**SE Laboratory**
Structural Engineering Laboratory

**AIT**
Asian Institute of Technology

# Report on Testing and Evaluation of Strength and Robustness Performance of Autoclaved Aerated Concrete "Smart block G4"

Client:
SMART CONCRETE PUBLIC CO., LTD.

Doc. No. S0239-15

# CONTENT



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# CHAPTER 1
# INTRODUCTION

## 1.1 GENERAL

At the request of The Smart Concrete Public Co., LTD., the Structural Engineering Laboratory, Structural Engineering Field of Study, School of Engineering and Technology, Asian Institute of Technology was engaged to carry out the strength and robustness performance of partitions. Partition grade can be derived when all the relevant tests are applied to the test specimen. The methods of test are given for stiffness, hard and soft body impacts, door slamming, crowd pressure, lightweight anchorages (pull-out and pull-down), heavyweight anchorages (wash basin and wall cupboard). All testing programs are conformed to BS 5234: Part 2: 1992. Partitions are graded according to the level of activity in adjacent spaces and the degree of care likely to be exercised by people that described in Table 1.1.

Table 1.1 Partition Grades by Categories of Duty

| Grade | Category of Duty | Examples |
|---|---|---|
| Light duty (LD) | Adjacent space only accessible to persons with high incentive to exercise care. Small chance of accident occurring or of misuse. | Domestic accommodation |
| Medium duty (MD) | Adjacent space moderately used primarily by persons with some incentive to exercise care. Some chance of accident occurring and of misuse. | Office accommodation |
| Heavy duty (HD) | Adjacent space frequently used by the public and others with little incentive to exercise care. Chances of accident occurring and of misuse. | Public circulation areas Industrial areas |
| Severe duty (SD) | Adjacent space intensively used by the public and others with little incentive to exercise care. Prone to vandalism and abnormally rough use. | Major circulation areas Heavy industrial areas |

## 1.2 OBJECTIVES OF TESTING AND EVALUATION

The main objective of the test will be to determine the strength and robustness performance of partition system and to classify the performance grade of different types of partition systems.

## 1.3 SCOPE OF WORK

One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

### 1.3.1 Determination of partition stiffness

The test is to establish the ability of the partition to withstand persons or ladders leaning against it without causing unacceptable cracking or movement. To simulate the partition is subjected to a static horizontal load at a set height and the maximum deflection and residual deflection measured, recording surface or structural damage.

### 1.3.2 Determination of surface damage by small hard body impact

The test is to determine the resistance of the partition to damage from impacts by small, hard objects. A 3-kg impact or, with its head being a 50-mm diameter steel sphere, is swung to impact approximately perpendicularly the face of the partition. The nature and extent of any damage to the specimen is recorded

### 1.3.3 Determination of resistance to damage by impact from a large soft body

The test requires that the partition is subjected to two separate impacts from a soft body impactor in the form of a spheroconical bag capable of being swung at the partition to determine the resistance to damage. A bag, suspended from the test rig applies the impact. The bag is positioned so that when at rest it just touches the face of the specimen at the point of intended impact. The permanent deformation and any damage are recorded after each single impact.

### 1.3.4 Determination of resistance to perforation by small hard body impact

The test is to determine the resistance of the partition to perforation from impacts by small, hard objects. A 3-kg impact or, with its head being a 50-mm diameter steel sphere, is swung to impact approximately perpendicularly the face of the partition. Surface damage and any perforation of the specimen is recorded.

### 1.3.5 Determination of resistance to structural damage by multiple impacts from a large soft body

The test is similar to that described in item 3.3 except that structural damage recorded after three impacts of greater impact energy.



### 1.3.6 Determination of the effects of door slamming

The test requires that the partition is subjected to an impact from the test specimen door leaf slamming, transmitted through the doorframe to the partition. The residual

displacement of the doorframe is measured and recorded together with any damage to the partition or doorframe.

1.3.7 Determination of resistance to crowd pressure

The test requires that the partition is subjected to a continuous load transmitted through a 2.5 m horizontal beam at a set height and the maximum deflection measured. Surface of structural damage is also recorded.

1.3.8 Lightweight anchorage pull-out test

The test is to establish the ability of the partition to sustain a load at an anchorage point subjected to an axial load transmitted through a pull-out test bracket using a single anchorage and to avoid dislodgment of a shim plate, positioned between the bracket and the surface of the partition.

1.3.9 Lightweight anchorage pull-down test

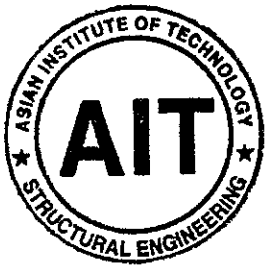
The test is to establish the ability of the partitions to sustain a load at an anchorage point subjected to a transverse load transmitted through a pull-down test bracket using a single anchorage, to avoid dislodgment of a shim plate and displacement of the pull-down bracket.

1.3.10 Heavyweight anchorage (wash basin) eccentric downward loading test

The test is to establish the ability of the partition to sustain a load applied through a pair of brackets designed to support a wash basin or similar. The maximum and residual deflection of the partition at specified points is measured and any loosening of the supporting brackets, damage to the partition or anchorage failure is recorded.

1.3.11 Heavyweight anchorage (high level wall cupboard) eccentric downward loading test

The test is to establish the ability of the partition to sustain a load applied to a frame designed to simulate a high-level wall cupboard. The maximum and residual deflection of the partition is measured and any loosening of the supporting brackets, damage to the partition or anchorage failure is recorded.



# CHAPTER II
# EXPERIMENTAL PROGRAM

## 2.1 GENERAL

The testing shall be on specimen partition and junction assemblies representative of those to be supplied and/or erected in practice fitted into a test rig. The test series are consisted of 11 tests as follows:

a) Determination of partition stiffness
b) Determination of surface damage by small hard body impact
c) Determination of resistance to damage by impact from a large soft body
d) Determination of resistance to perforation by small hard body impact
e) Determination of resistance to structural damage by multiple impacts from a large soft body
f) Determination of the effects of door slamming
g) Determination of resistance to crowd pressure
h) Lightweight anchorage pull-out test
i) Lightweight anchorage pull-down test
j) Heavyweight anchorage (wash basin) eccentric downward loading test
k) Heavyweight anchorage (high level wall cupboard) eccentric downward loading test

## 2.2 DETERMINATION OF PARTITION STIFFNESS

### 2.2.1 Apparatus

2.2.1.1 Test rig

2.2.1.2 Calibrated loading equipment, capable of applying a load of 500 N perpendicularly to wards the surface of the partition through a circular metal plate 150 mm ± 1 mm in diameter covered with a pad of resilient material 6 mm ± 2 mm thick. The equipment shall apply the load to an accuracy of ± 15 N. The rate of application of the load shall not exceed 50 N/s.
*Note: Closed cell natural sponge rubber with a density between 145 kg/m$^3$ and 225 kg/m$^3$ has been found to be a suitable resilient material.*

2.2.1.3 Measuring instrument, for measuring the maximum deflection of the specimen to the nearest 0.1 mm.

2.2.1.4 Clamps and/or other devices, that position the measuring instruments and ensure their stability during the test.

### 2.2.2 Procedure

2.2.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.

2.2.1.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.

2.2.1.3 Allow time for the curing, drying and/or conditioning of certain materials.

2.2.1.4 Record the laboratory temperature and humidity during the installation of the specimen and the test.

2.2.1.5 Prepare to record any changes in the specimen observed during the test together with the readings from the measuring instrument

2.2.1.6 Position the loading equipment to apply a force perpendicular to a solid area of the specimen, with the pad at the surface of the partition, at a height of 1500 mm ± 10 mm measured from the bottom of the specimen and horizontally where the testing organization considers maximum deflection will occur.

2.2.1.7 Position the devices for measuring deflection at 125 mm above the centre point of the application of the load, on the load side.

2.2.1.8 Gradually apply a preload of 100 N.

2.2.1.9 Allow the loaded specimen to stabilize for 1 min.

2.2.1.10 Remove the load and allow the unloaded specimen to stabilize for 1 min.

2.2.1.11 Set the deflection measuring instrument to datum.

2.2.1.12 Apply a load of 100 N, then pause for approximately 2 min. Examine the specimen and record the deflection. Increase the load in 100 N increments at approximately 2-min intervals to 500 N, recording the deflection at each increment.

2.2.1.13 At 500 N Sustain the load for 2 min.

2.2.1.14 Record the deflection to the nearest 1.0 mm.

2.2.1.15 Remove the load and pad.

2.2.1.16 Record any residual deformation in millimeters to the nearest 0.1 mm when the specimen has fully stabilized or 1 h after completing the test,whichever occurs first st.

2.2.1.17 Thoroughly examine the specimen, and record all damage and defects.

## 2.3 DETERMINATION OF SURFACE DAMAGE BY SMALL HARD BODY IMPACT

2.3.1 Apparatus

2.3.1.1 Test rig.

2.3.1.2 Impact or, a head comprising a 50-mm diameter steel sphere mounted on a shaft not exceeding 20-mm diameter, weighted to bring the total mass of the impact head to 3 kg. The head shall be mounted as a pendulum 600 mm ± 1.0 mm long, as shown in figure B.1 a, from a bearing allowing it to swing freely in a vertical plane perpendicular to the plane of the partition, but prevented from sideways movement. The arm of the pendulum shall be in the form of a metal rod or tube of approximate mass 1.3 kg/m length. The centre line of the pendulum arm shall meet the shaft to the impact or head 125-mm from centre of the 50-mm sphere. At least 80 mm of the shaft of the impact or head, between the sphere and the attachment for the pendulum arm, shall be unobstructed to facilitate penetration.

2.3.1.3 Support frame for impact or, to allow impact or pendulum to be positioned as required for test, to hold pivot of pendulum in position during impact, and incorporating release mechanism to control pendulum's angle of fall.

2.3.1.4 Measuring instrument, to measure the depth of indentation to the nearest 0.1 mm.

*Note: A convenient instrument for this purpose is a dial gauge mounted in the middle of a reference bar with a flattened knife edge at one end and a single rounded point contact at the other, forming a 100 mm bridge.*

2.3.2 Procedure

2.3.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.

2.3.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.

2.3.2.3 Allow time for the curing, drying and/or conditioning of certain materials.

2.3.2.4 Record the laboratory range of temperatures and humidity during the installation, conditioning and testing of the specimen.

2.3.2.5 Select 10 positions to be impacted.

*Note: The impact positions should be at the discretion the testingorganization, which should select points that it considers to be most critical.*

2.3.2.6 Set up the test apparatus at the first impact position, so that when at rest the impact or just touches the face of the partition as shown in figure B.1a.

2.3.2.7 Raise the impact or to the angle of swing required for the impact energy being tested as follows:

| Angles of swing for small hard body impact test : surface damage | | |
|---|---|---|
| Impact energy N.m | Pendulum head drop height m | Angle of swing o |
| 3 | 0.10 | 33.6 |
| 6 | 0.20 | 48.2 |
| 10 | 0.33 | 63.6 |

2.3.2.8 Release the impact or once only and prevent it from bouncing.

2.3.2.9 Inspect the specimen for damage, e.g. indentation, delamination, fracture of surface, etc. Record and photograph the nature and extent of the damage and, if practicable, measure the depth of indentation to the nearest 0.1 mm.

*Note: Marking the impact or with chalk or inserting a sheet of carbon paper will help to identify the indentation.*

*Note: When photographing, having an indication of scale, e.g. a ruler, beside the damaged area will assist in assessing the damage.*

2.3.2.10 Move the test apparatus to the next impact position and repeat the test procedure as before. Continue until a total of 10 impactions have been made.

## 2.4 DETERMINATION OF RESISTANCE TO DAMAGE BY IMPACT FROM A LARGE SOFT BODY



2.4.1 Apparatus

2.4.1.1 Test rig.

2.4.1.2 Spheroconical bag, having a mass of 50 kg. ± 0.5 kg made of eight sections sewn together. The dimensions of the bag when filled are those of a volume

composed of a sphere of 400 mm diameter inscribed in a cone, the top of which is located at a distance of 400 mm from the center of the sphere. The bottom of the bag is strengthened by a circular piece of leather of 120 mm. diameter sewn into it. The top of the bag is slightly truncated in order to make an opening of 80-mm. diameter. This opening is strengthened by a leather strip sewn onto the bag, to which are fixed four equidistant rings held together by a suspension ring. The bag is filled with hardened glass beads of nominal 3-mm diameter.

*Note: To prevent the glass beads spilling if the seams burst, it is advisable to put them in a heavy duty polyethylene bag.*

*Note: The spheroconical bag is identical to the large soft impact body specified in ISO 7892 : 1988.*

2.4.1.3 Two pulleys and a suspension line, with means of attachment to the test rig.

2.4.1.4 Winding and release mechanisms, for suspending the bag at the required drop height.

2.4.1.5 Measuring instrument, capable of measuring, to an accuracy of 0.1 mm, the deformation of the specimen.

2.4.1.6 Devices that position the measuring instrument and ensure its stability during the test.

2.4.2 Procedure

2.4.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.

2.4.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.

2.4.2.3 Allow time for the curing, drying and/or conditioning of certain materials.

2.4.2.4 Be prepared to record any changes or damage to the partition specimen observed during the test, together with the readings from the measuring instrument. In the event of collapse, discontinue the test.

2.4.2.5 Record the laboratory temperature and humidity during the installation of the specimen and the test.

2.4.2.6 Select two points at which single impacts shall be applied normal to the solid area of the specimen within the horizontal band 1.2 m and 1.75 m above the bottom of the specimen.

*Note: The impact points should be selected within the defined band where the test is most likely to damage the partition and should be selected by the testing organization.*

2.4.2.7 Position the device for measuring deformation on the back of the specimen or leaf opposite of where the impact will occur.

*Note: In twin leaf construction this would require the leaf not receiving the impact to be perforated.*

2.4.2.7 Set up the test apparatus and raise the bag to the first point selected.

2.4.2.8 Raise the bag using the winch to give a drop height of 204 mm, 82 mm or 41 mm to produce an impact respectively, and secure the line.

2.4.2.9 The level of impact energy shall be specified for the grade being tested.

*Note: The line needs to be long enough to ensure that its angle to the plane of the partition does not exceed 65°.*

2.4.2.10 Release the line allowing the bag to impact the partition. Restrain the bag to prevent rebounding.

2.4.2.11 Allow the partition to stabilize for 5 min.

2.4.2.12 Measure and record the permanent deformation to the nearest 0.5 mm.
2.4.2.13 Relocate the test apparatus to the other selected point on the partition and repeat the procedure.
2.4.2.14 Examine and record and damage to the specimen.

## 2.5 DETERMINATION OF RESISTANCE TO PERFORATION BY SMALL HARD BODY IMPACT

2.5.1 Procedure

2.5.1.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.
2.5.1.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.5.1.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.5.1.4 Record the laboratory temperature and humidity. during the installation of the specimen and the test.
2.5.1.5 Select 10 positions to be impacted.
*Note: The selection of the positions to be impacted should be done by the testing organization, who should select that it considers to be most critical.*
2.5.1.6 Set up the test apparatus at the first impact position, so that when at rest the impactor just touches the face of the partition.
2.5.1.7 Raise the impactor to the angle of swing required for the impact energy being tested as shown in the below table.

**Angles of swing for small hard body impact test : surface damage**

| Impact energy N.m | Pendulum head drop height m | Angle of swing o |
|---|---|---|
| 5 | 0.17 | 43.8 |
| 15 | 0.50 | 80.4 |
| 30 | 1.00 | 131.8 |

2.5.1.7 Release the impactor once only.
2.5.1.8 Inspect the specimen for damage and any perforation, photograph and record.
*Note: When photographing, having an indication of scale, e.g. a ruler, beside the damaged area will assist in assessing the damage.*
2.5.1.9 Move the test apparatus to the next impact position.
2.5.1.10 Repeat the test procedure as before and continue for the specified number of impacts.

## 2.6 DETERMINATION OF RESISTANCE TO STRUCTURAL DAMAGE BY MULTIPLE IMPACTS FROM A LARGE SOFT BODY



2.6.1 Apparatus

2.6.1.1 Test rig.
2.6.1.2 Spheroconical bag, as described in 2.4.2.
2.6.1.3 Two pulleys and a suspension line, with means of attachment to the test rig.

2.6.1.4 Winding and release mechanisms, for suspending the bag at the required drop height.

2.6.2 Procedure

Proceed as described in 2.5 except for the following.

a) Select an impact energy of either 120 N·m or 60 N·m. These will require drop heights of 245 mm and 122 mm respectively.
b) Apply three impacts at the two selected points.
*Note:The two selected points should be different from points previously impacted.*
c) Examine and record any surface or structural damage to the specimen.
*Note: Deflection is not measured in this test.*

## 2.7 DETERMINATION OF THE EFFECTS OF DOOR SLAMMING

2.7.1 Apparatus

2.7.1.1 Test rig.
2.7.1.2 Light strong line, to transmit the force generated by a falling mass of 15 kg, and a suitable means of attaching the line to the door leaf, such as a brass or steel hook or eye.
2.7.1.3 Swivel pulley system, 100 mm diameter, greased or oiled in accordance with the manufacture's instructions so that it is free running.
2.7.1.4 Weight, of 15 kg ± 50 g.
2.7.1.5 Platform able to arrest a free falling mass of 15 kg at a predetermined point.
2.7.1.6 Measuring instrument, capable of measuring the residual displacement of the door frame to an accuracy of 0.1 mm.

2.7.2 Procedure

2.7.2.1 Check that the specification and drawing provided by the sponsor correspond with the specimen to be tested.
2.7.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.7.2.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.7.2.4 Record the laboratory temperature and humidity throughout the installation of the specimen and the test.
2.7.2.5 Be prepared to record any changes observed during the test, together with the readings from the measuring instrument. In the event of failure, discontinue the test.
2.7.2.6 Position the devices for measuring the residual displacement of the doorframe on the closing jamb 1 m above the bottom of the door leaf.
2.7.2.7 Set up the test equipment by assembling the line, pulley and weight, so that the door leaf is closed by the action of the weight falling onto the platform. Connect the line to the door leaf 1 m ± 25 mm above the bottom of the door leaf and 50 mm ± 5 mm from lock side; pass the line through the pulley, positioned not less than 400 mm from the door jamb, so that the line is horizontal and approximately normal to the closed door leaf. Attach the line to the weight strikes the platform and removes the tension in the line, the door leaf is within 20 mm of closing.
2.7.2.8 Set the displacement measuring instrument to datum.

2.7.2.9 Open the door leaf to $60^{\circ} \pm 1^{\circ}$ and release it. The weight shall fall free and cause the door to slam. Repeat this operation three times as a preslam test.
2.7.2.10 Record the residual displacement.
2.7.2.11 Reset the deflection measuring instrument to datum.
2.7.2.12 Open the door leaf to $60^{\circ} \pm 1^{\circ}$ and release it. Repeat this for the required number if slams specified.
2.7.2.13 On completion of the required number of slams, examine the condition of the partition.
2.7.2.14 Record any damage to the partition and fixings, also any loosening or dislodgment of fittings or trims.
2.7.2.15 Allow the partition and doorframe to stabilize for 5 min.
2.7.2.16 Measure any residual displacement of the doorframe to the nearest 0.1 mm.

## 2.8 DETERMINATION OF RESISTANCE TO CROWD PRESSURE

2.8.1 Apparatus

2.8.1.1 Test rig.
2.8.1.2 Calibrated loading equipment, capable of applying the specified loads (up to 8 kN depending on the test level selected) perpendicularly to wards the surface of the partition through the timber beam. The equipment shall be capable of applying the load to an accuracy of ± 50 N. The rate of application of the load shall not exceed 800 N/s.
2.8.1.3 Timber beam, of strength class not less than SC3 when graded to BS 4978 : 1988, 225 mm x 100 mm x (2500 ± 10) mm in length and capable of transmitting the load to the partition.
2.8.1.4 Resilient material, 10 mm ± 2 mm thick to spread the load from the 100 mm face of the timber beam to the partition.
2.8.1.5 Calibrated measuring instrument, for measuring the maximum deflection of the specimen to the nearest 0.1 mm.
2.8.1.6 Clamps or other devices, that position the measuring instruments and ensure their stability during the test.

2.8.2 Procedure

2.8.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.
2.8.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.8.2.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.8.2.4 Record the laboratory temperature and humidity during the installation of the specimen and the test.
2.8.2.5 Be prepared to record any changes of damage to the partition specimen observed during the test, together with the readings from the measuring instrument. In the event of collapse, discontinue the test.
2.8.2.6 Position the beam with one end 250 mm from the lock side of the door and with the 100 mm face in contact (through the resilient material) with the partition, to apply a force horizontally and normal to a solid area of the specimen at the surface of the partition, 1.2 m measured from the bottom of the specimen; the resilient material shall be in contact with the surface of the partition specimen along the length of the beam.

2.8.2.7 Position the loading device normal to the face of the partition to apply the load horizontally and to the centre of the timber beam.

2.8.2.8 Position the instrument for measuring deflection, on the loaded side of the partition, 125 mm above the centre point of the application of the load. Gradually apply a preload of 200 N to the beam. Allow the loaded specimen to stabilize for 1 min. Remove the load.

2.8.2.9 Allow the unloaded specimen to stabilize for 1 min. Set the deflection measuring instruments to datum. Gradually apply and sustain for 2 min a load of 0.75 kN, 1.5 kN or 3 kN per metre length of beam.
*Note: the sponsor should select the magnitude of the load.*

2.8.2.10 Examine the specimen and record the deflection. Remove the load and beam.

2.8.2.11 Allow the specimen to stabilize for 5 min after completing the test and record any residual deformation to the nearest 0.5 mm.

## 2.9 LIGHTWEIGHT ANCHORAGE PULL-OUT TEST

2.9.1 Apparatus

2.9.1.1 Test rig.

2.9.1.2 Calibrated loading equipment, capable of applying a load of 100 N ± 3 N perpendicularly away from the surface of the partition axially with the screw/blot shank, through the pull-out test bracket anchored to the partition. If a variable loading device is used, the rate of application shall not exceed 10 N/s; if dead weights, they shall be applied without shock.

2.9.1.3 Shim plate, of stainless steel 1 mm ± 0.2 mm thick.

2.9.1.4 Device, capable of applying an upward force of 20 N ± 1 N.

2.9.1.5 Anchorage, of a type specified by the test sponsor.

2.9.1.6 Pull-out test bracket, of steel with a minimum thickness of 3 mm and having a smooth flat surface.

2.9.2 Procedure

2.9.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.

2.9.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.

2.9.2.3 Allow time for the curing, drying and/or conditioning of certain materials.

2.9.2.4 Record the laboratory temperature and humidity during the installation of the specimen and the test.

2.9.2.5 Fix the pull-out test bracket and the shim plate to the partition with the appropriate anchorage.
*Note: The position at which the pull-out bracket is fixed should be at the discretion of the testing organization who should select the location it considers to be the most critical.*

2.9.2.6 Apply the 20 N upward force continuously to the shim plate.

2.9.2.7 Prepare to record any changes observed during the test.

2.9.2.8 Position the loading equipment and connect it to the pull-out test bracket to apply a load perpendicularly away from the partition, axially with the screw or bolt shank.

2.9.2.9 Gradually apply a load up to 100 N over a minimum period of 10 s.

2.9.2.10 At 100 N sustains the load for 1 min.
2.9.2.11 Record any changes to the specimen.
2.9.2.12 Remove the load from the pull-out bracket.
2.9.2.13 If the pull-up shim plate is released the anchorage is deemed to have failed. In the event of failure, discontinue the test.

## 2.10 LIGHTWEIGHT ANCHORAGE PULL-DOWN TEST

2.10.1 Apparatus

2.10.1.1 Test rig.
2.10.1.2 Calibrated loading equipment, capable of applying a load of 250 N ± 7.5 N vertically downwards through the pull-down test brackets anchored to the partition. If a variable loading device is used, the rate of application shall not exceed 25 N/s; if dead weights, they shall be applied without shock.
2.10.1.3 Shim plates, of stainless steel 1 mm ± 0.2 mm thick.
2.10.1.4 Device, capable of applying an upward force of 20 N ± 1 N.
2.10.1.5 Anchorages.
2.10.1.6 Pull-down test brackets, of steel with a minimum thickness of 3 mm and having a smooth, flat surface.
2.10.1.7 Calibrated measuring instrument, for measuring the movement of the pull-down test bracket to the nearest 0.1 mm relative to the partition face.
2.10.1.8 Clamps or other devices, that position the measuring instrument and ensure its stability during the test.

2.10.2 Procedure

2.10.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.
2.10.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.10.2.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.10.2.4 Record the laboratory temperature and humidity during the installation of the specimen and test.
2.10.2.5 Fix the pull-down test bracket, the pull-up shim plate and the packing shim plate, to the partitions with the appropriate fastener or anchor.

*Note: The position at which the pull-down bracket is fixed should be at the discretion of the testing organization who should select the location that it considers to be the most critical.*

2.10.2.6 Position and secure the displacement measuring device above the pull-down bracket.
2.10.2.7 Apply the 20 N upward force to the pull-up shim plate.
2.10.2.8 Prepare to record any changes observed during test together with the readings from the measuring instrument.
2.10.2.9 Position the loading equipment and connect it to the pull-down test bracket (J.3.6).
2.10.2.10 Set the displacement movement measuring instrument to [illegible]
2.10.2.11 Gradually increase an applied load from 0 to 250 N over a minimum period of 10 s.
2.10.2.12 At 250 N sustain the load for 1 min.

2.10.2.13 Record any displacement and any changes to the specimen.
2.10.2.14 Remove the load from the pull-down test bracket.
2.10.2.15 If the pull-up shim plate is released, or the pull-down test bracket is displaced more than 2 mm the anchorage is deemed to have failed.

## 2.11 HEAVYWEIGHT ANCHORAGE (WASH BASIN) ECCENTRIC DOWNWARD LOADING TEST

2.11.1 Apparatus

2.11.1.1 Test rig.
2.11.1.2 Calibrated loading equipment, capable of applying the specified loads (up to 1500 N depending on category of duty) vertically downwards through the mid point of the horizontal member connected to the steel test brackets which are anchored to the partition. The equipment shall be capable of applying the loads to an accuracy of ± 30 N. If a variable loading device is used, the rate of application shall not exceed 150 N/s; if dead weights, they shall be applied without shock.
2.11.1.3 Four calibrated measuring instruments, for measuring the maximum deflection of the specimen to the nearest 0.1 mm.
2.11.1.4 Two pairs of shims, of stainless steel, 1.0 mm ± 0.2 mm thick.
2.11.1.5 Device or devices, capable of applying an upward force of 20 N ± 1 N to each pull-up shim plate.
2.11.1.6 Wash basin test bracket assembly.
*Note: If the test sponsor specifies an alternative method of securing the wash basin brackets, provision should be made to modify.*

2.11.2 Procedure

2.11.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.
2.11.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.11.2.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.11.2.4 Record the laboratory temperature and humidity during the installation of the specimen and the test.
2.11.2.5 Fix each bracket 500 mm ± 1 mm apart from each other with their tops level and at 800 mm ± 10 mm above the bottom of the test specimen and equidistant from the door frame and the end of the partition, or as close as the partition construction will conveniently permit, using two anchorages per bracket, of the type specified by the test sponsor. Insert the shims before finally tightening the anchorages.
2.11.2.6 Apply 20 N upward forces continuously to each pull-up shim plate. Prepare to measure the deflection of the partition on both faces at a mid point between the two brackets and at 1.2 m and 1.75 above the bottom of the test specimen.
2.11.2.7 Record any changes in the specimen observed during the test together with the readings from the measuring instrument.
2.11.2.8 Gradually apply a preload of 200 N.
2.11.2.9 Allow the loaded specimen to stabilize for 1 min.
2.11.2.10 Remove the preload.

2.11.2.11 Allow the unloaded specimen to stabilize for 1 min.
2.11.2.12 Set the deflection measuring instruments to datum.
2.11.2.13 Apply a constant load of 500 N to the bar joining the brackets.
*Note: This load may be by weights totaling 50 kg symmetrically distributed.*
2.11.2.14 Apply and remove additional loads, at approximately 1 min intervals, in the following sequence: 250 N, 250 N, 500 N, 750 N, 750, 1000 N, 1000 N.
2.11.2.15 If either pull-up shim is released, stop the test.
2.11.2.16 At each load, record the deflections both sides of the partition to the nearest 1.0 mm.
2.11.2.17 Remove all loads.
2.11.2.18 After 5 min measure any residual deformation of the partition to the nearest 0.1 mm.
2.11.2.19 Record any damage to the specimen or loosening of the fixings.

## 2.12 HEAVYWEIGHT ANCHORAGE (HIGH LEVEL WALL CUPBOARD) ECCENTRIC DOWNWARD LOADING TEST

2.12.1 Apparatus

2.12.1.1 Test rig.
2.12.1.2 Calibrated loading equipment, capable of applying the specified loads (up to 4000 N depending on category of duty) vertically downwards through the mid point of the horizontal member connected to the steel test brackets which are anchored to the partition. The equipment shall be capable of applying the loads to an accuracy of ± 80 N. If a variable loading device is used, the rate of application shall not exceed 400 N/s; if dead weights, they shall be applied without shock.
2.12.1.3 Four measuring instruments, for measuring the maximum deflection of the specimen to the nearest 0.1 mm.
2.12.1.4 Two pairs of shims, of stainless steel, 1.0 mm ± 0.2 mm thick.
2.12.1.5 Device or devices capable of applying an upward force of 20 N ± 1 N to each pull-up shim plate.
2.12.1.6 Frame, comprising two brackets joined by a mild steel angle drilled at mid point with a 10 mm hole in one flange. The two holes in each bracket shall be of a diameter to suit the sponsor's specified fixings.

2.12.2 Procedure

2.12.2.1 Check that the specification and drawings provided by the sponsor correspond with the specimen to be tested.
2.12.2.2 Install the specimen vertically in the test rig and fix it in accordance with the sponsor's instructions.
2.12.2.3 Allow time for the curing, drying and/or conditioning of certain materials.
2.12.2.4 Record the laboratory temperature and humidity throughout the installation of the specimen and the test.
2.12.2.5 Assemble the frame and fix the brackets to the partition 1000 mm ± 1 mm apart, their tops level and with the horizontal member

1500 mm ± 10 mm above the bottom of the test specimen and equidistant from the door frame and the end of the partition, or as close as the partition construction will conveniently permit using anchorages of the type specified by the test sponsor. Insert the steel shims, before finally tightening the anchorages.

2.12.2.6 Apply 20 ± 1 N upward force continuously to each pull-up shim plate.

2.12.2.7 Prepare to measure the deflection of the partition on both faces at a mid point between the two brackets and at 1.2 m and 1.75 above the bottom of the test specimen.

2.12.2.8 Record any changes in the specimen observed during the test together with the readings from the measuring instrument.

2.12.2.9 Gradually apply a preload of 200 N.

2.12.2.10 Allow the loaded specimen to stabilize for 1 min.

2.12.2.11 Remove the preload.

2.12.2.12 Allow the unloaded specimen to stabilize for 1 min.

2.12.2.13 Set the deflection measuring instruments to datum.

2.12.2.14 Apply loads, increased at approximately 1 min intervals (up to a maximum of either 2000 N or 4000 N as specified by the sponsor) in the following sequence: 500 N, 1000 N, 1500 N, 2000 N, 2500 N, 3000 N, 3500 N, 4000 N.

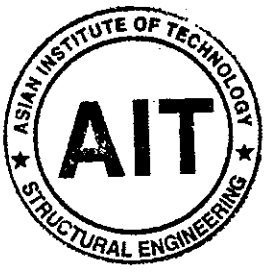
2.12.2.15 At each load, if either pull-up shim is released stop the test.

2.12.2.16 At each load, record the deflections both sides of the partition to the nearest 1 mm.

2.12.2.17 Remove all loads.

2.12.2.18 After 5 min measure any residual deformation of the partition to the nearest 1 mm.

2.12.2.19 Record any damage to the specimen or loosening of the fixings.



# CHAPTER III
# SUMMARY OF TEST RESULTS

## 3.1 PERFORMANCE REQUIREMENT

For a partition to conform to an individual performance requirement, a specimen partition shall be tested by the method given in the relevant test and shall satisfy criteria for test performance that falls within the criteria given in the Tables 3.1 and 3.2.

Table 3.1 Summary of grade requirements and performance levels

| Requirement | Units | Grade | | | | Criteria |
|---|---|---|---|---|---|---|
| | | LD | MD | HD | SD | |
| Stiffness | mm. | 25 | 20 | 15 | 10 | Maximum deflection |
| | mm. | 5 | 3 | 2 | 1 | Maximum residual deformation |
| Small hard body impact: | | | | | | |
| Surface damage | N.m | 3 | 3 | 6 | 10 | Judgment of indent |
| Perforation | N.m | -[1)] | 5 | 15 | 30 | No perforation of facing |
| Large soft body impact: | | | | | | |
| Damage | N.m | 20 | 20 | 40 | 100 | 2 mm. maximum deformation |
| Structural damage | N.m | 60 | 60 | 120 | 120 | No collapse or dislocation |
| Door slam | No. | 20 | 20 | 100 | 100 | No damage and 1 mm Maximum displacement |
| 1) No requirement for this grade | | | | | | |

Table 3.2 Summary of tests for crowd pressure, lightweight anchorages and heavyweight anchorages

| Requirement | Units | Performance level | Criteria |
|---|---|---|---|
| Crowd pressure | kN/m. | 0.75, 1.5 or 3.0 | No collapse or dangerous damage |
| Lightweight anchorages: | | | |
| Pull-out | N | 100 minimum | Shim retained |
| Pull-down | N | 250 minimum | Shim retained and 2 mm maximum displacement |
| Heavyweight anchorages: | | | |
| Wash basin | N | 500 minimum | 5 mm maximum deflection |
| | N | 1,000 to 1,500 range | 20 mm maximum deflection |
| Wall cupboard | N | 2,000 to 4,000 range | 5 mm. maximum deflection |



## 3.2 SUMMARY OF TEST RESULTS

The test results on strength and robustness performance of partition system summarized and shown in Table 3.2.1. The detail of testing results is also presented in Appendix A.

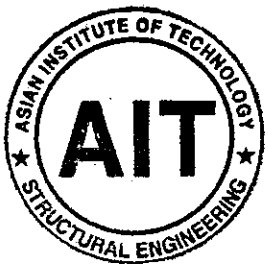
Table 3.2.1 summary of tests results for partition systems

| Requirement tested | Grade performance achieved | | | |
|---|---|---|---|---|
| | LD | MD | HD | SD |
| Stiffness | | | | Tested* |
| Surface damage by small hard body impact: Straight partition | | | | Tested* |
| Surface damage by small hard body impact: Right-angle junction | | | | Tested* |
| Resistance to damage by large soft body impact: Straight partition | | | | Tested* |
| Perforation by small hard body impact: Straight partition | | | | Tested* |
| Resistance to structural damage by large soft body impact | | | | Tested* |
| Door Slamming | | | | Tested* |

Remark: Show "Tested*" under grade tested.

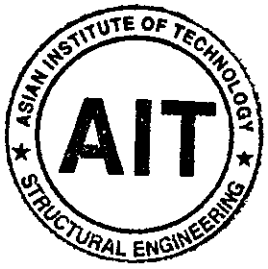
| SUMMARY OF OTHER TESTS ON PARTITION SPECIMEN | |
|---|---|
| Requirement tested | Performance achieved |
| Crowd pressure | 1.88 kN/m. |
| Lightweight anchorage-Pull-out | Pass |
| Lightweight anchorage-Pull-down | Pass |
| Heavyweight anchorages – (Wash basin) | 588 N* |
| Heavyweight anchorages – (Wall cupboard) | 765 N* |

Remark: * defined the maximum load as the shim plate releases from the interface between the partition and apparatus.



# APPENDIX A

# RESULTS OF TESTING



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of partition stiffness (BS 5234: Part2:1992 Annex A)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 30, 2015

**Test Result:**

Table A1 Deflection of partition subjected to the applied load

| Load (N) | Deflection of partition | | |
|---|---|---|---|
| | Point 1 (mm.) | Point 2 (mm.) | Average (mm.) |
| 0 | 0.00 | 0.00 | 0.00 |
| 98 | 0.00 | 0.00 | 0.00 |
| 196 | 0.00 | 0.00 | 0.00 |
| 304 | 0.00 | 0.01 | 0.01 |
| 392 | 0.00 | 0.01 | 0.01 |
| 490 | 0.00 | 0.00 | 0.00 |
| Residual deformation | 0.00 | 0.00 | 0.00 |

Table A2 Summary of tested results for determining partition stiffness

| Description | Maximum Deflection | Residual Deformation | Condition of surface partition |
|---|---|---|---|
| Tested specimen | 0.01 | 0.00 | No surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 10.00 | 1.00 | The partition shall be no damage or detachment, loosening or dislodgment of a partition's parts or fixings, other than superficial cracking of the surface. |

**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of surface damage by small hard body impact (BS 5234 Part2:1992 - Annex B)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 30, 2015

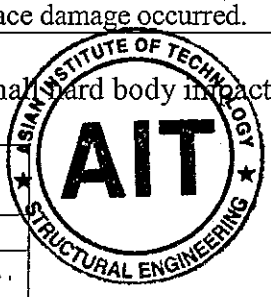
**Test Result:**

Table A3 Indentation due to small hard body impact by using a drop height of 330 mm. to produce an impact energy of 10 N-m.

| No. of Impact | Diameter of Indentation | Depth of Indentation | Surface condition |
|---|---|---|---|
| 1 | 25.60 | 2.46 | No surface damage occurred. |
| 2 | 25.45 | 2.38 | No surface damage occurred. |
| 3 | 25.05 | 2.10 | No surface damage occurred. |
| 4 | 24.30 | 1.36 | No surface damage occurred. |
| 5 | 25.20 | 1.95 | No surface damage occurred. |
| 6 | 26.10 | 1.37 | No surface damage occurred. |
| 7 | 27.25 | 2.07 | No surface damage occurred. |
| 8 | 25.70 | 1.61 | No surface damage occurred. |
| 9 | 27.10 | 1.66 | No surface damage occurred. |
| 10 | 26.15 | 1.87 | No surface damage occurred. |

Table A4 Acceptance criteria for testing of surface damage by small hard body impact

| Description | No. of Impact | Surface condition |
|---|---|---|
| Tested specimen | 10 | No surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 10 | No specific criterion for acceptance. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

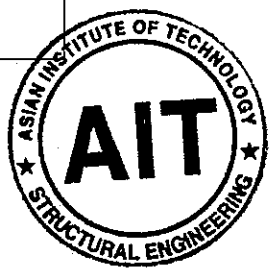
**SCHOOL OF ENGINEERING AND TECHNOLOGY**

Table A5 Indentation due to small hard body impact at particle junction by using a drop height of 330 mm. to produce an impact energy of 10 N-m.

| No. of Impact | Diameter of Indentation | Depth of Indentation | Surface Condition |
|---|---|---|---|
| 1 | 26.30 | 1.83 | No Surface damage occurred. |

Table A6 Acceptance criteria for testing of surface damage at particle junction by small hard body impact

| Description | No. of Impact | Surface condition |
|---|---|---|
| Tested specimen | 1 | No surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 1 | No specific criterion for acceptance. |



**STRUCTURAL ENGINEERING LABORTORY**
**STRUCTURAL ENGINEERING FIELD OF STUDY**
**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of resistance to damage by impact from a large soft body (BS 5234 Part2:1992 - Annex C)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 31, 2015

**Test Result:**

Table A7 Deformation due to large soft body impact by using a drop height of 204 mm. to produce an impact energy of 100 N-m.

| No. of Impact | Permanent deformation (mm.) | | Surface condition |
|---|---|---|---|
| | Point 1 | Point 2 | |
| 1 | 0.03 | 0.01 | No Surface damage occurred. |

Table A8 Comparison the tested results with acceptance criteria

| Description | Permanent Deformation (mm.) | Surface condition |
|---|---|---|
| Tested specimen | 0.03 | No Surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 2.00 | The partition and a right-angle junction shall be capable of withstanding the impact energies for the grade being tested without sustaining further permanent deformation in excess of 2 mm. or any damage. |

**STRUCTURAL ENGINEERING LABORTORY**

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**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of perforation by small hard body impact (BS 5234 Part2:1992 - Annex D)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

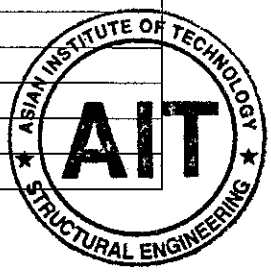
**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 30, 2014

**Test Result:**

Table A9 Indentation due to small hard body impact by using impact a drop height of 1,000 mm. to produce an impact energy of 30 N-m.

| No. of Impact | Diameter of Indentation (mm.) | Depth of Indentation (mm.) | Surface condition |
|---|---|---|---|
| 1 | 28.05 | 2.40 | No Surface damage occurred. |
| 2 | 28.60 | 2.45 | No Surface damage occurred. |
| 3 | 29.80 | 2.77 | No Surface damage occurred. |
| 4 | 30.05 | 2.47 | No Surface damage occurred. |
| 5 | 29.05 | 2.73 | No Surface damage occurred. |
| 6 | 29.10 | 3.05 | No Surface damage occurred. |
| 7 | 28.80 | 2.46 | No Surface damage occurred. |
| 8 | 30.30 | 2.94 | No Surface damage occurred. |
| 9 | 29.30 | 3.03 | No Surface damage occurred. |
| 10 | 29.90 | 2.55 | No Surface damage occurred. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

Table A10 Acceptance criteria for testing of perforation by small hard impact

| Description | No of Impact | Surface condition |
|---|---|---|
| Tested specimen | 10 | No Surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 10 | The partition shall be capable of withstanding the impact energies. |

**STRUCTURAL ENGINEERING LABORTORY**

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**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of resistance to structural damage by multiple impacts from a large soft body (BS 5234 Part2:1992 - Annex E)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 31, 2015

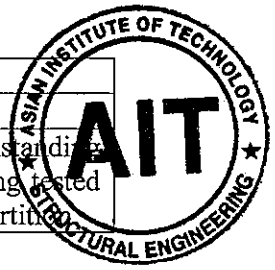
**Test Result:**

Table A11 Condition of the tested specimen after three impacts by using a drop height of 245 mm. to produce an impact energy of 120 N-m.

| No. of Impact | Surface condition |
|---|---|
| 3 | No Surface damage occurred. |

Table A12 Comparison the tested results with acceptance criteria

| Description | No. of Impact | Surface condition |
|---|---|---|
| Tested specimen | 3 | No Surface damage occurred. |
| Acceptance criteria for partition grade "Severe Duty (SD)" | 3 | The partition shall be capable of withstanding the impact energies, for the grade being tested without collapsing or dislocating the partition |



**STRUCTURAL ENGINEERING LABORTORY**
**STRUCTURAL ENGINEERING FIELD OF STUDY**
**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of the effects of door slamming (BS 5234 Part2:1992 - Annex F)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 31, 2015

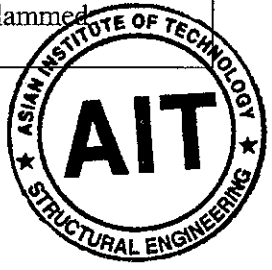
**Test Result:**

Table A13 Residual displacement of the door leaf

| Type of test | No. of Impact | Residual displacement (mm.) |
|---|---|---|
| Pre-Slam test | 3 | 0.03 |
| Main test | 100 | 0.05 |

Table A14 Acceptance criteria for testing of door slamming

| Description | Residual displacement (mm.) | | Partition condition |
|---|---|---|---|
| | Pre-Slam | Tested at 100 slams | |
| Tested specimens | 0.03 | 0.05 | No partition damage occurred after tested. |
| Acceptance criteria for "Severe Duty (SD)" | 3.00 | 1.00 | The partition shall not be damaged, nor shall door frame fittings and architraves become detached or loose after the door leaf has been slammed. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of resistance to crowd pressure (BS 5234 Part2:1992 - Annex G)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 31, 2015

**Test Result:**

Table A15 Deformation due to crowd pressure

| Load applied to beam (kN/m.) | Deflection of partition (mm.) | | | Surface condition |
|---|---|---|---|---|
| | Point 1 | Point 2 | Average | |
| 0.00 | 0.00 | 0.00 | 0.00 | No damage of partition occurred. |
| 0.76 | 0.50 | 0.57 | 0.54 | No damage of partition occurred. |
| 1.88 | 2.85 | 3.18 | 3.02 | Partition damage occurred at this step. |

Table A16 Acceptance criteria for testing of crowd pressure

| Description | Acceptance criteria |
|---|---|
| Tested specimen | Partition damage occurred after tested. |
| All | When tested as described, there shall be no collapse or damage that would render the partition dangerous, due to any of its parts becoming dislodged or shattered in such a way that could cause injury. |

**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of lightweight anchorage pull-out (BS 5234 Part2:1992 - Annex H)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** February 16, 2015

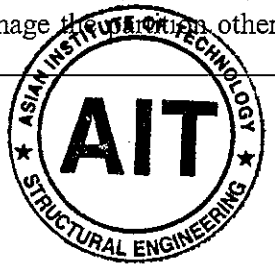
**Test Result:**

Table A17 Condition of partition as applied pull-out load

| Applied load (N) | Bracket and partition condition |
|---|---|
| 100 | The shim plate did not release from the interface between bracket and partition. |
| 623 | The pull-up shim plate released from the interface between bracket and partition. |
| 712 | Maximum tested load. The bracket was pulled out from the partition. |

Table A18 Acceptance criteria for testing of pull-out of a lightweight anchorage

| Description | Acceptance criteria |
|---|---|
| Tested specimen | The partition can withstand the axial load of 100 N without releasing the pull-up shim plate or damage the partition other than superficial cracking. |
| All | The partition shall withstand the axial load of 100 N without releasing the pull-up shim plate or damage the partition other than superficial cracking. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of lightweight anchorage pull-down (BS 5234 Part2:1992 - Annex J)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** February 16, 2015

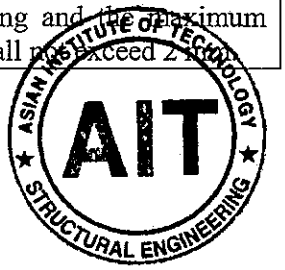
**Test Result:**

Table A19 Condition of partition as applied pull-down load

| Applied Load (N) | Movement of Bracket (mm.) | Bracket and partition condition |
|---|---|---|
| 250 | 0.13 | The pull-up shim plate did not release from the interface between bracket and partition. |
| 1,334 | - | Maximum tested load. The bracket was pulled out from the partition. |

Table A20 Acceptance criteria for testing of pull-down of a lightweight anchorage

| Description | Acceptance Criteria |
|---|---|
| Tested Specimen | The partition can withstand the transverse load of 250 N. without releasing the pull-up shim plate or damage the partition other than superficial cracking. The movement of the pull-down bracket is 0.13 mm. |
| All | The partition shall withstand the transverse load of 250 N. without releasing the pull-up shim plate or damage the partition other than superficial cracking and the maximum movement of the pull-down bracket shall not exceed 2 mm. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of eccentric downward loading of heavyweight anchorage – wash basin (BS 5234 Part2:1992 - Annex K)

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m. The plaster layers were reinforced by welded wire mesh.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** March 31, 2015

**Test Result:**

Table A21 Condition of partition as applied downward load

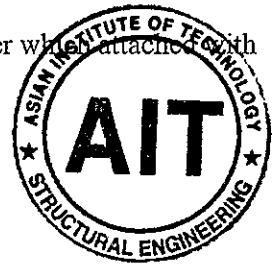
| Applied Load (N) | Movement of partition (mm.) | | | | Bracket and partition condition |
|---|---|---|---|---|---|
| | 1* | 2** | 3*** | 4**** | |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 588 | 1.86 | -0.90 | 0.02 | -0.04 | The pull-up shim plate released from bracket and partition. |
| Released Load | 1.00 | -0.89 | 0.03 | -0.03 | - |

Remarks: 1* : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.20 m. height from base.

2** : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.75 m. height from base.

3*** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.20 m. height from base.

4**** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.75 m. height from base.



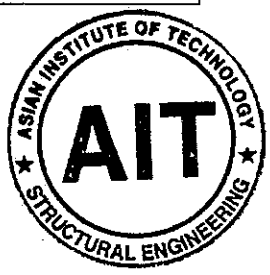
**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

Table A22 Acceptance criteria for testing of heavyweight anchorage – wash basin

| Description | Acceptance criteria |
|---|---|
| Tested specimen | The maximum deflection at the maximum applied load is 1.86 mm. and maximum residual deformation is 1.00 mm. |
| All | The anchorage shall be capable of withstanding the load selected applied to the two linked brackets without releasing either pull-up shim plate, exceeding the deflection or residual deformation limits given in Table 10 Page 7 in BS 5234:Part 2:1992 and without loosening, detaching or damaging the partition. |



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**Type of Test:** Determination of eccentric downward loading of heavyweight anchorage - high level wall cupboard ( BS 5234 Part2:1992 - Annex L )

**Test Specimen:** One (1) specimen of partition wall having a size of 300x450x7.5 cm, made of autoclaved aerated concrete "Smart block G4" of size of 20x60x7.5 cm. The lintels of wall were installed at the height of 1.5 m.

**Client:** SMART CONCRETE PUBLIC CO., LTD.

**Date of Test:** February 16, 2015

**Test Result:**

Table A23 Condition of partition as applied downward load

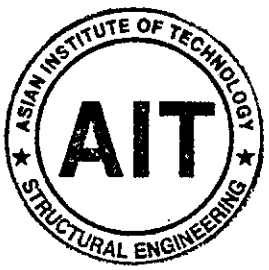
| Applied Load (N) | Movement of partition (mm.) | | | | Bracket and partition condition |
|---|---|---|---|---|---|
| | 1* | 2** | 3*** | 4**** | |
| 0 | 0.00 | 0.00 | 0.00 | 0.00 | |
| 510 | -0.01 | 0.00 | 0.00 | 0.01 | No partition damage occurred. |
| 765 | 0.00 | 0.03 | 0.03 | 0.01 | The pull-up shim plate released from bracket and partition. |
| Released Load | 0.00 | 0.03 | 0.03 | -0.02 | |

Remarks: 1* : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.20 m. height from base.

2** : The movement was measured from the displacement transducer which attached with the same side of applied load and 1.75 m. height from base.

3*** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.20 m. height from base.

4**** : The movement was measured from the displacement transducer which attached with the other side of applied load and 1.75 m. height from base.



**STRUCTURAL ENGINEERING LABORTORY**

**STRUCTURAL ENGINEERING FIELD OF STUDY**

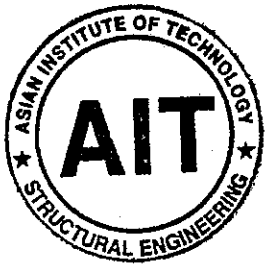
**SCHOOL OF ENGINEERING AND TECHNOLOGY**

Table A24 Acceptance criteria for testing of heavyweight anchorage – high level wall cupboard

| Description | Acceptance criteria |
|---|---|
| Tested specimen | The maximum deflection at the maximum applied load is 0.03 mm. and maximum residual deformation is 0.03 mm. |
| All | The anchorages shall be capable of withstanding the load selected applied to the two linked brackets without releasing either pull-up shim plate, exceeding the deflection or residual deformation limits given in Table 11 Page 7 in BS 5234:Part 2:1992 and without loosening, detaching or damaging the partition. |

# APPENDIX B

# PICTURE OF TESTING



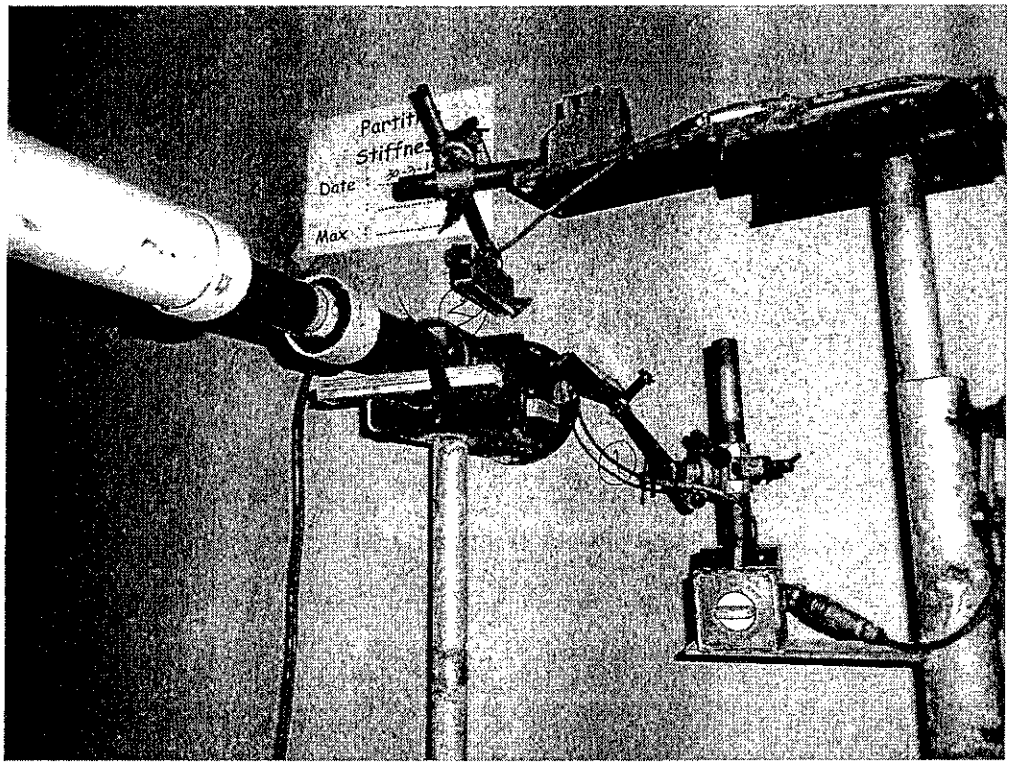



Figure 1 Setup the equipment for testing of partition stiffness.

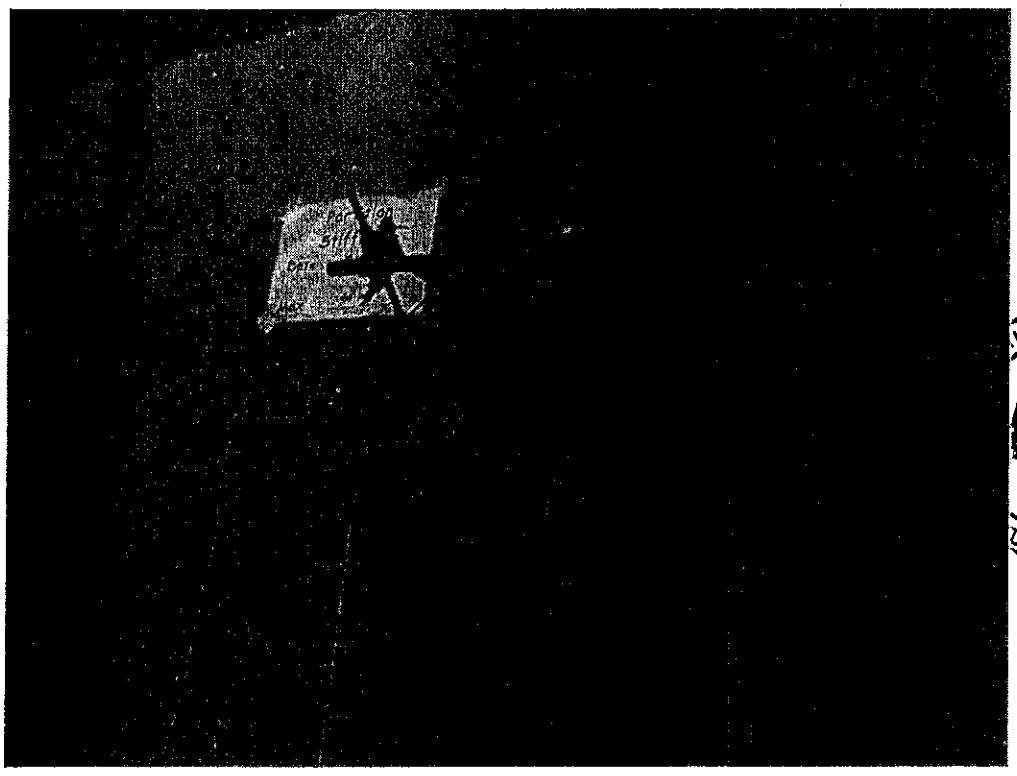




Figure 2 No damage was found after testing.

Figure 11 Conducting the pull-out test.

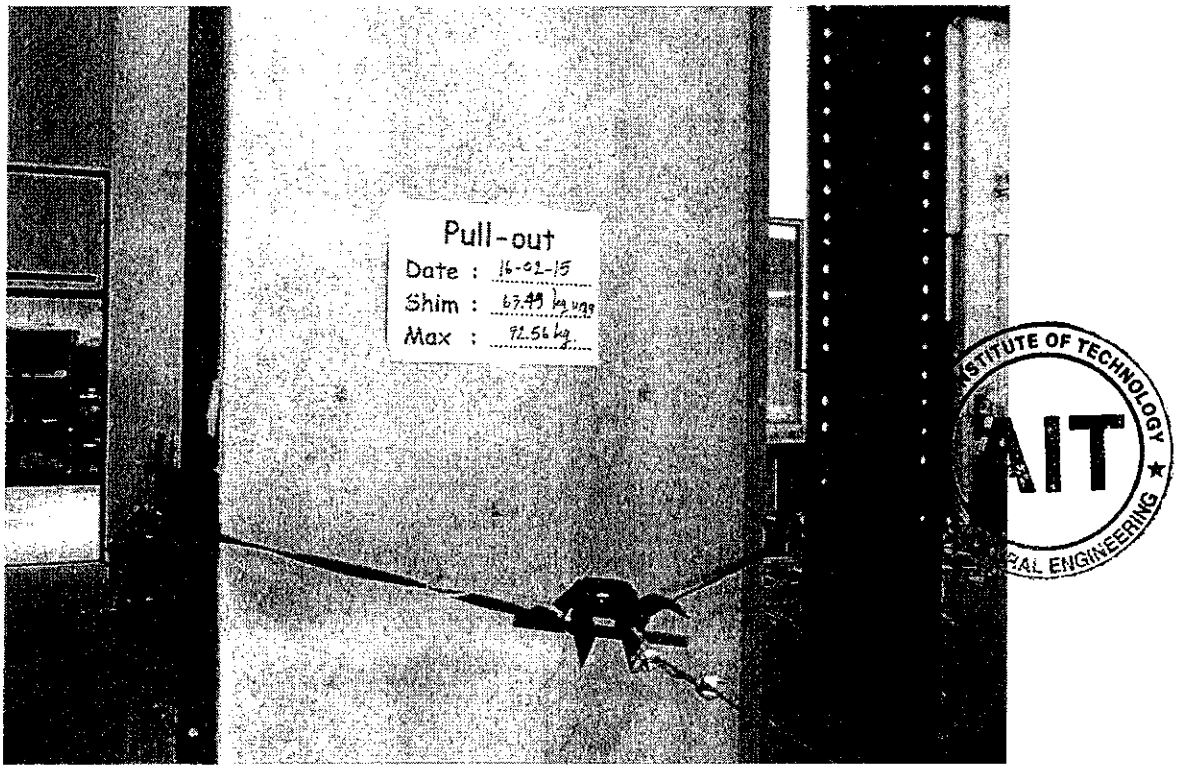



Figure 12 The bracket was pulled out from the partition at the load of 712 N.

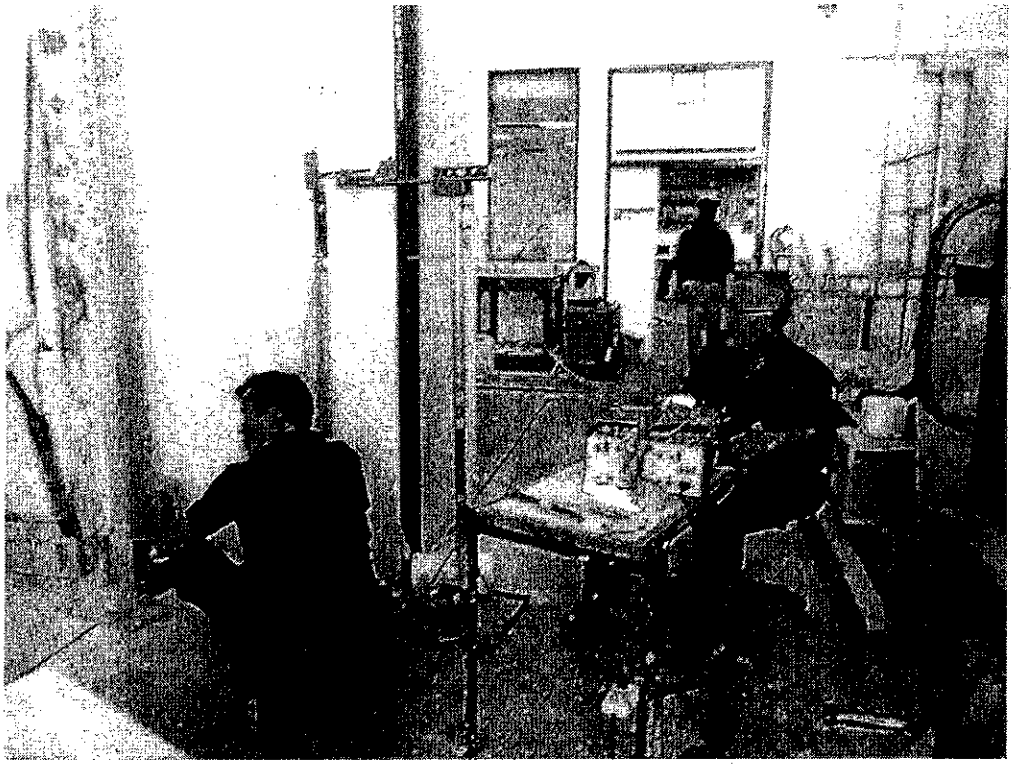


Figure 13 Conducting the pull-down test.

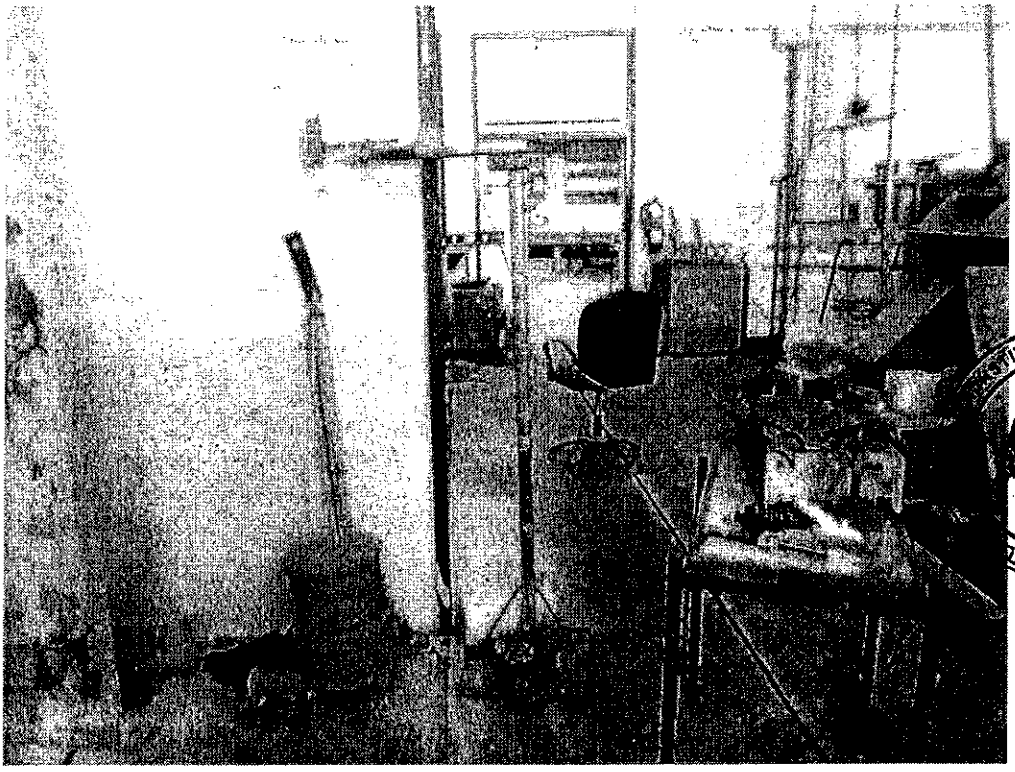


Figure 14 The bracket was pulled down from the partition at the load of 1,334 N.

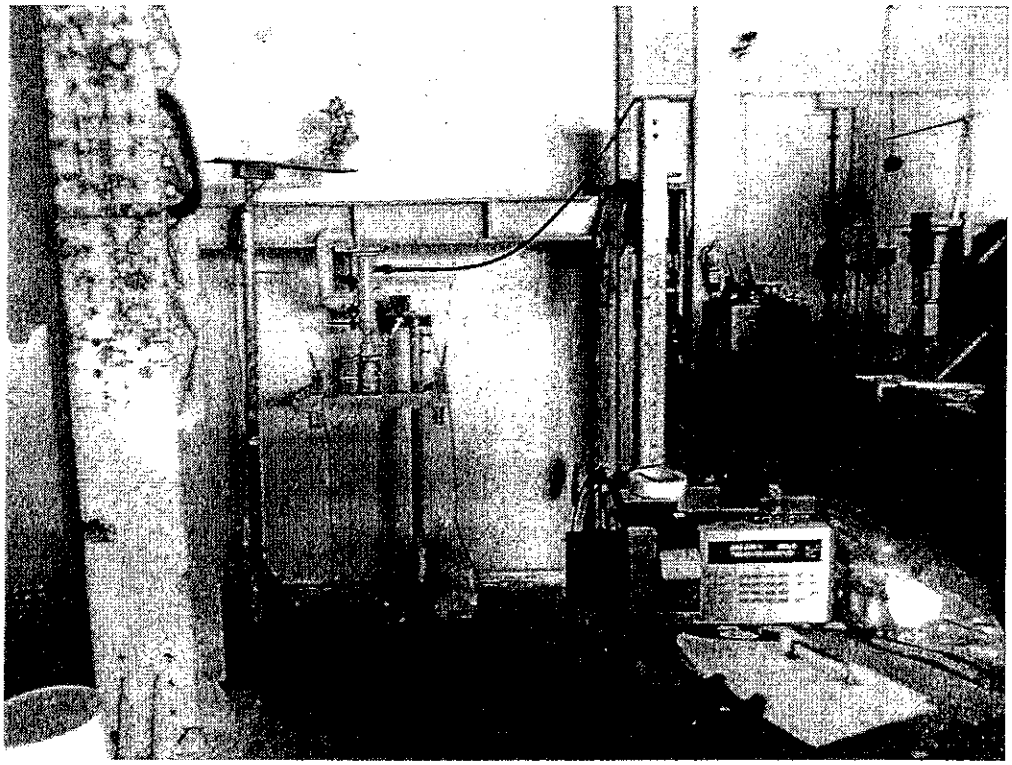


Figure 15 Testing the heavyweight anchorage by eccentric downward loading (wash basin).

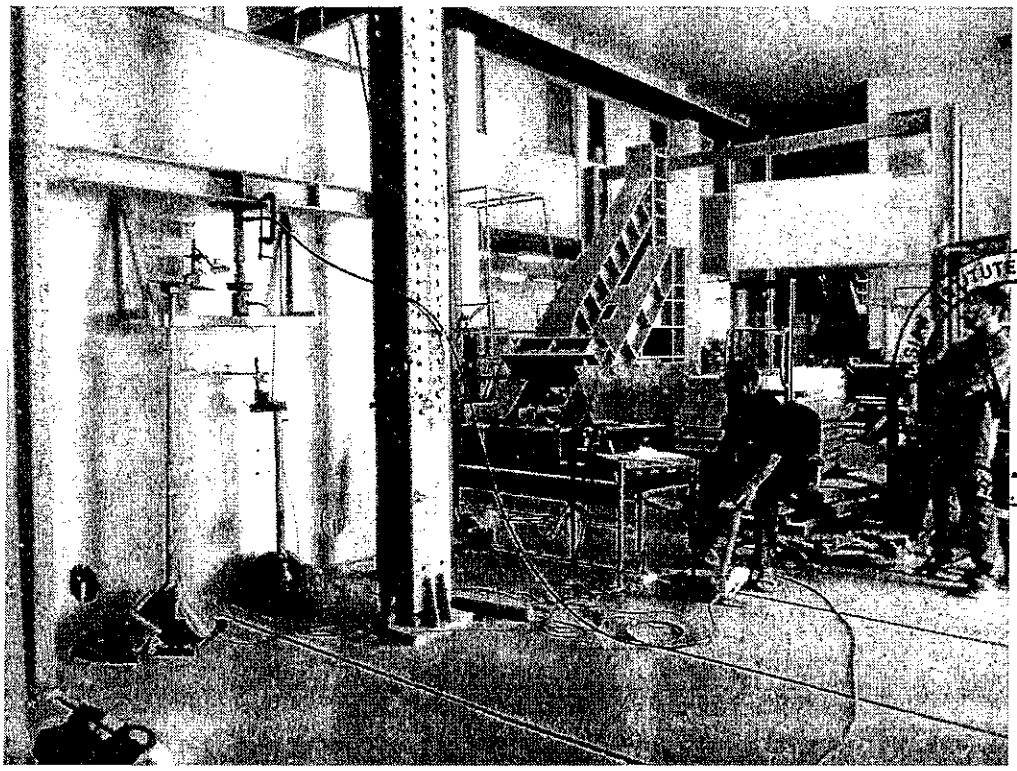


Figure 16 Testing the heavyweight anchorage by eccentric downward loading (wall cupboard).

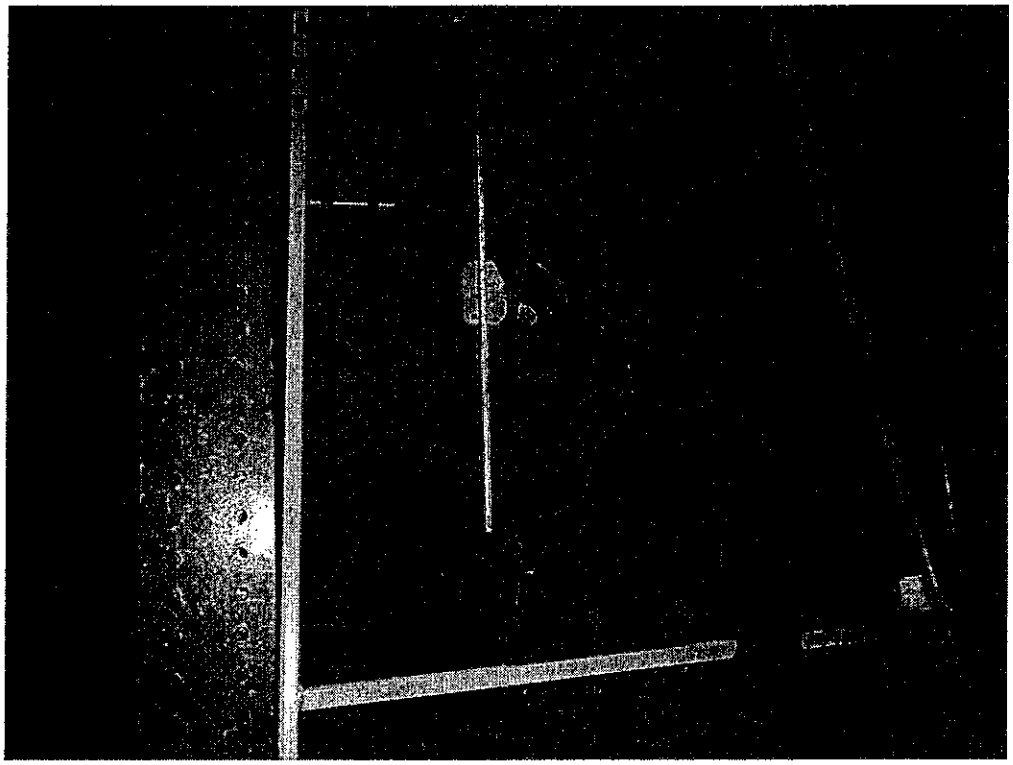


Figure 3 Setup the drop height for testing of surface damage by small hard body impact.

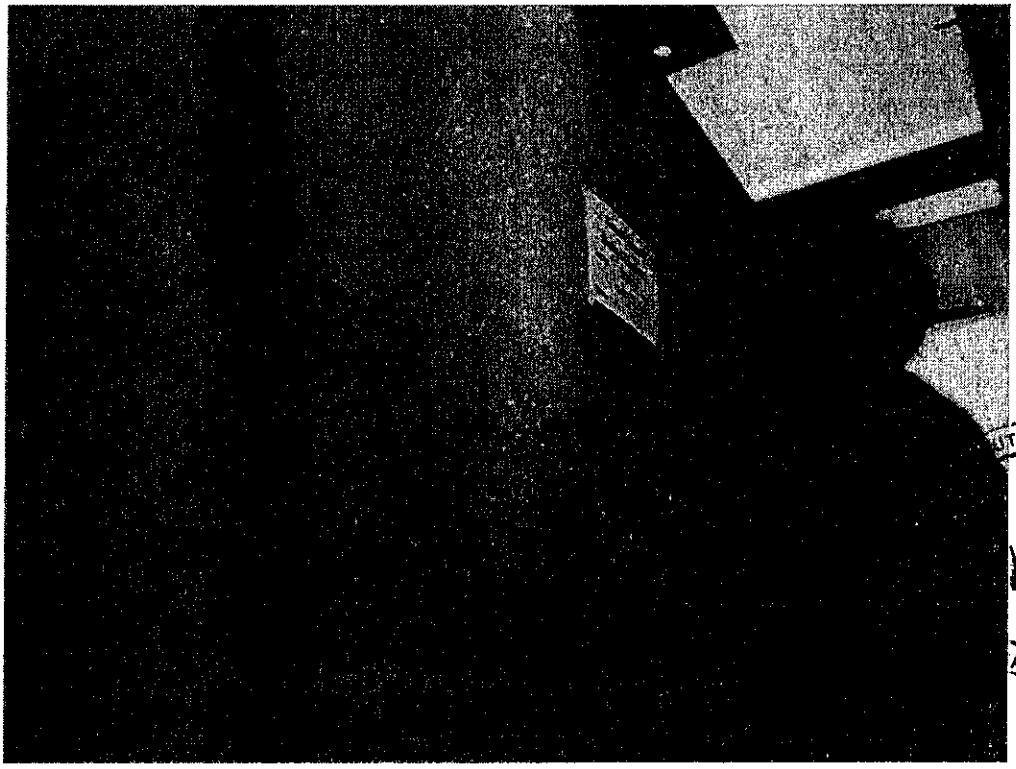


Figure 4 Measuring the depth by displacement gauge.

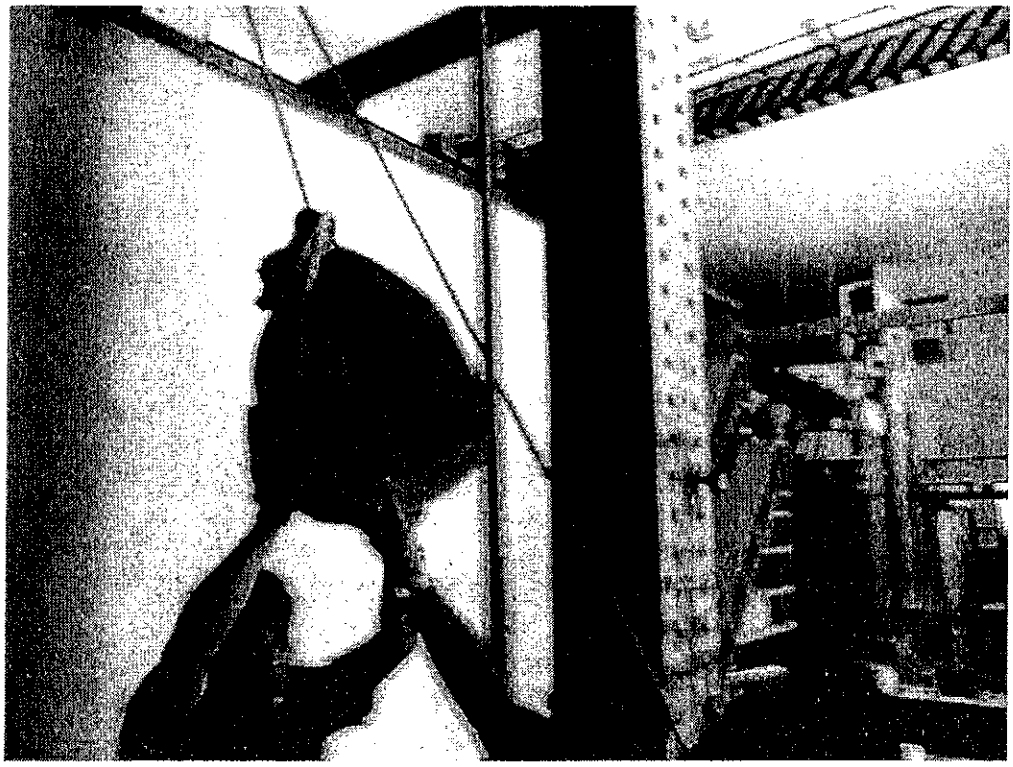


Figure 5 Setting drop height for testing of large soft body impact.

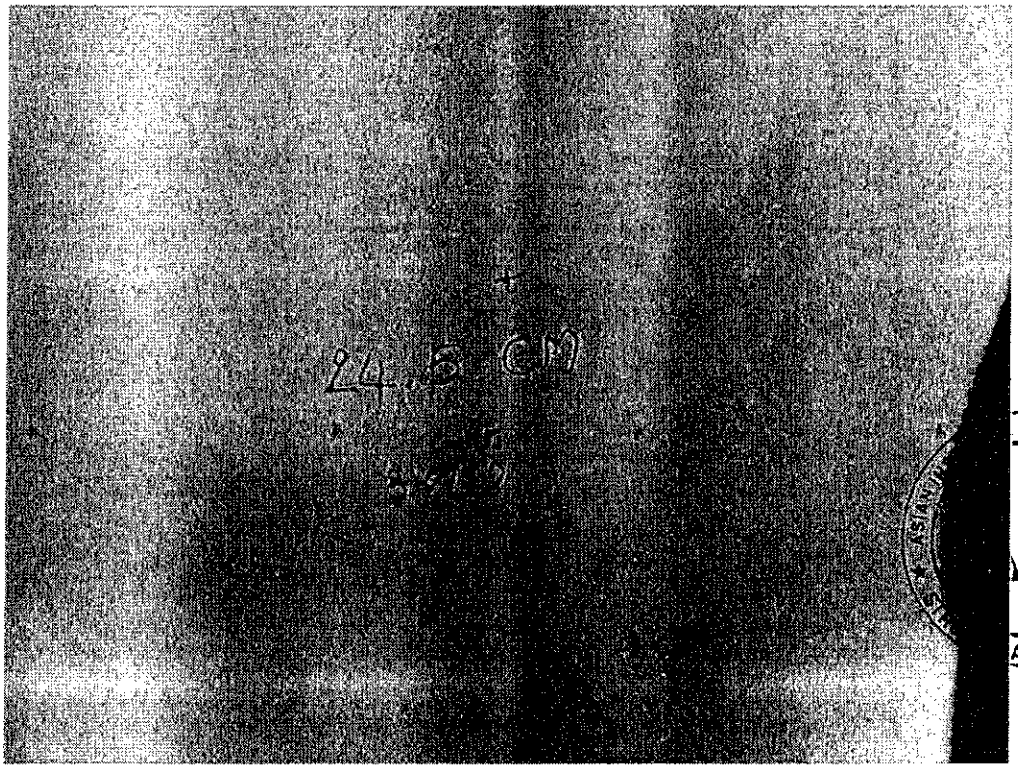



Figure 6 No crack was found after testing.

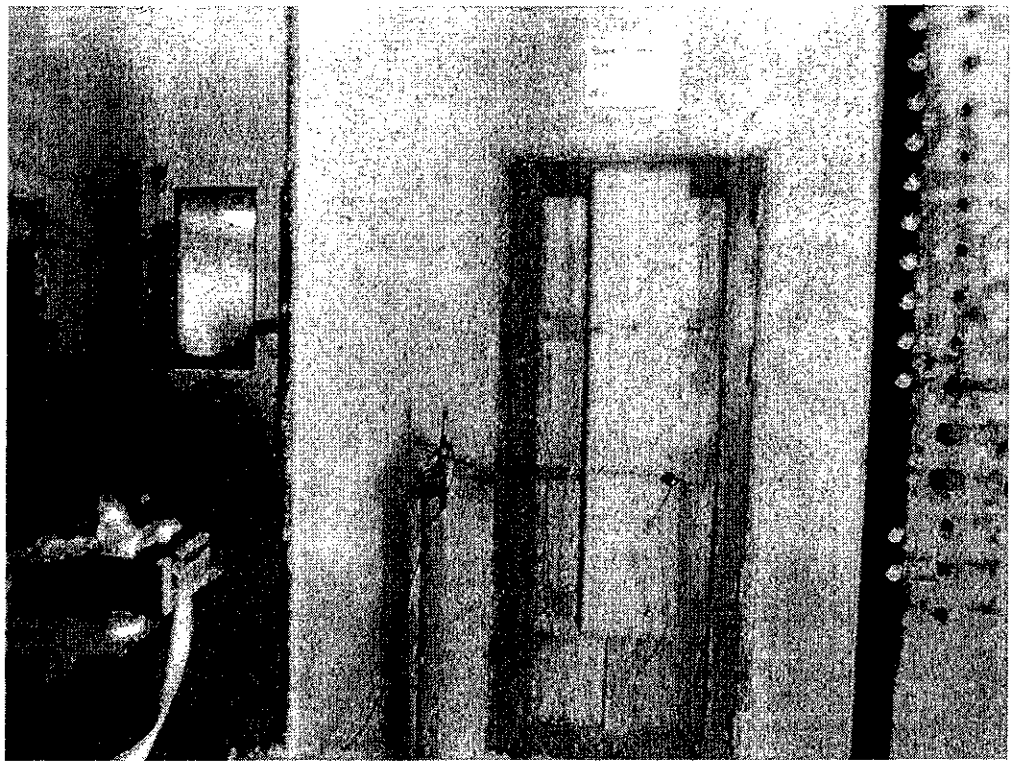


Figure 7 Setup the equipment for testing of door slam test.

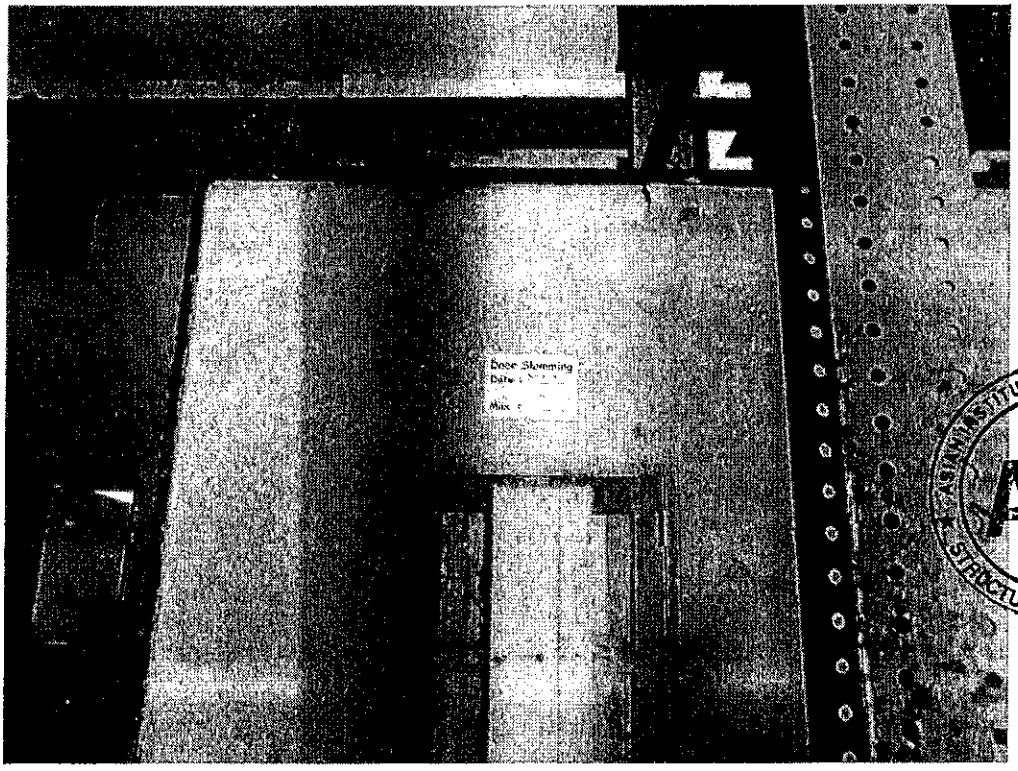


Figure 8 No crack was found after testing.

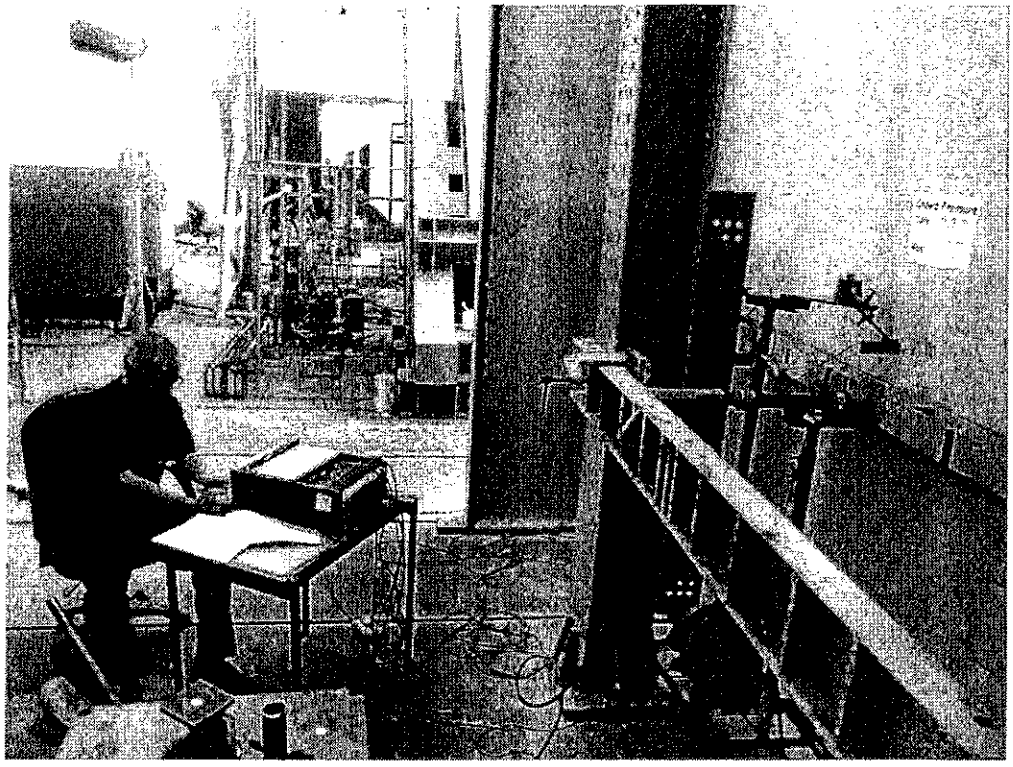


Figure 9 Setup the equipment for determination of resistance to crowd pressure.

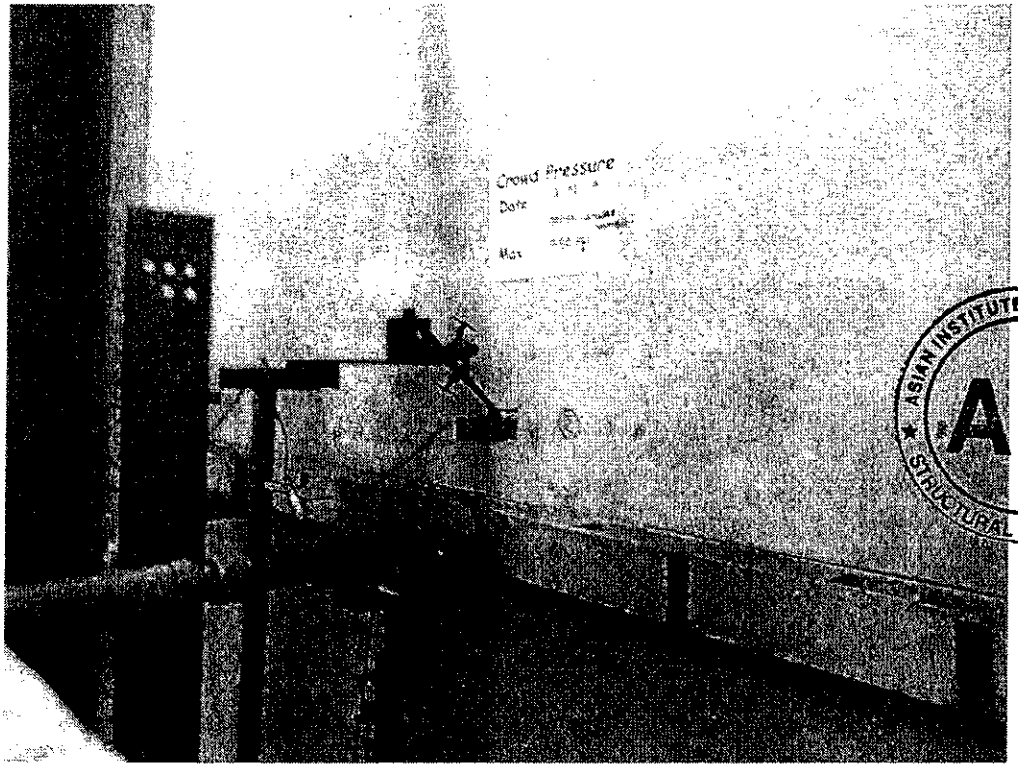





Figure 10 Conducting the crowd pressure test.