

FROM HOLLOW BRICK TO BRICK VENEER

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ABSTRACT The cavity or hollow brick wall, long thought by Australians to be a local innovation, and designed primarily to prevent water penetrating external walls, is traced to its English origins. It is shown to be the end product of an evolution through partially hollow walls achieved by special patterns of laying, and double-leafed walls with bonding blocks or bricks, to walls with various forms of iron tie. These tied walls are shown to be the true antecedent of modern Australian brick veneer construction, as distinct from the United States version, which is part of a local tradition of timber sarked walls to which various surfaces - in this case a leaf of brick - are applied. Australian examples have been found at early dates, and especially after the turn of the century, but it appears to have been in 1928 that brick veneer was established in its canonical form.

Note: although metric dimensions are used in this paper the terms 4 1/2 inch, nine inch, fourteen inch, are used in the established way to describe walls of one, two and three bricks thickness.

1. EARLY FORMS OF HOLLOW WALLING IN BRITAIN

Although there were early experiments in the use of hollow terra cotta blocks for walling, there is only scattered evidence of true brick walls being formed with cavities inside them during the first half of the nineteenth century. In 1850 C.B. Allen, the English writer on cottage building, stated:

Mr Loudon is probably correct in fixing the minimum thickness of external walls in this country, for human habitations, at 18 inches: but indeed nothing less than a series of experiments with walls of different materials and different thicknesses can satisfactorily determine these matters. Some singular and unexpected results would probably arise. (1)

Nevertheless Loudon himself had published various ingenious and much less substantial systems of walling, and Allen had copied them. In Victoria Charles Mayes used Allen's work as the basis for his remarks on hollow walls in the Australian Builders' Price-Book. Though he does mention hollow walls in nine, eleven, twelve and fourteen inch thicknesses, it is clear that he is not referring to true cavity walls. (2) According to Freeland two types of hollow wall, Dearn's and Loudon's, were known in Australia in 1854. (3) There is no positive evidence that these were actually used in Victoria, but Silverlock's certainly was.

The first hollow wall was developed by one Silverlock of Chichester, and by the 1860's was in frequent use in the southern counties of England. It was simply a nine inch wall in Flemish bond with the bricks laid on edge rather

than flat, and as both faces were flush this meant that there was a cavity of about 76 mm between parallel stretchers, though headers passed from one face to the other. A wall of this type, clearly intended for improved insulation, has recently been identified in a meat house at Bacchus Marsh, Victoria, thought to date from the mid-1850's, (4) and at least three others, probably of the 1860's, exist at Beechworth. (5)

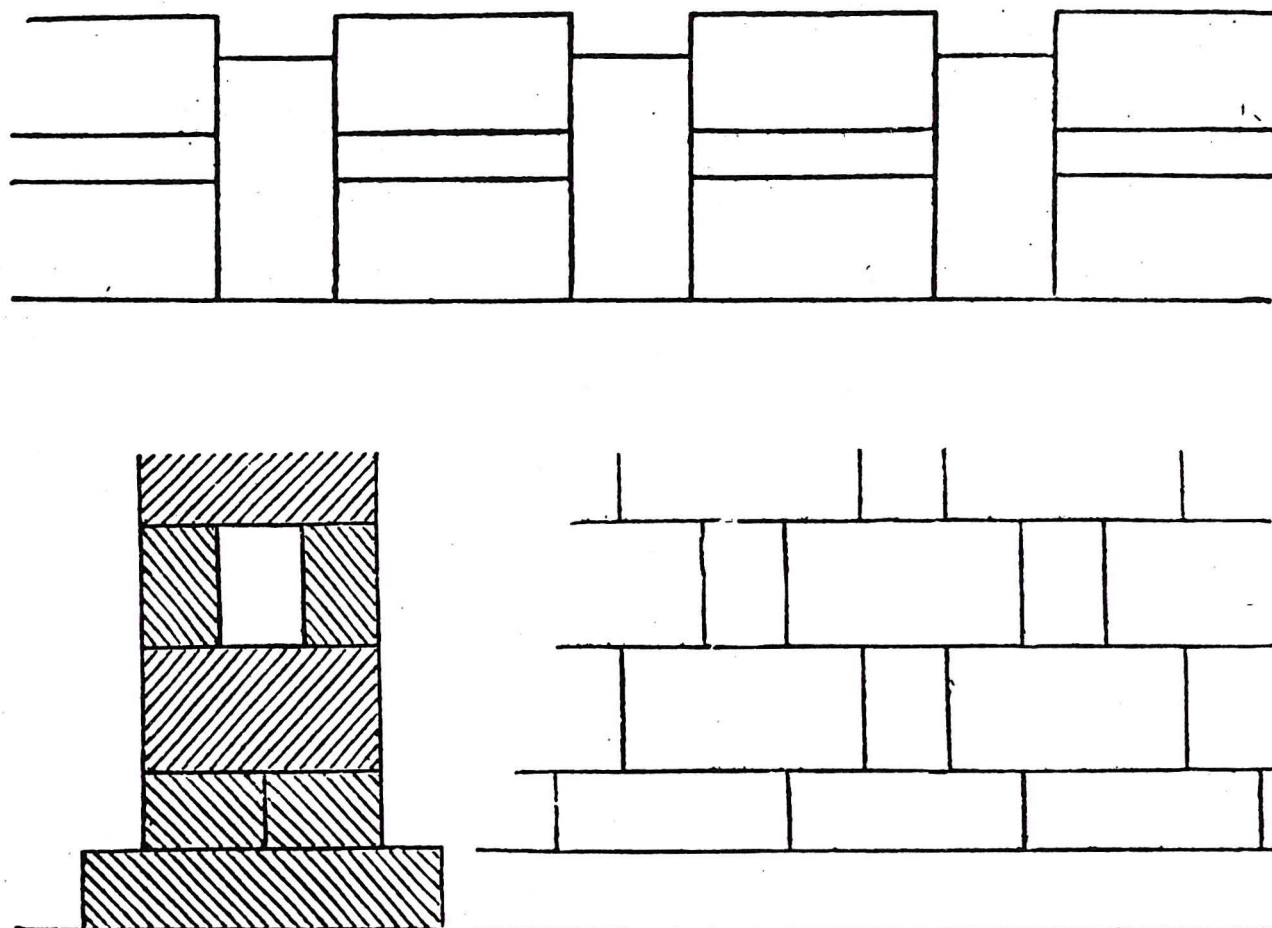


Fig. 1. (Top) Loudon's hollow brick wall, eleven inches thick, plan. (Bottom) Silverlock's wall, nine inches thick, section and elevation. Allen, Cottage Building, pp 35, 34.

A better known method was the one which Dearn first proposed in a communication to the Repertory of Arts in 1814, and subsequently developed in his Hints on an Improved Method of Building, published in 1821. This was a nine inch wall in English bond, with the header courses laid flat in the usual way, but the stretchers on edge so that there was a continuous cavity running the full length of each alternate course. As a further refinement Dearn proposed that the stretchers be cut in half along the

lengthwise direction, so that the cavity was bigger and fewer bricks were used. To avoid duty being levied on each half, the brick would be cut only part way through before burning, but it would later be struck with a trowel to break it in two. This also avoided the warping which would occur if such thin bricks were burnt separately. Dearn also suggested a fourteen inch wall using either half or whole stretchers in combination with specially made headers fourteen inches long.

Loudon's method was to build a nine inch wall in Flemish bond, but with all the stretchers on one side brought out two inches (50 mm) beyond the normal face, leaving a two inch cavity behind each. These walls were said to be 'always dry, and less easily penetrated by the cold in winter, or the heat in summer. The inner surface being uneven, is peculiarly favourable for receiving and retaining the plaster.' The Dictionary of Architecture described a wall much the same as this, but that the headers were only half as frequent as in true Flemish bond, and used a special 294 mm (or 11½ inch) header or bonding brick invented and manufactured by J.W. Hiort in 1833, allowing each side to be finished flush. Various other types of hollow wall were suggested, (6) and likewise Allen in his Cottage Building showed additional ways of building hollow twelve and fourteen inch walls using only ordinary nine inch bricks laid on the flat. (7) Henry Roberts suggested the use of a special brick measuring 90 x 90 x 230 mm, so that when a nine inch or 230 mm wall was laid in Flemish bond there was a 76 mm cavity between stretchers. Another possibility, he suggested, was to build an eleven inch or 280 mm wall of normal bricks, with a 50 mm cavity between stretchers, and to make up the headers with special 50 mm long bricks. (8)

2. TOWARDS THE TRUE CAVITY

Fairly obviously the major defect of all these walling systems was that there was still a substantial connection between the inner and outer leaf of bricks, so that in unfavourable conditions they could not possibly keep out the damp. It is therefore all the more remarkable that something very close to the true cavity wall was in existence without its virtues being recognised. J.B. Papworth in his Rural Residences, of 1818, illustrated a dairy and ice-house which had cavity walls which, at least in the case of the subterranean ice-house, were 'for drainage of surrounding water or damp.' (9) In 1826 Pasley referred to cavity walls designed by Nicholson at Rochester with two 4½ inch (or 115 mm) leaves and a 102 mm cavity crossed by only occasional bonding bricks, and to other cavity walls in several ordnance buildings around Portsmouth, some houses at Cranbrook in Kent, and a barracks at Shorncliffe. At Shorncliffe damp came through the walls on the bonding bricks, but this did not suggest to Pasley that a true cavity wall was desirable: on the contrary it indicated that the system was not effective, and merely reinforced his general opinion that it was 'scarcely worth while to construct the external walls of any building of importance in the manner alluded to.' (10)

In 1839 S.H. Brooks published the designs of two houses with cavity walls intended mainly for the purpose of distributing air to the rooms, and though the cavity was, admittedly, bridged at intervals by bonding blocks, this bridging amounted to between 3% and 7% of the area as opposed to 25% and more in Dearn's, Silverlock's and Loudon's walls. In one of the buildings Brooks proposed

to erect the walls hollow by carrying up 4 1/2 inch work externally and internally, leaving a cavity between them of 5 inches. The bond of the brickwork is to be made by bricks, 14 inches by 9 inches, which may be placed in every fifth or seventh stretcher horizontally, and in every third or fifth course vertically. In this way an excellent bond may be obtained, and if the sides of the openings be pargetted, in the same manner as fire-place flues, they may be made to convey rarefied air to all apartments; and, with suitable ventilators, the rooms may be kept at an equal temperature, which cannot be done with a common English fireplace.

External air was to be admitted by vents and to pass through heat boxes behind the fireplaces, or to the kitchen stove, before being allowed into the rooms. The cavity ran through internal and external walls alike, so that there is no suggestion that weatherproofing was a significant motive. (11)

Another device which might be regarded as a precursor of the true cavity wall was published at about the middle of the century. It was a method of keeping damp away from foundation walls by digging out a clear space next to them and just above the footings (like a miniature area), and from the outer side of this trench taking a brick vault back to the foundation wall at a point just above ground level but below the damp-proof course. Earth was then filled back over the barrel vault, leaving an underground drainage cavity all around the outside of the foundation walls. (12)

3. BONDING OF THE CAVITY WALL

The cavity wall proper had apparently already been brought into use in the early 1840's at the Isle of Wight, where a wrought iron cramp or tie was introduced, consisting of a 18 mm rod with the ends bent sideways to bond well into each leaf of brick, and a depression at the middle to stop it transmitting water. (13) As a correspondent of the English Builder wrote in 1854,

The only method yet practised to prevent completely the percolation of water from the outer surface is by means of iron stays, the two ends built into the outer and inner walls respectively, and the middle part is bent downwards, so that water cannot follow the course of the iron, but must drop to the bottom of the cavity between the walls: these stays connect the two walls so that they form one firm wall.

Even this enlightened writer doubted the durability of iron stays, and he mentioned a proposal for a cavity wall bonded by means of stones 430 mm wide and coated with pitch to stop them transmitting water. The building in question was a large house which was to have an outer nine inch (230 mm) wall of porous Sussex sandstone, a 76 mm cavity, and a nine or twelve inch (230 or 305 mm) inner brick wall. (14)

An article in the Dictionary of Architecture early in the 1860's described some types of cramps or ties which were thought to be better than those used at the Isle of Wight. Those used in Hampshire were of wrought iron, measuring 19 x 6 x 178 mm with a central depression and forked ends, and

were commonly tarred over, and built in every fourth course at 685 mm or three brick length intervals. At Southampton, where in the decade 1851-61 more than 80% of workers' dwellings were built with cavity walls, there were cramps rather like the Hampshire one available in wrought iron, cast iron or hoop iron, but there was also a more novel H-form made of two bars of 76 x 25 x 6 mm, each intended to rest in the frog of a brick, connected by a 9.5 or 13 mm diameter rod with a boss or moulding cast on it to prevent water crossing it. The cramps, which were built into every fourth course of the wall at 900 mm horizontal intervals, were available from every local ironmonger, and were also used in Devonshire.

In 1860 the Builder reported that some houses with cavity walls and wrought iron ties had been built near the sea using porous bricks, but had been incorrectly constructed with two courses of brick bridging the cavity at window sill line, causing a line of damp which rapidly spread to drench the whole wall; the problem was solved by cutting out the offending bricks and opening weepholes at the base of the cavity. (15) The use of the cavity wall was spreading to the remaining parts of England, and to more pretentious houses, of which two built in 1864 can be named. Rosebank Villa, at Barlow Moor eight miles south of Manchester, was designed by the Manchester architects Speakman and Charlesworth with a 410 mm wall consisting of a nine inch or 230 mm outer leaf, a 64 mm cavity, and a single thickness (115 mm) inner leaf, though the type of bonding is not known. The other example was a pair of semi-detached houses on the Osmaston Road on the outskirts of Derby, designed by Hine and Evans of Nottingham. Here the wall was an eleven inch one with a two inch (50 mm) cavity, and the bonding was said to consist of a header at every fourth course, with the deficiency in its length made up by a two inch cut brick at one end. (16) Another eleven inch cavity wall of which no detail is known appeared in a lodge at Hertfordshire, the design of which was published by the architect G.A. Dean in 1867. (17)

4. THE UNITED STATES

America was not far behind Britain in these developments. A.J. Downing's Architecture of Country Houses of 1850 discussed hollow walls in detail, and it appears that they had been introduced some years before by the architect Ithiel Town, and used in nearly all the best villas in New Haven. These do not seem to have been true cavity walls: Downing illustrated Dearn's method, in which there is about 25% linkage between the two leaves, as well as other types with a cavity of a full brick's width (a little over 100mm in America) and linkage of from 25% to 50%. The motivation was primarily the prevention of damp, for it was accepted that dampness 'always strikes through a solid wall', and in normal practice the inner plasterwork was firmed off from the outer brick wall with a cavity in between. If hollow walls could stop dampness the plaster could be applied straight to the brick at a great saving in cost and with much better fire resistance. In reality, however, such walls must surely have transmitted a considerable amount of moisture, though Downing admitted this only of Dearn's wall, where it was attributed to the fact that a single brick passed right through from the outer to the inner face. (18)

Downing's partner Calvert Vaux was English born and trained, and when he came to write his Villas and Cottages seven years later he wasted no time on these semi-cavity walls, but recommended two 'entirely and totally distinct' leaves of brick connected by painted or tarred strips of iron, 'for if brick bond is used, there will be a slight connection at intervals

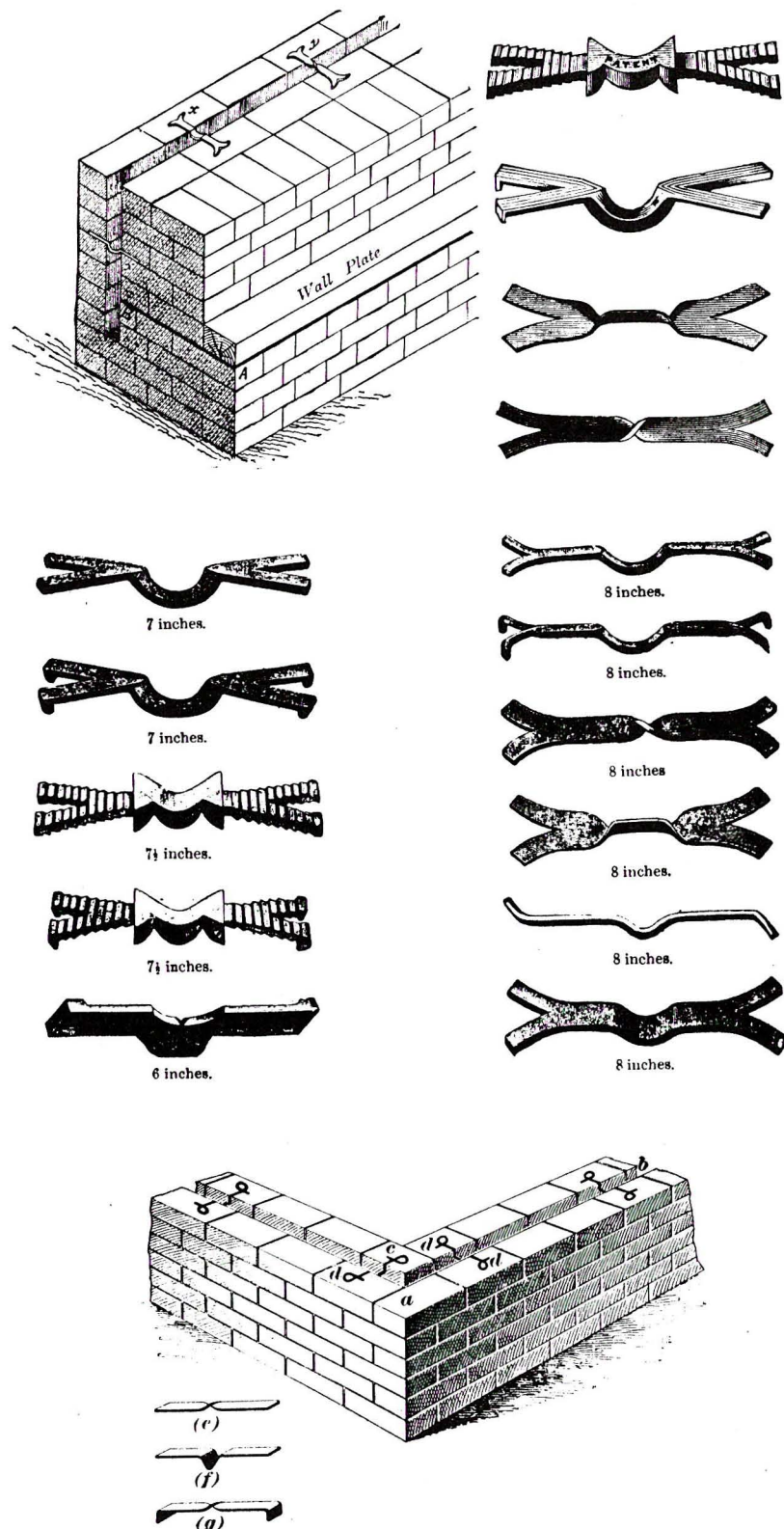


Fig. 2.

(Top left) Hollow wall with iron ties, (top right) two cast iron and two wrought iron ties. Notes on Building Construction, Part II, 1901, p 9. (Centre left) Cast iron ties, (centre right) wrought Iron ties. G.L. Sutcliffe, Modern House Construction, vol. 1, London 1900, p 108. (Bottom) Hollow wall using American Morse or galvanized steel wire ties, and varieties of wrought iron tie. International Library, Masonry, p 118.

between the two walls, and in driving storms some damp may possibly get through. (19) How rapidly such walls came into use is not clear, but in 1876 John Bullock illustrated a building designed by Robert Warry which had a cavity wall. This was Alexander Davis's house at Stuyvesant, New York, which had foundation walls two feet (0.6 m) thick, and ground and upper storey walls of sixteen inches (410 mm) 'with a four inch opening, or hollow wall.' This was said to give all the advantages that could be gained from building in hollow brick, and to ensure that the walls were impervious to damp. (20)

5. THE LATER NINETEENTH CENTURY

Present indications are that the cavity wall reached Victoria not only in the form with iron ties between the leaves, but also with bonding bricks in the later of the two forms developed and patented in England by George Jennings. In 1858 Jennings had patented perforated air bricks as well as bonding bricks perforated vertically through their thickness and made in lengths to suit the thickness of hollow walls. (21) It would seem to be this type which is demanded by John Blenkarn in a specification for a villa at East Cowes, prior to 1865: they were to be used in every second course vertically, and at intervals of 460 mm (two stretchers) horizontally within walls consisting either of two leaves, each one brick thick, or else one of two bricks thickness and one of a single thickness, the former inside. (22) The form next patented by Jennings consisted of a single brick appearing as a header in the outside face, but ramping up within the cavity so as to appear as a header one course higher up in the inner leaf. (23)

By 1873 the cavity wall was so much accepted in Britain that Frederick Rogers wrote:

In damp or exposed situations, as in basement-stories, or where from the climate during rains, water is liable to soak through the walls, double walling is necessary: the inner and outer wall being tied together in every course; thus in a wall two bricks thick the wall should be built with a 13½ inch outside wall, 2 inch cavity, and 4½ inch inside wall. (24)

In 1876 Edmund Beckett wrote that hollow walls were 'now at last generally admitted to be expedient, though architects are still wonderfully slow to propose them'; the two leaves should be tied together with 'bits of iron' given a twist to prevent water crossing on them, and coated in tar (other than gas tar, which would rust the iron rather than preserve it). He preferred a three inch (about 80 mm) to a two inch (50 mm) cavity, and stressed its secondary use as a means of ventilating rooms without making openings to the outside air. (25) From 1880 to 1900 the cavity wall is discussed in both British and American textbooks, and they illustrate a wide variety of ties of metal and other materials. (26)

6. THE CAVITY IN AUSTRALIA

In Australia a number of forms of cavity appeared almost simultaneously round about 1870. In a house of about this date at 242 Drummond Street, Carlton, the rear wing is a wall of nine inch thickness and appears on the exterior face like a version of English garden wall bond, with three

courses of stretchers to every single course of headers. In fact the wall is partially hollow because on the inner face, concealed beneath the plaster, the three courses of stretchers are replaced with two courses laid on edge, leaving a space behind. This is a novel type, but essentially a late variation on the proto-cavity walls of Silverlock, Dearn and others.

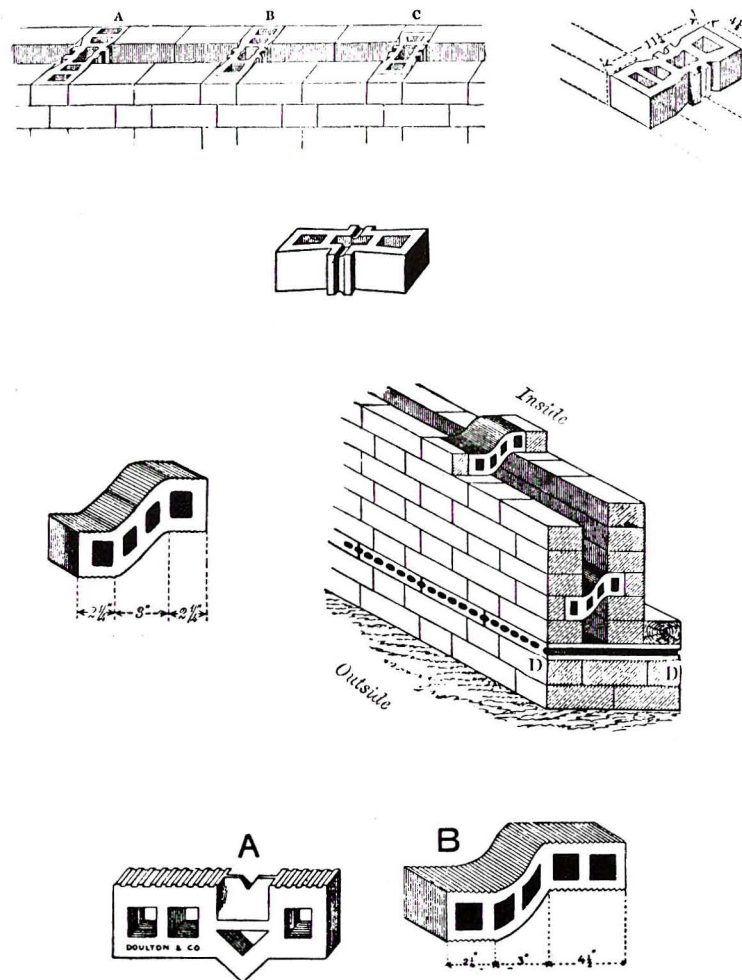


Fig. 3. (Top) Jennings's bonding bricks used in a wall, and detail. Gwilt, *Encyclopaedia*, p 564. (Next down) Later version of Jennings's bonding brick. *Notes*, Part II, 1887, p 216. (Centre) Jennings's later, ramped-up, bonding brick. *Notes*, Part II, 1901, p 8. (Bottom) Doulton & Co. bonding brick as manufactured by J.C. Edwards, and an extended version of the Jennings brick. Sutcliffe, *Modern House Construction*, p 108.

At Geelong the architects Davidson and Henderson are now known by the researches of Allan Willingham to have introduced the Jennings patent stepped-up bonding brick, which was made for them by the local brickmaker T.H. Widdicombe of Portarlington. It was clearly the desire of the architects to adopt the polychrome brick walls which had become fashionable in Melbourne which made them seek a way of preventing water penetration once the usual coat of stucco was omitted. On 1 January 1870 the partners were on holiday in Melbourne looking at examples of 'fancy brickwork', and in April they called tenders for Geelong College, their first major polychrome cavity-walled building. (27) By the end of 1872 Widdicombe was advertising the bonding bricks on the local market. (28) A report at this time indicates that Widdicombe had the Victorian patent for the stepped-up bricks, and also illustrates an otherwise unknown bonding system (described as an Englis one) using flat metal plates bridging the cavity in the vertical plane, and with a central notch out of the lower edge to prevent water passing across. (29)

At about the same time true cavity walls with only metal ties, or in some instances possibly no ties at all, appeared in the more remote country town of Stawell, Victoria. The Stawell Literary and Scientific Institute is a small two-storeyed building dating from 1868 and with external walls of eleven inch (or slightly greater) brickwork in a slightly irregular bond of generally two or three stretchers to one header in each course. In some parts there are 3 mm x 19 mm iron straps with their protruding ends bent down, and these must be the ties. At Stawell Grammar School, at least part of which was built in 1869-70 to the design of the architect R.A. Love, the master's house which is the core of the complex, shows similar straps. A detached classroom of a rather extraordinary Jacobean design, probably somewhat later in date, has no apparent bonding, but a cavity as wide as a leaf of brickwork. As all of these buildings at Stawell are or were of simple red brick, the motive of introducing polychromy cannot have been the dominant one, and the rationale is unclear. Nor is it apparent whether the idea of the cavity wall was being promoted by a local bricklayer (there is some oral tradition to this effect) or somebody else such as the architect R.A. Love.

From this time forward the cavity became increasingly common, especially in Melbourne. As early as 1877 a barrister, H.P. Walker, unsuccessfully sued his architect, William Ellis, for damages in relation to a house built twelve months earlier. The house had leaked, and it was asserted that hollow walls should have been used. (30) In 1879 a house designed by Edward Twentyman in St. Vincent's Place, South Melbourne, had a cavity external wall except for the back or service wing, which was of nine inch brickwork. A house at 83 Walpole Street, Kew, built in 1885, is interesting in that it had a nine inch wall where there was to be a protective verandah, but a cavity wall on what was conceived as an exposed side flank, though a verandah was actually built here as well.

In the same year the prominent local architect and exponent of polychromy, Percy Oakden, went into print to advocate the use of hollow walls. (31) The influence of the English Queen Anne Revival in architecture was soon to ensure that exposed red brick became far more prevalent than polychromy (which was largely a Melbourne fashion) and in 1899 James Barnet of Sydney wrote disparagingly of the influence of Bedford park in various matters

such as "red brick hollow wallery". (32) Little is known of the technical detail of cavity wall construction over this period, but the house at Kew had an arrangement of tarred and sanded 32 mm hoop iron rivetted at the joints in the shape of a ladder with the sides laid in each leaf of brickwork and the rungs acting as ties across the cavity at 0.6m intervals. By 1900 a local building text was illustrating both the Jennings's stepped up blocks, and individual ties of cast or wrought iron similar to those in use overseas. (33)

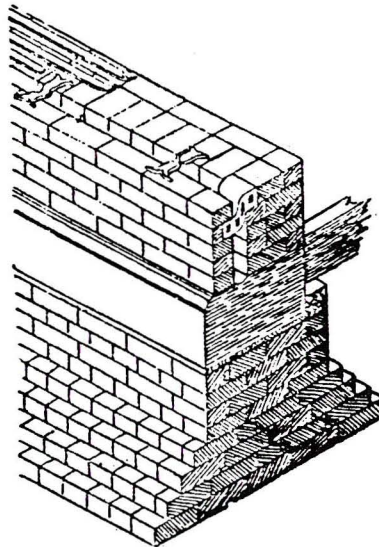


Fig. 4. The first Australian illustration of cavity wall construction, showing both iron ties and Jennings's bonding blocks. Nangle, Australian Building Practice, 1900, p 6.

7. BRICK VENEER

Once the cavity brick wall had been accepted as a normal part of building practice, no great conceptual leap was required to replace the inner leaf with a timber partition. The same effect was nearly achieved, however fortuitously, whenever an existing timber building had a brick skin placed around it. This was done at Tyntyndyer homestead in Victoria. Peter Beveridge added a brick skin in 1850, and much has been made of this. (34) It was only after the turn of the century that deliberately conceived examples of brick veneer were built. In 1903 there was built for the Armytage family a house at Gnarwarre, west of Geelong, which is now known as 'Ardoo', (35) and this appears to be of some form of brick veneer, though it has not been possible to open up the walls for internal inspection. Similarly a house behind a shop at 69 Main Street, Beeac, in Western Victoria, appears to be of brick veneer. Tapping the wall surfaces clearly indicates that the inner side of the external wall is timber framed and plastered, while the outside is brick and the shop its front, it is claimed, is of solid brick. (36)

The situation is confused by the fact that the local trade journal, Building, in 1924 published an article on insulation which included illustrations taken from the Architectural Forum showing how to insulate a brick veneer house. What it shows is a house frame of timber lined on the

outer face with horizontal boarding to which is nailed a thin layer of insulating material. The text mentions as insulating materials cork board and fabrics made of vegetable fibres such as seaweed, flax straw, wood pulp and bagasse from sugar cane. The outer leaf of the brick is built directly against the insulating material and it is this, together with the complete lining or sarking of boards on the outer or mid-wall face of the timber frame which distinguishes the method from that which was to become common in Australia, and places it in line of descent from American practice extending back at least to the mid-nineteenth century, in which materials other than brick were used as cladding over board sheathing. (37)

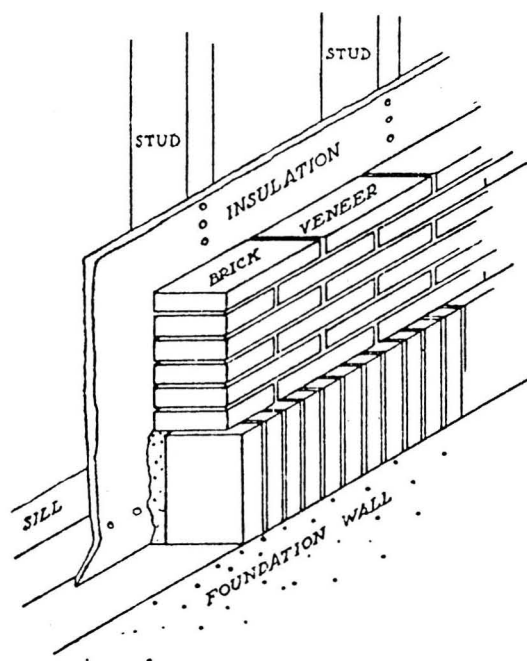


Fig. 5. American brick veneer construction. Building, 12 April 1924, p 61, after Architectural Forum.

In about 1928 brick veneer appears in the Melbourne suburbs and rapidly spreads into normal practice, though there are at least two rival accounts of its origins. Christopher Procter, according to his widow, (38) built a brick veneer house at 42 Beach Street, Frankston, in 1928, which has since been demolished. Joe Clift, who is still alive, claims to have built the first example, for his father, at 32 Gilbertson Street, Essendon, in 1928.(39) Contemporary directory information, however, suggests a date no earlier than 1930 for the Essendon house. Both accounts refer to the efforts made to persuade the Chief Architect of the State Savings Bank, G.B. Leith, that the construction was suitable for money to be lent on it. Procter went on to build other examples, including his own house at Frankston, 'Kallara', (40) and Clift, a few months after his first brick veneer house, built another for his brother at 18 Glenbervie Road, Strathmore. The system was then taken up in Essendon by a bigger builder, R.J. Shaw. (41)

It may be because of the strength of the local cavity wall tradition that the brick veneer took root so quickly in Victoria, for it never seems to have been so prevalent in the other Australian states. It was of course

partly a response to the economic stringency of the Depression, but elsewhere other solutions were adopted, such as building cavity walls in brick on edge. By 1938 the brick veneer system was being used for large and pretentious houses in Melbourne and Ballarat, and by leading architects such as W.A.M. Blackett, (42) but it was not until after the second world war that the method became totally and widely accepted. (43)

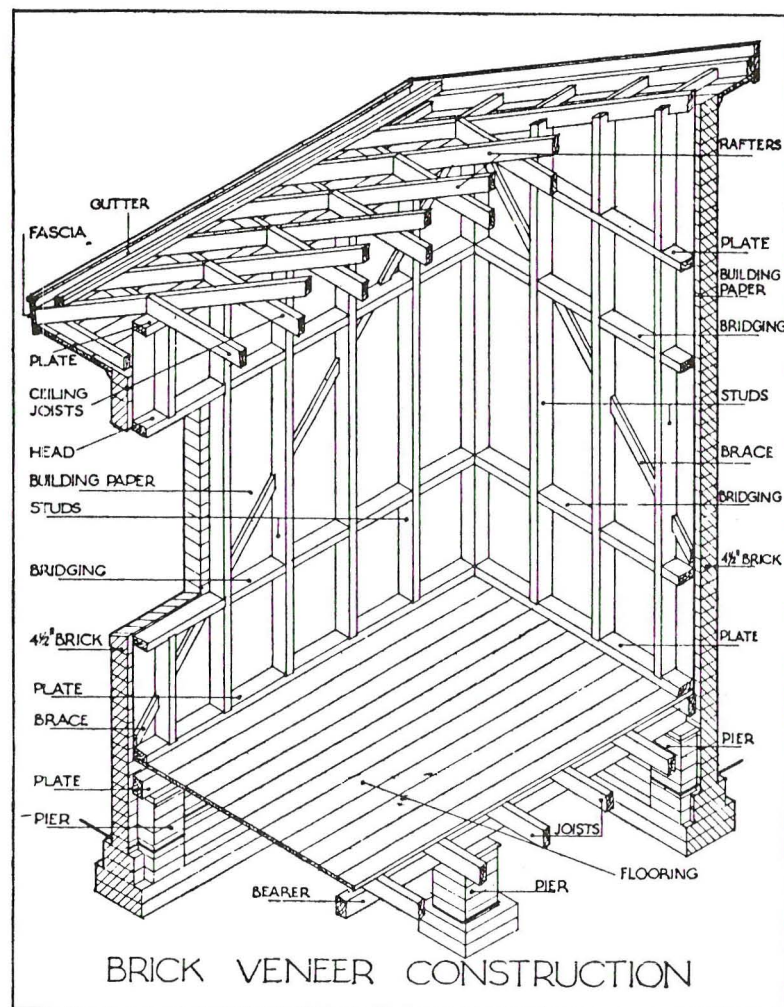


Fig. 6. Australian brick veneer construction. Sharp, Australian Methods of Building Construction, 1946, p 120.

8. REFERENCES

- (1) ALLEN, C.B. Rudimentary Treatise on Cottage Building, 2nd ed., London, 1854, p 38.
- (2) MAYES, C.B. The Australian Builders' Price-Book, Melbourne, 1862, p 19, and ALLEN, op.cit, pp 34-6.
- (3) FREELAND, J.M. Architecture in Australia, Melbourne, 1968, p 134.
- (4) LEWIS, M.B. Personal communication to Mrs. J. Hibbens, Ellerslie, Pilmer Street, Bacchus Marsh, Victoria, 3 July 1984.

- (5) TIBBITS, G.R. Department of Architecture and Building, University of Melbourne, personal communication 14 November 1984.
- (6) LOUDON, J.C. Encyclopaedia of Cottage, Farm and Villa Architecture, London 1853 (1833) pp 14, 168-172, 186-188; PAPWORTH, W. (ed.), Dictionary of Architecture, London, 1848-1892, sv. Hollow Wall.
- (7) ALLEN, op.cit., p 36
- (8) ROBERTS, H. The Dwellings of the Labouring Classes, London, 1850, pp 24-5.
- (9) PAPWORTH, J.B. Rural Residences, London, 1832 (1818), pp 89-90, 99, and pl 24.
- (10) PAPWORTH, W. loc. cit., ref. PASLEY, C.W. Outline of a Course, &c., Chatham, England, 1826, pp 252-4.
- (11) BROOKS, S.H. Designs for Cottage and Villa Architecture. London n.d. (c.1839), pls xii-xiv; pp 252-4
- (12) (TARBUCK, J.L., et al) Builder's Practical Director, Leipzig &c., n.d. (c.1856), p 189.
- (13) PAPWORTH, W. loc.cit.
- (14) Builder, London, XII, 583 (8 April 1859), p 190.
- (15) PAPWORTH, W. loc.cit.
- (16) Villa and Cottage Architecture, London, 1869, pp 109-11, 22-23.
- (17) DEAN, G.A. Selected Designs for Country Residences, London, 1867, pl 13.
- (18) DOWNING, A.J. The Architecture of Country Houses, New York, 1850, pp 59-63.
- (19) VAUX, C. Villas and Cottages, New York, 1864 (1857), pp 76-77.
- (20) BULLOCK, J. The American Cottage Builder, Philadelphia, 1876, p 189.
- (21) GWILT, J. (revised PAPWORTH, W.) An Encyclopaedia of Architecture, London, 1899, p 564; Notes on Building Construction. Part III Materials, London, 1879, p 135.
- (22) BLENKARN, J. Practical Specifications of Works, London, 1865, pp. 101-102.
- (23) Notes on Building Construction, loc.cit.; also part II, 3rd. ed., London, 1887, pp 216-7, illustrating a range of types and sizes.
- (24) ROGERS, R.R. Secifications for Practical Architecture, London, 1873, p 239.
- (25) BECKETT, E. A Book on Building, London, 1876, pp 155-7.

- (26) GWILT, J. loc.cit.; Notes on Building Construction. Part III. Materials, p 139; Notes on Building Construction. Part II, 3rd. ed., London, 1887, pp 216-217; Ibid., 8th ed., London, 1901, pp 7-10; International Library of Technology. Masonry, (c.1903), pp 118-119; SUTCLIFFE, G.L. The Principles and Practice of Modern House Construction, vol. I, London, 1900, pp 106-109.
- (27) Willingham, A. Two Scots in Victoria, M. Arch. thesis, University of Melbourne, 1984, pp 108, 110.
- (28) Geelong Advertiser, 14 December 1872, p 4.
- (29) Australian Mechanic, vol. I, 15 November 1872, p 134.
- (30) Argus, Melbourne, 28 February 1877, p 5.
- (31) LEWIS, M. "Architectural Drawings as Historical Sources", La Trobe Library Journal, 5, 20 (October 1977), p 81.
- (32) TERRY AND OAKDEN (firm). What to Build and How to Build it, Melbourne, 1885, p 6.
- (33) BARNET, J. "Architectural Work in Sydney, New South Wales, 1788-1899", Journal of the Royal Institute of British Architects, V1, 3rd series, 17 (29 July 1899), p 516.
- (34) NANGLE, J. Australian Building Practice, Melbourne, 1900, p 6.
- (35) HOLLOWAY, R.G. 'Tyntynder Homestead' - a Short History (no publication details), n.p.
- (36) ROBILLIARD, A.H. Interview, 2 November 1984; inspection of building, 6 November 1984.
- (37) Inspection, 2 November 1984; DALEY, E.C. Personal communication, 2 December 1984; STEPHENS, G.W. Personal communication, 12 December 1984.
- (38) "Insulation of the Home", Building, Sydney, 12 April 1924, pp 59-62.
- (39) PROCTER, J. Personal communication to Sue McFall, of the Sun newspaper, Melbourne, 4 January 1984.
- (40) CLIFT, J. Personal discussions, 15 May 1982, and subsequently.
- (41) Undated newspaper cutting accompanying PROCTER, J. Op. cit.
- (42) CLIFT, J. Ibid.
- (43) 'Architect'. "The Principles of Brick Veneering", Australian Home Beautiful, Melbourne, 1 November 1938, pp 28-30.
- (44) Brick veneer is still not mentioned in Bricklaying, Melbourne, November 1945 (Technical publication No. 20 of the Commonwealth of Australia Department of Labour and National Service). It is dealt with in SHARP, W.W. Australian Methods of Building Construction, Sydney, 1947, pp 118-120, and in LLOYD, C. The Australian Carpenter, Melbourne, 1948, pp 116-117.