

Clay Brick

Clay brickwork is made from selected clays that are moulded or cut into shape and fired in ovens. The firing process transforms the clay into a building component with high compressive strength and excellent weathering qualities, attributes that have been exploited for millennia to build structures ranging from single-storey huts to enormous viaducts. Clay brickwork is Australia's most widely used external cladding and loadbearing wall medium.

Clay bricks are readily available, mass-produced, thoroughly tested modular building components. Their most desirable acoustic and thermal properties derive from their relatively high mass. Clay bricks are generally affordable, require little or no maintenance and possess high durability and load bearing capacity. The use of clay brickwork is informed by extensive Australian research, manufacturing and construction experience.

PERFORMANCE SUMMARY

Appearance

Clay brickwork is available in a wide variety of natural colours and textures derived from fired clay used in combination with cement mortar joints of various colours and finishes. Bricks remain stable and colour-fast and do not need to be rendered or painted. Clay brickwork is most commonly used uncoated to display the richness and texture of the material.

Structural capability

The high compressive strength of fired clay bricks has been exploited for millennia to build structures ranging from single-storey huts to massive public buildings and enormous bridges and viaducts.

Clay brickwork walls can support relatively high loads such as suspended concrete slabs. Clay brickwork is commonly used in four storey construction and with suitable detailing can be used for load bearing walls in much higher buildings. Clay bricks are manufactured under close controls to the requirements of AS/NZS

4455 Masonry units and segmental pavers and AS 3700 provides the means of determining the strength of clay brickwork walls when subjected to horizontal loads resulting from wind, earthquake or fire. [See: 5.5 Construction Systems]

Thermal mass

Clay brickwork has high thermal mass. If a building with internal clay brickwork walls and concrete floors is subjected to a heating and cooling cycle that crosses the comfort zone, the brickwork and concrete will maintain a relatively stable level of heat energy for an extended period. In summer, they will remain relatively cool and in winter, the same building will remain relatively warm. [See: 4.9 Thermal Mass]





Reverse brick veneer

Conventional brick veneer construction places the high mass of brickwork on the outside of the building, where it contributes little to the thermal performance of the building and fails to take maximum advantage of the inherent properties of brick other than its capacity for long life and low maintenance.

Despite its popularity in the mainstream marketplace, conventional brick veneer is not an ideal construction system for climate responsive design.

On the other hand, reverse brick veneer, in which the brickwork is the inside skin of an otherwise conventional stud framed construction, takes advantage of the thermal mass properties of clay brickwork and can result in high performing buildings with lower than average energy demands for both heating and cooling.

Insulation

Clay brickwork, combined with internal and external air films and a cavity, has moderate thermal resistance. Typical R-values are shown below.

The thermal resistance of clay brick veneer or cavity walls can be greatly enhanced by adding foil or bulk insulation. Wall insulation should be accompanied by appropriate detailing to avoid thermal transfers by bridging through window and door frames, by radiation through window openings or by convection through leakage. [See: 4.7 Insulation]

Sound insulation

Due to their mass, clay bricks provide excellent sound insulation, particularly for low frequency noise.

The Building Code of Australia has specific requirements for sound attenuation for multi-unit dwellings which can be satisfied by two leaves of 110mm clay brick masonry with cavity of 50mm between leaves and 13mm cement render on each outside surface. [See: 2.7 Noise Control]

Toxicity and breathability

Clay bricks are inert and are not prone to off-gassing of volatile materials. Clay brickwork and its constituents are non-toxic, however when handling cement (used in the mortar) or cutting brickwork with a masonry saw, manufacturers' safety procedures must be observed to minimise the risk of skin irritation and lung damage.

Fire resistance

Clay bricks are an excellent medium for achieving fire resistance, with their design for fire covered by Australian Standard, AS 3700.

Clay brickwork does not burn when exposed to bushfire and can help protect the more combustible items inside a house.

DESIGN OF CLAY BRICKWORK FOR FIRE		
Fire resistance period (minutes)	Required material thickness for insulation (mm)	Maximum slenderness for structural adequacy (mm)
30	60	25.0
60	90	22.5
90	110	21.0
120	130	20.0
180	160	18.0
240	180	17.0

THERMAL RESISTANCE, R, OF CAVITY BRICKWORK				
Description of cavity brick wall				
Brick width / cavity / brick width (mm)	90 /50/90	110/50/110		
Description of bricks				
Bulk density of bricks (kg/m ³)	1690	1950	1690	1430
Thermal conductivity of bricks, k (W/m.K)	0.653	0.547	0.653	0.778
Thermal resistance, R (m ² K/W)				
External air-film	0.03	0.03	0.03	0.03
External leaf of brickwork	0.14	0.14	0.17	0.20
Cavity	0.16	0.16	0.16	0.16
Internal leaf of brickwork	0.14	0.14	0.17	0.20
Internal air-film	0.12	0.12	0.12	0.12
Total thermal resistance of wall, R (m ² K/W)	0.59	0.59	0.65	0.71

Adapted from AS3700.



Vermin resistance

Clay brickwork consists of dense inorganic materials that do not harbour vermin. Termite resistance may be achieved in a variety of ways, including proprietary termite barriers developed for use with clay brickwork.

Durability and moisture resistance

Clay brickwork is extremely durable. AS 3700 masonry structures tables provide the prescriptive requirements for bricks, mortar, built-in components and reinforcement to achieve various levels of durability.

Clay brickwork walls resist the penetration of rainwater, including wind-driven rain, although they are not completely waterproof. Some moisture may eventually soak through the mortar joints. For this reason external clay brickwork is generally constructed as either cavity walling (two leaves of brickwork separated by ties) or brick veneer (one leaf of brickwork separated from, but tied to a structural frame – may be reversed).

Detailing for clay brickwork needs to incorporate:

- > Damp-proof courses.
- > Flashings.
- > Weep holes.

Environmental impacts

Clay brick manufacture uses energy but the investment of embodied energy is repaid by the longevity of the material. Clay brick homes have a long life, low maintenance requirements and are highly recyclable making them a potentially sustainable form of construction.

Clay bricks can often be reclaimed for re-use when a building is demolished. After cleaning they can either be directly re-used as bricks again, or they can be crushed for making path and road surfaces. Because of their inert, inorganic nature, another use for crushed clay

bricks is as part of the mix for the growing medium of extensive green roofs. [See: 5.13 Green Roofs and Walls]



Buildability, availability and cost

As a result of the long history of cavity brick and brick veneer construction in Australia, there is a huge body of knowledge and experience on construction standards and techniques.

Clay bricks are manufactured throughout Australia and are available at competitive prices throughout the whole of Australia. Even in remote areas, clay bricks can be supplied at moderate prices due to the wide availability of truck transport and back-loading opportunities. Consideration should be given to transport energy costs for any long-distance movement of heavy material. [See: 5.2 Embodied Energy]

TYPICAL DOMESTIC CONSTRUCTION

Typical details

AS 3700 Masonry structures and the BCA Volumes 1 and 2 provide the regulatory framework for the design and construction of clay brickwork. Think Brick Australia (formally Clay Brick and Paver Institute) and many of the brick manufacturing companies publish design manuals and standard details.

Footings

For clay brickwork houses, concrete footings and concrete raft slabs should comply with AS 2870 Residential slabs and footings. This standard has been based largely on the behaviour of clay brickwork houses. Footings for brick veneer buildings are generally smaller than the corresponding footings for cavity brickwork.

For other clay brickwork buildings, concrete footings and concrete slabs should be designed and constructed in accordance with AS 3600 Concrete structures.

Frames

For brick veneer and reverse brick veneer houses, frames provide the required strength and stability. Timber frames should comply with AS 1684 Residential timber framed construction and steel frames should comply with AS 3623 Domestic metal framing.



In architecturally designed homes the use of frames and clay brick walls may more freely exploit the qualities of bricks to achieve particular design outcomes.

Loadbearing walls

Critical to the function of any building is the ability of the walls to support suspended floors in addition to the roof and walls in the storeys above. In most cases, the inclusion of concrete floor slabs dictates the use of loadbearing masonry. Think Brick Australia provides comprehensive manuals with charts and tables for the design of loadbearing clay brickwork walls.

Fixings

Major anchorages (such as roof tie-down anchorages) should be built into brickwork during construction. For high wind uplift, anchorages should pass down the brickwork cavity and be tied into supporting concrete slabs or footings. Windows and doors may be built into brickwork by setting the attached ties in the mortar joints.

Minor anchorages (such as hanging light loads from walls) may employ any of the wide range of commercially available proprietary mechanical or chemical anchors. These are set in holes drilled using a hammer drill of the appropriate size. If set into brick rather than mortar, higher anchorage strength can be achieved.

OPENINGS

Most commercially available doors and windows are manufactured to be compatible with clay brickwork, either in veneer or cavity construction. CAD and hard copy details that provide information on the required sizes of openings and fixing information are available from window manufacturers and on the internet.

Finishes

External face clay brickwork capitalises on the broad variety of colours, textures and finishes of Australian bricks, mixed and matched with coloured or plain mortars in struck, ironed, pointed or raked joints.

Clay brickwork is often used for internal feature walls – a particularly appropriate approach for reverse brick veneer construction. Internal brickwork, loadbearing walls, firewalls and acoustic partitions may also be painted, rendered or sheeted with plasterboard.

ADDITIONAL READING

Think Brick Australia publications
www.thinkbrick.com.au

Energy Smart Housing Manual, Victorian Government
www.sustainability.vic.gov.au/resources/documents/ESHousingManualCh061.pdf

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