تـــودو
TUDO

Malaco

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مجلس أبوظبي للجودة والمطابقة
Abu Dhabi Quality & Conformity Council

وثيقة التسجيل

Registration Document

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Expiry Date:	**02 November 2024**	تاريخ الإنتهاء:
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Conformity Scheme:	**Construction and Infrastructure Materials TA**	برنامج المطابقة:
Product:	**Tudo**	المنتج:
Name and Address of the Applicant:	**Malaco Building Materials Trading LLC First Nahda Street, Dubai, UAE**	اسم وعنوان مقدم الطلب:
Name and Address of the Manufacturer:	**Pratley Perlite Mining Co 14 Jackson street,Factoria, Krugersdorp, Gauteng, South Africa**	اسم وعنوان المصنع:
Trademark / Brand Name:	**Tudo**	العلامة التجارية / الاسم التجاري:

Model	Characteristics	Additional information
Tudo Plaster /99031	TEMPERATURE DIFFERENCE ON SAMPLE (K) 18.6 k THICKNESS BEFORE CONDITIONING (mm) THICKNESS AFTER CONDITIONING (mm) 40.99 (mm) 40.99 (mm) Difference 0% DENSITY (MEASURED) (kg/m3) 677.0 kg/m3 THERMAL CONDUCTIVITY AT SPECIFIED MEAN TEMPERATURE (W/m.K) 0.20067 W/m.K THERMAL RESISTANCE AT SPECIFIED MEAN TEMPERATURE (m2K/W) 0.20432 W/m.K	

TUDO PERLITE

THE MODERN SOLUTION FOR ENERGY EFFICIENT BUILDING

Tudo perlite, when mixed with cement, produces an eco-friendly, ultra lightweight, thermally insulating & fireproof concrete.

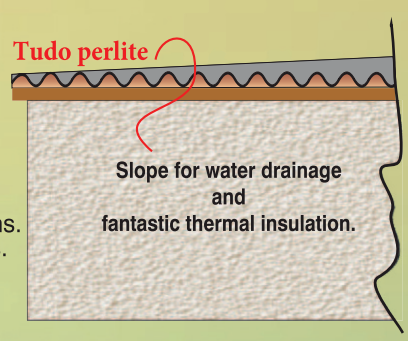
Use Tudo perlite to render your buildings SANS 204 complient.

BENEFITS:

- Exceptional thermal insulation.
- Energy saving "green" product.
- Ultra lightweight; reduces high rise structural building costs.
- Nailable.
- Completely fireproof.
- Durable.
- Good acoustic properties.
- Easy to apply.
- May be gunited when applied to large surfaces (e.g. mine tunnels).

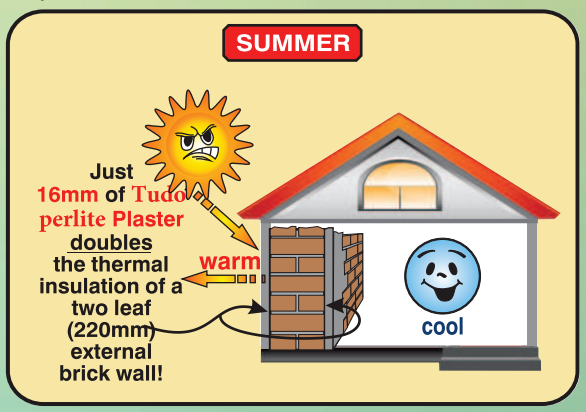
SOME EXAMPLES OF

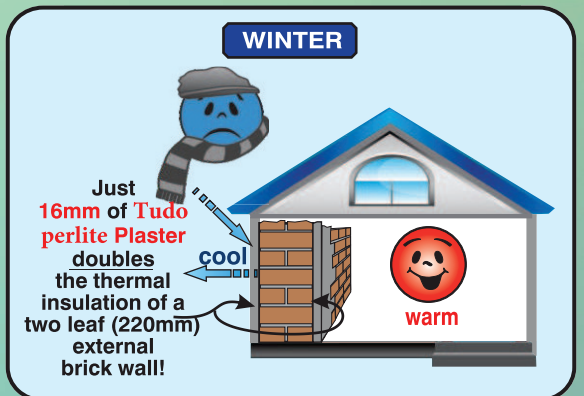
- Thermally insulating and fireproof wall plaster.
- Ultra lightweight concrete, bricks and boards.
- Underfloor insulation and insulated roof decks.
- Lightweight screeds on corrugated iron and concrete roofs.
- Fire proofing structural steel columns.
- Insulating industrial cryogenic tanks.
- Loose fill thermal insulation in wall cavities.
- Pizza oven liners.
- Lightweight tile adhesive filler.



PROPERTIES:

- ***Excellent Thermal Insulator*** - As a result of Tudo perlites's low density and physical structure, it keeps your house warm in the Winter and cool in the Summer.





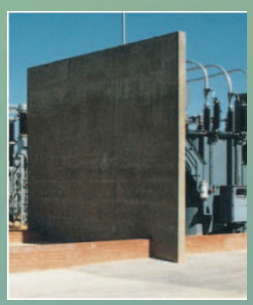
- ***Resistant to Spalling*** - Under fire conditions and, more severely, under water quench conditions (e.g. from a fire hose) following extreme heat, conventional concrete will spall and lose it's integrity. Tudo perlite remains intact.
- ***Super Strength*** - Once cured, **Tudo perlite** has superior strength when compared to ordinary lightweight concretes.
- ***Compatible with Cement and Other Binders*** - cement (and other binders) can produce ultra lightweight panels, boards, bricks and blocks that can be cut, nailed and drilled.

Thermally insulated fireproof Tudo perlite roof

- ***Non-toxic and Completely Environmentally Friendly.***
- ***During a Fire, Tudo perlite Will Not Spall nor Release Smoke or Toxic Fumes.***
- ***Exceptional Fire and Heat Resistance*** Can withstand temperatures up to 1250°C without losing it's structural integrity.

Tudo perlite used to insulate Cryogenic tanks

Fire Resistant Tudo perlite wall between transformers



Eco-friendly

2 INTRODUCTION

TUDO PERLITE

Tudo perlite is a unique ultra lightweight and insulating material of volcanic origin, tudo perlite is unique in that it is well suited for use with Cement. The reasons for this are twofold. Firstly: Unlike ordinary Perlites which are brittle and friable, **Tudo perlite** has a tough surface structure. Secondly: Tudo perlite is pre-treated with a special chemical, thereby rendering it compatible with ordinary Cements and additives. This leads to an absolutely unique 21st century eco-friendly lightweight building material that is both fireproof and thermally insulating.

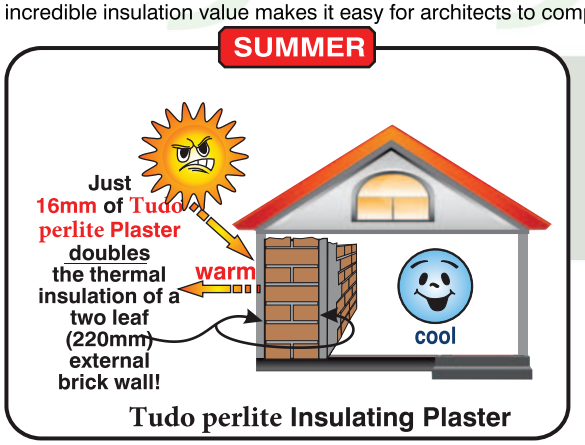
3 PROPERTIES

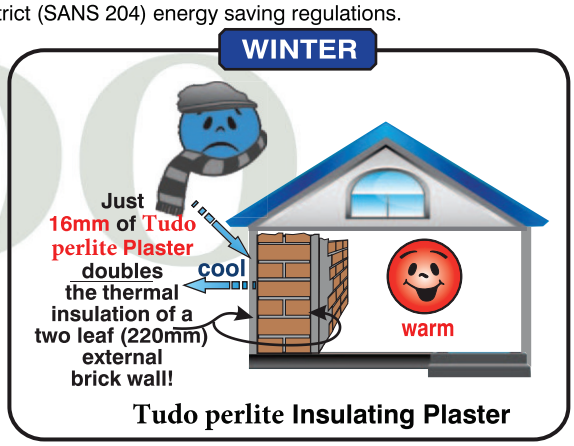
TUDO PERLITE

3.1. Excellent Thermal Insulator

Tudo perlite has a conductivity (k) value in the loose state of 0.05 W/m.K. This is 20 times more insulating than sand! This property derives from the low density and the "vacuum flask" like structure of Tudo perlite beads.

Just 16 mm of Tudo perlite plaster each side gives the same thermal insulation as a double brick (220 mm thick) wall. This incredible insulation value makes it easy for architects to comply with strict (SANS 204) energy saving regulations.





3.2. Ultra Lightweight

Loose density is approximately 100 kg/m³ and, when mixed with cement, practical concrete densities range from 300 kg/m³ to 1100 kg/m³ depending upon the mix. **Concrete that floats on water!**

3.3. Exceptional Fire Resistance: 4 hour fire rating (see CSIR report page 9)

In addition to the almost refractory melting temperature of 1250°C, Tudo perlite concrete also maintains its high temperature structural integrity via its incredible thermal insulation.

The latter ensures a very high thermal gradient on the heated surface during fire conditions, resulting in low temperatures immediately below the surface. Even if the surface melts, it coalesces into molten glass beads which continue to insulate and protect the interior.

3.3.1. Zero Smoke and Zero Fumes

Tudo perlite releases no smoke or fumes during a fire. This property gives Tudo perlite an advantage over expanded Polystyrene based insulation products which may give off harmful fumes.

3.3.2. Amazing Resistance to Spalling

Under fire conditions and, more severely, under water quench conditions following a fire, (e.g. from a fire hose) conventional concrete will spall and lose its integrity. Tudo perlite exhibits no such tendency.

3.4. Compatible with Cement and Other Binders

EachTudo perlite particle has a well-sealed and tough bead structure. This ameliorates bead damage during mixing and facilitates low water adsorption and proper curing of the cement. Tudo perlite supplied in the green labeled bag has been pre-treated during production rendering the Tudo perlite compatible with cement.

3.5 Superior Strength

Ordinary lightweight concretes are typically weak. Aerated concrete is also susceptible to total slump shortly after casting, especially if any vibration or disturbance like passing traffic is present. Tudo perlite concrete does not rely on air-entrainment and can be cured under any conditions of vibration. Once cured, it exhibits superior strength when compared to other lightweight concretes. Strength varies with density, but practical strengths in the range of 1.5 MPa up to 15 MPa are possible. This is nearly double the strength of aerated concrete of similar density.

LABORATORY STRENGTH RESULTS FROM "PORTLAND CEMENT INSTITUTE"

Mix Ratio (By volume) Tudo perlite : Cement	3 : 1 Mix Ratio		4.5 : 1 Mix Ratio		6 : 1 Mix Ratio		10 : 1 Mix Ratio	
Water Quantity	**Low Water Mix**	High Water Mix	**Low Water Mix**	High Water Mix	**Low Water Mix**	High Water Mix	**Low Water Mix**	High Water Mix
7 -day ISO comprehensive strength (Mpa)	14.2	5.0	12.6	5.2	3.9	2.3	N/A	N/A
28 -day ISO comprehensive strength (Mpa)	19.8	7.5	16.9	6.3	4.4	2.9	N/A	N/A
Dry density (kg/m^3)	1100	900	800	650	550	450	360	350

3.6. Non-Toxic Dust

Although no dust is healthy, due to its amorphous structure. Tudo perlite is classified as a low health-risk dust.

3.7. Ultra Smooth Plaster Finish

An ultra smooth plaster finish can be obtained just by steel trowel floating. **No gypsum or finishing plaster is necessary.**

4 TYPICAL APPLICATIONS

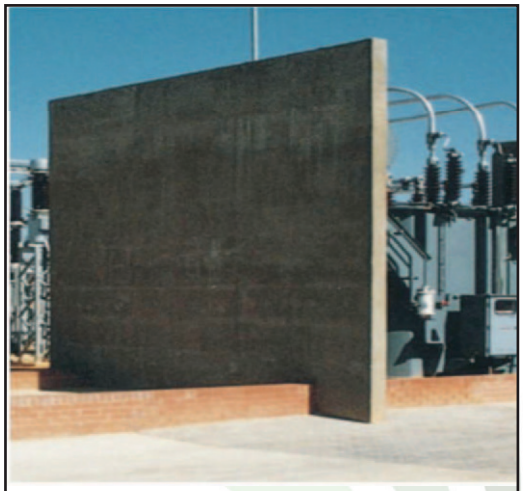
- **Plaster:** Internal & External thermally insulating.
- **Lightweight Floors:** High rise buildings.
- **Roof Decks**: Thermally Insulating.
- **Fire Barriers:** Fire seals and walls.
- **Pre-cast Mouldings:** eg. flower pots.
- **Fireproofing:** Tunnels in mines etc.
- **Screeds:** Lightweight and thermally insulating.
- **Bathtubs**: Insulation below.
- **Under Floor Heating:** Insulation below elements.
- **Tile Adhesive Filler:** Lightweight.
- **Bricks and Boards:** Ultra-lightweight concrete.
- **Pizza Oven:** Liners.
- **Cryogenic tanks**: Insulating.
- **Loose Fill:** thermal insulation.
- **Paint texturing** agent.
- **Refractory cements.**
- **Molten Metal:** Insulating surface.

Thermally Insulating roof decks.

Tudo perlite Concrete is Fireproof and has a low Thermal Conductivity Typical k=0.13 W/mC°

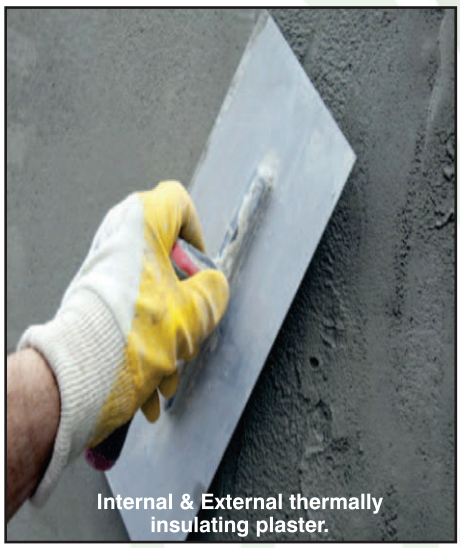
4 TYPICAL APPLICATIONS

TUDO PERLITE



Fire barrier wall between transformers.

Insulation on surface of molten metal



Internal & External thermally insulating plaster.

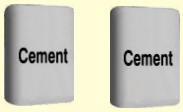
Computer server room plastered with Tudo perlite to reduce energy requirements for cooling.

Insulating Cryogenic tanks. (Special Grade 45 Tudo perlite required)

5 HOW TO MIX TUDO PERLITE WITH CEMENT

TUDO PERLITE

1. **Cement Type**
   For Tudo perlite Plaster, use a reputable multipurpose cement. Screed mixes must be produced using either a 42.5 Mpa or 52.5 Mpa cement.
2. **Mix Ratios**
   All mixing ratios are volume based!
3. **Tip**
   The volume of a Tudo perlite bag = ±100 Litres.
   The volume of a Cement bag (Pocket of Cement) = ±33 Litres.

3:1 mix may therefore be achieved by mixing 1 bag of Tudo perlite with 1 pocket of cement.	1 Bag  1 Bag ± 100 ℓ	+ 1 Pocket  1 Pocket ± 33ℓ
4.5:1 mix Similarly a may be achieved by mixing 3 bags of Tudo perlite with 2 pockets of cement.	3 Bags  1 Bag ± 100ℓ	+ 2 Pockets  1 Pocket ± 33ℓ

4. Mixing

Automated mixing is recommended and a pan mixer is preferred. Drum mixers can sometimes cause the formation of balls. This phenomenon results from Tudo perlites ultra light weight. Where automated mixing is not possible, mixing small quantities with a shovel is very effective.

Pan Mixer

4.1. In both automated and manual mixing, **it is essential that the Tudo perlite and cement are mixed in a dry state before adding any water.** This ensures uniform mixing of the cement powder and Tudo perlite beads. Adequate mixing is indicated by a uniform light grey colour throughout the dry mix.
Only once the dry mix is thoroughly blended, should water be added.

4.2. Once the Tudo perlite and cement have been thoroughly mixed, the recommended water volumes must be added (see tables 1 to 4 on the mix ratio chart below). When compared to ordinary concrete, the mix may appear dry. This is completely normal. It is important to monitor the amount of water added since small variances in water have a significant effect on the overall consistency and slump. Do no overdo mixing; approximately 30 seconds in a pan mixer is sufficient.

4.3. Yield

Approximately 11 bags of Tudo perlite will be required for each cubic meter of screed/plaster. This value is valid for all Tudo perlite mix ratios and accounts for compaction and slight spillage. For more accurate yields, **refer to tables 1 to 4 on the mix ratio chart.**

TUDO PERLITE MIX RATIO CHART

TABLE 1. 3 : 1 MIX RATIO (BY VOLUME)

3 : 1 Volume Mix Ratio Recommended Uses	Mix Ratio	TUDO PERLITE	Cement	Water (May vary with cement type)	Approximate Compacted Volumetric yield
External Plaster. Internal Plaster. Built Up Floors. Insulating Roof Decks. Fire Seals. Castables. Spray Applications. Underfloor Heating Insulation. Lightweight Screeds (High Strength).	Tudo perlite : Cement 1 Bag : 1 Pocket	~1 Bag ± 100ℓ	~1 Pocket ± 33ℓ	Litres for Screed = 25-30 Litres for Plaster = 28-37 DON'T USE TO MUCH WATER	± 0.093m³
	3 : 1 Mix Ratio by Volume	1 Bag = 10 Kg's = ± 100 Litres	1 Bag = 50 Kg's = ± 33 Litres		

TABLE 2. 4.5 : 1 MIX RATIO (BY VOLUME)

4.5 : 1 Volume Mix Ratio Recommended Uses	Mix Ratio	TUDO PERLITE	Cement	Water (May vary with cement type)	Approximate Compacted Volumetric yield
External Plaster. Internal Plaster. Built Up Floors (Light Loads). Insulating Roof Decks (No Heavy Loads). Fire Seals. Castables (Medium Strength). Spray Applications. Lightweight Screeds (Medium Strength).	Tudo perlite : Cement 3 Bags : 2 Pockets	~1 Bag ± 100ℓ	~1 Pocket ± 33ℓ	Litres for Screed = 58-72 Litres for Plaster = 74-93 DON'T USE WATER	± 0.280m³
	4.5 : 1 Mix Ratio by Volume	3 Bags = 30 Kg's = ± 300 Litres	2 Bags = 100 Kg's = ± 66 Litres		

TABLE 3. 6 : 1 MIX RATIO (BY VOLUME)

6 : 1 Volume Mix Ratio Recommended Uses	Mix Ratio	TUDO PERLITE	Cement	Water (May vary with cement type)	Approximate Compacted Volumetric yield
Fire Seals. Castables (Low Strength). Spray Applications.	Tudo perlite: Cement 2 Bags : 1 Pocket	~1 Bag ± 100ℓ	~1 Pocket ± 33ℓ	Litres for Screed = 39-45 DON'T USE TO MUCH WATER	± 0.186m³
	6 : 1 Mix Ratio by Volume	2 Bags = 20 Kg's = ± 200 Litres	1 Bag = 50 Kg's = ± 33 Litres		

TABLE 4. 10 : 1 MIX RATIO (BY VOLUME)

10 : 1 Volume Mix Ratio Recommended Uses	Mix Ratio	TUDO PERLITE	Cement	Water (May vary with cement type)	Approximate Compacted Volumetric yield
(Low Strength) (Reenterable) Fire Seals. Castables (Low Strength Very Light Reenterable) Insulation Between Cavity Wall.	Tudo perlite: Cement 7 Bags : 2 Pockets	~1 Bag ± 100ℓ	~1 Pocket ± 33ℓ	Litres for Screed = 134-170 DON'T USE TO MUCH WATER	± 0.651m³
	10 : 1 Mix Ratio by Volume	7 Bags = 70 Kg's = ± 700 Litres	2 Bags = 100 Kg's = ± 66 Litres		

6 APPLICATION PROCEDURES:

A. TUDO PERLITE PLASTERING PROCEDURE

6.1. Surface Preparation: As with any plaster application, the substrate surface must be thoroughly prepared before the plaster is applied. Poor surface preparation leads to poor adhesion between the plaster and the substrate.
The following surface preparation steps are recommended.

Step 1. Ensure that the surface of the substrate is strong, clean and free of loose material. Dust, oil, mould, and any material that could hamper adhesion must be removed from the substrate surface. This may be achieved using a high-pressure hose, steel brush, hard-bristled broom, vacuum cleaner or high pressure compressed air (oil free). Applying plaster directly onto a smooth, previously painted surface is not recommended. Should this be a requirement, it is recommended that the painted surface be roughened to a point where the substrate surface has a texture of "coarse sand paper". This may be achieved by either chipping the surface with a hammer or shot blasting the surfaces. For steps on plastering and preparing smooth surfaces such as concrete monolithic structures or hard clay face bricks, refer to section 6.2 (Plastering Smooth Surfaces Such as Monolithic Concrete).

STEP 2. To ensure a uniformly thick plaster layer, ensure that there are no high or low points on the substrate surface. Any high spots which exceed approximately 10mm from the level of the main substrate plane should be chopped down.

STEP 3. The absorptive characteristics of the substrate surface is an important factor to consider when applying any plaster. Water repellant surfaces such as monolithic concrete, or hard clay face bricks tend to have less adhesion between plaster and substrate. These require special surface preparation techniques described in section 6.3 (Plastering Smooth Surfaces such as Monolithic Concrete). Substrates can generally be classified into 3 absorption classes, each of which requires different surface preparation techniques to control the amount of water absorption. A simple technique used to determine which class your substrate falls into is to throw some water onto the surface. Based on the absorption rate of the water, the following procedures should be applied (see table below)

Substrate Absorption Class	Water Absorption Result	Surface Preparation Procedure
CLASS I	No Water Absorbed	Refer to Section 6.3 (Plastering Smooth Surfaces such as Monolithic Concrete)
CLASS II	Little Water Absorbed	Other than items listed in **step1**, no further preparation required
CLASS III	Lots of Water Absorbed	Saturate surface with Water at least 1 hour before plaster application. As soon as substrate surface appears dry, apply Tudo perlite Plaster. The material immediately behind the surface will still be saturated.

6.2. Plastering Normal Surfaces

STEP 1. Unlike ordinary plaster application methods, where the plaster is typically "thrown" onto the wall,Tudo perlite plaster is forcefully smeared onto the wall with a float trowel using an upward motion. Tudo perlite plaster is very light and has less inertia than ordinary "sand plaster mixes" if thrown onto the wall. Smearing the plaster upwards with pressure ensures a good bond and minimizes the possibility of air being trapped between the wall and the plaster.

STEP 2. Allow the plaster to dry **for at least an hour** before applying a straight edge. A good check is to try and indent the plaster using your thumb. It should only be possible to apply a small dent to the Tudo perlite plaster. Should a large dent occur, more time must be given before applying a straight edge. Failure to do this will result in "smiley face" delamination.

STEP 3. Once leveled, the plaster may be floated using a steel or wooden trowel.

STEP 4. Steel floated Tudo perlite produces an extremely smooth finish. The application of a gypsum based finishing plaster is therefore unnecessary. Do not over float the plaster as this will result in surface defects and surface hairline cracks.

STEP 5. As with ordinary plaster, Tudo perlite plaster should be kept moist for at least 3 days after application (7 days recommended). The plaster should not be allowed to dry in direct sunlight or drying winds. Cement within any plaster that dries too quickly does not have sufficient time to hydrate, resulting in brittle plaster and cracks.

6.3 Plastering Smooth Surfaces such as Monolithic Concrete

As with ordinary plasters, it is essential that smooth surfaces be thoroughly prepared before applying Tudo perlite Plaster. Proper surface preparation is crucial as this will improve adhesion between the Plaster and the smooth substrate. The following preparation steps are recommended.Tudo perlite

STEP 1. Ensure substrate surface is free from any loose material.

STEP 2. Remove any mould or plant growth from the substrate surface.

STEP 3. Apply a spatter dash coating or fasten a wire mesh to the substrate. A suitable spatter dash may be produced by mixing one-part cement with one and a half parts of coarse Sand. To further improve adhesion, Tudo perlite Platergrip primer (product code 99031) may be added into the mix. The consistency of the mix should be a "thick pourable" consistency. After application, the spatter dash coating must have a rough texture. Once dry, test the adhesion of the spatter dash to the substrate using a steel trowel. If suitable adhesion is found, apply Tudo perlite plaster onto the spatter-dash using standard plastering techniques. Described in section 6.2.

6.4 Plastering Tudoperlite to a Thickness Greater than 16mm.

Should there be a need to apply Tudoperlite plaster in sections greater than 16mm, the following steps are recommended.

STEP 1. Apply the first layer of Tudo perlite plaster using standard TUDO PERLITE Plastering techniques (see section 6.1). Ensure the substrate surface has been cleaned and no loose material is on the wall. For smooth surfaces, refer to the section of this catalogue which deals with plastering smooth surfaces and monolithic concrete (section 6.3).

STEP 2. Once the first 16mm layer is ready to be straight edged, roughen the surface using a trowel. Scratching the plaster surface in a cross-hatch pattern approximately 5mm deep will promote adhesion of the subsequent layer. Keep plaster wet for 3 days before applying the second layer.

STEP 3. Again, using standard TUDO PERLITE Plastering techniques apply the second layer of plaster to a thickness of 16mm. Continue with steps 2 and 3 until the desired plaster thickness is achieved.

B. TUDO PERLITE SCREEDING PROCEDURE

1. For lightweight screeds, a 3:1 (Tudo perlite to cement) volume mix ratio is recommended. This may be achieved by mixing one bag of ITudo perlite with one bag of cement.
2. Ensure the surface to be topped is clean and free from any oil, loose dust or particles.
3. Prior to screeding, smooth surfaces should be painted with Grip Primer. This ensures good adhesion. (Tudo perlite screeds can even be applied to smooth steel/ galvanised roofs with the use of Pratley Plaster-Grip Primer). **Grip Primer must not be dry completely and should still be tacky when the screed is applied.** NOTE:- To prevent "chalking" surface temperatures above 10°C (preferably 15°C) degrees are essential when using Grip Primer.
4. Use a mix ratio and water content per chart on page 5. (Use lower limit of water) Note:- The mix must appear to be very dry.
5. Using your hands, form a ball with the Tudo perlite Screed mix. If the mixture binds together, the correct amount of water and cement has been used. When the mixture is compressed between your hands no water should flow from the mix. Water flowing from the mix indicates that too much water has been added and the Tudo perlite mix will have significantly reduced strength. Over-use of water can be rectified by adding the applicable ratio of dry cement/Tudo perlite into the mix. Remember to always premix the dry cement/Tudoperlite mix before exposing it to water.
6. Pack the screed onto the surface and compact by tamping (It should not flow). When casting thick sections, it is recommended that the screed be compacted (tamped) in sections of 100mm. To achieve maximum compressive strength adequately compact the entire screed. Screeds having a thickness less than 50mm are not recommended.
7. Once compacted, level with a straight edge and smooth using a wooden or steel trowel.
8. If the Tudoperlite surface is to be tiled, a wooden float or broom finish is recommended.
9. Following application, the Tudoperlite screed should be kept wet for at least 3 days (7 days recommended). Direct sunlight and drying winds must be avoided during curing. Drying under plastic is by far the most preferred method.
10. The screed **must** be dry and fully cured before applying ceramic tiles, paint, Bitumen and the like. (This is essential!)
11. For screeds where water penetration is not acceptable, a waterproofing layer on top of the Tudoperlite screed is recommended.
12. Where Tudoperlite screeds are used between parapet walls, it is recommended that expansion joints be used.
13. In high traffic areas where there is a possibility of point loading eg. (trolleys wheels, heavy equipment, etc), a hard-wearing layer on top of the Tudoperlite Screed is recommended. Typical hard wearing surfaces include tiles and laminated flooring.

C. TUDO PERLITE GUNITING PROCEDURE

Lower air velocities are used than those used when applying ordinary concrete. Lower velocities minimize rebound and reduce waste. Tudo perlite rebound can however be put back into the gunite machine and re-used. A more cohesive mix is obtained by using a fly ash rich cement. This is recommended.

TUDO PERLITE, REDUCES ENERGY COSTS AND SAVES YOU MONEY.

Thermal Properties:

A material that insulates well has a low "k" value (conductivity value). Tudo perlite plaster insulates extremely well and therefore has a very low "k" value. "k" has the units : **W/m°C**

Where: W = Watts
°C = Degree Celsius (same as degrees Kelvin)
m = Meter

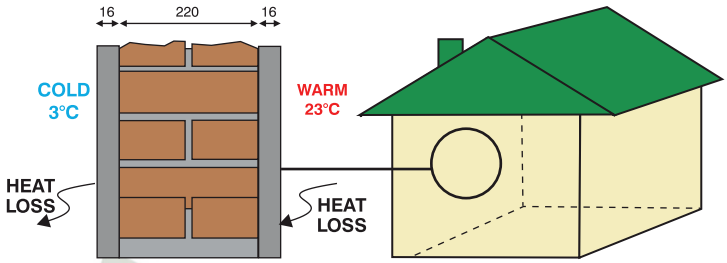
A wall material with a "k" value of say 0.8W/m°C would by definition conduct 0.8 Joules of heat energy per second through every square meter of a wall which is 1m thick and where the temperature difference across the wall is 1°C. The typical k values for common brick, ordinary plaster and Tudo perlite plaster are given below.

Wall Type	Typical k Value
Common brick	0.84 W/m°C
Ordinary Plaster	0.80 W/m°C
Tudo perlite Plaster	0.12 W/m°C

Example of Energy Saving

Consider a 4m x 4m room with 220mm double leaf brick walls. For comfort the inside temperature is kept at 23ºC using heating. Assume the outside air temperature is a wintery 3ºC.

For ease of calculation the convective heat transfer on the wall surface has been neglected. Similarly windows and doors have been neglected.*



The thermal resistance of the Brickwork is $R_B = \frac{\text{BRICK THICKNESS}}{\text{BRICK CONDUCTIVITY}} = \frac{0.220}{0.84} = 0.262$

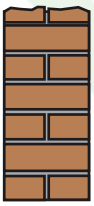
The thermal resistance of the Plaster is $R_P = \frac{\text{PLASTER THICKNESS}}{\text{PLASTER CONDUCTIVITY}} = \frac{0.016}{0.80} = 0.020$

The thermal resistance of the Tudo perlitePlaster is $R = \frac{\text{PLASTER THICKNESS}}{\text{Tudo perlite PLASTER CONDUCTIVITY}} = \frac{0.016}{0.12} = 0.133$

The electrical analogue for the plastered wall is:

Calculating the Heat transfer we get:

Unplastered Brick Wall



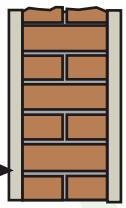
$Q = \frac{\Delta t}{R_B} = \frac{20}{0.262}$

$\therefore Q = 76.4\ W/m^2$

(Note: The electrical analogue ohm's(Ω) law $I\ (\text{Current}) = \frac{\mathbf{V}\ (\text{Voltage})}{\mathbf{R}\ (\text{Resistance})}$)

Ordinary Plastered Brick Wall

ORDINARY PLASTER

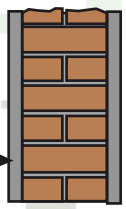


$Q = \frac{\Delta t}{R_{TOTAL}} = \frac{20}{.020+.262+.020}$

$\therefore Q = 66.2 W/m^2$

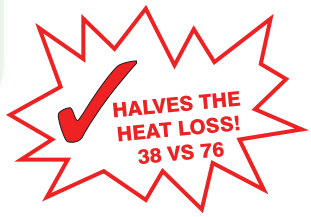
Tudo perlite Plastered Brick Wall

TUDO PERLITE PLASTER

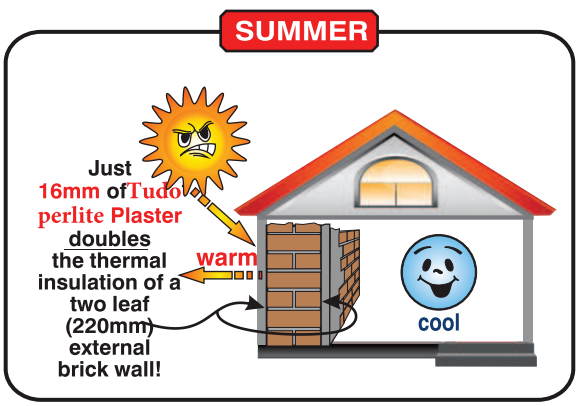


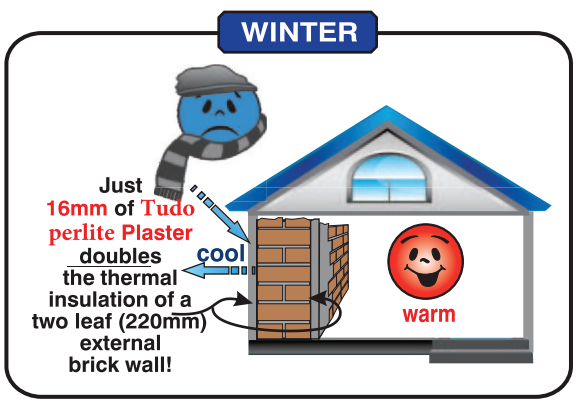
$Q = \frac{\Delta t}{R_{TOTAL}} = \frac{20}{.133+.262+.133}$

$\therefore Q = 37.9\ W/m^2$



The Tudo perlite Plaster DOUBLES the thermal insulation of the wall and HALVES the heat loss!
For our 4m x 4m room (with 40m² of walls) this is a saving of 1.54 Kw.
Assuming electricity costs **DH** 2.00 / Kw hr this is a saving of **DH** 73.92 / DAY!
If the floor screed was Tudo perlite and the roof was insulated further savings would be achieved.
(*: If the convective heat transfer coefficient were accounted for the % of saving would be less but still very significant.





The pages of this Appendix comprise summaries of official test reports issued by:

- **1. CSIR** (Council for Scientific and Industrial Research)
- **2. SABS** (South African Bureau of Standards)
- **3. PCI** (Portland Cement Institute - now the Cement and Concrete Institute)
- **4. *COMRO** (Chamber of Mines Research Organisation) - Now CSIR Mining Tech.

Reports:

CSI — The Fire Properties of Tudo perlite Panels
SABS — Hydrocarbon Fire Tests (and Fire Resistance on Cable Penetration).
SABS — Fire exposure Tests on Protected Steel Columns (2500mm x 200mm x 150mm).
SABS — Thermal Conductivity Tests.
SABS — Surface Fire Index on Tudo perlite
SABS — Non-Combustibility Test on Tudo perlite
PCI — Evaluation of "Pre-treated
*COMRO — Heat Gain Measurements on Tudo perlite Insulation Systems.

1. CSIR TEST REPORTS

CSIR - THE FIRE PROPERTIES OF TUDO PERLITE

A summary of a report undertaken by The Division of Building Technology, CSIR follows (the complete report is available for inspection upon request).

PANELS Procedure:

Three large panels (3 m x 1 m x 75 mm, masses 102 kg, 142 kg, and 182 kg respectively) consisting of Tudo perlite aggregate with portland cement binder applied over "Space-frame" reinforcing cage were tested for non-combustibility (SABS 0177: Part 5), determining suitability as a transformer fire shield and for fire resistance, using the standard time-temperature mode.

Hose stream application after one minute.

Condition of panels after application of hose steam.

Slight inwards dashing of the panels after 3 hours.

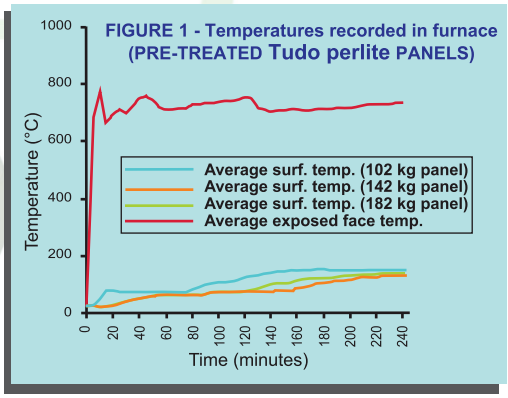
Results:

Non-combustibility -

Temperatures recorded are presented in Figure 1.

Transformer Fire Shield Test

The maximum deflection, in the form of slight inwards (into the furnace) dishing was 15 mm in the centre of the panels. This slight dishing after 3 hours exposure can be seen in the enclosed photographs. The condition of the fire-exposed face of the panels immediately after the test and after shock-quenching can also be seen in the enclosed photographs. The fire-exposed surfaces of the panels showed only surface cracking, with none of the cracks extending through the thickness of the panels. There were no signs of spalling and the panels were strong enough to be removed from the furnace frame without the panels disintegrating.



CSIR - THE FIRE PROPERTIES OF TUDO PERLITE PANELS

Results:

Fire Resistance

Average temperature on cold face of panel after 2 hours fire-exposure = 70°C.
Furnace temperature = 1 055°C.
Calculations indicate that a 75mm thick panel made of Tudo perlite with a density of 1 000 kg/m³ will have a fire-resistance of at least 4 hours, as a non-loadbearing element.

Conclusions:

- Tudo perliteis non-combustible and liberates no smoke or toxic gas on exposure to fire.
- Unlike normal concrete panels, Tudo perlite panels with "Spaceframe" reinforcing do not spall and deflect only slightly on exposure to fire. Heat-flow through these panels is substantially less than through normal concrete of equivalent thickness.
- The panels also did not disintergrate or spall explosively when subjected to a hose stream when hot, like ordinary concrete panels do.
- Fire shields constructed of Tudo perlite panels will effectively protect adjacent equipment such as transformers from radiation and conducted heat from a transformer oil fire for periods of at least 4 hours. When used as a non-loadbearing element in buildings or for other applica-tions, a fire-resistance rating of at least 4 hours can be allocated to 75mm thick panels with a density of 1000 kg/m³.

2. SABS TEST REPORTS

SABS - HYDROCARBON FIRE TESTS

A summary of reports undertaken by SABS, 20 June 1991 [Ref. 19/03/21/07; Report Nos 653/82280/H3723/A, B, C, D, E] follows (the complete reports are available for inspection upon request).
A series of tests was conducted to evaluate samples for cable protection in high risk fire areas.

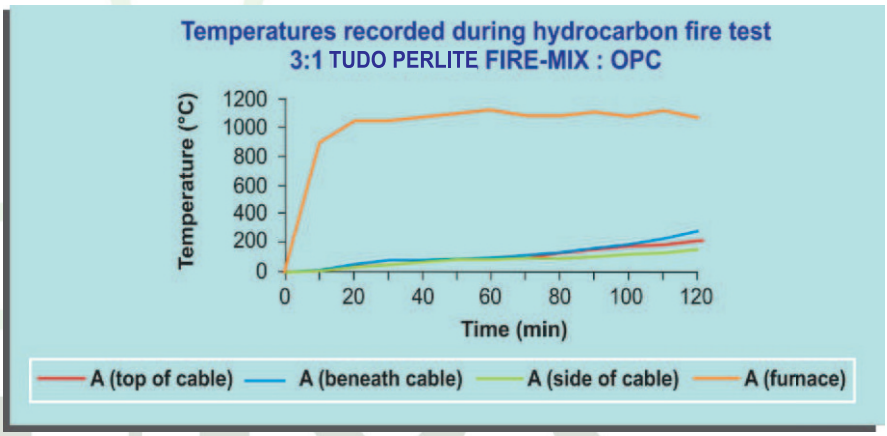
Test Procedure:
A cable tray was installed in the removeable wall of a vertical furnace, extending approximately 800mm horizontally into the furnace. A cable length was installed in the tray in such a manner to form a loop. The cable tray was filled with a 3:1 Tudo perlite plaster mix. Thermocouples were attached to the cable, one to the top of the cable, one underneath the cable and one to the side of the cable. The compositions described were exposed in the vertical furnace, in accordance with the procedures described in SABS 0177II. During the test, a 220V electrical current was passed through two conductors of the cable. The current was used to glow an electric light bulb. The time at which the bulb failed to glow was recorded. The temperature/ time curve recorded was the hydrocarbon fire curve, also known as the "Mobile Fire Curve".

Sample	Minimum Cover Thickness (mm)	Time Taken by Light Bulb to Stop (min)
3:1 Tudo perlite fire-mix : OPC	35	103

Table 1: results of Hydrocarbon Fire tests

Remarks:

The exposure of materials to a simulated hydrocarbon fire (Mobile Fire Curve) is a method to study the behaviour of materials under defined fire conditions. The designer of a specific construction can use the information obtained to decide on the parameters to be specified for specific applications.



SABS - FIRE EXPOSURE TESTS ON PROTECTED STEEL COLUMNS

A summary of reports undertaken by the SABS, 15 July 1991 [Nos 653/82280/h3724 and H3725] follows (the complete reports are available for inspection upon request).

Sample:

Standard H Section Steel Columns, 2 500 mm x 150 mm, with an average flange thickness of 15mm and a weft thickness of 10 mm were protected as follows:

- The steel surface was treated with Tudo perlite Plaster Grip Primer.
- A layer of plaster material, 30 mm thick, was applied to the column.
  5:1 tudo perlite : OPC
  3:1 tudo perlite : OPC

Nature of Tests:

The tests were conducted in a vertical furnace in accordance with procedures described in code of practice SABS 0177-II

Observations and Remarks:

A 5:1 Tudo perlite: OPC: At the end of the 120 min test procedure, the average steel temperature was temperature of 314°C (furnace temperature 1046°C)

B 3:1 Tudo perlite : OPC: At the end of the 120 min test procedure, the average steel temperature was 364°C and a single highest point reached a temperature of 384°C (furnace temperature 1050°C

SABS - THERMAL CONDUCTIVITY TESTS

A summary of reports undertaken by SABS, 5 August 1996 [Nos 722/82402/4249] follows (the complete reports are available for inspection upon request).

Method of Testing:
Samples A-D were tested on a Heat Flow Meter Apparatus in accordance with ASTM C518.

Table 1:
Results of Thermal Conductivity Tests

SAMPLE	MEAN TEMP. (°C)	MIX RATIO (Pre-treated Tudo perlite:Cement)	NORMAL DENSITY (kg/m³)	THERMAL CONDUCTIVITY (W/m.K)
A	25.5	3:1	770	0.15
B	25.3	4.5:1	670	0.13
C	25.3	6:1	480	0.12
D	25.3	10:1	360	0.09

SABS - SURFACE FIRE INDEX TEST ON TUDO PERLITE

A summary of a report undertaken by the SABS, 16 October 1987 [Nos 653/81590/D2462] follows (the complete report is available for inspection upon request).

Sample:
Boards made of 5:1 Tudo perlite : Cement

Nature of Test:
Tests to establish the surface fire index were carried out in a tunnel furnace according to SABS 0177: Part III.

Results:

Spread of flame index	0
Heat contribution index	0
Smoke emission index	< 0.1
Surface fire index	0
Class	1

SABS - NON-COMBUSTIBILITY TEST ON TUDO PERLITE

A summary of a report undertaken by the SABS, 16 October 1987 [Nos 653/81590/D2463] follows (the complete report is available for inspection upon request).

Sample:
Blocks made of 1:5 cement: Tudo perlite

Nature of Test:
Tests to determine the non-combustibility of the material were carried out in a furnace according to SABS 0177: Part V.

Results: The sample was found to be non-combustible.

3. PORTLAND CEMENT INSTITUTE REPORTS

PORTLAND CEMENT INSTITUTE - EVALUATION OF TUDO PERLITE

A summary of a report produced by the PCI, 30 March 1992 [Ref. 984/94NPD/jaf] follows (the complete report is available for inspection upon request)

A series of tests was conducted to evalute Pre-treated Tudo perlite. These included strength tests and limited shrinkage tests on nominal 3:1, 4.5:1, 6:1 and 10:1 (volume) mixes covering a range of consistence between 40 mm slump and 120 mm slump. In the list of tests which follow, the test procedure adopted is shown in parenthesis.

- 7-day and 28-day compressive strength on water- and air-cured specimens (SABS Method 863)
- Permeability tests at 28 days (DIN 1048)
- Wet density (100 mm cube specimens, weighing immediately after demoulding).
- Dry density and rate of moisture loss (weighing, to constant mass, 100 mm cube specimens air-dried and in a drying oven between 100°C and 110°C).
- Initial drying shrinkage (SABS Method 836).
- Wetting expansion (SABS Method 836).
- Slump (PCI TM 6.2)
- Flow (SABS Method 862-2)
- Air content (SABS Method 1252)
- Water retentivity (BS 4551)
- Consistence retentivity (BS 4551)
- ISO flexural and compressive strength (EN 196)
- Modulus of elasticity (PCI TM 7.6)
- Assessment of “plasterability” of each mix.

3. PORTLAND CEMENT INSTITUTE REPORTS

PORTLAND CEMENT INSTITUTE EVALUATIONOF TUDO PERLITE

(Also see page 11)COMMENTS

General

- The water : cement (W:C) ratio is very important. It was considered better to measure properties over a range of water contents rather than a range of slumps, since consistence achieved was dependent on mixing time.
- The water requirement is fairly consistent over a wide range of aggregate : cement ratios. Water should be added slowly during mixing over a period of time to activate the admixture in case the required slump is exceeded.

Compressive Strength

- For richer mixes, water content had a large influence on the resultant consistence, compressive strength and flexural strength. Its influence diminished as the aggregate : cement ratio increased. The compressive strengths achieved were well above average for a lightweight mortar using OPC.
- Relationship between 7-day and 28-day strengths are normal for standard-cured specimens.
- Specimens dry-cured for 28 days yielded strengths approximately 70% of standard-cured specimens. At 7 days there was virtually no difference.
- Results of ISO tests follow a similar pattern.

Density

- Wet densities varied from approximately 700 kg/m³ to 1 100 kg/m³. Dry densities varied from approximately 300 kg/m³ to 800 kg/m³.
  Graphs showing the rate of moisture loss are shown in Figure 1.
- Specimens were virtually dry in 24 hours at 100°C (oven drying). Specimens took longer than two weeks to dry (Figure 1) when air-dried under favourable drying conditions (22,5°C, RH<50%). No micro-cracking was observed for both methods.

Permeability

- According to DIN 6.5.72 a concrete with thickness of 100-400mm will be waterproof if maximum penetration is not >50mm. Further, the W:C ratio should not be >0.6.
- The 3:1 mix was deemed watertight. This may be partially due to the mix having a W :C ratio of 0.57 and partially due to the high air content (18.5%).
- The 4.5:1 mix was not tested.
- The 6:1 mix was not watertight. Very little water passed through at 1 bar pressure but this increased significantly when pressure was increased to 3 bars.
- The 10:1 mix was not watertight.

Initial Drying Shrinkage and Moisture Movement

- The shrinkage values are relatively low for lightweight mortar .
- The shrinkage values are only slightly affected by change in consistence but significantly affected by change in cement content.
- Wetting expansion values are above average for conventional aggregate but are quite normal for lightweight aggregate.

Slump Testing

- If slump tests are not done quickly, water bleeds from the base of the slump cone, leaving a mortar with poor flow properties. This leads to anomalous slump readings, especially for the 10:1 mixes. In these situations the flow test is considered a better test.

Air Content

- The measured air content increased with increasing consistence and with decreasing cement content.
- Mostly, air contents were in the order of 20%. Notable exceptions were the rich 3:1 mixes, particularly at the drier consistence.

Water and Consistence Retentivity

- BS 4551 recommends that, when masonry cement is used , water retentivity should be between 70% and 95%. The European standard for masonry cement (EN 413-1) specifies that water retentivity should fall between 80 and 95%. PCI believes that for good workability the value should fall between 85 and 95%.
- Water retentivity, for 3:1 and 4.5:1 mixes, was considered satisfactory . It was considered borderline for the 6:1 mix and poor for the 10:1 mix.

Plasterability

- The ability to successfully plaster with the various nominal mixes is in line with the measured and observed water retentivities.
- The 3:1 and 4.5:1 mixes could be used for plaster without difficulty . The 6.1 mix could be used for plaster but the mix lacked adequate cohesion. The 10:1 mix was unsuitable for plastering.

PORTLAND CEMENT INSTITUTE - EVALUATION OF TUDO PERLITE

FIGURE 1 - PRE-TREATED Tudo perlite
Rate of Loss of Moulding Moisture

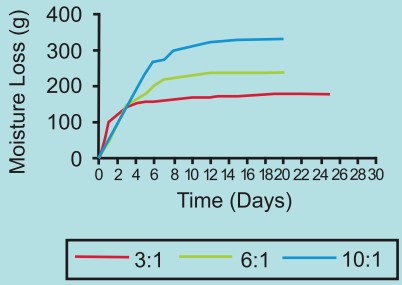


FIGURE 2 - PRE-TREATED Tudo perlite
Strengths - Range of Consistence

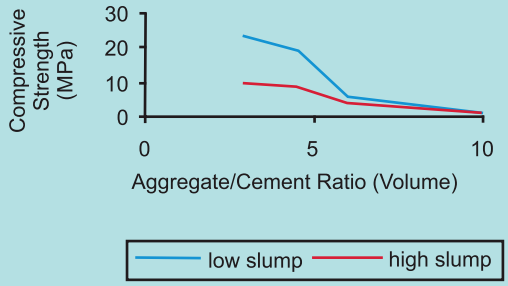


FIGURE 3 - PRE-TREATED Tudo perlite **ISO Strengths - Range of Consistence**

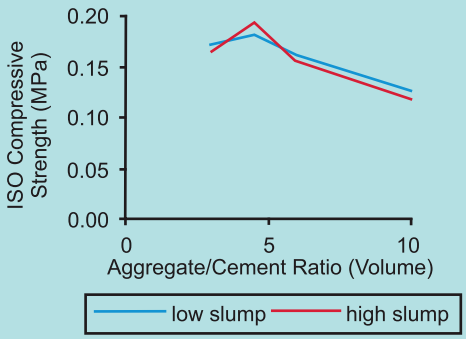


FIGURE 4 - PRE-TREATED Tudo perlite
Approximate Slump vs Compressive Strength

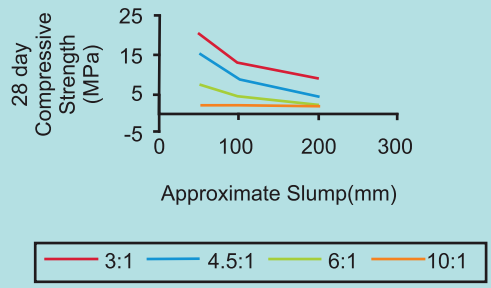


FIGURE 5- PRE-TREATED Tudo perlite
Water Content vs Slump

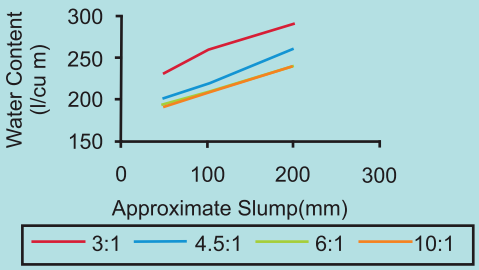


FIGURE 6 - PRE-TREATED Tudo perlite
Density vs Air/Cement (vol) Ratio

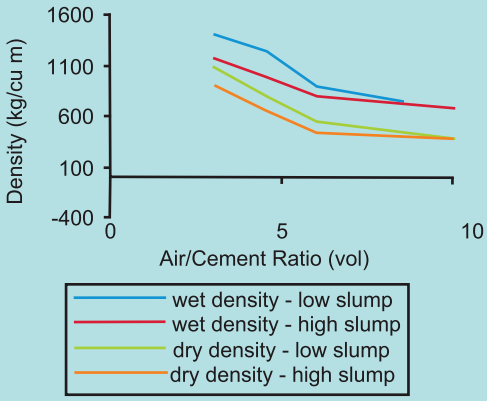


FIGURE 7- PRE-TREATED Tudo perlite
Air/Cement Ratio (vol) vs Compressive Strength

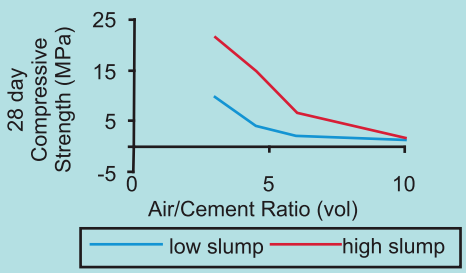
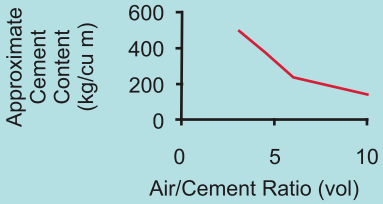


FIGURE 8- PRE-TREATED Tudo perlite **Cement Content vs Air/Cement Ratio (vol)**

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