مواد الانشاء

Construction Materials

الفصل الاول

First Edition

MATERIALS FOR CIVIL AND CONSTRUCTION ENGINEERS

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Principle Properties of Construction Materials
الخصائص الاولية لمواد البناء

Introduction

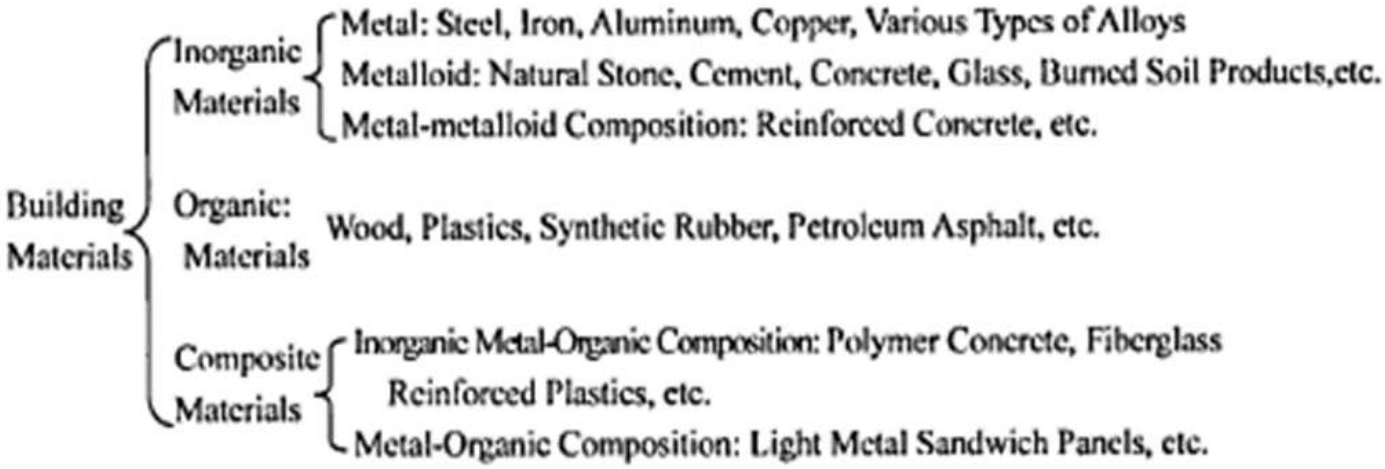
في البيئة العامة التي يعيش فيها البشر، فان جميع المواد أو المنتجات المستخدمة في الهياكل أو المباني تسمى (مواد البناء) التي هي الأساس المادي لهندسة مواد البناء. مواد البناء التي سيتم شرحها في هذا الصدد هي جميع المواد المستخدمة في بناء الأسس والقواعد والأرضيات والجدران والألواح والسقوف والديكورات المعمارية وغيرها.

هناك مجموعة واسعة من مواد البناء. وتصنف عادة من زوايا مختلفة حسب الدراسة والتطبيق والوصف. وتستند التصنيفات الأكثر شيوعا إلى مكوناتها ووظائفها الكيميائية.

Classification of Building Materials

1- According to the chemical components

وفقا للمكونات الكيميائية لمواد البناء:، ويمكن تصنيفها إلى المواد غير العضوية والمواد العضوية والمواد المركبة، على النحو التالي



2. According to the functions of materials:

فإنها يمكن تقسيمها إلى المواد الهيكلية والمواد الوظيفية

Structural Materials ：

تستخدم أساسا كأعضاء الحاملة، مثل المواد المستخدمة للحزم والألواح والأعمدة

Functional Materials：

تمتلك أساسا بعض الوظائف الخاصة في البناء، مثل المواد المانعة والعازلة للماء، ومواد العزل الحراري وغيرها....

Physical properties:

1- Density (ρ)

is the mass of a unit volume of homogeneous material denoted by

$$\rho = \frac{M}{V} \quad g/cm^3$$

Where M = mass under dry conditions (g)

V = volume is the volume under absolute compact conditions (cm^3)

وكثافة بعض مواد البناء هي كما يلي:

Material	Density (g/cm3)
Brick	2.5–2.8
Granite	2.6–2.9
Portland cement	2.9–3.1
Wood	1.5–1.6
Steel	7.8–7.9

2- Bulk Density (ρ_b)

is the mass of a unit volume of material in its natural state (with pores and voids) calculated as

$$\rho_b = \frac{M}{Vo} \quad kg/m^3$$

Where M = mass of specimen under dry conditions (kg)

Vo = volume of specimen in its natural state (m^3)

ملاحظة: يمكن التعبير عن الكثافة الظاهرية بوحدات (غم / سم³) ولكن هذا يسبب بعض الارباك او عدم الفهم بشكل صحيح, لذلك يفضل احتسابها بوحدات (كغم/ م³) كما موضح اعلاه.

For most materials, bulk density is less than density but for liquids and materials like glass and dense stone materials, these parameters are practically the same. Properties like strength and heat conductivity are greatly affected by their bulk density.

الكثافات الضاهرية لبعض مواد البناء هي كما يلي:

Material	**Bulk density (kg/m3)**
Brick	1600–1800
Granite	2500–2700
Sand	1450–1650
Pine wood	500–600
Steel	7850

3- Density Index (ρ_0),

$$\rho_0 = \frac{Bulk\ density}{Density}$$

$$\rho_0 = \frac{\rho_b}{\rho}$$

It indicates the degree to which the volume of a material is filled with solid matter. For almost all building materials ρ_0 is less than 1.0 because there are no absolutely dense bodies in nature.

4- Specific weight (ɣ):

also known as the(unit weight) is the weight per unit volume of material,

$$\gamma = \rho * g$$

Where: γ = Specific weight (kN /m3)
ρ= density of the material (kg/m)
g= gravity (m/s²)

ويمكن استخدام (الوزن النوعي) في الهندسة المدنية لتحديد وزن منشأ مصمم لتحمل بعض الأحمال في حين يبقى المنشأ سليما ويبقى ضمن الحدود المقبولة فيما يتعلق بالتشوه. كما انه يستخدم في ديناميكيات السوائل كخاصية للسوائل (على سبيل المثال، الوزن النوعي للمياه على الأرض هو 9.80 كيلو نيوتن / متر مكعب عند 4 درجات مئوية).

5- Specific Gravity :(G_s) of solid particles of a material is the ratio of weight/mass of a given volume of solids to the weight/mass of an equal volume of water at 4°C.

$$G_s = \frac{\gamma s}{\gamma w} = \frac{\rho s}{\rho w}$$

At 4° C γw = 1 g/cc or 9.8 kN/m3

6- Apparent or mass specific gravity (G_m):

If both the permeable and impermeable voids are included to determine the true volume of solids, the specific gravity is called apparent specific gravity. It is the ratio of mass density of fine grained material to the mass density of water.

$$G_m = \frac{\rho}{\rho w}$$

7- Porosity (n):

Porosity (***n***) is the percentage of the pores volume to the total volume with the volume of a substance. It is defined by:

$$n = \frac{V_V}{V}$$

or $n = \frac{Vo-V}{Vo} * 100$

❖ $n = (1 - \frac{V}{VO}) * 100$

وتعتبر المسامية مؤشرا على خصائص رئيسية أخرى للمواد مثل الكثافة الظاهرية والتوصيل الحراري والمتانة وما إلى ذلك. وتستخدم المواد الكثيفة ذات المسامية المنخفضة في المنشأت التي تتطلب مقاومة انضغاط عالية ، من جهة اخرى فان جدران المباني تشيد عادة من المواد تضم مسامية كبيرة, وهناك **علاقة بين نسبة الفراغات والمسامية كمايلي:**

$$n = \frac{\mathrm{e}}{1 + \mathrm{e}}$$

8- Void Ratio (e) :

is defined as the ratio of volume of voids (*Vv*) to the volume of solids (*Vs*).

$$e = \frac{V_V}{Vs}$$

إذا تم تفريغ ركام من اي نوع في وعاء ، سيتم ملاحظة أنه لا يتم ملء كل الحيز داخل الحاوية, حيث يعبر مصطلح (نسبة الفراغات) عن الفراغات الموجودة بين جزيئات الركام. وبالتاكيد فان نسبة الفراغات هي مثل الوزن النوعي للمادة تتأثر بدرجة رص المادة وكذلك كمية الرطوبة التي تحتويها. على العموم فان تحديد نسبة الفراغات تجرى على المواد التي تقاس فيها الفواقد في المادة.

9- Hygroscopicity:

is the property of a material to absorb water vapour from air. It is influenced by 1- air-temperature
2-relative humidity
3- pores—their types, number and size
4-the nature of material involved

10- Water absorption:

denotes the ability of the material to absorb and retain water. It is expressed as percentage in weight or of the volume of dry material:

$$W_W = \frac{M1-M}{M} * 100$$

$$W_V = \frac{M1-M}{V} * 100$$

Where: M1 = mass of saturated material (g), M = mass of dry material (g)
V = volume of material including the pores (mm3)

The water absorption depends on the porosity and characteristics of the pores. For normal materials, the higher the porosity is, the stronger the water absorption is. The more the open and connected tiny pores are, the stronger the water absorption is; it is not easy for water to be absorbed if the pores are closed; if they are large and open, water is easy to be absorbed but is hard to be hold, and thus the water absorption is weak. The water-absorption ratios of various materials vary greatly. For example, the specific absorption of quality of granite rock is 0.2%-0.7%, that of ordinary concrete is 2%-3%, that of, ordinary clay brick is 8%-20%' and that of wood or other light materials is often above 100%.

The water absorption will have a negative impact on materials' nature. If a material absorbs water, its volume will expand, its thermal conductivity will increase and its strength and durability will decrease.

ان امتصاص الماء من حيث الحجم فهو دائما أقل من 100 %، في حين أنها كنسبة مئوية وزنية من وزن المواد ذات المسامية قد يتجاوز 100 %.
تتأثر خصائص مواد البناء بشكل كبير عندما تكون مشبعة بالماء. تعرف نسبة مقاومة الانضغاط للمادة المشبعة بالماء إلى تلك الموجودة في الحالة الجافة ((بمعامل التلين)) ويصف تأثير الماء على المواد.

Coefficient of softening: The ratio of compressive strength of material saturated with water to that in dry state.

للمواد مثل الطين التي تنقع بسهولة هو معامل التلين =0 ، في حين للمواد مثل الزجاج والمعادن =1.
اما بالنسبة للمواد التي لها معامل تليين أقل من 0.8 لا ينبغي أن تستعمل في الحالات تتعرض للرطوبة بشكل دائم.

11- Weathering Resistance:

is the ability of a material to endure alternate wet and dry conditions for a long period without considerable deformation and loss of mechanical strength.

12- Water Permeability:

is the ability of a material to allow water to penetrate under pressure. Materials like glass, steel and bitumen are impervious.

13- Frost Resistance:

denotes the ability of a water-saturated material to endure repeated freezing and thawing with considerable decrease of mechanical strength. Under such conditions the water contained by the pores increases in volume even up to 9 per cent on freezing. Thus the walls of the pores experience considerable stresses and may even fail.

15- Heat Conductivity:

is the ability of a material to conduct heat. It is influenced by 1. nature of material, 2. its structure, 3. porosity, 4. character of pores , 5. mean temperature at which heat exchange takes place.

Materials with large size pores have high heat conductivity because the air inside the pores enhances heat transfer. Moist materials have a higher heat conductivity than drier ones. This property is of major concern for materials used in the walls of heated buildings since it will affect dwelling houses.

16- Thermal Capacity *Q*:

Thermal capacity is the property of a material to absorb heat when it is heated and to release heat when it is cooled. It is defined by:

$$Q = m * C * (T2 - T1)$$

OR

$$C = \frac{Q}{m(T2-T1)}$$

In this formula:

Q is the heat absorbed or released by a material (J);

m is the mass of a material (g);

C is the specific heat of a material [J/(g.K)];

T2-T1 is the temperature difference before and after heating or cooling (K).

EXAMPLE:
A copper specimen with a mass of 500 g, its initial temperature is 40 ° F, is heated to a temperature of 800 ° F. Calculate specific heat of the specimen if it is known that its thermal capacity is 145000 J.

17- Fire Resistance:

is the ability of a material to resist the action of high temperature without any appreciable deformation and substantial loss of strength. Fire resistive materials are those which char, smoulder, and ignite with difficulty when subjected to fire or high temperatures for long period but continue to burn or smoulder only in the presence of flame, e.g. wood impregnated with fire proofing chemicals.

18- Refractoriness:

denotes the ability of a material to withstand prolonged action of high temperature without melting or losing shape. Materials resisting prolonged temperatures of 1580°C or more are known as refractory.

High-melting materials can withstand temperature from 1350–1580°C, whereas low-melting materials withstand temperature below 1350°C.

19- Chemical Resistance:

is the ability of a material to withstand the action of acids, alkalis, sea water and gases. Natural stone materials, e.g. limestone, marble and dolomite are eroded even by weak acids, wood has low resistance to acids and alkalis, bitumen disintegrates under the action of alkali liquors.

20- Durability:

is the ability of a material to resist the combined effects of atmospheric and other factors.

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EXERCISES

1. (a) Why is it important to study the properties of building materials?
   (b) List and define the physical properties of building materials.

2. (a) What are the factors influencing the choice of a building material?
   (b) Why is it important to make standards for building materials?

3. Define the following:
   (a) Density (b) Bulk density
   (c) Density index (d) Specific weight
   (e) Porosity (f) Void ratio

4. Write short notes on the following:
   (a) Refractoriness (b) Heat conductivity
   (c) Selection of building materials (d) Fire resistive materials

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Mechanical Properties of Materials:

1- Strength of Materials:

المقاومة هي أكبر قدر من الإجهاد للمادة التي يمكن أن تتحملها تحت تأثيرالقوى الخارجية (الأحمال) في لحظة ما قبل الفشل.

هناك أشكال مختلفة من المقاومة، وتشمل :

- Tensile Strength
- Compressive Strength
- Shear Strength
- Flexural Strength

These kinds of strength are all determined by static test, known as the **static strength**. The static strength is tested by destructive experiments based on standard methods. The stress states of a material are shown in Figure

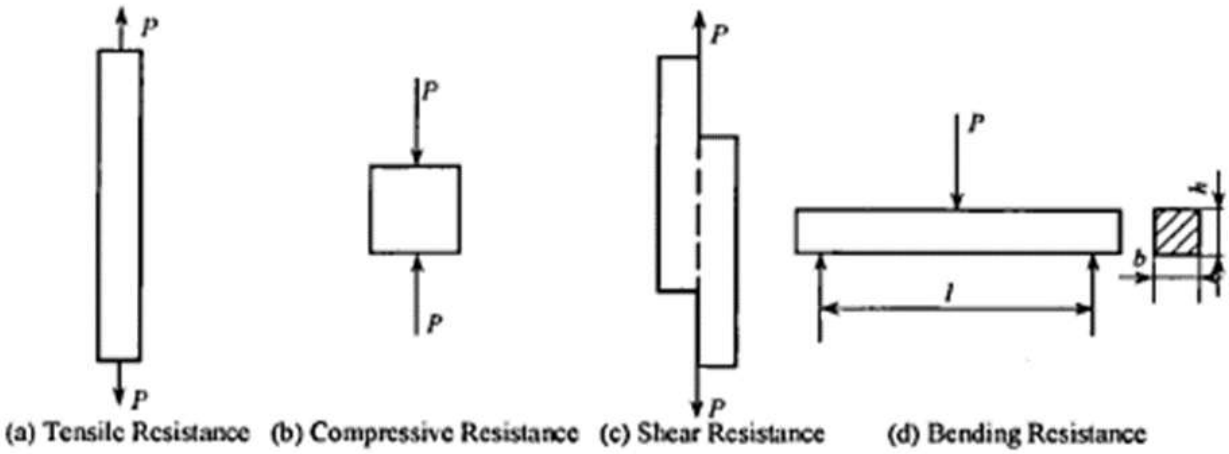


Figure 2.2 The Stress States of a Material

The **tensile strength, compressive strength and shear strength** can be defined by:

$$\sigma = \frac{P}{A}$$

In this formula:

$\boldsymbol{\sigma}$ is the strength of a material (MPa);

$\boldsymbol{P}$ is the largest load of a specimen when it is destructed (N);

$\boldsymbol{A}$ is the force bearing area of a specimen (mm^2).

Example: A steel bar with a diameter **of** 10 mm is used to test the tensile strength. And the tension measured at the destruction is **3 1.5 kN.** Calculate the tensile strength of steel.

The **Flexural strength** is related to the force that a material bears and the cross-section shape. For the strip specimen with **rectangular cross-section**, when it is **supported at both ends and a load converges in the middle**, its bend strength can be calculated by:

$$\sigma = \frac{3Pl}{2bh^2} \quad \text{.....}$$

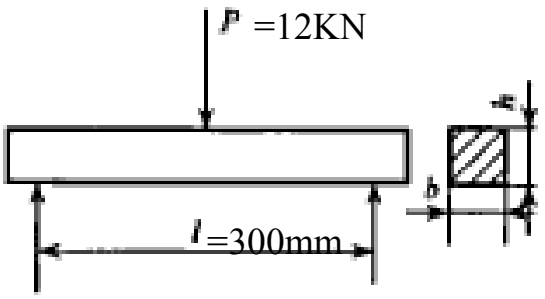
In this formula:

$\boldsymbol{\sigma}$:is the bend strength of a substance (MPa);
P: is the largest load of a specimen when it is destructed (N);
l: is the distance between two supporting ends (mm);
b: is the width of the cross-section (mm);
h: is the height of the cross-section (mm).

ان مقاومة المادة تعتمد على طبيعة البنية الداخلية لها, لذلك فان المقاومة سوف تكون متغيرة ومختلفة حتى عندما يكون التركيب الداخلي متشابه لكن البنية مختلفة.

The bigger the porosity is, the smaller the strength will be. The strength is also concerned with testing conditions, such as the sample's size, shape, surface and water content, loading speed, temperature of the test environment, the accuracy of test equipment, and the skill level of the operators.

Example: A concrete prism with daimension (100*100*400mm) loaded as shown in figure below, calculate the flexural strength.



2- Elasticity

The elasticity is the property of a substance to deform with external forces and return to its original shape when the stress is removed. The deformation fully capable of restoration is called elastic deformation. Within the range of the elastic deformation, the ratio of the stress **(σ)** to the strain (**ε**) is a constant (E) **which is known as elastic modulus, namely, E=$\frac{\sigma}{\varepsilon}$.**

المرونة هي خاصية تشوه المادة عند تعرضها لقوى خارجية وعودتها الى شكلها الاصلي عند زوال التأثير. ان التشوه القادر على استعادة شكله الاصلي تماما يسمى (التشوه المرن).

في حدود التشوه المرن فان نسبة الأجهاد/الأنفعال تكون ثابتة وتسمى

Elastic modulus, namely, E=$\frac{\sigma}{\varepsilon}$.

The elastic modulus is a measure of the ability to resist deformation. The bigger E is, the more difficultly the material deforms. The elastic modulus of low-carbon steel is $E=2.1x10^5$ MPa; and the elastic modulus of concrete is a variable value, with its strength grades increasing from C15 to C60 and its elastic modulus (**E**) increasing from $1.5\,x10^5$ MPa to $4x10^5$ MPa.

ACI 318 equation:

$$Ec = 4730\sqrt{f`c} \qquad \text{.....1}$$

Where $f'c$ = concrete compressive strength for Cylinder MPa.

and the ACI 363 equation:

$$Ec=3320\sqrt{f`c} + 6900 \qquad \text{.....2}$$

Where $f'c$ = concrete compressive strength for Cylinder MPa.

3- Plasticity

The plasticity describes the deformation of a material undergoing non-reversible changes of shape in response to external forces. This non-reversible deformation is called plastic deformation.

تصف (اللدونة) تشوه المادة التي تخضع لتغييرات غير قابلة للعكس في الشكل وذلك تحت تأثير القوى الخارجية, ويسمى هذا التشوه اللاعكسي (تشوه البلاستيكي)

في مواد البناء، لا توجد مواد مرنة نقية تماما. بعض المواد لديها تشوه مرن إذا كان الإجهادات المسلطة ليست كبيرة، ولكن التشوه (البلاستيكي) يحصل فيها عندما تكون الإجهادات المسلطة عليها اكبر من قدرة تحملها، مثال ذلك الحديد الصلب منخفض الكربون.

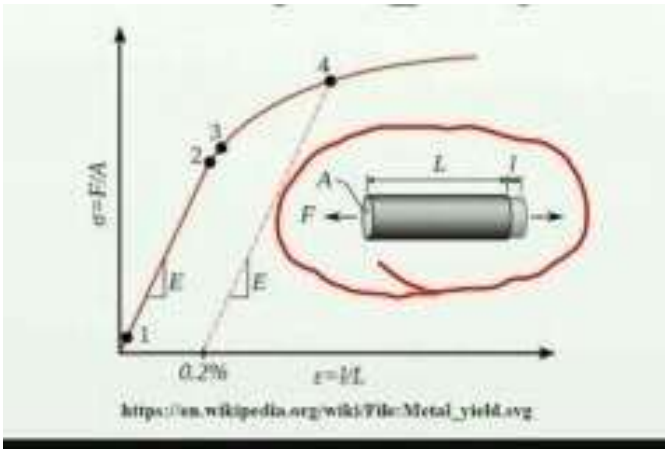
تحت تأثير القوى الخارجية، فان بعض المواد يحصل فيها تشوه مرن وتشوه البلاستيكي في نفس الوقت، لكن مع زيادة الاجهادات المسلطة سوف يختفي تدريجيا التشوه المرن ويبدا بعدها التشوه اللدن (البلاستيكي) حيث يبقى هذا النوع من التشوه في المادة حتى بعد رفع الاجهادات عنها، مثل الخرسانة.

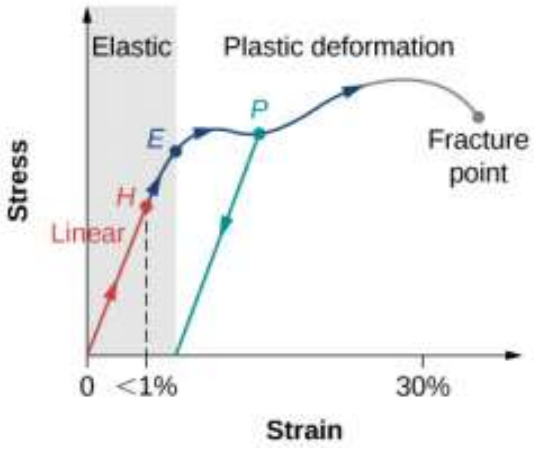
What is the difference between plasticity and elasticity?

Elasticity is defined as the property which enables a material ***to get back to*** (or ***recover***) its original shape, after the removal of applied force. For example… *A Rubber Band,* which can be stretched easily,

Plasticity is defined as the property which enables a material to be ***deformed*** *continuously and permanently* without ***rupture*** during the application of force. *This deformation determines the* ***viscous behavior*** *of the material and is* ***irrecoverable***.

For example… *A metallic cylinder,* which is stretched along its cross-sections with a force **F**,





4- Brittleness:

Brittleness describes the property of a material that fractures when subjected to stress but has a little tendency to deform before rupture. Brittle materials are characterized by little deformation, poor capacity to resist impact and vibration of load, high compressive strength, and low tensile strength. Most of inorganic non-metallic materials are brittle materials.

هذه الخاصية تصف سلوك المواد التي تحدث فيها تكسرات عندما تتعرض للضغط الكبير لكن لها ميل قليل للتشوه قبل التحطم بشكل نهائي.
وتتميز المواد القصيفة بتشوه قليل، وضعف القدرة على مقاومة تأثير واهتزاز الحمل، وارتفاع في مقاومة الانضغاط، وانخفاض قوة الشد. ومعظم المواد غير الفلزية غير العضوية هي مواد قصيفة.

5- Toughness:

Impacted or vibrated by stress, a material is able to absorb much energy and deform greatly without rupture, which is known as toughness, also called impact toughness. Tough materials are characterized by great deformation, high tensile strength, and high compressive strength, such as construction steel, wood and rubber. Tough materials should be used in the structures bearing impact and vibration, such as roads, bridges, cranes and beams.

وهي خاصية تصف قدرة المواد على تحمل وامتصاص الكثير من الطاقة والتشوه الى حد كبير دون حصول الفشل النهائي. وتتميز هذه المواد المتينة بتحمل تشوه كبير، وقوة شد عالية، وقوة ضغط عالية، مثل حديد التسليح في البناء والخشب والمطاط.
ويفضل استعمال هذا النوع من المواد في الهياكل المعرضة للاحمال صدم واهتزازات مثل الطرق والجسور.

6- Hardness:

Hardness refers to the property of a material **to** resist pressing-in or scratch of **a** sharp object. The materials of different kinds of hardness need various testing methods. The hardness of steel, wood and concrete **is** tested by pressing-in method.

وهي خاصية مقاومة المادة للضغط والخدش بواسطة الة حادة , الكثير من المواد لها طرق مختلفة لغرض فحص الصلابة , مثلا يتم اختبار صلابة كل من الحديد والخشب والخرسانة عن طريق اسلوب الضغط, اما في الطابوق مثلا يتم فحص الصلابة بواسطة اسلوب الخدش بآلة حادة.

For example, **Brinell Hardness** (HB) test is expressed by the pressure loaded on the press mark per unit area. The hardness of natural minerals is often tested by **scratch hardness.**

7- Abrasive Resistance:

Abrasive resistance refers to the capacity of a material to resist abrasion. It is expressed by the abrasion ratio, calculated as:

$$N = \frac{m1 - m2}{A}$$

In this formula:

N is the abrasion ratio (g/cm^2);

m1, is the mass before abrasion (g);

m2 is the mass after abrasion (g);

A is the abrasive area (cm^2).

Clay Bricks

Definition of Clay Bricks: تعريف الطابوق الطيني

الطابوق الطيني هو احد أقدم مواد البناء والتي لا تزال لها شعبية كبيرة وهو من مواد البناء الرائدة بسبب كونها رخيصة ووذات ديمومة وسهلة التعامل والعمل بها. ويستعمل الطابوق الطيني في بناء الجدران الداخلية والخارجية وفي الجدران (القواطع), وفي الارصفة او الاسس في الابنية الهيكلية وغير الهيكلية.

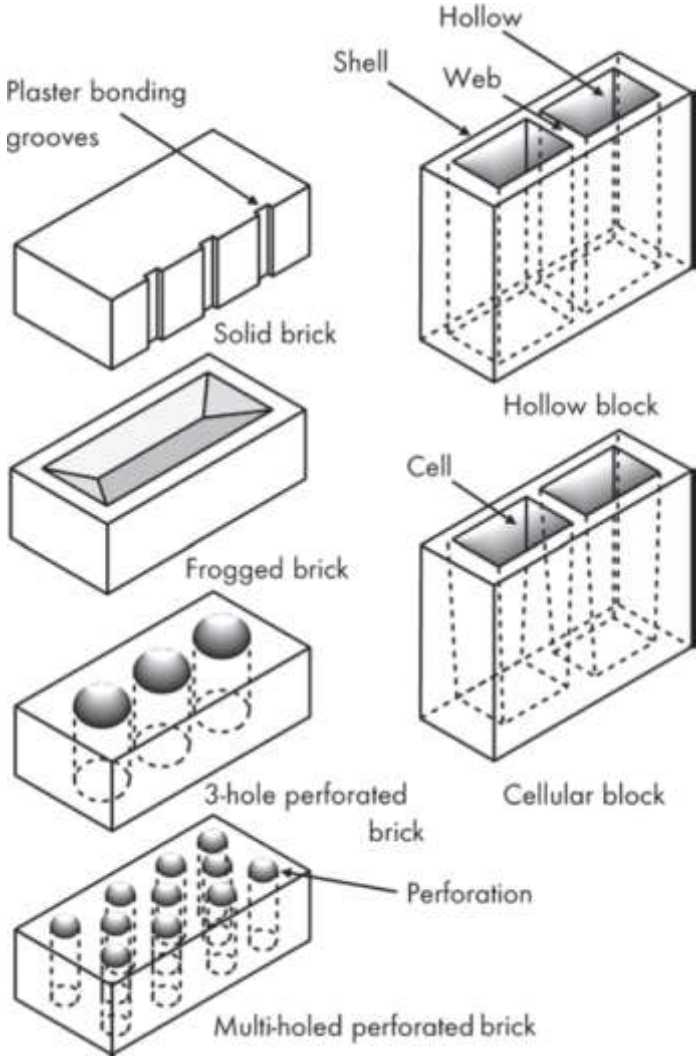
تتم عملية صناعة الطابوق بواسطة قولبة الطين النقي الخالي من الشوائب في قوالب معينة ذات اشكال وابعاد ثابتة ومن ثم تجفيفها وحرقها في افران خاصة.

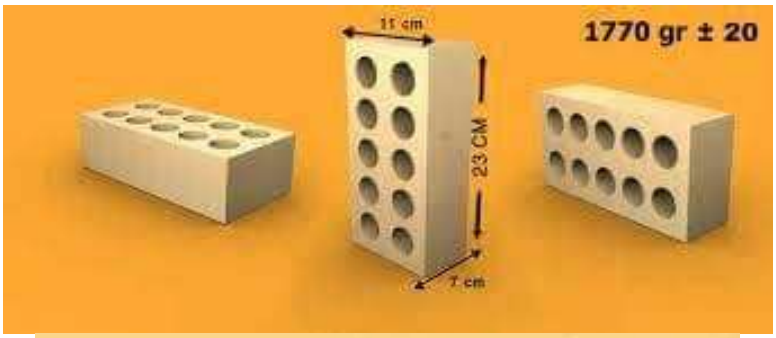
الطابوق في الغالب يكون باشكال مستطيلة وباحجام يسهل حملها والتعامل معها بيد واحدة.

يمكن صناعة الطابوق من الطين المحروق او من خليط من

Sand and lime or of Portland cement concrete.

ويستخدم الطابوق المصنع من الطين بكثرة كونه رخيص الثمن وسهل التعامل معه ومتوفر بشكل كبير.




11 cm
1770 gr ± 20
23 CM
7 cm

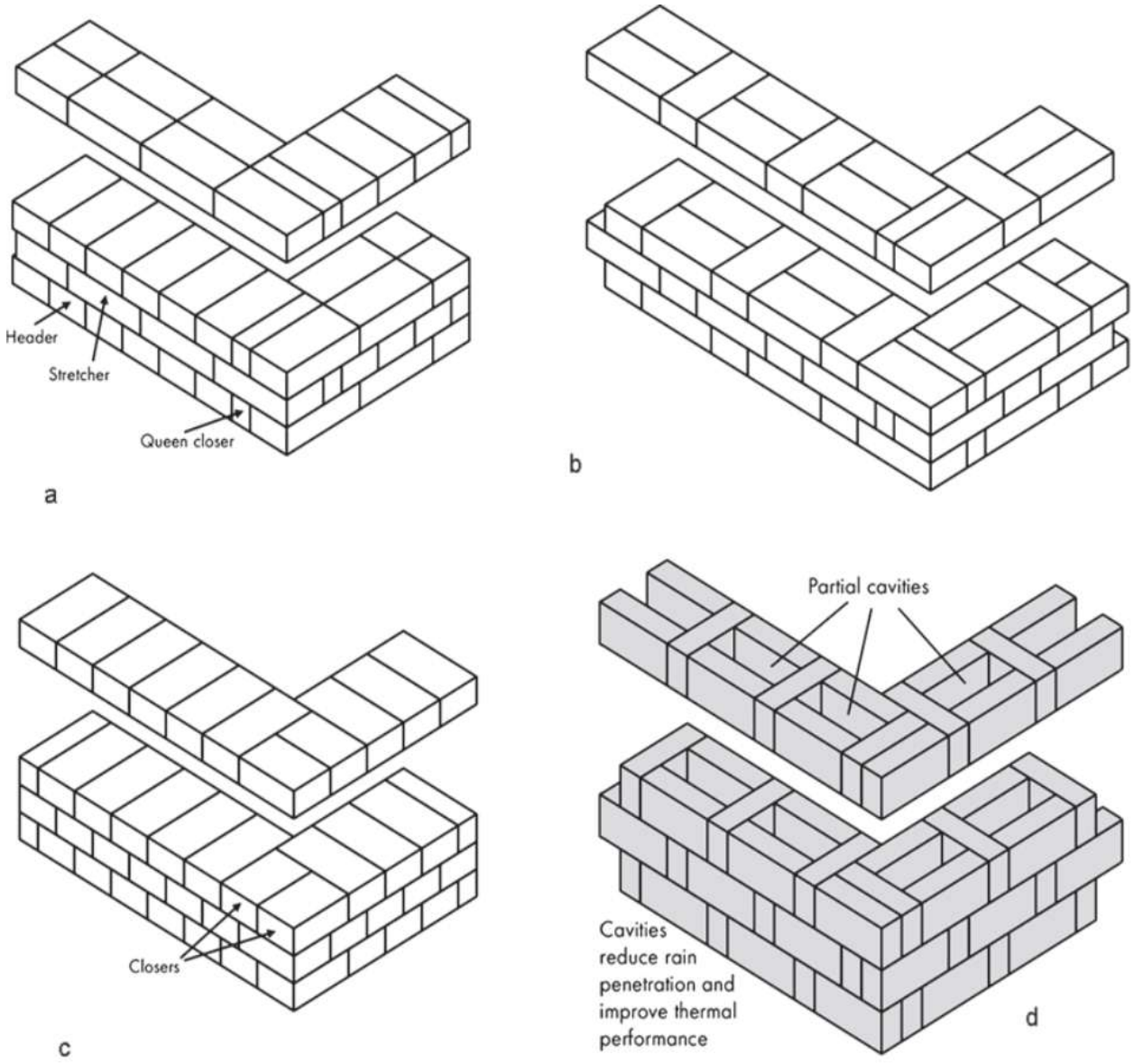


Fig. : *Common bonded wall types thicker than half brick. (a) English bond; (b) Flemish bond; (c) Heading bond; (d) 'Rat trap' bond.*

Classification of Clay Bricks:

1- On Field Practice; متطلبات الموقع

Clay bricks are classified as first class, second class, third class and fourth class based on their physical and mechanical properties.

يصنف كدرجة اولى, ودرجة ثانية ودرجة ثالثة ودرجة رابعة .... بالاعتماد على على خواصه الفيزيائية والميكانيكية

1- First class Bricks: طابوق صنف الدرجة الاولى

مواصفاته كما في ادناه:

1. These are thoroughly burnt and are of deep red, cherry or copper color

2. The surface should be smooth and rectangular, with parallel, sharp and straight edges and square corners

3. These should be free from flaws, cracks and stones

4. These should have uniform texture.

5. No impression should be left on the brick when a scratch is made by a finger nail.

6. The fractured surface of the brick should not show lumps of lime.

7. A metallic or ringing sound should come when two bricks are struck against each other.

8. Water absorption should be 12–15% of its dry weight when immersed in cold water for 24 hours.

9. The crushing strength of the brick should not be less than 10 N/mm2. This limit varies with different Government organizations around the country.

Uses: First class bricks are recommended for pointing, exposed face work in masonry structures, flooring and reinforced brick work.

2- Second Class Bricks:

Are supposed to have the same requirements as the first class ones except that:

1. Small cracks and distortions are permitted.
2. A little higher water absorption of about 16–20% of its dry weight is allowed.
3. The crushing strength should not be less than 7.0 N/mm².

Uses: Second class bricks are recommended for all important or unimportant hidden masonry works and centering of reinforced brick and reinforced concrete (RC) structures.

3- Third Class Bricks:

Are under-burnt. They are soft and light-colored producing a dull sound when struck against each other. Water absorption is about 25 per cent of dry weight.

Uses: It is used for building temporary structures.

قليلة الحرق. تكون لينة وذات لون فاتح تصدر صوتا مملا عند ضربها ببعضها.
نسبة امتصاص الماء فيها بحدود 25% من وزنها الجاف, وتستعمل في بناء المنشأت المؤقتة

4- Fourth Class Bricks:

Are over-burnt and badly distorted in shape and size and are brittle in nature.

Uses: such bricks is used for foundation and floors in lime concrete and road.

2- On Basis of Uses

A- Common Bricks: الطابوق العام

It is a general multi-purpose unit manufactured economically without special reference to appearance. These may vary greatly in strength and durability and are used for filling, backing and in walls where appearance is of no consequence.

وهي وحدات ذات استخدامات عامة متعددة مصنعة اقتصاديا بدون الاهتمام بمظهرها. هذا النوع قد تختلف القوة والديمومة فيه اختلافا كبيرا , ويستخدم في العادة لبناء الجدران الداخلية وفي الجدران حيث يكون المظهر غير مهم.

B- Facing Bricks: طابوق الواجهات

Are made primarily with a view to have good appearance, either of color or texture or both. These are durable under severe exposure and are used in fronts of building walls for which a pleasing appearance is desired.

مصنوعة أساسا بهدف الحصول على مظهر جيد، إما من اللون أو الملمس أو كليهما. هذا النوع يكون ذو ديمومة تحت التعرض للظروف الشديدة ويستخدم في واجهات الابنية حيث يكون المظهر الجميل مطلوبا.

C- Engineering Bricks: الطابوق الهندسي

Are strong, impermeable, smooth, table mounded, hard and conform to defined limits of absorption and strength. These are used for all load bearing structures.

هي قوية، غير منفذة، ملساء، مقولبة منضديا، قوية وتتفق مع محددات الامتصاص والمقاومة. تستعمل في كل المنشآت الحاملة للاثقال.

3- On The Basis of Finish: حسب طريقة الانهاء

1- **Sand Faced-Bricks:** has textured surface manufactured by sprinkling sand on the inner surfaces of the mold.

لها سطح نسيجي مصنع بواسطة رش الرمل على الاسطح الداخلية للقالب

2- **Rustics Bricks:** has mechanically textured finish, varying in pattern.

لها انهاءات نسيجية مصنعة بطريقة ميكانيكية, متغايرة في النمط.

4- On The Basis of Manufacture: حسب التصنيع

1- **Hand-made:** These bricks are hand molded.

2- **Machine-made:** Depending upon mechanical arrangement, bricks are known as wire-cut bricks—bricks cut from clay extruded in a column and cut off into brick sizes by wires; pressed-bricks— when bricks are

manufactured from stiff plastic or semi-dry clay and pressed into molds; molded bricks—when bricks are molded by machines imitating hand mixing.

تعتمد في الاساس على الترتيب الميكانيكي ويعرف الطابوق بانه مقطع بواسطة الاسلاك.
الطابوق يقطع من عمود الطين ويقطع الى احجام الطابوق.
اما الطابوق المكبوس – عند تصنيع الطابوق من عجينة الطين الصلبة او نصف جافة تكبس في القوالب .
اما الطابوق المقولب – عند وضع العجينة في قوالب بواسطة الماكنة التي تقلد الخلط اليدوي.

5- On The Basis of Burning: بالاعتماد على الحرق

1- **Pale Bricks:** are under-burnt bricks obtained from outer portion of the kiln.
الطابوق الباهت: هو طابوق محروق قليلا يحصل عليه من الحواف الخارجية للفرن.
2- **Body Bricks:** are well-burnt bricks occupying central portion of the kiln.
طابوق محروق جيدا يحتل الجزء المركزي من الفرن
3- **Arch Bricks:** are over-burnt also known as clinker bricks obtained from inner portion of the kiln.
طابوق القوس: محروق كثيرا ويعرف بطابوق الكلنكر يحصل عليه من الجزء الداخلي للفرن.

6- On The Basis of Types: بالاعتماد على انواعه

1- **Solid Bricks:**
Small holes not exceeding 25 per cent of the volume of the brick are permitted; alternatively, frogs not exceeding 20 per cent of the total volume are permitted.

2- **Perforated Bricks:**
Small h oles may exceed 25 per cent of the total volume of the brick.

3- **Hollow Bricks:**
The total of holes, which need not be small, may exceed 25 per cent of the volume of the brick.

4- **Cellular Bricks:**
Holes closed at one end exceed 20 per cent of the volume.
الفراغات تكون المغلقة من احد جهاتها تتجاوز 20 % من الحجم الكلي

Note: Small holes are less than 20mm in diameter or less than 500mm2 in cross section.

Chemical Composition of Clay Bricks:

A good brick earth should have the following composition:

Composition	% of weight
Alumina	20-30 %
Silica	50–60%
Silt	20-25%
Lime	5-10%
Magnesia Iron oxide Alkalis	< 1% < 7% < 10% — Less than 20%
Carbon dioxide Sulphur trioxide Water	Very small percentage

Function of Various Ingredients:

Silica

- Brick earth should contain about 50 to 60 % of silica.
- It is responsible for preventing cracking, shrinking and warping of raw bricks.
- It also affects the durability of bricks.
- If present in excess, then it destroys the cohesion between particles and the brick becomes brittle.

Alumina

- Good brick earth should contain about 20% to 30% of alumina.
- It is responsible for plasticity characteristic of earth, which is important in molding operation.
- If present in excess, then the raw brick shrink and warp during drying.

Lime

- The percentage of lime should be in the range of 5% to 10% in a good brick earth.
- It prevents shrinkage of bricks on drying.
- It causes silica in clay to melt on burning and thus helps to bind it.
- Excess of lime causes the brick to melt and brick loses its shape.

Iron oxide

- A good brick earth should contain about 5% to 7% of iron oxide.
- It gives red color to the bricks.
- It improves impermeability and durability.
- It gives strength and hardness.

- If present in excess, then the color of brick becomes dark blue or blackish.
- If the quantity of iron oxide is comparatively less, the brick becomes yellowish in color.

Magnesia

- Good brick earth should contain less a small quantity of magnesia about 1%)
- Magnesium in brick earth imparts yellow tint to the brick.
- It is responsible for reducing shrinkage.
- Excess of magnesia leads to the decay of bricks.

Harmful Ingredients Clay Bricks:

Below mentioned are some of the ingredients which are undesired in brick earth.

1- Lime الجير

- A small quantity of lime is required in brick earth. But if present in excess, it causes the brick to melt and hence brick loses its shape.
- If lime is present in the form of lumps, then it is converted into quick lime after burning. This quick lime slakes and expands in presence of moisture, causing splitting of bricks into pieces.

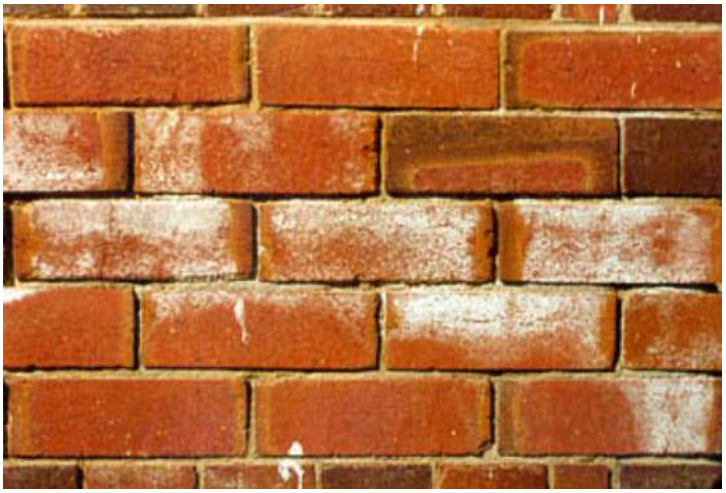
2- Iron pyrites

- The presence of iron pyrites in brick earth causes the brick to get crystallized and disintegrated during burning, because of the oxidation of the iron pyrites.
- Pyrites discolourise the bricks.

3- Alkalis القلويات

- These are exist in the brick earth in the form of soda and potash. It acts as a flux in the kiln during burning and it causes bricks to fuse, twist and warp. Because of this, bricks are melted and they lose their shape.

- The alkalis remaining in bricks will absorb moisture from the atmosphere, when bricks are used in masonry. With the passage of time, the moisture gets evaporated leaving grey or white deposits on the wall surface (known as **efflorescence**). This white patch affects the appearance of the building structure.



Efflorescence in Brick

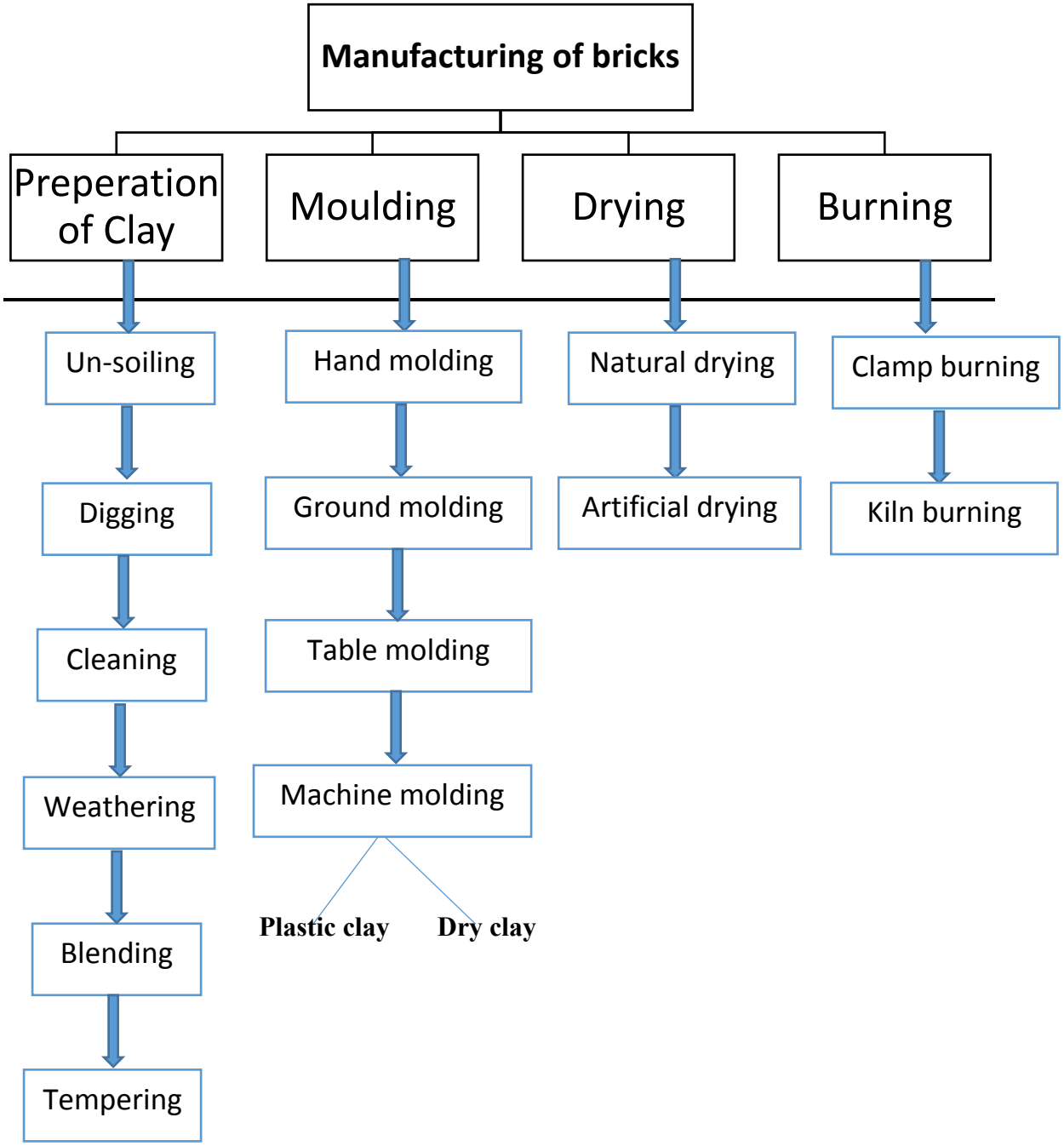
4- Pebbles

- Pebbles in brick earth create problem during mixing operation of earth. It prevents uniform and through mixing of clay, which results in weak and porous bricks
- Bricks containing pebbles will not break into shapes as per requirements.

5- Vegetation and Organic Matter

- The presence of vegetation and organic matter in brick earth assists in burning. But if such matter is not completely burnt, the bricks become porous. This is due to the fact that the gasses will be evolved during the burning of the carbonaceous matter and it will result in the formation of small pores.

Manufacturing of Bricks Earth:



Defects of bricks:

1- *Overburning bricks*

Bricks should be burned at temperatures at which incipient, complete and viscous vitrification occur. However, if the bricks are overburnt, a soft molten mass is produced and the bricks lose their shape. Such bricks are not used for construction works.

يجب حرق الطابوق في درجات حرارة يحدث فيها التزجيج الأولي والكامل واللزج. ومع ذلك، إذا تم حرق الطابوق اكثر من اللازم فانه سينتج كتلة منصهرة لينة ويفقد عندها الطابوق شكله المنتظم, مثل هذا الطابوق لا يستعمل لاعمال البناء.

2- *Underburning bricks*

When bricks are not burnt to cause complete vitrification, the clay is not softened because of insufficient heat and the pores are not closed. This results in higher degree of water absorption and less compressive strength. Such bricks are not recommended for construction works.

عندما لا يتم حرق الطابوق حتى يحدث التزجيج الكامل، فان الطابوق لا يكون لينا كفاية وذلك بسبب عدم كفاية الحرارة والمسامات تكون غير مغلقة. وهذا يسبب درجة عالية من نسبة امتصاص الماء وبالنتيجة مقاومة انضغاط اقل. مثل هذا النوع من الطابوق لا ينصح به للاعمال الانشائية.

3- *Bloating*

This defect observed as spongy swollen mass over the surface of burned bricks is caused due to the presence of excess carbonaceous matter and sulphur in brick-clay.

هذا العيب يلاحظ ككتلة اسفنجية منتفخة على سطح الطابوق المحروق ويحدث هذا بسبب وجود المواد الكربونية الزائدة واكبريت في الطابوق الطيني

4- *Black Core*

When brick-clay contains bituminous matter or carbon and they are not completely removed by oxidation, the brick results in black core mainly because of improper burning.

عندما يحتوي الطابوق الطيني على المواد القيرية او الكاربونية ولم يتم ازالتها بالكامل بواسطة عملية الاكسدة, فان ذلك ينتج عنه طابوق ذو لب اسود بسبب عملية الحرق الغير جيدة

5- *Efflorescence*

This defect is caused because of alkalies present in bricks. When bricks come in contact with moisture, water is absorbed and the alkalis crystalize. On drying grey or white powder patches appear on the brick surface. This can be minimized by **selecting proper clay materials for brick manufacturing, preventing moisture to come in contact with the masonry, by providing waterproof coping and by using water repellent materials in mortar and by providing damp proof course.**

6- *Chuffs*

The deformation of the shape of bricks caused by the rain water falling on hot bricks is known as ***chuffs.***

7- *Cracks*

This defect may be because of lumps of lime or excess of water. In case of the former, when bricks come in contact with water, the absorbed water reacts with lime nodules causing expansion and a consequent disintegration of bricks, whereas shrinkage and burning cracks result when excess of water is added during brick manufacturing.

قد يحدث هذا الخلل بسبب كتل الجير أو الزيادة في الماء. في الحالة الأولى، عندما يتلامس االطابوق مع الماء، تتفاعل المياه الممتصة مع العقيدات الجيرية مما يؤدي إلى توسعها وانتفاخها وما يترتب على ذلك من تفكك الطابوق، في حين أن الانكماش وتشققات الحرق يحصل عندما يتم إضافة فائض من الماء أثناء تصنيع الطابوق.

8- *Spots*

Iron sulphide, if present in the brick clay, results in dark surface spots on the brick surfaces. Such bricks though not harmful are unsuitable for exposed masonry work.

كبريتيد الحديد، إذا كان موجودا في الطابوق الطيني،فانه ينتج بقع سطحية داكنة على أسطح الطابوق. هذا النوع من الطبابوق غير مناسبة لأعمال البناء المكشوفة.

9- *Blisters*

Broken blisters are generally caused on the surface of sewer pipes and drain tiles due to air imprisoned during their moulding.

تحدث بثور مكسورة عادة على السطح على انابيب الصرف الصحي والبلاطات (الكاشي) المصنوعة من المواد الطينية بسبب الهواء المحبوس خلال عملية القولبة.

10- *Laminations* *التصفيح (حدوث صفائح)*

These are caused by the entrapped air in the voids of clay. Laminations produce thin lamina on the brick faces which weather out on exposure. Such bricks are weak in structure.

تنتج هذه بسبب الهواء الموجود داخل الفراغات في الطين. التصفح ينتج صفائح رقيقة على وجه الطابوق المعرض للظروف الجوية الخارجية. مثل هذا النوع ضعيف في المنشآت.

Testing on Bricks Earth

To know the quality of bricks following 7 tests can be performed. In these tests some are performed in laboratory and the rest are on field.

1- **Compressive strength test**
2- **Water Absorption test**
3- **Efflorescence test**
4- **Hardness test**
5- **Size, Shape and Color test**
6- **Soundness test**
7- **Structure test**

1- Compressive strength test

This test is done to know the compressive strength of brick. It is also called crushing strength of brick. Generally 10 specimens of bricks are taken to laboratory for testing and tested one by one. In this test a brick specimen is put on crushing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. All ten brick specimens are tested one by one and average result is taken as brick's compressive/crushing strength.

2- Water Absorption test

In this test bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion those are taken out from water and wipe out with cloth. Then brick is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated .The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight.

3- Efflorescence test

The presence of alkalies in bricks is harmful and they form a grey or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test a brick is immersed in fresh water for 24 hours and then it's taken out from water and allowed to dry in shade .If the whitish layer is not visible on surface it proofs that absence of alkalis in brick. If

the whitish layer visible about **10% of brick surface then the presence of alkalis is inacceptable range**. If that is about **50% of surface then it is moderate**. If the alkalies' presence is over **50% then the brick is severely affected by alkalies**.

4- **Hardness test**

In this test a scratch is made on brick surface with a hard thing. If that doesn't left any impression on brick then that is good quality brick.

5- **Size, Shape and Color test**

In this test randomly collected 30 bricks are staked along lengthwise, width wise and height wise and then those are measured to know the variation of sizes as per standard. Bricks are closely viewed to check if its edges are sharp and straight and uniform in shape. A good quality brick should have bright and uniform colour throughout.

6- **Soundness test**

In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

7- **Structure test**

In this test a brick is broken or a broken brick is collected and closely observed. If there are any flows, cracks or holes present on that broken face then that isn't good quality brick.

Requirements of a good brick earth

A good brick earth should fulfil with the following requirements:

1- It must have proper proportion of sand, silt and clay.
2- It must be homogeneous.
3- It should have sufficient plasticity.
4- It must be free from lumps of lime.
5- It should not be mixed with salty water.
6- The bricks should be table moulded, well burnet in kilns, copper coloured, free from cracks and with sharp and square edges.
7- The bricks should be uniform in shape and should be standard in size.
8- The bricks should give a clear metallic ringing sound when stuck with each other.
9- The bricks should not absorb water more than 15% by weight for first class bricks, and 20% by weight for second class.
10- The bricks should not break into pieces when dropped on hard ground from a height about one meter.
11- No bricks should have compressive strength less than 5.5 N/mm2.

Advantages & disadvantages of clay bricks

Advantages of Bricks

1. Economical (Raw material is easily available)
2. Hard and durable
3. Compressive strength is good enough for ordinary construction
4. Different orientations and sizes give different surface textures
5. Very low maintenance cost is required
6. Demolishing of brick structures is very easy, less time consuming and hence economic
7. Reusable and Recyclable
8. Highly fire resistant
9. Produces less environmental pollution during manufacturing process

Disadvantages of Bricks:

1. Time consuming construction
2. Cannot be used in high seismic zones
3. Since bricks absorb water easily, therefore, it causes fluorescence when not exposed to air
4. Very Less tensile strength
5. Rough surfaces of bricks may cause mold growth if not properly cleaned
6. Cleaning brick surfaces is a hard job
7. Color of low quality brick changes when exposed to sun for a long period of time

Sand-lime bricks

Sand lime bricks are manufactured by mixing sand, fly ash and lime in desired proportion that may be followed by chemical accelerator during wet mixing. This mixture is moulded under pressure.

Materials Used for Sand Lime Bricks:

The materials listed below are used for the production of **calcium silicate bricks**.

- Sand
- Lime
- Water
- Pigment

Sand

Calcium silicate bricks contains high amount of sand is about 88 – 92%. It means the properties of these bricks depends upon the characteristics of sand used. So, the sand used shall be well graded and should not contain any impurities like organic matter, soluble slats etc.

طابوق سليكات الكالسيوم: يحتوي على كمية عالية من الرمل بحدود 88-92%. مما يعني ان خواص هذا الطابوق يعتمد على خواص الرمل المستخدم. لذلك فان الرمل المستخدم يجب ان يدرج ولا يحتوي على اية شوائب مثل المواد العضوية, الاملاح المذابة او غيرها.

Lime

Lime content in calcium silicate bricks varies from 8 to 12%. The lime used shall be of good quality and high calcium lime.

Water

Clean water should be used for preparing calcium silicate bricks. Sea water or water containing soluble salts or organic matter more than 0.25% are not suitable.

Pigment

Pigments are generally used to give color to the bricks. They are added to the sand and lime while mixing.

Total weight of brick contains 0.2 to 3 % of pigment quantity. Different pigments used to get different colors are tabulated below:

Pigment	Color
Carbon black	Black, grey
Iron oxide	Red, brown
Chromium oxide	Green
Ochre	yellow

Sand Lime Bricks

The **green bricks** can be air cured for 24-48 hours and then steam cured in autoclave at desired pressure and temperature. The green bricks may be steam / hot water cured at atmospheric pressure also.

الطابوق الاخضر يمكن معالجته بالهواء الطلق لمدة 24-48 ساعة وبعد ذلك يعالج بالبخار بواسطة جهاز (اوتوكليف) حسب درجة الحرارة واضغط المرغوبان. الطابوق الاخضر يمكن معالجته بالبخار/الماء الحار تحت الضغط الجوي كذلك.

In presence of moisture, fly ash reacts with lime at ordinary temperature and forms a compound possessing cementitious properties. After reactions between lime and fly ash, calcium silicate hydrates are produced which are responsible for the high strength of the compound.

بوجود الرطوبة فان (الرمادالمتطاير) يتفاعل مع الجير بدرجات الحرارة ويشكل مركب يمتلك الخواص السمنتية. بعد التفاعل بين (الرماد المتطاير) والجير, تنتج **(سليكات الكالسيوم المهدرجة)** والتي تكون مسؤولة عن المقاومة العالية للمركب.

Bricks made by mixing lime and fly ash are, therefore, chemically bonded bricks. These bricks are suitable for use in masonry just like common burnt clay bricks.

الطابوق المصنوع من خلط الجير مع (الرماد المتطاير) لذلك يكون طابوق مترابط كيميائيا. هذه النوعية من الطابوق تكون مناسبة للاستخدام في الجدران مثل الطابوق الطيني المحروق.

These bricks have the following **advantages** over the clay bricks:

1. **Possess adequate crushing strength as a load-bearing member.**
2. **Have cement color in appearance, are uniform in shape and smooth in finish and require no plastering for building work.**
3. **They are lighter in weight than ordinary clay bricks.**

Generally, dry fly ash available from power plants meets the properties specified in **IS: 3812** and is suitable for manufacture of **Fly Ash – lime bricks** in accordance With the requirements of **IS: 12894**.

عموما, (الرماد المتطاير) الجاف متوفر بشكل مسحوق يطابق خواص المواصفة ( ) ويكون مناسبا لتصنيع (طابوق الجير-الرمادالمتطاير) مطابقا لمتطلبات المواصفة ( )

Decorative bricks:

Sand Lime Bricks or **Decorative bricks** are made of sand and lime mixed with water and then pressed in an atmosphere of steam for hardening. It is a firebrick made of refractory silica sand with lime as a bonding agent.

الطابوق الرملي الجيري او(طابوق الديكورات) يصنع من الرمل والجير الذين يخلطان مع الماء وبعدها يكبس بواسطة ضغط البخار لغرض التصلب. اما الطابوق الناري يصنع من سليكا الرمل الحرارية و الجير كمادة رابطة.

In presence of moisture, fly ash reacts with lime at ordinary temperature and forms a compound possessing cementitious properties. After reactions between lime and fly ash, calcium silicate hydrates are produced which are responsible for the high strength of the compound.

بوجود الرطوبة فان (الرمادالمتطاير) يتفاعل مع الجير بدرجات الحرارة ويشكل مركب يمتلك الخواص السمنتية. بعد التفاعل بين (الرماد المتطاير) والجير, تنتج (سليكات الكالسيوم المهدرجة) والتي تكون مسؤولة عن المقاومة العالية للمركب.

Bricks made by mixing lime and fly ash are, therefore, chemically bonded bricks. These bricks are suitable for use in masonry just like common burnt clay bricks.

الطابوق المصنوع من خلط الجير مع (الرماد المتطاير) لذلك يكون طابوق مترابط كيميائيا. هذه النوعية من الطابوق تكون مناسبة للاستخدام في الجدران مثل الطابوق الطيني المحروق.

These bricks have the following advantages over the clay brick:

1. Possess adequate crushing strength as a load-bearing member

2. Have cement color in appearance, are uniform in shape and smooth in finish, require no plastering for building work and consume less mortar

3. Are lighter in weight than ordinary clay bricks

4. They can produced in desired colors

Concrete Blocks

Background

A concrete block is primarily used as a building material in the construction of walls. It is sometimes called a **concrete masonry unit (CMU).**

(البلوك الكونكريتي) يستخدم بشكل رئيسي كمادة انشائية في الجدران. حيث انه في بعض الاحيان يسمى(وحدات الجدران الكونكريتية).

A concrete block is one of several precast concrete products used in construction. The term precast refers to the fact that the blocks are formed and hardened before they are brought to the job site.

البلوكات الكونكريتية هي واحدة من بعض المنتجات الكونكريتي(**مسبقة الصب)** المستخدمة في الانشاءات. ان مصطلح **(مسبقة الصب)** يشير الى حقيقة ان البلوكات الكونكريتية تم قولبتها واكتسبت الصلابة قبل جلبها الى موقع العمل.

Most concrete blocks have one or more hollow cavities, and their sides may be cast smooth or with a design. In use, concrete blocks are stacked one at a time and held together with fresh concrete mortar to form the desired length and height of the wall.

معظم البلوكات الكونكريتية فيها تجويف او اكثر, وجوانبها قد تكون ملساء او حسب التصميم والطلب. اثناء الاستخدام فان البلوكات الكونكريتية يتم رصفها وبناءها سوية وربطها بواسطة المونة سوية لكي تعطينا الطول والارتفاع المطلوب للجدران.

Concrete mortar was used by the Romans as early as 200 B.C. to bind shaped stones together in the construction of buildings. During the reign of the Roman emperor Caligula, in 37-41 A.D., small blocks of precast concrete were used as a construction material in the region around present-day Naples, Italy.

مونة السمنت استخدمت من قبل (الرومان) قبل 200 سنة قبل الميلاد لربط اشكال الحجر اثناء عمليات البناء, وخلال فترة حكم الامبراطور ( ) في سنة 37-41 بعد الميلاد, استخدمت وحدات كونكريتية صغيرة (مسبقة الصب) كمادة انشائية, قرب المنطقة المعروفة بالوقت الحاضر بـ (نابلس-ايطاليا).

Much of the concrete technology developed by the Romans was lost after the fall of the Roman Empire in the fifth century. It was not until 1824 that the English **Stonemason Joseph Aspdin** developed portland cement, which became one of the key components of modern concrete.

اغلب التكنولوجيا التي تم تطويرها من قبل الرومان فقدت بعد سقوط الامبراطورية الرومانية في القرن الخامس. وفقدت تماما لحد سنة 1824 حيث طور الانكليزي ( ) السمنت البورتلاندي, والذي اصبح احد مفاتيح مركبات الكونكريت الحديث.

The first hollow concrete block was designed in 1890 by **Harmon S. Palmer** in the United States. After 10 years of experimenting, Palmer patented the design in 1900. Palmer's blocks were (20.3 cm) by (25.4 cm) by (76.2 cm), and they

were so heavy they had to be lifted into place with a small crane. By 1905, an estimated 1,500 companies were manufacturing concrete blocks in the United States.

اول بلوك كونكريتي مجوف تم تصميمه في 1890 من قبل ( ) في الولايات المتحدة الامريكية. وبعد (10) سنوات من التجارب اخترع (بالمر) التصميم سنة 1900. بلوكات (بالمر) كانت بقياس 20.3*25.4*76.2 سم حيث كانت ثقيلة الوزن جدا ويتم حملها بواسطة كرين صغير. بحلول عام 1905 بحدود 1500 شركة كانت تصنع البلوك الكونكريتي في الولايات المتحدة.

These early blocks were usually cast by hand, and the average output was about 10 blocks per person per hour. Today, concrete block manufacturing is a highly automated process that can produce up to 2,000 blocks per hour.

هذا النوع من البلوكات كانت عادة تصب يدويا, ومعدل الانتاج كان تقريبا 10 بلوكات / شخص / ساعة. اما في الوقت الحاضر فان صناعة البلوك الكونكريتي تتم بعمليات عالية التقنية والتي تنتج لحد 2000 بلوكة في الساعة

Raw Materials المواد الخام

The concrete commonly used to make concrete blocks is a mixture of powdered Portland cement, water, sand, and gravel. This produces a light gray block with a fine surface texture and a high compressive strength.

الخرسانة المستخدمة عادة لصنع البلوك الكونكريتي هي خليط من مسحوق السمنت البورتلاندي والماء والرمل والحصى. هذا ينتج كتلة رمادية فاتحة مع سطح ناعم وقوة ضغط عالية.

A typical concrete block weighs (17.2-19.5 kg). In general, the concrete mixture used for blocks has a higher percentage of sand and a lower percentage of gravel and water than the concrete mixtures used for general construction purposes.

الوزن النموذجي للبلوك يتراوح بين (17.2-19.5). عموما الخليط المستخدم في صناعة البلوك يحتوي على نسبة عالية من الرمل ونسبة اقل من الحصى والماء من للخلطات الخرسانية المستخدمة عموما للاغراض الانشائية

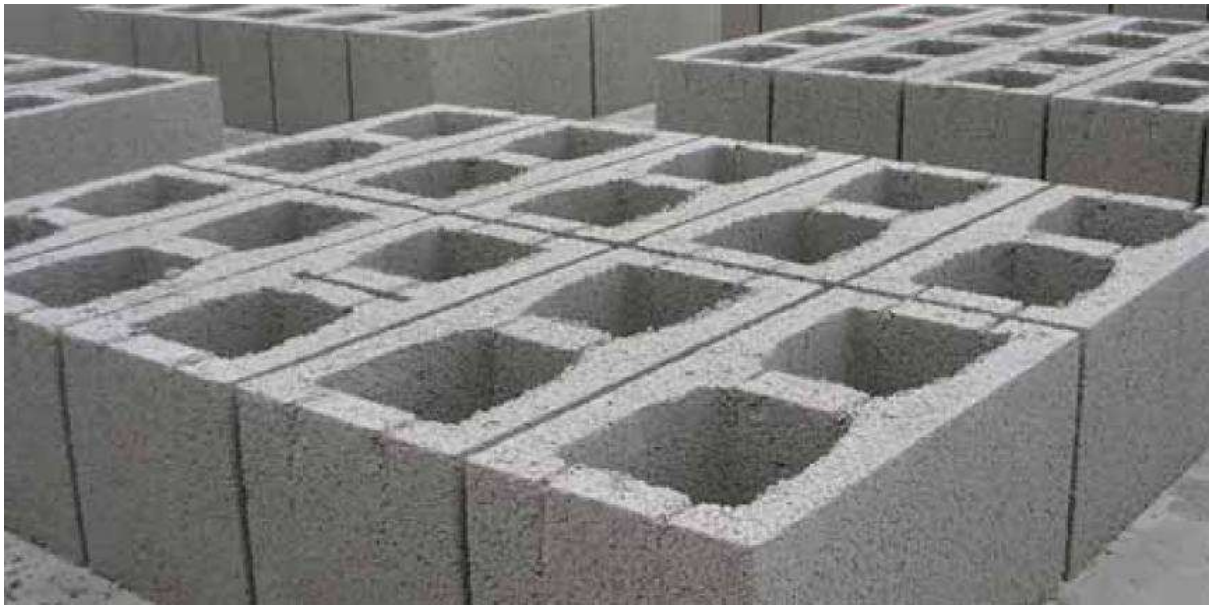
This produces a very dry, stiff mixture that holds its shape when it is removed from the block mold.

If granulated coal or volcanic cinders are used instead of sand and gravel, the resulting block is commonly called a **cinder block**. This produces a dark gray block with a medium-to-coarse surface texture, good strength, good sound-deadening properties, and a higher thermal insulating value than a concrete block. A typical cinder block weighs (11.8-15.0 kg).

اذا استخدم الفحم المدرج او الجمر البركاني بدلا من الرمل والحصى فان البلوك الناتج يعرف باسم ( ) هذا المنتج لونه اسود غامق مع نعومة سطح متوسطة – خشنة, مقاومته جيدة, وخصائص جيدة لتخفيف الصوت, مع عزل حراري عالي مقارنة بالبلوك الكونكريتي العالي. وزنه النموذجي يتراوح بين (11.8-15.0)كغم.

In addition to the basic components, the concrete mixture used to make blocks may also contain various chemicals, called admixtures, to alter curing time, increase compressive strength, or improve workability. The mixture may have pigments added to give the blocks a uniform color throughout, or the surface of the blocks may be coated with a baked-on glaze to give a decorative effect or to provide protection against chemical attack. The glazes are usually made with a thermosetting resinous binder, silica sand, and color pigments.

بالإضافة إلى المكونات الأساسية، فإن الخليط الخرساني المستخدم لصنع الكتل قد يحتوي أيضا على مواد كيميائية مختلفة، تسمى المواد الإضافية، لتغيير زمن المعالجة، زيادة مقاومة الانضغاط، أو تحسين قابلية التشغيل. قد تضاف بعض انواع الاصباغ لاعطاء البلوك لون موحد, او قد يطلى (بالطلاء المزجج) سطح البلوك بنقشات او زخرفات معينة لغرض الديكور او للحماية من التأثيرات الكيميائية. الطلاء المزجج عادة يصنع من الراتنجات المثبتة بالحرارة او سليكا الرمل و بعض الاصباغ لاعطاء اللون المناسب.

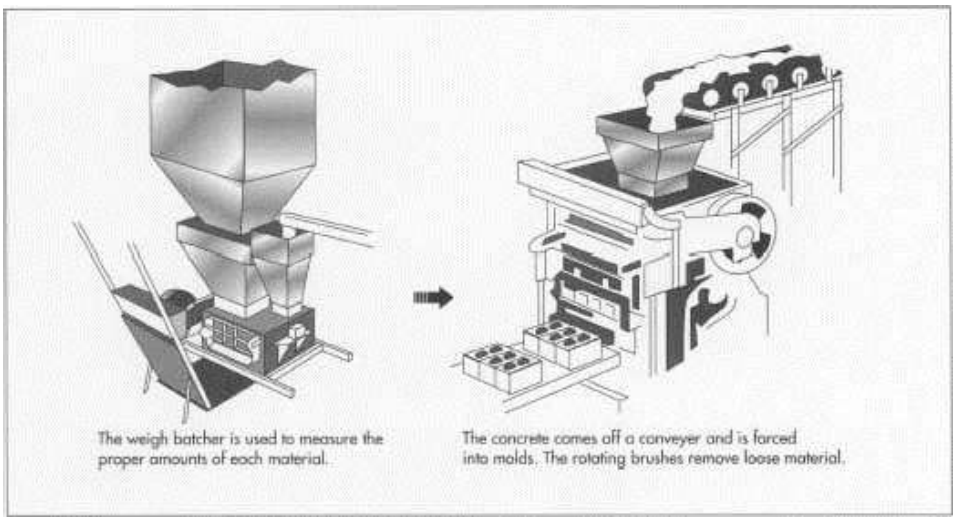


The Manufacturing Process

The production of concrete blocks consists of four basic processes: **mixing, molding, curing, and cubing.** Some manufacturing plants produce only concrete blocks, while others may produce a wide variety of precast concrete products including blocks, flat paver stones, and decorative landscaping pieces such as lawn edging. Some plants are capable of producing 2,000 or more blocks per hour.

عملية انتاج البلوك تتضمن اربعة عمليات اساسية هي: **الخلط, القولبة, المعالجة, التكعيب.**
تنتج بعض المصانع كتل البلوك الخرسانية فقط، في حين أن البعض الآخر قد ينتج مجموعة واسعة من منتجات الخرسانة سابقة الصب بما في ذلك البلوك الكونكريتي وحجارة الرصف المسطحة، وقطع المناظر الطبيعية المزخرفة.

The following steps are commonly used to manufacture concrete blocks.



Mixing

1- The sand and gravel are stored outside in piles and are transferred into storage bins in the plant by a conveyor belt as they are needed. The portland cement is stored outside in large vertical silos to protect it from moisture.

يتم تخزين الرمال والحصى في الخارج في أكوام ويتم نقلها إلى صناديق تخزين في المصنع بواسطة حزام ناقل حسب الحاجة. يتم تخزين الأسمنت البورتلاند خارجا في صوامع عمودية كبيرة لحمايته من الرطوبة

2- As a production run starts, the required amounts of sand, gravel, and cement are transferred by gravity or by mechanical means to a weigh batcher which measures the proper amounts of each material.

عند بدء الإنتاج، يتم نقل الكميات المطلوبة من الرمل والحصى والأسمنت عن طريق المكائن أو بالوسائل الميكانيكية إلى جهاز قياس الوزن الذي يقيس الكميات المناسبة من كل مادة

3- The dry materials then flow into a stationary mixer where they are blended together for several minutes. There are two types of mixers commonly used. One type, called a planetary or pan mixer, resembles a shallow pan with a lid. Mixing blades are attached to a vertical rotating shaft inside the mixer. The other type is called a horizontal drum mixer. It resembles a coffee can turned on its side and has mixing blades attached to a horizontal rotating shaft inside the mixer.

ثم تتدفق المواد الجافة إلى خلاط ثابت حيث يتم مزجها معا لعدة دقائق. هناك نوعان من الخلاطات التي يشيع استخدامها. احدهما، يعرف بـ (كوكبي) أو وعاء الخلط والذي يشبه وعاء ضحل (قليل العمق) مع حافة. يتم إرفاق شفرات الخلط مع عمود الدوران الرأسي داخل الخلاط. اما النوع الآخر يسمى خلاط طبل أفقي.

4- After the dry materials are blended, a small amount of water is added to the mixer. If the plant is located in a climate subject to temperature extremes, the water may first pass through a heater or chiller to regulate

its temperature. Admixture chemicals and coloring pigments may also be added at this time. The concrete is then mixed for six to eight minutes.

بعد خلط المواد الجافة، تضاف كمية صغيرة من الماء إلى الخلاط. إذا كان المصنع موجودا في منطقة ذات مناخ خاضع لدرجات الحرارة المنخفظة اوالعالية، قد تمرر المياه أولا عبر سخان أو مبرد لتنظيم درجة حرارته. ويمكن أيضا إضافة المواد الكيميائية وأصباغ التلوين في هذا الوقت , ثم يتم خلط الخرسانة لمدة ست إلى ثماني دقائق اخرى.

Molding القولبة

5- Once the load of concrete is thoroughly mixed, it is dumped into an inclined Concrete Block bucket conveyor and transported to an elevated hopper. The mixing cycle begins again for the next load.

وبمجرد أن يتم خلط حمولة الخرسانة بشكل دقيق، يتم شحنها في ناقل دلو مائل ويتم نقله إلى قادوس مرتفع. تبدأ دورة الخلط مرة أخرى للتحميل المقبل.

6- From the hopper the concrete is conveyed to another hopper on top of the block machine at a measured flow rate. In the block machine, the concrete is forced downward into molds. The molds consist of an outer mold box containing several mold liners. The liners determine the outer shape of the block and the inner shape of the block cavities. As many as 15 blocks may be molded at one time.

من القمع المخروطي يتم نقل الكونكريت (الخليط) الى قمع مخروطي اخر موجود في اعلى ماكنة صنع البلوك وذلك بنسبة تدفق ثابتة. في ماكنة البلوك يتم كبس الخليط الى الاسفل داخل القوالب. القوالب موجودة في صندوق اكبر يحتوي على عدة قوالب موضوعة بشكل مستقيم. وفيها قوالب واشكال تعطينا شكل التجاويف للبلوك. بعض المكائن قد تكبس 15 بلوكة في كل مرة.

7- When the molds are full, the concrete is compacted by the weight of the upper mold head coming down on the mold cavities. This compaction may be supplemented by air or hydraulic pressure cylinders acting on the mold head. Most block machines also use a short burst of mechanical vibration to further aid compaction.

عندما تكون القوالب ممتلئة، يتم ضغط الخرسانة من وزن رأس القالب العلوي الذي ينزل على تجاويف القالب. ويمكن استكمال هذا الضغط بواسطة اسطوانات ضغط الهواء أو الهيدروليكي التي تعمل على رأس القالب. معظم مكائن صناعة البلوك الكونكريتي الاهتزاز الميكانيكي لفترة قصيرة لزيادة الرص.

8- The compacted blocks are pushed down and out of the molds onto a flat steel pallet. البلوك المرصوص جيدا يتم دفعه للاسفل والخروج من الماكنة والقالب الى سطح مستوي.

Curing المعالجة

Concrete blocks are left to dry for 24 hours outdoors. After that, water spraying will continue for several days until the appropriate strength is acquired.

يتم تترك الكتل الخرسانية لتجف لمدة ٢٤ ساعة في الهواء الطلق. بعد ذلك تستمر عملية الرش بالماء لعدة ايام لحين اكتساب المقاومة المناسبة.

Cubing التكعيب

The blocks pass through a cuber which aligns each block and then stacks them into a cube three blocks across by six blocks deep by three or four blocks high. These cubes are carried outside with a forklift and placed in storage.

What Are The Benefits Of Concrete Masonry?

- **Reasons which makes concrete masonry units best choice.**

1. **Dimensional Accuracy & Symmetry - دقة الأبعاد& التناظر**
   concrete masonry is batch produced moulds and therefore the size can vary in only one plane, usually the height, as opposed to other products on the market that can vary in length, width and height.

2. **Consistency – الإتساق**
   because concrete masonry is batch produced, the quality of the units is consistent within a particular batch.
3. **Versatility - البراعة**
   concrete masonry is probably the most versatile masonry product available.

4. **Energy efficiency – كفاءة الطاقة** concrete masonry is also naturally energy efficient, the secret being in its mass. The thermal mass of concrete slows down the passage of heat moving through a wall and allows the masonry structure to absorb heat instead of passing it through to the inside of the building, keeping the inside cool.

5. **Modular system – حداثة النظام** another major architectural benefit of concrete masonry is the modular masonry design concept.

6. Thermal & Acoustic insulation – العزل الحراري والصوتي

thermal insulation properties are covered above under the heading Energy Efficiency. Concrete masonry is a highly suitable material for attenuating noise as it is an extremely dense material which reduces the transmission of airborne sound. Resistance to sound transmission will obviously increase with wall thickness.

7. Resistance to cracking: مقاومة التشقق

8. Fire resistant – مقاومة الحريق concrete masonry is fire resistant.

9. Weatherproof –مقاومة التجوية concrete masonry can be manufactured almost totally waterproof with the addition of specialized admixtures.

10. Availability in winter – توفره في الشتاء concrete masonry does not have to be baked, but cures naturally over time.

11. Cost Effective – when looked at from an overall perspective, concrete masonry is completely cost effective.

12. Durability – الديمومة concrete masonry is a highly durable material, and is manufactured to resist local exposure conditions for the intended life of the building.

13. Environmentally friendly - the use of concrete masonry also benefits the environment and promotes sustainable building practice. Not only is concrete masonry fully recyclable, but leading manufacturers such as Cape Brick are using recycled crushed aggregate in the manufacture of their products.

Types of blocks:

❖ Concrete blocks

Its dimension (200x300) mm and its height should not less than 100mm

(the height less than the length or the height less than 6 times the

There are 3 types of concrete blocks

1. Solid block: this block does not have pores except two circular

Holes Ø 10 cm each. This type of block used in bearing walls the modulus of rupture not less than (70 kg /cm3)

But nowadays this type rarely used due to:

1- Heavy weight
2- High cost
3- Moisture insulation (it keeps the inner moisture for long time)
4- Difficulty in extended the sanitary and electric services.

❖ Hollow blocks

This block has artificial holes and can be classified in to:

a) Lightweight hollow block: the weight of this block is light due to the use of aggregate have high ratio of pores this type is used for special purposes, due to its high cost, such as (adding loads

b) Regular hollow blocks: can be classified due to its dimensions, and it will be named according to its thickness to:

-block 20 (20x20x40) cm=used in external walls or architectures.

-block 15(15x20x40) cm= used in external and internal walls

-block 12(12x20x40) cm=used in partitions

-block 10(10x20x40) cm= used in partitions

-block 4 (4x20x40) cm= used in sliding windows

Cellular Lightweight Concrete (CLC)

Cellular Lightweight Concrete (CLC) also known as **Foamed concrete** is one of the most significant type of **concrete** used for construction purposes due to its various advantages and usages over traditionally produced **concrete**.

الخرسانة الخلوية خفيفة الوزن: وتعرف ايضا بالخرسانة الرغوية وهي واحدة من اهم انواع الخرسانة لاغراض البناء بسبب فوائدها واستعمالاتها المتنوعة التي تمتاز بها عن الخرسانة التقليدية.

Foamed concrete is manufactured by mixing تصنع الخرسانة الخلوية من:

1- Portland cement,
2- sand,
3- fly ash,
4- water
5- preformed "foam"

Cellular lightweight concrete can be produced at building sites using machines and moulds devised for normal concrete at ambivalent conditions.

ويمكن إنتاج الخرسانة الخلوية الخفيف الوزن في مواقع البناء باستخدام آلات وقوالب للخرسانة تحت مختلف الظروف.

One of profound characteristics of specially formulated foamed concrete is the self-compacting property wherein no compaction is required and it steadily flows out of a pump outlet to fill mold. Due to this property, it can be pumped over major height and distances.

واحدة من الخصائص التي تم ايجادها للخرسانة الرغوية هو خاصية الرص الذاتي حيث لا يلزم الرص, وتتدفق بشكل تلقائي من منفذ المضخة لملء القالب, بسبب هذه الخاصية، يمكن ضخها على ارتفاع كبير والمسافات بعيدة.

Constituents of Cellular Lightweight Concrete

Important constituents of cellular lightweight concrete are:

- **Foam,**
- **Fly ash, and**
- **Cement**

Foam: The foam generator is employed to produce stable foam by using an **appropriate agent**. The air content is maintained at 40 to 80 percent of the total volume. The size of the bubbles differs from around 0.1 to 1.5 mm in diameter. The main raw material for foaming is Genfil and its organic substance.

يتم استخدام مولد الرغوة لإنتاج رغوة ثابتة باستخدام عامل مناسب. يتم الحفاظ على محتوى الهواء في 40 إلى 80 في المئة من الحجم الكلي للخرسانة. حجم الفقاعات يختلف من حوالي 0.1 إلى 1.5 ملم في القطر. المواد الخام الرئيسية للرغوة هو جينفيل وموادها العضوية.

Fly ash: Generally considered as an industrial waste, it's not easy to dispose of fly-ash easily. Since Fly-ash is one of the key ingredients of cellular lightweight concrete, it resolves the issue of disposal and at the same time it's very economical. For same reason, foamed concrete is considered environment friendly.

يعتبر(الفلاي اش) من المخلفات الصناعية, والتي ليس من السهل التخلص منها. بما ان الرماد المتطاير واحد من المكونات الرئيسية للخرسانة خفيفة الوزن, فانه يحل مشكلة التخلص من المخلفات وفي نفس الوقت فانه يكون اقتصادي جدا. ولنفس السبب اعلاه تعتبر الخرسانة الرغوية صديقة للبيئة.

Cement: Cellular lightweight concrete is homogenous combination of Portland cement, cement-silica, cement-pozzolana, lime-pozzolana; lime-silica pastes having identical cell structure obtained using gas-forming chemicals of foaming agents at measured levels.

Production of Cellular Lightweight Concrete

انتاج الخرسانة الخلوية خفيفة الوزن

1. **Batches of cellular lightweight concrete** is manufactured by combining key elements in an ordinary concrete mixer. The strength and dry density of the ingredients differ based on its composition and air pocket content.

يتم تصنيع دفعات من الخرسانة الخلوية خفيفة الوزن من خلال الجمع بين العناصر الرئيسية في خلاطة الخرسانة العادية. المقاومة والكثافة تختلف حسب قوة وكثافة تراكيبها ومحتوى الهواء فيها.

2. Continuous Cellular Lightweight Concrete is produced by mixing light mortar and preformed foam under pressure in a special static mixer.

يتم إنتاج الخرسانة الخلوية خفيفة الوزن من خلال الخلط المستمر للمونة خفيفة الوزن وافوم تحت ضغط معين في خلاص خاص.

Density of Cellular Lightweight Concrete

كثافة الخرسانة الخلوية خفيفة الوزن

The variable density is described in terms of kg per m³. The density of regular concrete is normally measured at 2400 kg/m³ whereas the density of the foamed concrete ranges from 400 kg/m3 to 1,800 kg/m3.

التغاير في الكثافة يوضح بوحدات (كغم/م3). كثافة الكونكريت الاعتيادي بحدود 2400 كغم/م3 بينما كثافة الخرسانة الرغوية خفيفة الوزن تتراوح بين 400 كغم/م3 الى 1800 كغم/م3.

The density of cellular lightweight concrete can be effectively determined by introducing foam formed utilizing a foam-generator. Using fly-ash based CLC lowers the density but it has absolutely no effect on the overall strength of the structures. Large volume is notably realized even with low quantity of concrete.

Density Ranges and their Significance

Foamed concrete is produced in varied ranges for different purposes:

الخرسانة الخلوية تنتج بمديات كثافة مختلفة لاغراض مختلفة:

1. **The lower densities** (400 –600 kg/m3): CLC at this range of density are ideal for **thermal and sound insulations**. They act as resistance against fire accidents, termite and moisture absorbent.

2. **The medium densities** (800-1000 kg/m3): This density of foamed concrete in attained for manufacturing pre- cast blocks for non-load-bearing walls. The size of blocks may vary based on the design and construction requirements.

The high densities (1200kg/m3 to 1800 kg/m3). This is structural-grade material used for:

- Construction of load-bearing walls and ceilings of low rise structures.
- Formation of partitioning walls

- Production of pre-cast blocks for load -bearing brickwork.

Density (kg/m3)	Applications
300 to 600 kg/m3	Lightweight and insulating cements for floor foundation, for heat insulation and slope for flat roofs, rigid floor foundation, tennis court foundation, interspaced concrete filling, raceways insulation; thermos insulating blocks, steel structures fireproofing, tunnels and pipelines compensating mass, dumps, foundation and coverings.
600 to 900 kg/m3	Stables and pig-sites foundations; industrial foundations, partition and tamponing slabs,الواح التحشية ceiling slabs, concrete and lightweight concrete mixed panels.
800 to 1200 kg/m3	Blocks for outside walls, slabs for partitions,الواح للتقطيع concrete and lightweight concrete mixed panels for covering, foundations for elastic floors.
1200 to 1800 kg/m3	Prefabricated panels for civil and industrial buildings plugging; walls casting. ألواح مسبقة الصنع للمباني المدنية والصناعية: صب الجدران

Advantages of Cellular Lightweight concrete

Cellular lightweight concrete has several advantages associated with their applications:

1. Lightweight
2. Fire resistant
3. Thermal insulation
4. Sound absorption and Acoustical Insulation
5. Environmental Friendly
6. Cost-efficient
7. Termite proof and resistant towards freezing issues.

1. Lightweight: Cellular lightweight concrete is low on weight and thus it has a positive impact on weight management of building material and craning work. Normal concrete on the other hand is very dense and it's difficult to work on it especially once it sets into a form.

2. Fire resistance: In CLC, the air pockets in its structure are responsible for high resistance to fire breakout. Irrespective of density range CLC walls are non-combustible and can endure fire breakout for hours.

3.Thermal insulation: At reduced density foamed concrete acts as a perfect thermal insulator. Although at this density it has absolutely no structural reliability in terms of strength.

4. Sound absorption and Acoustical Insulation: The low density increases acoustical insulation

5. Environmental Friendly: Fly ash based cellular lightweight concrete is suitable for surrounding because fly-ash is one of the by-products of industrial waste.

6. Cost-efficient: Apart from fruitful application of industrial waste addition of fly ash also saves considerable amount of investment on cement products. Hence it substantially diminishes cost of construction.

7. Cellular light weight concrete is also **termite proof and resistant towards freezing issues**.

نماذج خلطات خرسانة خلوية خفيفة الوزن

Table-: Sample mix proportion for cement, sand, fly ash foamed concrete

Required density (kg/m^3)	Required Compressive Strength at 28-day (N/mm^2)	W/C+FA ratio	OPC 53 grade (kg)	Fly ash (kg)	Fine sand passing 4 mm IS sieve (kg)	Water (kg)
1200	6.5	0.55	294	126	549	231
1400	12.0	0.50	336	144	680	240
1600	17.5	0.45	378	162	817	243
1800	25.0	0.40	420	180	960	240

Applications of Cellular Lightweight Concrete

☒ Cellular lightweight concrete is utilized as thermal insulation in the form of bricks and blocks over flat roofs or non-loading walls.

☒ Bulk filling by applying relatively low strength material for old sewer pipes, wells, unused cellars and basements, storage tanks, tunnels and subways.

☒ Production of heat-insulated light wall panel.

☒ Maintain Acoustical balance of concrete.

☒ Manufacture cement and plaster-based light plate.

☒ Production of special of light heat resistant ceramic tiles.

☒ For soil water drainage purposes.

☒ Application in the bridge to prevent freezing.

☒ Utilized for tunnel and shaft filling and lightweight concrete manufacturing.

☒ Production of Perlite plaster and Perlite lightweight concrete.

TERRAZO FLOORING

INTRODUCTION:

Terrazzo is also called Venetian mosaic. It is essentially a decortitive concrete in which the aggregate is marble chips and the matrix is white colored or grey cement. It was first used in Venice where there were plenty of marble chips resulting from marble statue work. It is used not only for floors but also for skirting, walls, door frames, staircases, counter tops, etc.
There are two methods of laying the terrazzo flooring—"terrazzo tile work" and "terrazzo mix laid in situ".

Terrazzo is a composite material, poured in place or precast, which is used for floor and wall treatments.

وهي مادة مركبة تصب موقعيا أو تكون مسبقة الصنع والتي تستعمل للإكساء الأرضيات أو تغليف الجدران

It consists of chips of marble, quartz, granite, glass, or other suitable material, poured with a cementitious binder (for chemical binding), polymeric (for physical binding), or a combination of both.

وتتكون من رقائق من الرخام أو الكوارتز أو الجرانيت أو الزجاج أو أي مواد أخرى مناسبة، وتصب مع رابط أسمنتي (للربط الكيميائي)، أو بوليمري (للربط المادي)، أو مزيج من الاثنين معا

Metal strips divide sections, or changes in color or material in a pattern. Additional chips may be sprinkled a top the mix before it sets.

After it is cured it is ground and polished smooth or otherwise finished to produce a uniformly textured surface.

Terrazzo was created by Venetian construction workers as a low- cost flooring material to surface the patios around their living quarters.

TERRAZZO TILEWORK

IS 1143-1959, Code of Practice for Laying and Finishing of Cement Concrete Floor Tiles, gives the method of laying these tiles. Terrazzo tiles are used for flooring, rises of steps, skirting &do, etc. The materials used and the method of preparation of terrazzo tiles are described in the book on Building Materials. The work is carried out as described further.

Laying of Tiles

Tiles laid as flooring. When tiles are laid as flooring, it can be laid on- a subgrade of concrete in case of ground floor or on RCC slab in case of top floors. This subgrade should have a sufficiently rough surface for bonding. It is cleaned, wetted and mopped before the tiles are laid.

عندما يتم وضع البلاطات كأرضيات, فانه يمكن وضعها على طبقة أساس من الكونكريت في حالة الطابق الارضي او على سقف من الخرسانة المسلحة في حالة الطوابق العلوية.
طبقة الاساس يجب ان يكون سطحها فيه خشونة كافية لغرض الربط. يجب ان تنظف وتبلل وتكنس قبل وضع الكاشي.

Brushing with cement slurry will help the adhesive of mortar. The bonding of the tiles should be in mortar. The mortar can be lime surki mortar (1: 1: 2), lime mortar (1 : 3) or cement mortar (1 : 6).

رشها بطبقة من محلول السمنت سوف يساعد على التلاصق للمونة. للربط في الكاشي يجب ان يكون في المونة. المون قد تكون:

lime surki mortar (1:1:2), lime mortar (1:3) or cement mortar (1: 3).

The thickness of the mortar can be maximum of 30 mm for 25-30 mm tile and minimum 10 mm for 20-25 mm thick tile. (The thickness of mortar is to be approximately equal to the thickness of the tile.)
If lime mortar is used, it is spread, tamped and corrected to proper levels. It is allowed to harden for a day before the tiles are set.

سمك المونة ممكن ان يكون كحد أقصى 30 ملم للكاشي بسمك 25-30 ملم وكحد أدنى 10 ملم. تقريبا سمك المونة يكون مساويا لسمك الكاشي.

If cement mortar is used, it is spread, tamped and screeded to proper levels. The mortar is allowed to harden but not completely and the tiles are laid on it while the mortar is still green.

أذا استعملت مونة السمنت, فانها تنثر وتدك وتسوى الى المنسوب المناسب. يسمح للمونة بالتصلب قليلا لكن ليس كليا ويتم وضع الكاشي عليها بينما ماتزال المونة رطبة.

(Terrazzo tiles can be laid in the same way as we lay ceramic tiles Over the mortar, a bedding of neat cement slurry of the consistency of honey is spread at the rate of 4.4 kg of cement per sq m

يمكن وضع كاشي الموزائيك بنفس طريقة وضع الكاشي السيراميك على طبقة المونة, يتم عمل محلول من السمنتي ويرش بنسبة 4.4 كغم سمنت لكل واحد متر مربع

The tiles are washed clean and fixed over the bedding one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in line with the adjoining tile. The joint must be kept as thin as possible not exceeding 1.5 mm and in a straight line or to suit the required pattern. The surface of the tiles must be frequently checked with a straight edge at least 2 meter long so as to obtain a true surface with the required slope.

Grouting, Curing, Grindings and Finishing of Tile work

Some factories deliver terrazo tiles to the site after an initial first, one or even two, grindings in the factory. Such terrazzo tiles will have the second grinding, then cured and finally grind for the third time and polished floor is put for final use.

بعض المصانع تسلم الكاشي للموقع بعد اجراء الجلي برجة واحدة او اثنين. مثل هذا النوع يحتاج الى معالجة اولية ثم يجلى للمرة الثالثة ويصقل بشكل نهائي على الارض للاستخدام النهائي.

Terrazzo work with unground tiles is carried out as follows. The day after laying the tiles, all joints are cleaned of cement grout to a depth of 5mm by a wire brush. All dust and loose mortar are removed and tiles cleaned.

يتم العمل بالكاشي الموزائيك كما ياتي:

بعد وضع الكاشي بيوم تنظف جميع المفاصل من السمنت او الشوائب بعمق 5مم بواسطة فرشاة حديد. يتم ازالة الاتربة والمونة السائبة وينظف الكاشي.

The joints are then grouted with grey or white cement slurry, if necessary, mixed with necessary pigment to match the color of the surface. The same cement slurry is also applied to the whole surface of the tiles as a thin coat.

ثم يتم حشو المفاصل مع محلول الاسمنت الرمادي أو الأبيض، إذا لزم الأمر، مختلطة مع الصباغ اللازم لتتناسب مع لون السطح. يتم تطبيق نفس محلول الاسمنت (الشربت) أيضا على سطح كامل من البلاط كطبقة رقيقة.

This protects the surface from abrasive damage and also to fill any pinholes that may be present on the surface. The floor is then cured by keeping it wet for a minimum period of 7 days and the second and third grinding carried out as described below.

هذا يحمي السطح من الأضرار الكاشطة وأيضا لملء الثقوب التي قد تكون موجودة على السطح. ثم يتم معالجتها عن طريق الحفاظ عليها رطبة لمدة لا تقل عن 7 أيام والجلي الثاني والثالث ينفذ كما هو موضح أدناه:

First ground using a machine with coarse grade grit block (No. 60). Water is used profusely during grinding.

الجلي الاولي باستعمال جلاية للجلي الخشن قياس (60) يستعمل الماء بغزارة خلال عملية الجلي.

After this first grinding, the surface is thoroughly washed with water (to remove all grinding mud), cleaned and mopped. It is then covered again with the same cement slurry as used before and cured for 3 to 5 days.

بعد هذا الجلي الأولي، يتم غسل السطح جيدا بالماء (لإزالة طحن الجلي) وتنظيفها. ثم يتم تغطيتها مرة أخرى مع نفس محلول الاسمنت كما استخدم من قبل ويترك لمدة 3 إلى 5 أيام

The second machine grinding is then carried out with a fine grade No.120 to 150 grit block. The day after the second grinding, a third grinding is made with a finer No. 320 to 400 grit block.

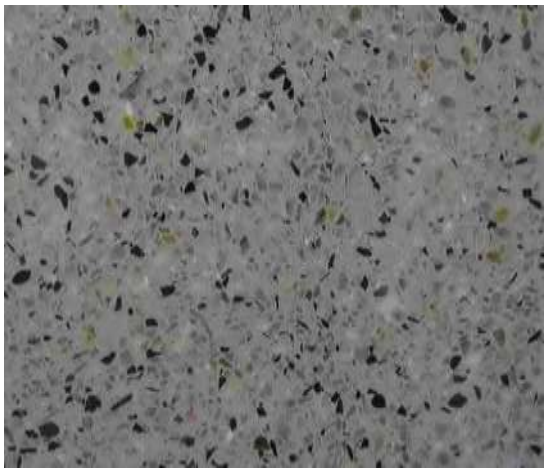
عملي الجلي الثانية تنفذ بدرجة نعومة رقم 120 الى 150 , اليوم الذي يلي ذلك نقوم بعملية جلي ثالثة بدرجة نعومة من 320 الى 400.

If necessary, an intermediate grinding with No. 80 grit block may be done after the second grinding. In some places (as in restricted areas), hand grinding may have to be resorted to. For such cases, the carborundum stones used are first grinding — coarse grade No. 60,

second grinding — machine grade No. 80, and final grinding — fine grade No. 120.
If the tiles are received from the factory as already grind (with the first two grinding), only final grinding is done at the site. This considerably saves the time for laying these tiles.
(Time taken for laying terrazzo tiles is considered as a factor against its selection in many places.)

Final finishing: For the final polishing of terrazzo floors, oxalic acid is dusted over the surface at the rate of 33 gm per sq m. The surface is then sprinkled with water and rubbed hard with a pad of woolen rag. On the next day, the floor is wiped clean with a moist rag. After laying the floor, no tile should be loose and no part of the floor should sound hollow when tamped with a wooden mallet.

للتلميع النهائي للأرضيات تيرازو، يتم غبار حمض الأكساليك على السطح بمعدل 33 غم لكل متر مربع. ثم يرش السطح بالماء ويفرك بشدة مع قطعة قماش من الصوف. في اليوم التالي، يتم مسح الأرض بشكل جيد بواسطة قطقة قماش نظيفة رطبة
لا ينبغي ان تكون أي جزء من الكاشي سائب الحركة ولا يجب ان يكون اي جزء من الارضية يصدر صوت الفراغ عندما يضرب بواسطة قطعة من الخشب.




TYPES OF TERRAZO FLOORING:

1- **Epoxy terrazzo:** epoxy terrazzo is potentially the type with requires the lowest maintenance. And it is also one of the more versatile types as it can be used for both flooring and countertop installations.

من المحتمل أن هذا النوع يتطلب أدنى صيانة. وهو أيضا واحد من أنواع أكثر تنوعا كما يمكن استخدامها لكلا الأرضيات وعمل الكونترتوب

Add to this, the flexibility for design customization is almost limitless – in terms of color combination, the aggregate materials that can be added.

إضافة إلى ذلك، المرونة في التصميم لا حدود لها تقريبا - من حيث تركيبة الألوان، ومواد الركام التي يمكن أن تضاف.

One setback of epoxy terrazzo is that is not advisable for exterior use as it is unable to withstand the harsher weather conditions; otherwise it makes for stunning interior countertops and flooring.

عيب واحد في (تيرازو الايبوكسي) هو أنه لا ينصح به للاستخدام الخارجي لأنه غير قادر على تحمل الظروف الجوية القاسية؛ وإلا فإنه يجعل للأسطح الداخلية والأرضيات مذهلة

2- **Cement terrazzo:** This type of terrazzo is particularly preferred for areas with high foot traffic like malls, airport terminals, universities because of its durability and the fact that it's cost-effective and versatile, design wise. Preferably, during installation of cementitious terrazzo, weather conditions have to be suitable to ensure that no cracks are formed as a result.

هذا النوع يفضل بشكل خاص للمناطق مع حركة المرور (السابلة) عالية مثل مراكز التسوق ومحطات المطار والجامعات بسبب متانته وحقيقة أنها فعالة من حيث التكلفة والتنوع، والتصميم. ويفضل، أثناء تركيبه ، يجب أن تكون الظروف الجوية مناسبة لضمان عدم حصول الشقوق.

Extreme care should also be taken in mixing, laying out cement terrazzo to ensure that the installation would last as long as 60 years and onwards.

3- Rustic terrazzo: Much like epoxy terrazzo only more suitable for exterior use because of its smooth and marble-like surface with a rough surface added as a means to increase slip resistance.

يشبه إلى حد كبير الايبوكسي تيرازو إلا انه أكثر ملاءمة للاستخدام الخارجي بسبب السطح الأملس والرخام المشابه للسطح الخشن يضاف كوسيلة لزيادة مقاومة الانزلاق

Rustic terrazzo can be found more commonly in outdoor areas of hotels, malls, museums, townhouses and most commercial establishments with water features like pools, fountains and man-made waterfalls.

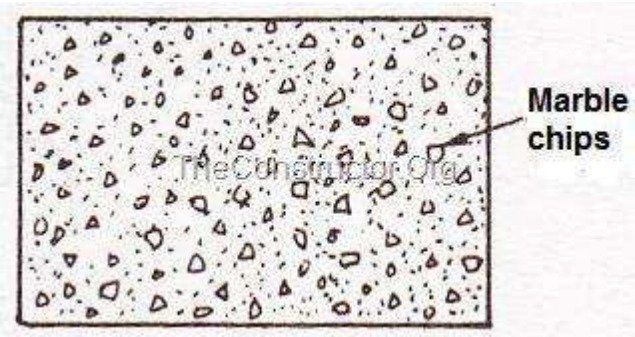
يمكن ان نجده بشكل عام في المناطق الخارجية من الفنادق والمراكز التجارية والمتاحف والمنازل، ومعظم المؤسسات التجارية وفي مرافق المياه مثل حمامات السباحة والنوافير والشلالات التي من صنع الإنسان

4- Sand Cushion Terrazzo: The most prominent characteristic of this type of terrazzo is its basic construction. When used as flooring, it is made up of different layers of material – such as wire meshes or reinforcing, isolation sheets and layers of sand. This is to allow for minor defects whilst preventing mirroring on the surface which makes it perfect for incorporating designs such as logos and works of art with multiple colors.

وأبرز سمات هذا النوع هو طبقات البناء الأساسية. عندما تستخدم كأرضيات، يتكون من طبقات مختلفة من المواد – مثل الشبكات او أسلاك التعزيز، أو صفائح العزل وطبقات من الرمال. وهذا يسمح لنا منع العيوب الطفيفة من الظهور على السطح مما يجعلها مثالية لدمج التصاميم مثل الشعارات والأعمال الفنية مع ألوان متعددة

TERRAZZO INSTALLATION

Terrazzo flooring consists of:
(1) Concrete bed,
(2) Mortar bed, 1- 5 cm of cement mortar (cement sand mixture 1:3),
(3) Metal strips,
(4) Marble cheeps 3 to 6mm.



Terrazzo is concrete containing marble chipping as an aggregate. Terrazzo mixture is made up of cement and marble chips in different proportions.

كاشي (التيرازو) هو عبارة عن خرسانة تحتوي على قطع من الرخام. يتكون خليط الكاشي من الإسمنت ورقائق الرخام بنسب مختلفة.

First of all, a concrete bed is formed as a base course which is covered by tarred paper. Over this, a layer of rich mortar is spread. This mortar bedding is struck off about 2.5 to 7.5 cm below the finished

floor level. After that metal dividing strips of 20 gauges in thickness are inserted into the mortar base and the terrazzo covering. After the mortar base has hardened the terrazzo mixture is placed at the top level of the dividing strips. After the terrazzo mixture has hardened the surface is ground by hand or by a machine. After cutting we use waxing for glazing floor.

CHARACTERISTICS OF TERRAZZO:

- **Composition:** Marble, granite, quartz and/or glass chips mixed with Portland cement or epoxy resin.
- **Durability:** Terrazzo is man-made, but with natural materials like marble or other stone pieces and a sand/cement mix. Because of its all-natural material, Terrazzo lasts so long.
- **Physical Characteristics:** Terrazzo flooring is hard, heavy, durable and long lasting.
- **Seamless flooring:** ارضية سلسة Terrazzo floors are poured and polished at the site and so has a seamless appearance.
- **Porosity:** Terrazzo is impenetrable to water.
- **Scratches:** Terrazzo floors tend to take scratches because of the embedded Marble pieces.
- **Stains**: Terrazzo floors are not completely stain-resistant.
- **Choices**: Terrazzo is available in a wide choice of colors, textures, and shapes.
- **Cost:** Terrazzo is relatively expensive as it needs specialized installation.
- **Maintenance:** Terrazzo flooring is easy to maintain because of its shiny surface.
- **Green rating**: Terrazzo is made of natural materials and doesn't harm the environment. Also it is recyclable.

ADVANTAGES OF TERRAZZO FLOORING:

1- **Durable**: It is very durable material. This type of flooring should last a lifetime if maintained properly.
2- **Dense:** Terrazzo flooring is very dense and if sealed well, is impermeable to water.
3- **Water resistant:** It is nearly impenetrable to water due to its low moisture absorbency and hydrophobic nature (non-affinity for water). Therefore, it keeps the floor from harboring bacteria.
4- **Easy to maintain:** It requires less and inexpensive maintenance. You simply have to sweep up the floor often to remove the dust that can act as an abrasive.
5- **Cool under foot:** It is cool under feet.
6- **Appearance:** Terrazzo provides an elegant look to a room as it almost looks like Granite. Because of the unique way that terrazzo flooring is made, it is quite unlike any other flooring and no two floors will be exactly alike.
7- **Environment-friendly:** Terrazzo flooring doesn't harm the environment. It is constructed out of all natural materials including sand, marble, and other types of stone. You can even recycle this type of floor.

DISADVANTAGES OF TERRAZZO FLOORING:

1- **Professional installation:** Terrazzo flooring can only be installed by a professional because it is made, poured and cured at the point of installation.
2- **Relatively expensive**: Because of the specialized installation, the upfront cost is considerably higher than resilient flooring but when viewed long-term, it can actually be less expensive.
3- **Slippery:** Terrazzo can be slippery when wet.
4- **Hard underfoot**: Terrazzo doesn't have any cushioning, so it will be hard to stand on for an extended period of time.
5- **Cold:** It is a good conductor of heat so it leads to a lot of heat loss in room heating.
6- **Stains:** Terrazzo tiles are prone to stain marks caused by acidic substances like vinegar and tamarind.
7- **Maintenance:** Terrazzo requires heavy polishing at the time of laying. Periodic polishing is required to maintain that shine.

APPLICATIONS OF TERRAZO FLOORING

- Terrazzo is a durable, long lasting and cheaper option to marble and granite flooring. It is used in entryways, the entire house and public and commercial buildings.

TERRAZZO FLOOR-COMMERCIAL BUILDING

TERRAZZO FLOOR-OUTDOOR

- Terrazzo is hypoallergenic and is water and bacteria-resistant. For these reasons, it is often used in kitchens, bathrooms, laundries and recreation rooms.

TERRAZZO FLOOR-KITCHEN