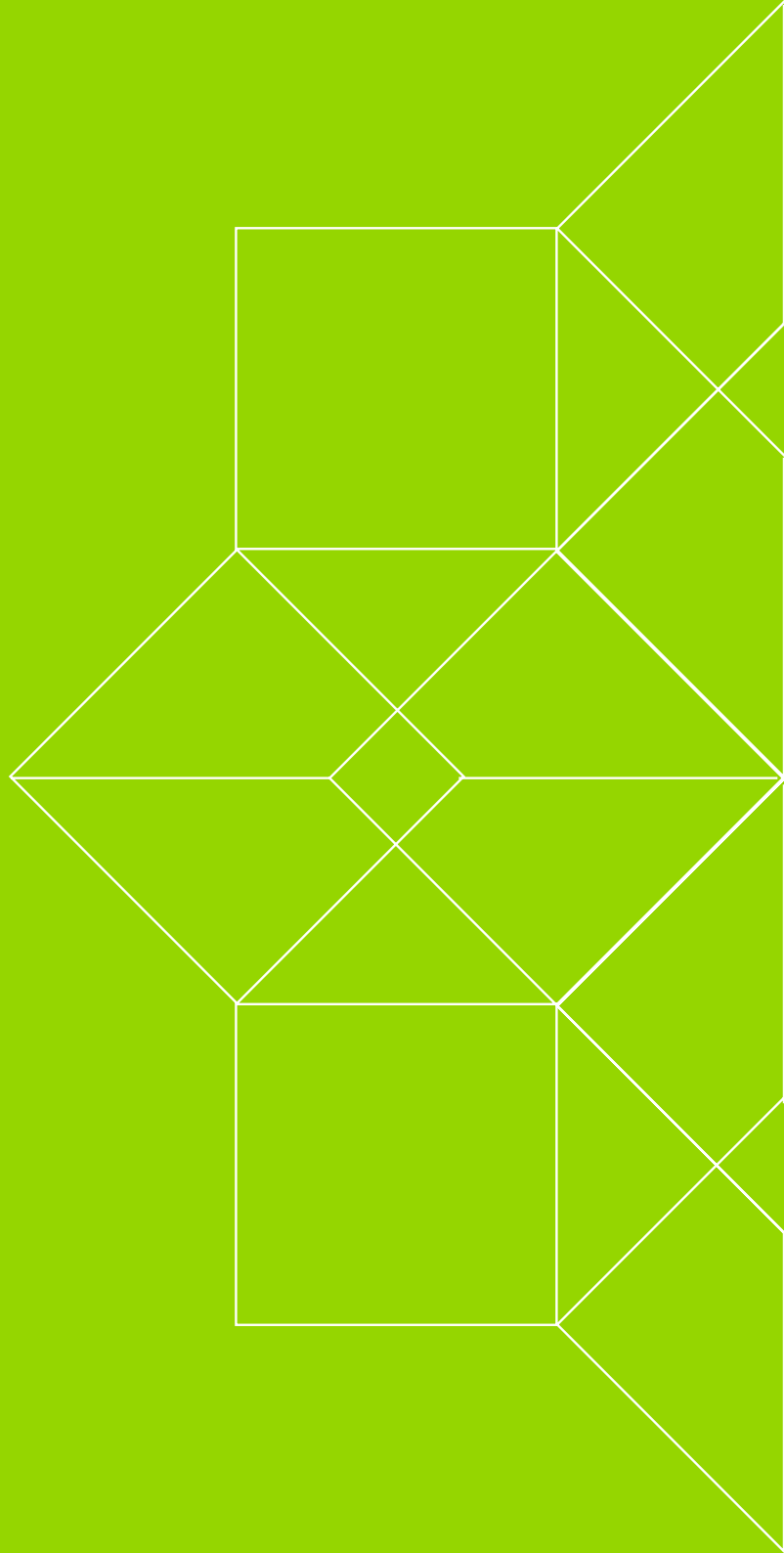
ESPAC
Precast Aerated Concrete إسباك

A.A.C Products



www.espac.com

ESPAC represents the **green standard** in the Autoclave Aerated Concrete industry **that others strive to match.**

ESPAC is a Saudi-Emirati company that specialises in Precast Aerated Concrete (PAC). The company uses the latest technologies in accordance with the highest quality standards to deliver to the market superior PAC products. With a team of highly qualified experts who excel in the fields of architecture and engineering, ESPAC plans, manufactures, designs and constructs green buildings using PAC.

ESPAC has a production capacity of 1,200 m^3 per day of a range of PAC products, including blocks, wall panels and roof slabs, designed to meet the needs of the Saudi market and neighbouring countries.

ESPAC also provides technical support to ensure the best results for our customers. Our company's highly skilled technicians ensure that throughout the manufacturing, construction and installation process all health, safety and environmental goals are achieved on all projects.

Our Commitment

ESPAC is committed to the highest levels of manufacturing, installation and technical support for all the projects we execute. We deliver projects professionally and efficiently and aim to exceed the expectations of our clients.

We are also committed to preserve and maintain the environment in which we live and work.

Our Vision

Our vision is to be the leading provider of the best thermally insulated structures that are both sustainable and environment friendly.

Our Mission

To provide our customers with effective construction solutions using our expertise in the design, manufacture and installation of Precast Aerated Concrete building systems.

Autoclave Aerated Concrete
was developed in the mid-1920 in Sweden by Dr. John Axel Eriksson

An architect working with Professor Henrik Kroger at the Royal Institute of Technology; it was produced in Sweden in 1923 and industry level production was achieved in 1929. Since that time, its production and use has spread to more than 40 countries in Europe, The Middle East, The Far East, North America, Central and South America, and Australia.

This wide experience has produced many case studies of the use of AAC in different climates and under different building codes

Definitions

Autoclaved Aerated Concrete is a cementitious product based on calcium silicate hydrates in which low density is attained by the inclusion of an expanding agent – aluminium powder - resulting in macroscopic voids.

It is subjected to high-pressure steam curing (ASTM C1386).

Cementitious product based on calcium silicate hydrates in which **low density** is attained by the inclusion of an expanding agent

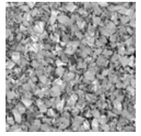
Unlike most other concrete applications, AAC is produced using **no aggregate larger than sand.**

Under controlled conditions quartz sand, aluminium powder, cement and water are mixed. Aluminium powder is used at a rate of 0.05%–0.08% by volume (depending on the pre-specified density). When AAC is mixed and cast in forms several chemical reactions take place that gives AAC its light weight property (25% of the weight of concrete) and thermal properties. Aluminium powder reacts with calcium hydroxide and water to form hydrogen. The hydrogen gas foams and doubles the volume of the raw mix (creating gas bubbles up to 3mm (1/8 inch) in diameter). At the end of the foaming process, the hydrogen escapes into the atmosphere and is replaced by air.

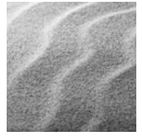
When side forms are removed from the material, it is solid but still soft. It is then cut into either blocks or panels, and placed in an autoclave chamber for 8 hours in the case of blocks and 12 hours for reinforced products. During this steam pressure hardening process, when the temperature reaches 190° Celsius (374° Fahrenheit) and the pressure reaches 8 to 12 bars, quartz sand reacts with calcium hydroxide to form calcium silica hydrate, which accounts for AAC's high strength and other unique properties. After the autoclaving process, the material is ready for immediate use on construction sites.

Raw Materials

The basic raw materials are cement, sand, aluminium powder (expanding agent), lime and water.



Aluminium Powder

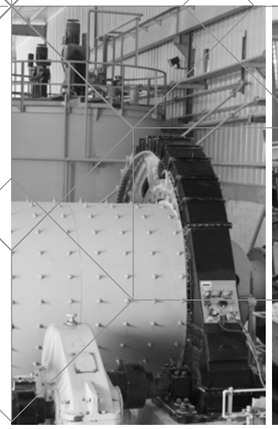


Sand

Water

Lime

Cement



Batching

Sand is ground to the required fineness in a ball mill, if necessary, and is stored along with other raw materials. The raw materials are then batched by weight and delivered to the mixer. Measured amounts of water and expanding agent are added to the mixer, and the cementitious slurry is mixed.

Steel

Steel coils are straightened, cut and spot-welded into meshes, where cross bars provide anchorage to the longitudinal reinforcements. Blocks are not reinforced.

After dipping the welded mesh in a homogenized anti-corrosion mix for rust protection, they are dried and assembled into cages and set accurately in the moulds before the slurry is poured in.

Casting

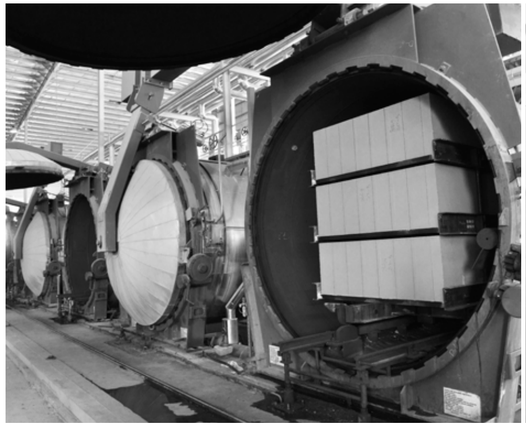
Moulds are prepared to receive the fresh AAC. If reinforced AAC panels are to be produced, steel reinforcing cages are secured inside the moulds. After mixing, the slurry is poured into the moulds.

The expanding agent creates small, finely dispersed voids in the fresh mixture that increases the volume by approximately 50% in the moulds within 3 hours.

Cutting & Milling

Within a few hours after casting, the initial hydration of the cementitious compounds in the AAC gives it sufficient strength to hold its shape and support its own weight.

The material is detached, then cut in a cutting machine guided by wires which section the blocks and panels into the required sizes and shapes along with required profile. After cutting, the units are kept in their original positions in the larger AAC mass.



Autoclaving

After cutting the aerated concrete product is transported to a large autoclave, where the curing process is completed. Autoclaving is required to achieve the desired structural properties and dimensional stability.

The process takes about 8 to 12 hours under a pressure of approximately 12 bars and at a temperature of around 360 °F (180 °C), depending on the grade of material produced.

During autoclaving, the wire-cut units remain in their original positions in the AAC block.

After autoclaving, the individual units are dimensionally stable and are specified to have a drying shrinkage of no more than 0.02% (ASTM C1386).

Packaging

The blocks are de-moulded, strapped, marked and stored on wooden pallets for shipping. Unreinforced units are typically shrink- wrapped, while reinforced elements are typically banded only, using edge guards to minimize localised damage from the banding.

We use edge guards to **minimise localised damage from the banding**

Density

Normally PAC is produced with nominal dry density of 550 kg/m^3. Other densities from 400 to 800 kg/m^3 can be produced upon request. Many physical properties of aerated concrete depend on the density. Typical physical properties of PAC are given in Table 1.

Table 1. Physical Characteristics of PAC

Properties	Units	Range
Dry Density	Kg/m^3	400-800
Compressive Strength	N/mm^2	2.5-7.5
Modulus of Elasticity	N/mm^2	1550-3000
Thermal Conductivity	W/m-K	0.1082-0.1731

Compressive strength

PAC material can be used as a load bearing construction material with a minimum nominal density of 400 kg/m^3. The lower density material is used for thermal insulation purposes. PAC is produced with normal dry density of 550 kg/m^3. Autoclaving increases the compressive strength significantly, as high temperature and pressure result in a more stable form of tobermorite. Macro pores in this case mean artificial air pores. Micro pores are a part of the skeleton material. First, tobermorite occurs in the binding phase as very small crystals. The minor constituent and the micro pores are embedded inside the mass of tobermorite.

The compressive strength achieved depends also on temperature, pressure and duration of autoclaving. Generally compressive strength increases linearly with density. Typical properties of PAC material with nominal dry density of 550 kg/m^3 is given in Table 2.

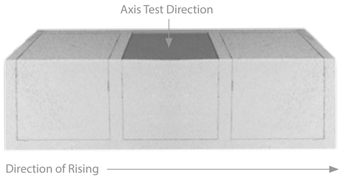


Table 2: Properties at a nominal dry density of 550 kg/m^3

Properties	Unit	Range
Compressive strength	N/mm^2	3.5 - 5.0
Splitting tensile strength	N/mm^2	0.28 - 0.41
Modulus of Rupture	N/mm^2	0.75 - 0.90
Shear strength	N/mm^2	0.35 - 0.50
Modulus of Elasticity	N/mm^2	1897.5 – 2350.2

Thermal conductivity

Low density, air bubbles, the amount of pores and their distribution and the absence of coarse aggregate are critical factors for thermal insulation. The thermal conductivity is also influenced by the moisture content.

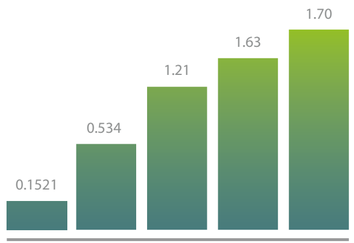
At a nominal density of 550 kg/m^2, the thermal conductivity K- value for PAC material is 0.1521 for completely dry conditions. This meets international codes such as ASTM, ACI and British Standards as well as those of Saudi Electricity Co. (SCECO), King Fahd University and Saudi Arabian Standards Organization (SASO).

Based on the above:

1. The U-value of AAC 20cm thickness is 0.62 w/m^2 ^{o}C = 0.11 BTU/f t2h ^{o}F.
2. The U-value of AAC 25cm thickness is 0.51 w/m^2 ^{o}C = 0.08 BTU/f t2h ^{o}F.

Note: 1 BTU/f t2h ^{o}F = 5.678 w/m^2 ^{o}C.

Table 3: Thermal conductivity

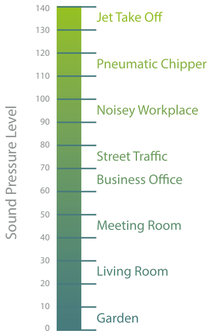


Acoustic properties

Sound transmission refers to the transmission loss of air-borne sound. It is dependent on the mass law, which is a function of frequency and the surface density of the component (i.e. its mass to area ratio) in addition to its rigidity. AAC has very high sound absorption because of its high internal porosity. Sound reduction is the ratio of sound energy at its source to another location expressed in decibel (db) and its scale is logarithmic.

Table 4. Sound pressure reduction by decibel (db)

AAC thickness	10cm	15cm	20cm	25cm
Finish type				
Plain	34	36	40	42
Painted	36	39	42	45
Plaster	37	40	43	46
Gypsum Board	46	49	52	55



Fire resistance

PAC is incombustible and remarkably fire resistant. Consequently, it is especially suited for fire-rated applications. Depending on the application and thickness, the resistance to fire with respect to time up to the temperature of 1000 ºC are as in Table 5.

Table 5. Fire resistance

Thickness (cm)	10	15	20	25
Fire ratings (hours)	3	6	7	8

Durability

PAC is a highly durable material. It can resist harsh climatic conditions and over time does not degrade structurally. It does not contain organic material which may be subjected to deterioration.

Quake resistance

The light weight property of PAC material reduces the total dead load of any given building and results in a reduction of applied seismic load. As a result, PAC exhibits stability for building in quake prone areas.

Thermal expansion

AAC thermal expansion is 8x10-6/ ºC. This means that PAC is the least expansive materials when compared with other construction materials.

Shrinkage

Average AAC shrinkage strain is 200x10-6/ºC. Autoclaving (high temperature and high average pressure steam curing) is the main reason for lower shrinkage with AAC.

Melting point

AAC starts melting at around 1200 ºC.

Water absorption

The water absorption property of materials can be classified by the water absorption coefficient. The water absorption coefficient gives information about how much water is absorbed in a defined time period. The special inner structure of AAC, which consists mainly of closed pores (micro pores and macro pores), prevents the capillary transport of moisture over long distances. Table 6 shows the water absorption coefficient for some selected building materials.

Table 6. Water Absorption

Material	Water absorption coefficient ($kg/m^2/S$)
Dispersion coating	8.44 x10-4 – 3.30 x10-3
Concrete	1.69 x10-3 – 8.44 x10-4
Cement plaster	0.033 – 0.05
AAC	0.041 – 0.12
Solid sand-lime bricks	0.067 – 0.134
Hollow bricks	0.148 – 0.415
Solid bricks	0.330 – 0.50
Gypsum	0.584
Gypsum board	0.584 – 1.195

- High thermal insulation and energy
- Quake resistant
- Multi-purpose
- Strong and durable
- Fire resistant and no emission of gases
- High dimensional stability
- Light weight
- Noise resistant
- Non-toxic and no emission of radioactive material
- Easy to work with
- Clean implementation on site
- Environment friendly
- Fast Construction
- Sustainability and long life
- Results in breathable buildings
- Economical
- Achieves green build
- Affords high quality control

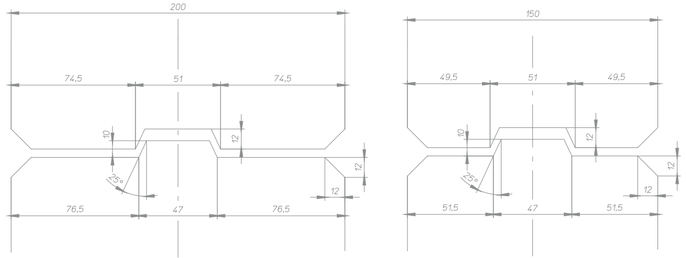
Reinforced Products

	Product Name	Description	Dimensions by mm with tolerance is +- 3mm for thickness & width and +- 5mm for length			Usage
			Thickness	Width	Length	
	VP	PAC Vertical Wall Panels	100, 150, 200, 250, 300	Up to 600mm	Up to 6000mm	• Load bearing Walls • Partition walls • Cladding walls • Parapet walls
	HP	PAC Horizontal Wall Panels	100,150, 200, 250, 300	Up to 600mm	Up to 6000mm	• Boundary wall • Cladding wall • Parapet walls • Partition walls
	FS	PAC Floor Slabs	100, 150, 200, 250, 300	Up to 600mm	Up to 6000mm	• Floor slabs with design load up to 600 kg/m^2
	RS	PAC Roof Slabs	100, 150, 200, 250, 300	Up to 600mm	Up to 6000mm	• Roof slabs with design load up to 400 kg/m^2
	LP	PAC Wall Lintels Panels	100, 150, 200, 250, 300	200 to 600mm	Up to 6000mm Depend on designs	• Load-bearing lintels over window or door opening for external or internal walls
	LX	PAC Box Lintels Panels	100, 150, 200, 250, 300	200, 250, 300	Up to 3600mm	• Load-bearing box lintels over window or door opening for external walls

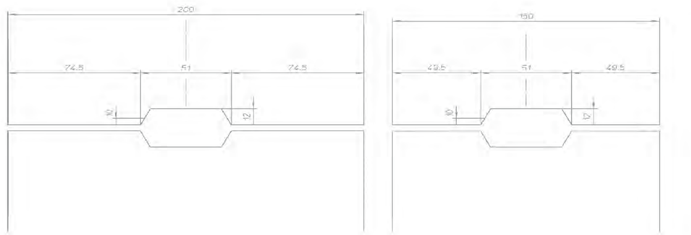
Reinforced Products

	Product Name	Description	Dimensions by mm with tolerance is +- 3mm for thickness & width and +- 5 mm for length			Usage
			Thickness	Width	Length	
	S - Blocks	Standard PAC blocks	50,100, 150, 200, 250, 300, 375, 400	200 – 250	600mm	• Load bearing wall • Non load bearing
	MP	PAC Mini Panel	200 – 250 – 300	600	Up to 1200mm	• Masonry Wall • Parapet Wall • Below Windows
	H – Blocks	Hordi PAC blocks	400	250	600mm	• Light weight to be infilled between concrete ribbed slabs
	PT	PAC roof tiles	50x250x600 75x250x600 75x600x600			• To insulate conventional roof
	Termo 34	High Thermal insulation Block	300x200x600			

Horizontal Panel Profile (HP)



Vertical Panel Profile (VP)



Slabs Profile

D	T1	T2	T3
75mm	37mm	20mm	28.5mm
100mm	45mm	30mm	32.5mm
>>125mm	64mm	50mm	51.5mm

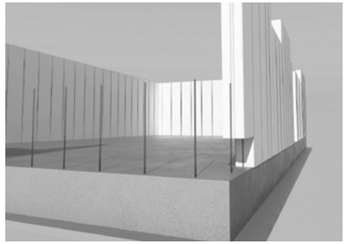
With the wide range of benefits of Precast Aerated Concrete materials, and the expertise of our engineering, installation and supervision teams, ESPAC is not simply a building material manufacturer. Rather, we are a provider of engineering solutions, offering a wide range of building systems and applications.

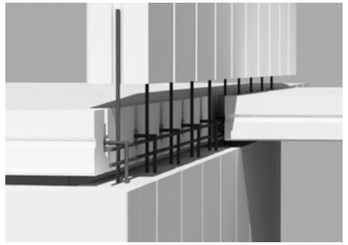
If you are an individual building your family home or a developer planning a new residential compound or a consultant looking for innovative solutions or a contractor planning to deliver your project on time with the least resources possible, ESPAC has the ability to provide you with the effective, efficient, economical and environmentally sound solutions you seek.

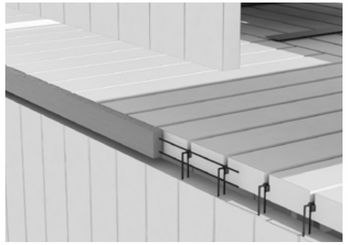
1. Full Panel System
2. Full Block System
3. Partition Panels
4. Panels on Steel Structures
5. Post Tension Slabs
6. Boundary Walls
7. Shaft Walls
8. Rib-Hordi Roof
9. Rib-Hordi Stairs
10. Masonry Blocks

Full Panel System

Aerated concrete full panel systems can be used in a variety of structures as shown.







ESPAC has the ability to provide you with the **effective, efficient, economical** and environmentally sound solutions.

Full Block System

As a semi-precast system, our Full Block System is a more economical solution than standard systems. The Full Block System is composed of high density load bearing blocks and reinforced PAC lintels for the walls and reinforced PAC Slabs for the roof. It is a load bearing wall system where no columns are needed except in very rare cases for the staircase or as support for some steel beams.

Aerated concrete slab panels with block work construction can be used in a variety of structures such as shown

Partition Panels

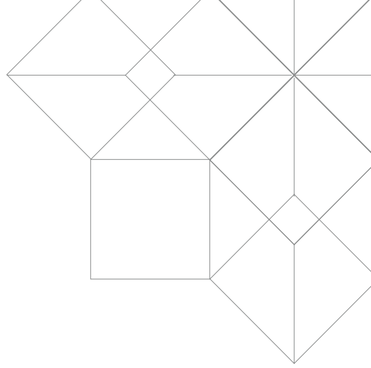
The PAC Partition Panel System is the best solution for high rise buildings where speed is needed to complete all interior walls (10cm or 15cm) and exterior walls (20cm or 25cm or 30cm) in conjunction with the completion of post tension slabs (usually 2 weeks for each floor).

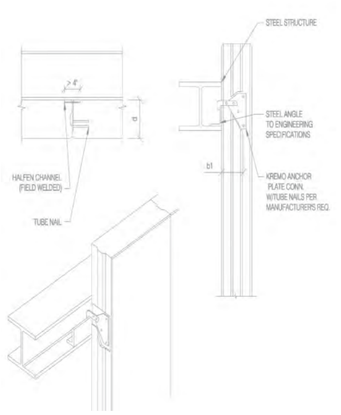
PAC Panels can be erected before slab casting using a tower head crane for 20cm or 25cm panels (due to their weight) or via a special trolley provided by ESPAC for 10cm and 15cm panels after slab casting.

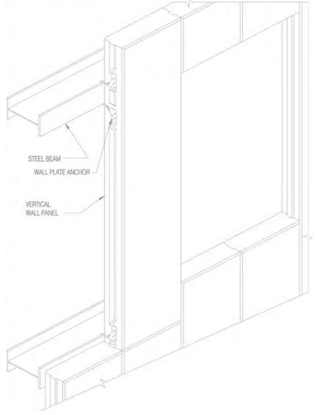
Fast and easy to install using a small mobile truck mounted crane.

Panel Cladding on steel Structure

PAC panels can be used with steel or concrete structures as curtain walls in a horizontal and/or vertical arrangement suitable for commercial and industrial buildings. PAC Panels are lightweight, fire resistant, water penetration resistant, pest resistant, and fast and easy to install using a small mobile truck mounted crane.





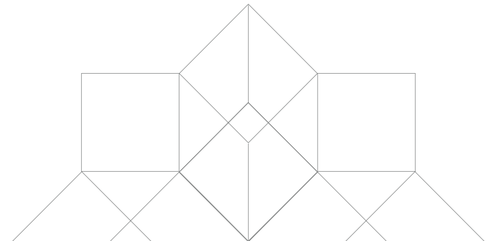


Post Tension Slabs

ESPAC's Post-Tensioning Slab systems, supported by expert design, quality control, technical backup, execution supervision and training provide architects, designers and builders with the ideal solution for today's construction environment.

Post Tensioned Concrete is an architect's dream, a delight for developers, a great tool for builders and kind on the environment; it allows almost any shape of structure to be constructed, while reducing environmental impacts, construction time, materials and costs. But what is it? And why should you be interested?

What is Post Tensioning? Post-tensioning is a method of reinforcing (strengthening) concrete with high-strength steel strands, typically referred to as tendons. Post-tensioning applications include office and apartment buildings, parking structures, bridges, sports stadiums, and water-tanks. In many cases, post tensioning allows construction that would otherwise be impossible due to either site constraints or architectural requirements. Although post-tensioning systems require specialised knowledge and expertise to fabricate, assemble and install, the concept is easy to explain. Imagine a series of wooden blocks with holes drilled through them, into which a rubber band is threaded. If one holds the ends of the rubber band, the blocks will sag. Post-tensioning can be demonstrated by placing wing nuts on either end of the rubber band and winding the rubber band so that the blocks are pushed tightly together. If one holds the wing nuts after winding, the blocks will remain straight. The tightened rubber band is comparable to a post-tensioning tendon that has been stretched by hydraulic jacks and is held in place by wedge-type anchoring devices.

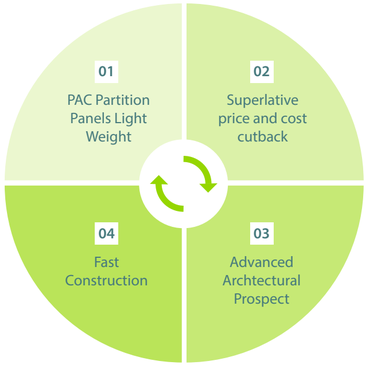


Benefits of Post Tension Slabs:

- Reduces or eliminates shrinkage cracking. Therefore, no joints, or fewer joints, are needed, Cracks that do form are held tightly together.
- Allows slabs and other structural members to be significantly thinner.
- Enables longer spans in elevated members, like floors or beams.
- Ensures considerable cost savings due to reductions in steel and concrete requirements, rather than saving in formwork sets due to fast slab de-shuttering resulting a fast construction system.

ESPAC's scope of work for Post Tension Slab Systems:

- Design review for superior solutions
- Selection of the finest construction method
- Value engineering, cost minimisation and project evaluation
- Post-tensioning design and shop-drawings
- Technical support in all project phases
- Timely project completion
- Installation of Post Tension system
- Provision of trained expert personnel and site supervision
- Inspection and monitoring services
- Stressing and grouting
- Supply of post-tensioning materials: anchors, strands, ducts etc.
- Supply of post-tensioning equipment: strand dispenser, stressing jacks & pumps, grouting machines, onion frame, etc.
- Maintenance and Quality Assurance.
- A reduction in loads transferred to columns and footing



01 PAC Panels light weight property reduces the loading on structural members such as PT slabs, resulting in less thickness leading to less overall load on the foundations

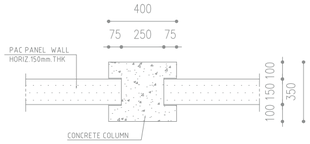
02 By adopting our combined system, a considerable saving is achieved in all structural elements due to a reduction in the amount of concrete and steel required

03 Elimination of drop beams and the 60cm panel width module allow the designer to excel and provide creative solutions

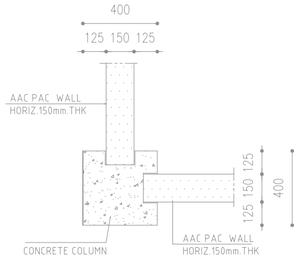
04 Faster construction and shorter cycle for slab and partition walls due to identical panel heights which makes it easier for production and installation.

Boundary Walls

The combination of PAC horizontal Panels and concrete or steel columns will result in an attractive and versatile fence system that affords efficient and effective privacy and acts as a noise barrier for residential applications. Our boundary wall system provides a modular masonry structure using lightweight panels which can be easily and quickly erected without the need for extensive excavation or strip footings, as is normally the case for traditional masonry fence construction.



MIDDLE COLUMN

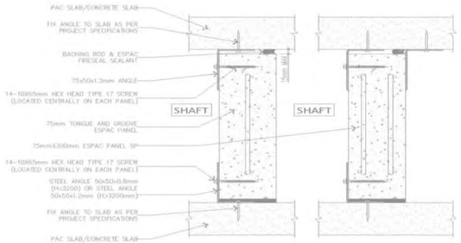


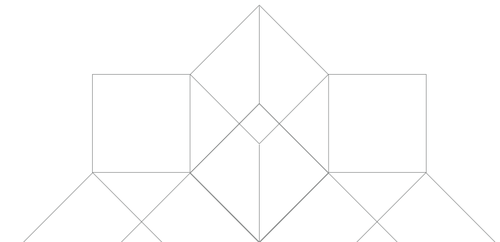
CORNER COLUMN

Fast and easy to install using a small mobile truck mounted crane.

Shaft Walls

ESPAC Shaft Wall Systems are available for service shaft and secure plant rooms which provide acoustic suppression and excellent fire resistance. Shaft walls can be applied in both dry and wet areas. They provide a solid, secure wall with a narrow width around service shafts and between scissor stairs. PAC Shaft Walls maximize space utilization and minimize risks and costs in high rise and multi-residential construction. ESPAC helps prevent the spread of fire to adjoining rooms and buildings and never emits toxic gases or vapours when exposed to fire.





Rib-Hordi Roof

ESPAC's Precast Rib-Hordi system is a pre-fabricated structure for floors and roofs which is made from pre-cast Reinforced concrete ribs, PAC blocks, cross ribs and concrete topping for classic construction. It meets the following standards and regulations:

- Hordi Blocks ACI-530.1
- Precast Rib ACI-318
- Concrete ACI-211

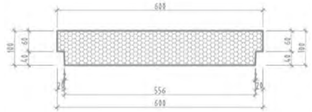
The ESPAC Precast Rib-Hordi roof system is intended primarily for houses, low rise and civil buildings. The static calculation for the Rib-Hordi roof system will determine the size of the ribs, the concrete grade used, the reinforcement requirement and the concrete topping.

Table 7: ESPAC Hordi Block Specifications

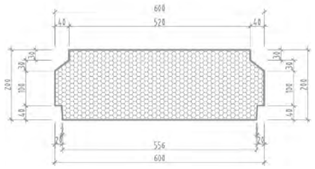
Technical Characteristics	Unit	G4-500/600
Dry Density (Max)	Kg/m^3	500 - 600
Compressive Strength	N/mm^2	5.0
Coefficient of thermal conductivity	W/[m.k]	0.130 - 0.160

Dimensional Data & Delivery Details						
Type	Dimensions HxTxL mm	Pieces/m^2 ceiling	Pieces/ pallet KS/pal	Volume/ pallet m^3/pal	Shipping weight/ Piece	Shipping weight/pallets kg/pal
Hordi Block 200	200x200x600	5.9	70	1.68	15.2	1064
Hordi Block 250	250x200x600	5.9	60	1.80	19.0	1140
Hordi Block 100	100x100x600	1.5	300	1.80	3.8	1140

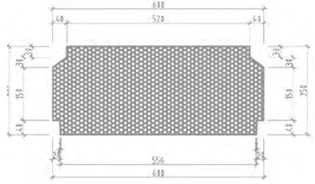
The ceiling area includes transverse ribs at intervals of 1.0 m c/c in this calculation. It can vary as per design requirements.



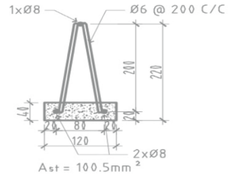
Hordi Block Detail 100mm Thick

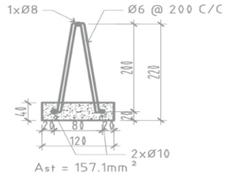


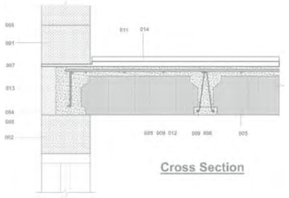
Thordi Block Detail 200mm Thick

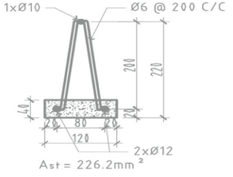


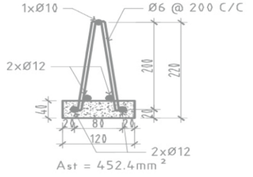
Hordi Block Detail 250mm Thick

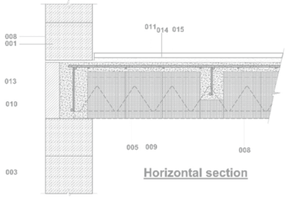


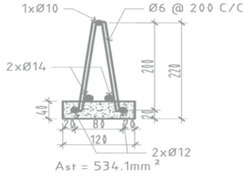


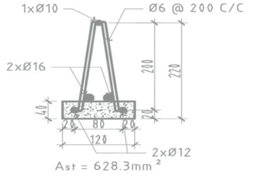


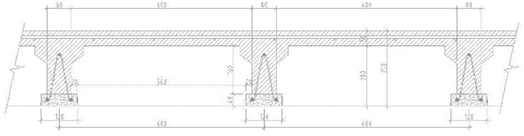












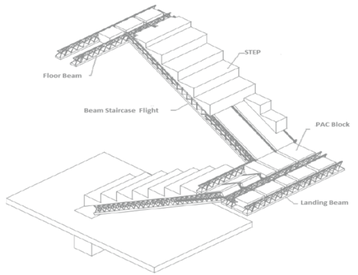
Type of Pre-Cast Rib	Length of Girder (m)	Bottom Reinf. (dia-mm)	Top Reinf. (dia-mm)	Shear Stirrups (dia-mm & spacing mm c/c)	Shape	Weight		Total (kg)	Weight per Pre-Cast Rib (kg)
						Concrete (kg)	Steel (kg)		
PR 1	0.60	208	108	06/200		10	2.50	12.50	
PR 2	1.20	208	108	06/200		10	2.50	12.50	
PR 3	1.80	208	108	06/200		10	2.50	12.50	
PR 4	2.40	208	108	06/200		10	2.50	12.50	
PR 5	3.00	2010	108	06/200		10	2.90	12.90	
PR 6	3.60	2012	1010	06/200		10	3.70	13.70	
PR 7	4.20	2012	1010	06/200		10	3.70	13.70	
PR 8	4.80	2012 + 2012	1010	06/200		10	4.90	14.90	
PR 9	5.40	2012 + 2012 2014 + 2014	2010	06/200		20	12.50	32.50	16.30
PR 10	6.00	2012 + 2012 2016 + 2016	2010	06/200		20	13.80	33.80	16.90

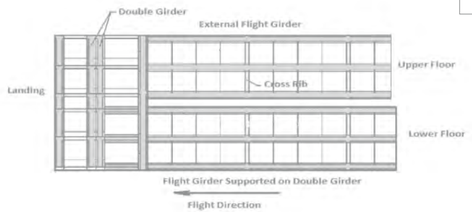
The advantages of Rib-Hordi Roof slabs are:

- Fast, easy and safe installation
- Applicable for large spans (up to 6.0m)
- Applicable for remote areas
- Applicable for locations where crane is inaccessible
- Economical

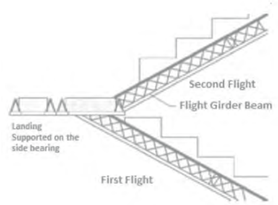
Rib-Hordi Stairs

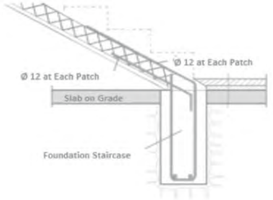
The ESPAC staircase system is made of ESPAC lattice girder beams, PAC blocks, cross ribs and steps. The steps can be manufactured from PAC blocks with a thickness of 30 or 40cm, or constructed with normal concreting of the formwork. With this system, it is necessary to incorporate additional reinforcement joint beams as transverse ribs, in place of appropriate transverse direction main beam girders. Reinforcement of supporting beams is designed solely on the basis of structural analysis.



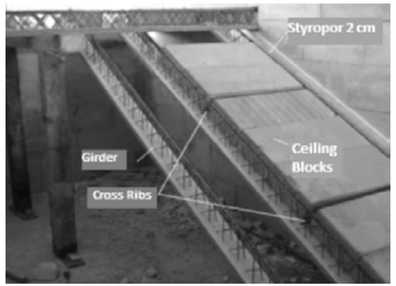


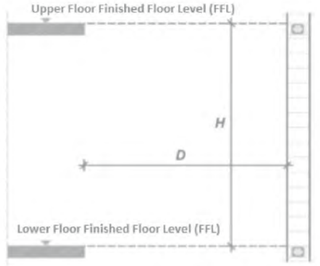
The stairs are connected to the foundation/tie beam using two dowel bars extended and connected to the starter girder of the staircase.





Supports for the landing are preformed along with the masonry construction rather than after the walls are made. The height of the upper edge of the corner construction is the upper floor. This defines an aperture D x H as shown in the diagram





If steps are formed by cutting PAC blocks, the steps are adhesively placed on an AAC thin bed mortar. Temporarily adherence to steps on the slope is provided by nails. The edges of the steps are protected from harm.

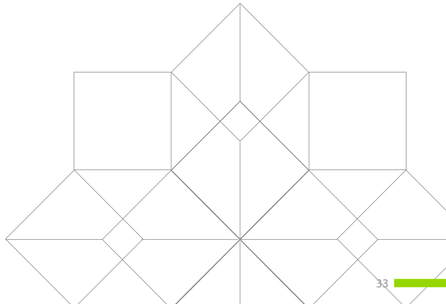
The lintels allow the wall to remain as a homogenous unit, **reducing the risk of material incompatibility.**

Masonry Blocks

Autoclave Aerated Concrete AAC block is considered the best single wall structure when it comes to thermal insulation. ACC is made from lime, sand and cement, to which a frothing agent (aluminium powder) is added to aerate the Concrete. The partially cured concrete is then autoclaved to complete the curing and to promote the formation of a crystalline structure. The aeration and low density (approximately one quarter of the density of standard reinforced concrete) enables blocks to be easily cut, drilled and shaped by hand. Blocks are glued together to form solid Masonry structural walls with excellent thermal and acoustic properties.

PAC lintels are a convenient supplement to the blocks as they eliminate most of the work and inconvenience associated with cast-in-situ concrete lintels. Being of the same material, the lintels allow the wall to remain as a homogenous unit, reducing the risk of material incompatibility.

A range of standard lintels length can be manufactured to bridge most common sized openings for doors and windows up to a maximum clear span of 3 meters. Adequate bearing length should be provided at the end supports and this should not be less than 150mm for infill walls. For load bearing applications, longer bearing lengths will be required.



Architectural Principles

1. Vertical wall panels, floor, roof slabs panels and lintels combine to form complete precast systems as load bearing structure buildings.
2. The maximum span of AAC panels is 6m which means clear span dimensions between the load bearing walls should not exceed 5.80m.
3. A steel or concrete beam must be used to support the slabs if the clear span is more than 5.80m.
4. Direct support of wall panels on floor slabs is not allowed without steel or concrete beam support. However, a 10cm thickness non-bearing partition wall can be directly placed taking into account its land property.
5. 3 m storey heights are preferred to ensure full mould utilization and cost effective solutions. However, other heights are possible.
6. Designs should aim to use 600mm modules for zone dimensions or for windows openings, which means multiples of 1000mm for room sizes and windows in plan.
7. Non-modular window opening widths can be formed with cut panels, preferably widths of 300mm in addition to the standard multiple of 600mm.
8. Doors are generally made to sizes that suit customer requirements. In general, doors should not exceed 2200 mm in height and 1000 mm in width.
9. A.C. units are normally wider than 600mm and pass through (between) wall panels, as this is the most effective and easiest positioning.
10. Exhaust fan ducts are best centred on wall panel joints.
11. Is preferred to be 600 mm for both sides but minimum and supports. 250 to 300mm can also be used us

Structural principles

1. AAC material is approximately one third to one quarter of the weight of conventional concrete, which reduces the foundation requirements. Strip footing is general used for PAC Buildings.
2. Slab on grade should be higher than the external finished ground level so that wall panels are not in contact with soil.
3. Vertical wall panels (VP) are reinforced for load bearing applications. Table 9-1 shows the permissible compressive stress on vertical wall panels (VP) based on ACI codes. Table 9-2 shows the maximum length of VPs & Horizontal Wall Panels (HP) with various design lateral loads.

Table 9-1 Permissible Compressive Stress

Permissible Compressive Stress (Newton/mm^2) for the walls					
Wall Height (m)	Thickness (mm)				
	-	150	200	250	300
2.50	-	0.62	0.91	1.1	1.1
2.75	-	0.48	0.83	1.020	1.1
3.00	-	0.36	0.74	0.96	1.1
3.50	-		0.55	0.81	0.98
4.00	-			0.66	0.86
4.50	-				0.74
5.00	-				0.62

Table 9-2 Maximum Length of Wall Panels with various lateral loads.

Thickness (mm)	**Maximum Length of Wall Panels design wind load (KN/m^2)**			
	0.800	1.4	2.0	2.6
100	350cm	300cm	250cm	
125	400cm	350cm	300cm	250cm
150	450cm	400cm	350cm	300cm
200	600cm	600cm	600cm	600cm
250	600cm	600cm	600cm	600cm
300	600cm	600cm	600cm	600cm

Lintels are used as load bearing members over window and door openings for external or interior walls. Tables 9-3 shows the maximum clear span of lintels in cm with design load.

Table 9-3 Maximum Clear Span of (LP) With Various Design Loads

Design Load(KN/M)	Thickness of Lintel Panel LP (in mm for 600mm height)				
	100	150	200	250	300
5.0	250	450	450	540	600
10.0	200	325	400	450	500
15.0	100	240	320	375	410

PAC slabs attain their design strength during the high pressure steam curing process in autoclaves. Thus slabs can be erected and ready for occupancy use immediately after delivery to the site. Slabs are reinforced with double steel welded mats and anticorrosion coated.

FS & RS slabs are produced in various thickness and spans depending on the required load bearing capacities. The Table 9-4 shows the permissible spans of slabs with different design loads.

Table 9-4 Permissible Spans in meter of Various Slab Thickness and Design Loads

Superimposed Load	Slabs thickness			
(Kg/m^2)	15cm	20cm	25cm	30cm
250	4.45	5.85	6.00	6.00
300	4.25	5.50	6.00	6.00
350	4.00	5.15	6.00	6.00
400	3.80	5.00	6.00	6.00
450	3.65	4.80	5.80	6.00
500	3.50	4.60	5.65	6.00
550	3.35	4.45	5.45	6.00

Slabs can be erected and **ready for occupancy use immediately** after delivery to the site

Approvals & Codes

AAC materials are approved by Saudi Government Authorities including Municipalities, Civil Defence, Royal Commission, Aramco, SCECO, Health Ministry and SASO.

AAC materials are covered by several international codes such as

Manpower

For a three floor residential building preferred crane and manpower is as follows:

Crane 20 ton with its operator	1
Helper for Crane operator & material handling	1
Skilled mason I AAC for erection	1
Labour for Erection	2
Total Manpower	5

Notes

- This team can erect approximately 30 cubic meters per day.
- All PAC material, consumables, tools and auxiliary materials should be on site before work begins.
- Depending on project conditions and requirements, the typical requirement is for a 10-15 ton crane.
- Installation increases slowly reaching to the indicated rate.

Consumables

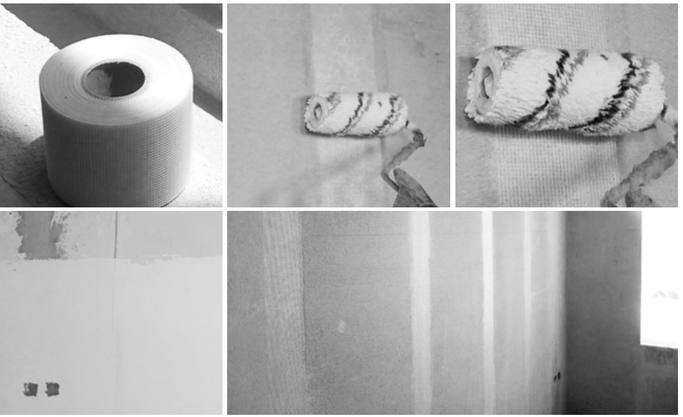
Consumables required are approximately as follows:

- PAC Adhesive mortar: 10 Kg/m^3. (PAC Adhesive mortar = 25 Kg/Bag)
- PAC Repair mortar: 4 Kg/m^3
- PAC Adhesive mortar: 30 Kg/m^3 (For block masonry works)
- Sand paper: 0.06 lm/m^3
- Fibreglass tape:
  For panels 20 thickness: 17 lm/m^3
  For panels 15 thickness: 23 lm/m^3
  For panels 10 thickness: 34 lm/m^3
  Note: 1 roll = 90 lm
- Binding agent for fibreglass tape 0.6 Kg/m^3
- Ring beam steel: 2.2 Kg/m^3 (ø10mm steel)
- Starter bars & top bars: 3.5 Kg/m^3 (ø10mm steel)
- Stretch dowel bars: 0.15 Kg/m^3 (ø6mm steel)
- Grout & ring beam cement: 14 Kg/m^3 cement
- Plastic wedges: 2 pieces/m^3

Tools and Equipment

The following tools are needed for PAC material construction:

1. Hook
2. Wall Brace
3. Lever
4. Nipper
5. Slab Clamp
6. Sling
7. Lintel Grab
8. Saw



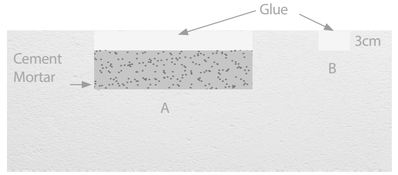


Fig No.1

Repairing

Damaged AAC panels which are structurally defective or which would impair strength of the panel or its structural integrity should be rejected. In addition, any cropped slabs or lintels should be rejected and replaced with new panels. Slight damages such as chipping, small cracks, holes and conduit openings in the panels surfaces or on the edges are normal and can be repaired as follows:

1. Deep holes or deep conduit openings can be filled with ordinary cement mortar mixed with bonding agent. Then paste fiberglass mesh on the repaired surfaces as shown in Figure 1
2. Shallow damages or small openings can be filled with PAC glue mortar directly.

Painting on AAC Wall Panels

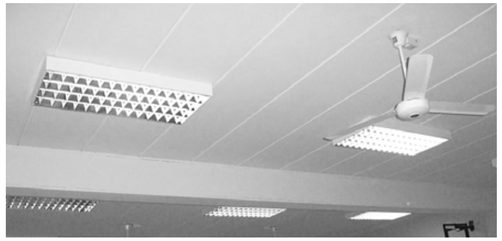
PAC Panels do not need plaster. Finishing work can start immediately after closing all openings and after repairing all damages.

The procedure for painting on PAC walls is as follows:

1. Clean the surface and remove all loose and dirty material.
2. Sand complete surface with sand paper or sand machine. Care should be taken in this process to ensure a good finish on the AAC surface.
3. Clean the surfaces with water and remove the excess dust or powder.
4. Use bonding agent to tape fibreglass mesh on to panel joints and on openings which have been closed or repaired by mortar.
5. Apply primer coat to the surface.
6. Apply two coats of putty to the surface.
7. Apply the last finishing layer which may be paint and/or designed textures.

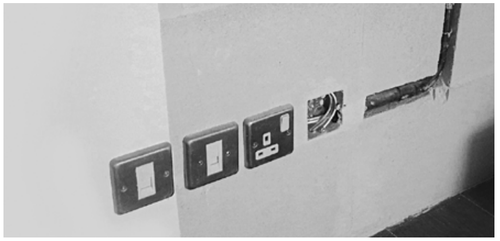
Ceiling

V-grove ceilings can be finished directly with spray paints. However, non V-grove ceilings should follow the same steps as described for the AAC wall panels painting procedure.



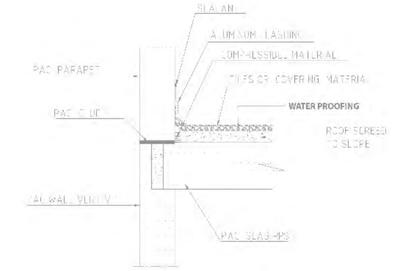
Electrical/ Plumbing Fixture

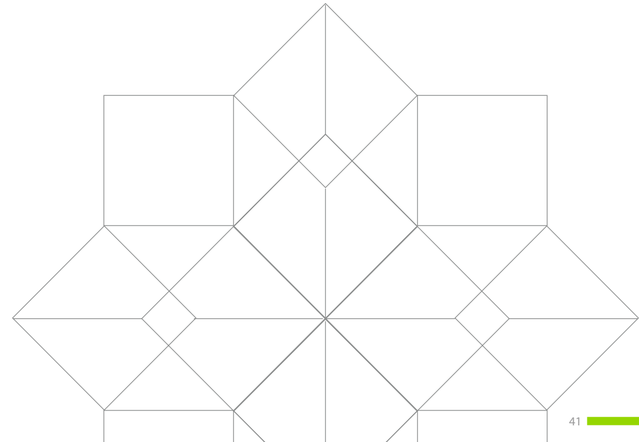
Electrical/ Plumping conduits are cut by hammer or by cutting machine such as a Makita or equivalent



Roof

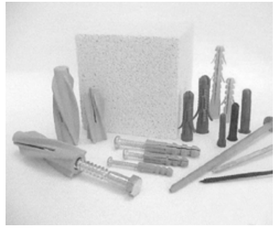
PAC roof slabs need to be made waterproof. Figure 2 shows a typical section of finishing layers on top of PAC roof slabs.

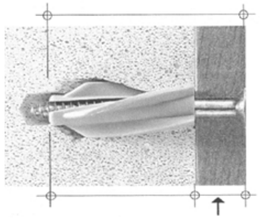




Fixing on AAC material

A bolt with plastic plug is recommended for fixing on AAC materials.
Alternatively use AAC nails.





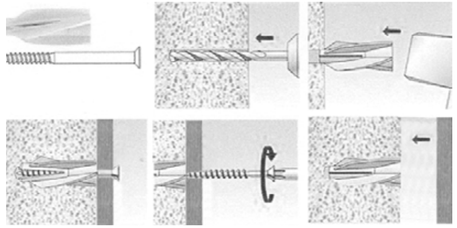
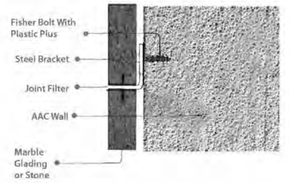
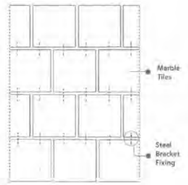


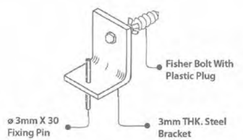
Table 10: Permissible loads of various anchors to AAC:

Type	Designation	Permissible Tension	Permissible Shear
AAC Nails	100mm long	10 kg	25 kg
	125mm long	12 kg	35 kg
	150mm long	18 kg	40 kg
Hilti	HGN 8	30 kg	35 kg
	HGN 10	50 kg	60 kg
	HGN 12	65 kg	70 kg
	HGN 14	80 kg	80 kg
Fisher	S 10	18 kg	40 kg
	S 10 H 90	40 kg	80 kg
	S14	50 kg	100 kg
	S 16	60 kg	120 kg

Marble fixing







Consumables used in erection & finishing works

PAC Glue:

For Panel Fixing

PAC Mortar:

For Block masonry without cement mortar

Repair damaged panels, filling openings & conduct.

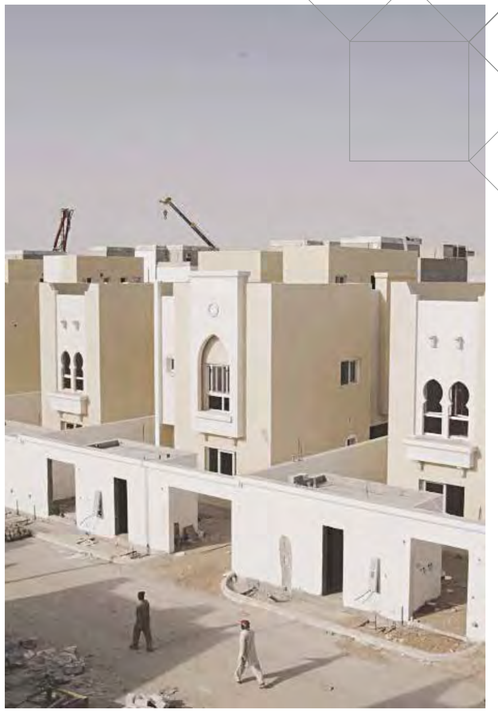
Bounding Agent:

Added to cement mortar for masonary or plastering.

Paste fiber glass.

Project	Client	Contractor	Consultant	Year
Al Zenia Tower	Al DAr	Al Dar Laing O'Rouke	Turner	2009
Burj Al Yaqut	Rasyat Real State	Belbadi	Hanouver	2009
Al Reef Villas	Manazel	Fibrex	Crang & Boake	2009
Park Hyatt Hotel	AHDN/TDIC	Alec	Ehaf	2010
Khalifa Port Industrial Zone	Abu Dhabi ports company	Al Masaood Bergum	Dutco	2010
Mubarak Juma Tower	Mubarak Juma Al Khaily	Al Fusaifesa	Tameer	2010
Yazeem Villas	Private Villa	Al Yazeem constructions	Tameer	2010
Development Projects in Sir Bani Yas	TDIC	ASTCC-LLC	Atkins	2010
Al Falh community	Al Dar	SPK constructions	Turner	2010
United Printing Press Labor Accommodation	United Printing Press	Alba Tech	Tameer	2011
64 Villas In Riyadh	Maskan Arabia	Maskan Arabia	Hatmia	2011
30 Individual Villas	Different Project and Locations			
Export to GCC	Kuwait, Qatar,Oman and Iraq			

Maskan Arabia Project in Riyadh



Al Dar Project





Other Projects





ESPAC

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