3200.6

No. RW/NHVI-50(3)/83-Vol.II *Dated the 4th January, 1988*

To,

1. The Chief Engineers of States and Union Territories Public Works Departments dealing with National Highways and other Centrally Financed Schemes.
2. The Director General (Works), Central PWD.
3. The Director General (Border Roads).

**Subject : Quality Assurance on bridges on National Highways and under other Centrally Financed Schemes.**

Of late, the performance of some of our bridge structures has been causing concerns as they have either become unserviceable or are needing heavy repairs, in a relatively short-span of life. Whereas, adverse climatic conditions leading to corrosion has been a factor, the major problem seems to be lack of professionalism and quality assurance.

2. Enforcement of quality assurance in bridges has been emphasised time and again as of paramount importance. In the past this task has essentially been viewed as inspection, checking and applying the acceptance criteria to the bridge construction activities rather than ensuring a controlled environment, wherein each activity proceeds in a planned manner as per prescribed specifications and gets completed within acceptable tolerance limits, matching the functional needs.

3. The traditional linear concept is no longer suitable. It is time to consider the inter-dependence of all linked activities and conceive of a network system, wherein chances of common errors are eliminated and the activities get successfully completed, achieving desired quality standards. This network system concept is basically the Quality Assurance (QA) System.

A review of the quality control measures being adopted on bridges has also become necessary due to the following reasons :

(a) Increasing complexity of bridge structures.

(b) Increasing complexity of Engineering Project Organisation.

(c) Increasing public awareness of and concern for safety, serviceability and durability of structures.

(d) Increasing costs of maintenance and repair.

3. The concept of Quality Assurance, aims to plan forward by 'engineering for quality' rather than 'inspection for quality'. Quality in this context means compliance with specified requirements and quality control is the element in QA which is used to verify such compliance. Evidently the QA system has to encompass the following activities covering the entire life cycle of a bridge, for creating an environment, whereby human errors creeping in can be eliminated :

— site investigation
— design
— construction
— maintenance
— condition assessment
— repair and rehabilitation
— replacement

4. To achieve the desired objectives of QA, the system should have the following four elements :

— quality requirement-specifications
— organisation
— documentation
— quality control

Specifications relating to quality requirement generally form an integral part of the Contract Documents. The other three elements are briefly discussed hereunder :

4.1 Organisation is an important element of the system. It is essential that the overall organisational set-up for the Department and the Contractor are drawn up focussing on the interface between the parties.

Internal charts identifying the instructions/decision lines within each unit such as site, office, laboratory, etc. and any crossline functions of individuals should be prepared and made known to the concerned personnel. This will help in clearly demarcating the functions of informing, reporting, consulting, supervising and approving, and thus establishing a proper information flow path and decision making levels.

4.2 Documentation of QA system comprises plans, data, computation, test results, inspection records, definition of task and responsibilities. All such information should be stored in a manner amenable to easy access and retrieval and for this purpose computers should be extensively used.

4.3 Quality control is the most important element of QA and should form an integral part of the QA system. Whereas QA system aims to provide an optimised environment (wherein ingress of errors is sought to be eliminated or reduced), quality control is the last step helping to sieve out the errors which may have still crept in, despite the controlled environment. Quality control should not be confused with quality audit functions, performed by separate Quality Control organisations set up by the Highway Departments. Rational Quality Control concepts should encompass all phases of the process of bridge building right from planning through design, construction and service. The fact remains that the entire control procedures should be designed keeping in view the hazard scenario and safety plan forming part of the total QA system.

5. For an effective planning and implementation of the quality assurance measures, a check list is necessary for each item of the work to be executed. A suggestive check list for some items of work is enclosed for reference at Annexure I. It is emphasised that this check list will need modifications in individual cases as it is not possible to foresee all possible variations in input. Secondly this check list should not be considered as a substitute for clear thinking about the problem in hand.

6. Similarly a list of tests on materials to be done at site has been given at Annexure II and list of records to be kept at site has been given an Annexure III. It is requested that for each bridge project these lists may be modified to suit the specific requirements.

7. It is requested that the contents of this circular may kindly be brought to the notice of all officers in your Department engaged on National Highways/other Central works and action taken in this regard may be intimated to the Ministry.

*ANNEXURE I*

*Enclosure to letter No. RW/NHVI-50(3)/83-Vol. II dated 4.1.88*

## TENTATIVE CHECK LIST

The qualities of materials in a product are determined by the Quality Control tests. However, this is not enough to assure the quality of products. Certain checks must therefore be made for Quality Assurance. These checks may be divided into three groups, based on the stages of work :

(i) Before execution of an item.

(ii) During execution of an item.

(iii) After execution of an item.

The check lists for different items of work may be prepared on the basis of the technical specifications, approved drawings and other instructions in the form of Notes on the drawings. Check lists for a few items of work are given below, which are suggestive.

1. **Preparation of Estimate**

1.1 **Preparation of estimate (before execution)**

(a) Whether detailed survey of the proposed site has been done as per requirements laid down in IRC : 5-1985.

(b) Whether survey of materials required in construction has been done.

(c) Whether testing of materials required in construction has been done.

(d) Whether any land acquisition is necessary.

(e) Whether all the designs and drawings have been prepared.

(f) Whether necessary bore logs have been taken to decide about the soil properties.

1.2 **Preparation of estimate (during execution)**

(a) Whether lead charts for all the materials have been given

(b) Whether all the rates adopted are as per schedule of rates. If not, whether analysis of rates has been given for such items.

(c) Whether approach estimate is necessary and its cost has been included. If not necessary, whether this has been specified clearly.

1.3 **Preparation of estimate (after execution)**

(a) Whether the report prefacing the estimate is complete in all respects.

(b) Whether all the plans and drawings have been enclosed.

2. **Calling of Tenders**

2.1 **Calling of tenders (before execution)**

(a) Whether the sanction of the competent authority has been received.

(b) Whether any follow up action on estimate is required before calling of tenders.

(c) Whether prequalification of tenderers is to be done.

(d) Whether land acquisition, if required, has been done.

2.2 **Calling of Tenders (during execution)**

Whether all the necessary directions for calling of tenders have been followed.

2.3 **Calling of Tenders (after execution)**

Whether all the tenders have been evaluated for technical points before opening the financial bids.

3. **Awarding of work**

3.1 **Awarding of work (before execution)**

(a) Whether the tender to be accepted has been evaluated technically and financially.

(b) Whether any escalation clause is included.

(c) Whether sanction of the competent authority has been obtained before awarding the work.

3.2 **Awarding of Work (during execution)**

3.3 **Awarding of Work (after execution)**

(a) Whether the work has been awarded at 15% beyond the sanctioned cost. If so, revised estimate has to be prepared.

4. **Testing of Materials**

4.1 **Testing of Materials (before execution)**

(a) Whether quarry to be used for fine and coarse aggregates has been inspected.

(b) Whether fine and coarse aggregates available satisfy the relevant specifications laid down in IRC/IS Codes.

(c) Whether necessary testing of aggregates has been carried out to ascertain their suitability for the specified work.

(d) Whether sufficient quantity of fine and coarse aggregates is available from the source identified to complete the job.

(e) In cases where sufficient quantity of fine and coarse aggregate is not available from a single source, whether additional source has been identified and the materials have been tested to ascertain their suitability

(f) Whether water proposed to be used on the job has been tested as per the relevant specifications laid down in IRC/IS Codes.

(g) Whether cement and steel has been tested for the relevant specifications laid down in the IS Codes. Certificate of testing submitted by the contractor or manufacturer's certificate should not be considered as adequate and independent testing should always be carried out.

(h) Whether the admixtures, proposed to be used, if any, have been got tested as per relevant IS Specification for their specific use on the particular job.

(i) Whether the sheathing in prestressed concrete work satisfy the tests as laid down in Appendix-I of IRC : 18 :-1985.

4.2 **Testing of Materials (during execution)**

(a) Whether cement and steel of new batches have been got tested as per the relevant specifications of IS Codes.

(b) Whether fine aggregates, coarse aggregates and water being used in from the source approved earlier. If not, has it been tested again.

5. **Setting out of Works**

5.1 **Setting out of Works (before execution)**

(i) Whether the approved drawings are available;

(ii) Whether permission of any authority is required and the same has been obtained.

(iii) Whether the original layout and permanent bench mark are available and are properly referenced;

(iv) Whether the site has been cleared properly within which the machines, equipment can freely move and there is no obstruction to sight from one end to the other both longitudinally and laterally.

5.2 **Setting out of Works (during execution)**

(i) Whether proper equipment, surveying instruments like levels and theodolites are being used for setting out.

(ii) Whether the equipment and surveying instruments are of good quality and initial errors determined.

(iii) Whether qualified personnel have carried out the work according to standard procedure of surveying.

(iv) Whether precautions for accurate surveying have been taken.

(v) Whether the original setting out and permanent B.M. have been correctly located.

5.3 **Setting out of Works (after execution)**

(a) Whether the centre line is defined by nail heads or iron pins in a block of concrete of sufficient mass embedded completely in ground so that the same cannot be disturbed by vehicles, should they happen to trample on it. The concrete line is defined by the line connecting centres of the nails. In case of iron pins, a cross mark by chisel may indicate the centre. Such iron pins should not project by more than 3mm above the surface of concrete.

(b) Whether the centre posts are well protected and clearly demarcated so that there is little chance of the same being hit.

(c) Whether these are referenced in a similar way and references are recorded and named and are available with the Contractor and the Engineer.

(d) Check independently whether the centre line is in complete conformity with the approved drawing. Check references also.

(e) Whether temporary Bench Marks have been fixed, in similar manner, named and levels marked, near the locations of each foundation, such that it is beyond the zone of movement of machines.

(f) Whether the Bench Marks are referenced and well protected.

(g) Check levels of the Temporary B.Ms. independently.

6. **Setting out for Foundations**

6.1 **Setting out for Foundations (before execution)**

(i) Check whether approved drawing for the foundation is available.

(ii) Check whether the setting out of centre line is approved.

(iii) Check whether permission of any authority is required.

6.2 **Setting out for Foundation (during execution)**

Similar as 5.2 above.

6.3 **Setting out for Foundation (after execution)**

Similar as 5.3 above. In addition check lengths, diagonals, squareness and orientation of foundations with respect to the bridge. In case of well foundations, check at least four diameters.

7. **Concrete Works**

7.1 **Concrete Works (before execution)**

(i) Check the characteristic strength of concrete required for the work from approved drawings.

(ii) Check whether the 'Design of Mix' has been got approved by the Engineer.

(iii) Check whether the materials to be used for concrete work have been got tested or test results have been obtained and approved by the Engineers.

(iv) Check whether mechanical concrete mixer and vibrator has been approved. Check the suitability and number of concrete mixers and vibrators being used for the quantity of concrete. Provision of standby vibrators should always be made.

(v) Inform the departmental Quality Control Organisation to take some random samples.

(vi) Check whether the design and drawing for false work has been got approved by the Engineer and check the same at site with approved drawing.

(vii) Check all materials, machines and availability of site personnel on the day of concreting, both from PWD and from the Contractor.

7.2 **Concrete Works (during execution)**

(i) Check the quality of materials, whether they are the same as approved.

(ii) Check quality of cement.

(iii) Check water cement ratio.

(iv) Check whether concrete is being mixed properly — minium 2 minutes and not more than 5 minutes.

(v) Check the method of transportation. Free fall of concrete by more than 2 metre should not be allowed to avoid segregation.

(vi) Check the time between mixing and placing of concrete. It should not be more than 30 minutes or more than initial setting time.

(vii) Check temperature. Concreting should not take place at temperatures below 4.5°C or above 38°C.

(viii) Whether Contractor is taking requisite number of samples of concrete at frequency as required in the specifications. Whether the method of sampling is correct and the samples have been marked. The names of sample, component, time of sampling, temperature, names of the persons preparing the sample and supervising the same should be recorded in a register.

(ix) Whether any sample taken by the Quality Control Organisation of PWD? Similar register to be maintained by them and the Contractor.

(x) Whether concrete is being vibrated properly so that concrete is available in all corners, bottom and sides of the member.

(xi) Whether finishing of concrete (of exposed surface) has been done in accordance with the approved drawings and specifications.

(xii) Whether any false work has moved during concreting.

(xiii) Whether the curing of concrete is being done as stipulated in the Specifications.

7.3 **Concrete Works (after execution)**

(i) Check any honey combing.

(ii) Check any place where concrete is unsound (such as presence of voids) by gently tapping on all surfaces;

(iii) Check the lines and lengths and finishing as per drawings.

(iv) Check concrete strength according to acceptance criteria.

(v) Check whether the concrete surfaces may be rendered or rejected or may be approved only after remedial measures, all in accordance with Specifications.

8. **For RCC Works**

8.1 **For RCC Works, Additional Points (before execution)**

(i) Check whether the batch of steel has been approved after getting the test certificates.

(ii) Check reinforcement lay out in accordance with approved drawing and bar bending schedule furnished by the Contractor.

(iii) Check that all laps are in accordance with Codal provisions. Notes on approved drawings should be followed in respect of such provisions.

(iv) Check the starter reinforcements of members joining it and whether they are properly embedded into the present member.

(v) Whether the reinforcements are free of oil and loose rust and scale and they are properly bound by binding wire. Sufficient chairs should be used for the spacing of reinforcements so that there is no likelihood of the cages being disturbed from the position during concreting.

(vi) Check whether sufficient number of concrete cover blocks of the correct dimensions have been placed alround the cage of reinforcement.

(vii) Check whether concrete can be placed around the reinforcement and vibrated properly.

8.2 **For RCC Works— additional points (during execution)**

Note the movement of reinforcement cage during concreting, if any.

8.3 **For RCC Works— additional points (after execution,**

Check whether any reinforcement is exposed.

9. **Prestressed Concrete Works**

9.1 **Additional points for Prestressed Concrete Works (before execution)**

(i) Check the quality of sheathing and ascertain whether the same has been approved after getting test certificates.

(ii) Check whether the layout of sheathings is in accordance with approved drawings and whether they are free from any crack or holes.

(iii) Check whether the sheathings are rigidly held at proper intervals so that there is no sagging during placement and vibration of concrete.

(iv) Check whether sheathings are free of oil and loose scales.

(v) Check whether concrete can be placed around the sheathings in a proper way.

(vi) Check whether the launching arrangement proposed for launching of precast beam is safe.

9.2 **Additional points for Prestressed Concrete (during execution)**

(i) Check whether sheathing is being disturbed during concreting.

(ii) Check whether the Contractor has got trained personnel for this type of work.

9.3 **Additional points for Prestressed Concrete (after execution)**

Check whether there is any crack or unsoundness of concrete along the lines of sheathings.

*ANNEXURE II*

*Enclosure to letter No. RW/NHVI-50(3)/83-Vol. II dated 4.1.88*

## TESTS ON MATERIALS

1. Tests of coarse aggregate for concrete (Table Q/Br./1)
2. Tests of water for bridge construction works (Table Q/Br./2)
3. Tests of fine aggregates for concrete (Table Q/Br./3)
4. Tests for cement concrete (Table Q/Br./4)
5. Tests of mortar for masonry work (Table Q/Br./5)
6. Tests of stone/brick for masonry/pitching work (Table Q/Br./6)
7. Tests for HT wire for prestressed works (Table Q/Br./7)
8. Tests for grout for prestressed concrete works (Table Q/Br./8)
9. Tests for steel bearings (Table Q/Br./9)
10. Tests for neoprene bearings (Table Q/Br./10)
11. Tests on sheathing for prestressed concrete work.
12. Tests of Cement (Table Q/Br./11)
13. Tests of HYSD bars.

Note ; For the formats of Table Q/Br./1 to Q/Br./11 please see the attached sheets.

**Methodology for carrying out tests on material**

The following specifications shall be followed for carrying out the above mentioned tests : —

1&3. As per IS : 2386.
2. As per IRC : 21-1987 and IS : 3025.
4. As per IRC : 21-1987
5 & 8. As per IS : 2250.
6. As per IS : 1077 and IS : 1597.
7. As per IS : 1785 (Part I) and IS : 1521.
9. As per IRC : 83 (Part I) -1982
10. As per IRC : 83 (Part II) -1987.
11. As per IRC : 18-1985
12. As per IS : 269, IS : 8112 and IS : 4031
13. As per IS : 1786, IS : 1608 and IS : 226

Q/Br./1

## TESTS OF COARSE AGGREGATES FOR CONCRETE

| S.No. | Qty. Collected cum. | Gradation % Passing IS 80 | 40 | 20 | Sieve 12.5 | c size 10 | (mm) 4.75 | c Impact or crushing value % | c Deleterious constituents % | X Water absorption | X Soundness | Checking by AE % | EE % | SE % | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

Minimum : X — One test for each source of supply and subsequently when warranted by charges in quality of aggregate.

Maximum : c — One test for every 50 cum of collection.

Q/Br./2

## TESTS OF WATER FOR BRIDGE CONSTRUCTION WORKS

| S.No. | Date | Source | 0.1 Normal Nao H. to Neutralise 200 ml of sample (ml) | 0.1 Normal Hcl to neutralise 200 ml of sample (ml) | Organic % | Inorganic % | % SOLIDS IN WATER Sulphates % | Alkali Chloride % |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

Minimum : X One test for each source of water or subsequently when warranted by change in quality.

Q/Br./3

## TESTS OF FINE AGGREGATES FOR CONCRETE

| S. No. | Qty. Supplied | GRADATION % passing Sieve size (mm) 10 4.75 | LS. 2.36 | i.18 | 600 m | 300 m | 150 m | Deleterious constituents % | Bulking % | Silt contents % |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| | | | | | | | | | | |

Minimum : One test for 50 cum of supply.

Q/Br./4

## TESTS FOR CEMENT CONCRETE

| S. No. | Date | Location in the structure | Qty. (cum) | Workability Slump/Compaction/ factor vee bee value | Compressive Strength After 7 days Sample Nos. I II III IV V | After 28 days Sample Nos. I II III IV V | Checked by AE % | EE % | SE % |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

Minimum : Ten samples per 60 cum of concrete.

Q/Br./5

## TESTS OF MORTAR FOR MASONRY WORK

| S.N. | Qty. cum. | Location in structure | Compressive.....Strength ($Kg/cm^2$) After 7 days I II III Samples | After 28 days I II III Samples | Checking AE % | EE % | SE % |
|---|---|---|---|---|---|---|---|
| 1 | 2a | 2b | 3 4 5 | 6 7 8 | 9 | 10 | 11 |
| | | | | | | | |

Minimum : Six Samples per 20 cum of Masonry work.

Q/Br./6

## TESTS OF STONE/BRICK FOR MASONRY/PITCHING WORK

| S. no | Date | Quantity Supplied cum | *Compressive Strength Kg/Cm² | Water Absorption % | Efflorescence % | c For Bricks Only Warp cm/cu | Dimension cm | K For pitching stone weight per unit kg | Specific Gravity | Checking AE % | EE % | SE % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | | |

* For Bricks minimum one test per 10,000 nos.
c Once for each source and subsequently when warranted due to change in quality
K All stones to be checked.

Q/Br./7

## TESTS FOR H.T. WIRE FOR PRESTRESSED WORK

| S. No. | Quantity | UTS kg/mm | Tolerances % | Proof Strength at 20% Strain kg/mm² | Checking for AE % | EE % | SE % |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Q/Br./8

## TESTS FOR GROUT FOR PRESTRESSED CONCRETE WORK

| Sl. No. | Date | Quantity | Location in Structure | Bleeding % | Compressive Strength kg/cm² I Sample | II Sample | III Sample | Checking AE % | EE % | SE % |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

Q/Br./9

## TESTS FOR STEEL BEARINGS

| S. No. | TOLERANCES IN (mm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Diameter of Rollers and all convex surfaces | Diameter of all concave surfaces mm | Height of Components mm | Base Plate Length mm | Width mm | MC on deviation on rolling/ rocking/ sliding surfaces M | Checking AE % | EE % | SE % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |

Q/Br./10

**TESTS FOR NEOPRENE BEARINGS**

| Sl. No. | Date | Identi-fications | Durometer Hardness (pts) | Ultimate Tensile Strain % | Tensile Strength kg/cm² | Adhesion to metal kg/cm² | Ozone resistance for 20% Strain | Tolerances | | | Total thickness mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Length mm | Width mm | Thickness of single layer mm | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |

Q/Br./11

**TESTS FOR CEMENT**

| S. No. | Date | Lot identification No. | Quantity received | Name of factory | Initial setting time | Final setting time | Compressive strength |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |

Checked by

| AE | EE | SE |
|---|---|---|
| % | % | % |

*ANNEXURE-III*

*Enclosure to letter No. RW/NHVI-50(3)/83-Vol. II dated 4.1.88*

**RECORDS TO BE KEPT AT BRIDGE SITE**

1. Records of all tests specified in Annexure-II.
2. Other important records to be maintained at bridge site are :
   (i) Particulars of concrete work (Proforma R/Br./1).
   (ii) Progress of well steining & sinking (Proforma R/Br./2).
   (iii) Record about tilts & shifts of wells (Proforma R/Br./3).
   (iv) History of wells (Proforma R/Br./4).
   (v) Different methods adopted and phenomenon encountered during sinking of wells (Proforma R/Br./5).
   (vi) Record of prestressing work (Proforma R/Br./6).
   (vii) Record relating to bearings (Proforma R/Br./7).
3. The handling and placing of reinforcement in respect of their shape, spacing and cover in the case of reinforced members should be checked and a certificate recorded in the site register of having done so before concreting is done.
4. Wherever guide bunds are provided, it is necessary to maintain record of settlement of the foundation soil and of the body of the guide bund and the same compared with respective calculated settlements.
5. To prevent excessive tilting of bearings during service, a proper record should be kept about the placing of bearings (especially reverse tilt actually provided in the case of segmental rollers), date, time and temperature at the time of casting superstructure concrete. Similar records will also be needed in case of prestressed concrete girders laid in stages.

R/Br./1

Particulars of Conerete work

1. Name of Division
2. Name of work
3. Name of contractor

| Date | Item in which concrete laid | Quantity of concrete | Mix of concrete | Material used Coarse aggregate with its fineness modulus | Fine aggregate with its fineness modulus | Time of start |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

| Time of completion | Bulking of sand | Extra sand actually used | Water contents | | | | Slump | Range of humidity |
|---|---|---|---|---|---|---|---|---|
| | | | In fine aggregate | In coarse aggregate | Total used | Water cement ratio | | |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |

| Temp | Concrete cube No. Filled with Identification mark | Cube Strength test results | | Cube Strength required | | Source of supply of cement batch No. | Whether batch of cement has been tested or not. |
|---|---|---|---|---|---|---|---|
| | | at 7 days | at 28 days | at 7 days | at 28 days | | |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |

R/Br./2

Progress of Well Steining & Sinking

1. Name of Division
2. Name of work
3. Name of Contractor

| Date | Time of observation | Well No. | Steining work | | Total | R.L. of tilt plane | Guage marks for Col. 7 | R.L. of Cutting edge | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Previous | Today | | | | When placed | As on previous observation | As today |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |

| R.L. of L.W.L. as per contract | Sinking below LWL | | Sump observation | | Strata met with at the time of observation | Any obstacle met since last observation |
|---|---|---|---|---|---|---|
| | Since last obseration (11-10) | Total sinking (12-11) | Depth of bottom of sump below top of well | Magnitude of sump | | |
| 12 | 13 | 14 | 15(i) | 15(ii) | 16 | 17 |

| Any blasting done since last observation | Any sand below since last observation | Kentledge Observations | | | | | |
|---|---|---|---|---|---|---|---|
| | | Extra kentledge over the well | Eccen-tricity along Y-axis | Eccen-tricity along X-axis | App. total qty. of dredged material on last observation | App. qty. of dredged material at time of observation | Total app. qty. dredged material todate |
| 18 | 19 | 20(i) | 20(ii) | 20(iii) | 20(iv) | 20(v) | 21 |

| Remarks | Signature of JE taking observation | Signature of AE in token of check | Signature of EE/SE on inspection and occasional check |
|---|---|---|---|
| 22 | 23 | 24 | 25 |

R/Br./3

## Record about Tilts & Shifts of Wells

1. Name of Division
2. Name of work
3. Name of contractor

| Date | Time of observation | Well No. | Total steining done in the well upto date | Total sinking done upto date | Reduced levels at gauge marks on the Tilt plane Along X-axis Along Y-axis | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Side | Side | U/s side | D/s side |
| 1 | 2 | 3 | 4 | 5 | 6(i) | 6(ii) | 7(i) | 7(ii) |

| Difference of levels taken on Tilt Plane | | Extent of Tilt | | Shifts | | Action being taken in case tilt exceeded 1/80 |
|---|---|---|---|---|---|---|
| Along X-axis | Along Y-axis | Along X-axis | Along Y-axis | Along X-axis | Along Y-axis | |
| 8(i) | 8(ii) | 9(i) | 9(ii) | 10(i) | 10(ii) | 11 |

| Remarks | Signature of JE taking observation | Signature of AE in token of check | Signature of EE in token of having been the Register and occasional check |
|---|---|---|---|
| 12 | 13 | 14 | 15 |

R/Br./4

## History of Wells

1. Name of Division
2. Name of Work
3. Name of Contractor

| Date | Well No. | Steining work from to | Sinking work from — to | Average sump during the stage | Strata | |
|---|---|---|---|---|---|---|
| | | | | | As per boring chart (showing position of bore) | As actually met |
| 1 | 2 | 3 | 4 | 5 | 6(i) | 6(ii) |

| Kentledge | | | Any obstacles met during sinking (Yes/No) | Sand blowing during sinking (Yes/No) | Dewatering done during sinking (Yes/No) | Any special method used during sinking (Yes/No) |
|---|---|---|---|---|---|---|
| Average Value | Accentri city Along X-axis | Along Y-axis | | | | |
| 7(i) | 7(ii) | 7(iii) | 8 | 9 | 10 | 11 |

| Tilts | | Shifts | | Action taken when tilts went beyond 1/80 | Remarks |
|---|---|---|---|---|---|
| Along X-axis | Along Y-axis | Along X-axis | Along Y-axis | | |
| 12(i) | 12(ii) | 13(i) | 13(ii) | 14 | 15 |

R/Br./5

## Statement showing Particulars of Different methods Adopted & Phenomenon Encountered during Well Sinking

Name of Division
Name of Work
Name of Contractor

| Date | Well No. | Total steining up-to date | Total sinking upto date | Work in progress on steining or sinking | Total weight available for sinking | | |
|---|---|---|---|---|---|---|---|
| | | | | | Weight of well for portion below water level allowing for buoyancy | Weight of well above water level | Kentledge weight |
| 1 | 2 | 3 | 4 | 5 | 6(i) | 6(ii) | 6(iii) |

| Total | Eccentricity of Kentledge | | Hours of working for which sinking was done | Quantity of material taken out from well pocket | | Details of explosive if used and name of person in whose presence it was used. |
|---|---|---|---|---|---|---|
| | Along X-axis | Along Y-axis | | During last 24 hrs. | Per rft of sinking of well done in 24 hrs. | |
| 7 | 8(i) | 8(ii) | 9 | 10(i) | 10(ii) | 11 |

| Whether de-watering was done during sinking and if so how much below river water level | Whether dewatering done after bottom plugging and if so how much below river water level | Rate of rise of water inside the well in dewatering test | Signature of person recording the inforamtion | Remakrs |
|---|---|---|---|---|
| 12 | 13 | 14 | 15 | 16 |

R/Br./6

## Record of Prestressing Work

1. Name of Division
2. Name of Work
3. Name of Contractor
4. Span length
5. Span No.
6. Name and No. of component
7. Date of casting _____
   (indicate average cube strength at 7 days and 28 days as per design)
8. Gauge pressure not to exceed _____

| Date of prestressing | No. of cable/wire or pair of wires | Side ..... ..... | | | | |
|---|---|---|---|---|---|---|
| | | Gauge reading | Initial Extension in mm | Locking pressure | Slip observed in mm | final extension in mm |
| 1 | 2 | 3(i) | 3(ii) | 3(iii) | 3(iv) | 3(v) |

| Gauge reading | Side ..... | | | | Total final extension in mm | Calculated extension in mm for an initial pull per cable/wire/ pair of wire |
|---|---|---|---|---|---|---|
| | Initial extension in mm | Locking pressure | Slip observed in mm | Final extension in mm | | |
| 4(i) | 4(ii) | 4(iii) | 4(iv) | 4(v) | 5 | 6 |

| Theoretical extension required in mm | Losses or gain in extension in mm | Progressive loss or gain of extension in mm | Slip observed if any, after 10 days | Remakrs | Signatures | | |
|---|---|---|---|---|---|---|---|
| | | | | | AE | EE | Contractors representative |
| 7 | 8 | 9 | 10 | 11 | 12(i) | 12(ii)- | 12(iii) |

R/Br./7

## Record Relating to Bearings

1. Name of Division
2. Name of Work
3. Name of Contractor

### Details of Bearings

| No. | Type of bearing | Items | Date of receipt | Dimensions as actually measured | Dimensions as per approved drawing | Remarks of AE & EE whether tolerances within permissible limits or not |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Type D Rocker | | Top plate<br>Bottom plate | | | | |
| Type D Roller | | Top plate<br>Saddle plate<br>Bottom plate<br>Roller | | | | |

**Details of fixing bearings**

| No. | Exact location | Type | Sketch as actually fixed before concreting under A.E's initials | Sketch as actual after removing plate under A.E.'s initials | Remakrs by EE |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| Pier No. 1 U/s Rocker<br>Middle Rocker<br>D/s Rocker<br><br>Pier No. 2 Roller | | | | | |

| Sketch as actual on the date of completion of Bridge under A.E's initial | Remakrs of EE. | Sketch as actual before the date of expiry of defect liability period under AE's initial | Remarks by EE |
|---|---|---|---|
| 7 | 8 | 9 | 10 |