

Tests of Bricks

1 - Dimension Test

A good brick should be rectangular in shape with smooth, even surfaces, homogeneous, full burning and straight edges. They shall be free from cracks and flows and nodules of free lime.

Purpose of test:-

To measuring the dimensions of bricks and conforms to Iraqi Standard specification (IQS).

Standard specification:-

Iraqi Standard specification (IQS No. 24)

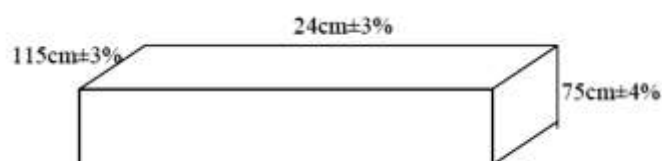
Iraqi Standard specification (IQS No. 25)

Test specimen:-

- Test specimen conform to (IQS No. 24)
- Calculate the average of (24) bricks, by opportunities in adjacent bricks along a straight line to the surface as shown in the form below.
- Measuring length, wide and thickness by steel ruler or tape.

Notes:

- If cannot measure the 24 bricks we can measure 12 bricks by two sets or by three sets (8 bricks).
- Arithmetic average of (24) bricks dimension representatives to bricks test.



2- Compressive strength of bricks

Compressive is the applied force on the unit area.

Purpose of test :-

To measuring the compressive strength of clay bricks and classifying to uses.

Standard specification :-

Iraqi Standard Specification (IQS No. 24)

Iraqi Standard Specification (IQS No. 25)

The table below shown the compressive strength of bricks according to
IQS No. 25

class	Minimum compressive strength N/mm ²	
	Average of compressive strength 10 bricks	Compressive strength of one brick
Grade A	18	16
Grade B	13	11
Grade C	9	7

Classification of clay bricks in accordance with Iraqi standard No. 25 / 1988:

Bricks used in construction works are classified into three grades:

Grade A:

Intended for use in building construction and footing subjected to loads and exposed to sever abrasion by weathering action.

Grade B:

Intended for use in building construction subjected to loads and not exposed to sever abrasion by weathering action, such as exterior walls not exposed to penetration of water.

Grade C:

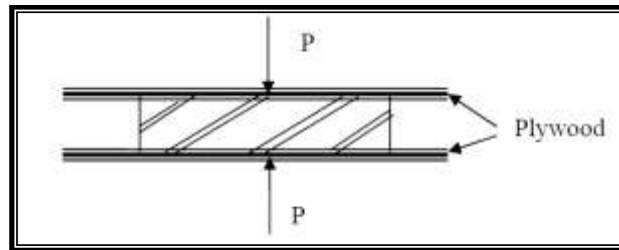
Intended for use in building construction not subjected to loading such as interior masonry walls and partitions, not exposed to sever abrasion by weathering action.

Tools:-

- Basin measured appropriately enough to submerge the specimen with water .
- Compression testing machine.
- Steel ruler or tape.
- Plywood sheets (± 4 mm).

Test specimen:-

- The test is carried out in accordance with Iraqi standard No. 24.
- Take a sample and submerging in water for 24 hours .
- Extract from water and drying it with a piece of cloth.
- Measured the dimensions of each of the surface load to the nearest 1 mm and use the smaller surface .
- The brick placed between two plywood sheets and carefully centered between plates of the compression testing machine.



- The load shall be applied at a uniform rate(14MPa/min) until failure occurs.

Compressive strength = Load at failure/ Cross sectional area subjected to load



No.	Load (N)	Area (mm ²)	Compressive strength (N/mm ²)

Average =

3- Efflorescence:

A white crystalline deposit will appear on the surface. These deposits may be efflorescence, water-soluble salts that occasionally occur on the surface of masonry. When water containing soluble salts is brought to the surface of masonry, the water evaporates and the salts are left on the surface of the masonry.

There are certain simultaneous conditions that must exist in order for efflorescence to occur:

- Soluble salts must be present in bricks work. These salts may be present in brick, backing materials, mortar, soil, etc.
- There must be a source of water.
- The masonry must have a pore structure that allows the migration of salt solutions to the surface or other locations where evaporation of water can occur.

Purpose of test:-

To measuring percentage of soluble salts of bricks (efflorescence).

Standard specification:-

Iraqi Standard Specification (IQS No. 24)

Iraqi Standard Specification (IQS No. 25)

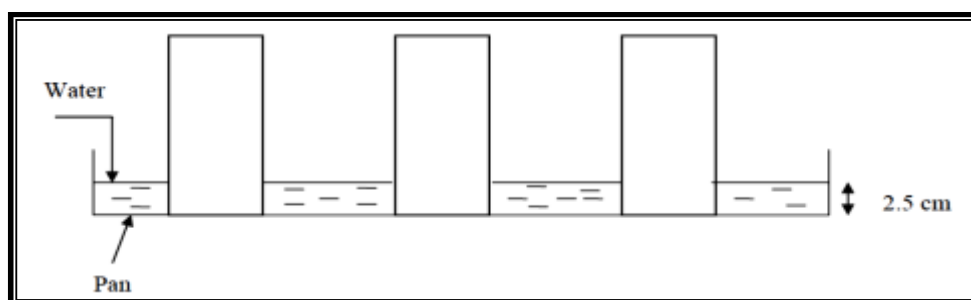
The table below shown the maximum absorption of clay bricks according to IQS No. 25 / 1988.

Class of bricks	Susceptibility of efflorescence	percentage of efflorescence
A	Slight	0-10 %
B	Moderate	10-50 %
C	Heavy	More than 50 %

- 1- **Nil** - No effloresce visible.
- 2- **Slight**- A thin deposit of salts on less than 10% of the area of the brick.
- 3- **Moderate**- A heavier deposit of salts covering between 10-50% of the area of the brick, but no powdering or flaking of the surface.
- 4- **Heavy**- A heavy deposit of salts covering more than 50% of the area, but no powdering or flaking of the surface.
- 5- **Serious** a heavy deposit of salts and some powdering and flaking of the surface.

Tools:-

- Steel ruler or tape.
- Pan measured appropriately enough (depth not less than 5 cm) content distilled water to a depth of 2.5 cm in room temperature (24 ± 8).



Test specimen:-

- Take sample of brick (10) and measure the dimension.
- Put a sign to the sample that will be test.
- Place them on end in the pan containing distilled water to a depth of 2.5 cm for 7 days the test is carried out in accordance with Iraqi standard No. 24.
- After 7 days dry the pan from water at least 3 days at the same room.
- Measure the effloresce area to the nearest geometric shape.
- The percentage of efflorescence is

$$= (\text{effloresce area} / \text{summation area of bricks}) \times 100 \%$$

No.	efflorescearea	Sum. area of bricks	percentage of efflorescence %
1			
2			
3			
			Average % =

4- Water Absorption of bricks

The absorption of water by brick is often considered to be indicative of its probable durability. The test also provides a means of checking on the consistency of the bricks produced by one factory.

Purpose of test:-

To measuring percentage of absorption for bricks and classifying to uses.

Standard specification:-

Iraqi Standard Specification (IQS No. 24)

Iraqi Standard Specification (IQS No. 25)

The table below shown the maximum absorption of clay bricks according to IQS No. 25 / 1988.

Class of bricks	Maximum percentage of bricks absorption	
	Average of ten bricks	One brick
A	20 %	22 %
B	24 %	26 %
C	26 %	28 %

Tools:-

- Electrical ventilated oven.
- Basin measured appropriately enough to submerge the specimen with water.
- Sensitive balance accuracy 0.1% of the mass unit.

Test specimen:-

- Put a sign to the sample that will be test.
- The test is carried out in accordance with Iraqi standard No. 24.
- The specimen shall be dried to constant weight in a ventilated oven at 110 °C to 115 °C for about 48 hours.
- Take a sample and immersed in clean water for 24 hours.
- Extract from water and drying it with a damp of cloth then weight it.

The absorption of bricks computing from the formula below:-

$$\text{Water absorption} = \{ (W_2 - W_1) / W_1 \} \times 100\%$$

Where:

W_2 = weight of brick after 24 hours in water (wet brick) .

W_1 = weight of dry brick.

No.	weight of dry specimen (gm)	weight of wet specimen (gm)	Absorption %
1			
2			

Average =

Tests of Tiles

1 – Dimension and Shape Test

A good Tiles should be square in shape or variable depending on product ,surfaces must be levels, straight edges constant thickness and rectangular in section. They shall be free from cracks and flows and pitting or scaling. Tiles divided in two types ordinary tiles and terrazzo tiles.

Purpose of test:-

To measuring the dimensions of tiles, shape and conforms to Iraqi Standard specification (IQS).

Standard specification:-

- ❖ Iraqi Standard specification (IQS No. 1043) for ordinary tiles.

Ordinary Tiles	
Length (mm)	Thickness (mm)
200 ± 1	22 ± 3
250 ± 1	25 ± 3

- ❖ Iraqi Standard specification (IQS No. 1042)for terrazzo tiles.

Terrazzo Tiles	
Length (mm)	Thickness (mm)
150 ± 1	20 ± 3
200 ± 1	20 ± 3
250 ± 1	25 ± 3
300 ± 1	30 ± 3
350 ± 1	30 ± 3
400 ± 1	35 ± 3
500 ± 1	40 ± 3

Note:

- ❖ Sampling, use 12 tiles from 5000 tiles or less.
- ❖ If two or more from the tiles are not conforming to the specification the sampling rejected.

Tools:-

- Steel ruler or tape.

Test specimen:-

- Test specimen conform to (IQS No. 1043) for ordinary tiles and (IQS No. 1042) for terrazzo tiles.
- Measuring the length of each (6) tiles, by steel ruler or tape and calculated the variation.
- Measuring thickness by steel ruler or tape and calculated the variation.
- Measuring the levels of surface by but two tiles face to face then press the corner of two tiles, the corner of first tile fixed and other movement finally showed the spacing between the two pressing corners if there is no movement, the tiles will be surface levels.



Terrazzo Tiles



Ordinary Tiles

2–Flexural Rapture test of Tiles

Purpose of test:-

To computing flexural rapture of tiles and conforms to Iraqi Standard specification (IQS).

Standard specification:-

- ❖ Iraqi Standard specification (IQS No. 1043) for ordinary tiles.

Ordinary Tiles	
Age (days)	flexural strength (N/mm ²)
28	Not less than 2.5

- ❖ Iraqi Standard specification (IQS No. 1042)for terrazzo tiles.

Terrazzo Tiles	
Age (days)	flexural strength (N/mm ²)
28	Not less than 3

Note:

- ❖ Sampling, use 12 tiles from 5000 tiles or less, for flexural test use 6 tiles.
- ❖ If two or more from the tiles are not conforming to the specification the sampling rejected.

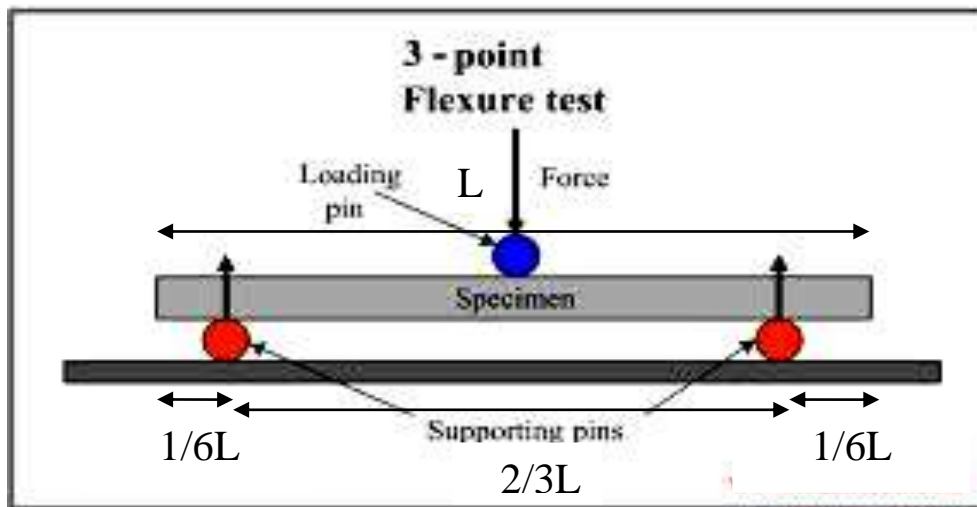
Tools:-

- Flexural test machine.
- Basin measured appropriately enough to submerge the specimen with water.

Test specimen:-

- Put a sign to the sample that will be test.
- Test specimen conform to (IQS No. 1043) for ordinary tiles and (IQS No. 1042)for terrazzo tiles.

- Take the specimen and immersed in basin of water with temperature $(20 \pm 2)^\circ \text{C}$ and the face of tile on top for 24 hours.
- Extract from water and drying it with a damp cloth.
- Put the specimen on the cylinder supporting in test machine, that the space between the cylinder supporting $2/3$ from length of tile and the face of tile on top.
- Put the third cylinder supporting in middle of $(2/3 L)$ and applied uniform load until failure.
- Measuring the wide and thickness by steel ruler in failure section.



The Flexural rapture computing from the formula below:-

$$F_r = \{ (3 \times \text{max. load} \times \text{space between supporting}) / 2 \times \text{wide} \times (\text{thickness})^2 \} \times 100 \%$$

Where:

F_r = Flexural rapture of tile (N/mm^2).



3–Water Absorption of Tiles

A-Total absorption:-

The absorption of water by tiles is often considered to be indicative of its probable durability. The test also provides a means of checking on the consistency of the bricks produced by one factory.

Purpose of test:-

To measuring percentage of total absorption for tiles and conforms to Iraqi Standard specification (IQ).

Standard specification:-

- ❖ Iraqi Standard specification (IQS No. 1043) for ordinary tiles.

Ordinary Tiles	
Total absorption %	Not more than 10 % by weight
Face absorption %	Not more than 0.4 gm/cm ²

- ❖ Iraqi Standard specification (IQS No. 1042)for terrazzo tiles.

Terrazzo Tiles	
Total absorption %	Not more than 8 % by weight
Face absorption %	Not more than 0.4 gm/cm ²

Note:

- ❖ Sampling ,use 12 tiles from 5000 tiles or less, for total absorption test use 6 tiles and for face absorption test use 6 tiles.
- ❖ If two or more from the tiles are not conforming to the specification the sampling rejected .

Tools:-

- Electrical ventilated oven.
- Basin measured appropriately enough to submerge the specimen with water.
- Sensitive balance accuracy 0.1% of the mass unit.

Test specimen:-

- Put a sign to the sample that will be test.
- The specimen shall be dried to constant weight in a ventilated oven at 110 °C to 115 °C for about 24 hours.
- Left the sample until get the same room temperature then weight the dry sample (W_1).
- Take a sample and immersed in clean water on face for 24 hours.
- Extract from water and drying it with a damp of cloth then weight it (W_2).

The total absorption of tiles computing from the formula below:-

$$\text{Water absorption} = \{ (W_2 - W_1) / W_1 \} \times 100\%$$

Where:

W_2 = weight of tile after 24 hours in water (wet tile) .

W_1 = weight of dry tile.

No.	weight of dry specimen (gm)	weight of wet specimen (gm)	Absorption %
1			
2			

3–Water Absorption of Tiles

B- Face absorption :-

The absorption of water by tiles is often considered to be indicative of its probable durability. The test also provides a means of checking on the consistency of the bricks produced by one factory.

Purpose of test:-

To measuring percentage of face absorption for tiles and conforms to Iraqi Standard specification (IQ.S).

Standard specification:-

- ❖ Iraqi Standard specification (IQS No. 1043) for ordinary tiles.

Ordinary Tiles	
Total absorption %	Not more than 10 % by weight
Face absorption %	Not more than 0.4 gm/cm ²

- ❖ Iraqi Standard specification (IQS No. 1042)for terrazzo tiles.

Terrazzo Tiles	
Total absorption %	Not more than 8 % by weight
Face absorption %	Not more than 0.4 gm/cm ²

Note:

- ❖ Sampling ,use 12 tiles from 5000 tiles or less, for total absorption test use 6 tiles and for face absorption test use 6 tiles.
- ❖ If two or more from the tiles are not conforming to the specification the sampling rejected .

Tools:-

- Electrical ventilated oven.
- Basin measured appropriately enough to submerge the specimen with water.
- Sensitive balance accuracy 0.1% of the mass unit.

Test specimen:-

- Put a sign to the sample that will be test.
- The specimen shall be dried to constant weight in a ventilated oven at 110 °C to 115 °C for about 24 hours.
- Left the sample until get the same room temperature then weight the dry sample (W_1).
- Mark (5 mm) in the depth direction from the tile face, and then mark a line around the tile.
- Put the tile marker in a pan for 24 hours so that the tile face must be on the base of the pan, then pour water in the pan till it reaches the line marked not exceed (± 2 mm) above the line marker.
- Extract from water and drying the face with a damp of cloth then weight it (W_2).

The total absorption of tiles computing from the formula below:-

$$\text{Face absorption} = (W_2 - W_1) / A$$

Where:

W_2 = weight of absorption face for tile after 24 hours in water (wet tile) .

W_1 = weight of dry tile.

A= area of tile face cm^2 .

No.	weight of dry specimen (gm) W_1	weight of wet specimen (gm) W_2	Area (cm^2)	Absorption gm/cm^2
1				
2				

Gypsum test

1- Gypsum fineness:-

This test method covers a procedure for determining the fineness of gypsum. The mineral consisting primarily of fully hydrated calcium sulfate, $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ or calcium sulfate dehydrate. Gypsum plaster have composition $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$.

Purpose of test:-

To determine the gypsum fineness degree and conforms to Iraqi Standard specification (IQ.S).

Standard specification:-

❖ Iraqi Standard specification (IQS No. 28 at 1988) for gypsum.

Gypsum type	Fineness degree %
Pure gypsum(plaster)	Not exceed 0% by weight
Normal gypsum	Not exceed 8%
Technical gypsum	Not exceed 5%

Tools:-

- Electrical ventilated oven.
- Sieve no. 16 (1.18 mm opening diameter)
- Sensitive balance accuracy 0.1% of the mass unit.
- Pan.
- Gypsum (100 gm).

Test specimen:-

- The amount of gypsum shall be dried to constant weight in a ventilated oven at 110 °C to 115 °C.
- Weight an amount of gypsum (100 gm) by using the accurate balance (W_1).

- After putting the sample of gypsum on the sieve No.16 for 5 minute in vibration machine, continue sieving until the particles of gypsum passes through the sieve slots.
- Then compress the retained particles on the sieve by fingers so they could pass through the slots.
- Then weight the gypsum after sieving by using the accurate balance.
- Weight the passes gypsum from sieve No. 16 (W_2).
- Calculate the gypsum fineness degree.

The fineness degree of gypsum computing from the formula below:-

$$\text{Fineness degree} = (W_1 - W_2) / w_1 \times 100\%$$

Where:

W_1 =weight of sample before sieving.

W_2 =weight of sample after sieving.

No.	weight of specimen before sieving (gm) W_1	weight of specimen after sieving (gm) W_2	Fineness degree %
1			
2			

Gypsum test

2- Standard Consistency of Gypsum:-

Purpose of test:-

To determine the standard consistency of gypsum and conforms to Iraqi Standard Specification (IQ.S).

Tools:-

- A conical mold made of non-corroding nonabsorbent materials, and with an inside diameter of (35mm) and (51mm) height.
- Base plate (250mm for each rib) to support the ring mold.
- Knife.
- Clean dry mixing bowl.
- Timer.
- (75 gm.) Of gypsum & (50 ml as a first attempt) of water.
- Accurate balance (sensitive to 0.1 gm.).

Test specimen:-

- Put the mold on the base plate, then spray (75 gm) of gypsum to a known volume of water (50 ml as a first attempt).
- Mixing bowl within 15 seconds, after that leave it for 30 seconds and vibrate to drive off bubbles.
- Then mix it by a knife for 30 seconds, after that pour the mixture into the ring mold settle by a knife.
- Raise the conical mold after 2 minutes from the time of adding the gypsum sample to water, the mixture will spread on the base plate.
- Measure the maximum and minimum diameter after spreading, repeat this procedure until you have an average diameters equal to $(100 \pm 3 \text{ mm})$.

$$(\text{Maximum diameter} + \text{Minimum diameter})/2 = 100 \pm 3 \text{ mm}$$

Calculations:-

$\text{Standard consistency\%} = (\text{water volume used to get the standard diffusing /75 gm of gypsum}) \times 100\%$
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Gypsum test

3- Setting time of gypsum.

Purpose of test: to record the time of setting of the gypsum sample in minutes.

Iraqi standard specifications no. 28 at 1988:

- Pure gypsum: the gypsum setting time not less than 8 minutes and not more than 25 minutes.
- Normal gypsum: the gypsum setting time not less than 8 minutes and not more than 25 minutes, also not more than 15 minutes when using gypsum for building trimmings.

Tools:

- 1- Vicate apparatus with needle of (1 mm) diameter.
- 2- Base plate and mixing plate.
- 3- A conical ring mold which has a (70 mm) diameter for lower base, (60 mm) diameter for upper base and (40 mm) height.
- 4- Timer and knife.
- 5- Accurate balance.
- 6- (200 gm) of gypsum and water.

Test specimen:-

Weight a gypsum sample of (200 gm) and prepare a quantity of water which is calculated from the normal consistency depending on the weight of the sample, after that add the gypsum to water and mix it together, mark the time and then pour the mixture into the conical ring mold after applying a thin coat of suitable oil to the mold and base plate, settle mold surface by knife, then move the mold and base plate to vicate apparatus then let the vicate needle sink into the mold and repeat this operation from time to time (the distance between each attempt not less than 12 mm), setting will be considered when the needle no longer penetrates to the bottom of the base plate, the final setting time in minutes is considered from the time when the sample was first added to the water to the time when setting is complete.

Calculations:

Volume of water= (normal consistency /100) x weight of gypsum sample gm)
(Milliliters)

Gypsum test

4- Compressive strength of gypsum.

Purpose of test: to find the compressive strength of gypsum.

Iraqi standard specifications no. 28 at 1988:

- Pure gypsum: Compressive strength must not be less than (50 kg/cm²).
- Normal gypsum: Compressive strength must not be less than (30 kg/cm²).

Tools:

- 1- Specimen molds (50x50x50 mm).
- 2- Knife.
- 3- Accurate balance.
- 4- Oil.
- 5- (1000 gm) of gypsum.
- 6- Water.
- 7- Clean dry mixing bowl

Test specimen:-

Mix the gypsum sample with water as tests before, drive the bubbles by a gentle knocking on mixing bowl, coat the molds with a thin layer of oil cast the mixture into the molds in two layers each layer (25 mm) high, for each layer vibrate the molds to drive off bubbles five times, after filling the molds settle its surface by a knife. The cubes may be removed from the molds as soon as they are hardened, place the cubes for 7 days in humidity processor (20 C°, 65% moisture) then place the cubes in an oven at a temperature of (40±5 C°) until the weight of the cubes will be constant, remove cubes from the oven and test the cubes in the testing machine to get the failure load to calculate the compressive strength (average of three cubes).

Calculations:

Volume of water= (normal consistency /100) x weight of gypsum sample (gm)
(milliliters)

Compressive strength = (failure load (kg) /cross section area)
kg/cm² (5x5 cm²)

Wood Tests

1- Compressive strength of wood

- a- Compressive strength test in the parallel direction of the wood fiber.**
- b- Compressive strength test in the perpendicular direction of the wood fiber.**

Purpose of test:

To notice the difference between the compressive strength test in the parallel direction of the wood fiber and the compressive strength test in the perpendicular direction of the wood fiber.

Tools:

- 1-Wood cubes (50x50x50) mm.
- 2- Compressive strength device.

Procedure:

Each group takes two cubes of wood, put the first cube in the compressive strength device so that the load direction of the device must be in the parallel direction of the wood fiber in the cube, then mark the failure load and calculate the compressive strength. Take the second cube and put it in the compressive strength device so that the load direction of the device must be in the perpendicular direction of the wood fiber in the cube, then mark the failure load and calculate the compressive strength.

Calculations:

Compressive strength= failure load (N) / (cross section area)
(N/mm²) subjected to the load (mm²)

Note:

Calculate the Compressive strength in the parallel direction of the wood fiber and the Compressive strength in the perpendicular direction of the wood fiber.

Wood Tests

2- Modulus of rupture of wood

Purpose of test:

To know the failure load at which the wood prism fail in the modulus of rupture test.

Tools:

- 1- Wood prism (750x50x50) mm.
- 2- Compressive strength device.
- 3- Measuring strip.
- 4- Steel bars.

Procedure:

Take the wood prism (750x50x50)mm and measure and point 125 mm from each edge in the longitudinal direction and 375 mm from one edge and then mark lines in these points , put the prism in the device and calculate the failure load.

Calculations:

$$\text{Modulus of rupture (MPa)} = 3PL/2bd^2$$

Where:

P= failure load (N)

L= test length (500 mm)

b= prism width (mm)

d= prism depth (mm)

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جمهورية العراق
وزارة التعليم العالي
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جامعة كربلاء
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قسم المدني

Booklet of laboratory construction material

كراس مختبر مواد البناء



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