

# **METHODOLOGY FOR INITIAL VERTICAL LOAD ON PILE**



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# (KENTELEDGE METHOD)

## 01) PURPOSE

The purpose to find application in foundation to transfer load from a structure to competence subsurface strata having adequate load bearing capacity. Piles load test by kenteledge method through anchorage by piles or dead load is the most direct method for determining the ultimate load carrying capacity of pile and arrive the safe loads on piles including its structural capacity with request to soil in which it is installed. This code IS2911 (Part 4) covers all types of piles test and provides guide lines for determining of safe load based on the following types of

- A) Vertical load test (Compression)
- B) Lateral Test
- C) Uplift Test

*This statement does not address all of the safety concerns, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices before test.*

## 02) TERMINOLOGY

**Cut-off level:** The level where the installed pile is cut-off to support the pile caps or beams.

**Datum Bar:** A rigid bar placed on immovable supports at a distance of  $3D$  (Subjected to minimum, of 1.5 m) from the edge of piles. (Where  $D$  is dia pile)

**Initial Test:** It is carried with a view to determine ultimate load capacity and the safe load capacity (2 to 2.5 times of safe load)

**Kenteledge:** Dead weight used for applying the test load on piles by dead load method or anchorage method through pile.

**Ultimate Load:** The maximum load which a pile can carry load before failure of ground.

**Safe Load:** It is load on a pile derived by applying a factor of safety on ultimate load capacity of pile as determined by load test.

**Working Load:** The load designed to a pile according to design.

Pile test may be carried out on a single pile or group of piles as required. For group of piles, cap will be provided for test.

Before starting the pile load test work at the site ensure the availability of below list of equipment and tools.

- 🔧 Hydraulic Jacks

- 📌 Power pack
- 📌 Pressure Gauge
- 📌 Magnetic stand and Deflectometer (0.01 mm sensitivity) and Glass sheet
- 📌 Crane
- 📌 Concrete block for ded load

### **03) Roles & Responsibilities**

#### **Project Manager**

- He shall be responsible to control all the activities for the construction all works.
- Ensures that the project works in his zone are carried out in accordance with company policies and in accordance with the requirements of the project quality plan.
- Ensuring the full compliance of subcontractor operations with corporate quality policies and with the requirements of quality plan.
- Make sure that all the suitable equipment requirement to execute the works according to the construction program are available, in good condition, and provide any additional equipment.
- Coordinate with the Construction Manager, Project Engineer, Safety Engineer, for a safe and proper execution of the works.
- To guide specific attention to all safety measures in co-ordination with the safety officer/engineer.
- Selection of equipment's according to work condition in coordination with plant and machinery team.

#### **Construction Manager**

- Report to the Project Manager
- Ensure area is ready and safe to start the works.
- Concrete Mix design shall be submitted to Employer's representative and take approval before use

- Ensure reinforcement / structural steel is ready before start of work.
- Set up necessary equipment and plant through discussion with the Project Manager and Project Engineer/Works Supervisor.
- Ensure the works are carried out according to the specification, quality and approved shop drawings.
- Liaise and coordinate with the project manager for the agreed sequence of works with respect to the construction methodology and program.
- Allocation of required manpower through co-ordination with the PM.
- Ensure the availability of the risk assessments for the works activities in hand.
- Provide sufficient and safe access for operatives, Crain, trucks and pumps.
- Take precautionary measures with regards to protecting works from hot weather, cold, sun and rain etc.

#### **HSE Engineer/Officer**

- Report to the Project Manager
- To ensure implementation of all safety measures related to the nature of works being carried out, and in accordance with the Project Safety Plan.
- Ensure that all the persons involved in the works are aware of their responsibilities, and that they have

- enough understanding of the safety procedures.
- The safety officer in co-ordination with the Project Manager will ensure that all the implemented safety measures are effective enough to maintain safe working conditions on the site.
  - To maintain continuous inspections of the site activities, advise and train persons on a daily basis to prevent accidents and personnel injury.
  - Give special concern to housekeeping, and ensure that the site is well maintained clean and tidy.
  - To ensure all the relevant safety sign boards for different works are in place.

#### **QA/QC In-charge**

- Report to the Project Manager
- Ensuring that Consultant/Client inspection requests are implemented.
- Compilation of all necessary quality control checklists.
- Assisting consultants during the Inspections.
- Coordinating with the third party lab regarding tests and results.
- The control of work performance by means of checking the work before consultants inspection and issuing RFIs, punch lists as necessary.
- Completion of documentation to verify the work performed.
- Controlling all inspection activities on site in line with ITP's.
- Ensuring that all test equipment including surveying equipment is calibrated and is suitable for use on the project site.

#### **Plant In-charge**

- Report to the Project Manager.

- Analyze suitability of Plants & Machinery required to execute work, check technical specifications.
- Ensure good working condition of all P&M.
- Regular inspection of P&M along with safety officer to maintain good mechanical condition of P&M.
- Ensure all Third Party Inspections of P&M as per statutory requirements.
- Ensuring suitable and skilled technicians to keep P&M in good working condition and training to workmen using P&M.
- Controlling minimum spares inventory at site to ensure smooth operation of P&M and to tackle breakdowns.
- Controlling storage, allocation of diesel, monitoring consumptions to avoid misuse.
- Monitoring performance, availability, utilization of P&M

#### **Project Engineer**

- Report to the Construction Manager
- The engineer will carry out his duties in a manner that will be coordinated by the Construction manager on a daily basis, and will ensure proper distribution of the workforce and equipment at different site locations.
- To be aware of test frequencies related to the work.
- Control disposal of waste excavation material according to the instructions from the project manager/customer.
- Coordinate with the Safety Officer to maintain safe working and proper housekeeping of the site. To comply with the safety measures and ensure that all the HSE team is

- aware of the same to prevent accident and loss.
- Ensure reinforcement ready to working as per requirement.
  - To monitor and check all activities and ensure that works will be carried out according to specifications, quality and approved drawings.
  - To inform the QC Inspector of the areas ready for inspection

### **QC Engineer**

- Report Site QA/QC In-Charge.
- Shall be responsible for overall control and inspection of QC activities as per checklist and QAP at site during concrete work.
- Shall be responsible for performing all checks and taking slump / temperature tests and accepting / rejecting concrete.

### **Surveyor**

- Co-ordinate with the Foreman /Project Engineer and Construction Manager
- To establish benchmarks from agreed reference points, provide required setting out and level markings and follow up with regular checks.
- Co-ordinate with the Project Engineer / Foreman and ensure the approved shop drawings/construction drawings will be implemented properly.
- Maintain survey details and reports, periodically check the progressing works and advise the project manager of any deviation from the drawings.

### **Foremen/ Works Supervisor**

- Report to the Project Engineer
- Ensure the work progress inline with the targets and sequence as per the PM directions and orders.

- Liaise with the Project / Construction Manager for the allocation of the work force, ensuring adequate manpower is available.
- Liaise with the site manager to ensure all the plant/materials are available to perform the construction works.
- Full time supervision to ensure the works are in accordance to specifications, quality and IFC drawings.

## **04) Preliminary Activities**

### **Traffic Management**

The traffic management shall be implemented as per the submitted 'Environment Health & Safety' plan & IRC: SP: 87-2010, Section 9 & IRC: SP: 55)

### **Structures & Other Encumbrances**

Identified structures and encroachments along the alignment shall be removed by the authority before commencement of the work

### **Cube Test for the Concrete**

The Cube tests for the pile concrete shall be carried out and shall be recorded prior to the load test.

### **Calibration of Deflection dial gauges**

The deflection dial gauges shall be calibrated in a accredited laboratory for their correction factor. The calibration certificate for the dial gauges shall be submitted to client for the review.

### **Calibration of Pressure Gauges**

The pressure gauges shall be calibrated in a accredited laboratory for their correction factor. The calibration certificate for the dial gauges shall be submitted to client for the review.

### **Calibration of Hydraulic jacks**

As such there is no proving ring higher capacity available for testing the efficiency of hydraulic Jacks. For the purpose of Pile load test the efficiency of Hydraulic Jacks can be considered as 97%. The Manufacturer's drawing shall be used to calculate the area of the ram under pressure shall be considered.

## **05) Sequential Construction Activities**

### **Vertical Load Test (Compression)**

In this type of test, compression load is applied to the pile top by means nos. of hydraulic jack (according to load and capacity of jack) against rolled steel joist or suitable load frame capable of providing reaction and settlement is recorded by suitably positioned dial gauges. Maintained load method is according to 6.2 of I.S. code 2911 Part (IV) should be used for termination of safe load.

### **Preparation of pile head**

After casting of piles, a proper pit shall be excavated with proper slope as shown in general arrangement drawing. A sump shall be provided for percolating water. After casting of pile, the additional built-up portion shall be Chipped up to the design cutoff level / or till sound concrete is reached, whichever is lower. The pile shall be



cast with a suitable pile head as detailed in drawing. Suitable structural arrangement shall be made to facilitate fixing of magnetic stand and deflecto meter for measuring the settlement of pile.



## Reaction

- The reaction on pile for testing can be done by following ways:
- Kentledge on a platform supported clear of the test pile by using dead load.
- Reaction through anchorage piles (designed as per I.S. 2911 (Part III)). The distance between center of test pile and anchor pile should be 3 times of test pile dia or subjected to minimum 2 m.
- Reaction through rock anchors with distance 2 times of edge of piles.

## Placement of Jack

Before placing the jacks on the pile head a structural steel plate shall be provided for distribution of load uniformly over the pile head. All the required capacity jacks shall be identical and connected to the power pack with a common manifold; this shall ensure that equal pressure is developed in all the jacks simultaneously.



## Placement of Kentledge and Structural platform

Structural platform and kentledge shall be placed in position as per drawing.

## Datum Bar

The datum bar of size as detailed in the drawing shall be positioned.



## **06) Method of loading**

After Placing of concrete blocks on top of the test frame and after construction of reference system for measurement of pile deflection, the hydraulic jacks shall be activated with the help of powerpack. The rate of activation in the hydraulic jacks shall be @50Kg/sq.cm per minute. However, there is no specific codal requirement for this. The rate of activation shall be controlled from the powerpack. After reaching the required pressure the pressure shall maintained for the required time as specified in the cycle. If any loss in pressure during the standing time shall be applied.

## **07) Measurement of Settlement**

4 Dial gauges of 0.01 mm sensitivity are used to measure the pile top settlement. Four settlement gauges are placed equally at the sides of the test pile to measure the settlement of the pile and firmly held by magnetic base as shown in figure. The average of the four readings is taken as the pile settlement. A temporary bench mark will be established on the well-founded structures. Hence the TBM will serve as a second check for the pile top settlement.

## **08) Maintained Load**

The test should be carried out by applying a series of increment load of each increment being 20% of safe load for initial load pile test. In this, increment 20% is given through hydraulic jacks pump and taking measurement or displacement (by dial gauges) in each stage of loading, is maintained till rate of displacement of the piles top is either 0.1 mm in first 30 minutes or 0.2mm in first one hour or till 2 hour whichever occur first. If the limit, if permissible displacement in 6.1.5 or 6.1.6 of I S 2911 part (IV) is not exceeded, testing of pile is not required to be contained further. If it is not then test load shall maintained for 24 hrs.

This safe load on single pile for the initial pile test should be least of the following.

Final load at which the total displacement attains a value of 25mm.

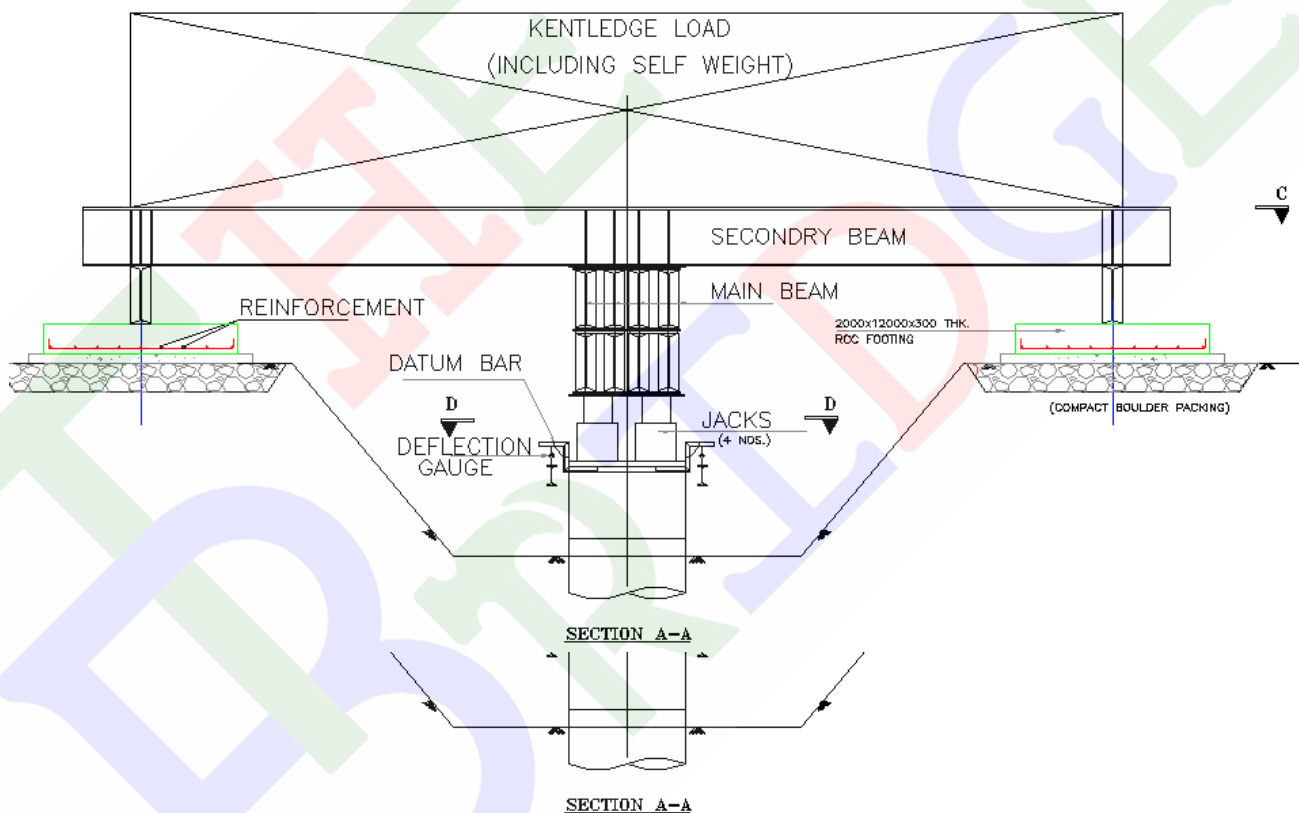
2/3 of final load at which the total displacement attains a value of 40mm.

## 09) Criterion for Load Test

After plotting the load against settlement curve, the load test results shall be analyzed for the ultimate load and safe load carrying capacity of the pile shaft or pile.

The safe load on single pile for the initial test should be least of the following:

- Two- thirds of the final load at which the total displacement attains a value of 12mm.
- 50 percent of the final load at which the total displacement equal to 10 percent of the pile diameter.



## 10) At Offsite Location

- **Plotting Load Vs. Settlement Curve:** The data observed and recorded for load test shall be plotted for test data analysis.
- **Plotting Time Vs. Settlement Curve:** The data observed and recorded for load test shall be plotted for test data analysis.
- **Test Data Analysis & Reporting:** After completion of the test data shall be analyzed and reported as a design report for finalizing the design criteria for the design of working piles.

