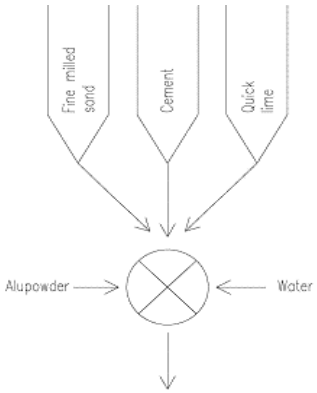
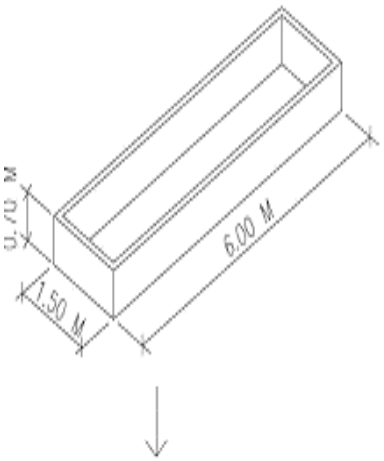
PRODUCTION PROCESS OF AAC (SIMPLIFIED MODEL)



Raw Material

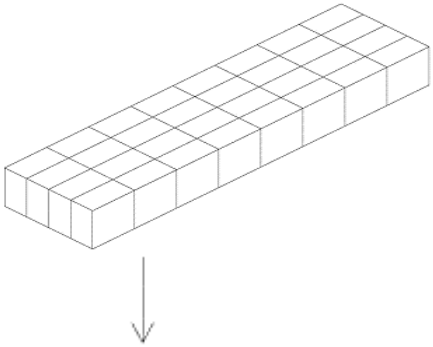
Mixer

Steel mould



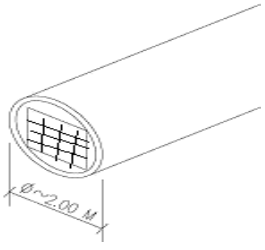
Cast into steel moulds to a high ≈50 cm.
Within ≈10 minutes the reaction of quick lime and Aluminum causes to rise to a height of ≈70 cm. and will increase the temperature of the cake.
Within ≈ 1-3hr. the cement part will prepare the stiffness of the cake for transporting it (without steel mould to the cutting machine)

Cutting machine



Cutting by thin wires in the desired dimensions.

Autoclave



Autoclaving with high steam pressure ≈ 10-12 bars and high temperature ≈200 C.

Unloading and transport on Stock.
(Ready to use)

SOME PRODUCTION KNOWLEDGE OF AUTOCLAVE AERATED CONCRETE

Approximate quantities to produce a G2 with a density ≤ 500 Kg/m3 and a compressive strength ≥ 2.5N/mm2.

≈250 - 300 Kg fine milled sand with high silicate content.

≈ 100 -130 Kg ordinary port land cement.

≈ 70 – 100 Kg quick lime

≈ <1 Kg Aluminum powder

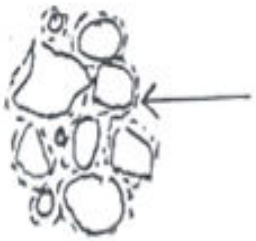
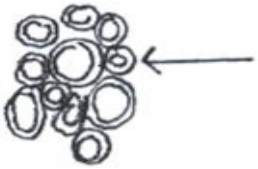
Autoclave curing time ≈ 9-11 h, steam pressure ≈ 10 – 12 bars.

For higher compressive strength like G4 and G6 an increasing of the density (More sand and more cement) is required and the autoclaving time is to extend.

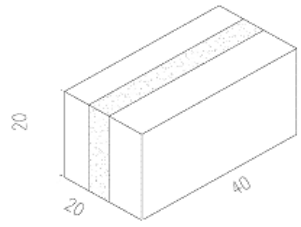
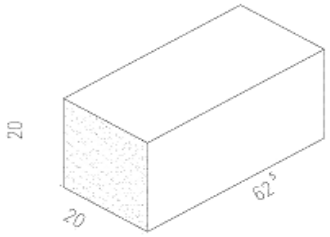
Remarks:

- There could be other recipes, using more lime and reducing the cement.
- Higher lime content tends to less brittleness.
- Higher cement is not so sensitive to frost.

MAIN DIFFERENCES PRODUCING CONCRETE/AAC

CONCRETE	AAC
Aggregates: Gravel & Sands	Aggregates: Gravel & Sands
Binders: Cement,≈250-400Kg/m3	Cement and quick lime ≈ 120/80/Kg/m3
Strength: After mixing the aggregates With cement & water, cement covers all aggregate-surfaces and fix it together after curing time.	There is no covering the tiny fine milled sand-corn with cement because it has the same dimension as the cement-corn. Strength is given by steam-curing autoclaving. (≈10-12 bars and ≈ 200C.)
 Cement glue connected the aggregates and filled pores.	 Crystalline structure (Tobermorite etc) in the tiny pore walls.
Reinforcement: Cement covers the steel bars and protected it against corrosion. (Oxygen can not contact the steel)	No sufficient covering the bars (welded mesh) by cement. So a treatment is required, usually by acrylic or bitumen based protection.

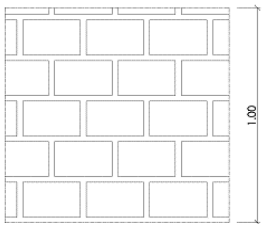
COMPARISON OF INFIL BLOCKS

PROPERTY	SANDWICH BLOCK	SPECTRUM BLOCK
TYPE DIMENSIONS		
WEIGHT / BLOCK	21 Kg	15 Kg
WEIGHT/M2 WALL	≈12	≈7
CUT TO SIZE (SHAPING)	By Hammering	By Saw
LEFT OVER APPROX.	≈ 4% Waste	≈ 2% Waste
APPROX. TIME FOR ERECTION	0.5 h/m2	0.25 h/m2
MORTAR CONSUMP.	≈ 38 1/m2	≈3 1/m2
THERM. TRANSMI. U BLOCK ONLY	.053 W/ (m2 x K)	0.57 W/ (m2 x k)
THERM. TRANSMI. U M2 WALL INCL. JOINTS	1.06 w/ (m2 x K)	0.60 W/ (m2 x K)
FIRE RESISTANCE DIN 4102	≈ 90 MIN. (F90)	≈ 180 MIN. (F 180)
ARCHITECTURE DECORATIONS	Plain walls only	Useful as decoration-Blocks. Mainly for Villas (See Spectrum Details)

THERMAL TRANSMISSION OF 1M2 INFILL MASONRY

(WITHOUT PLASTER OR OTHER FINISHINGS)

A) **SANDWICH BLOCKS** ERECTED BY CEMENT MORTAR



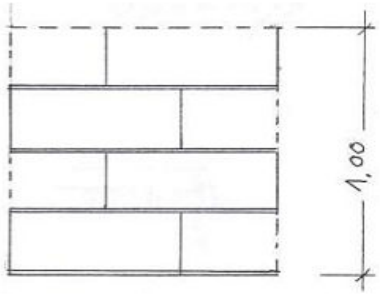
Joint Area:
5 m Horizontal Joints x 0.02m = 0.10m2
3 m Vertical Joints x 0.03 m = 0.09m2
Blocks = 0.035 ⟶ 0.81 m2
Mortar = 1.6 ⟶ 0.19 m2

$$U_B = \frac{1}{0.13 + \frac{0.07}{1.80} + \frac{0.06}{0.035} + \frac{0.07}{1.80} + 0.04} = 0.53 \times 0.81 \text{ m2} = 0.43 \text{ W/ (m1.K)}$$

$$U_M = \frac{1}{0.13 + \frac{0.20}{1.60} + 0.04} = 3.34 \times 0.19 \text{ m2} = 0.63 \text{ W/ (m2.K)}$$

AVERAGE TRANSMISSION = 1.06 W/(m2.k)

B) **SPECTRUM BLOCKS** ERECTED BY THINBED MORTAR



Joint Area:
5 m Horizontal Joints x 0.02m = 0.10m2
3 m Vertical Joints x 0.03 m = 0.09m2
Blocks = 0.035 ⟶ 0.81 m2
Mortar = 1.6 ⟶ 0.19 m2

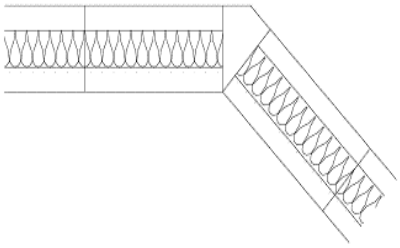
$$U_B = \frac{1}{0.13 + \frac{0.02}{0.13} + 0.04} = 0.58 \times 0.992 \text{ m2} = 0.57$$

$$U_M = \frac{1}{0.13 + \frac{0.20}{1.60} + 0.04} = 3.34 \times 0.008 \text{ m2} = 0.03$$

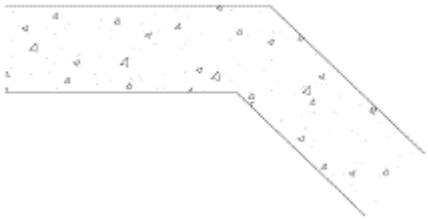
AVERAGE TRANSMISSION = 0.60 W/ (m2.K)

SANDWICH BLOCK – INFILL **SPECTRUM BLOCK – INFILL**

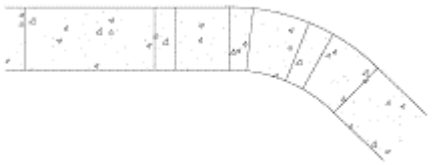
1. Shaping Infill (Blocks) in case of not straight walls.



Impossible

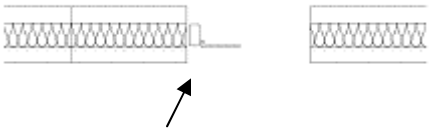


Bonding by overlapping



2. Openings (Windows) situations

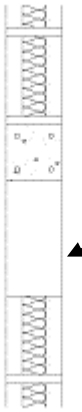
Not covered insert



Fixing Frames?

Horizontal section

Easy fixing by plug



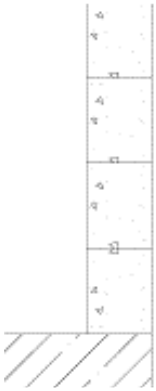
Concrete lintel shuttering reinforcing casting time thermal bridge

Spectrum lintel fast, easy no thermal bridge

Vertical Section

3. Infill – Masonry Stability

As per DM Approval: All third coursed a galvanized mesh reinforcement is to embedded.



Glue mortar in horizontal joints only

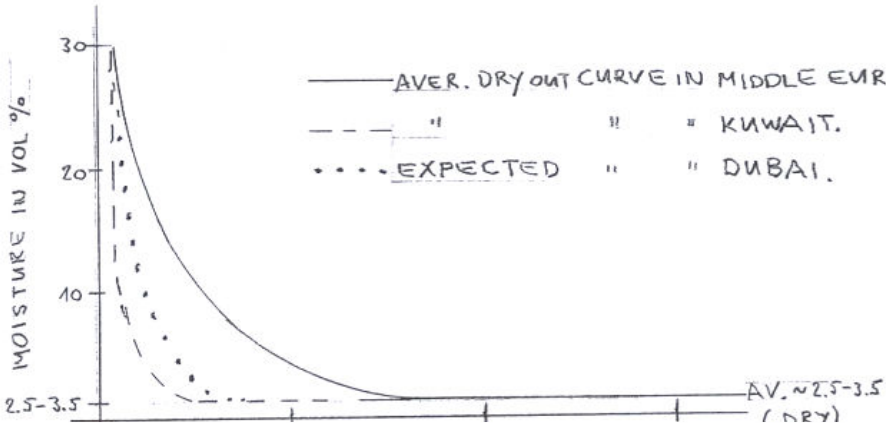
MOISTURE BEHAVIOR OF AAC

Directly after production (Autoclaving), AAC has a high moisture content of ≈ 20-30 volume % (≈40-60% by mass)

The dry out is mainly depending on the climate conditions. The dry out process starts immediately after autoclaving. Weather, rain, temperature exterior/interior, plasterwork etc. have an influence on the dry out.

The equalized moisture content is ≈ 2.5 – 3.5 volume % (Very dry) **IN EACH** case AAC will reach this level, it is only a matter of time.

The curve below is based on international research.

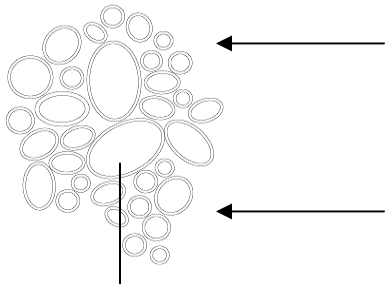


Remarks:

During wintertime in the U.A.E. it is expected to have a similar dry out process as found in Kuwait. In summertime the dry out period can be longer due to higher humidity.

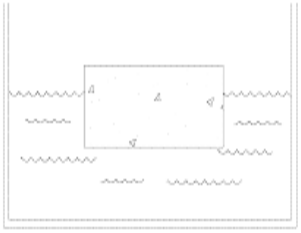
WATER ABSORPTION OF AAC

Each mineral based building material has water absorption, depending on its structure. Compare to many other products (Clay-bricks, Sand-lime blocks, Cement Blocks, Gypsum etc). The absorption factor of AAC is not high because the material has less capillary.



Tiny walls around the pores formed by crystalline-structure (Tobermorite) nearly no capillary.

But after cutting, the open pores absorb a lot of water. This leads on the surface to moisture of ~ 1-2 cm deep.



Put a **DRY** SPECTRUM AAC Block into a container with water. The block will float for a longer period of time because of less water transport/absorption.

WORKMANSHIP – NOTES:

ORDINARY PLASTER WORK

The wall surface is to be wet before applying plaster, mortar etc.

SPECTRUM EXT. PLASTER GYPSUM PL., THINBED-MORTAR + TILE GLUE

We recommend wetting the surfaces in summertime due to high Temperatures and directly exposure to intensive sunlight.

SHRINKAGE BEHAVIOR OF AAC

The shrinkage of AAC almost depends on the materials dry out. Most of the shrinkage movements are in the last stage of the dry out period. This is approximately 10 volume % 3.5 vol.% ⟶

It is always less than 1 mm/m.

The shrinkage of AAC is generally less then that of normal concrete.

The dry out situation of AAC mainly depends on local climate conditions.

Sample:

- Dry out time in Europe ≈ 12 – 24 months
- Dry out time in Kuwait ≈ 1 – 2 months
- Expected dry out time in U.A.E ≈ 4 – 8 months

ARGUMENTS FOR CUSTOMERS: SAVING ENERGY & COST FOR AIR CONDITION

Assumptions:

- Villa 15 x 15 m, 2 floors ⟶ overall wall surface = 360m2
- 240 m2 of this infill masonry (other are openings beams, columns)
- Cost of 240 m2 infill with 20cm AAC Blocks x 60Dhs/m2 = 14,400 Dhs
- Cost of 240 m2 infill with 20cm sandwich blocks x 48Dhs/m2 = 11,520 Dhs

Difference with Sandwich Blocks	2,800 Dhs

*** Cost June 06 AAC AED 300/m3; Sandwich AED 240/m3**

THERMAL TRANSMITTANCE

SPECTRUM BLOCKS

- Thermal Conductivity φ = 0.13 W /(M2.K)
- Thermal Transmittance
  U – Value for 20cm thick wall = 1/(0.04 + 0.2/0.13 + 0.13) = 0.58W/(M2.k)

SANWICH BLOCKS

- Thermal Conductivity φ = 0.13 W /(M2.K)
- Thermal Transmittance
  U – Value for 20cm thick wall = 1/(0.04 + 0.2/0.35 + 0.13) = 1.35W/(M2.k)

- Air Condition works for 270 days (9 months x 30 days) x 24 Hrs = 6,480 hrs
- Temperature difference interior/Exterior average 21°C / 35°C = 14°C
- Cost of Electricity = 0.15Dhs/kwh (Abu Dhabi)

  = 0.20Dhs/kwh (Dubai)

ENERGY CONSUMPTION - YEARLY COST (ABU DHABI RATES)

SPECTRUM BLOCKS

*240m2 x 6480 hrs x 14°C x 0.58 W/(m2.k)/1000 = 12,268 x .15Dhs = 1,894.20Dhs

SANDWICH BLOCKS

*240m2 X 6480 hrs x 14°C x 1.35W/(m2.k)/1000 = 29,393 x .15Dhs = 4,408.95Dhs

Difference (Saving) 2,514.75Dhs

ENERGY CONSUMPTION - YEARLY COST (DUBAI RATES)

SPECTRUM BLOCKS

*240m2 x 6480 hrs x 14°C x 0.58 W/(m2.k)/1000 = 12,268 x .20Dhs = 2,453.60Dhs

SANDWICH BLOCKS

*240m2 X 6480 hrs x 14°C x 1.35W/(m2.k)/1000 = 29,393 x .20Dhs = 5,878.60Dhs

Difference (Saving) 3,425.60Dhs

***within one year, the owner will save more than his investment**
*** Every consecutive year is a saving**
*** Within five years SPECTRUM Blocks are free of cost**