

**TECHNICAL SPECIFICATION FOR  
INSTALLATION OF DRIVEN CAST-IN-SITU STONE COLUMN  
2 X 250MW BARAUNITHERMAL POWER STATION, EXTENSION UNITS**

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**1.00.0 SCOPE**

**1.01.0** This specification covers the installation of driven cast-in-situ stone columns as specified by BHEL . It also covers test to be carried out on the virgin as well as improved ground.

**2.00.00 GENERAL REQUIREMENT**

2.01.00 This specification covers the technical requirements for stone column.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour etc as required to carryout the complete stone column works including necessary testing and submission of records as per schedule.

2.03.00 All works shall be executed as per the specification to the satisfaction of the Engineer.

2.04.00 The design of detachable pile shoe shall be furnished for approval by BHEL / BSEB customer consultancy along with this specification.

2.05.00 It is essential that all equipments and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values.

2.06.00 The coordinates and position of stone columns as shall be as per the approved drawings. All the required survey instruments shall provided at site to the satisfaction of the Engineer so that the work can be carried out accurately according to specification and drawings.

2.07.00 The quality of stone column work including quality of sand and gravel used shall be approved at Site before use.

**3.00.00 MATERIALS**

**3.01.00 General**

All materials viz stone aggregate and sand shall conform to IS:383. Sand and stone aggregate mix of 1 (sand) : 2 (stone aggregate with size 50 mm and down) shall be used. For quality of materials refer to Cl 5.05.01

**4.00.00 STONE COLUMN INSTALLATION**

Installation of stone columns shall be as per procedure outlined elsewhere in the specification, relevant drawings and as per the direction of the Engineer.

**4.01.00 Equipment and Accessories**

4.01.01 The equipment and accessories for installation of driven cast-in-situ stone columns shall be with Driven Piling Rig of suitable capacity to suit the installation procedure mentioned below. These shall be of standard type and shall have the approval of the Engineer.

4.01.02 Among the commonly used plants, tools and accessories, there exists a large Variety; suitability of which depends on the subsoil conditions, manner of Operations etc. Brief definitions of some commonly used equipment are given below.

**Dolly:** A cushion of hardwood or some suitable material placed on the top of the casing to receive the blows of the hammer.

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**Drop hammer (or Monkey):** Hammer, ram or monkey raised by a winch and allowed to fall under gravity. Minimum weight of hammer to be adopted shall not be less than 4 MT.

**Pile frame (or Pile rig) :** A movable steel structure for deriving the casing for stone columns in the correct position and alignment by means of a hammer operating in the guides or (leaders) of the frame.

- 4.01.03 The list and details of equipment and accessories proposed to be used for the job shall be submitted.

**4.02.00 Installation Procedure**

- 4.02.01 Drive a 500 mm/550mm / 600 mm diameter M.S. casing pipe with detachable shoe (flat or conical) at the bottom using a monkey/hammer at the desired locations as shown in the construction drawings. The depth of driving the casing shall be as shown in the drawing. The height of free fall of the monkey shall be at least 1 m during driving the casing.
- 4.02.02 Fill the casing pipe for 1000 mm depth with desired back fill material as specified elsewhere in the specification.
- 4.02.03 Withdraw/lift the casing pipe for about 800 mm from the bottom.
- 4.02.04 After withdrawal/lifting the casing for about 800 mm, the backfill material inside the hole shall be thoroughly compacted using dynamic compaction method so as to achieve maximum compaction. Dynamic compaction may be done using a tamper/hammer operating inside the hole. The base diameter of tamper/hammer may be about 300 to 550 mm and the weight of tamper/hammer shall be at least 500 kg. The minimum height of fall of the hammer during compaction shall be 750 mm. To achieve the desired compaction of backfill material for 1000 mm depth, about 15 to 20 blows are required with a hammer of 500 kg.
- 4.02.05 Once the first layer is compacted, fill the casing pipe for another 1000 mm height with the desired backfill material and the procedure mentioned above shall be repeated so as to achieve maximum compaction.
- 4.02.06 After achieving the compaction of 2<sup>nd</sup> layer, repeat the procedure as mentioned above layer wise till the stone columns are installed up to the existing ground level.
- 4.02.07 While installing a large group of stone columns, the sequence of installation shall be from the centre to the periphery or one side to the other for avoiding possibility of damaging the neighboring stone columns and heaving of soil.
- 4.02.08 Centre to centre spacing of stone columns shall be as per the relevant drawing.

**4.03.00 Control of position and alignment**

- 4.03.01 Stone columns shall be installed as accurately vertical as possible.

**4.04.00 Adjacent Structures**

- 4.04.01 When working near existing structures care shall be taken to avoid any damage to such structures.

**4.05.00 Reference of Stone column Installation**

- 4.05.01 Each stone column shall be identified with a reference number.

**4.06.00 Rejection and Replacement of Defective Stone columns**

- 4.06.01 The Engineer reserves the right to reject any stone column which in his opinion is defective on account of position, alignment, quality of workmanship and materials etc. Stone columns that are defective shall be left in place as judged convenient by the Engineer without affecting the performance of adjacent stone columns.

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The Bidder shall install additional stone columns to substitute the defective stone column as per the directions of the Engineer at no extra cost to BHEL.

**4.07.00 Recording of Stone column Data**

4.07.01 The Bidder shall record all the information during installation of stone columns. Typical data sheet for recording pile data shall be as shown in Annexure-D of IS: 15284, Part I. On completion of each stone column installation, stone column record in triplicate shall be submitted to Engineer .

**5.00.00 TESTING AND QUALITY ASSURANCE**

5.01.00 Facilities required for testing of stone columns in field should be provided by the Bidder. The Bidder shall carry out all testing in accordance with the relevant Indian Standards and as per this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the same shall be arranged by BHEL.

5.02.00 All inspection and testing records shall be maintained which shall be made available to the Engineer.

5.03.00 Materials found unsuitable for acceptance shall be removed and replaced. The work done by this unsuitable material shall be redone as per specification requirements & and to the satisfaction of the Engineer.

**5.04.00 Quality Assurance Programme**

- a) The installation procedure mentioned above shall be followed and any deviations in the same shall be brought to the notice of the Engineer. This shall also include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, etc. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.
- b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table -
  1. The testing shall be done at field, laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

**5.05.00 Testing of Materials**

5.05.01 Sand and other materials shall be tested for quality, strength and other properties please refer to Table -1

5.05.02 Plate load test and Dynamic penetration test on virgin and improved ground shall be conducted as per required depth and location as shown in the relevant drawings.

5.05.03 The acceptance criteria shall be as mentioned in Table-1.

**5.06.00 Testing for position and alignment**

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5.06.01 Each stone columns shall be checked for its position and alignment as per relevant drawings.

**6.00.00 FIELD TESTS** The following tests shall be carried out as per relevant Indian Standards or as directed by Engineer.

**6.01.00 DYNAMIC CONE PENETRATION TEST ( FOR 600 MM DIA STONE COLUMNS )**

**6.01.01** The specification for the equipment and accessories required for performing the test, test procedure, field observations and reporting of results shall conform to IS:4968, Part-I. The location and depth of the test shall be as given in the drawing or as indicated by the engineer-in-charge.

**6.02.00 PLATE LOAD TEST (FOR 500 MM DIA STONE COLUMNS)**

**6.02.01** The specification for equipment and accessories required for conducting the test, the test procedure, field observations and reporting of results etc shall conform to IS: 1888. The location and depth of the test shall be as given in the drawing or as indicated by the engineer-in-charge.

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**ANNEXURE-A**

**TABLE -1  
FREQUENCY PLAN OF SAMPLING AND TESTING**

Sl. No	Type of material / work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Stone Column				
	a) diameter		Physical measurement	Each stone column	As per specification
	b) length				
2.	Position and Alignment	-	Survey Instrument / any Approved method	Each stone column	As per specification
3.	Stone aggregate and sand	As per IS:383	Site Lab test regularly / In approved lab on change in source		As Below
a	50 mm and down stone aggregates	Aggregate Crushing Value	In approved lab, as per IS 2386 Part-IV	One test for every 5000 m3 and at every source	as per IS 2386 Part-IV
b	50 mm and down stone aggregates	Sieve Analysis	Site Lab test regularly / In approved lab on change in source	-do	As per Annexure-B
c	Sand	Grading of Sand	Site Lab test regularly / In approved lab on change in source	-do-	Zone-I/Zone-II/Zone-III As per IS 383 Table- 4

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**ANNEXURE-B**

Grading Requirement of 50 mm and down stone aggregates

Sieve size, mm	Percent passing the sieve, by weight
50	100
40	35-70
20	0-10
10	0-5