

## Ultrasonic Pulse Velocity Tests

### **Application:**

These tests are primarily done to establish:

- the homogeneity of concrete
- presence of cracks, voids and other imperfections
- changes in quality of concrete over time
- this test does not establish compressive strength of tested concrete

UPV Tests are done in accordance with Indian standards IS: 13311 (Part 1)



**UPV Test on a beam**

### **Procedure:**

- The concrete surface where probes are to be applied is cleaned properly.
- Grease is applied on the test surfaces
- The probes are pressed on the surface of the structural element to remove air gaps.
- Distance between the two probes is noted.
- Read time taken for the ultrasonic pulse from the instrument.
- Calculate Velocity = distance / time

Sr. No	Pulse velocity by cross probing	Concrete Quality Grading
1	Above 4.5 km/s	Excellent
2	3.5 km/s to 4.5 km/s	Good
3	3.0 km/s to 3.5 km/s	Medium
4	Below 3.0 km/s	Doubtful

## Rebound Hammer Tests

### **Application:**

These tests are primarily done to assess:

- the likely compressive strength of concrete
- the uniformity of concrete

Rebound Hammer tests are done in accordance with Indian standards IS: 13311 (Part 2)

### **Procedure:**

- The concrete surface is cleaned properly
- The hammer is pressed against the concrete surface and released
- Six readings are taken and an average is taken.
- Correlate the average with the compressive strength



**Rebound Hammer Test**

## Half Cell Potential & Carbonation Tests

### **Application:**

These tests are used to assess the probability of corrosion in reinforcement.

HCP Tests are done in accordance with ASTM C876 standard.

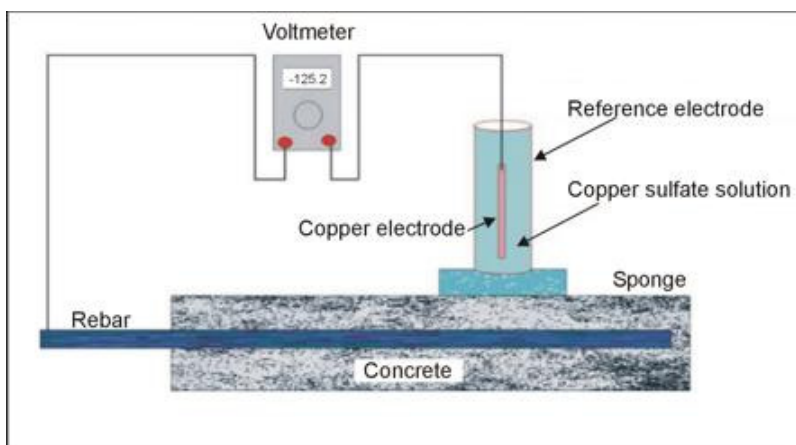
### **Procedure for Half Cell Potential Tests:**

- Identify test location & drill a hole in the concrete to reach the reinforcement.
- Establish electric contact with the reinforcement.
- Place the half cell at various locations on the concrete surface & measure voltage in the voltmeter.
- Correlate the obtained voltages to probability of corrosion as per ASTM standard.

### **Procedure for Carbonation Tests:**

- Identify test location & drill a hole in the concrete to reach the reinforcement.
- Inject chemical & insert steel rod
- The color change determines till what depth carbonation has taken place

Carbonation tests can also be done on extracted cores by applying the chemical on the core and measuring the depth till which the carbonation has taken place.



**Half Cell Potential Test**



**Carbonation Test**

## Concrete Core Test

### **Application:**

These tests are primarily done to obtain the compressive strength of the concrete sample. In addition, the density of the concrete sample is also obtained.

Concrete Core tests are done in accordance with Indian standards IS: 1199 and IS: 516

### **Procedure:**

- The exact position from where the core can be extracted from the concrete member is determined using a rebar mapping device so as to avoid the reinforcing bars within the concrete member.
- Concrete core of diameter of at least three times the maximum nominal size of coarse aggregate is obtained using a core cutting machine.
- The obtained cores are capped on both sides in the laboratory using epoxy mortar. The capped surfaces shall be at right angles to the axis of the specimen and shall not depart from a plane by more than 0.05 mm.
- The core is then placed in water at a temperature of 24° to 30°C for 48 hours before testing.
- The core is then subjected to compression forces on a compression testing machine. The breaking point is observed & noted.
- The obtained compressive strength is converted to equivalent cube strength and is reported after applying suitable correction factors in accordance with the Indian standards.



**Core Extraction**



**Extracted Core**



**Compression Testing**

## Reinforcement Mapping Tests

### **Application:**

Rebar mapping is a mechanism to obtain information related to reinforcement in existing concrete buildings where drawings are missing or reinforcing data needs to be verified.

These tests are carried out to:

- check the size and numbers of reinforcing bars present in concrete members
- determine the concrete cover provided to reinforcement
- prepare structural drawings for RCC structures where original drawings are not available

### **Procedure:**

- Identify the test locations on each member so that all required reinforcement data can be captured.
- Clean the surface of the structural member.
- Locate main reinforcement bars and determine number/spacing of the bars.
- Determine diameter of main bars.
- Locate secondary bars (or stirrups) and determine number/spacing of the bars.
- Determine diameter of secondary bars.
- Data obtained for similar members must be correlated to obtain more meaningful results in terms of rebar diameter.
- This test does not determine grade of reinforcement.



**Rebar Mapping of column**



**Rebar Mapping of Footing**



## Pile Dynamic Test

### **Application:**

Pile dynamic tests are used to determine the load carrying capacity of piles. These are an alternate to static load tests. The dynamic tests offer a considerable saving of time and cost compared to static pile test.

Modified Hiley formula as per IS: 2911, (Part 1, Section 1) is used to calculate the pile capacity.

$R = Whn/(S + C/2)$ , where

R = Ultimate driving resistance in tonnes

W = Mass of Ram in ton

h = Height of free fall in cm

n = Efficiency of the blow representing ratio of energy after impact to striking energy of ram

S = Final settlement per blow in cm

C = Sum of the temporary elastic compression of the pile, dolly packing and the ground in cm

The safe load for the pile is calculated applying the appropriate factor of safety.

### **Procedure:**

- The pile head is cleaned and sand cushion is put on the pile head.
- The wooden plate is put on the sand cushion and then a steel plate is put on top of the wooden plate.
- The displacement sensor is connected on the side of the pile.
- The laptop is connected to the dynamic recorder.
- The ram height is adjusted to the required level and the ram is dropped on the pile.
- The displacement is recorded by the dynamic recorder and data is transferred to the laptop for further calculations



**Equipment Setup**



**Displacement Recorder**

## Pile Integrity Test

### Application:

- Used for qualitative evaluation of the physical dimensions & continuity of the pile. Any necking or bulging is detected.
- Checks the consistency of the concrete used for constructing the pile.

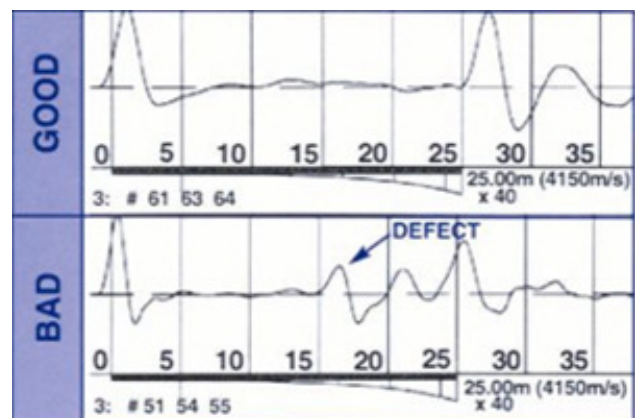
These tests are done in accordance with Indian Standard IS:14893.

### Test Procedure:

- Clean the pile head.
- Fix the sensor at the pile head using glue or similar material
- Hit the pile head with a plastic/rubber hammer
- Sonic waves are recorded by the sensor and data transferred to a laptop
- Multiple blows are recorded for each pile to confirm consistency of signals and to reject improper blows.
- Recorded data is analyzed to arrive at conclusions.
- For pile diameter greater than 600mm, the test should be done at multiple locations on the same pile so as to cover the entire pile cross section.



**Pile Integrity Test**



**Specimen Test Result**

## Weld Test - Magnetic Particle Inspection

### **Application:**

Magnetic particle inspection is a method of locating and defining discontinuities in magnetic materials. It is excellent for detecting surface & sub-surface defects in welds, including discontinuities that are too small to be seen with the naked eye.

### **Procedure:**

- Test locations are cleaned of paint, primers and any other contaminants.
- Probes are placed on each side of the area to be inspected, and electric current is passed between them.
- A magnetic flux is produced at right angles to the flow of current.
- When a discontinuity such as a crack is detected, the magnetic flux leaks, creating points of attraction.
- A magnetic powder is then applied to the surface and clings to the leakage area more tenaciously than elsewhere, forming an indication of the discontinuity.

## Weld Test – Liquid Penetrant Inspection

### **Application:**

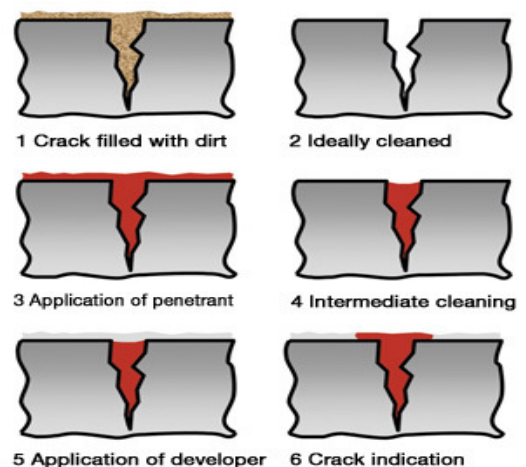
Liquid penetrant inspection is used to detect any surface discontinuities such as cracks from fatigue, improper welding, porosity and incomplete fusion in welds.

### **Procedure:**

- Test locations are cleaned of paint, primers and any other contaminants.
- Penetrant is applied on the surface and some time is allowed for the penetrant to soak in into the discontinuities
- Excess penetrant is then removed from the surface
- A developer powder is then applied on the surface which shows any defects clearly
- The defects are inspected and noted



**Magnetic Particle Inspection**



**Liquid Penetrant Inspection**

## Vibration Measurement

### **Application:**

Some structures are subjected to routine dynamic loads such as blast loads in structures close to rock blasting sites. Many of these structures have not been designed for these vibration loads, especially where these loads were not present during planning. In these cases it is important to quantify the vibration loads and check the adequacy of the structure in terms of strength and serviceability.



**Equipment setup on terrace**

### **Procedure:**

- Fix the accelerometers at important locations on the structure using glue or similar material.
- The accelerometers are connected to the laptop.
- The accelerometers capture the data whenever any vibration event occurs.
- Data is transferred to the laptop for further processing and use in structural analysis.



**Accelerometer fixed on a beam**

## Ultrasonic Thickness Measurement

### **Application:**

Ultrasonic thickness gauge is used to measure the thickness of steel or any other metallic members. This technique is especially useful because access is required only from one side of the member/plate whose thickness is to be measured.

Thickness measurements are required to:

- Check if the fabricated items conform with the drawings & Indian Standards
- To estimate the loss in thickness of steel members due to corrosion
- Can be used to check thickness of pressure vessels, boilers, storage tanks, tubes & pipes and steel sections (I beams, Channels etc)

### **Procedure:**

- Test locations are cleaned of paint and rust using a sand paper so that the surface is smooth.
- Oil is applied on the test probe.
- The probe is pressed against the member and the reading is recorded.



**Ultrasonic Thickness Measurement**