construction systems

aerated concrete block (AAC)

Autoclaved Aerated Concrete (often shortened to 'AAC') is effectively concrete with lots of bubbles in it. It is lightweight and energy efficient and is produced by adding a foaming agent to concrete and 'cooking' it with steam (autoclaving), after which blocks or slabs are wire cut from the resulting 'cake'.

The use of AAC in Australia is not yet widespread but aerated concrete blocks have been used in Europe for more than 50 years. While it is a relatively high energy material, AAC performs very well as thermal and sound insulation and provides moderately good thermal mass. It does not burn, is light and can carry quite large loads. It is relatively easy to work with and can be cut and shaped with hand tools. Blocks are made to very exacting dimensions and are usually laid in thin-bed mortar that is applied with a toothed trowel, although more conventional thick-bed mortar can be used. AAC has a long life and does not produce toxic gases after it has been put in place.

PERFORMANCE SUMMARY

APPEARANCE

Autoclaved Aerated Concrete is very light coloured. It contains many small air bubbles (similar to those in aerated chocolate bars) that can be clearly seen when looked at closely. The bubbles contribute to the material's insulating properties and also its porous nature. AAC can be sculpted with wood working tools but its softness means that it is rarely used an exposed finish owing to its need for surface protection.

STRUCTURAL CAPABILITY

The compressive strength of AAC is very good and load-bearing structures up to 3 storeys high can be safely erected. Entire building structures can be made in AAC from walls to floors and roofing with reinforced lintels, floor slabs and roofing panels available from the manufacturers. AS 3700—2001 now includes provisions for AAC block design. AAC panels and lintels contain steel reinforcement to ensure structural adequacy during installation and design life. [See: Construction Systems]

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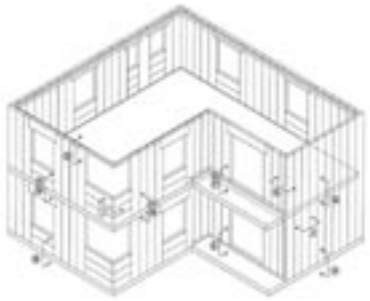
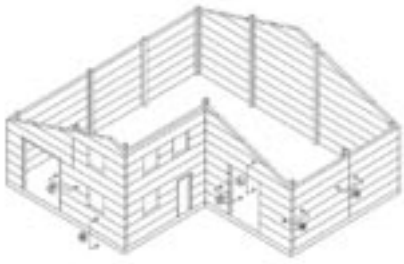
Block construction



HEBEL

Vertical wall panel construction



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Horizontal wall panel construction

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Floor panel construction

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Veneer construction

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Block construction showing two storey house

THERMAL MASS

The thermal performance of AAC, as for other high-mass materials, is dependent on the climate in which it is used. With its mixture of masonry and air, AAC has a moderate overall level of thermal mass performance. The temperature moderating thermal mass is most useful in climates with high cooling needs. [See: Thermal Mass]

INSULATION

AAC has reasonably good insulation qualities. In most Australian climates the need for supplementary insulation can be avoided. A 200mm thick AAC wall gives an R rating of 1.67 which is a lower insulation value than a well insulated, timber-framed structure but the combination of thermal mass and insulation offered by AAC can deliver savings in heating and cooling costs through the life of a home. Walls of 250mm can provide a very good thermal performance in much of Australia. [See: Insulation Overview]

Load-bearing, insulating and capable of being 'sculpted', AAC has enormous potential as an environmentally responsible building material choice.

SOUND INSULATION

With its closed air pockets, AAC can provide very good sound insulation. As with all masonry construction, care must be taken to avoid cracks and open or unfilled joints that can allow unwanted sound transmission. [See: Noise Control]

FIRE AND VERMIN RESISTANCE

AAC is inorganic and incombustible and is thus especially suited for fire-rated applications. Depending on the application and the thickness of the blocks or panels, fire ratings up to 4 hours can be achieved. AAC does not harbour or encourage vermin.

DURABILITY AND MOISTURE RESISTANCE

The purposely lightweight nature of AAC makes it prone to impact damage. With the surface protected to resist moisture penetration it is not affected by harsh climatic conditions and will not degrade under normal atmospheric conditions. The level of maintenance required by the material varies with type of finish applied.

The porous nature of the material means that it can soak up moisture. Appropriate design can avoid this. AAC will not easily degrade structurally when exposed to moisture but its thermal performance may suffer.

There are a number of proprietary finishes available (acrylic polymer) which when mixed with sand and cement provide a very durable and water resistant coating to AAC blockwork. They are relatively inexpensive when they are applied as a bagged finish. They need to be sealed in a similar fashion with acrylic polymers in wet areas such as showers prior to tiling. Appropriate formulations need to be obtained from the manufacturers but mixtures of 50% water and 50% acrylic modifier will give good water repellant properties prior to tiling in wet areas.

Plasticised, thin coat finishes are common but here a non-pasticized thick coat (10mm approximately) render was used for environmental reasons. Some variation in the amount of 'show-through' of the blockwork pattern can be seen in this example that also illustrates the use of glass blocks as well as more conventional windows. The external plumbing was a choice made to reduce loss of internal space, avoid potential problems with wall cavities, and express the decision to avoid the use of PVC plastic in the construction.

TOXICITY AND BREATHABILITY

The porous nature of the material facilitates breathability. There are no toxic substances and no odour in the final, inert product. However, the fine cementitious dust requires the wearing of masks during cutting and sanding, and/or use of wet cutting techniques. From an occupant health perspective, AAC has the advantage of being an inert material, replacing the framing and sometimes problematic fibres of a stud wall. If low-toxic coatings are used on the walls and care is taken not to trap moisture where it can condense, AAC may be an ideal material for homes for the chemically sensitive. [See: Indoor Air Quality]

SUSTAINABILITY (ENVIRONMENTAL IMPACTS)

Weight for weight, AAC has manufacturing, embodied energy and GH emission impacts similar to those of concrete but can be up to one quarter to one fifth that of concrete based on volume. Its much higher insulation value reduces heating and cooling energy consumption. AAC has some significant environmental advantages over conventional construction materials addressing longevity, insulation and structural demands in one material. As an energy and material investment it can often be justified for buildings intended to have a long life. [See: Material Use Introduction]

Off-cuts from construction can be returned to the manufacturer for recycling, or be sent out as concrete waste for re-use in aggregates, or the odd pieces can be used directly for making other walling, eg. Garden walls or landscape features. In this illustration there is a clear difference between the lower course and higher course of blockwork in the AAC apartment building under construction – this shows the kind of difference in quality that can be derived from the same material by differently skilled tradespeople.

BUILDABILITY, AVAILABILITY AND COST

Blocks are one-fifth of the weight of concrete and are produced in a variety of sizes, but although AAC is relatively easy to work, is light and easily carved, cut and sculpted, it generally requires careful and accurate placement so that skilled trades and good supervision are essential. Competent bricklayers or carpenters can work successfully with AAC. Very large block sizes may require two-handed lifting and be awkward to handle but can result in fewer joints and more rapid construction.

Autoclaved Aerated Concrete is about one-fifth the density of normal concrete blocks.

Withdrawal of one of the two manufacturers from the Australian market leaves the source of AAC on the east coast, adding cost and potential logistical difficulties to central and western locations. The cost of AAC is moderate to high. In Australia, AAC is competitive with other masonry construction but more expensive than timber frame. Lack of competition in the marketplace makes consumers highly dependent on one manufacturer.

TYPICAL DOMESTIC CONSTRUCTION

CONSTRUCTION PROCESS

All structural design should be prepared by a competent person and may require preparation or checking by a qualified engineer. Qualified professionals, architects and designers provide years of experience and access to intellectual property that has the potential to save house builders time and money as well as help ensure environmental performance. All masonry construction has to comply with the Building Code of Australia and relevant Australian Standards, eg. all masonry walls are required to have movement/expansion joints at specified intervals.

The standard block size is 200mm high by 600mm long (there was also a block 256mm high on the Australian market until recently). Block thickness can range from 50mm to 375mm but for residential construction the most common block widths used are 100mm, 150mm and 200mm. AAC blocks can be used in a similar manner to traditional masonry units like bricks and be used as a veneer in timber frame and as one or both skins in cavity wall construction. AAC panels may also be used as a veneer in timber-framed construction.

AAC manufacturers provide a wealth of detailed technical advice that, if followed, should help to ensure successful use of the product.

FOOTINGS

AAC block construction requires level footings designed for full or articulated masonry in accordance with AS 2870. Stiff footings are preferred because the wall structure of thin-bed AAC acts as if it were a continuous material and cracking tends not to follow the mortar beds and joints like it does in traditional masonry walling. Thick-bed mortar AAC walls do act more like traditional masonry but are not the preferred method for AAC.

FRAMES

Frames may be required for various structural reasons. Earthquake provisions tend to require multi-storey AAC structures to have a frame of steel or reinforcement to withstand potential earthquake loads that may induce strong, sharp horizontal forces. It is a relatively simple matter to build AAC block work around steel frames but embedding reinforcement rods can be costly and difficult.

LOAD BEARING WALLS

AAC is available in blocks of various sizes and in larger reinforced panels. These are sold as part of a complete building system that includes floor and roof panels in addition to interior and exterior walls.

JOINTS & CONNECTIONS

AAC manufacturers provide proprietary mortar mixes. Although more conventional thick-bed (10mm approx.) mortar can be used with AAC, the preferred option is 'thin-bed' mortar. Using thin-bed mortar the procedure of laying the blocks is more like gluing than conventional brick laying. This is why many traditionally trained bricklayers may experience a need for a period of adjustment to a different method of working. In addition, brickies are used to lifting bricks with a single hand and AAC blocks often require two-handed manipulation.

AAC is laid in a similar manner to conventional masonry. This illustration shows 'thick-bed' mortar (about 10mm) being used, but thin-bed AAC joints are only 2mm or so and the end result behaves more as a monolithic wall.

FIXINGS

AAC is very friable (easily crumbled). It is therefore important to provide fixings that are designed to accommodate the nature of the material by spreading the forces created by any given load, whether it is a beam, shelf or a picture hook. There are a number of proprietary fixings for AAC with extensive guidance available in product literature. In the event of uncertainty regarding the appropriateness of a fixing an engineer or skilled builder should be consulted.

OPENINGS

AAC is soft enough to be cut with hand tools. Niches can be carved into thicker walls and corners can be chamfered or curved for visual effect. Channels for pipes and wires are easily made with an electric router but with all carving and cutting care must be taken to use appropriate dust reduction strategies and masks should be worn at all times.

This dry-lined interior shows how AAC can be exploited to make niches and unusual openings.

FINISHES

AAC blockwork and panels can accept conventional cement render but the manufacturers recommend using a proprietary render mix. These mixes can be based on traditional cement renders or be more similar to plasticised paint. All renders should be vapour permeable (but water-resistant) to achieve a healthy breathable construction. All external finishes should provide good UV resistance and be proven suitable for AAC.

ADDITIONAL KEY REFERENCES

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