g	To be used as required.
	Peat moss	335	g	To be used as required.
Curing materials	Cationic asphalt emulsion	1.0	ℓ	2 times aqueous solution, to be used as required.
	Polyvinyl acetate	2.0	ℓ	20 times aqueous solution, to be used required.
Water		3.0	ℓ	Additionally 6ℓ is needed for washing machines.

(1) This work should be used where the earth is very hard.

(2) Kind and amount of seeds to be glued on seed paper should be designated for manufacturing.

(3) Kind and amount of seeds should be determined by taking account of weather, soil and other special environmental conditions at the site.

(4) Curing materials should be used in accordance with items for the Seeds Spray Work.

(c) Slope seeding

> The following points should be met when carrying out the slope seeding work:
>
> a. Slope should be graded to eliminate excessive unevenness in advance, and all stumps and stones obstructive to the work must be removed.
>
> b. Seeding should not be performed during or immediately before strong wind or heavy rainfall.
>
> c. When seeds of trees are used, treatment for accelerating germination should be performed in advance as required.
>
> d. Horizontal terraces, each being 20cm wide, should be cut on the slope with a spacing equal to 80% of straw length between the terraces.
>
> e. Remove dirts, floated stones or floating earth from the slope.
>
> f. Mix seeds, fertilizer and soil dressing together. Add water to this mixture and sow the mixture in the soil as if the mixture is forcibly thrown against the slope.
>
> g. When seeding is completed, cover the slope in accordance with the method for the mat covering. If mats are not used for covering, other curing material should be used.

Standard Quantities of Materials Used for Slope Mix Seeding

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	To be determined per Para. 3.1.1.
Fertilizer	Basic fertilizer N14-P17-K13	100	g	High compound fertilizer.
Soil dressing	Good quality humus soil	0.005	m^3	
Straws	Dried long paddy straws	300	g	For covering.
Straw rope		2	m	For fixing straws.
Curing material	Asphalt emulsion, etc.	1 ～ 2	ℓ	When straws are not used.
Pegs	20cm long, bamboo	3		For fixing rope.
Water	Clear water	2	ℓ	

(1) This work is generally used in wet sedimentary land where the slope is gentle and the soil conditions are good.

(2) When the slope is steep, the face of slope should be covered with curing materials or straws to prevent the seeds from being flowed out.

(3) Kind and amount of seeds should be determined by taking account of weather, soil conditions and other special environmental conditions at the site.

Section   Sketch
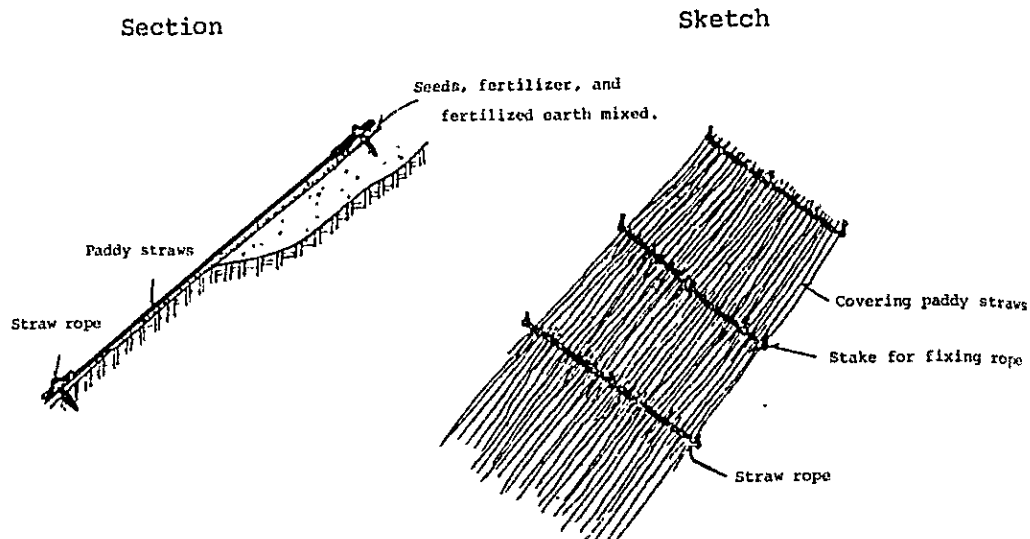
Slope Seeding

(d)   Seeds spray A (gun spray)

The following points should be specially taken into account when carrying out the seeds spray A:

a.   Slope should be graded to eliminate excessive unevenness in advance, and all stumps and stones obstructive to the work must be removed.

b.   Seeding should not be performed during or immediately before strong wind or heavy rainfall.

c.   When seeds of trees are used, treatment for accelerating germination should be performed in advance as required.

d.   If the slope is dry, water should be sprayed gradually until the earth gets wet up to 20cm in depth or deeper.

e.   Equipment such as spray gun, compressor and mixer should be used, and the chamber should be able to withstand pressure of at least $2.5kg/m^2$ and be suited to seed spraying.

f. When mixing the materials, they should be added to the mixer in the order of water, fertilizer and seeds and mixed at least for one minute.

g. Spraying should be performed while adjusting the nozzle in response to the spraying distance and hardness of the ground. Spraying must be performed uniformly in thickness without roughening or damaging the slope.

h. Curing material should be sprayed immediately after the surface water on the seeded slope disappears.
Spraying of curing material should be performed uniformly in thickness without roughening or damaging the slope.

i. If required, the slope should be then covered with mats.

Standard Quantities of Materials Used for
Seeds Spray A (per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds				
Fertilizer	Basic fertilizer N14-P17-K13	100	g	High compound fertilizer.
Soil dressing	Good wuality cohesive soil	0.01	m³	
Curing materials	Polyvinyl acetate	2.0	ℓ	20 times aqueous solution (1.0ℓ if 10 times aqueous solution is used).
	Cationic asphalt emulsion	1.0	ℓ	2 times aqueous solution.
Straw mats	1.0×2.0m, 0.5kg to be used per mat.	0.5	sheet	
Fixing rope	0.9cm dia., straw rope or vinyl rope.	2.0	m	To be used when the surface is very dry or likely to be separated due to frost-heaving because of site or work conditions.
Pegs	20cm long bamboo, or #10 iron wire.	6.0		
Water	For spraying	3.0	ℓ	

> NOTE: In addition to the spraying water, about 3.0ℓ of water
> is needed for pre-spraying and 5.0ℓ of water for washing
> machines.

(1) This work should be used for steep and high slopes having
a high hardness of soil.

(2) When comparing this work to the slope seeding work, this
work is advantageous in view of labor saving but is
restricted by topographic conditions since machines are
used. Thus, this work should be selected by taking account
of labor conditions, construction time and degree of
easiness in transporting the machinery.

(3) Curing materials must be used in this work. Curing materials
selected should be suited to the site conditions, and proper
amount of curing materials should be sprayed uniformly.
Seeded surface should not be left alone without giving
curing for a long period of time.

(4) If seeds are likely to be separated because of various
site conditions or seasonal conditions, straw mat or slope
net covering should be added to spraying of curing material.

(5) Kind and amount of seeds should be determined by taking
account of the weather, soil and special environmental
conditions at the site.

(e) Seeds spray B (pumping)

> The following points should be specially taken into
> account when carrying out the seeds spray B:
>
> a. Grading of slope, consideration for weather conditions,
> treatment for accelerating germination of seeds, spraying
> and curing should conform to the points for the Seeds
> Spray A.

b. Water spraying in advance to the slope should not be performed.

c. Mixer with tank and pump are required as equipment for this work. Pump should have the total head greater than 30m in case of clear water and be fitted for seed spraying.

d. When mixing materials, they should be added to the tank in the order of water, curing material, bonding material, fertilizer and seeds and mixed for more than 3 minutes, more than 5 minutes if bonding material is used, or more than 10 minutes if dry fibers are used until uniform slurry can be obtained.

e. Special method of work such as jet seeder method should be performed in accordance with the special specifications.

Standard Quantities of Materials Used for
Seeds Spray B (per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	
Fertilizer	Basic fertilizer, N14-P17-K13	100	g	High compound fertilizer
Fibers	Fibers (dry weight)	0.15	kg	
Curing materials	Polyvinyl acetate	2.0	ℓ	Either type to be used for film curing.
	Cationic asphalt emulsion	1.0	ℓ	
Bonding material	Polyvinyl alcohol	40.0	g	When film curing is not performed.
Straw mats			sheet	Per seeds spray A.

Material	Shape & Size	Q'ty	Unit	Remarks
Fixing rope			m	Per seeds spray A.
Pegs				
Water	For spraying	5.0	ℓ	Additional 5ℓ is needed for washing machines.

(1) While the seeds spray A uses spraying gun, this work will use a pump for spraying. While seeds spray A is used for steep slope with a high hardness of soil, seeds spray B is suited to the area where the slope is relatively gentle with low hardness of soil and is frequently used because of its merits such as high work efficiency, labor-saving and economy.

(2) So-called HGF method, DOROGEN-ACE method, Light method, Hydro method, S-FIX method and other special methods may have different qualities of materials, specifications or quantities used from those shown in the above table.

(f) Seeding by helicopter A (slurry method)

> The following points should be met when performing the seeding by helicopter A:
>
> a. Slope should be graded whenever possible. Method of grading should conform to the points described for Seeds Spray A.
>
> b. Consideration for weather condition during seeding and treatment for accelerating the germination of seeds should conform to the provisions for Seeds Spray A.
>
> c. Prior to starting spraying, identification marks notice-able from helicopter should be set up at the site.

d. Spraying device with mixer and agitator suited for spraying from helicopter should be used.

e. Materials should be mixed by the sequence and method suited to spraying at least for 5 minutes to produce uniform slurry. If dry fibers are used, mixing must be continued for at least 10 minutes. If method and time of mixing of materials are clearly indicated in the special specifications, such specifications should be met but, in any case, solidification or separation of materials should not be permitted.

f. Spraying should be conducted from an elevation of about 10 to 30m and uniform spraying should be assured while making adjustment depending upon the terrain and slope.

g. Extra precautions should be taken not to contaminate the houses and other properties, and other necessary measures such as use of guardsmen should be taken to prevent the accidents.

h. Heliport should have sufficient area for landing, take-off and operation, and its location should be so selected as to assure the safe operation without giving any troubles to nearby residents and houses.

Example of Quantities & Materials Used for Seeding by Helicopter A (per $1m^2$)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	
Fertilizer	High compound fertilizer	150	g	Area example A, B
	High compound fertilizer	100	g	" C
	Organic manures	100	g	" C
Curing material	Cationic asphalt emulsion	350	g	" A
	Petroleum resin type, RUNAZOL AH	70	g	" B, C
	STABILA	80	g	" C
Conditioner	AZUMINART	70	g	" A, B
Bonding material	CMC type	2	g	" C
Coloring agent	MARAKITE green	0.15	g	" B
	CHIYODA green	4	g	" C
Repellants	Iron oxide, JOBANMINORI powder, etc.	0.01	g	" A, B
Mixing water	Clear water	0.35	ℓ	" A
	Clear water	1.0	ℓ	" B
	Clear water	1.2	ℓ	" C

(1) This work is suited to the area where the slope is relatively gentle and soil conditions are good but labor is in short supply or land traffic is impossible.

(2) There are two types of seeding by helicopter; slurry method and base method. Slurry method will use slurry mixture made of curing material, admixture, seeds and fertilizer for spraying.

(3) Slurry method can be classified into side-attaching method and suspension method depending upon the spraying equipment used. The side-attaching method will have spraying devices at both sides of the helicopter body while the suspension method will have a suspended bucket containing slurry during spraying operation. The latter is advantageous since spraying is possible even to the concealed portion on the hillside by giving vibration to the bucket.

(4) This spraying method by helicopter was developed by the airplane companies, and thus kind and amount of materials used, mixing method, and spraying method and its features will slightly vary depending upon the airplane companies.
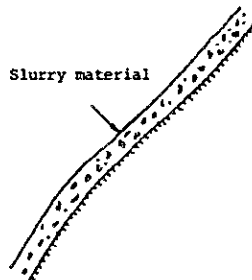
Slurry method   Base method
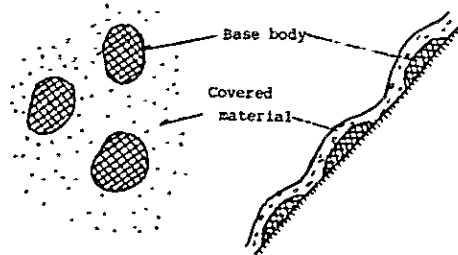
Seed Spraying Method by Helicopter

(g) Seeding by helicopter B (base method)

> The following points should be met when performing the seeding by helicopter B:
>
> a. When spraying materials, the base bodies should first be dropped and then slurry should be sprayed. Base body should weigh 40g per each, ten base bodies per 1 square meter should be used, and 1.0ℓ of slurry should be used per 1 square meter as standard.
>
> b. Grading of slope, mixing method, spraying of slurry and spraying precautions for this work should conform to the points stated for the Seeding by Helicopter A.

Example of Quantities of Materials Used for
Seeding by Helicopter B (per 1m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Seeds			g	
Fertilizer	Compound fertilizer, granular	80	g	Area example A
	Compound fertilizer, liquid	60	g	" A
	Pulp type organic material	200	g	" A
	Compound fertilizer, granular	80	g	" B
	Compound fertilizer, liquid	60	g	" B
	Organic material	280	g	" B
Curing material	Vegetable oil PET	300	g	" A
	Vegetable oil PET	400	g	" B

Material	Shape & Size	Q'ty	Unit	Remarks
Conditioner	Bentonite	40	g	Area example A
	Bentonite	20	g	" B
Bonding material	PVA	5	g	" A, B
	CMC	2.5	g	" A, B
Mixing water	Clear water	0.8	ℓ	" A
	Clear water	0.9	ℓ	" B

(1) Since base bodies are used in performing this work, this
     can be applied to the steeply sloped area or sand gravel
     area where only small amount of earth exists.

(2) In this base method, cow-feces-like cohesive base bodies
     consisting of admixture, seeds and fertilizer are dropped
     from base spread device attached to a helicopter at a rate
     of about 400g (about 10 base bodies) per 1 square meter.
     Then, slurry covering material as same as the slurry method
     stated before is sprayed from slurry spraying device
     attached to a helicopter uniformly over the face of slope
     at a rate of about 0.9 to 1.2ℓ per 1 square meter in order
     to prevent the erosion of earth between the base bodies.

(3) If sand or soil is too dry, slurry is occasionally sprayed
     first uniformly and then base bodies are dropped in the
     order reverse to the sequence stated previously since the
     base bodies have a high viscosity.

(4) Some standards should be established since the kinds and
     materials for base method currently being used considerably
     vary.

(5) Covering work

(a) Brush covering

Materials and work for the brush covering should conform to the following items:

1. Unless specifically prescribed in the working drawings or specifications, the materials should conform to the following points:

   a. Standard brush should be 1.2m in minimum length and 2cm in minimum base diameter, and each bundle of brush should be of 1m binding by straw rope.

   b. Each fixing log should be 2m in minimum length and 3cm in minimum top end' diameter as standard.

   c. Each piling log should be 80cm long and have 6cm top end diameter approximately.

   d. Miscanthus, weeds and tree stubbles, and cuttings should conform to the items for the simple terracing work.

2. The following points should be taken into account during work:

   a. Slope should be graded in advance to eliminate unevenness, and any stones or stumps obstructive to the work should be removed.

   b. If work of seeding and planting of stubbles is accompanied, such work must be performed in advance.

   c. Piling logs should be used at center and both ends of the fixing logs at 1.0m on centers. Since the piling logs tend to float easily, they must be driven into sufficient depth.

d. Brush should be placed longitudinally along the slope in staggered pattern while the fixing logs should be placed across the brush. Fixing logs should be tied to piling logs with iron wire. Standard spacing between fixing logs should be 50cm.

Standard Quantities of Materials Used for Brush Covering

Material	Shape & Size	Q'ty	Unit	Remarks
Brush	1.2m long, 2cm min. base dia., 1m binding by straw rope.	5.0	bundle	
Fixing logs	2m long, 3cm minimum top end dia.	11.0		Across brush, 50cm spacing, 2m slope length.
Piling logs	80cm long, 6cm top end dia.	33.0		To fix the fixing logs, 1m spacing, 2m slope length.
Iron wire	Galvanized, #18	0.1	kg	30cm long at each point.
Miscanthus stubbles	Weeds stubbles, 30cm stem length, 1m binding by straw rope.	3.0	bundle	To be used as required.
Cuttings	30cm long			To be used as required.

(1) This work is used for preventing erosion or sliding of slopes between terraces due to rainfall. Brush must be easily available and driving of piling logs must be easy when performing this work.

(2) Brush covering is frequently used together with miscanthus simple terracing or seeding work. However, if the slope length increases, longer fixing logs may become necessary and the work may become more difficult.

(3) Brush should be placed longitudinally along the slope in principle. Laying brush across slope from terrace may cause cracks due to rain along the brush.

(4) Maximum spacing between fixing logs should be 1.0m, and these logs should be firmly secured to piling logs.
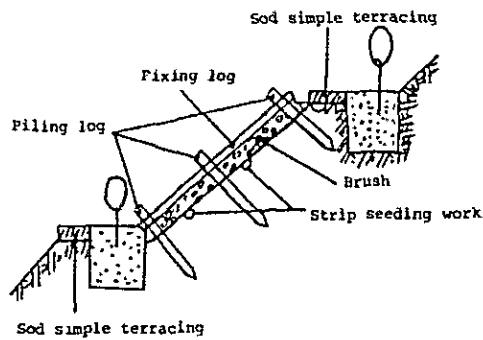
Brush Covering

(b) Straw covering

> Materials and method of the straw covering should conform to the following items:
>
> 1. Unless specifically prescribed in working drawings or specifications, materials for the straw covering should conform to the following points:
>
>   a. Standard diameter of straw rope is 12mm.
>
>   b. Pegs should be made of bamboo or green stems which has high sprout ability, and its standard length is 25cm.
>
> 2. The follwoing points should be taken into account when performing the work:

a. Slope should be graded in advance to eliminate excessive unevenness, and all stumps or stones obstructive to the work should be removed.

b. If seeding is planned, it should be done prior to the straw covering.

c. If this work is performed in association with simple terracing work involving excavation of terraces, the tips of straws should be embedded in terrace, stems of straws should be laid straight over the slope, and lower portion of stems should be secured with straw rope tensioned.

d. When covering the simple terracing work without cutting terraces, straws should be laid flat and secured with straw ropes at both ends of straws to prevent them from being moved.

e. Straw ropes should be completely fixed with pegs.

Standard Quantities of Materials Used for
Straw Covering (per 10m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Straws	Long dried paddy straws	4.5	kg	
Straw rope	Rough rope, 0.9 to 1.2cm in diameter.	1.0	kg	For securing straws.
Pegs	Bamboo or green stems, 20 to 30cm long.	40.0		For securing straws.

(1) This work is used mainly in dry area where the rain rarely occur and the slope is relatively gentle for the purpose of preventing erosion of hillside slope, evaporation of moisture, and flowing of seeds. It is also used for

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preventing erosion on poor hillside or on area having
floating sands, and in many cases is adopted together with
other seeding work.

(2) If slope's grading is gentle, straws may be laid in parallel
to sloping direction. But if the grading is steep, straws
should be laid longitudinally along the terrace in principle
since straws tend to slip downward as topsoil moves.

(3) Straws will easily scatter if wind or rainfall occurs.
Thus, they should be secured with straw ropes and spacing
of these ropes should be determined based upon the actual
site conditions.

(4) If plenty of miscanthus is available, it may be used in
lieu of straws.
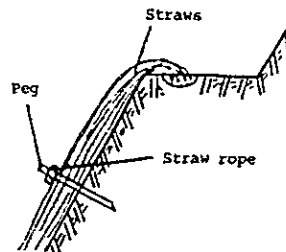
Straw Covering

(c) Net covering

Materials and work of the net covering should conform
to the following items:

1. Material size, shape, etc. should be as follows:

  a. Net or rope should be made of either steel or synthetic
     fiber conforming to the prescribed standards.

b. Anchor bolts should be made of steel and conform to prescribed standards. Head of each anchor bolt must have a U-shaped hook.

c. Each peg, 9mm in diameter and 20cm in length, should be made of iron with U-shaped hook at its head.

2. The following points should be taken into account when carrying out the work:

a. Slope should be graded in advance to eliminate excessive unevenness, and any stones or stumps obstructive to the work must be removed.

b. Any seeding work should be performed in accordance with the seeding specification.

c. Anchor should be driven at the top of slope and be covered by net, and the top end of a transversal rope should be tied to this anchor. Longitudinal rope should be connected to both the anchors and the transversal ropes for fixing.

d. Nets should be sticked together, pulled up to the location of the rope, and fixed to anchors and rope.

e. Anchors should be driven into the ground along the periphery of the slope other than the top edge of the slope, pegs should be driven into the middle portion of the slope, and both anchors and pegs must be connected to the net.

f. Rope should be tensioned longitudinally and transversely over the net and fixed to anchors and pegs, and finally the lowest portion of the transversal rope should be fixed.

Standard Quantities of Materials Used for Net Covering (per 10m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Nets	Wire net or synthetic fiber	12.0	m²	
Anchors	Steel bolts	1.0		For fixing net.
Pegs	Steel bolts	20.0		For fixing net.
Rope	Steel rope or synthetic fiber rope		m	To be selected based on slope conditions.

(1) Net covering work is performed generally for protection in association with seeds spray work and also for the purpose of protection against sliding of stones. That is, net covering is performed for seeding purpose and for physically controlling the stones and gravel in the areas where seeding is difficult. Therefore, it is important to select materials suitable to the purposes.

(2) For the net covering performed mainly for seeding, synthetic fiber nets are mostly used in sedimentary areas and on slopes located between terraces for which vegetation work is needed. However, in recent years, new types of nets that are attached with seeds and fertilizer have been developed, so that both seeding and covering work can be performed at the same time by using these new types of nets.

(3) For mainly protecting the sliding of earth and stones in the areas where seeding is difficult, nets made of big iron wire are used. In this case, introduction or invasion of vegetation can be expected as a result of weathered rock or stabilized slope as time elapses, and seeding should be performed by seeding work after weathering of rock and stabilization of slope.

(4) Both wire net and synthetic fiber net should be fixed at
    each end of the rope and made of material equal to that
    of the net and tensioned in both longitudinal and transverse
    direction of the slope.

(5) Some wire net is made for stones heavier than 1 ton, but
    the yield strength of synthetic fiber net is about 100kg
    at the most.

(6) The spacing between tensioned ropes is generally 4m maximum
    in the longitudinal direction and 5 to 10m in the transverse
    direction for wire net, and 5m maximum in the longitudinal
    direction and 5m in the transverse direction for the synthetic
    fiber net.

Use Conditions and Specification of Wire Nets

Size of falling rock	Head	Grade	Mesh	Strand dia.	Wire dia.	Guar. breaking force of rope	Anchor	
							Dia.	Length
Up to 500kg	20m	60°	50mm	3.2mm	12mm	7t	22mm	80–120cm
500–750kg	20m	60°	50mm	3.2mm	14mm	10t	22mm	80–120cm
750–1,500kg	20m	60°	50mm	4.0mm	16mm	13t	22mm	80–120cm

Use Conditions and Specification of Synthetic Fiber

Size of falling rock	Head	Grade	Mesh	Thread dia.	Rope		Anchor	
					Dia.	Guar. breaking force	Dia.	Length
Up to 60kg	Not applicable	63°	37.5mm	2.4mm	8mm	730kg	12mm	50cm
6–100kg approx.	15m	63°	30.0mm	2.4mm	12mm	1,560kg	19mm	50cm

(a) Mat covering

Materials and work of the mat covering should conform
to the following items:

1. Unless specifically prescribed in working drawings or
   specification, materials should conform to the following:

   a. The standard size of mat should be 1m × 2m.

   b. Standard diameter of straw rope should be 9mm.

   c. Peg should be made of bamboo or green trunk with high
      sprout ability, and have a standard length of 25cm.

2. The following points should be taken into account during
   work:

   a. The slope should be graded in advance to eliminate the
      unevenness, and any stones or stumps obstructive for
      the work must be removed.

   b. If seeding work is needed, it should be done in ad-
      vance.

   c. Laying of mats and fixing method should conform to
      the points of the straw covering work.

Standard Quantities of Materials Used for
Mat Covering (per 10m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Mats	Roughly woven, 1m × 2m	5.0		
Straw ropes	Rough rope: 0.9 to 1.2cm in diameter	1.5	kg	For securing mat.
Pegs	Made of bamboo or green trunk, 20 to 30cm long	40.0		For securing ropes.

(1) Mat covering is effective for protecting slope with light, soft soils.

(2) Since this work is capable to retain the moisture in soil as same as the straw covering, it is used in dry areas.

(e) Over-spread foundation work

1. Unless specifically prescribed in working drawings or specifications, materials for this work should conform to the following:

   a. Framing log should be 3.6m in length and 6cm minimum top end diameter as standard, and piling log should be 60cm in length and 6cm minimum top end diameter.

   b. Wire net for use where extra strength is needed should be of #14 iron wire with 50mm lozenge-shaped mesh.

   c. Standard bolt for fixing wire net should be made of steel with 30cm length and 9mm diameter.

2. The following points should be taken into account during the work:

   a. Work should be performed in the order of slope grading, wire net covering, frame assembling, tensioning of straw ropes, and soil covering. If seeding is needed, the seeding work should as a rule be performed after the covering work.

   b. The slope should be graded to eliminate unevenness, and any stones or stumps obstructive for the work must be removed.

   c. Wire net covering should be started from the upper portion to the lower, and net should be fully secured to the ground with bolts. When connecting the wire

nets, at least one mesh of net should be overlapped
with the lower net at the bottom and the upper net
at the top. Nets should be tied together with iron
wire having the wire quality as same as that of net.

d. Assembling of the frame should proceed from the lower
portion to the upper along the contour lines, and
logitudinal frame should be placed in close contact
with the ground surface.

e. Joint of logs should be firmly fastened with designated
iron wire.

f. Bolts should be fully driven and wire net should be
completely secured.

g. Straw ropes should run along the contour lines through
the meshes of nets and be placed at 20cm on centers
to secure the nets.

h. Soil covering should be performed until the meshes of
nets are concealed.

Standard Quantities of Materials Used for
Over-Spread Foundation Work (per 10m²)

Material	Shape & Size	Q'ty	Unit	Remarks
Logs	6cm top end dia., 3.6m length	2.5		For framing.
Piling logs	6cm top end dia., 60cm long	5.0		For framing.
Iron wire	Glavanized #10	0.25	kg	For framing.
Wire nets	#14 iron wire, 5cm lozenge-shaped mesh	10.0	m²	To be selected per site conditions.
	#23 iron wire, 3.2cm tortoise-shell shaped mesh.	10.0	m²	

Material	Shape & Size	Q'ty	Unit	Remarks
Bolts	0.9cm dia., 30cm long.	10.0		For fixing wire net.
Straw ropes	Rough rope, 0.8cm dia.	1.7	kg	50m long.
Earth	For soil covering.	0.05	m^3	0.5cm soil covering thickness.

(1) This work is mainly used in the Tertiary or volcanic sedimentary zone.

(2) Though this is called "Over-Spread Foundation Work", the content of the work is practically similar to covering work.

(3) Expected effect cannot be obtained unless the wire nets are closely contacted to the ground surface.

(4) Longitudinal frame must be assembled first.

(5) Regardless of seeding, soil covering is always required.

(6) In volcanic sedimentary zone, soil cement is sometimes used to provide the functions of wire nets and straw ropes.
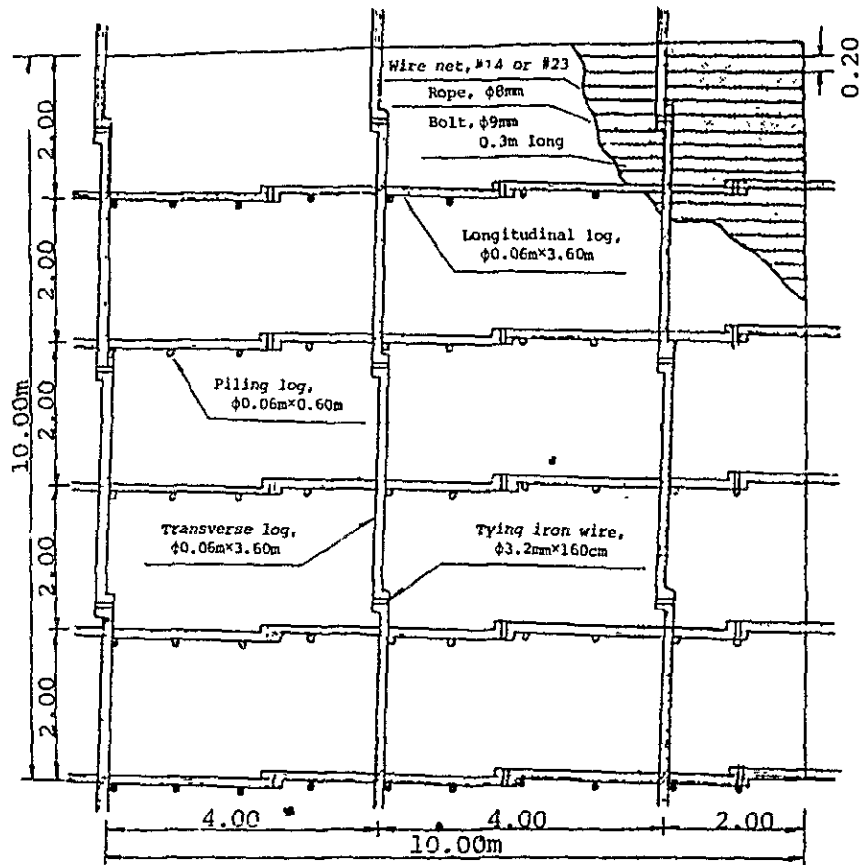
Over-Spread Foundation Work

(f) Covering work using secodnary products

The following items should be taken into account when performing the covering work using the secondary products:

a. The slope should be graded to eliminate excessive unevenness, and any stones or stumps obstructive to the work must be removed.

b. Work sequence, laying and method of fixing should generally conform to the points of the covering work.

(1) This work is performed in accordance with the method of straw or mat covering work or net covering work.

(2) Main secondary products used for this work are shown below.

HARISHIBATAI: Seeds and fertilizer are sandwiched between dissolvable papers and victoria lawn is bonded to the paper.

Grass Belt W: Seeds and fertilizer are glued to whole surfaces of mat, and net and paper are covered on the mat.

GASONLONG: Seeds and fertilizer are attached to straw mat and sandwiched with non-woven cloth.

GN Lawn: Seeds and fertilizer are bonded with water soluble polyvinyl alcohol to paddy straws woven by wire.

RONBEL Lawn: Seeds and fertilizer are glued to straw screen woven with wire and covered with water soluble paper.

SUNKET: Seeds and fertilizer are sandwiched with two pieces of non-woven cloth and polyethylene net is glued to the cloth.

RONTEX: Seeds and fertilizer are inserted to non-woven cloth and polyethylene pipe net is glued to the cloth.

HARISHIBA GREEN NET: Seeds are sprayed over non-woven cloth and water soluble film is covered on the cloth.

(3) Work method and precautions are almost the same as those for other ordinary covering work.

(4) Generally, these secondary products should be laid with their seed-attached side down, closely contacted to the ground surface and firmly secured. About 5cm from each edge of the product should be overlapped when laying for not causing any gap. If needed, about $0.02m^3$ of soil per $1m^2$ should be used for covering the joints.

(5) Planting work

  (a) Normal planting

The following items should be taken into account when performing the normal planting work:

a. Extra precautions should be taken when transporting and temporarily planting the nursery stock.

b. When transporting the nursery stock, special measures such as sacks should be used for preventing the roots from being exposed.

c. Trunk and roots should be cut during planting as directed by supervisor.

d. Planting when strong sunshine or strong wind occurs should be avoided if possible. If planting under such conditions is inevitable, drying of nursery stock, holes for planting and covering soil must be prevented.

e. Hole for planting should have 25 to 35cm in diameter and depth. Obstructive objects such as gravel, stones, or stumps should be removed and drying of excavated soil must be prevented.

f. When adding compost, it should be placed to the bottom of hole and 5 to 10cm thick soil covering should be made.

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g. When applying chemical fertilizer, some amount of earth should be backfilled first, fertilizer should be placed outside of roots swelling (or branches) in the spot, semi-circular or ring form by not contacting the fertilizer to the nursery stock, remaining earth should be backfilled until the depth to fertilizer becomes 3 to 10cm, and the backfilled earth should be tamped.

h. When planting the tree, roots should be extended first as natural as possible, then the tree should be placed to the center of the hole and the earth should be backfilled. Fine earth should be used for backfilling by hands while shaking the tree. When the hole is fully backfilled, earth should be tamped while slightly lifting the tree upward.

i. Planted tree should not be located too high or too low. And the top of the tamped earth should be slightly higher than adjacent ground level when planting is completed.

Standard Quantities of Materials Used for
Normal Planting (per 1 tree)

Material	Shape & Size	Q'ty	Unit	Remarks
Nursery stock	Product conforming to standards	1		
Fertilizer	Chemical fertilizer		g	Amount to be determined based on species of tree & type of fertilizer.
	Compost (fully ripen)	300	g	Other equal type may be also used.
Soil dressing	Good quality humus soil	3-6	kg	To be used as required.
Conditioner	Various kinds		g	To be used as required.
Others				To be used as required.

(1) In case of broad-leaved nursery stock, pruning to 10 to 20cm length should be made if the tree is too long before planting.

(2) Hole for the tree should be suited to the nursery stock in size. Larger hole is more advantageous in view of growing in later years. Digging many holes at a time is not desirable if drying of soil or storm water filled in the holes cannot be prevented.

(3) Extra precautions will be necessary for not directly contacting the chemical fertilizer to roots since the tree may die due to such contact. Fertilizer may be placed to the bottom of the hole. However, if there is any danger of such contact, most of the earth should be backfilled first, then fertilizer should be applied to perimeter of the hole to prevent its contacting the roots, and earth should be backfilled again.

(4) Planting should be made slightly deeper if the soil is dry and slightly shallower if the soil is wet.

(b) Pot planting

Materials and work of the pot planting should conform to the following items:

1. Kinds and quantities of nursery stocks should conform to the points for the Planting Work (normal planting).

2. Kinds, standard dimensions and standard quantities of materials should conform to the working drawings or specifications.

3. The following points should be taken into account during the work of pot planting:

> a. Precautions in handling nursery stocks and for weather
> conditions should conform to the points stated for the
> Normal Planting.
>
> b. Planting depth should be such that the pot can be
> concealed by the tree.
>
> c. The earth should be well tamped after planting not to
> create any air gaps between pot and earth.

(1) Advantages of pot planting:

a. Good survival is expected.

b. Nursery stock with completed root ball can be planted,
resulting in extremely quick growth in early stage.

c. Nursery period can be shortened.

d. Conditions of planting area and planting seasons can be
widened.

e. Planting process can be simplified.

f. Temporary planting is not required and drying of roots can
be reduced.

Disadvantages of pot planting:

a. More cost is needed because pot is involved.

b. Nursery cost tends to increase.

(2) The following precautions will be needed when planting the
pot nursery stocks:

a. It should be first noted that even the pot nursery stock
may die if the forest is too dry since its moisture is
absorbed by the surrounding soil. If this is the problem,

planting should be performed when the forest land gets more wet. Pots should be stored in cartons placed in the shade.

b. If cohesive soil is involved, it is important to plant nursery stocks by providing proper draining measures to avoid the presence of excessive moisture in the pots.

c. While the naked nursery stock will have new active roots coming out after planting, pot nursery stock will have original roots grown further after planting. Thus, deeply planting a pot nursery with roots coming out from its bottom may cause poor growing of the tree.

d. When planting the pot nursery, it should be planted to a depth with which the pot will be fully concealed in the earth, and the earth should be well tamped so as to not create any air gaps between pot and soil.

e. Temporary planting of pot nursery stocks at the hillside is not required. Drying of pot nursery stocks can be prevented if they are placed, in the shade except the middle of summer season.
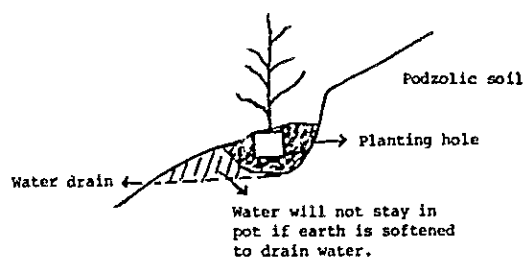
Pot Planting Work

(c) Planting of cuttings

(1) Different from seeding and planting, only a limited number
of species of trees can be used for cuttings.

(2) Generally, trees are rarely planted by means of cuttings
only, and fertilizer is also rarely applied for cuttings.
If only the cuttings are used for planting, precautions
required for ordinary planting must be taken.

(3) Advantages and disadvantages of cuttings are:

a. Properties of mother trees can be directly transferred.

b. This method is suited for propagating a variety of poor
fruiting independently from poor or rich fruiting in a
particular season.

c. Resistance to coldness or harmful insects and fungi is
higher than that of ordinarily planted trees.

d. Since fruiting after planting is less and the forest land
is closed, cuttings will grow well even the land has poor
conditions.

e. Generally, producing a large number of cuttings is difficult.

f. Growing of cuttings is poor compared to planted trees
unless sufficient nourishment is absorbed.

(4) The following work methods are available for cuttings:

a. Groove method: Groove is digged first by a hoe, cutting
is inserted to the groove, earth is
backfilled, and then ground is tamped.

b. Mud method: Bed soil is mixed with water and then
cuttings are inserted to the mud.

c. Semi-mud method: Water is added to the soil of groove
                      method, cuttings are inserted to the mud,
                      and mud soil is tamped.

d. Guide bar method: (a) A hole is made by inserting a guide
                           bar and cutting is inserted to the
                           hole.

                      (b) Water is filled in a hole made by
                           the guide bar and cutting is inserted.

e. Red clay method: Muddy clay is poured into a hole, and
                      a cutting is inserted to this hole.

Actual method to be used at the site should be determined
by considering soil properties, sprout ability of cutting, and
size of cutting. However, in hillside work, selecting the
easiest method is inevitable even though the conditions are
poor in many cases.

(5) Special specifications should be prepared when carrying out
    the work of cuttings.

(d) Underground green stems and stumps

Materials and work of underground green stems and
stumps should conform to the following items:

1. Kind and quantity of fertilizer should be as same as
   those prescribed for normal planting.

2. Kind, standard size and standard quantity of materials,
   and working method should conform to working drawings
   or specifications.

(1) Species of trees that can be planted by this method are almost the same as those for cuttings but this method has rarely been used in the past.

(2) Advantages and disadvantages of this method are almost the same as those described for the cuttings.

MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS

No. 1 Prevention of Depletion			Detail	
Explanation		Planting Work for Depletion Developing Land to be caused by Excessive Pasturage Execution Area out of 3,600m²: 2,000m², Replanting Area: 1,600m².		

Item	Amount	Unit	Structure	Digest
HILLSIDE WICKER	150.0	m	Log Intervals (Main): 5m, Height: 0.5m, Log Intervals: 0.75m, Terrace Width: 1.0m	
Piling Log	200.0	stake	Eucalyptus Tree (Antiseptic Treatment), Length: 1.5m, Top End ϕ: more than 8cm	
Fascine	75.0	bundle	1 Bundle: 22 stakes, Length: more than 2.0m, Butt End ϕ: 3~4cm, Height: 0.5m	
Weeds Stubble	15.0	bundle	Stem Length: 30cm, 1m Binding by Straw Rope	
Wire	4.5	kg	Zincic Coating #12 ~ #18	For Upper End Connection Use
Rice Straw	150.0	kg	Rice Straw or Weeds Compost	
Terracing	150.0	m	Horizontal Terrace Width: 1m, Digging Horizontal Ditch (0.5×0.25m) at the Bottom	
Seedling	100.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%	
Fertilizer	15.0	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13}, 100g per 1m	
SOD SIMPLE TERRACING	300.0	m	Height Intervals: 1.7m, Terrace Width: 0.75m	
Sod	900.0	sheet	Length: 33cm, Width: 20cm, Thickness: 6cm	
Peg	1,800.0	stake	Green Branch, Length: 20cm, 2 Stakes Using per 1 Sheet	
Rice Straw	300.0	kg	Rice Straw or Weeds Compost	
Fertilizer	30.0	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13}, 100g per 1m	
Terrace Cutting	300.0	m	Horizontal Terrace (Width: 0.75m), Digging Horizontal Ditch (0.5×0.25m) at the Bottom	
Seedling	200.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%	
PLANTING	400	stake	Replanting, 1 Seedling per 4m²	
Seedling	400	PC.	Planting Size: 0.5×0.5×0.5m, Leguminous Fertilizer Seedling: 80%, Araucaria: 20%	
Fertilizer	40	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13}, 100g per 1 Seedling	
Rice Straw	120	kg	Rice Straw or Weeds Compost, 0.3kg per 1 Seedling	

No. 2 Rehabilitation of Land Slide A-Type		Detail		

Explanation   Land Slide of Catchment Area to be Caused by Piping,
Execution Area: 1,600m²

Item	Amount	Unit	Structure	Digest
WIRE BASKET WALL	34.0	m	Upper Width: 11.0m, Down Width: 3.0m, Height: 2.5m, Outlet Length: 1.0m, Depth: 0.5m, Slope (1:0.4)	
Wire Basket	12.0	PC.	Mesh: 0.13m, Zincic Coating Wire: #10, Size: 2.0m ∿ 4.0m×0.5m×1.2m	
Fixed Stake	8.0	stake	Top End ϕ: 0.16m, Length: 3.5m, Eucalypus Tree (Antiseptic Treatment)	
Zincic Coating Wire	20.4	kg	#10 1.2kg Use per 1m²	
Filling Stone and Gravel	22.1	m³	ϕ: 0.15 ∿ 0.3m, 0.65m³ Use per Wire Basket 1m Long	
Bed Preparation	20.0	m³		
WOODEN FENCE	85.0	m	Fence Height: 0.5m, Log Intervals: 1.0m, Terrace Width: 1.0m	
Piling Log	91.0	stake	Eucalypus Tree (Antiseptic Treatment), Length: 1.5m, Top End ϕ: more than 8cm	
Fence Log	188.0	stake	Eucalypus Tree (Antiseptic Treatment), Top End ϕ: 5cm, Length: 3.6m	
Weeds Stubble	8.5	bundle	Stem Length: 30cm, 1m Binding by Straw Rope	
Wire	2.6	kg	#12 ∿ #18 (Annealed Wire)	
Rice Straw	85.0	kg	Rice Straw or Weeds Compost	
Terracing	85.0	m	Horizontal Terrace Width: 1.0m, Digging Horizontal Ditch (0.5×0.25m) at the Bottom	
Seedling	60.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%	
Fertilizer	8.5	kg	High Compound Fertilizer: $N_{14}-P_{17}-K_{13}$, 100g Use per 1.0m	
SODDING CHANNEL	54.0	sheet	Chord Length: 1.0m (Arc Length: 1.24m), Depth: 0.3m, 18m×3 spots	
Sod	1,350.0	sheet	Length: 33cm, Thickness: 3cm, Width: 20cm, (Sodding: 19 Sheets, End Sod: 6 Sheets per 1m)	
Peg	1,350.0	stake	Green Branch, Length: 0.2m, 1 Stake per 1 Sheet	
Bed Preparation	16.0	m³	54m	

Item	Amount	Unit	Structure	Digest
FOUR PIECES TERRACING WITH SOD	96.0	m	Terracing Intervals: 1.5 ∿ 1.7m (Main Height), Terracing Width: 0.75m, Height: 0.52m	
Turf	1,152.0	sheet	Length: 33cm, Width: 20cm, Thickness: 6cm, 12 Sheets Use per 1.0m	
Peg	2,304.0	stake	Green Branch, Length: 20cm, 2 Stakes Use per 1 Sheet	
Weeds Stubble	10.0	bundle	Stem Length: 30cm, 1.0m binding by Straw Rope	
Rice Straw	96.0	kg	Rice Straw or Weeds Compost	
Seedling	64.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%, 1 Seedling Use per 1.5m	
Terracing	96.0	m	Horizontal Terrace Width: 0.75m	
Fertilizer	9.6	kg	High Compound Fertilizer: $N_{14}-P_{17}-K_{13}$, 100g Use per 1.0m	
SOD SIMPLE TERRACING	220.0	m	Height Intervals: 1.7m, Terrace Width: 0.75m	
Sod	660.0	sheet	Length: 33cm, Width: 20cm, Thickness: 6cm	
Peg	1,320.0	stake	Green Branch, Length: 20cm, 2 Stakes Use per 1 Sheet	
Rice Straw	220.0	kg	Rice Straw or Weeds Compost	
Fertilizer	22.0	kg	High Compound Fertilizer: $N_{14}-P_{17}-K_{13}$, 100g per 1.0m	
Terracing	220.0	m	Horizontal Terrace Width: 0.75m, Digging Horizontal Ditch (0.5×0.25m) at the Bottom	
Seedling	150.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%, 1 Seedling per 1.5m	
Grading	150.0	m^3	Leveling Top of the Slided Land	

No. 3 Rehabilitation of Land Slide B-Type			Detail	

Explanation Land Slide (Gully Erosion) to be caused by Excessive Pasturage and Piping. For Acid Latosol-Type and Visid Soil Application. Execution Area: 2,600m^2

Item	Amount	Unit	Structure	Digest
SANDS BAG SIMPLE TERRACING	850.0	m	Terrace Intervals: 1.5m, Terrace Width: 75cm, Terrace Height: 45cm (3 Steps)	
Sands Bag	6,375.0	sheet	60cm×48cm, Packing 30kg earth with seeds, 7.5 Sheets Use Per 1.0m	
Terracing	850.0	m	Horizontal Terrace Width: 0.75m, Digging Horizontal Ditch (0.5×0.25m) at the Bottom	
Rice Straw	850.0	kg	Rice Straw or Weeds Compost, 1.0kg Use per 1.0m	
Fertilizer	85.0	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13}, 100g Use per 1.0m	
Seedling	570.0	PC.	Leguminous Soil Improving Tree: 80%, Araucaria: 20%	
MAT COVERING	1,450.0	m^2	Covering Slope between SANDS BAG SIMPLE TERRACING and Weeds Seeding	
Mat	850.0	sheet	1.0m×1.8m, Rough Weaving	
Fixed Log	750.0	stake	For Mat Putting Use, Eucalypus Tree, Small Log, Top End φ: 3cm, Length: 3.6m	
Fixed Peg	2,100.0	stake	Eucalypus, Top End φ: 5cm, Length: 30cm	
Wire	6.5	kg	For connecting with Fixed Pegs Use	
Seeds	3.0	kg	Grasses and Leguminous Weeds, Expectant Pieces of Sprouting: 4,000 pieces/1.0m^2	
Fertilizer	145.0	kg	High Compound Ferilizer: N_{14}-P_{17}-K_{13} 100g Use per 1.0m^2	
Fertile Soil	14.5	m^3	For Seeds Mixing Use, Thickness: 1.0cm	

No. 4 Rehabilitation of Land Slide C-Type			Detail	
Explanation			Sheet Erosion of Bare Land to be caused by Cutting Surface (Weathered Visid Soil of Silt Rock). Execution Area: 3,400m^2	

Item	Amount	Unit	Structure	Digest
SEEDING SIMPLE TERRACING	130.0	m	Terrace Intervals: 10.0m, Terrace Width: 1.0m	
Terracing	130.0	m	Terracing 1.0m Wide at the Slope, Digging Ditch (0.5m Wide, 0.25 Deep) at the Bottom	
Rice Straw	130.0	kg	Rice Straw or Weeds Compost	
Seeds			Leguminous Weeds and Araucaria	
Fertile Soil	0.26	m^3	Humus Soil, 0.002m^3 Use per 1.0m	
Straw	13.0	kg	For Scattering after Seeding, 100g Use per 1.0m	
SEEDS SPRAY	4,000.0	m^2	Gun Spray	Slope Area
Seeds			Grasses and Leguminous	
Fertilizer	400.0	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13}, 100g Use per 1.0m^2	
Soil Dressing	40.0	m^3	Good Quality Visid Soil, 0.01m^3 Use per 1.0m^2	
Curing Agent	8,000.0	ℓ	20 times Water Solution of Polyvinyl Acetate	
Water	12,000.0	ℓ	For Spraying	
VEGETATION DIGGING	1,350.0	m^2	Digging 18 Holes (φ: 8cm, Depth: 15cm) per 1.0m^2 at the Slope, Fertilizing, Soil Dressing and Pasting Paper with Seeds	Slope Area
Hole for Vegetation	24,300.0	pc.		
Paper with Seeds	24,300.0	sheet	5cm×5.5cm (with Seeds)	
Fertilizer	74.0	kg	High Compound Fertilizer: N_{14}-P_{17}-K_{13} For Soil Dressing Use, 55g per 1.0m^2	
Fertilizer	24,300.0	pc.	Solid Fertilizer (N_{16}-P_{14}-K_{17}), For Filling Use, 1 pc. per Hole	
Soil Dressing	20.0	m^3	Good Quality Soil, 830cm^3 Use per 1 Hole	
Curing Agent	2,700.0	ℓ	20 times Water Solution of polyvinyl Acetate, 2ℓ Use per 1.0m^2	
Water	4,050.0	ℓ	For Spraying	

No. 5 Rehabilitation of Land Slide D-Type			Detail	

Explanation Land Slip-Type and Infiltration Water-Type
Land Slide (Contact Surface between Diabase and Crystalline Schist)
Execution Area: 1,900m²

Item	Amount	Unit	Structure	Digest
WIRE BASKET WALL (A)	172.0	m	Length: 20m, Height: 2.5m, 2 Lines and 5 Steps, Crown Outlet: 1.0m×0.5m	
Wire Basket	43.0	stake	Mesh: 0.13m, Zincic Coating Wire: #10, Size: 2.0m∿4.0m×0.5m×1.2m	
Fixed Stake	18.0	stake	Top End φ: 0.16m, Length: 3.5m, Eucalypus Tree (Antiseptic Treatment)	
Zincic Coating Wire	103.0	kg	#10 1.2kg Use per 1.0m²	
Filling Stone and Gravel	111.8	m³	φ: 0.15∿0.3m, 0.65m³ Use per Wire Basket 1.0m Long	
Bed Preparation	80.0	m³		
WIRE BASKET WALL (B)	93.0	m	Length: 25.0m, Height: 2.0m, 4 Steps, Crown Outlet: 1.0m×0.5m	
Wire Basket	24.0	PC.	Mesh: 0.13m, Zincic Coating Wire: #10 Size. 2.0m∿4.0m×0.5m×1.2m	
Fixed Stake	16.0	stake	Same as (A)	
Zincic Coating	55.8	kg	Same as (A)	
Filling Stone and Gravel	60.5	m³	Same as (A)	
Bed Preparation	50.0	m³		
FLUMED PIPE CHANNEL	55.0	m	Flumed Pipe (Width: 70cm, Depth: 50cm), Gravel Paving: 30cm	
Flumed Pipe	110.0	PC.	Reinforcing Concrete Flumed Pipe, Length: 0.5m	
Backing Gravel	15.0	m³	φ: 0.05m∿0.15m, Paving Thickness: 30cm, Paving Width: 90cm	
Joint Surface Mortar	1.9	m³	0.034m³ Use per 1.0m	
Bed Preparation	55.0	m³	1.0m³ per 1.0m	
WIRE CYLINDER UNDERDRAIN	52.0	m	Depth: 1.5m, Wire Cylinder φ: 0.6m, Gravel and Boulder Filling, Vinyl Sheet and Sand Filter	
Wire Cylinder	13.0	PC.	Zincic Coating Wire, Mesh: 0.13m, Length: 4.0m, φ. 0.6m	
Boulder	13.3	m³	φ: 0.15m∿0.25m, 1.02m³ Use per 1 Cylinder	

Item	Amount	Unit	Structure	Digest
Fixed Stakes	26.0	stake	Eucalypus Tree, Top End ϕ: 6cm, Length: 1.5m, 2 Stakes Use per 1 Cylinder	
Vinyl Sheet	31.2	m^2	Thickness: 0.5mm, 0.6m^2 Use per 1.0m	
Sand Filter	104.0	m^2	Coconut Fiber, 2.0m^2 Use per 1.0m	
Gravel	2.6	m^3	ϕ: 0.05m~0.15m, For Gap Filling Use, 0.05m^3 Use per 1.0m	
Excavation	97.5	m^3	Depth: 1.5m, Bottom Width: 0.5m, Upper Width: 2.0m, 1.875m^3 Use per 1.0m	
Refilling	80.0	m^3		
Grading	600.0	m^3	Leveling Top of the Slided Land	
SOD SIMPLE TERRACING	650.0	m	See "SOD SIMPLE TERRACING" of No. 1 Prevention of Depletion	

NO1. MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS—PLEVENTION OF DEPLETION
(PLANTING WORK FOR DEPLETION DEVELOPING LAND TO BE CAUSED BY EXCESSIVE PASTURAGE)

DETAIL DRAWING   Scale 1/73

SOD SIMPLE TERRACING

PLANTING TREE

SOD

WICKER−WORK

RICE STRAWS

PILING LOG

WEEDS STUBBLE

PLANTING TREE

ARRANGEMENT DRAWING   Scale 1/726

PROFILE   Scale 1/726

SOD SIMPLE TERRACING

WICKER−WORK

LESS THAN 2°

20~30°

3600m²
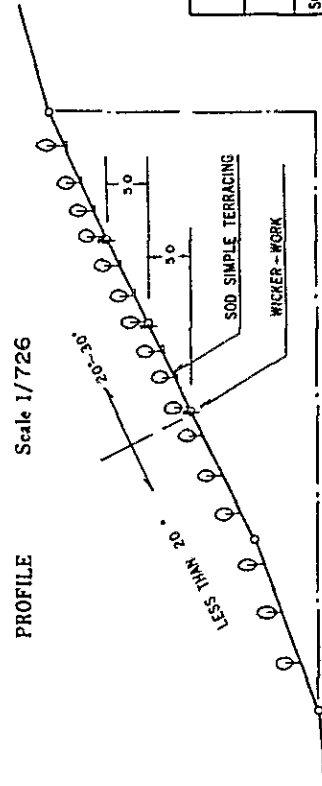
AREA

LEGEND		
ITEMS	SYMBOL	
WICKER−WORK		
SOD SIMPLE TERRACING		
PLANTING TREE		

E − 1

NO2. MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS—REHABILITATION OF LAND SLIDE A—TYPE
(LAND SLIDE OF CATCHMENT AREA TO BE CAUSED BY PIPING (REDDISH YELLOW PODSOL—TYPE SOIL))

ARRANGEMENT DRAWING   Scale 1/726
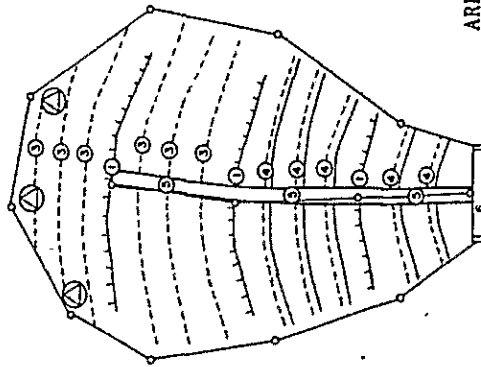
PROFILE   Scale 1/726
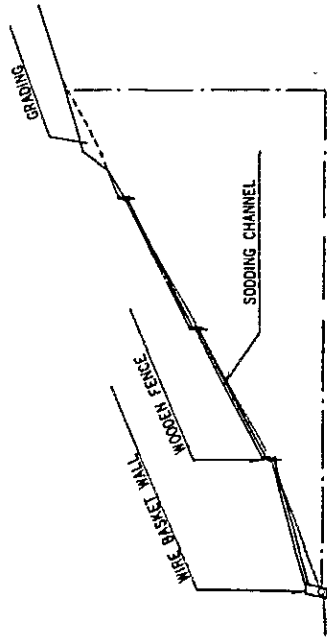
DETAIL DRAWING   Scale 1/73
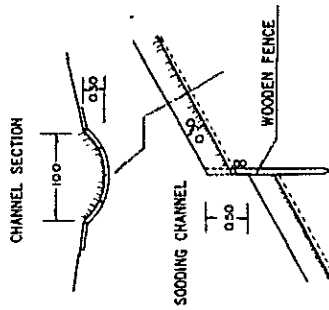
STRUCTURAL DRAWING OF WIRE BASKET WALL   Scale 1/145

AREA   1600 m²
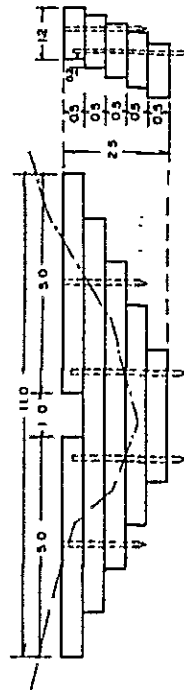
LEGEND	
ITEMS	SYMBOL
WIRE BASKET WALL	
WOODEN FENCE	
SODDING CHANNEL	
GRADING	
FOUR PIECES TERRACING WITH SOD	
SOD SIMPLE TERRACING	

E-2
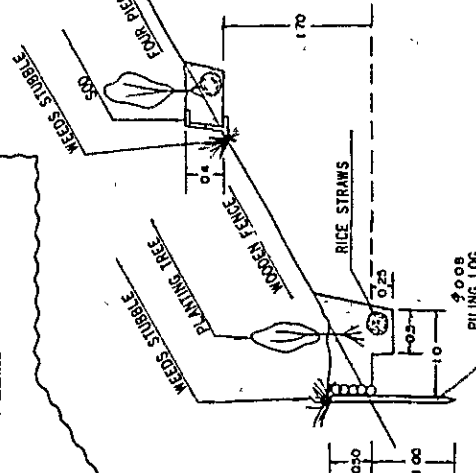
NO3. MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS—REHABILITATION OF LAND SLIDE B—TYPE
〔LAND SLIDE (GULLY EROSION) TO BE CAUSED BY EXCESSIVE PASTURAGE AND PIPING (ACID LATOSOL—TYPE AND VISIDSOIL)〕

DETAIL DRAWING   Scale 1/73

SANDS BAG SIMPLE TERRACING

MAT COVERING

120~150

RICE STRAWS

SAND BAGS

WEEDS STUBBLE

0.25

0.40

0.50~0.50

0.45

ARRANGEMENT DRAWING   Scale 1/726
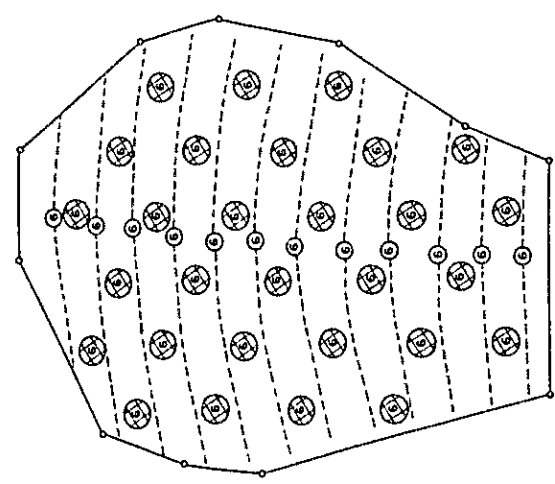
LEGEND		
ITEMS		SYMBOL
MAT COVERING		⊛
SANDS BAG SIMPLE TERRACING		--- ⊚ ---

E-3

NO4. MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS–REHABILITATION OF LAND SLIDE   C –TYPE
(SHEET EROSION OF BARE LAND TO BE CAUSED BY CUTTING SURFACE (WEATHERED VISID SOIL OF SILTROCK))

ARRANGEMENT DRAWING   Scale 1/726

AREA   3400m²

PROFILE   Scale 1/726

VEGETATION DIGGING

TERRACE WIDTH

SEEDS SPRAY
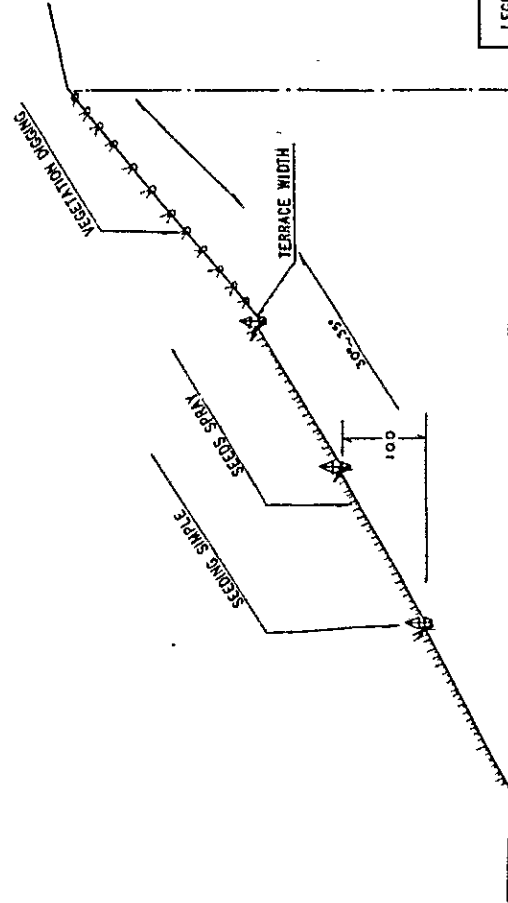
SEEDING SIMPLE

LEGEND		
ITEMS	SYMBOL	
SEEDS SPRAY		
VEGETATION DIGGING		
SEEDING SIMPLE TERRACING		

E – 4

NO5. MODEL DESIGN FOR SIMPLE EROSION CONTROL WORKS--REHABILITATION OF LAND SLIDE D-TYPE
(LAND SLIP-TYPE AND INFILTRATION WATER-TYPE LAND SLIDE (CONTACT SUFACE BETWEEN DIABASE AND CRYSTALLINE SCHIST))
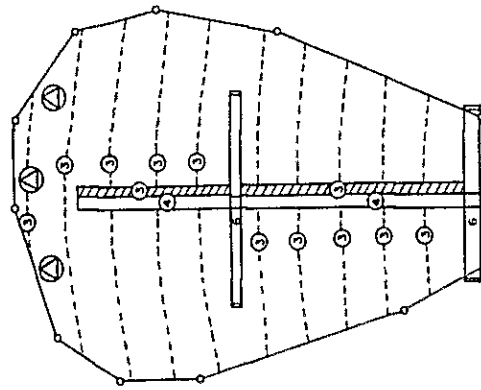
PROFILE   Scale 1/726

FLUMED PIPE
  WIDTH   DEPTH
  70ᴄᴍ   50ᴄᴍ

WIRE CYLINDER
         MESH
  φ60ᴄᴍ   13ᴄᴍ

WIRE BASKET
  WIDTH   HEIGHT
  120ᴄᴍ   50ᴄᴍ

SOD SIMPLE TERRACING

SEE PLEVENTION OF DEPLETION

GRADING

NO.2 BASKET WALL
WIRE BASKET WALL

FLUMED PIPE CHANNEL

WIRE CYLINDER UNDERDRAIN

WIRE CYLINDER UNDERDRAIN

NO.1 BASKET WALL
WIRE BASKET WALL

FLUMED PIPE CHANNEL

AREA   1900m²

ARRANGEMENT DRAWING   Scale 1/726
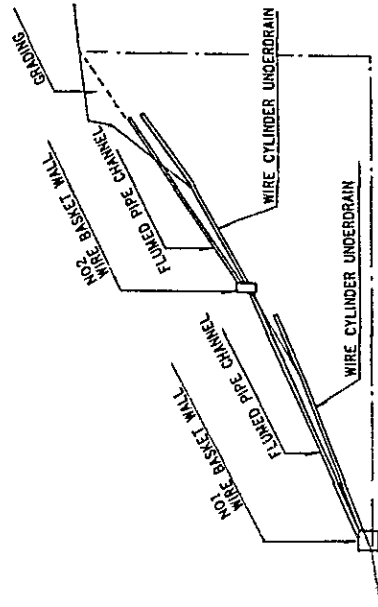
STRUCTURAL DRAWING OF WIRE BASKET WALL   Scale 1/290

NO 2

NO I
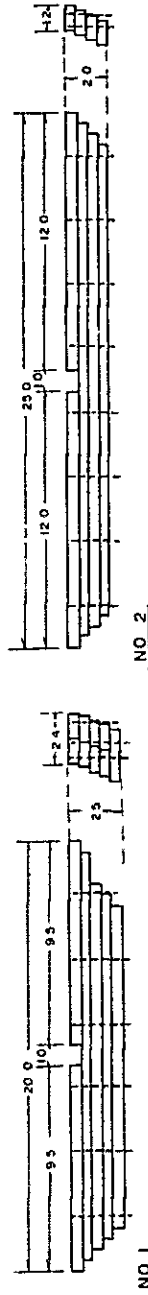
LEGEND	
ITEMS	SYMBOL
GRADING	
SOD SIMPLE TERRACING	
WIRE CYLINDER UNDERDYAIN	
FLUMED PIPE CHANNEL	
WIRE BASKET WALL	

E-5

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DETAIL DESIGN

Work	Amount	Unit	Price (Yen)	Sum (Yen)	No. Detail or U.P.T.		Digest
D Area Gauging Facilities							
Dam	116.1	m^3		3,370,865	1		
Upper End Wall of Channel	64.0	"		1,878,221	2		
Down End Wall of Channel	44.0	"		1,294,651	3		
Sedimentation Basin	11.0	m		1,967,354	4		
Channel	19.0	m		3,146,556	5		
Misc.Work	1	set		1,005,068	6		
Sub-Total				12,662,715			
D Area Overland Flow Facilities							
Compartment for Experimental Place	(1 600	spot) m^2		581,643	7		
Socket for Water and Soil	(1 20	spot) m		500,374	8		
Misc.Work	1	set		51,706	9		
Sub-Total				1,133,723			
D Area Water Balance Facilities							
Compartment for Experimental Place	(1 100	spot) m^2		3,434,692	10		
Inside Work	(1 100	spot) m^2	3,583	358,300		19	
Misc.Work	1	set		19,240	11		
Sub-Total				3,812,232			
Total				17,608,670			

The table title: TABLE OF WORKING COST DETAIL

Work	Amount	Unit	Price (Yen)	Sum (Yen)	No. Detail or U.P.T.	Digest
Temporary Work				1,192,680	12	
Sundry Expenses				1,198,650	13	
Total				2,391,330		
Grand Total				20,000,000		
A Area Gauging Facilities						
Gauging Dam	151.0	m^3		4,398,365	14	
Soil Saving Dam	85.6	"		2,411,311	15	
Misc. Work	1	set		346,207	16	
Sub-Total				7,155,883		
B Area Gauging Facilities						
Dam	83.6	m^3		2,674,430	17	
Down End Wall of Channel	77.1	"		2,267,951	18	
Channel	6.0	m		1,162,289	19	
Misc. Work	1	set		226,785	20	
Sub-Total				6,331,455		
C Area Gauging Facilities						
Dam	76.6	m^3		2,269,738	21	
Upper End Wall of Channel	40.8	"		1,209,926	22	
Down End Wall of Channel	50.0	"		1,458,117	23	
Sedimentation Basin	4.0	m		894.174	24	
Channel	19.0	"		2,868,086	25	
Misc. Work	1	set		547,499	26	
Sub-Total				9,247,540		
D Area Overland Flow Facilities						
Compartment for Experimental Place	2	spot	581,643	1,163,286	7	

Work	Amount	Unit	Price (Yen)	Sum (Yen)	No. Detail or U.P.T.		Digest
Socket for Water and Soil	2	spot	500,374	1,000,748	8		
Misc.Work	2	set	51,706	103,412	9		
Sub-Total				2,267,446			
D Area Water Balance Facilities							
Compartment for Experimental Place	2	spot	3,434,692	6,869,384	10		
Inside Work	(2 200	spot) m²	3,583	716,600		19	
Misc.Work	2	set	19,240	38,480	11		
Sub-Total				7,624,464			
Total				32,626,788			
Temporary Work				2,723,040	27		
Sundry Expenses				1,650,172	28		
Total				4,373,212			
Grand Total				37,000,000			
Grand Grand Total				57,000,000			

1. Concrete Dam Detail D Area

Explanation	Structure: Gravity-Type Plain Concrete Length: 30.0m, Crown width: 1.0m, Basic width: 1.9m Height: (4.2) 3.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	116.1	m^3	per $10.0m^3$ 185,607	2,154,897	1	
Frame (A)	185.3	m^2	per $10.0m^2$ 47,918	887,921	2	
Earth Excavation (A)	260	m^3	per $10.0m^3$ 2,842	73,892	4	
Water Stop	3	m	1,240	3,720		Vinyl chloride 220 × 6mm
Cement Milk Grouting	10.3	m^3	20,551	211,675	8	
Grouting Pipe	68	m	570	38,760		Field price 38mm
Total				3,370,865		

2. Upper End Wall of Channel Detail D Area

Explanation	Structure: Plain Concrete Length of Wall: 21.0m, Thickness of Wall: 1.0m, Height of Wall: (4.0) 2.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	64.0	m^3	per $10.0m^3$ 185,607	1,187,885	1	
Frame (A)	136.0	m^2	per $10.0m^2$ 47,918	651,685	2	
Earth Excavation (A)	136	m^3	per $10.0m^3$ 2,842	38,651	4	
Total				1,878,221		

3. Down End Wall of Channel   Detail   D Area

| Explanation | Structure: Plain Concrete, Length of Wall: 15.0m Thickness: 1.0m, Height: (4.0)2.0m | | | | | |

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	44.0	m^3	per 10.0m^3 185,607	816,671	1	
Frame (A)	93.7	m^2	per 10.0m^2 47,918	448,992	2	
Earth Excavation (A)	102	m^3	per 10.0m^3 2,842	28,988	4	
Total				1,294,651		

4. Sedimentation Basin   Detail   D Area

| Explanation | Bottom and Side Wall: Plain Concrete Length: 11.0m, Width: 12.0m, Depth: 2.7m | | | | | |

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	55.9	m^3	per 10.0m^3 185,607	1,037,543	1	
Frame (A)	138.4	m^2	per 10.0m^2 47.918	663,185	2	
Earth Excavation (A)	290	m^3	per 10.0m^3 2,842	82,418	4	
Gravel Foundation	73	m^3	per 10.0m^3 20,549	150,008	6	
Banking	90	m^3	per 10.0m^3 3,800	34,200	7	
Total				1,967,354		

5. Channel			Detail			D Area

Explanation	Bottom and Side Wall: Plain Concrete Side Wall with Reinforcing Bar Length: 19.0m, Upper width: 5.0m, Down Width: 1.0m, Depth: 2.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	91.8	m^3	per $10.0m^3$ 185,607	1,703,872	1	Channel Part $85.5m^3$ Stage Room $6.3m^3$
Frame (A)	142.0	m^2	per $10.0m^2$ 47,918	680,436	2	Channel Part $107.2m^2$ Stage Room $34.8m^2$
Frame (B)	114.0	m^2	per $10.0m^2$ 11,844	135,022	3	Opposite Side of Channel
Earth Excavation (A)	154	m^3	per $10.0m^3$ 2,842	43,767	4	
Gravel Foundation	185	m^3	per $10.0m^3$ 20,549	380,157	6	Channel Part $177m^3$ Stage Room $8m^3$
Banking	155	m^3	per $10.0m^3$ 3,800	58,900	7	
Reinforcing Bar	0.87	t		141,162	9	
Headrace Pipe	3.0	m	1,080	3,240		Vinyl Chloride $\phi 10cm$
Total				3,146,556		

6. Misc. Work | Detail | D Area

Explanation

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Stream Bed Excavation	35	m	1,245	43,575	11	
Temporary Coffering	35	m	2,643	92,505	12	Upper Portion 25m Down Portion 10m
Diversion Water Way	60	m	5,370	322,200	13	
Pumping Drainage	1	set		247,040	14	
Erection by Staging	1	set		126,630	15	
Wooden Fence	30	m	per 10.0m 57,706	173,118		
Total				1,005,068		

7. Compartment for Experimental Place | Detail | D Area

Explanation   A Slope
Mean Grade: 32.5%, Mean Slope Length: 31.6m,
Horizontal Distance for Compartment: 20×30m, Area: 600m^2

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Wall for Compartment	83.5	m	per 10.0m 63,719	532,054	17	
Frame (B)	0.6	m^2	per 10.0m^2 11,844	711	3	
Earth Excavation (B)	35	m^3	per 10.0m^3 13,965	48,878	5	
Total				581,643		

8. Socket for Water and Soil — Detail — D Area

Explanation	Structure: Plain Concrete Length: 20m, Upper Width: 1.12m, Down Width: 0.8m Depth: 0.8m					

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	13.2	m^3	per 10.0m^3 185,607	245,001	1	
Frame (A)	33.3	m^2	per 10.0m^2 47,918	159,567	2	
Frame (B)	34.7	m^2	per 10.0m^2 11,844	41,099	3	
Earth Excavation (B)	25	m^3	per 10.0m^3 13,965	34,913	5	
Gravel Foundation	9	m^3	per 10.0m^3 20,549	18,494	6	
Contraction Joint	1.0	m^2	1,300	1,300		Elastite Thickness 10mm
Total				500,374		

9. Misc. Work — Detail — D Area

Explanation						

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Headrace Pipe	2.0	m	4,800	9,600		Vinyl Chloride ϕ25cm
Stage Observation Box	1	spot	16,000	16,000		Steel Box 106kg
Drain Channel	60	m	per 10m 4,351	26,106	18	
Total				51,706		

10. Compartment for Experimental Place Detail D Area

Explanation Structure: Plain Concrete
A Compartment: 10×10m, Area: 100m^2

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	101.1	m^3	per 10.0m^3 185,607	1,876,487	1	
Frame (A)	198.2	m^2	per 10.0m^2 47,918	949,735	2	
Earth Excavation (B)	199	m^3	per 10.0m^3 13,965	277,904	5	
Gravel Foundation	41	m^3	per 10.0m^3 20,549	84,251	6	
Banking	127	m^3	per 10.0m^3 3,800	48,260	7	
Water Proof by Asphalt	137	m^2	per 10.0m^2 13,642	186,895	10	
Water Stop	9	m	1,240	11,160		Vinyl Chloride 220×6mm
Total				3,434,692		

11. Misc.Work Detail D Area

Explanation

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Headrace Pipe	3.0	m	1,080	3,240		Vinyl Chloride φ10cm
Stage Observation Box	1	spot		16,000		Steel Box
Total				19,240		

12. Temporary Work			Detail		D Area	
Explanation						
Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Road Repair	3000	m	per 100m 28,500	855,000	20	
Aggregate Shed	1	set		337,680	21	
Total				1,192,680		

13. Sundry Expenses			Detail		D Area	
Explanation						
Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Equipments Transport Cost	1	set		100,000		
Equipments Repair Cost	1	set		70,000		
Cost for Consumption Goods	1	set		28,650		
Cost for Appurtenant Office Work	1	set		1,000,000		
Total				1,198,650		

14. Gauging Dam — Detail — A Area

Explanation Length: 34.0m, Crown Width: 1.0m, Basic Width: 2.5m
Height: (4.0)3.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	151.0	m^3	per 10.0m^3 185,607	2,802,666	1	Dam 146.00m^3 Stage Room 4.96m^3
Frame (A)	233.9	m^2	per 10.0m^2 47,918	1,120,802	2	Dam 203.04m^2 Stage Room 30.86m^2
Earth Excavation (A)	73	m^3	per 10.0m^3 2,842	20,747	4	
Rock Excavation	81	m^3	5,337	432,297	22	
Water Stop	4	m	1,240	4,960	–	Vinyl Chloride 220×6mm
Sharp-Edged Steel	1	sheet	15,000	15,000	–	
Headrace Pipe	1.6	m	1,080	1,728		Vinyl Chloride ϕ10cm
Headrace Pipe	0.3	m	550	165	–	Vinyl Chloride ϕ5cm
Total				4,398,365		

15. Soil Saving Dam — Detail — A Area

Explanation Length: 28.0m, Crown Width: 1.0m, Basic Width: 1.6m
Height: (3.5)2.5m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	85.6	m^3	per 10.0m^3 185,607	1,588,796	1	
Frame (A)	128.7	m^2	per 10.0m^2 47,918	616,705	2	
Earth Excavation (A)	56	m^3	per 10.0m^3 2,842	15,915	4	
Rock Excavation	35	m^3	5,337	186,795	22	
Water Stop	2.5	m	1,240	3,100	–	Vinyl Chloride 220×6mm
Total				2,411,311		

16. Misc. Work			Detail			A Area

Explanation	Temporary Coffering (Upper Portion: 15m, The second time: 10m, Total: 25m), Diversion Water Way: 25+5=30m, Erection by Staging (Dam: $102m^2$, Soil Saving Dam: $84m^2$, 4 Times Use, 47 Apparent m^2)

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Temporary Coffering	25	m	2,643	66,075	12	
Diversion Water Way	30	m	5,370	161,100	13	
Erection by Staging	47	apparent m^2	10 apparent m^2 25,326	119,032		
Total				346,207		

17. Dam — Detail — B Area

Explanation Length: 25.0m, Crown Width: 1.0m, Basic Width: 1.75m, Height: (4.5)2.5m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	83.6	m^3	per 10.0m^3 185,607	1,551,675	1	
Frame (A)	158.1	m^2	per 10.0m^2 47,918	757,584	2	
Earth Excavation (A)	4.9	m^3	per 10.0m^3 2,842	13,926	4	
Rock Excavation	65	m^3	5,337	346,905	22	
Water Stop	3.5	m	1,240	4,340		Vinyl Chloride 220×6mm
Total				2,674,430		

18. Down End Wall of Channel — Detail — B Area

Explanation Length of Wall: 18.5m, Thickness: 1.0 and 1.6m, Height: 5.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	77.1	m^3	per 10.0m^3 185,607	1,431,030	1	
Frame (A)	140.4	m^2	per 10.0m^2 47,918	672,769	2	
Earth Excavation (A)	33	m^3	per 10.0m^3 2,842	9,379	4	
Rock Excavation	29	m^3	5,337	154,773	22	
Total				2,267,951		

19. Channel			Detail		B Area	

Explanation						

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	31.8	m^3	per $10.0m^3$ 185,607	590,230	1	Channel Part 25.50m^3 Stage Room 6.27m^3
Frame (A)	68.6	m^2	per $10.0m^2$ 47,918	328,717	2	Channel Part 33.84m^2 Stage Room 34.80m^2
Frame (B)	36.0	m^2	per $10.0m^2$ 11,844	42,638	3	
Gravel Foundation	54	m^3	per $10.0m^3$ 20,549	110,965	6	
Banking	119	m^3	per $10.0m^3$ 3,800	45,220	7	
Reinforcing Bar	0.25	t	162,255	40,564	9	
Headrace Pipe	3.0	m	1,080	3,240	–	ϕ10cm
Headrace Pipe	1.3	m	550	715	–	ϕ 5cm
Total				1,162,289		

20. Misc.Work			Detail		B Area	

Explanation	Temporary Coffering (Upper 2 Steps: 7+10=17m), Erection by Staging (Dam: 87.5m^2, Down End Wall of Channel: 74m^2, 4 Times Use, 40 Apparent m^2)					

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Temporary Coffering	17	m	2,643	44,931	12	
Diversion Water Way	15	m	5,370	80,550	13	
Erection by Staging	40	ap-parent m^2	10 apparent m^2 25,326	101,304	15	
Total				226,785		

21. Dam · Detail C Area

Explanation	Structure: Gravity-Type Plain Concrete, Length: 25.0m, Crown Width: 1.0m, Basic Width: 1.75m, Height: (3.5)2.5m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	76.6	m^3	per $10.0m^3$ 185,607	1,421,750	1	
Frame (A)	126.5	m^2	per $10.0m^2$ 47,918	606,163	2	
Earth Excavation (A)	160	m^3	per $10.0m^3$ 2,842	45,472	4	
Water Stop	2.5	m	1,240	3,100	–	Vinyl Chloride 220×6mm
Cement Milk Grouting	8.1	m^3	20,551	166,463	8	
Grouting Pipe	47	m	570	26,790	–	38mm
Total				2,269,738		

22. Upper End Wall of Channel .Detail C Area

Explanation	Structure: Plain Concrete Length of Wall: 16.0m, Thickness: 1.0m, · Height: (3.2)1.2m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	40.8	m^3	per $10.0m^3$ 185,607	757,277	1	
Frame (A)	89.6	m^2	per $10.0m^2$ 47,918	429,345	2	
Earth Excavation (A)	82	m^3	per $10.0m^3$ 2,842	23,304	4	
Total				1,209,926		

23. Down End Wall of Channel			Detail			C Area

Explanation Structure: Plain Concrete, Length of Wall: 18.0m, Thickness: 1.0m, Height: (3.5)1.5m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	50.0	m^3	per 10.0m^3 185,607	928,035	1	
Frame (A)	105.7	m^2	per 10.0m^2 47,918	506,493	2	
Earth Excavation (A)	83	m^3	per 10.0m^3 2,842	23,589	4	
Total				1,458,117		

24. Sedimentation Basin			Detail			C Area

Explanation Structure: Plain Concrete, Length: 4.0m, Width: 11.0m, Depth: (0.7)2.7m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	35.6	m^3	per 10.0m^3 185,607	660,761	1	
Frame (A)	44.5	m^2	per 10.0m^2 47,918	213,235	2	
Earth Excavation (A)	71	m^3	per 10.0m^3 2,842	20,178	4	
Total				894,174		

25. Channel　　　　　Detail　　　　　C Area

Explanation	Structure: Plain Concrete but Reinforcing Bar Use, Length: 19.0m, Upper Width: 4.5m, Down Width: 0.5m, Depth: 2.0m

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Concrete	87.0	m^3	per $10.0m^3$ 185,607	1,614,781	1	Channel Part 80.75m^3 Stage Room 6.27m^3
Frame (A)	142.0	m^2	per $10.0m^2$ 47,918	680,436	2	Channel Part 107.16m^2 Stage Room 34.80m^2
Frame (B)	114.0	m^2	per $10.0m^2$ 11,844	135,022	3	Back side of channel
Earth Excavation (A)	85	m^3	per $10.0m^3$ 2,842	24,157	4	
Gravel Foundation	109	m^3	per $10.0m^3$ 20,549	223,984	6	
Banking	179	m^3	per $10.0m^3$ 3,800	68,020	7	
Reinforcing Bar	0.73	t	162,255	118,446	9	
Headrace Pipe	3.0	m	1,080	3,240	-	Vinyl Chloride ϕ10cm
Total				2,868,086		

26. Misc. Work			Detail		. C Area	

Explanation	Erection by Staging (Dam: $62.5m^2$, Upper End Wall of Channel: $48m^2$, Down End Wall of Channel: $54m^2$, Total: $164.5m^2$, 4 Times Use, 41 Apparent m^2)

Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Temporary Coffering	30	m	2,643	79,290	12	
Diversion Water Way	40	m	5,370	214,800	13	
Pumping Drainage	1	set		149,572	23	
Erection by Staging	41	set	10 Apparent m^2 25,326	103,837	15	
Total				547,499		

27. Temporary			Detail		A∿C Area	
Explanation						
Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Road Repair	6000	m	per 100m 28,500	1,710,000	20	
Aggregate Shed	3	set	337,680	1,013,040	21	
Total				2,723,040		

28. Sundry Expenses			Detail		A∿C Area	
Explanation						
Item	Amount	Unit	Price (Yen)	Sum (Yen)	No. U.P.T.	Digest
Equipments Trans- Port Cost	1	set		200,000		
Equipments Repair Cost	1	set		200,000		
Cost for Con- sumption Goods	1	set		100,172		
Cost for Appur- tenant Office Work	1	set		1,150,000		
Total				1,650,172		

1. Concrete			Unit Price Table			Per 10m³
Explanation	MS: 25mm, SL: 8.0cm, W/C 55%, Air 5%, Crushed Stone and Sand Mixing, Extra Ratio of Materials (C: 2%, S: 10%, G: 5%)					
Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Water		1.7	t	-	-	Taking in the field
Cement	Portland 50kg	62.63	bag	1,220	76,409	Field price 307×1.02
Sand	φ: Less than 5mm	5.66	m³	5,620	31,809	Same as above 849×1.1/1650
Gravel	φ 25∿5mm	6.34	"	5,940	37,660	Same as above 997×1.05/1650
Water Reducing and Air Entraining Agent		7.83	kg	300	2,349	Same as above 307×1.02×0.25%
Light Oil		3.03	ℓ	70	212	For mixer use
Gasoline		10.91	"	160	1,746	For beltconveyor use
Gasoline		3.67	"	160	587	For vibrator use
Misc. Materials					255	10 P/C, per fuel price
Sub-Total					151,027	
Special Worker		2.44	man	1,900	4,636	
		1.22	"			Mixing
		1.22	"			Placing
Erosion Control Worker		14.54	"	1,900	27,626	
		9.70	"			Mixing
		4.84	"			Placing
Head		1.22	"	1,900	2,318	Placing
Sub-Total					34,580	
Total					185,607	

2. Frame (A)

Unit Price Table

Per 10m²

Explanation: Normal Frame
Total Area of Normal Frame· 927m²,
Mean Use Times of Frame: 3

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Plywood	12×600×1,800mm Waterproof plywood	3.17	sheet	550	1,744	9.5 sheets × 1/3
Square Lumber	30×60mm	0.04	m³	65,990	2,640	0.13m³ × 1/3
Round Nail	Several Size	0.33	kg	210	69	1kg × 1/3
Pipe	φ50mm	12	m	1,160	13,920	$7m \times 160m^2 \times \frac{10}{927}$
Form-Tie	C-type 'L210	19	pc.	70	1,330	38 pc. × 1/2
Metal Washer	3-type	19	pc.	30	570	38 pcs. × 1/2
Wooden Washer		19	pc.	5	95	38 pcs. × 1/2
Turn Buckle	W 3/8	14	kg	130	1,820	19 pcs. P/C, of loss: 100
Coating Agent		1	ℓ	270	270	
Sub-Total					22,458	
Head		0.60	man	1,900	1,140	Erection and removing
Frame Worker		6.60	man	1,900	12,540	
		3.60	man			Forming
		3.00	man			Erection and removing
Erosion Control Worker		6.20	man	1,900	11,780	
		1.80	man			Forming
		4.40	man			Erection and removing
Sub-Total					25,460	
Total					47,918	

3. Frame (B)   Unit Price Table   Per 10m^2

Explanation   Frame for Foundation, etc. use

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Plywood	12×600×1,800mm Waterproof plywood	9.50	sheet	550	5,225	P/C, of loss: 100
Square Lumber	30×60mm	0.07	m^3	65,990	4,619	Same as above
Round Nail	Several size	1.00	kg	210	210	Same as above
Coating Agent		1.00	ℓ	270	270	
Sub-Total					10,324	
Frame Worker		0.4	man	1,900	760	Forming and erection
Erosion Control Worker		0.4	man	1,900	760	Same as above
Sub-Total					1,520	
Total					11,844	

4. Earth Excavation (A)   Unit Price Table   Per 10m^3

Explanation   Excavation by Back-Hoe, Volume of Hoe: 0.35m^3,
Excavation Volume bailing out Water per One Hour: 8.1m^3 (viscid earth)

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Light Oil		10.99	ℓ	70	769	8.9/8.1 × 10
Misc. Materials					154	20 P/C, per fuel price
Operator		0.36	man	1,900	684	0.29/8.1 × 10
Assistant		0.19	"	1,900	361	0.15/8.1 × 10
Head		0.07	"	1,900	133	0.06/8.1 × 10
Erosion Control Worker		0.39	"	1,900	741	
Total					2,842	

5. Earth Excavation (B)   Unit Price Table   Per 10m^3

Explanation   Ground Excavation (viscid earth) by Man's power

Items	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Erosion Control Worker		7.35	man	1,900	13,965	Excavation and refilling
Total					13,965	

6. Gravel Foundation — Unit Price Table — Per 10m³

Explanation Gravel Paving and Tamping of Soft Ground
(Transportation Distance: 500m) of Gravel by Truck (Capacity Volume: 2.5m³)

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Gravel	5 ∿ 100mm	10.0	m³	~	~	Taking in the field
Light Oil	Truck fuel	0.80	ℓ	70	56	1/5 × 10/2.5
Misc.Materials					11	20 P/C, per fuel price
Sub-Total					67	
Driver		0.50	man	1,900	950	10/20
Erosion Control Worker		10.28	"	1,900	19,532	
		4.95	"			Gravel gathering
		2.00	"			Unloading and transport
		3.33	"			Gravel paving and tamping
Sub-Total					20,482	
Total					20,549	

7. Banking — Unit Price Table — Per 10m³

Explanation Use Sandy Portion of Excavation Earth in Banking

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Erosion Control Worker		2.00	man	1,900	3,800	
		1.25	"			Transport by hand cart
		0.30	"			Leveling
		0.45	"			Tamping
Total					3,800	

8. Cement Milk Grouting — Unit Price Table — Per 1m³

Explanation: Grouting Volume: 3m³ per One Hour, Grouting Pressure: 1∿2kg per cm²,
Actual Working Hour Per a Day: 3, Cement Milk Flow Value: 16∿26

Items	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Cement	Portland 50kg	12.00	bag	1,220	14,640	Field Price
Bentonite	200µ	100	kg	35	3,500	Same as above
Dispersing Agent		2.00	"	300	600	
Water		0.70	t	-	-	
Light Oil		1.66	ℓ	70	116	Fuel for grouting pump
Misc.Materials					23	20 P/C, per fuel price
Sub-Total					18,879	
Special Worker		0.22	man	1,900	418	2/9
Assistant		0.22	"	1,900	418	2/9
Erosion Control Worker		0.44	"	1,900	836	4/9
Sub-Total					1,672	
Total					20,551	

9. Reinforcing Bar — Unit Price Table — Per 0.87 ton

Explanation: φ9mm 190m × 0.499kg ≒ 95kg
φ16mm 490m × 1.58kg ≒ 774kg

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Bar		0.87	t	140,000	121,800	Field price
Wire		8.70	kg	260	2,262	Same as above
Sub-Total				-	124,062	
Special Worker		9.00	man	1,900	17,100	Assembling
Sub-Total					17,100	
Total					141,162	
		per 1 ton			162,255	

10. Waterproof by Asphalt		Unit Price Table				Per 10m^2
Explanation						
Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Asphalt Waterproof Agent	18ℓ Can	1.67	can	7,600	12,692	
Special Worker		0.50	man	1,900	950	
Total		,			13,642	

11. Stream Bed Digging		Unit Price Table				Per 1.0m
Explanation Digging Width (Upper: 5.0m, Down: 2.0m) Mean Depth: 1.25m, Mean Digging Section Area. 4.38m^2						
Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Digging		4.38	m^3	per 10m^3 2,842	1,245	No. 4 U.P.T Earth Excavation (A)
Total					1,245	

12. Temporary Coffering		Unit Price Table				Per 1.0m
Explanation Sandbags Accumulating 3 Steps, Finishing Size (Height: 0.9m, Length: 0.6m), Sandbags per 1m: 6×1/0.6 ≈ 10 Bags						
Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Hemp Bag	38 × 60cm	10	sheet	80	800	
Erosion Control Worker		0.97	man	1,900	1,843	
		0.67	"			Earth taking and sandbag making
		0.30	"			Bed preparation, accumulation and removal
Total					2,643	

13. Diversion Water Way		Unit Price Table				Per 1.0m
Explanation Use Hard Vinyl Chloride Pipe, φ300mm (thin thickness) Double Piping						
Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Vinyl Chloride Pipe	Thin thickness φ300mm	2.00	m	2,305	4,610	
Erosion Control Worker		0.40	man	1,900	760	Earth digging, pipe construction and removal, etc.
					5,370	
Total						

14. Pumping Drainage		Unit Price Table				A complete Set
Explanation	Use Two Centrifugal Pumps (5 PS), Concrete: $371.8m^3 \times 0.8 \times 1/16.5 \times 1.5 = 27$ Days Excavation: $94m^3 \times 0.9 \times 1/27.0 = 31$ Days, Gravel Foundation: $258m^3 \times 1.0 \times 1/20 = 13$ Days Total Drainage Days: 71 Days					
Items	**Dimensions**	**Amount**	**Unit**	**Price (Yen)**	**Sum (Yen)**	**Digest**
Light Oil		1,335	ℓ	70	91,450	71 days × 9.4ℓ × 2 pumps
Misc. Materials					18,690	20 P/C, per fuel price
Sub-Total					112,140	
Special Worker		71.00	man	1,900	134,900	1.0 man × 71 days
Sub-Total					134,900	
Total					247,040	

15. Erection by Stage		Unit Price Table				Per 10 Apparent m^2
Explanation	For Dam Use: $30m \times 3.0 = 90m^2$, For Upper End Wall of Channel Use: $21m \times 3.0 = 63m^2$ For Down End Wall of Channel Use: $15m \times 3.0 = 45m^2$, Total Erection: $198m^2$, Four Times Use: $198/4 \doteq 50m^2$					
Item	**Dimensions**	**Amount**	**Unit**	**Price (Yen)**	**Sum (Yen)**	**Digest**
Pipe	$\phi48.6m$	153	m	400	61,200	50×30.6 m/10
Right Angle Clamp		66	pc.	200	13,200	50×13.2 pc./10
Flexible Clamp		7	"	200	1,400	50×1.3 pc./10
Joint		27	"	200	5,400	50×5.4 pc./10
Base Plate		9	"	200	1,800	50×1.8 pc./10
Board	Pine, Thickness: 4cm	9.90	m^2	2,200	21,780	66m×0.6/4
Sub-Total					104,780	
Head		1.00	man	1,900	1,900	50×0.2/10
Scaffold Man		5.00	"	1,900	9,500	50×1.0/10
Erosion Control Worker		5.50	"	1,900	10,450	50×1.1/10
Sub-Total					21,850	
Total					126,630	
	Per 10 Apparent m^2				25,326	

16. Wooden Fence Work   Unit Price Table   Per 10m

Explanation   Fence Height: 10m, Pile Intervals: 1.0m,
Fence Board: Eight Steps

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Pile Log	Pine, Length 2m, Top End. 12cm	10	stake	1,550	15,500	
Fence Board	"	20	"	1,550	31,000	Use a half log
Round Nail	150mm	3.60	kg	210	756	
Sub-Total					47,256	
Erosion Control Worker		5.50	man	1,900	10,450	
		2.50	"			Piling and Fence making
		3.00	"			2.0 man×15/10
Sub-Total					10,450	
Total					57,706	

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17. Wall For Compartment   Unit Price Table   Per 10m

Explanation

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Concrete Board	1.2×1.5×0.03m	6.67	sheet	6,260	41,754	Field Price
Mortar	1:2	0.12	m^3	-	-	
Rough Sand	Less than 10mm	0.45	"	-	-	For paving use
Cement	50kg Bag	1.44	bag	1,220	1,757	For mortar use
Sand	Less than 5m	0.10	m^3	5,620	562	Same as above
Erosion Control Worker		10.34	man	1,900	19,646	
		0.90	man			Rough sand taking and transport
		0.50	"			Sand paving
		0.60	"			Small transport and mortar mixing
		8.34	"			Small transport, concrete board forming and finishing 6.67×5/4
Total					63,719	

18. Drain Channel — Unit Price Table — Per 10m

Explanation: Width: 1.0m, Depth: 0.3m, Arc Shaped Channel (12.4m² per 10m)

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Erosion Control Worker		2.29	man	1,900	4,351	
		0.50	"			Bed preparation
		1.79	"			Sodding and finishing
Total					4,351	

19. Inside Work — Unit Price Table — Per 1m²

Explanation: Gravel Layer: 0.3m, Sand Mat Layer, Earth Layer: 1.5m

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Gravel	3 ~ 10cm	0.30	m³	4,160	1,248	Field price
Sand Mat	Coconut fiber Thickness 20mm	1.00	m²	910	910	
Earth Filling		1.50	m³	–	–	
Sub-Total					2,158	
Erosion Control Worker		0.75	man	1,900	1,425	
		0.20	"			Small gravel transport and paving
		0.05	"			Sand Mat Paving
		0.50	"			Earth filling and finishing
Sub-Total					1,425	
Total					3,583	

20. Road Repair — Unit Price Table — Per 100m

Explanation: Leveling and Gravel Paving

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Gravel Paving	Unscreened gravel	30	m³	–	–	
Erosion Control Worker		15.00	man	1,900	28,500	
		10.00	"			Sand taking and small transport
		5.00	"			Leveling and gravel paving
Total					28,500	

21. Aggregate Shed Unit Price Table A Complete Set

Explanation   Sand: 100m², Gravel: 150m²

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Pile Wood	Eucalyptus Length 1.5m, Top end 10cm	35	pc.	300	10,500	19,400/m³
Board	Eucalyptus Thickness 3 cm	64	m²	870	55,680	Board to enclose 29,100/m³
Board	Eucalyptus Thickness 2 cm	250	m²	580	145,000	Decking Same as above
Cover Chute	Vinyl 0.4mm	300	m²	390	117,000	
Sub-Total					328,180	
Erosion Control Worker		5.00	man	1,900	9,500	
		2.00	"			Leveling
		3.00	"			Piling and enclosing
Sub-Total					9,500	
Total					337,680	

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22. Rock Excavation Unit Price Table Per 1m³

Explanation   Hard Rock

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Dynamite		0.15	kg	280	42	
Detonator		3	pc.	20	60	
Fuse		1.6	m	30	48	
Drilling Worker		0.99	man	1,900	1,881	
Special Worker		0.99	"	1,900	1,881	
Erosion Control Worker		0.75	"	1,900	1,425	
Total					5,337	

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23. Pumping Drainage Unit Price Table 1 Set for C Area

Explanation   Two Centrifugal Pump (5 PS) Use
Concrete: 290.0m³×0.8×1/16.5×1.5=21 days   Total Drainage Days: 43
Excavation: 481.0m³×0.9×1/27.8=16 days
Gravel Foundation: 109.0m³×1.0×1/20=6 days

Item	Dimensions	Amount	Unit	Price (Yen)	Sum (Yen)	Digest
Light Oil		808	ℓ	70	56,560	43 days×9.4×2 pumps
Misc. Materials					11,312	20 P/C, per fuel price
Special Worker		43.0	man	1,900	81,700	
Total					149,572	

Detail of Concrete Mix Proportion

Name of Place	D Area							
Factors of Concrete Mix Proportion								

Kind of Concrete	WD. AE	Cement Gravity			3.15
Kind of Cement	Port. C	Fine Aggregate Gravity			2.70
Max. Diameter of Coarse Aggregate	25mm	Coarse Aggregate Gravity			2.70
Water Cement	55%	Coarse Aggregate Ratio			2.80
Slump	8cm	Fine Aggregate Weight per Unit Volume			
Ratio of Fine Aggregate	38%	Coarse Aggregate Weight per Unit Volume			
Water Duty per Unit Weight	145kg	Name of Dispersing Agent			
Air Content (after placing)	5.0%	Crushed Stone and Sand Use			
Corrected Ratio of Fine Aggregate		Corrected Water Duty per Unit Weight -			
38.0+5+3 = 46.0		145+15+9 = 169			

Preliminary Mix Calculation

Unit Cement Volume	$169 \times 1/0.55 = 307$
Net Volume of Aggregate ℓ	$1,000 - (169+307/3.15+5.0 \times 10) = 683.5$
Net Volume of Fine Aggregate ℓ	$683.5 \times 46/100 = 314.4$
Net Volume of Coarse Aggregate ℓ	$683.5 - 314.4 = 369.1$
Fine Aggregate Weight per Unit	$314.4 \times 2.70 = 849$
Coarse Aggregate Weight per Unit	$369.1 \times 2.70 = 997$
Dispersing Agent per Unit	

Max. D.C.A.	Water Cement	Slump	F.A.R.	Water	Cement	P.A	C.A	D.A
MS 25mm	W/C 55%	SL 8cm	s/a 46.0	W kg 169	C kg 307	S kg 849	G kg 997	kg

QUANTITY CALCULATIONS

D Area Gauging Facilities

Dam (Drawing-No.2)

Item Parti- tion	Frame Calculation	(m²)	Volume Calculation	(m³)
A	9.00×1.20×2+(1.00×1.20)	22.80	9.00×1.20×1.00	10.80
A'	11.00×1.20×2+(1.00×1.20)	27.60	11.00×1.20×1.00	13.20
B	$\frac{30.00+14.00}{2}$×3.00×(1+1.044)	134.90	$\frac{3}{6}${(30.00×1.00)+(14.00×1.90)+[(30.00+14.00)(1.00+1.90)]}	92.10
Total		185.30		116.10

Item Parti- tion	Excavation Calculation						
	Earth					Rock	
	Down Width_m	Upper Width_m	Height_m	Length_m	Volume_m³		
a	1.74	4.44	2.7	2.20	18.35		
b	2.19	4.59	1.4	4.80	39.05		
c	2.50	4.30	1.8	2.00	12.24		
d	2.50	4.70	2.2	2.30	18.22		
e	2.50	5.00	2.5	8.60	80.63		
f	2.50	5.20	2.7	1.10	11.43		
g	2.41	5.51	3.1	1.80	22.10		
h	2.17	5.17	3.0	3.00	33.03		
i	1.81	3.91	2.1	4.20	25.23		
Total					260.28		

Other Materials		
Water Stop	Vinyl Chloride 220×6mm	3m
Grouting Pipe	Steel Pipe ø38mm 60+0.4×20pc.	68m
Cement Milk	[(1.0+1.9)×1/2×(9.49+7.62)+14×1.9]×1.0×0.2	10.28m³

Upper End Wall of Channel (Drawing-No.3)

Item Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$(\frac{4.00+9.00}{2}\times1.00)+(\frac{3.00+8.00}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	13.99	$(\frac{4.00+9.00}{2}\times1.00\times1.00)-(\frac{1.00\times1.00}{2}\times1.00)$	6.00
A'	$(\frac{4.00+9.00}{2}\times1.00)+(\frac{3.00+8.00}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	13.99	$(\frac{4.00+9.00}{2}\times1.00\times1.00)-(\frac{1.00\times1.00}{2}\times1.00)$	6.00
B	$(\frac{9.00+10.00}{2}\times1.00)+(\frac{8.00+9.00}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	19.99	$(\frac{9.00+10.00}{2}\times1.00\times1.00)-(\frac{1.00\times1.00}{2}\times1.00)$	9.00
B'	$(\frac{9.00+10.00}{2}\times1.00)+(\frac{8.00+9.00}{2}\times1.00)$ $+(1.41\times1.41\times100)$	19.99	$(\frac{9.00+10.00}{2}\times1.00\times1.00)-(\frac{1.00\times1.00}{2}\times1.00)$	9.00
C	$\frac{21.00+13.00}{2}\times2.00\times2$	68.00	$\frac{21.00+13.00}{2}\times2.00\times1.00$	34.00
Total		135.96		64.00

Item Partition	Excavation Calculation					
	Earth					Rock
	Down Width m	Upper Width m	Height m	Length m	Volume m³	
a	1.60	3.10	1.5	0.60	2.12	
b	1.60	3.80	2.2	3.40	20.20	
c	1.60	4.10	2.5	6.50	46.31	
d	1.60	3.30	1.7	1.70	7.08	
e	1.60	4.10	2.5	4.80	34.20	
f	1.60	4.30	2.7	0.70	5.58	
g	1.60	3.90	2.3	3.30	20.87	
Total					136.36	

Down End Wall of Channel (Drawing-No.4)

Item Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$(\dfrac{2.00+4.50}{2}\times0.50\times2)+(1.00\times0.50\times1.41)$	3.96	$\dfrac{2.00+4.50}{2}\times0.50\times1.00$	1.63
A'	$(\dfrac{4.00+6.50}{2}\times0.50\times2)+(1.00\times0.50\times1.41)$	5.96	$\dfrac{4.00+6.50}{2}\times0.50\times1.00$	2.63
B	$(\dfrac{4.50+6.00}{2}\times1.50\times2)+(1.00\times1.50\times1.41)$	17.87	$\dfrac{4.50+6.00}{2}\times1.50\times1.00$	7.88
B'	$(\dfrac{6.50+8.00}{2}\times1.50\times2)+(1.00\times1.50\times1.41)$	23.87	$\dfrac{6.50+8.00}{2}\times1.50\times1.00$	10.88
C	$\dfrac{15.00+6.00}{2}\times2.00\times2$	42.00	$\dfrac{15.00+6.00}{2}\times2.00\times1.00$	21.00
Total		93.66		44.02

Excavation Calculation						
Item Partition	Earth					Rock
	Down Width m	Upper Width m	Height m	Length m	Volume m³	
a	1.60	4.10	2.5	2.50	17.81	
b	1.60	5.00	3.4	1.00	11.22	
c	1.60	4.60	3.0	1.60	14.88	
d	1.60	4.10	2.5	1.40	9.98	
e	1.60	3.80	2.2	3.00	17.82	
f	1.60	3.20	1.6	1.50	5.76	
g	1.60	3.60	2.0	2.50	13.00	
h	1.60	4.20	2.6	1.50	11.31	
Total					101.78	

Sedimentation Basin (Drawing-No.3)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$0.70 \times 11.00 \times (1+1.02)$	15.55	$0.70 \times 11.00 \times \dfrac{0.50+0.64}{2}$	4.39
A'	$0.70 \times 11.00 \times (1+1.02)$	15.55	$0.70 \times 11.00 \times \dfrac{0.50+0.64}{2}$	4.39
B	$2.50 \times \dfrac{11.00+10.25}{2} \times (1+1.02)$	53.66	$\dfrac{2.5}{6}(0.64 \times 11.00)+(1.14 \times 10.25)+(0.64+1.14)(11.00+10.25)$	23.56
B'	$2.50 \times \dfrac{11.00+10.25}{2} \times (1+1.02)$	53.66	$\dfrac{2.5}{6}(0.64 \times 11.00)+(1.14 \times 10.25)+(0.64+1.14)(11.00+10.25)$	23.56
C			$\dfrac{0.5}{6}(10.92 \times 10.40)+(10.72 \times 10.25)+(10.92+0.72)(10.40+10.25)$	55.86
Total		138.42		111.76

Gravel Paving

$$\frac{0.5}{6}\{(14.00 \times 10.10)+(14.50+10.25)+[(14.00+14.50)(10.10+10.25)]\}=72.50$$

Item / Partition	Upper End Section		(m²)	Down End Section		(m²)
	Mean Height m	Length m	Area	Mean Height m	Length m	Area
a	1.0	1.4	1.40	1.2	1.4	1.68
b	1.8	2.0	3.60	2.2	7.0	15.40
c	2.1	2.3	4.83	1.4	1.7	2.38
d	2.5	8.7	21.75	2.1	5.3	11.13
e	2.7	1.0	2.70	1.3	1.6	2.08
f	1.6	1.9	3.04			
Total			37.32			32.67

Mean Length of Excavation 8.3m

$$\therefore \text{ Excavation Volume } \frac{37.32+32.67}{2} \times 8.3 = 290.46 m^3$$

Item / Partition	Upper End Section		(m²)	Down End Section		(m²)
	Mean Height m	Length m	Area	Mean Height m	Length m	Area
a	0.2	0.4	0.08	0.2	0.7	0.14
b	1.5	1.1	1.65	1.6	1.1	1.76
c	3.0	0.75	2.25	3.0	0.75	2.25
d	3.1	0.75	2.33	3.1	0.75	2.33
e	1.6	1.3	2.08	1.3	1.5	1.95
Total			8.39			8.43

Mean Length of Banking 10.6m

$$\therefore \text{ Banking Volume } \frac{8.39+8.58}{2} \times 10.6 = 89.94 m^3$$

Channel (Drawing-No.4)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	[(2.00×1.41)+(2.00×1.25)]×19.00	101.08	$\frac{0.50+1.00}{2}$×2.00×19.00	28.5
A'	[(2.00×1.41)+(2.00×1.25)]×19.00	101.08	$\frac{0.50+1.00}{2}$×2.00×19.00	28.5
B	0.50×2×19.00	19.00	0.50×3.00×19.00	28.5
Total		221.16		85.5

Other Materials   Reinforcing Bar   ⌀16mm   (3.0m+3.0m+2.6m)×57=490.2m

                      "   ⌀9mm   19m×10=190m

Gravel Paving (except Stage Observation Room)

Item / Partition	Volume Calculation (m³)
A+A'	$\frac{0.75+1.25}{2}$×2×19.00×2=76.00 ⎫
B+B'	$\frac{1.25+1.00}{2}$×0.5×19.00×2=21.38 ⎬ 182.88
C	$\frac{4.00+5.00}{2}$×1.0×19.00=85.50 ⎭
Stage Observation Room	$(\frac{0.75+1.25}{2}×2+\frac{1.25+1.00}{2}×0.5+\frac{1.00+0.50}{2}×1.0)×1.80=5.96$
Total	182.88−5.96=176.92

Item / Partition	Upper End Section		(m²)	Down End Section		(m²)
	Mean Height m	Length m	Area	Mean Height m	Length m	Area
a	0.8	0.9	0.72	1.2	1.8	2.16
b	1.6	2.0	3.20	2.2	0.6	1.32
c	1.2	1.7	2.04	2.2	1.4	3.08
d	1.5	0.3	0.45	1.8	2.0	3.60
e	0.8	0.9	0.72	0.7	0.8	0.56
Total			7.13			10.72

Mean Length of Excavation   17.3 m   ∴ Excavation Volume $\frac{7.13+10.72}{2}×17.3=154.40m^3$

Item / Partition	Upper End Section		(m²)	Down End Section		(m²)
	Mean Height m	Length m	Area	Mean Height m	Length m	Area
a	0.5	3.0	1.50	0.1	0.9	0.09
b	1.3	2.8	3.64	0.1	0.7	0.07
c	0.7	0.8	0.56	1.1	1.0	1.10
d	0.7	0.8	0.56	2.1	0.7	1.47
e	1.4	2.7	3.78	1.1	2.0	2.20
f	0.6	2.0	1.20	0.3	0.5	0.15
Total			11.24			5.08

Mean Length of Banking   19.00 m   ∴ Banking Volume $\frac{11.24+5.08}{2}×19.00=155.04m^3$

Observation Facilities

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
Right Wall	(4.00×1.80)+(3.50×1.50)	12.45	4.00×1.80×0.30	2.16
Left Wall	(4.00×1.80)+(3.50×1.50)	12.45	4.00×1.80×0.30	2.16
Upper Stream Wall	(4.00×1.60)+(3.50×1.00)	9.90	4.00×1.00×0.30	1.20
Bottom Part			1.50×1.00×0.50	0.75
Total		34.80		6.27

Other Materials

Gravel Paving $(\frac{1.50+3.50}{2}\times1.50+0.50\times1.50)\times1.80=8.10m^3$

Reinforcing Bar for Step Use

A Complete Set of Lodge

Headrace Pipe ϕ10mm 3.0m 1pc.

This excavation is included in that of Down End Portion of Channel.

D Area Overland Flow Facilities

Calculation of Partitive Wall

Facilities	Concrete Board				Mortar for Joint	Mortar in the Corner	Frame in the Corner	Rough Sand Paving	Excavation
	Left Board	Right Board	Upper Portion	Total					
A	31.5	32	20	83.5	1.00	0.03	0.6	3.79	34.71
B	31.5	31	20	82.5	1.00	0.03	0.6	3.72	34.09
C	31.5	32	20	83.5	1.00	0.03	0.6	3.77	34.58

Calculation of Socket for Water and Soil (Same as A ∿ C)

Partition		
Concrete	$(1.4 \times 20.28 \times 1.0) - 0.8/6 \times [19.68 \times 0.8 + (19.68 + 20)(0.8 + 1.12) + 20 + 1.12]$	13.15
Frame	$(20.28 + 1.4) \times 2 \times 0.8 + (19.84 + 0.96) \times 2 \times 0.8$	67.97
Gravel Foundation	$1.4 \times 0.3 \times 20.28$	8.52
Excavation	$1.5 \times 0.83 \times 20.38$	25.37
Contraction Joint	Asphalt Board $1.4 \times 1.0 - (1.12 + 0.8) \times 0.8 \times 1/2$	0.63

Other Materials (Same as A ∿ C)

Stage Observation Box   1.0×0.5×1.6   Steel Box   1pc.

Headrace Pipe   ∮25cm   2.0m

D Area Water Balance Facilities

Calculation of Wall and Its Bottom (Same as A ∿ C)

Item \ Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	(1+1.031)×2.2×10×4	178.73	(0.3×0.85)×2.2×1/2×10×4	50.60
A'	(0.3+0.85)×2.2×1/2×8	10.12	2.2/6×[0.85²+(0.85+0.3)²+0.3²]×4	3.13
B	0.2×10×4	8.00	0.4×10×10	40.00
B'	0.2×0.85×8	1.36	0.2×0.85×(0.85+10)×4	7.38
Total		198.21		101.11

Calculation of Gravel Foundation (Same as A ∿ C)

Partition		(m³)
B	0.3×10×10	30.00
B'	0.3×0.85×(0.85+10)×4	11.07
Total		41.07

Calculation of Excavation and Banking

Facilities	Excavation Calculation	(m³)	Banking Calculation	(m³)
A	(11.7²+13.0²)×1.3×1/2	198.83	(16.8²−10.6²)×1.5×1/2	127.41
B	(11.7²+13.5²)×1.8×1/2	287.23	(14.0²−10.6²)×0.9×1/2	37.64
C	(11.7²+13.3²)×1.6×1/2	251.02	(14.1²−10.6²)×1.2×1/2	51.87

Other Materials Calculation (Same as A ∿ C)

Waterproof Layer by Asphalt	(10+0.85×2)²	= 136.89m²
Gravel	10×10×0.3	= 30.00m³
Sand Mat	10×10	= 100.00m²
Headrace Pipe (Vinyl Chloride ∅10cm)		= 3.00m
Water Stop (220×6mm)	2.2×4	= 8.80m
Stage Observation Box	1.0×0.5×1.6	= 1pc. (Steel Box)

A Area Gauging Facilities

Gauging Dam (Drawing-No. 2)

Item \ Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	6.00×1.00×2+1.00×1.00×1	13.00	6.00×1.00×1.00	6.00
A'	20.00×1.00×2+1.00×1.00×1	41.00	20.00×1.00×1.00	20.00
B	$\frac{34.00+13.00}{2}$×3.00×(1.02+1.04) $+\frac{1.00+1.50}{2}$×1.41×2	149.04	$\frac{3}{6}${(34.00×1.00)+(13.00×2.50) +[(34.00+13.00)(1.00+2.50)]}	115.50
C		–	9.00×0.50×1.00	4.50
Total		203.04		146.00

Other Materials

Contraction Joint $\frac{1.08+2.69}{2}$×3.00+1.08×1.00=6.74m²

Water Stop 4.0m

Sharp-Edged Steel 1 pc.

Item \ Partition	Earth					Rock				
	Down Width	Upper Width	Height	Length	Volume	Down Width	Upper Width	Height	Length	Volume
a	2.35	3.65	1.30	3.00	11.70	2.35	2.35	1.50	3.00	10.58
b	3.10	4.80	1.70	1.00	6.72	3.10	3.10	1.00	1.00	3.10
c	3.10	4.50	1.40	2.00	10.64	3.10	3.10	0.50	2.00	3.10
d	3.10	3.50	0.40	4.00	5.28	3.10	3.10	0.70	4.00	8.68
e	3.10	3.20	0.10	2.00	0.63	3.10	3.10	0.90	2.00	5.58
f	3.10	3.50	0.40	4.00	5.28	3.10	3.10	1.10	4.00	13.64
g	2.69	3.29	0.60	9.80	17.58	2.69	2.69	0.90	9.80	23.73
h	2.07	2.77	0.70	5.00	8.47	2.07	2.07	0.50	5.00	5.18
i	1.73	2.73	1.00	3.20	7.14	1.73	1.73	0.50	3.20	2.77
Cut-Off Wall					0	9.00×0.50×1.00 (a ∿ e)				4.50
Sub-Total					73.44					80.86
Observation Facilities										
Total										

Soil Saving Dam (Drawing-No.3)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$\frac{7.00+8.00}{2} \times 1.00 \times 2+1 \times 1.41 \times 1$	16.41	$\frac{7.00+8.00}{2} \times 1.00 \times 1.00$	7.50
A'	$\frac{11.00+12.00}{2} \times 1.00 \times 2+1 \times 1.41 \times 1$	24.41	$\frac{11.00+12.00}{2} \times 1.00 \times 1.00$	11.50
B	$\frac{28.00+15.00}{2} \times 2.00 \times (1.00+1.044)$	87.89	$\frac{2}{6}\{(28.00 \times 1.00)+(15.00 \times 1.60)$ $+[(28.00+15.00)(1.00+1.60)]\}$	54.60
C		-	$15.00 \times 0.50 \times 1.60$	12.00
Total		128.71		85.60

Other Materials

Contraction Joint $\quad \frac{1.00+1.60}{2} \times 2.00+1.60 \times 0.50 = 3.40 m^2$

Water Stop $\quad\quad$ 2.5 m

Item / Partition	Earth					Rock				
	Down Width	Upper Width	Height	Length	Volume	Down Width	Upper Width	Height	Length	Volume
a	1.90	2.80	0.9	6.00	12.69	1.90	1.90	0.9	6.00	10.26
b	2.20	3.30	1.1	6.00	18.15	2.20	2.20	0.3	6.00	3.96
c	2.20	2.90	0.7	2.90	5.18	2.20	2.20	0.05	2.90	0.32
d	2.20	2.70	0.5	4.50	5.51	2.20	2.20	-	4.50	-
e	2.20	2.90	0.7	1.60	2.86	2.20	2.20	0.1	1.60	0.35
f	2.13	2.93	0.8	1.60	3.24	2.13	2.13	0.2	1.60	0.68
g	1.83	2.53	0.7	5.40	8.24	1.83	1.83	0.8	5.40	7.91
Excavated Part										12.00
Total					55.87					35.48

Stage Observation Facilities (Drawing-No.2)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
Right Wall	$[(2.00 \times 1.80)+(\frac{1.80+1.35}{2} \times 1.50)]$ $\times 2-(0.30 \times 3.50)$	10.88	$[(2.00 \times 1.80)+(\frac{1.80+1.35}{2} \times 1.50)]$ $\times 0.30$	1.79
Left Wall	$[(2.00 \times 1.80)+(\frac{1.80+1.35}{2} \times 1.50)]$ $\times 2-(0.30 \times 3.50)$	10.88	$[(2.00 \times 1.80)+(\frac{1.80+1.35}{2} \times 1.50)]$ $\times 0.30$	1.79
Down Stream Wall	$(3.50 \times 1.60)+(3.50 \times 1.00)$	9.10	$3.50 \times 1.00 \times 0.30$	1.05
Bottom Part		-	$\frac{1.05+1.14}{2} \times 1.00 \times 0.3$	0.33
Total		30.86		4.96

Other Materials

A Complete Set of Lodge, Reinforcing Bar for Step Use

Headrace Pipe $\quad \phi 0.1m \quad\quad$ 1.60m 1pc.

Drain Pipe $\quad\quad \phi 0.05m \quad\quad$ 0.3m 1pc.

B Area Gauging Facilities

Dam (Drawing-No.2)

Item / Partition	Frame Calculation	(m^2)	Volume Calculation	(m^3)
A	$(\frac{7.00+8.00}{2}\times1.00)+(\frac{6.00+7.00}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	15.99	$(\frac{7.00+8.00}{2}\times1.00\times1.00)-(\frac{1.00\times1.00}{2}\times1.00)$	7.00
A'	$(\frac{13.50+14.50}{2}\times1.00)+(\frac{12.50+13.50}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	28.99	$(\frac{13.50+14.50}{2}\times1.00\times1.00)$ $-(\frac{1.00\times1.00}{2}\times1.00)$	13.50
B	$(8.00\times1.00)+(7.00\times1.00)$ $+(1.41\times1.41\times1.00)$	16.99	$(8.00\times1.00\times1.06)-(\frac{1.00\times1.00}{2}\times1.00)$	7.50
B'	$(\frac{14.50+15.50}{2}\times1.00)+(\frac{13.50+14.50}{2}\times1.00)$ $+(1.41\times1.41\times1.00)$	30.99	$(\frac{14.50+15.50}{2}\times1.00\times1.00)$ $-(\frac{1.00\times1.00}{2}\times1.00)$	14.50
C	$\frac{21.50+4.00}{2}\times2.50\times(1.00\times1.044)$	65.15	$\frac{25}{6}\{(21.50\times1.00)+(4.00\times1.75)$ $+[(21.50+4.00)(1.00\times1.75)]\}$	41.09
Total		158.11		83.59

Item / Partition	Earth					Rock				
	Down Width	Upper Width	Height	Length	Volume	Down Width	Upper Width	Height	Length	Volume
a	1.60	2.10	0.5	1.00	0.93	1.60	1.60	2.6	1.00	10.82
b	1.98	2.28	0.3	2.50	1.60	1.98	1.98	2.5	2.50	12.38
c	2.35	2.45	0.1	1.80	0.43	2.35	2.35	1.6	1.80	6.77
d	2.35	–	–	2.20	–	2.35	2.35	0.8	2.20	4.14
e	2.31	2.81	0.5	1.75	2.24	2.31	2.31	1.1	1.75	4.45
f	1.93	3.03	1.1	13.25	36.15	1.93	1.93	0.7	13.25	23.02
g	1.60	3.00	1.4	2.50	8.05	1.60	1.60	0.8	2.50	3.20
Total					49.40					64.78

Down End Wall of Channel (Drawing-No.3)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$(\dfrac{2.00+7.00}{2}\times1.00\times2)+(1.00\times1.00\times1.41)$	10.41	$\dfrac{2.00+7.00}{2}\times1.00\times1.00$	4.50
A'	$(\dfrac{4.00+9.00}{2}\times1.00\times2)+(1.00\times1.00\times1.41)$	14.41	$\dfrac{4.00+9.00}{2}\times1.00\times1.00$	6.50
B	$(\dfrac{7.00+8.00}{2}\times1.00\times2)+(1.00\times1.00\times1.41)$	16.41	$\dfrac{7.00+8.00}{2}\times1.00\times1.00$	7.50
B'	$(\dfrac{9.00+10.00}{2}\times1.00\times2)+(1.00\times1.00\times1.41)$	20.41	$\dfrac{9.00+10.00}{2}\times1.00\times1.00$	9.50
C	$\dfrac{18.50+7.50}{2}\times3.00\times(1+1.02)$	78.76	$\dfrac{3}{6}\{(18.50\times1.00)+(7.50\times1.60)$ $+[(18.50+7.50)(1.00+1.60)]\}$	49.05
Total		140.42		77.05

Item / Partition	Earth					Rock				
	Down Width	Upper Width	Height	Length	Volume	Down Width	Upper Width	Height	Length	Volume
a	1.90	2.60	0.7	2.00	3.15	1.90	1.90	1.2	2.00	4.56
b	2.20	2.30	0.1	0.95	0.21	2.20	2.20	0.9	0.95	1.88
c	2.20	-	-	3.40	0	2.20	2.20	0.7	3.40	5.24
d	2.20	2.70	0.5	1.90	2.33	2.20	2.20	1.1	1.90	4.60
e	2.20	3.20	1.0	1.25	3.38	2.20	2.20	1.3	1.25	3.58
f	2.07	3.07	1.0	3.85	9.89	2.07	2.07	1.0	3.85	7.97
g	1.85	2.95	1.1	2.90	7.66	1.85	1.85	0.3	2.90	1.61
h	1.68	2.88	1.2	2.25	6.16	-	-	-	2.25	-
Total					32.78					29.44

Channel (Drawing-No.3)

Item \ Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	[(2.00×1.41)+(2.00×1.25)]×6.00	31.92	$\frac{0.50+1.00}{2}$×2.00×6.00	9.00
A'	[(2.00×1.41)+(2.00×1.25)]×6.00	31.92	$\frac{0.50+1.00}{2}$×2.00×6.00	9.00
B	(0.50×2×6.00)	6.00	0.50×2.50×6.00	7.50
Total	.	69.84		25.50

Other Materials

    Reinforcing Bar   ø16mm (2.5m+2.5m+2.0m)×20=140m

    Distribution Bar   ø9mm   6m×11=66m

Item \ Partition	Upper End Section (m²)			Down End Section (m²)			Earth Volume (m³)
	Mean Height	Length	Area	Mean Height	Length	Area	
a	1.7	2.5	4.25	2.0	2.4	4.80	$\frac{23.13+34.50}{2}$×6.00=172.89
b	3.8	0.4	1.52	4.3	1.0	4.30	
c	3.9	1.2	4.68	4.3	1.5	6.45	
d	2.5	1.4	3.50	3.1	1.5	4.65	
e	0.4	0.9	0.36	0.7	1.3	0.91	
f	0.8	1.4	1.12	0.1	1.3	0.13	
g	1.6	3.5	5.60	1.4	1.4	1.96	
h	0.7	3.0	2.10	2.2	3.5	7.70	
i				0.9	4.0	3.60	
Total			23.13.			34.50	

Stage Observation Facilities (Drawing-NO.2)

Item \ Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
Right Wall	(4.00×1.80)+(4.00×1.50)	13.20	4.00×1.80×0.30	2.16
Left Wall	(4.00×1.80)+(4.00×1.50)	13.20	4.00×1.80×0.30	2.16
Upper Stream Wall	(4.00×1.60)+(4.00×1.00)	10.40	4.00×1.00×0.30	1.20
Bottom part		-	1.50×1.00×0.50	0.75
Total		36.80		6.27

Other Materials

    A Complete Set of Lodge, Reinforcing for Step Use

    Headrace Pipe   ø0.1m 3.0m 1pc.

    Drain Pipe   ø0.05m 1.30m 1pc.

C Area Gauging Facilities

Dam (Drawing-No.2)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	11.0×1.0×2+1.0×1.0	23.00	11.0×1.0×1.0	11.00
A'	4.0×1.0×2+1.0×1.0	9.00	4.0×1.0×1.0	4.00
B	$\frac{25.0+12.0}{2}$×2.5×(1+1.044)	94.54	$\frac{2.5}{6}${(25×1)+(12×1.75)+[(25+12)(1+1.75)]}	61.56
Total		126.54		76.56

Excavation Calculation						
Item / Partition	Earth				(m³)	Rock
	Down Width	Upper Width	Height	Length	Volume	
a	1.75	3.45	1.7	4.0	17.68	
b	2.02	4.22	2.2	3.2	21.96	
c	2.23	4.03	1.8	2.4	13.52	
d	2.34	3.74	1.4	0.4	1.70	
e	2.35	4.15	1.8	10.2	59.67	
f	2.35	4.95	2.6	1.8	17.08	
g	2.17	5.27	3.1	1.3	14.99	
h	1.81	4.41	2.6	1.7	13.75	
Total					160.35	

Other Materials		
Water Stop	Vinyl Chloride 220×6mm	2.5m
Grouting Pipe	Steel Pipe ⌀38mm 40+0.4×16pc.	47m
Cement Milk	[(1.0+1.75)×1/2×(3.91+10.31)+12.0×1.75]×1.0×0.2	8.11m³

Upper End Wall of Channel (Drawing-No.3)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$(\dfrac{3.75+6.25}{2}+\dfrac{2.75+5.25}{2})\times0.5+0.5\times1.414^2$	5.50	$\dfrac{3.75+6.25}{2}\times0.5\times1.0-\dfrac{1.0\times0.5\times1.0}{2}$	2.25
A'	$(\dfrac{3.75+6.25}{2.1}+\dfrac{2.75+5.25}{2.0})\times0.5+0.5\times1.414^2$	5.50	$\dfrac{3.75+6.25}{2}\times0.5\times1.0-\dfrac{1.0\times0.5\times1.0}{2}$	2.25
B	$(\dfrac{6.25+7.75}{2}+\dfrac{5.25+6.75}{2})\times1.5+1.5\times1.414^2$	22.50	$\dfrac{6.25+7.75}{2}\times1.5\times1.0-\dfrac{1.0\times1.5\times1.0}{2}$	9.75
B'	$(\dfrac{6.25+7.75}{2}+\dfrac{5.25+6.75}{2})\times1.5+1.5\times1.414^2$	22.50	$\dfrac{6.25+7.75}{2}\times1.5\times1.0-\dfrac{1.0\times1.5\times1.0}{2}$	9.75
C	$\dfrac{16.0+12.0}{2}\times1.2\times2$	33.60	$\dfrac{16.0+12.0}{2}\times1.2\times1.0$	16.80
Total		89.60		40.80

Excavation Calculation						
Item / Partition	Earth				(m³)	Rock
	Down Width	Upper Width	Height	Length	Volume	
a	1.6	4.1	2.5	2.0	14.25	
b	1.6	4.1	2.5	2.0	14.25	
c	1.6	3.4	1.8	4.0	18.00	
d	1.6	3.0	1.4	1.6	5.15	
e	1.6	2.7	1.1	2.6	6.15	
f	1.6	3.6	2.0	1.8	9.36	
g	1.6	4.2	2.6	2.0	15.08	
Total					82.24	

Down End Wall of Channel (Drawing-No.4)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
A	$\dfrac{1.75+7.75}{2}\times2.0\times2+2.0\times1.0\times1.414$	21.83	$\dfrac{1.75+7.75}{2}\times2.0\times1.0$	9.50
A'	$\dfrac{3.75+9.75}{2}\times2.0\times2+2.0\times1.0\times1.414$	29.83	$\dfrac{3.75+9.75}{2}\times2.0\times1.0$	13.50
B	$18.0\times1.5\times2$	54.00	$18.0\times1.5\times1.0$	27.00
Total		105.66		50.00

Item / Partition	Excavation Calculation					Rock
	Earth				(m³)	
	Down Width	Upper Width	Height	Length	Volume	
a	1.6	3.6	2.0	6.0	31.20	
b	1.6	3.4	1.8	2.0	9.00	
c	1.6	2.6	1.0	2.2	4.62	
d	1.6	3.5	1.9	7.8	37.79	
Total					82.61	

Sedimentation Basin (Drawing-No.3)

Item / Partition	Frame Calculation	(m^2)	Volume Calculation	(m^3)
Upper Sidewall	$4.0 \times 0.7 \times (1+1.02) \times 2$	11.31	$\frac{0.5+0.64}{2} \times 0.7 \times 4 \times 2$	3.19
Down Sidewall	$\frac{4.0+3.4}{2} \times 2.0 \times (1+1.02) \times 2$	29.90	$\frac{0.64+1.04}{2} \times 2.0 \times \frac{4.0+3.4}{2} \times 2$	12.43
Bottom Part	$\frac{3.4+3.25}{2} \times 0.5 \times 2$	3.33	$\frac{3.4+3.25}{2} \times 0.5 \times 12.0$	19.95
Total		44.54		35.57

Item / Partition	Upper End Section			Down End Section		
	Mean Height	Length	Area	Mean Height	Length	Area
a	1.7	1.6	2.72	2.5	2.0	5.00
b	1.4	0.4	0.56	2.5	2.0	5.00
c	1.8	10.2	18.36	1.8	4.0	7.20
d	2.6	1.8	4.68	1.4	1.6	2.24
e	3.1	1.3	4.03	1.1	2.6	2.86
f	2.9	0.7	2.03	2.0	1.8	3.60
g	-	-	-	2.6	2.0	5.20
Total			32.38			31.10

Mean Length of Excavation $\quad \frac{1.8+2.65}{2} = 2.23m$ (Except Overlap Portion)

Excavation Volume $\quad \frac{32.38+31.1}{2} \times 2.23 = 70.78m^3$

Channel (Drawing-No.4)

Item / Partition	Frame Calculation	(m²)	Volume Calculation	(m³)
Front Sidewall	2.0×1.41×19.0×2	107.16	$\frac{0.5+1.0}{2}$×2.0×1.90×2	57.00
Back Sidewall	2.0×1.25×19.0×2	95.00		
Bottom	0.5×19.0×2	19.00	0.5×2.5×19.0	23.75
Total		221.46		80.75

Gravel Volume		(m³)	Volume of Stage Observation Room and Frame (m²)		
Upper Back Side	$\frac{0.5+1.0}{2}$×2.0×19.0×2	57.00	Sidewall	(1.8×1.6-1.5×1.0)×3.5	4.83
Down Back Side	$\frac{1.0+0.75}{2}$×0.5×19.0×2	16.63	Bottom Part	1.8×1.6×0.5	1.44
Bottom Part	$\frac{4.0+3.5}{2}$×0.5×19.0	35.63	Total		6.27
Total		109.26	Frame	(1.8+1.8+1.6)×4.0+(1.5+1.5+1.0)×3.5	34.80

Item / Partition	Upper End Section					(m³)	Down End Section					(m³)
	Mean Height	Length	Volume	Mean Height	Length	Volume	Mean Height	Length	Volume	Mean Height	Length	Volume
a				0.8	0.9	0.72				0.5	0.5	0.25
b				1.6	1.7	2.72				1.3	2.0	2.60
c				1.2	1.7	2.04				0.5	2.0	1.00
d				0.5	0.5	0.25				-	-	-
a'	0.7	1.1	0.77				0.7	3.0	2.10			
b'	1.1	0.7	0.77				1.5	0.7	1.05			
c'	0.5	0.7	0.35				0.8	0.8	0.64			
d'	0.9	1.3	1.17				0.8	1.3	1.04			
e'	2.2	0.9	1.98				1.7	2.7	4.59			
f'	1.2	1.8	2.16				0.8	2.7	2.16			
g'	0.2	0.5	0.10				-	-	-			
Total			7.30			5.73			11.58			3.85

Mean Length of Excavation $\frac{16.9+18.4}{2}$ =17.65m (Except Overlap Portion)

Excavation Volume $\frac{5.73+3.85}{2}$×17.65=84.54m³

Banking Volume $\frac{7.30+11.58}{2}$×19.0=179.36m³

Other Materials		
Reinforcing Bar	φ16mm (2.5+2.5+2.0)×57×1.579kg	0.63t
Reinforcing Bar	φ9mm 19.0×11×0.499kg	0.10t
Headrace Pipe	φ10cm ℓ 3.0m	1pc.
Metallic Material for Going up and down	⌐ Type 25cm	6pcs.
Lodge Materials	1.8×1.6×1.0m	1 set

A AREA GAUGING FACILITIES DRAWING NO.1

PLAN   Scale 1/286

Gauging Dam

Soil Saving Dam

BM (BP)

R-3   R-4   R-5

R-2

R-1

Wooden Bridge

Forest Road

N E W S

PROFILE   Scale 1/143

Soil Saving Dam

Gauging Dam

Sream Bed Line

BM

Survey Point	Distance (m)	Ground Height (m)	Structural Height (m)
BP		10.00	
R - 1		7.995	
	6.50		
R - 2		8.135	
	6.35		
D - 4		9.445	(3.055) 12.500
	4.40		
R - 3		10.040	
	5.20		
R - 4		11.525	
	10.40		
C - 4		12.055	
	5.00		
D - 5		12.105	(1.895) 14.000
	3.25		
R - 5		12.210	

A - 1
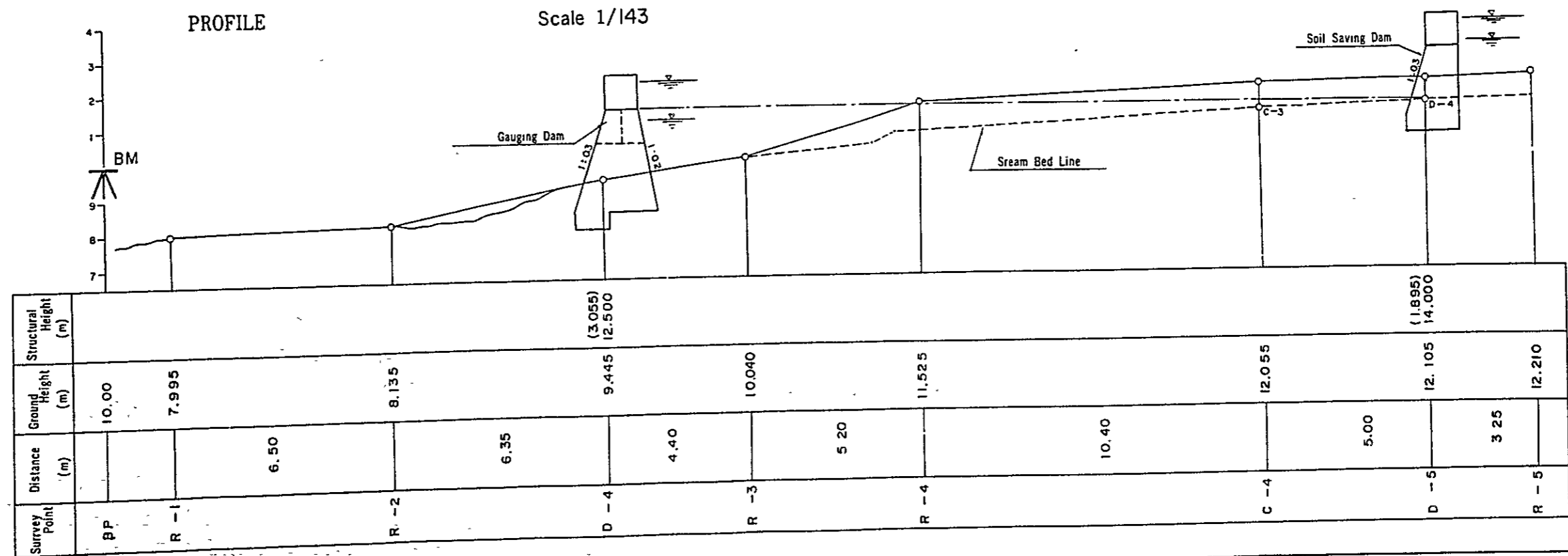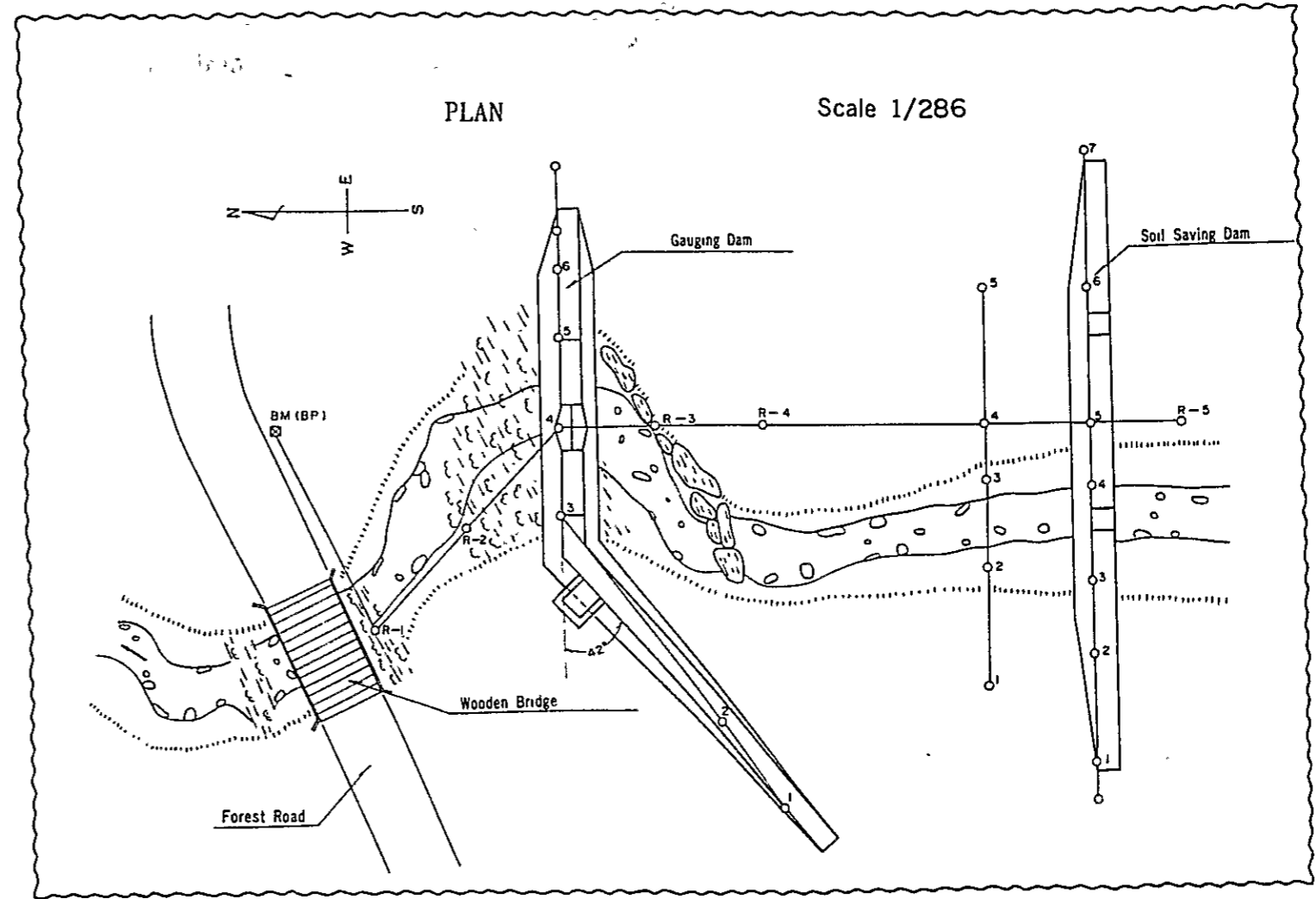
A AREA GAUGING FACILITIES DRAWING NO.2

STRUCTURAL DRAWING OF GAUGING DAM   Scale 1/143
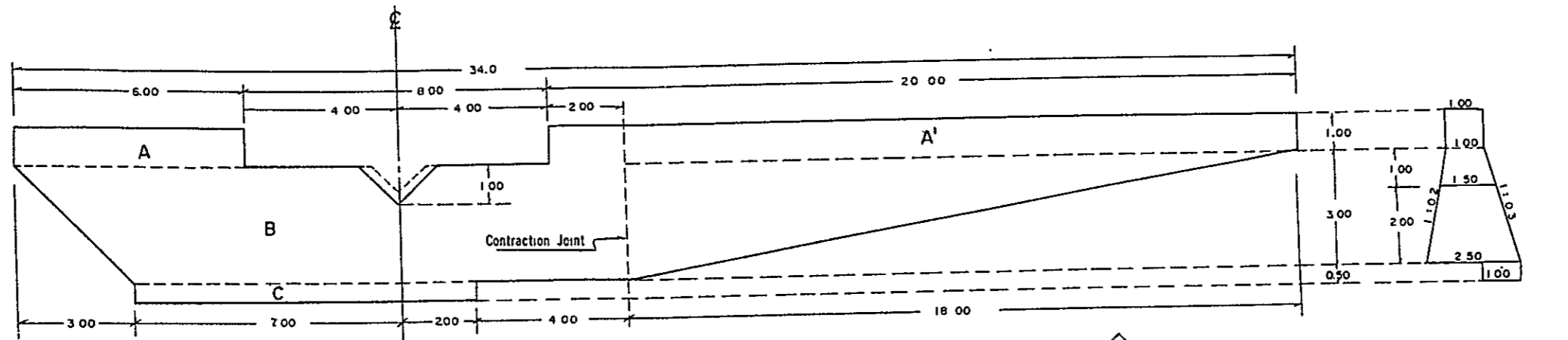
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[SIDE VIEW]
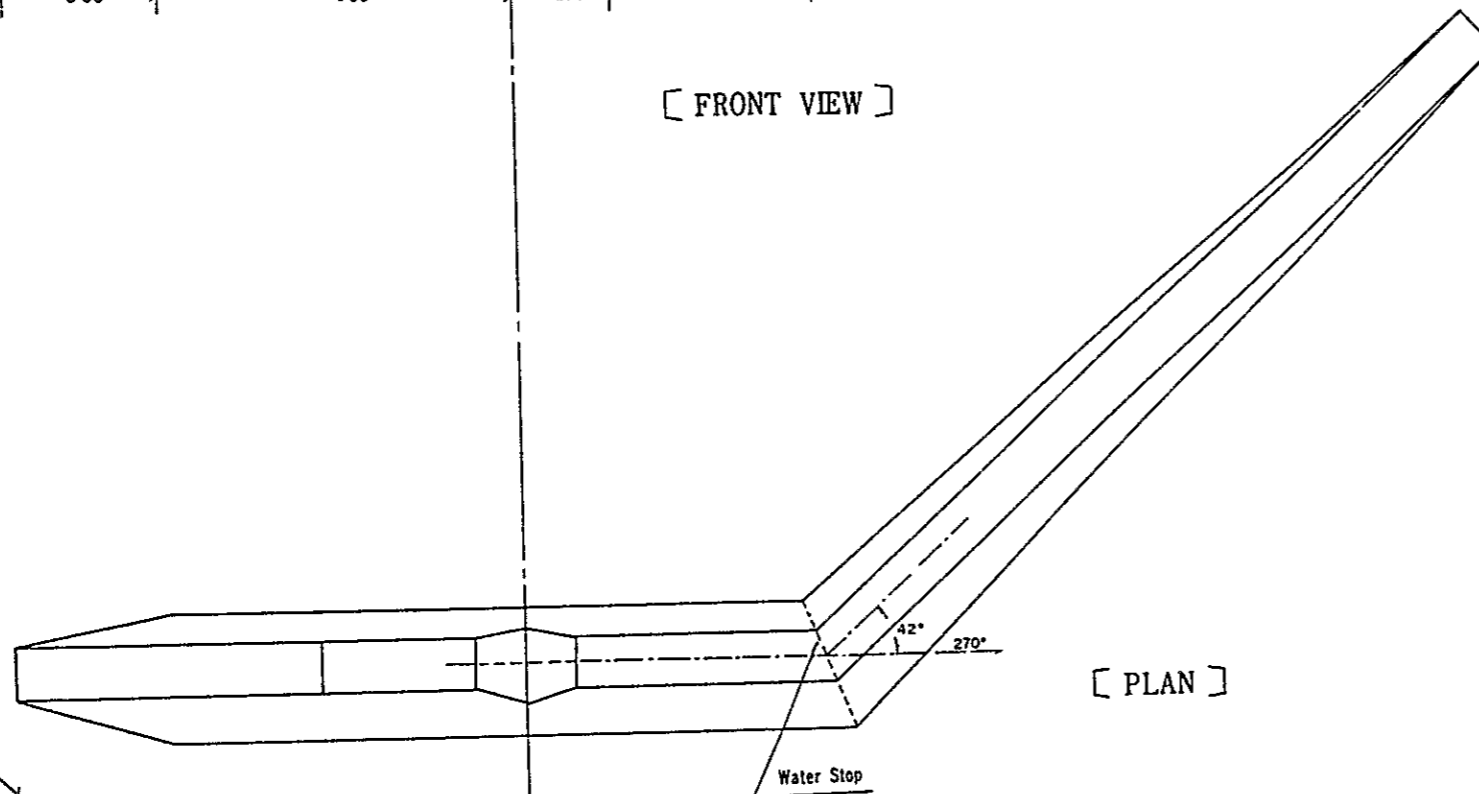
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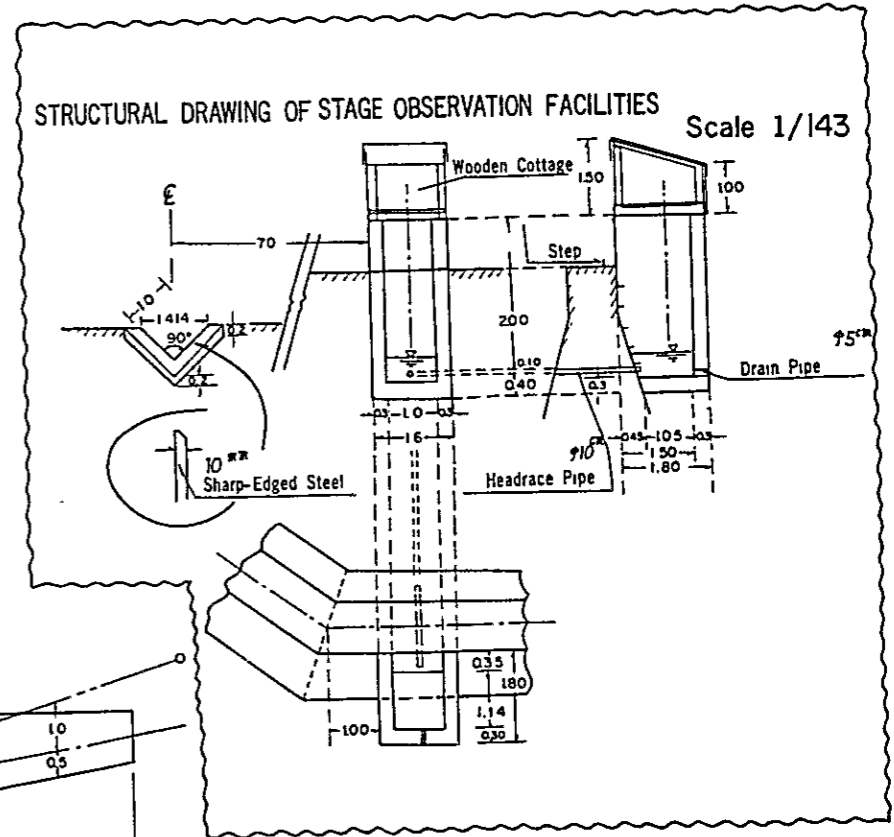
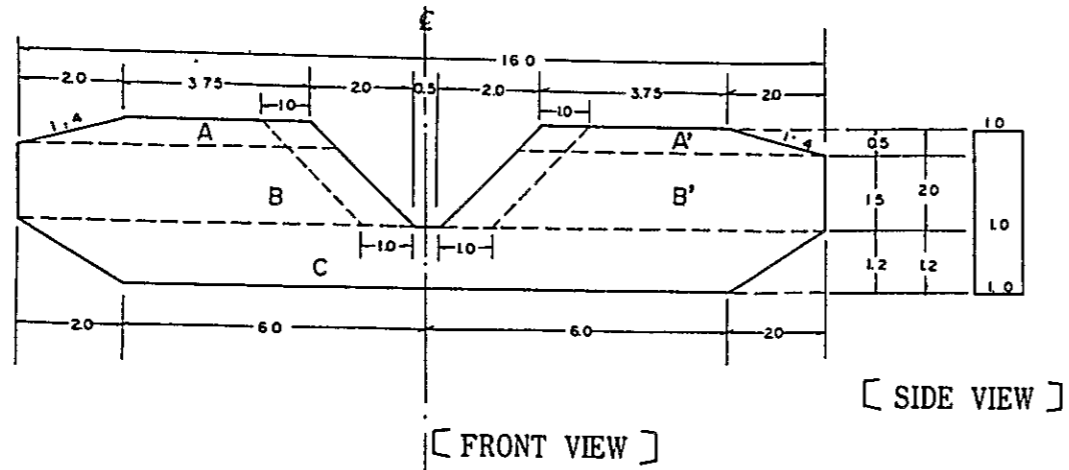STRUCTURAL DRAWING OF STAGE OBSERVATION FACILITIES   Scale 1/143

[EXCAVATION]

A-2
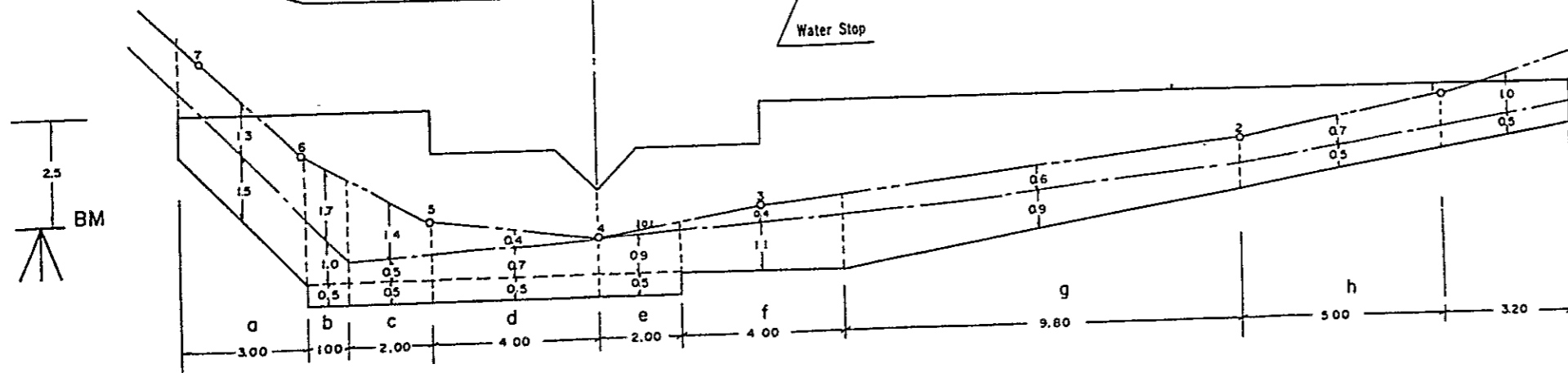
A AREA GAUGING FACILITIES DRAWING NO.3

STRUCTURAL DRAWING OF SOIL SAVING DAM   Scale 1/143
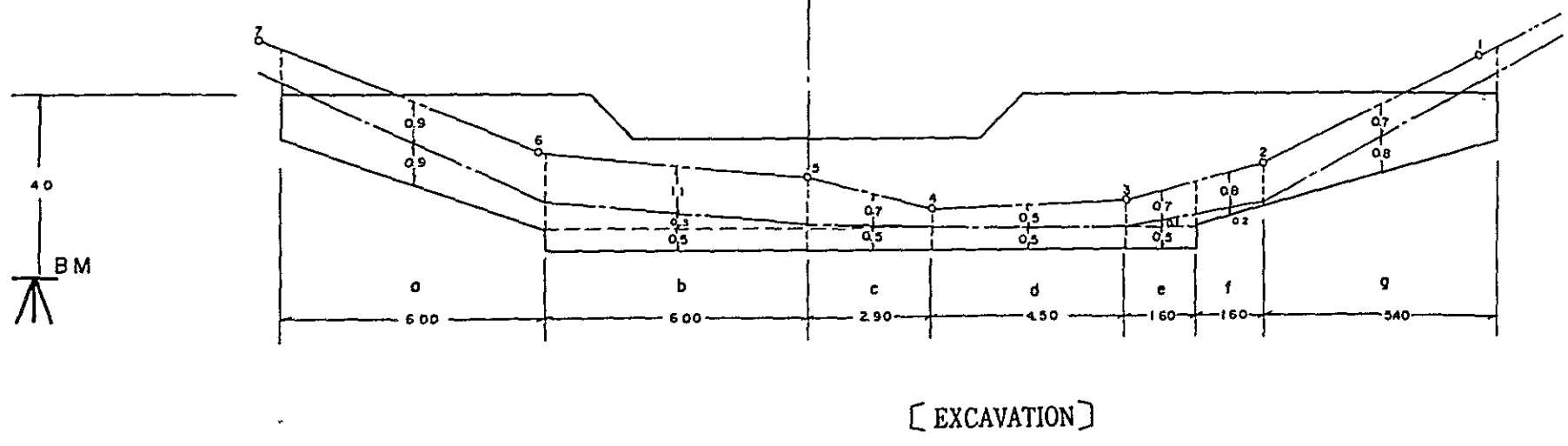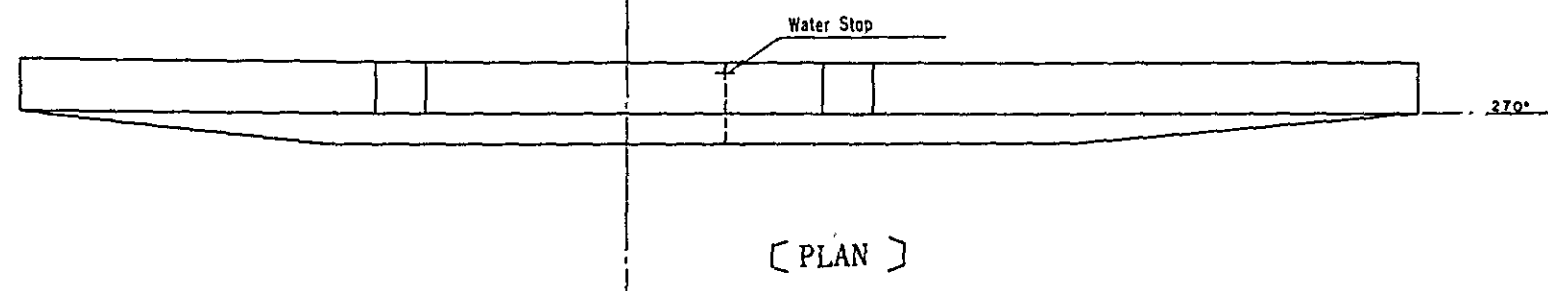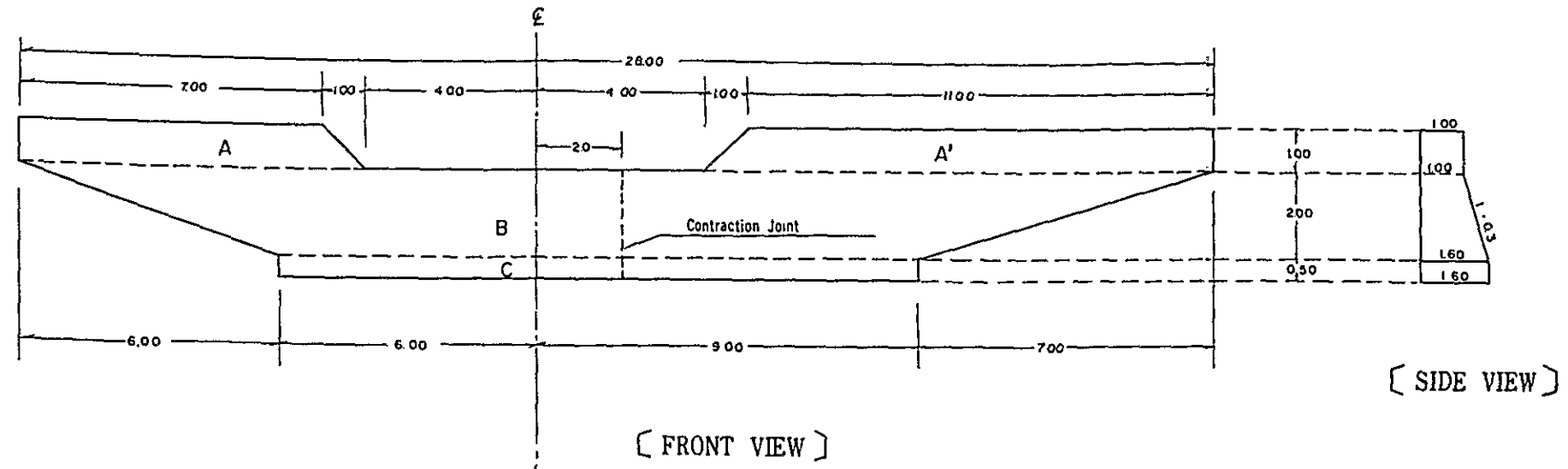
[FRONT VIEW]

[SIDE VIEW]

[PLAN]

[EXCAVATION]

B AREA GAUGING FACILITIES DRAWING NO.1

PLAN

Scale 1/286

Forest Road

Wooden Bridge

BM (BP)

R-1

R-4

Down End Wall of Channel

Channel

Dam

8.0

1%
Grade

0.5

1.0

Cu-5

D-5

Stream Bed Line

1.6

5.0

0.4

BM

PROFILE

Scale 1/143

9

8

7

6

5

4
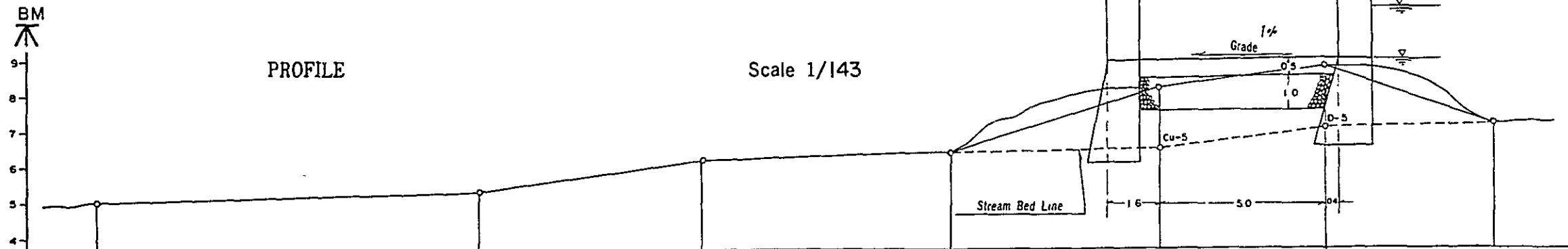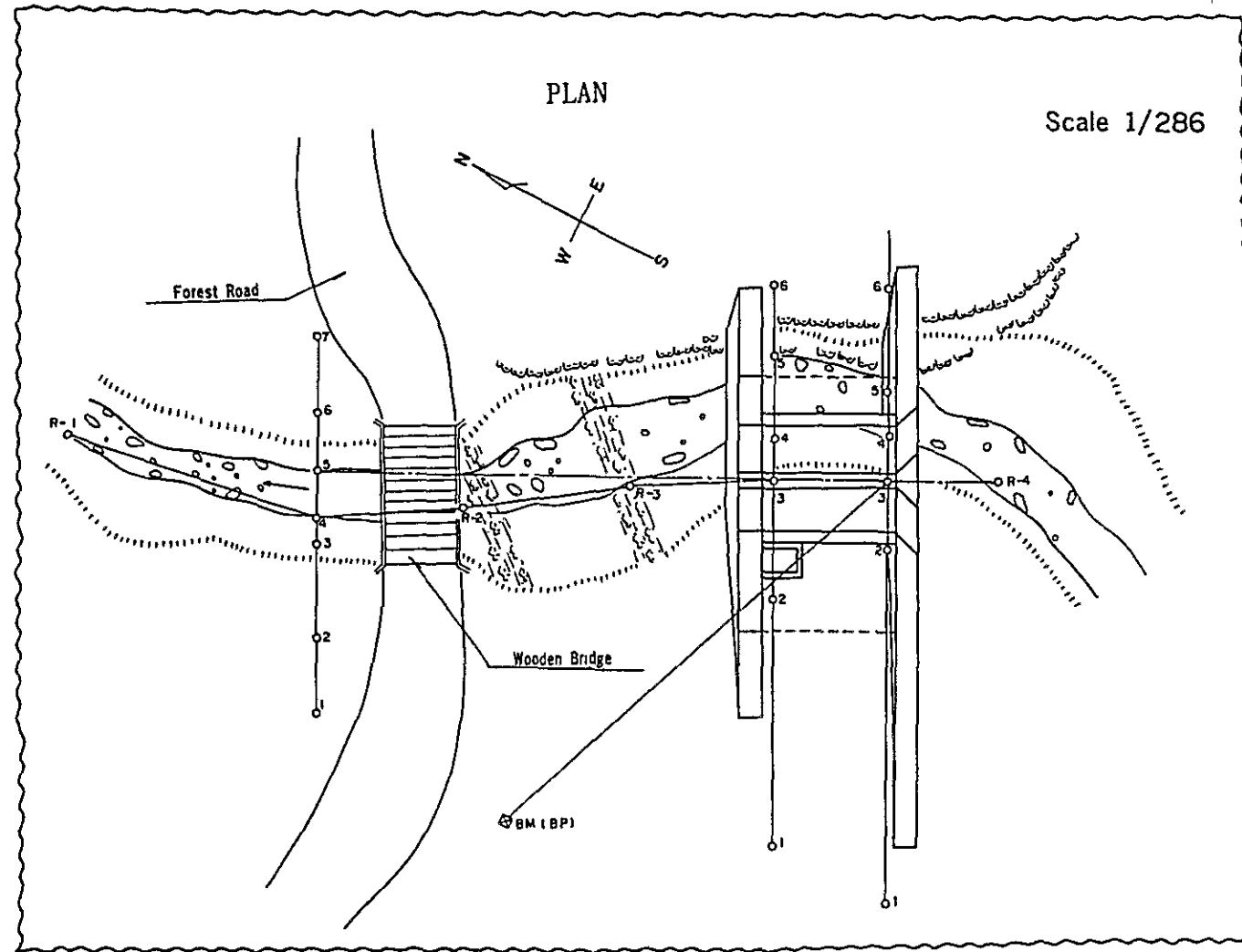
Survey Point	Distance (m)	Ground Height (m)	Structural Height (m)
B.P.		15.075	
R - 1	11.20	10.00	
Cu - 4	6.64	10.20	
R - 2	7.49	11.055	
R - 3	6.23	11.265	
Cu - 3	5.00	13.185	(4.56) 15.94
D - 3	5.00	13.760	(3.99) 16.00
R - 4			

B-1

STRUCTURAL DRAWING OF DAM   Scale 1/143

[SIDE VIEW]

[FRONT VIEW]

STRUCTURAL DRAWING OF STAGE OBSERVATION FACILITIES
Scale 1/143

[SIDE VIEW]

[PLAN]

[EXCAVATION]

[PLAN]

STRUCTURAL DRAWING OF DOWN NEND WALL OF CHANNEL　　Scale 1/143

[FRONT VIEW]

[PLAN]

0.865 BM

[EXCAVATION]
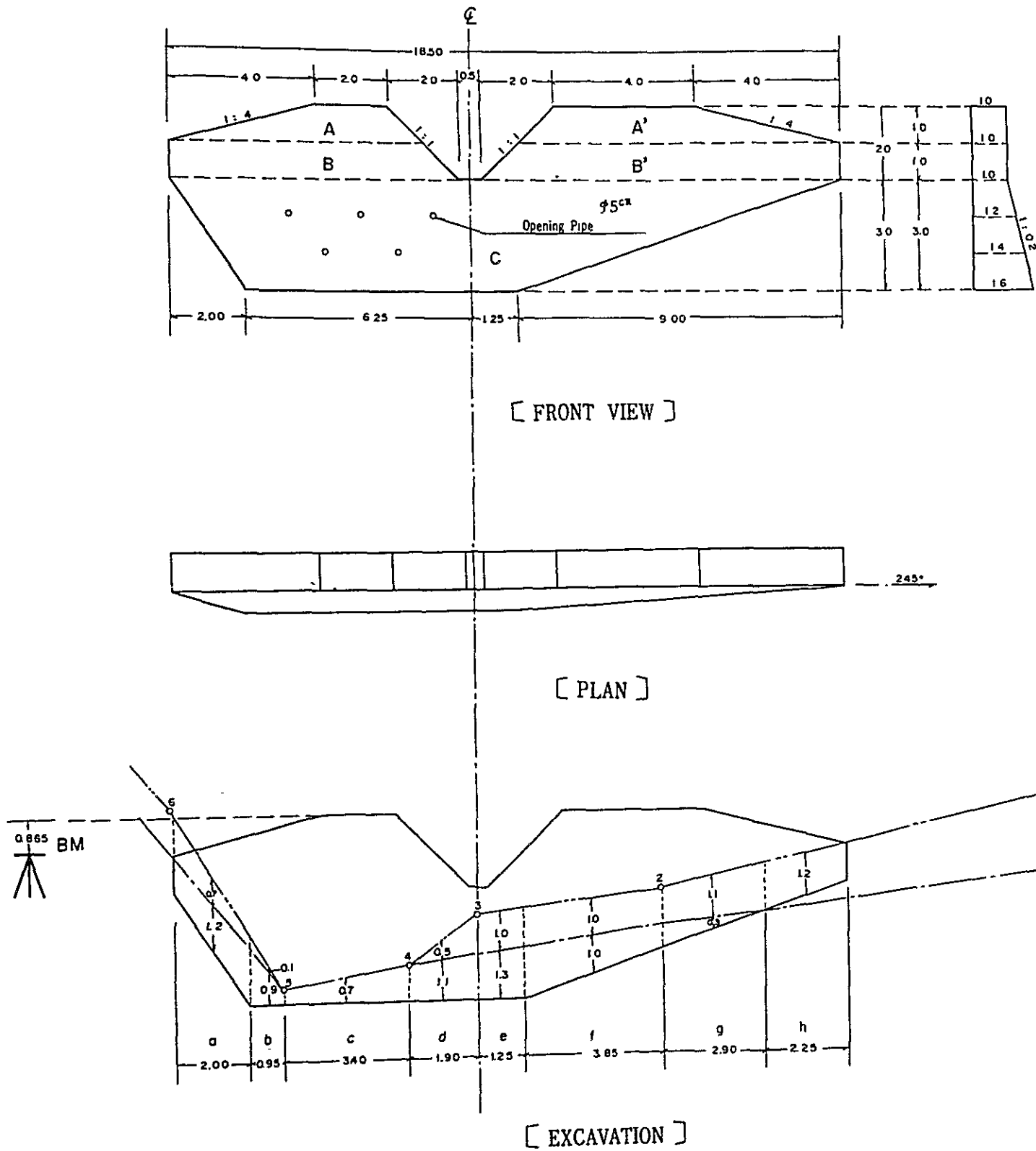
CALCULATING DRAWING OF CHANNEL AND BANKING　　Scale 1/143

[UPPER END DRAWING
OF CHANNEL]

[PLAN OF CHANNEL]

Reinforcing Bar　　Distribution Bar

[DOWN END DRAWING
OF CHANNEL]

B－3
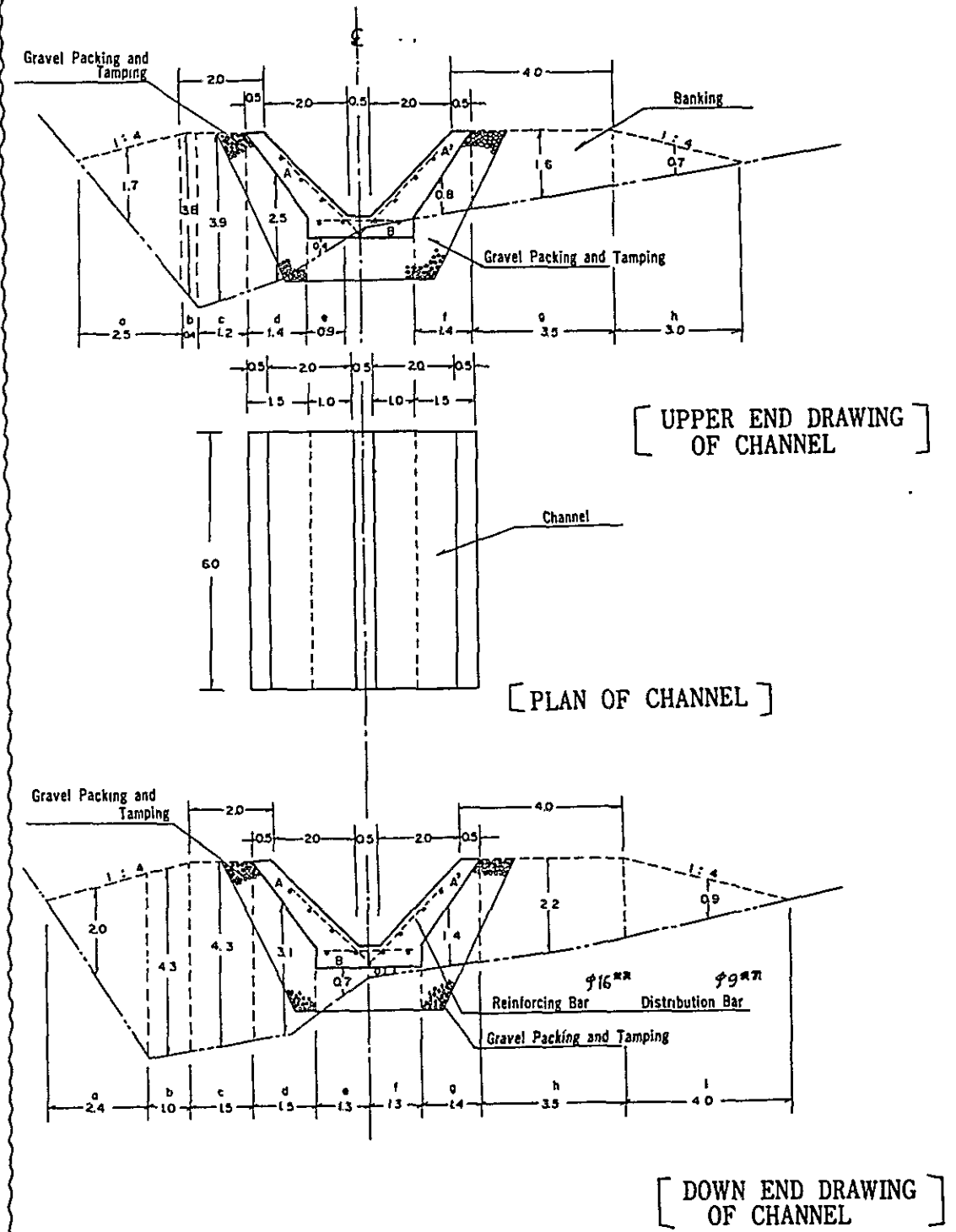
C AREA PLAN AND PROFILE   Scale 1/286
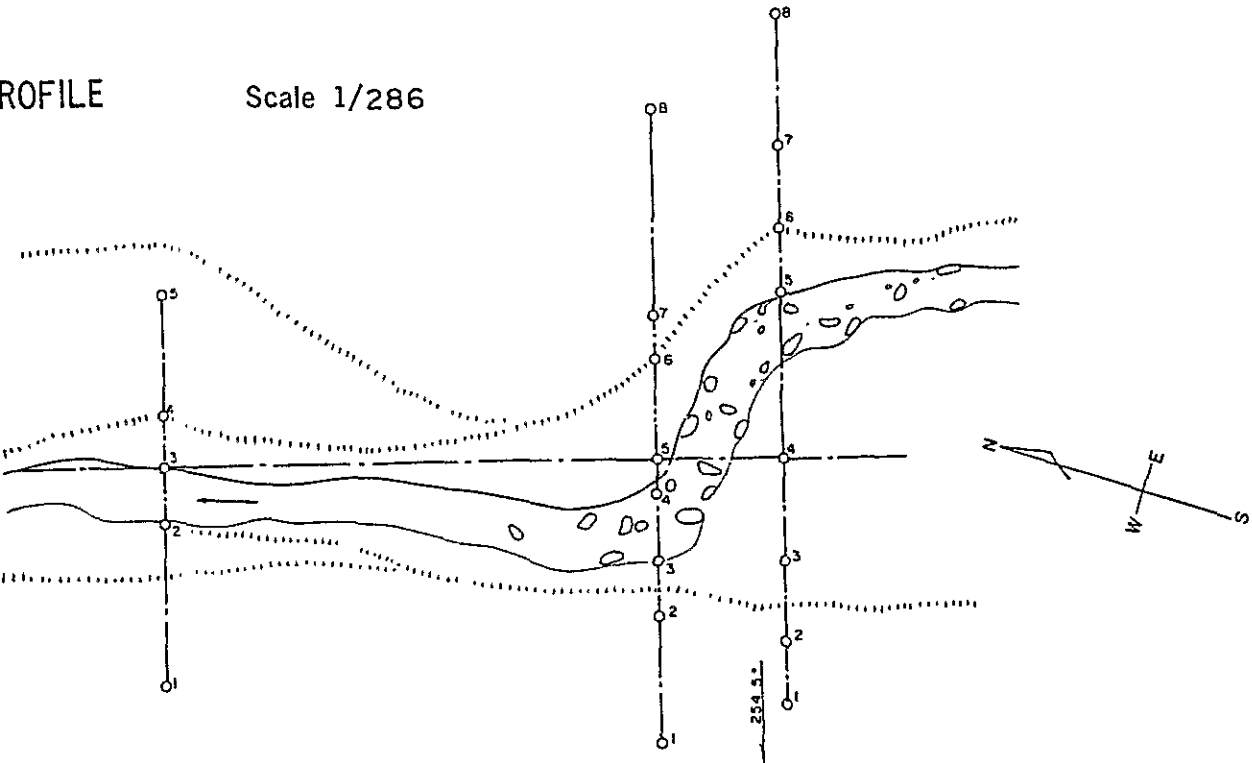
N
W — E
S

254.51

Stream Bed Line

Ground Height (m)		10.000		11.180	11.345
Distance (m)			20.00	5.00	
Survey Point		CL - 3		Cu - 5	D - 4

C - 1

C AREA GAUGING FACILITIES DRAWING NO.1

PLAN AND PROFILE   Scale 1/143

[PLAN]
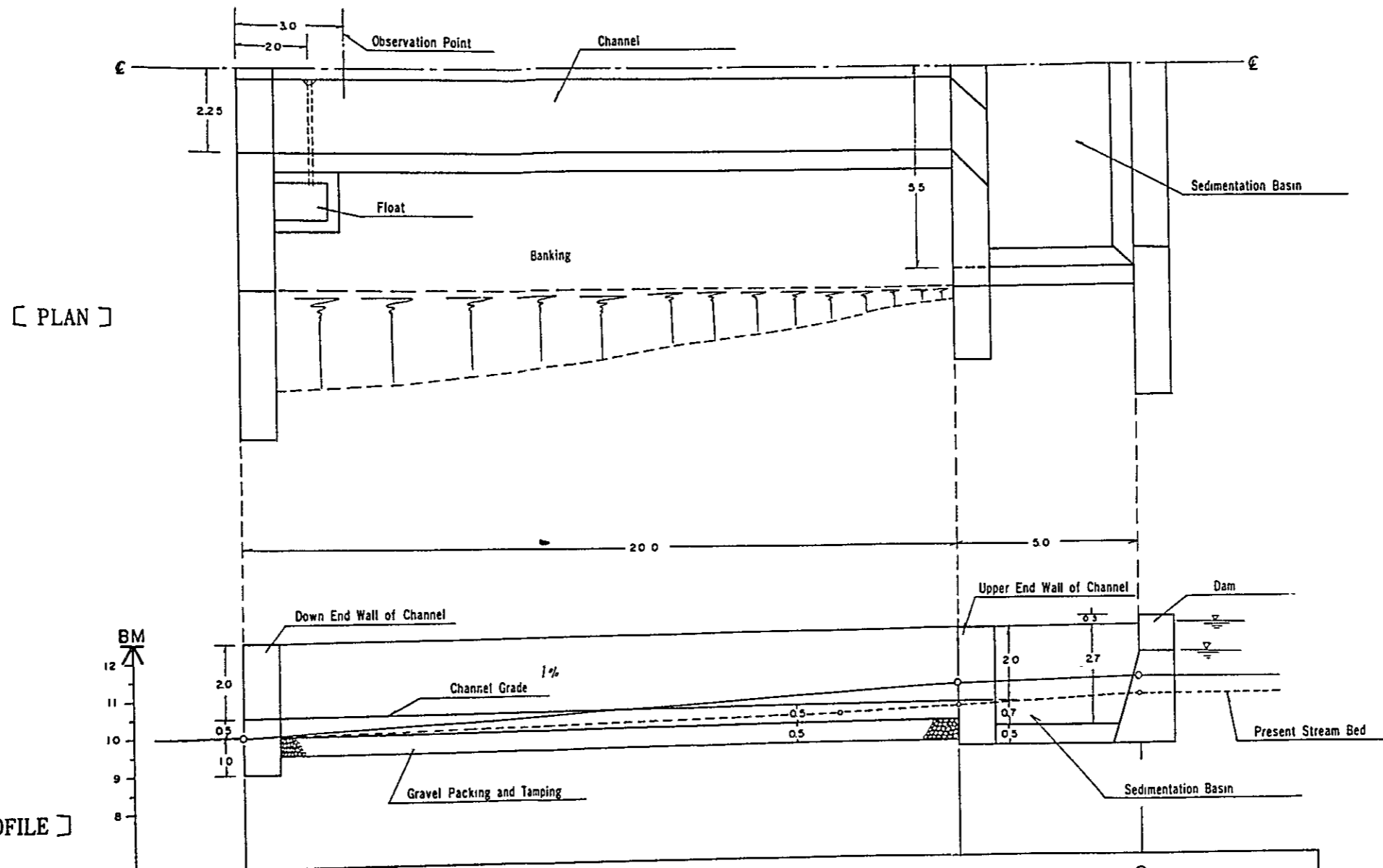
[PROFILE]

Survey Point		Distance (m)		Ground Height (m)		Structural Height (m)	
BP				12.500			
CL-3		20.00		10.000		(2.500) 12.500	
Cu-5		5.00		11.180		(1.520) 12.700	
D-4				11.345		(1.655) 13.000	

C-2

STRUCTURAL DRAWING OF DAM   Scale 1/143

A

A'

B   Contraction Joint

Grouting Pipe

[FRONT VIEW]

[SIDE VIEW]

Water Stop

254.5°

[PLAN]

BM
(BP)

a   b   c   d   e   f   g   h
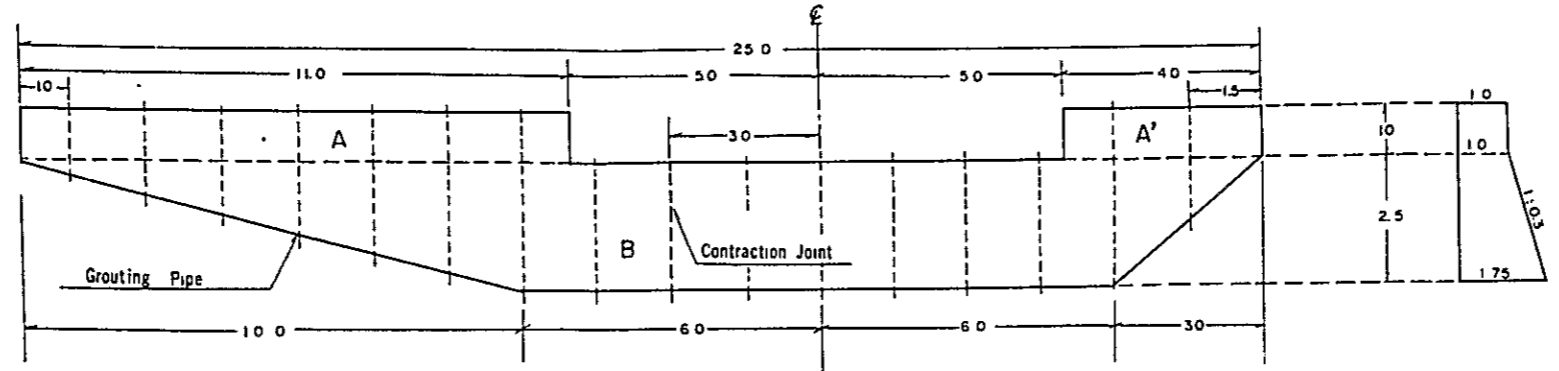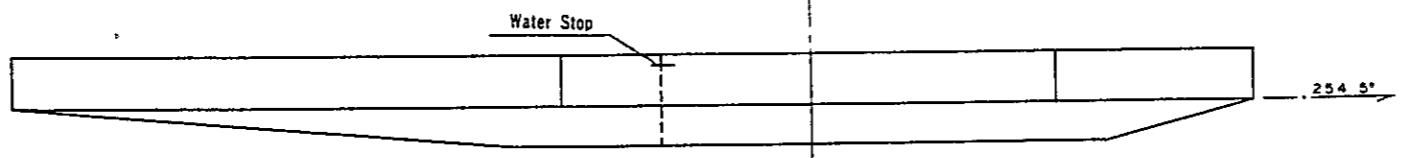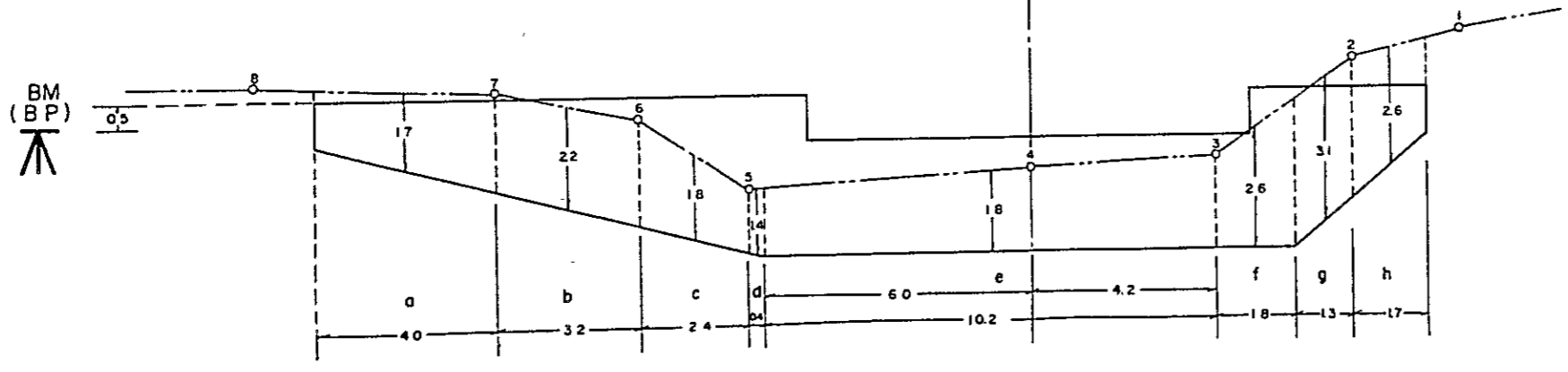
[EXCAVATION]

C AREA GAUGING FACILITIES DRAWING NO.3

STRUCTURAL DRAWING OF UPPER END WALL OF CHANNEL Scale 1/143

[FRONT VIEW]

[SIDE VIEW]

[PLAN]
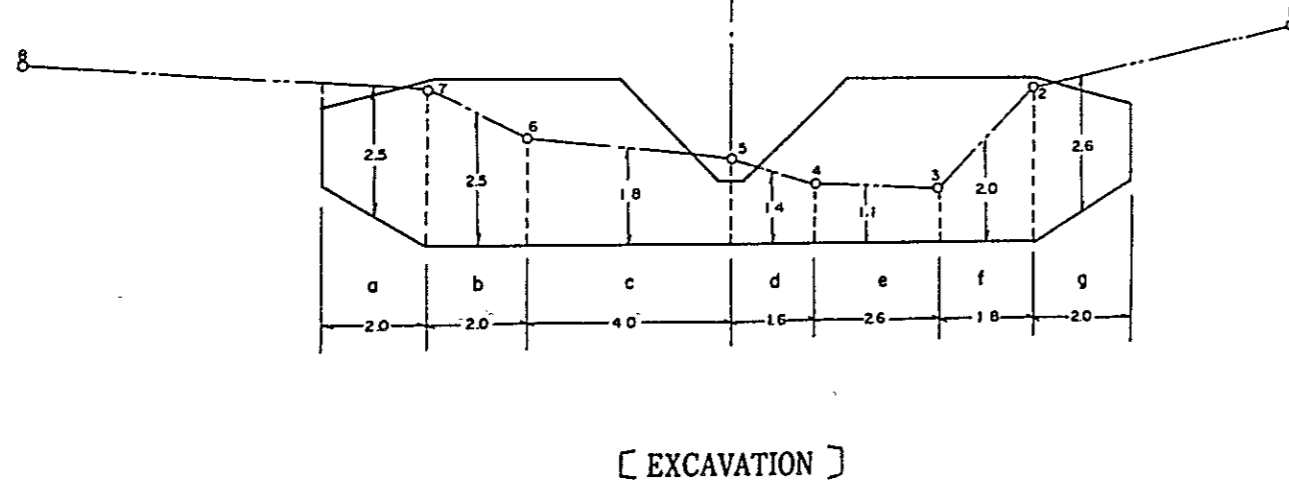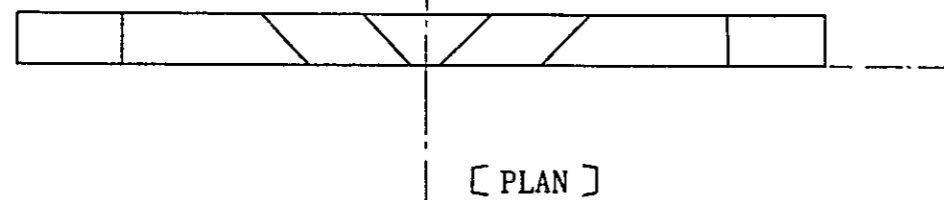
[EXCAVATION]

DRAWING OF STRUCTURE AND EXCAVATION FOR SEDIMENTATION BASIN Scale 1/143

[Upper End of Sedimentation Basin]

[Sedimentation Basin (Plan)]

[Down End of Sedimentation Basin]
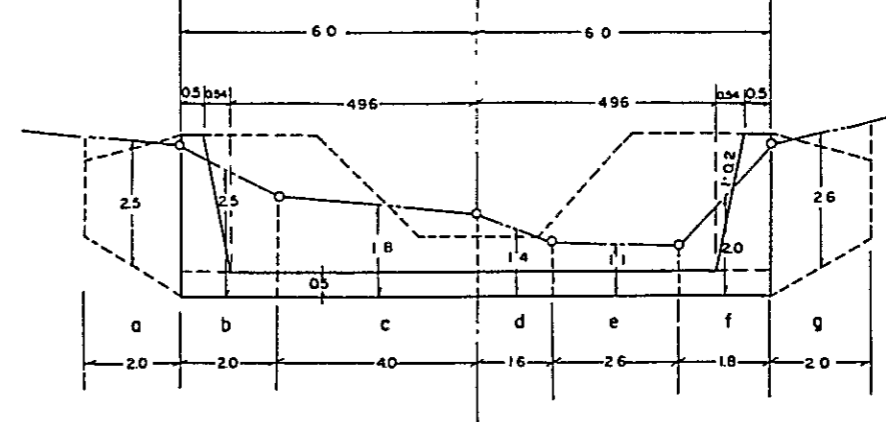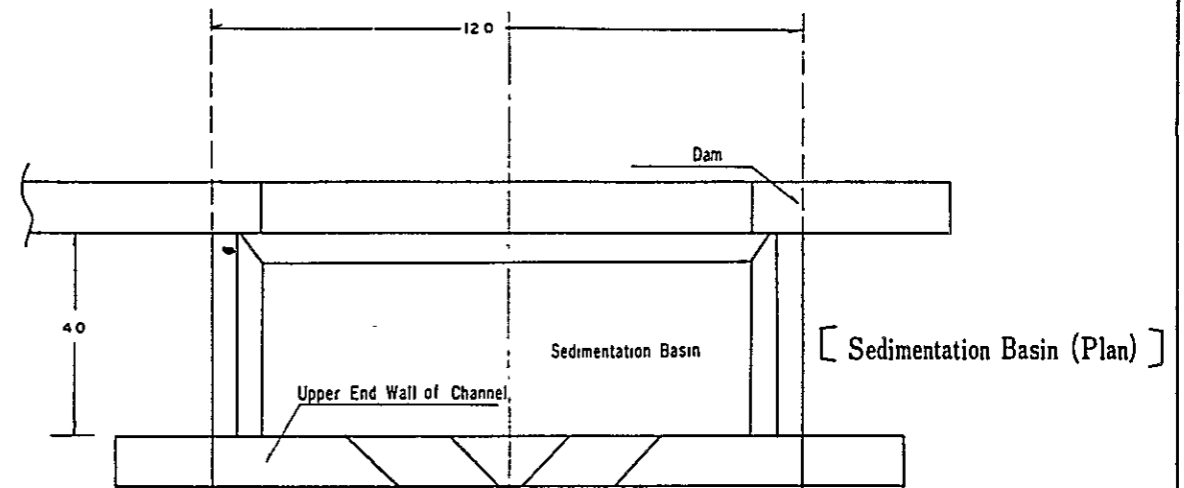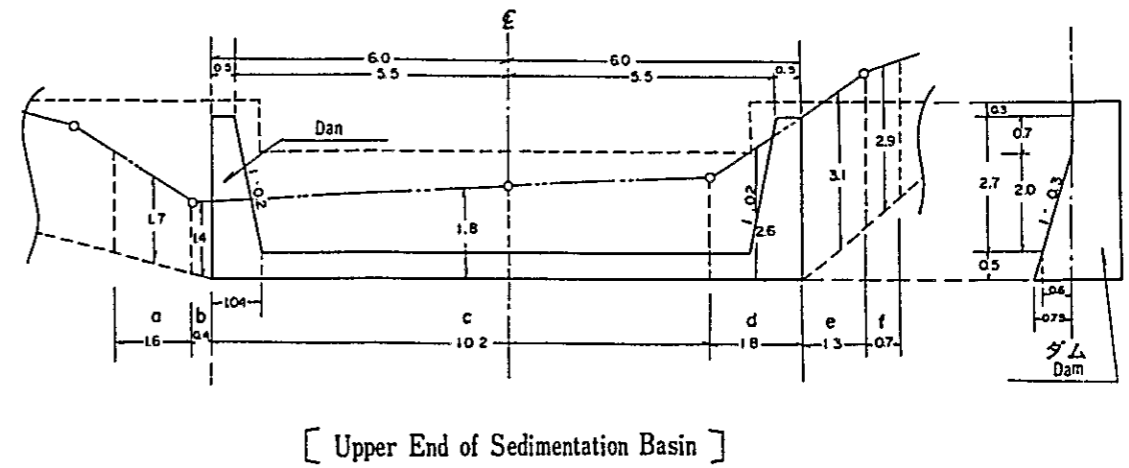
C AREA GAUGING FACILITIES DRAWING NO.4

STRUCTURAL DRAWING OF DOWN END WALL OF CHANNEL   Scale 1/143

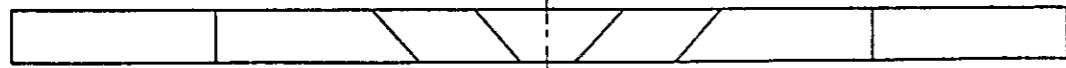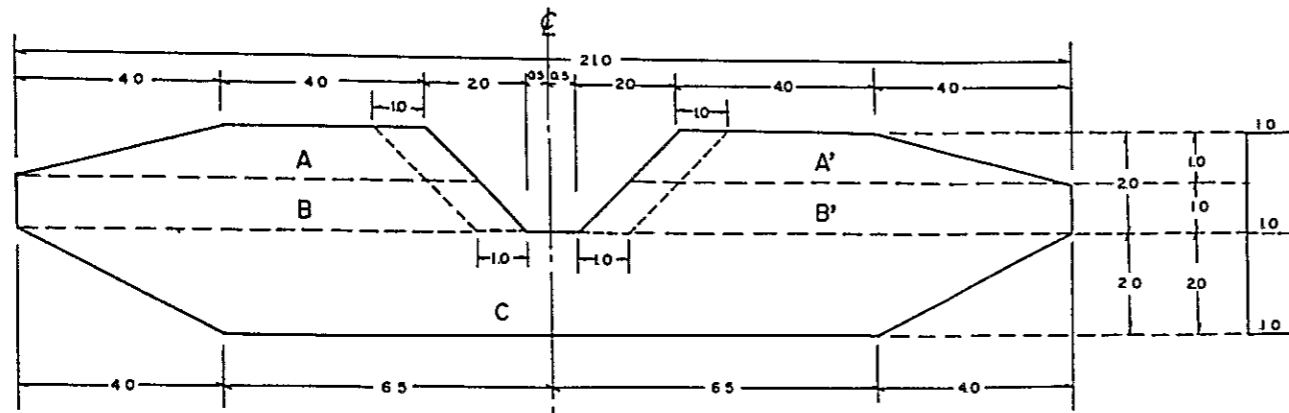[FRONT VIEW]   [SIDE VIEW]
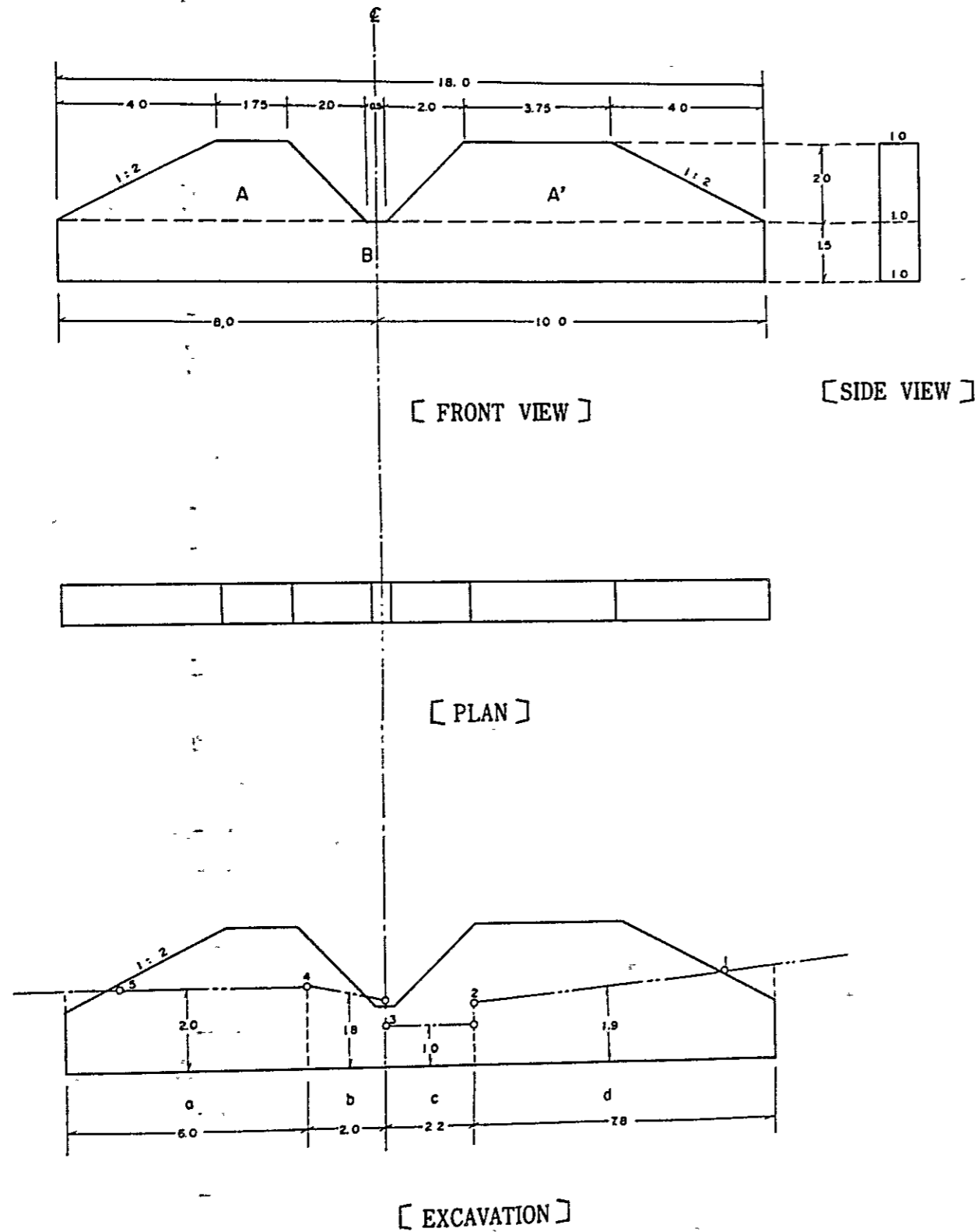
[PLAN]

[EXCAVATION]

CALCULATING DRAWING OF STRUCTURE, EXCAVATION AND BANKING FOR CHANNEL AND STAGE OBSERVATION ROOM

Scale 1/143

[Upper End Wall of Channel]

[Channelc (Plan)]

[Stage Observation Room]

[Down End of Channel]
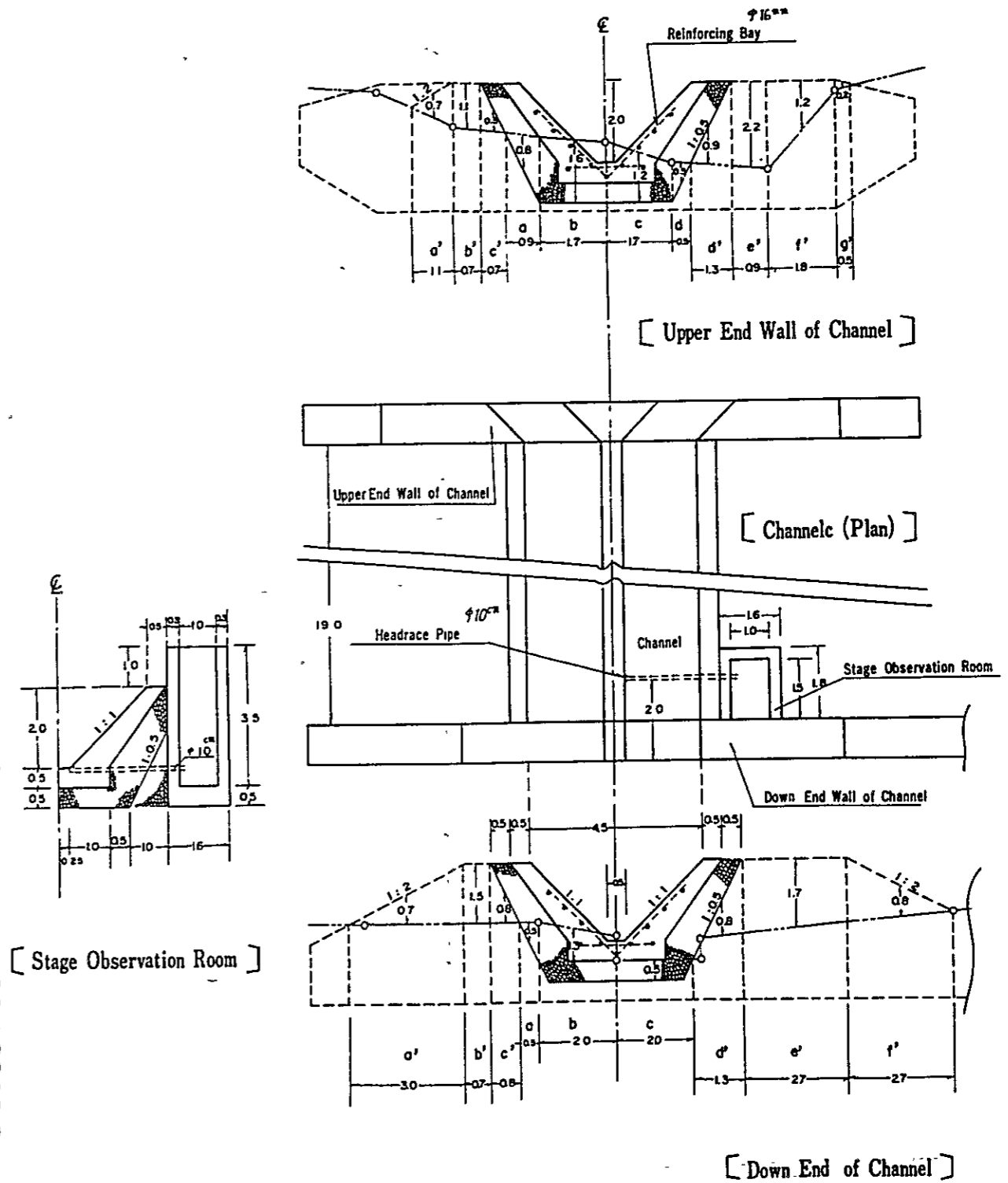
D AREA ARRANGEMENT DRAWING OF STRUCTURES
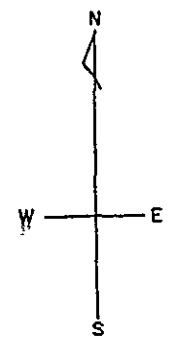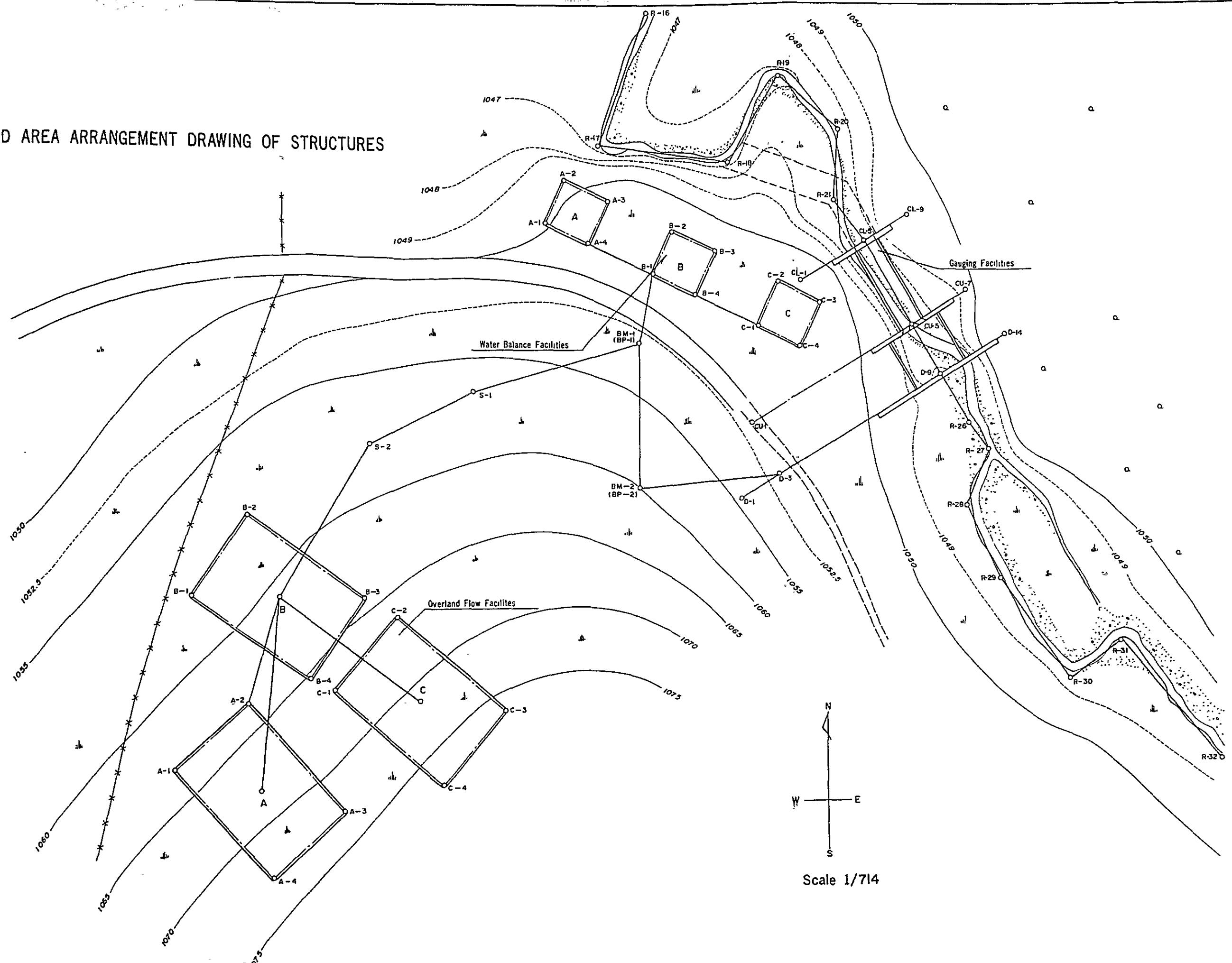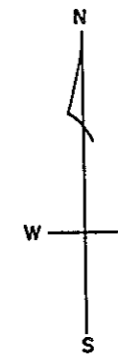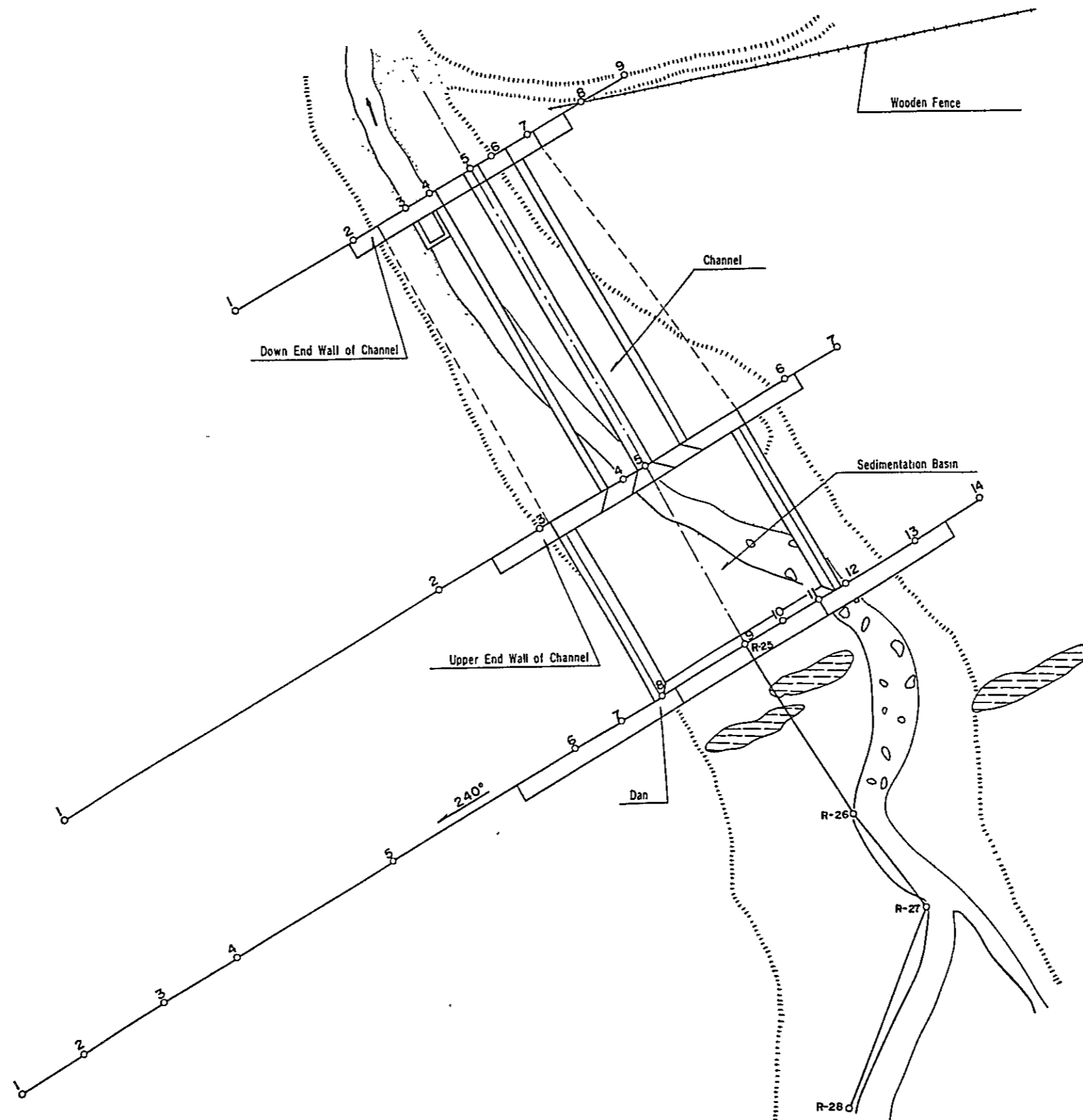
Water Balance Facilities

Gauging Facilities

Overland Flow Facilites

Scale 1/714

N
W — E
S

D-1

D AREA GAUGING FACILITIES PLAN

Wooden Fence

Channel

Down End Wall of Channel

Sedimentation Basin

Upper End Wall of Channel

240°

Dan

Scale 1/286

N
W — E
S

R-25

R-26

R-27

R-28

D-2

D AREA GAUGING FACILITIES DRAWING NO.1

PLAN AND PROFILE

Scale 1/143

[PLAN]

Observation Point

Headrace Pipe

Channel

Sedimentation Basin

Float

Banking

Banking

BM

[PROFILE]

Down End Wall of Channel

Upper End Wall of Channel

Dam

1%

Gravel Packing and Tamping

Sedimentation Basin

Channel Grade

Present Stream Bed

Gravel Packing and Tamping

Present Stream Bed

Digging

Survey Point	Distance (m)	Ground Height (m)	Structural Height (m)
B.P.-1		1053.070	
R-21	10.80		
CL-5	20.00	1047.565	(1.505) 1049.07
Cu-5	12.00	1047.280	(1.99) 1049.27
D-9		1048.045	(1.725) 1049.77

D-3

D AREA GAUGING FACILITIES DRAWING NO.2

STRUCTURAL DRAWING OF DAM   Scale 1/143

[SIDE VIEW]

[FRONT VIEW]

Contraction Joint

Water Stop

[PLAN]

BM−1
(BP 1)

Contraction Joint

[EXCAVATION]

D − 4
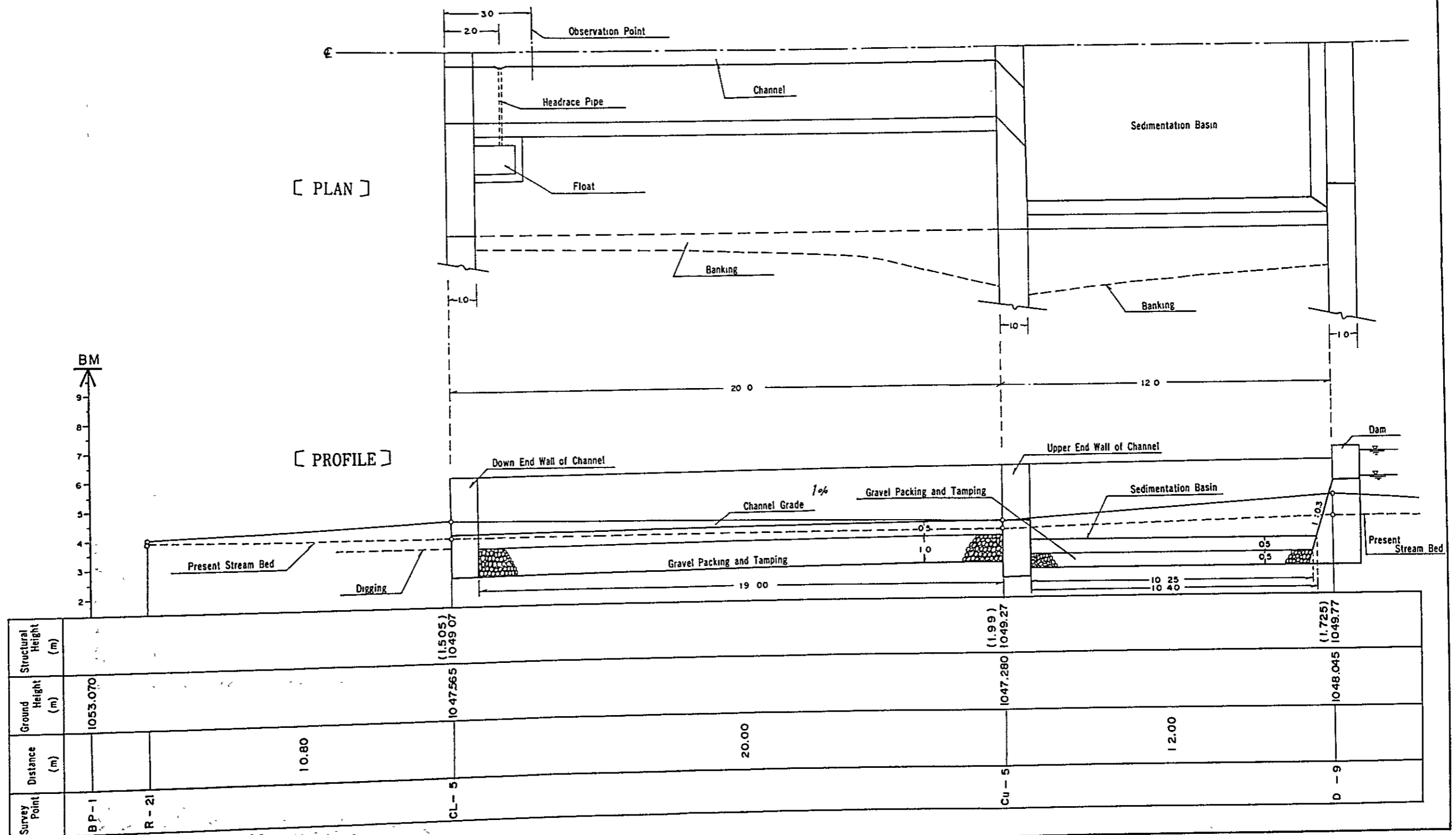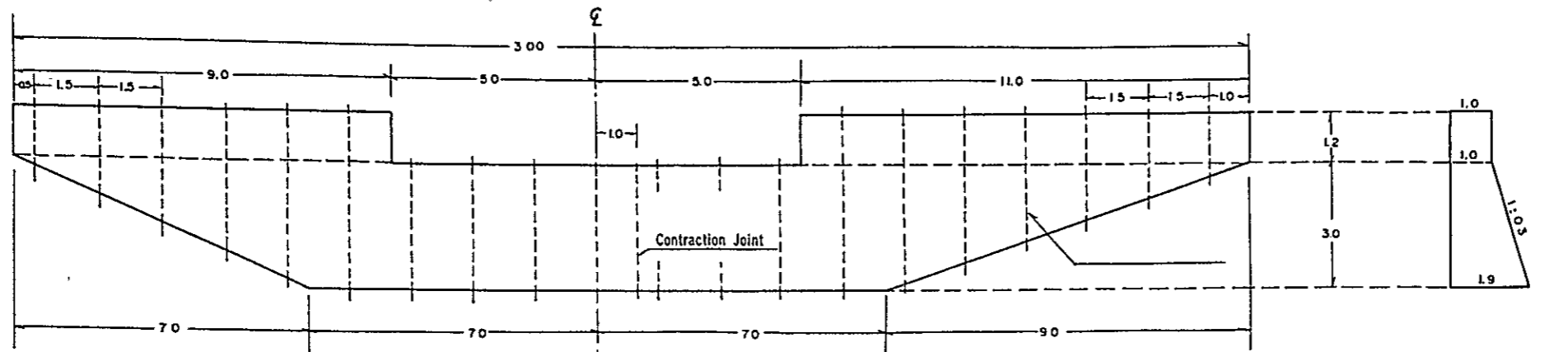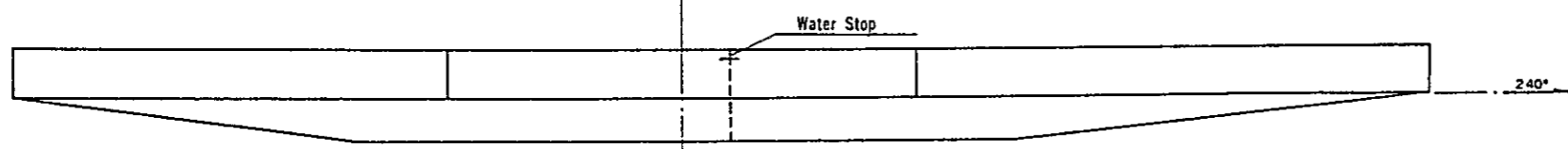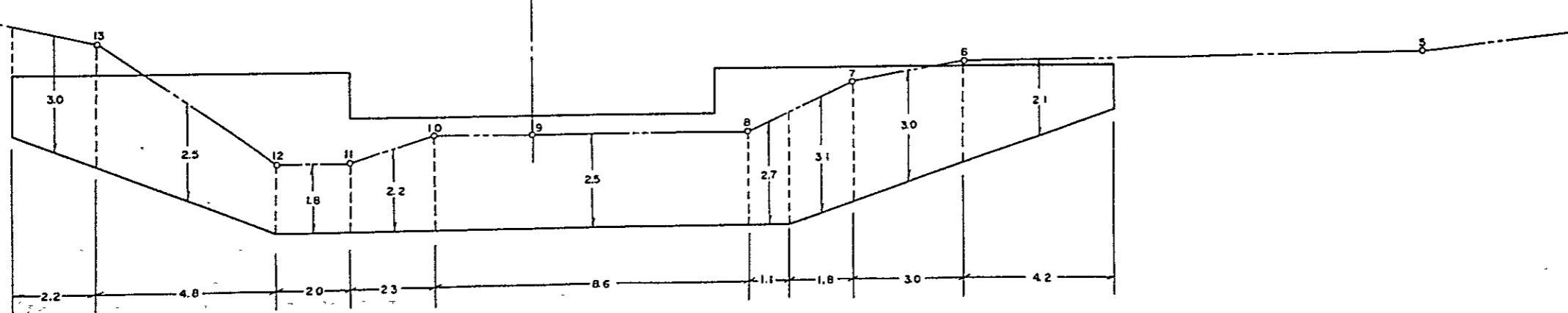
D AREA GAUGING FACILITIES DRAWING NO.3
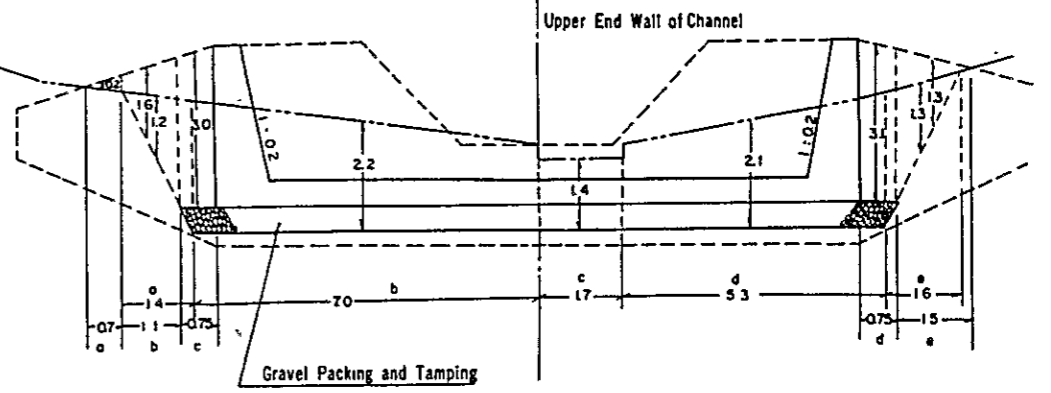
STRUCTURAL DRAWING OF UPPER END WALL OF CHANNEL
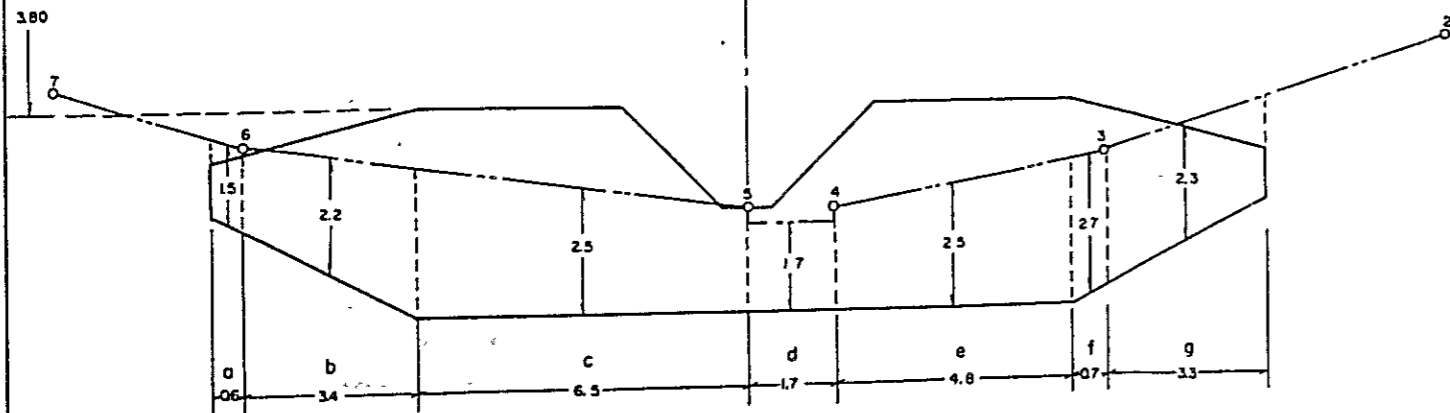
Scale 1/143

CALCULATING DRAWING OF STRUCTURE, EXCAVATION AND REFILLING FOR SEDIMENTATION BASIN
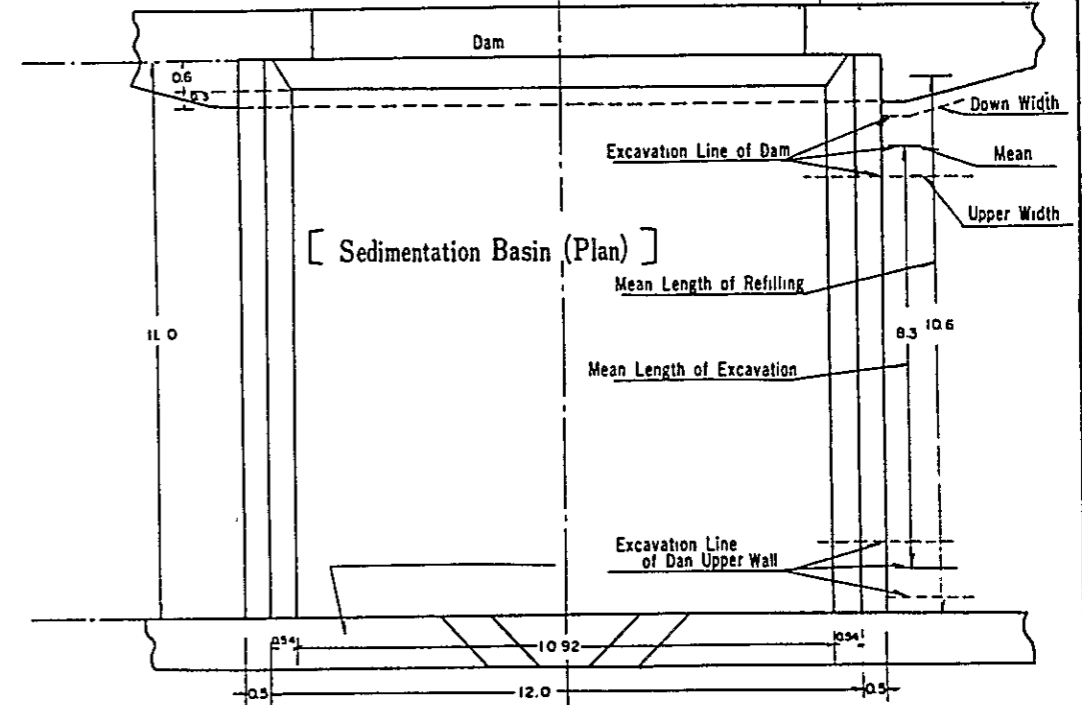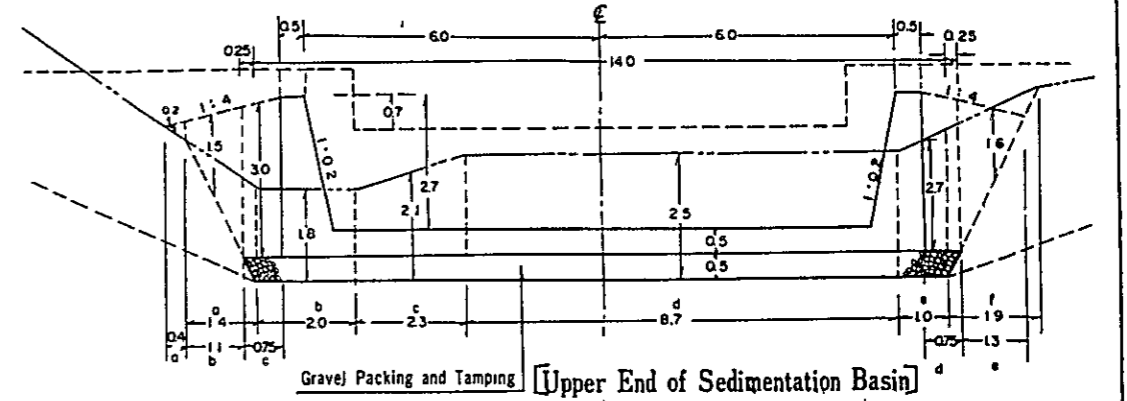
Scale 1/143

Gravel Packing and Tamping [Upper End of Sedimentation Basin]

Dam

Down Width

Excavation Line of Dam

Mean

Upper Width

[Sedimentation Basin (Plan)]

Mean Length of Refilling

Mean Length of Excavation

Excavation Line of Dan Upper Wall

Upper End Wall of Channel

Gravel Packing and Tamping

[Down End of Sedimentation Basin]

BM-I
(BP-I)

D-5

D AREA GAUGING FACILITIES DRAWING NO.4

STRUCTURAL DRAWING OF DOWN END OF CHANNEL
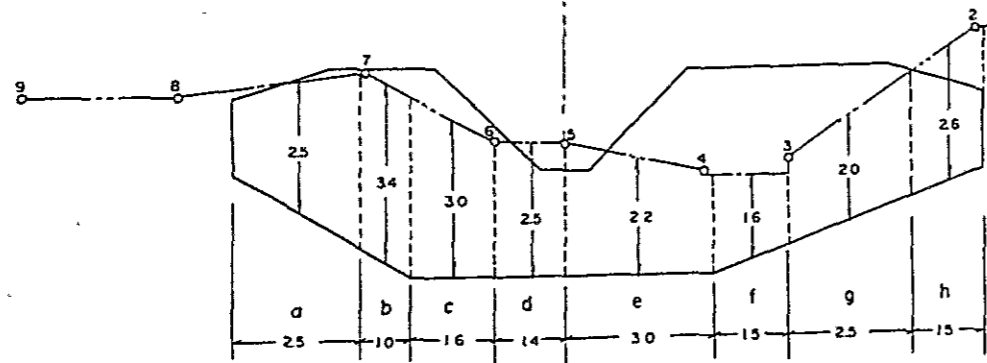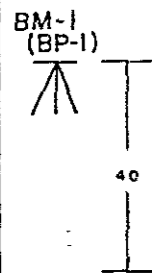
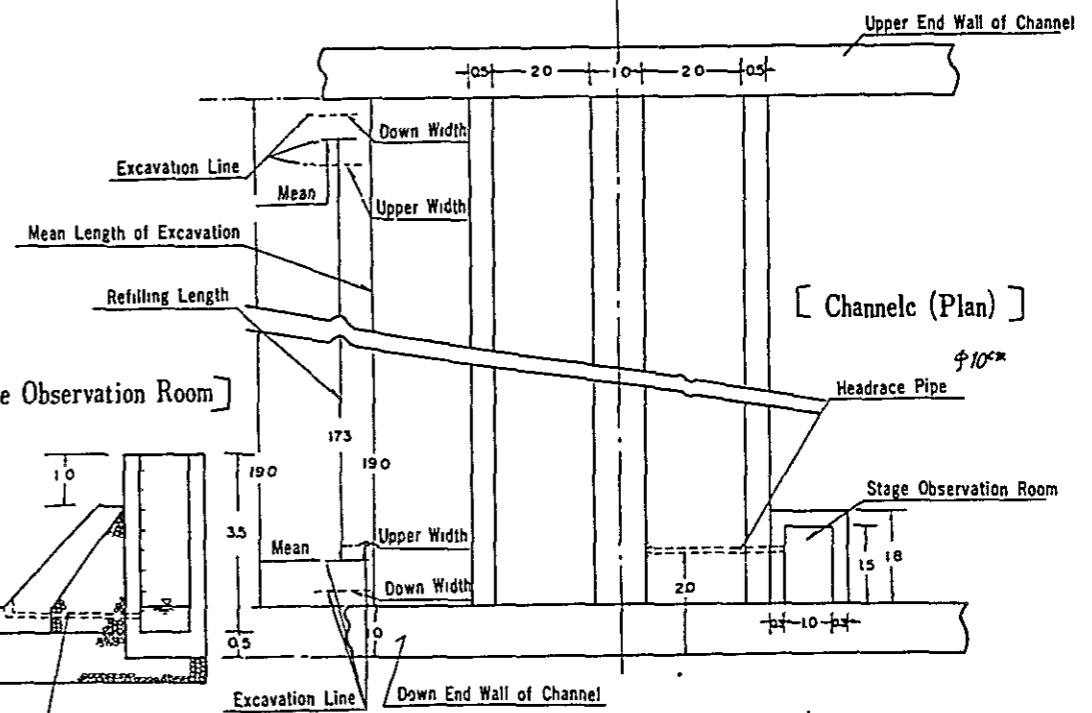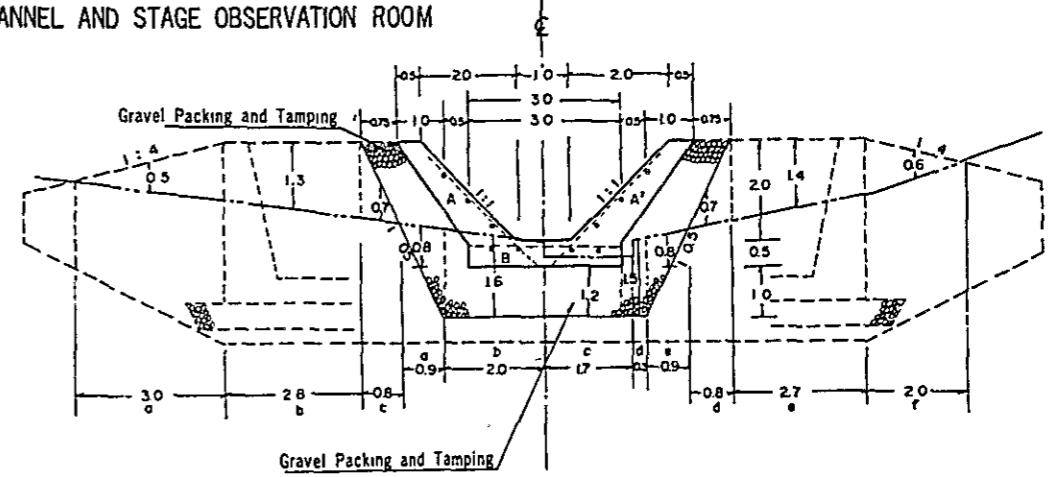Scale 1/143
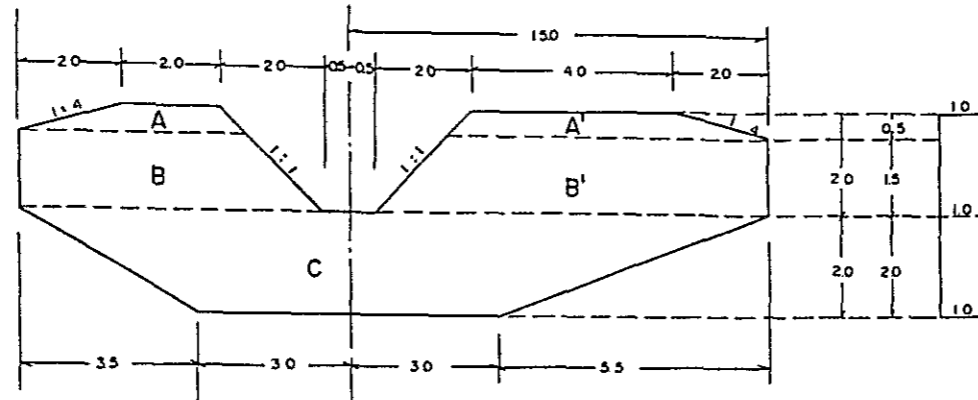
[FRONT VIEW]
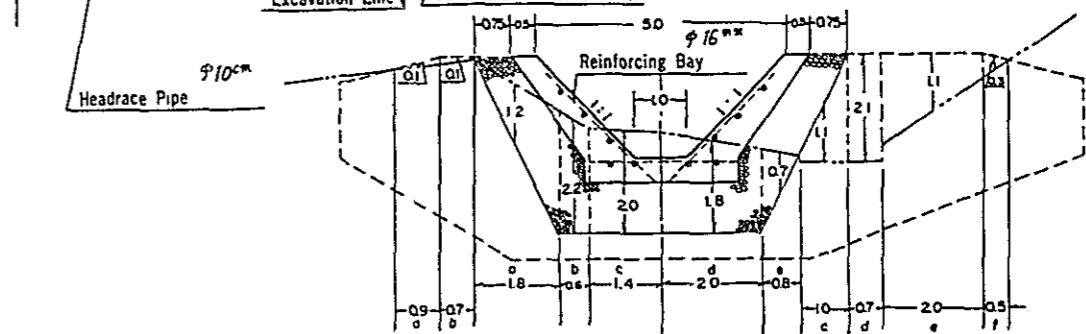
[SIDE VIEW]

[PLAN]

[EXCAVATION]

CALCULATING DRAWING OF STRUCTURE, EXCAVATION AND REFILLING FOR CHANNEL AND STAGE OBSERVATION ROOM
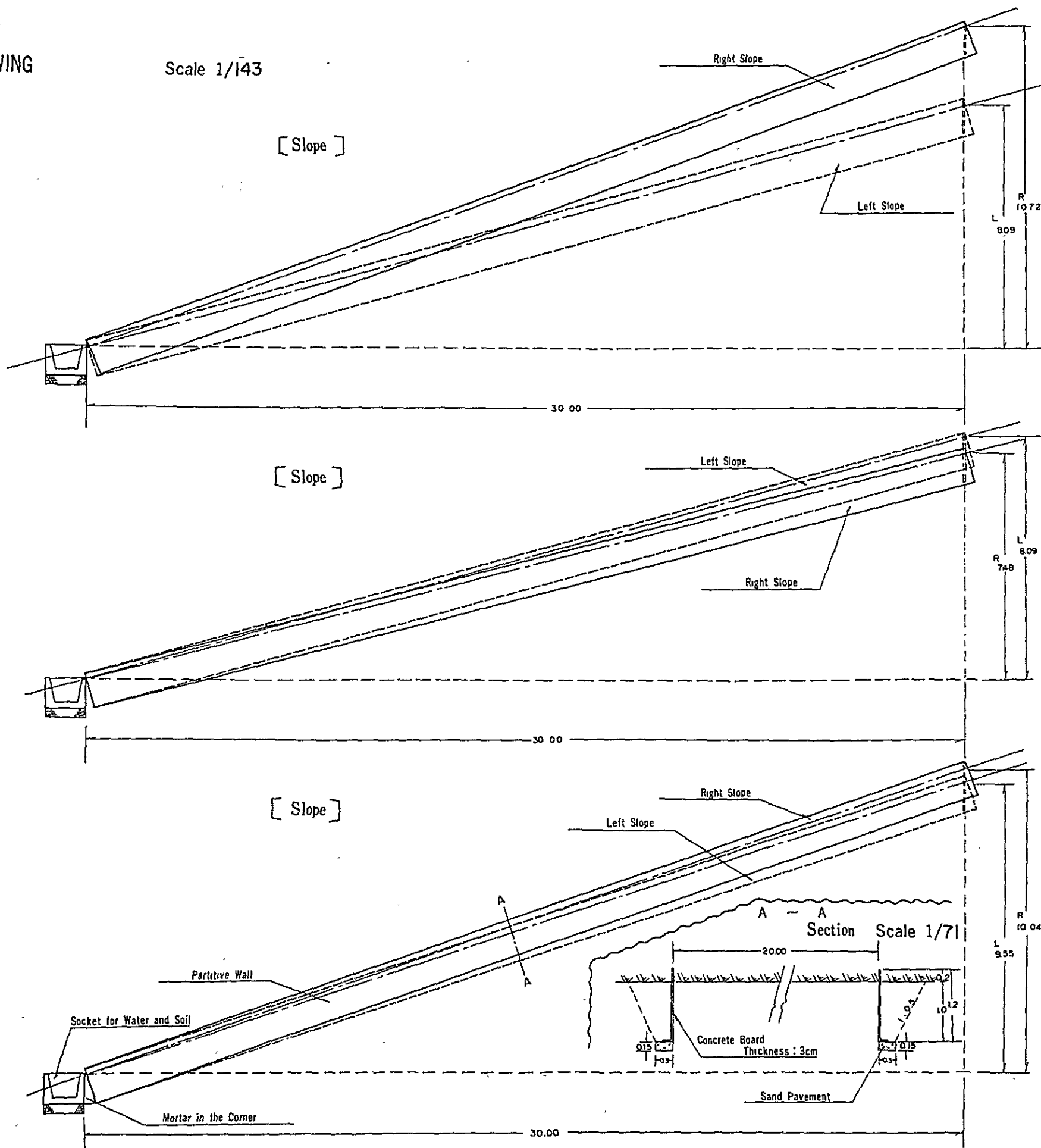
Scale 1/143

[Channelc (Plan)]

[Stage Observation Room]

[Down End Wall of Channel]

D-6

D AREA OVERLAND FLOW FACILITIES DRAWING

Scale 1/143

ARRANGEMENT DRAWING

Scale 1/714

C

A

B

30.00

20.00

Drain Channel

DETAIL DRAWING OF SOCKET FOR WATER AND SOIL
Scale 1/71

Insertion of Contraction
Joint in the Center

Gravel Packing and Tamping

Headrace Pipe

∅ 25 cm

[Slope]

Right Slope

Left Slope

R 10.72

L 8.09

30.00

[Slope]

Left Slope

Right Slope

L 8.09

R 7.48

30.00

[Slope]

Right Slope

Left Slope

A

A

Partitive Wall

Socket for Water and Soil

A ~ A   Section   Scale 1/71

20.00

Concrete Board
Thickness : 3cm

Sand Pavement

R 10.04

L 9.55

Mortar in the Corner

30.00

D-7

D AREA WATER BALANCE FACILITIES DRAWING NO.2

CROSS-SECTION
Scale 1/143

Banking

Gravel Packing and Tamping

A-1-1, A-1, A-2, A-2-2
A-4-1, A-4, A-3, A-3-1
B-1-1, B-1, B-2, B-2-1
B-4-1, B-4, B-3, B-3-1
C-1-1, C-1, C-2, C-2-1
C-4-2, C-4, C-3, C-3-1

PROFILE
Scale H : 1/ V : 1/143

(A)   (B)   (C)

6 12   575   6.07
D 12
CL 3 4   CU 4 5
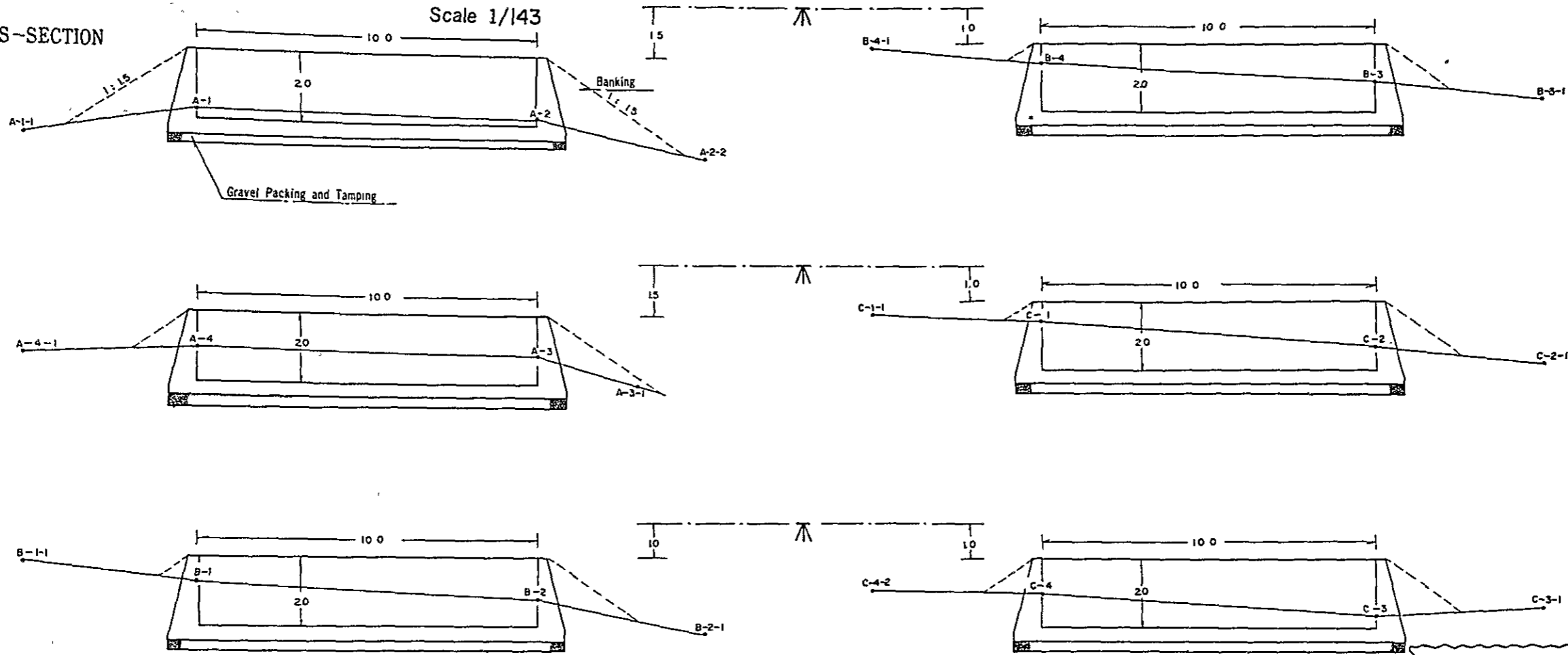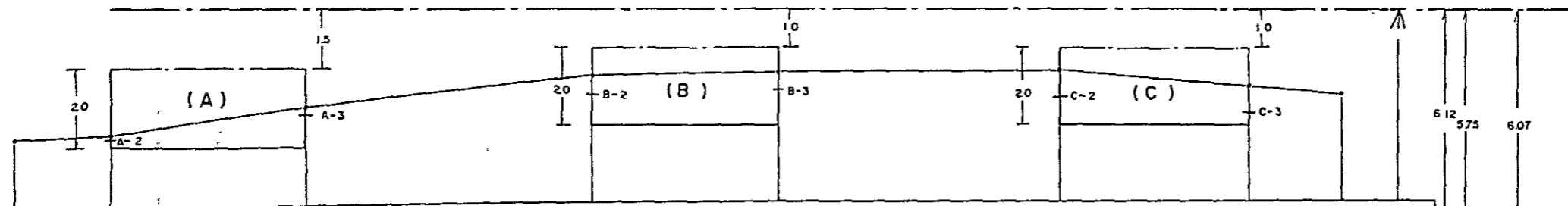
Suvey Distance Station (m)		Ground Height (m)	Planting Height (m)	Cutting (m)	Banking (m)
A-1-2		1049.78			
	5 00				
A-1		1049.89	1051.57	0.32	1.68
	10 00				
A-4		1050.57	1051.57	1.00	1.00
	15 00				
B-1		1051.41	1052.07	1.34	0.66
	10 00				
B-4		1051.44	1052.07	1.37	0.63
	15 00				
C-1		1051.48	1052.07	1.41	0.59
	10 00				
C-4		1051.05	1052.07	0.98	1.02
	5 00				
C-4-1		1050.91			
BP-1		1053.07			

ARRANGEMEN DRAWING
Scale 1/714

Water Observation Box

A1-1 A-1   A-2 A-2-2
A

A-4-1 A-4   A-3 A-3-1

150

B-1-1 B-1   B-2 B-2-1
B   10.0
B-4-1 B-4   B-3 B-3-1

15.0

C-1-1 C-1   C-2 C-2-1
C   10.0
C-4-2   C-3 C-3-1

D-8
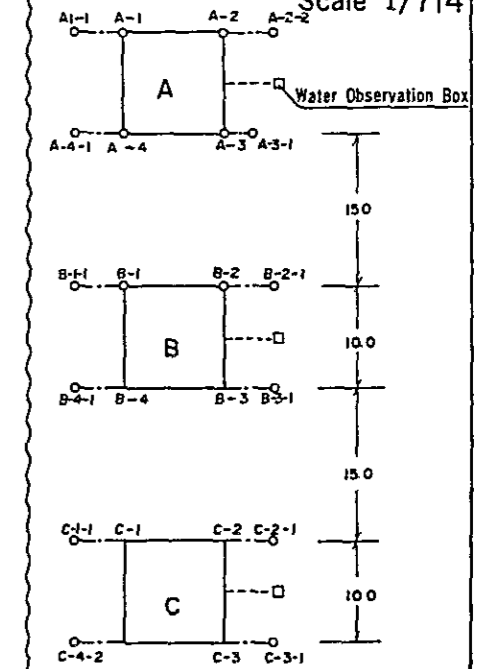
D AREA WATER BALANCE FACILITIES DRAWING NO.2

DETAIL DRAWING OF WALL AND ITS BOTTOM

Scale 1/71

Soil Layer
Mat
Gravel Layer
Second Layer Concrete
Water Proof Layer by Asphalt
First Layer Concrete
Layer Consisted of Gravel Packing and Taming

Contraction Joint
Water Stop

Headrace Pipe
10ᶜᵐ
To Stage Observation Box
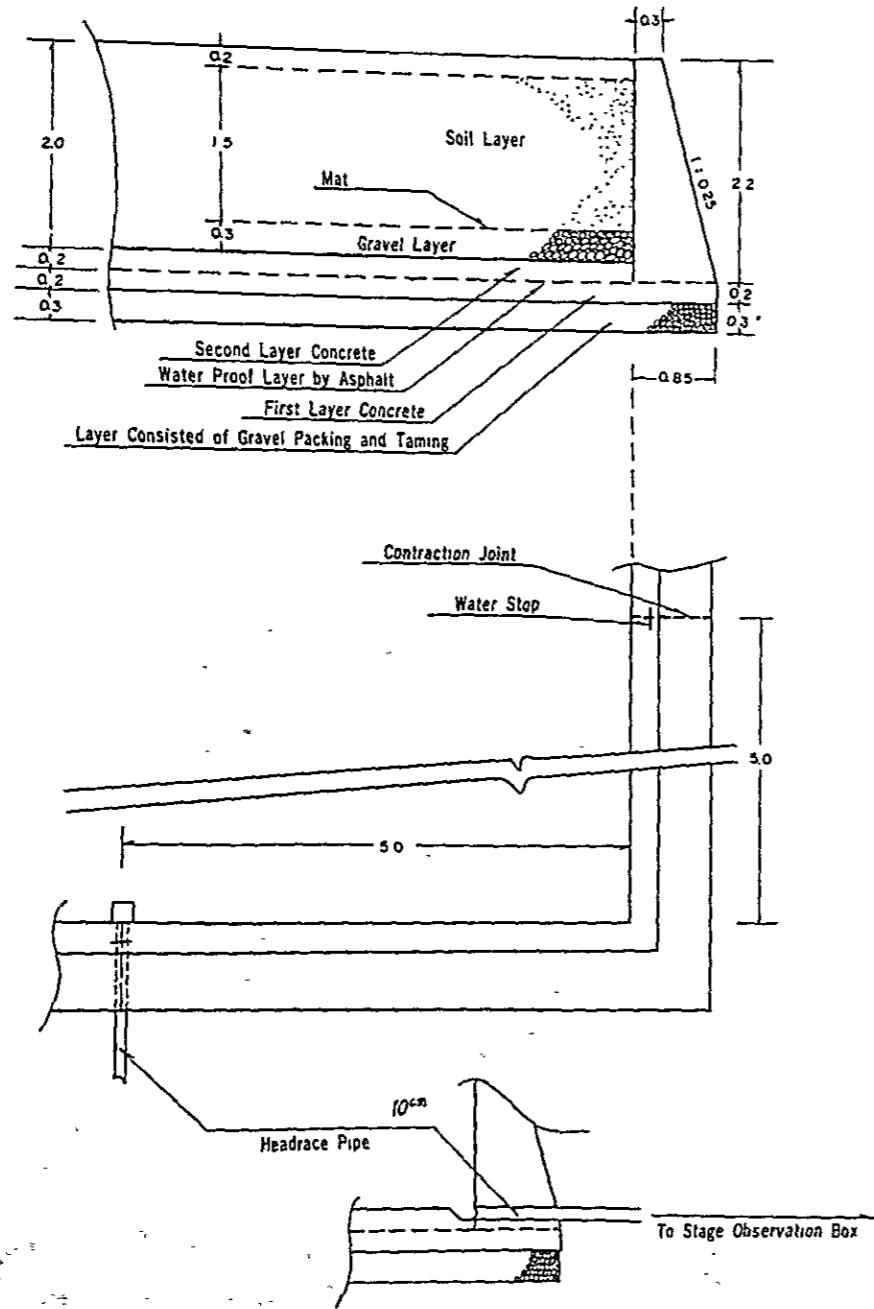
STRUCTURAL DRAWING OF STAGE OBSERVATION BOX FOR OVERLAND FLOW AND WATER BALANCE

Scale 1/29

Float

Iron Plate (Thickness 3mm) Coating with Anticorrosive

[For Overland Flow]

Bottom of Socket
for Water and Soil

60°

Headrace Channel
$\phi 25^{cm}$
Outlet
$\phi 5^{cm}$

[For Water Balance]

Bottom of Box

60°

Headrace Channel
$\phi 10^{cm}$
Outlet
$\phi 5^{cm}$

Stage of Stream Bed
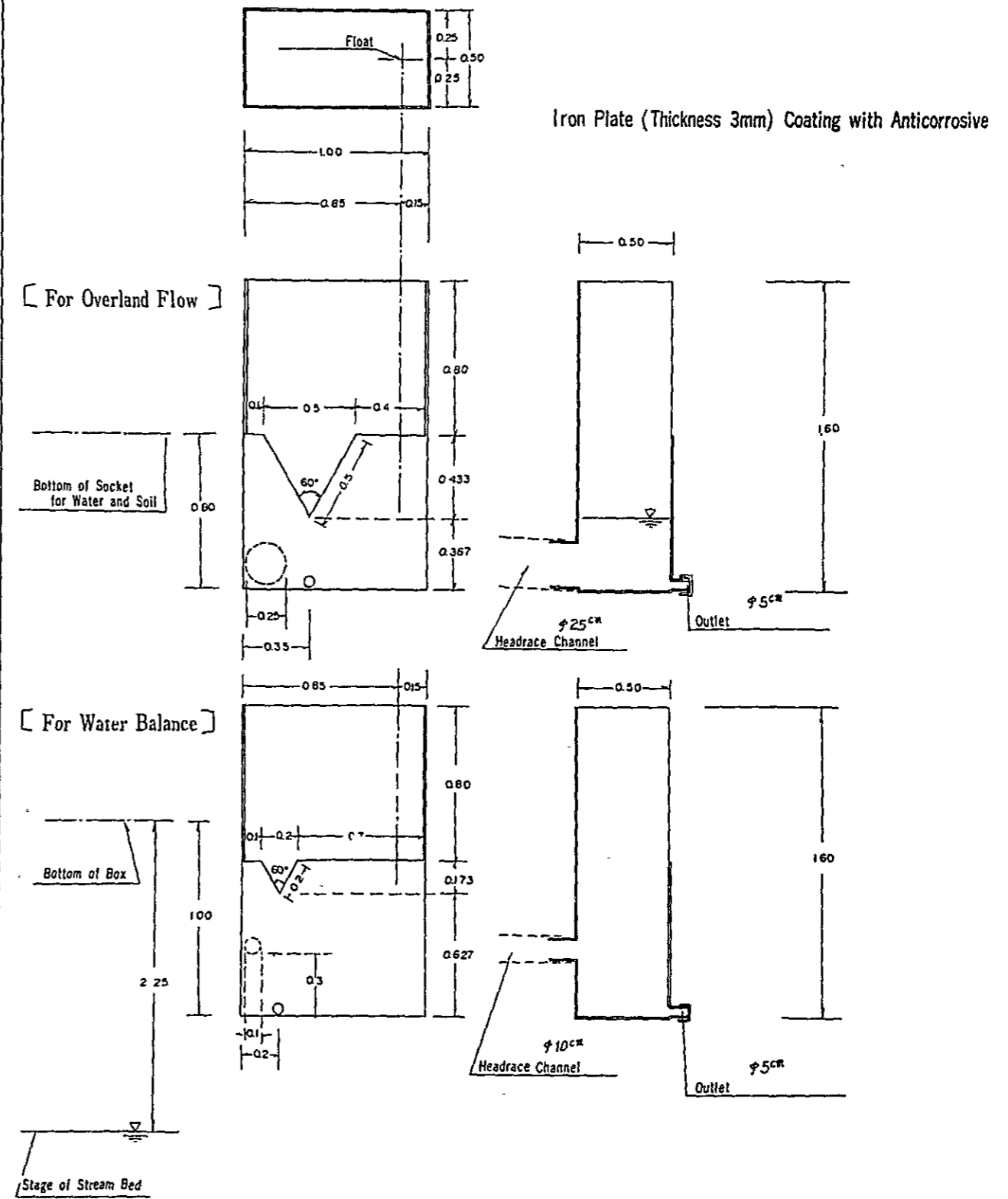
Scale 1/5,000

COMPARTMENT MAP FOR EXPERIMENTAL WTERSHED

RIO BONITO

RIO BONITO

B Area
(36,68ha)

A Area
(37,50ha)

C Area
(40,73ha)

D Area
(56,04ha)

Gauging Facilities

Gauging Facilities

Gauging Facilities

Gauging Facilities

RIO PARAIBUNA

RIO PARAIBUNA

Overland Flow Facilities

Water Balance Facilities

Instrument Platform

RIO PARAIBUNA

1 : 5000
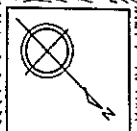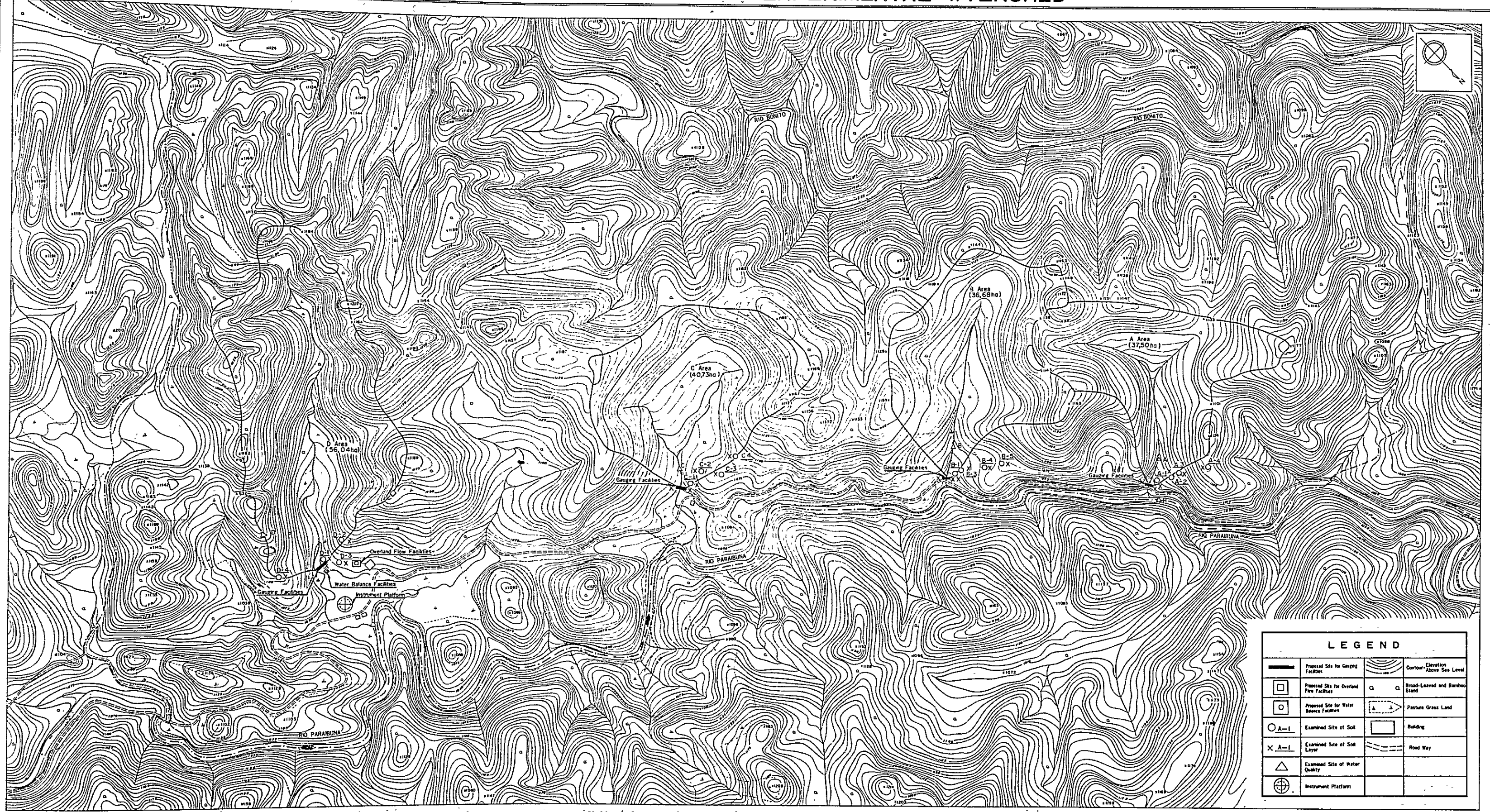
LEGEND

—	Proposed Site for Gauging Facilities		Contour Elevation Above Sea Level
▢	Proposed Site for Overland Flow Facilities	o o	Broad-Leaved and Bamboo Stand
▣	Proposed Site for Water Balance Facilities		Pasture Grass Land
○ A—1	Examined Site of Soil	▢	Building
× A—1	Examined Site of Soil Layer	═══	Road Way
△	Examined Site of Water Quality		
⊕	Instrument Platform		

D AREA PLAN

Scale 1/2,000

LEGEND

	River + Creek		Road Way
	Water Fall		Foot Way
	Bed Rock		Station-Course of Traverse
	Outcrop		Building
	Broad-Leved Stand		Wireless Tower
	Broad-Level Tree (Single)		Gauging Facilities
	Bamboo Stand		Water Balance Facilities
	Grass Land (Pasture)		Overland Flow Facilities
	Grass Land (Marsh)	o BM-1	Bench Mark
	Contour-Elevation Above Sea Line		
	Instrument Platform		

RIO PARAIBUNA

Instrument Platform

Water Balance Facilities

Overland Flow Facilities

Gauging Facilities

1 : 2,000