

HYDROLOGICAL PROCEDURE NO. 25

STANDARD STICK GAUGE FOR RIVER STATION

1982



JABATAN PENGAIRAN DAN SALIRAN
KEMENTERIAN PERTANIAN MALAYSIA

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**BAHAGIAN PARIT DAN TALIAIR
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CONTENTS

	Page
1. INTRODUCTION	1
2. ASSEMBLY	1
3. INSTALLATION	2
(a) In Normal Soil Foundation	2
(b) Under Water Foundation	2
(c) In Rocky Foundation	2
(d) Attachment to Structures	2
4. OBSERVATION	3
5. MAINTENANCE	3
APPENDIX A:-- ESTABLISHMENT OF TEMPORARY BENCH MARK AT RIVER STATION	4

1 INTRODUCTION

The stick gauge (or staff gauge) is used by the Drainage and Irrigation Department (D.I.D.) for observing water levels in a river station. Where the river station is equipped with stick gauges only, the water levels are normally read by paid observer at 6.00 a.m. and 6.00 p.m. daily. Where the river station is equipped with automatic water level recorder complete with stick gauges, the water levels are normally observed from the stick gauges at regular intervals, such as weekly or monthly, to check the records registered on the recorder charts.

In order to ensure the uniformity of stick gauge installations, the D.I.D. has adopted a standard 2-metre length for general application. Where the recorded range of water levels in any river station exceeds 2 metres, several successive stages of stick gauges of standard 2-metre length are installed.

2. ASSEMBLY

The standard 2-metre Stick Gauge consists of two graduated plastic plates of one metre length each and a timber backing of 2.2 metres length. Different lengths may be used where justified but a stick gauge must not be less than one metre long or consist of "part-metre" lengths.

The graduated plastic plates, including the "unit" numerals are to be screwed onto the timber backing using 25mm. x No. M4 (or 1" x No. 8 gauge) roundhead brass screws.

The left hand side of the plastic plate (as viewed from a reading position) must be 200mm. from the right-hand edge of the timber backing as shown in Fig. 1. The top of the plastic plate is to be approximately 200mm. down from the top of the timber backing. This allows for the fixing of the numeral or numerals indicating the unit length of the zero of the one metre section immediately above. This facilitates the reading of the stick gauge when the water level is high up on the gauge and the unit numerals for the respective metre sections are submerged.

When the combined length of stick gauges covers a range of more than 9 metres it will be necessary to screw onto the timber backing an additional numeral to cater for the double figure. This is to be screwed on flush with the right hand edge of the plastic plate and in line with the other numerals.

The timber backing must be of treated hardwood 250mm. wide by 40mm. thick and is machined with a bevel on one edge (Refer Fig. 1). It must be painted with a white, exterior enamel paint in conjunction with suitable priming and undercoats.

The assembly must be of a very high standard giving special attention to the joining of individual plastic plates. On no account should the plastic plate be damaged in any way.

3. LOCATION

For river station with artificial structures or natural conditions where there is a permanent rock control, the lowest stick gauge should be installed with zero of gauge below or corresponding with the zero of the control. For river station with natural conditions where there is no definite control, the zero of the lowest stick gauge should be set lower than the anticipated minimum water level, by one metre wheresoever possible or by the maximum amount possible under the limiting conditions.

The stick gauges should be installed as close as possible to the river cross-section in line with the inlets of the automatic water level recorder stilling well. This is to ensure minimum difference between observed river stage values (as obtained from the stick gauges in the river) and recorded river stage values (as obtained from the automatic water level recorder).

The stick gauges should be located on stable river banks, preferably where the velocity of flow is low and where they are not prone to damage by passing debris. They should be installed with the bevelled edge pointing towards the direction of flow to avoid unnecessary build-up of velocity head as well as to reduce collection of debris.

The graduated face of the stick gauges (i. e. plastic plates) must also be so positioned as to be at a reasonably readable angle to the observer. Provision must also be made to enable the relevant range of stick gauges accessible under all prevailing conditions including flood stages.

4. INSTALLATION

In addition to the assembly of a standard length of 2-metre stick gauge, suitable fittings, brackets, stays, bolts and nuts, etc. should be provided during the installation. All these fittings and accessories provided, must be either galvanised, zinc-coated or made of brass material in order to prevent rusting while under water. Brackets which are to be used for attaching the stick gauge to the timber post must be designed to allow for vertical adjustment of the stick gauge itself. The stick gauge must always be installed in a vertical position with the aid of a spirit level.

Installation of the stick gauges should preferably be undertaken during the periods of low flow in a river station. Four types of installation are mentioned below:—

(a) In Normal Soil Foundation

Where the stick gauge is to be installed in normal soil foundation of a river bank, a timber post of 125mm. x 100mm. x 2½ metres long treated hardwood should be used to support the stick gauge. This timber post should be placed vertically in an excavated hole to a minimum depth of 1 metre. Concrete will be used to strengthen the footing of the post. In addition, compacted filling of stones and boulders will be used within the hole to ensure a rigid installation.

The standard 2-metre stick gauge will then be attached temporarily to the timber post by means of bolts and nuts through four 130mm. x 11mm. vertical slot holes in the angle iron brackets provided as shown in Fig. 2. After the zero of the stick gauge is set corresponding to the desired Reduced Level (i.e. to any whole meter value) with the aid of a dumpy level instrument, the stick gauge should then be permanently installed by drilling and fixing additional 4 Nos. 80mm. x No. M5 locking bolts and nuts through the top pair of angle iron brackets to the timber backing.

Wherever necessary, one or more angle iron bracing stays may be used to strengthen the foundation of the stick gauge. The stays should be anchored to the ground by the use of an additional length of angle iron post driven into the ground. This angle iron post can also be strengthened with a concrete footing as shown in Fig. 3. The location of the bracing stays must be chosen in such a manner as to prevent the piling up of debris.

(b) Under Water Foundation

When the lower stage or stages of the stick gauge are to be installed in foundations under water, the use of angle iron posts is preferred. A pair of suitable lengths of 70mm. x 70mm. x 6mm. angle iron must be bolted to the back of the standard 2-metre stick gauge by means of bolts and nuts through four 130mm. x 11mm. vertical slot holes provided in the angle iron brackets. The complete assembly of the angle iron post with the stick gauge should then be driven into the soft river bed as shown in Fig. 4. The length of the angle iron post will depend on the site conditions but must be driven to sufficient depth to ensure a rigid installation. In addition, the angle iron bracing stays, as mentioned in previous paragraph and shown in Fig. 3, are required to improve the rigidity of this type of installation.

(c) In Rocky Foundation

Where the stick gauge is to be installed in rocky foundation, it is necessary to excavate a 450mm. x 450mm. square hole to a depth of 600mm. Having done this, the 125mm. x 100mm. timber post can then be placed vertically in the hole and mass concrete be used to cover back the hole in order to secure the post in position. If hard rocky foundation is encountered which does not allow the required depth of the hole to be achieved, the concrete footing should be built up to 300mm. above ground level as shown in Fig. 5. The angle iron bracing stay may also be used in order to achieve rigidity of the installation, if necessary.

(d) Attachment to Structures

Where the stick gauge is to be attached to an existing bridge or other suitably rigid structure at a river station, it is necessary to fabricate special fittings or brackets to suit individual cases of installation.

Stick gauges should never be installed on trees or such other forms of attachment that are in a state of continuous or periodic change which would cause changes in the stick gauge datum.

5. OBSERVATION

The observer must have access as close to the stick gauge as possible in order to avoid errors in reading the water level. The observer should not read the lower stages of the stick gauges from a steep bank at a river station as this would introduce errors in observation due to parallax. When there is surge around the stick gauge, it is necessary to estimate the mean of the surge to determine the corrected water level reading. Debris must be cleared from the stick gauge to avoid observational errors. Fig. 6 shows a typical graduated plastic plate for the stick gauge.

For all principal and secondary river stations other than those at the Experimental and Representative Basins, the observation of water level should be taken to the nearest one centimetre i.e. 0.01 metre. All readings should be recorded with the metre as the unit and qualified with a "metre" or "m" after the numbers.

6. MAINTENANCE

Regular maintenance of the stick gauge installation is essential for the collection of good quality data at a river station. The timber backing should be repainted as and when required to sustain the general appearance of the stick gauge at an acceptable level. The debris or "growth" around the stick gauge must be periodically cleared in order to enable accurate reading of the water levels. Damaged plastic plates and numerals must be replaced. All bolts and nuts holding the stick gauge in position must be checked and re-tightened, if necessary once a year.

The bottom of the stick gauge corresponding to the zero Reduced Level of any metre in all stages should be checked and adjusted to an accuracy of ± 1 mm. by levelling from the permanent bench mark or a Temporary Bench Mark established at the river station. (Please refer Appendix A and Fig. 7 for details of the establishment of temporary Bench Mark at a river station). This must be done **once a year** and more frequently if the zero level has changed or is suspected to have changed, e.g. immediately after the floods. Any damaged stick gauge should be repaired or replaced immediately. All stick gauges must also be checked and maintained **in a vertical position at all times**.

APPENDIX A

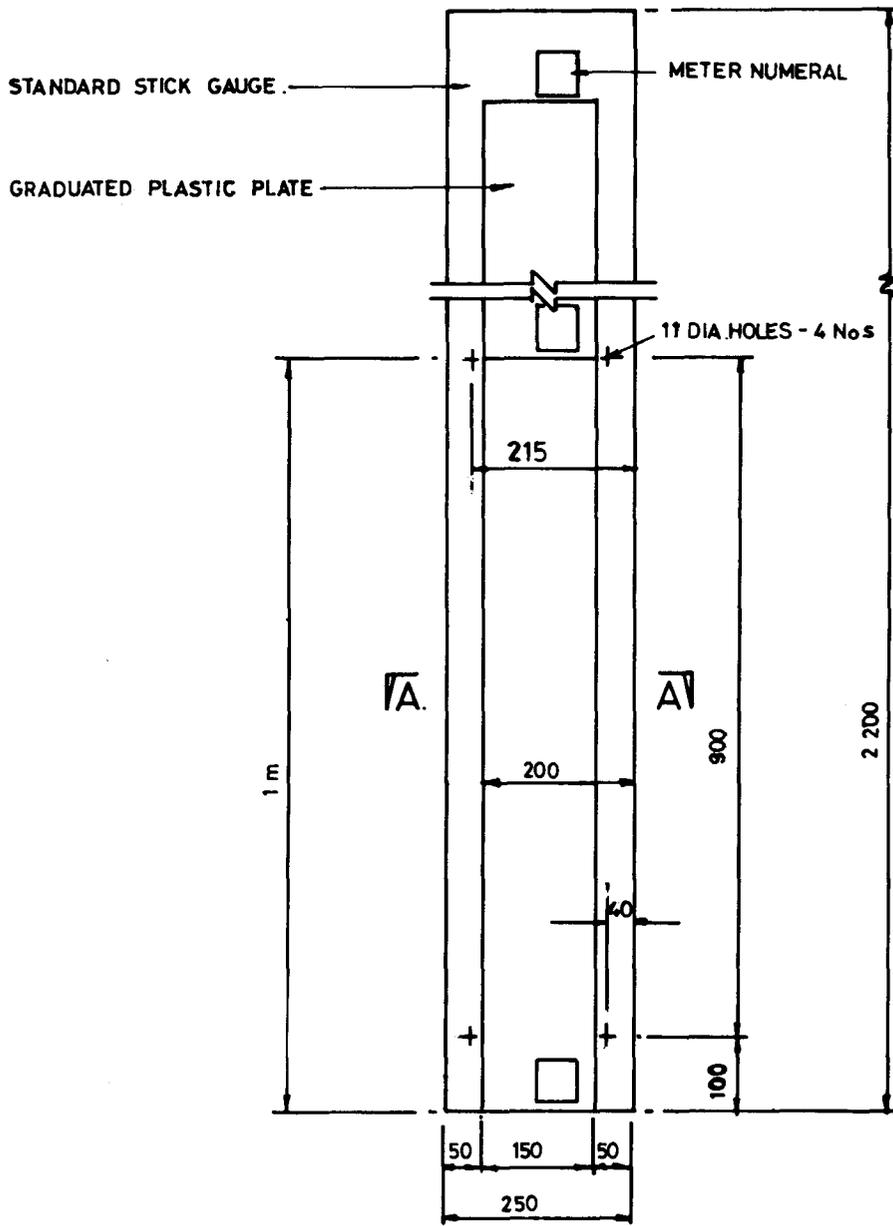
ESTABLISHMENT OF TEMPORARY BENCH MARK AT RIVER STATION

When a new stick gauge at the river station is installed after the original has been damaged by flood or other means, difficulty arises to set the zero of gauge correctly to the datum of M.S.L. (Mean Sea Level). It is also noted that scouring or silting up of the bed level will cause vertical movement of the existing stick gauge at the river station. It is thus necessary to check the graduated plastic plates of the stick gauge from a permanent Bench Mark at least once a year and also immediately after each and every flood. Such a Bench Mark is usually not available near the site of the river station. In order to overcome this difficulty, a T.B.M. (Temporary Bench Mark) should be constructed together with the stick gauges at all river stations.

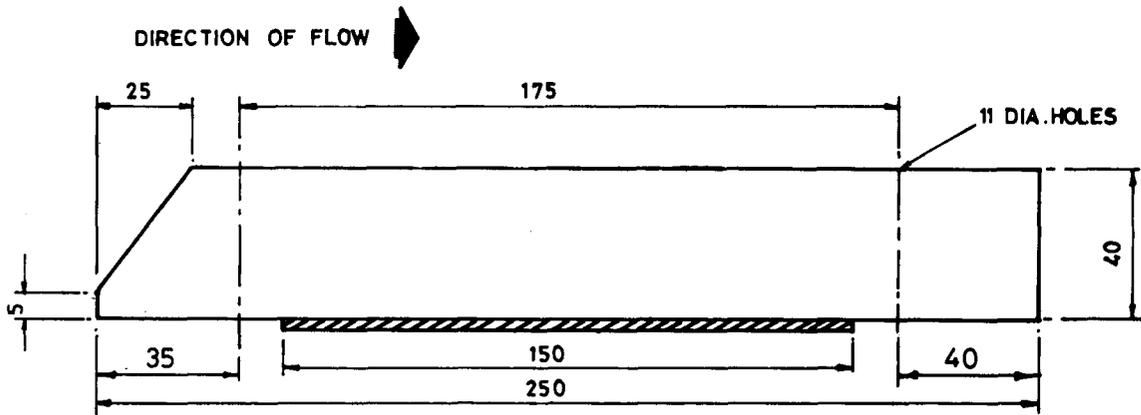
The T.B.M. should be firmly established well above maximum flood level in a position where it is easily located and preferably within a fenced area if available nearby. The T.B.M. should consist of a 40mm. dia. x 1½ metre long G.I. pipe cast in-situ with a 300mm. concrete cube with the top surface of the concrete block sloping towards the ground. The top end of the pipe should be filled and flushed level with concrete. A 10mm. dia. x 150mm. long brass bolt is then immersed into the concrete with bottom of head flushed level with the top of pipe. A sketch of the installation is shown in Fig. 7.

For stick gauges installed near concrete or railway bridges, the T.B.M. may be established on top of the abutment or on the deck.

After the installation, the value of the level of the T.B.M. should be marked on the sloped surface of the concrete block. The value should also be recorded in the River Station Registers (Form JPT. 11F), a copy of which should be submitted to the Hydrology Branch of D.I.D. Headquarters, Kuala Lumpur for record.



ELEVATION
(SCALE 1:10)



SECTION A A. (SCALE 1:2)

FIG.1 :- ASSEMBLY OF STICK GAUGE

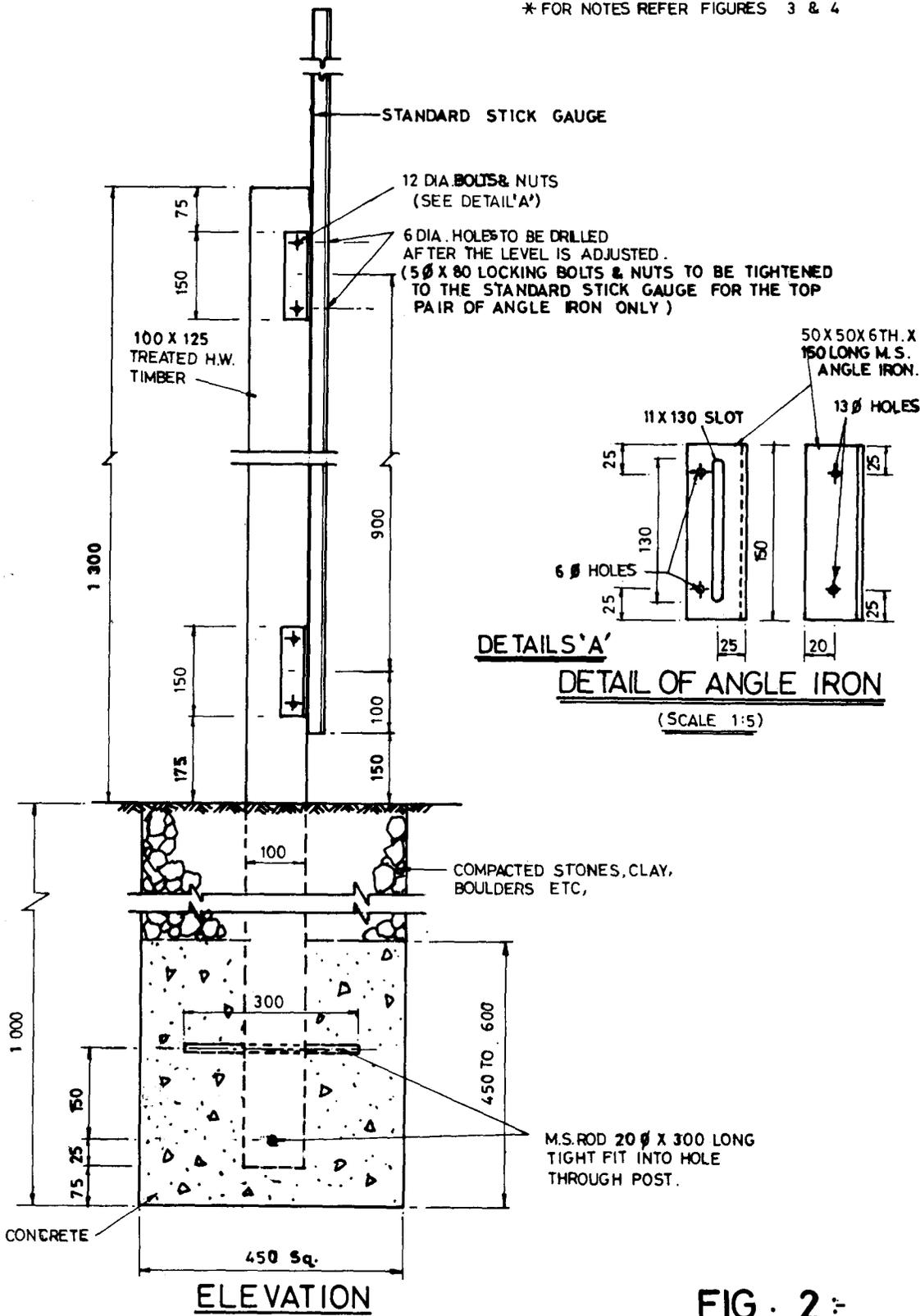
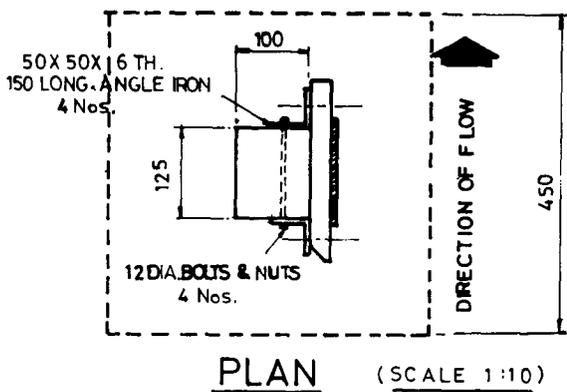


FIG. 2 :-
INSTALLATION IN
NORMAL SOIL
FOUNDATION



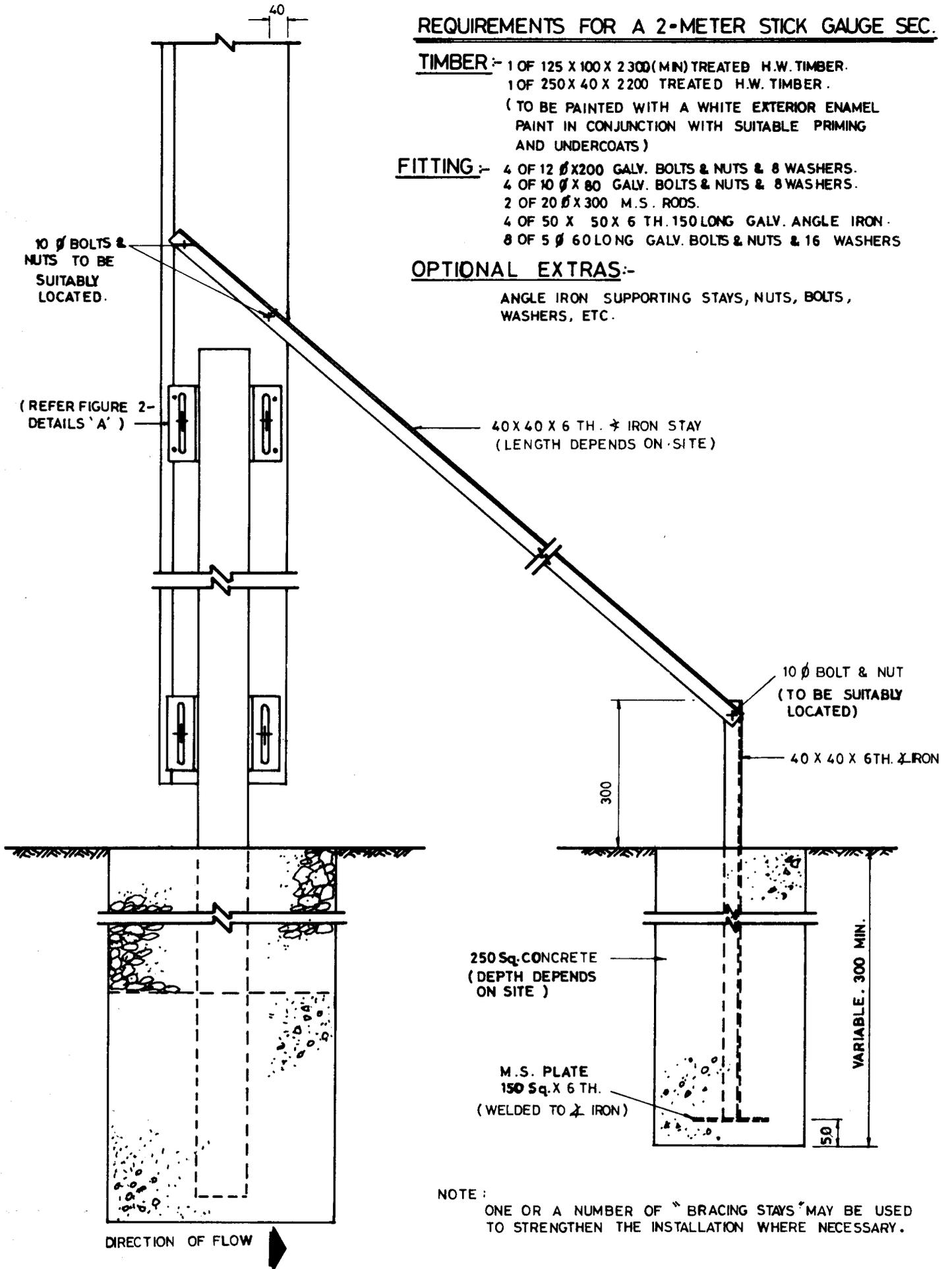
REQUIREMENTS FOR A 2-METER STICK GAUGE SEC.

TIMBER :- 1 OF 125 X 100 X 2300 (MIN) TREATED H.W. TIMBER.
 1 OF 250 X 40 X 2200 TREATED H.W. TIMBER.
 (TO BE PAINTED WITH A WHITE EXTERIOR ENAMEL
 PAINT IN CONJUNCTION WITH SUITABLE PRIMING
 AND UNDERCOATS)

FITTING :- 4 OF 12 ϕ X 200 GALV. BOLTS & NUTS & 8 WASHERS.
 4 OF 10 ϕ X 80 GALV. BOLTS & NUTS & 8 WASHERS.
 2 OF 20 ϕ X 300 M.S. RODS.
 4 OF 50 X 50 X 6 TH. 150 LONG GALV. ANGLE IRON.
 8 OF 5 ϕ 60 LONG GALV. BOLTS & NUTS & 16 WASHERS

OPTIONAL EXTRAS :-

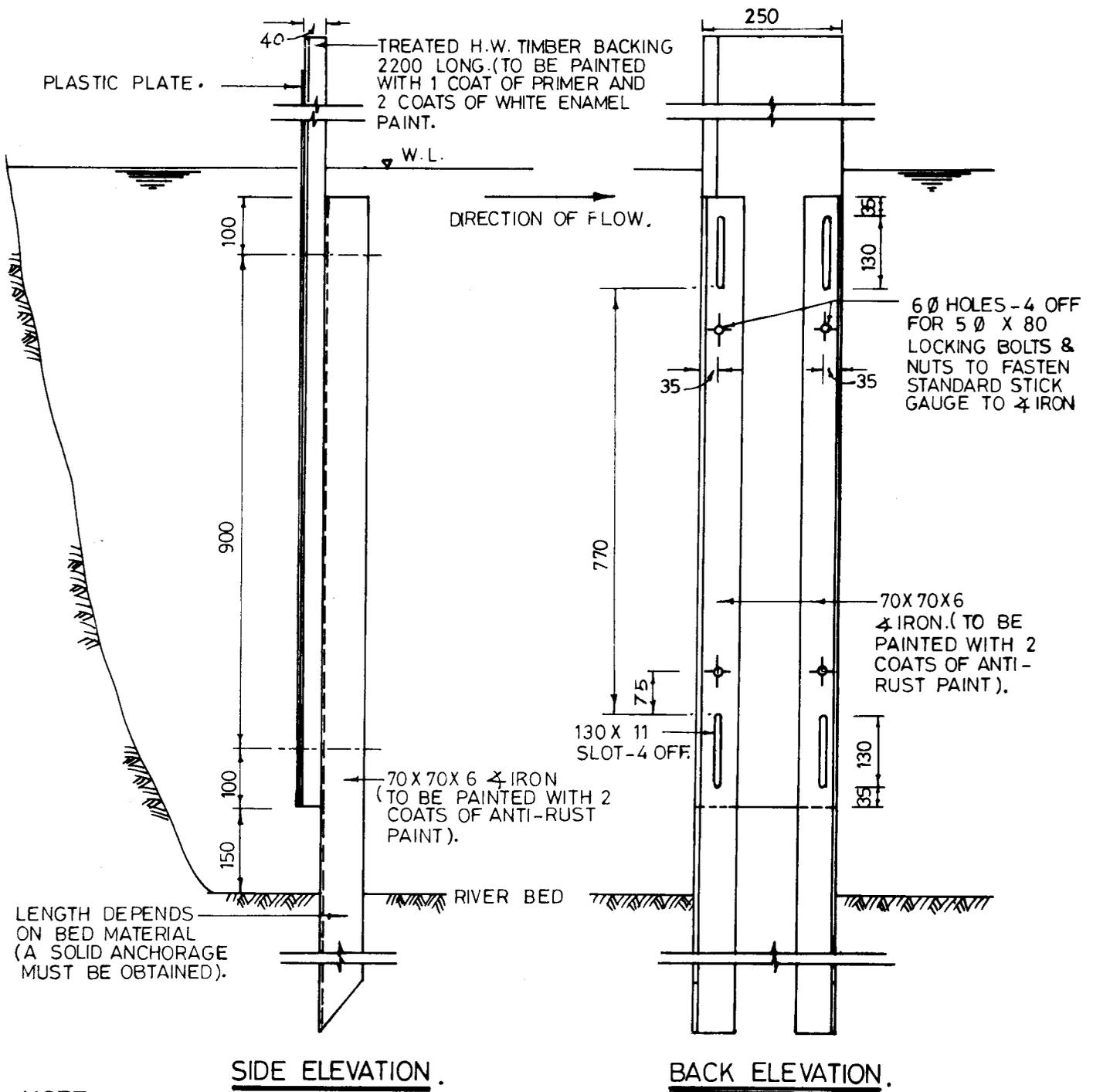
ANGLE IRON SUPPORTING STAYS, NUTS, BOLTS,
 WASHERS, ETC.



NOTE :
 ONE OR A NUMBER OF " BRACING STAYS " MAY BE USED
 TO STRENGTHEN THE INSTALLATION WHERE NECESSARY.

FIG. 3 :- STAY DETAIL FOR STICK GAUGE.

SCALE : 1:10

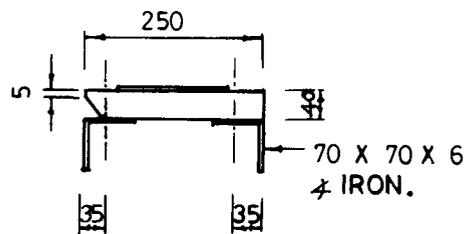


SIDE ELEVATION.

BACK ELEVATION.

NOTE

1. ANGLE IRON BRACING STAY TO BE USED FOR THIS TYPE OF INSTALLATION. REFER FIG. 3 FOR DETAILS.
2. ALL MEASUREMENTS ARE IN MILLIMETERS UNLESS OTHERWISE INDICATED.
3. ALL NUTS AND BOLTS ARE TO BE FABRICATED FROM BRASS OR SUITABLY STRONG ALLOYS OR, IF FABRICATED FROM STEEL TO BE GALVANISED AND WELL GREASED PRIOR TO INSTALLATION.
4. ALL TIMBER BACKING TO BE OF TREATED H.W. AND PAINTED WITH 1 COAT OF PRIMER AND 2 COATS OF WHITE ENAMEL PAINT. TIMBER POSTS TO BE ALSO OF H.W. AND PAINTED WITH 3 COATS OF SOLIGNUM OR CREOSOTE.
5. ALL ANGLE IRONS AND BRACKETS TO BE PAINTED WITH 2 COATS OF ANTI-RUST PAINT.



PLAN

FIG.4:-INSTALLATION UNDER WATER
FOUNDATION

SCALE 1 : 10

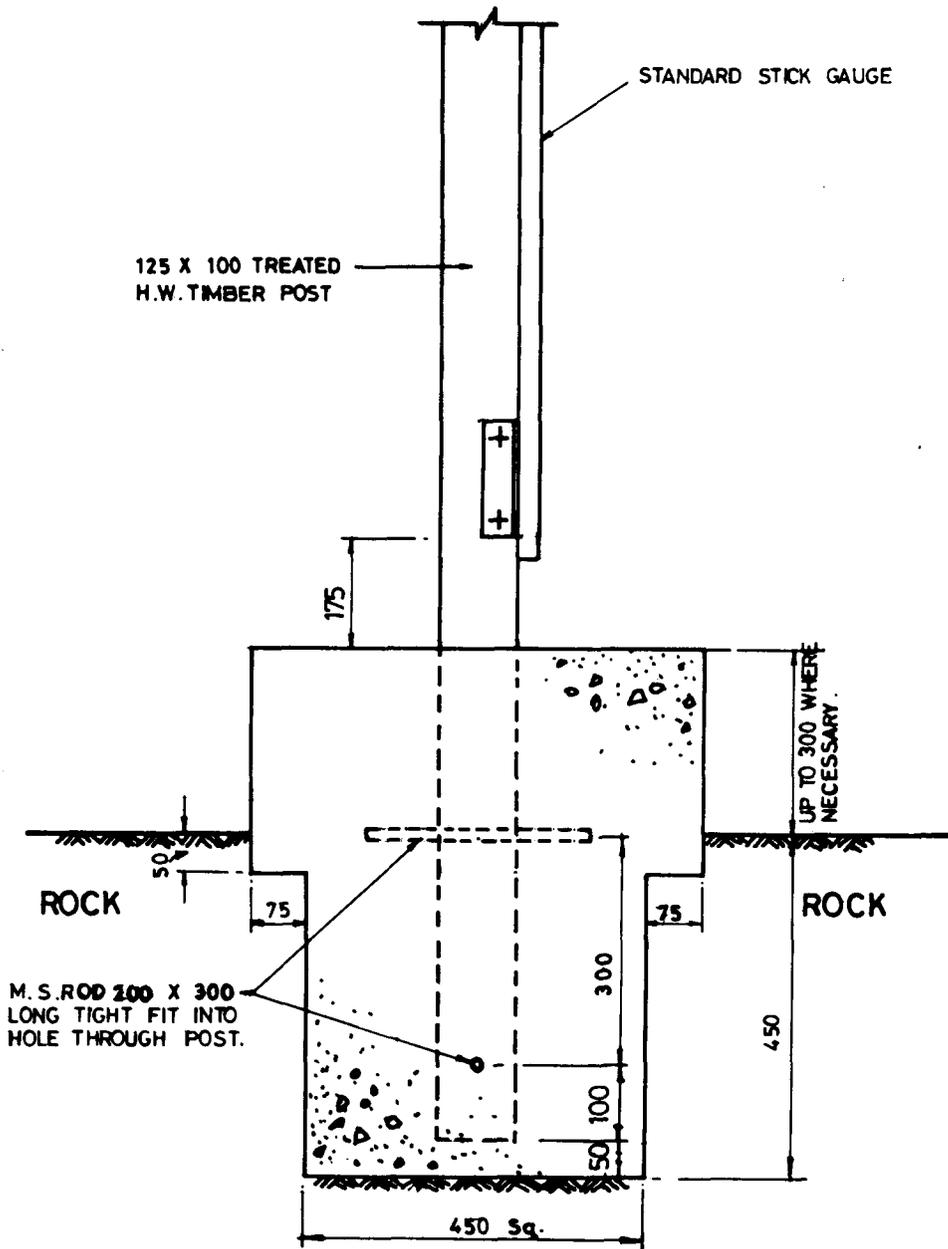
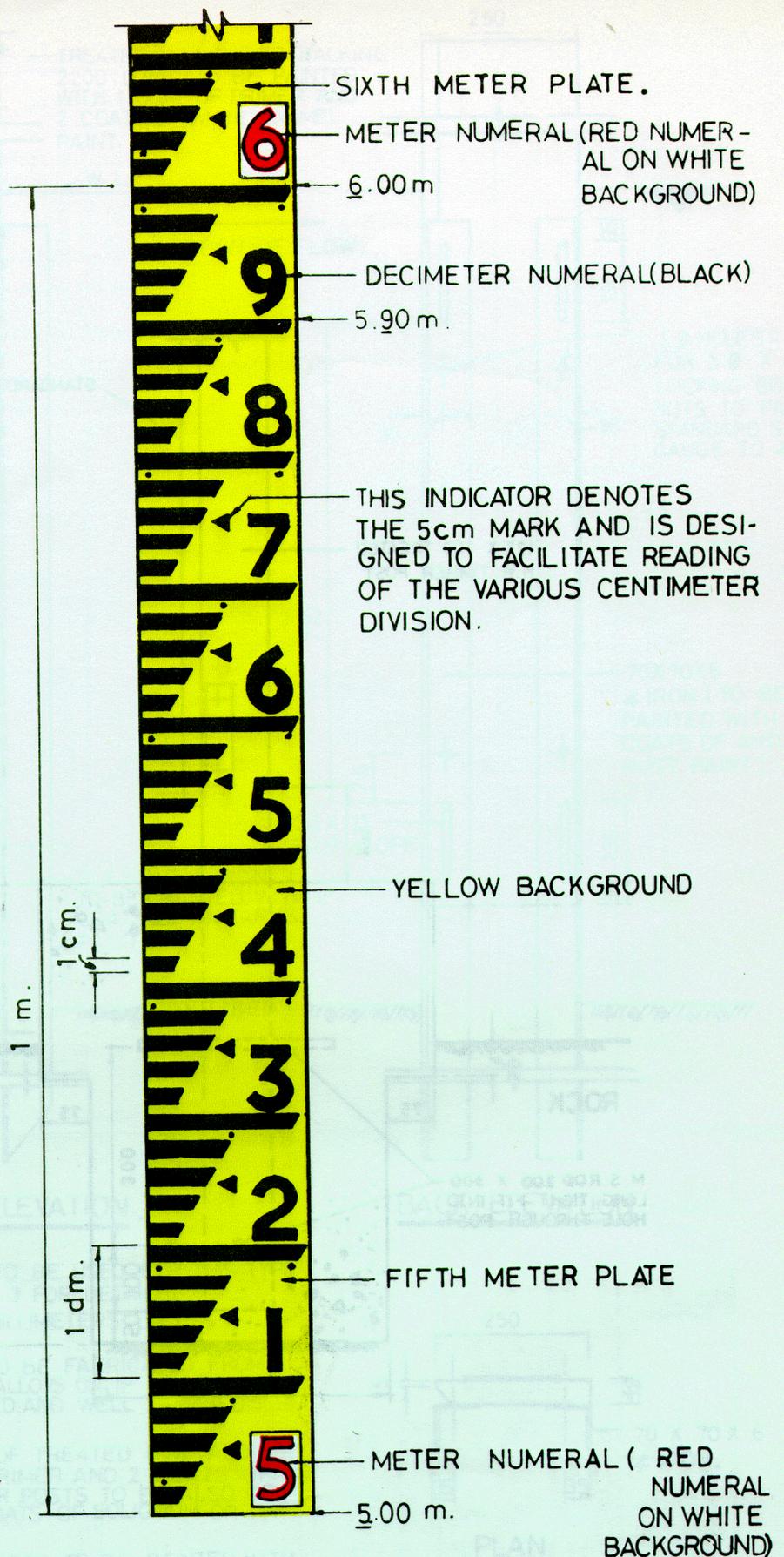


FIG.5 :- INSTALLATION IN ROCKY FOUNDATION

SCALE : 1:10



NOTES:

- 1) THE METER NUMBER REFERS TO THE INDIVIDUAL METER LENGTH, THE ZERO OF WHICH IS INDICATED BY THE GRADUATION SHOWN BELOW THE METER NUMERAL (i.e. 6.00m).
- 2) THE DECIMETER NUMERAL REFERS TO THE INDIVIDUAL DECIMETER INTERVAL, THE ZERO OF WHICH IS INDICATED BY THE GRADUATION SHOWN BELOW THE DECIMETER NUMERAL (i.e. 5.90m)

NOTE

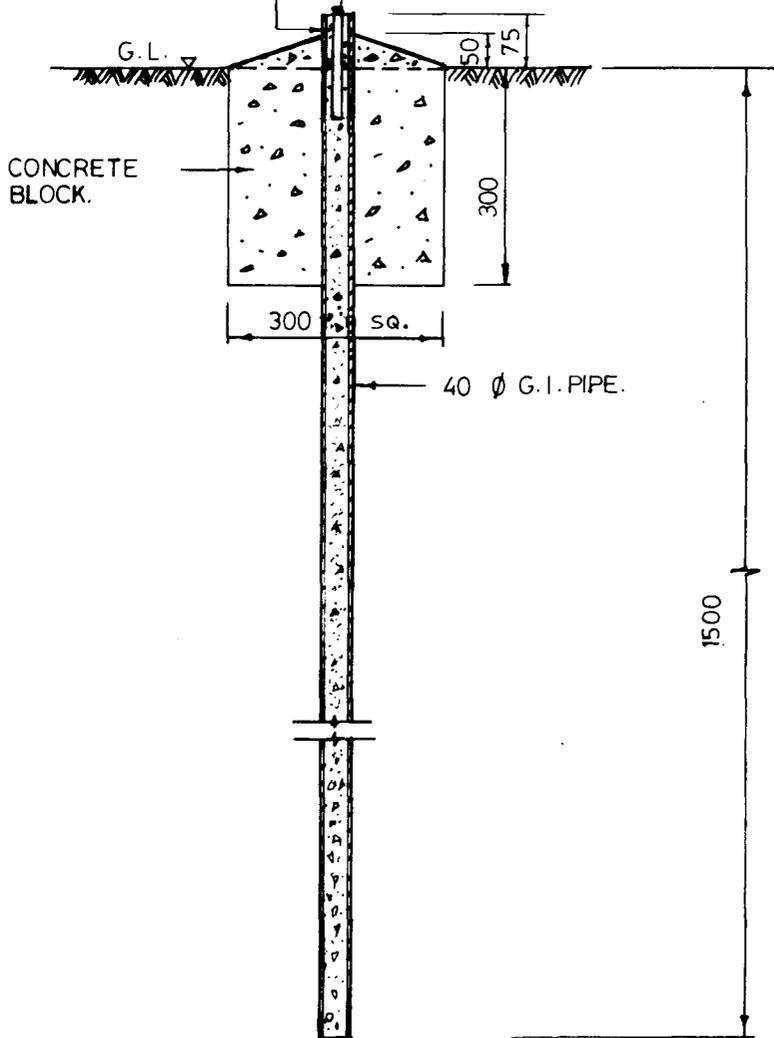
1. ANGLE IRON BRACKETS TO BE PAINTED WITH 3 COATS OF ANTI-RUST PAINT.
2. ALL MEASUREMENTS ARE TO BE TAKEN FROM THE OUTER SURFACE UNLESS OTHERWISE SPECIFIED.
3. ALL NUTS AND BOLTS ARE TO BE OF BRASS OR INVARIABLE STEEL. ALL BOLTS FROM STEEL TO BE GALVANIZED PRIOR TO INSTALLATION.
4. ALL TIMBER BACKING TO BE OF TREATED PINE OR OTHER DURABLE WOOD. PAINTED WITH 1 COAT OF PRIMER AND 2 COATS OF WHITE ENAMEL PAINT. TIMBER BOLTS TO BE GALVANIZED AND PAINTED WITH 3 COATS OF ANTI-RUST PAINT.

* CALL ANGLE IRON AND BRACKETS TO BE PAINTED WITH 3 COATS OF ANTI-RUST PAINT.

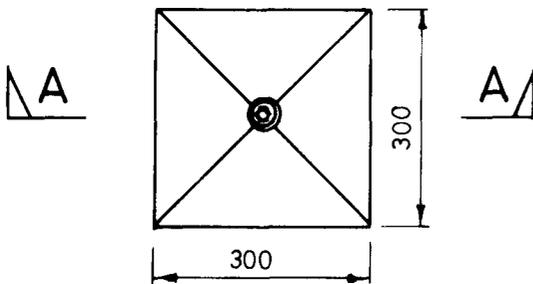
FIG. 6 :-

GRADUATED PLASTIC PLATE FOR STICK GAUGE.

THE G.I. PIPE IS FILLED AND FLUSHED LEVEL WITH CONCRETE .
10 ϕ x 150 LONG BRASS BOLT WITH BOTTOM OF HEAD FLUSHED LEVEL WITH G.I. PIPE.



SECTION A-A



PLAN

FIG. 7:-TYPICAL TEMPORARY BENCH MARK INSTALLATION

SCALE 1:10

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