

### 3.06 Earth & Composite Floors

- a earth floors
- b puddled floors
- c composite floors
- d plaster and concrete floors

#### a. earth floors

Earth floors, with various admixtures, and consolidated to a greater or lesser degree, are probably amongst the earliest building works of mankind, and many details of their manufacture, though they may have been developed independently in different places, are ubiquitous. In northern China, importantly, floors in the period 3000-2050 BC were covered in a smooth hard white plaster made of powdered ginger-like stone and a type of lime nodule, and sand. Some floors were overlaid with mud, straw and sand, then levelled with a plaster of nodular lime and sand. Surfaces such as elevated sleeping places might be treated by burning a fire on them, which made them moisture proof.<sup>1</sup> There is a long standing tradition of earth flooring in many other countries, in all periods.

There were numerous examples in nineteenth century Australia, some in New Zealand,<sup>2</sup> and many in South Africa, where a number have survived into modern times.<sup>3</sup> In Adelaide E W Andrews reported in 1839 that wooden floors were a luxury found seldom in dwellings and never in warehouses.<sup>4</sup> In the 1850s wooden flooring was an optional extra in the prefabricated cottages sent to Australia by manufacturers such as E T Bellhouse of Manchester. It remains a moot point, however whether the more sophisticated British recipes and methods had an impact here, or whether most local examples were simply natural earth consolidated by normal traffic. Freeland states, though upon what basis he does not explain, that 'trampled earth or packed clay' floors were the norm in the early days at Sydney.<sup>5</sup> It is known, however, that

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<sup>1</sup> 'The Formation and Early Development of Architecture in Northern China: Architectural-Archaeological Discoveries in the Yellow River Valley', in Hanna Lewi [ed], *In the Making: Architecture's Past* (conference of the Society of Architectural Historians Australia and New Zealand [SAHANZ] 2001), p 5: she speaks of a lime nodule made of CaCO<sub>3</sub> and SiO<sub>2</sub> – lime and sand – but this is unlikely, and the second component is probably clay.

<sup>2</sup> For example, 'The Cuddy' at Waimate, of 1854: Martin Hill, *Restoring with Style* (Wellington 1985), p 7.

<sup>3</sup> Ronald Lewcock, *Early Nineteenth Century Architecture in South Africa* (Cape Town 1963), pp 160/162.

<sup>4</sup> E W Andrews, journal, formerly in the possession of Mrs Bryce Andrews of 66 Hallett Road, Stonyfell, South Australia, entry for 3 September 1839.

<sup>5</sup> J M Freeland, *Architecture in Australia - a History* (Melbourne 1968), p 13.

the gaol built by Governor Hunter in 1797, had a floor of clay 200 mm thick, laid over logs.<sup>6</sup>

In 1827 Peter Cunningham writes of floors in New South Wales 'laid with well-wrought hard soil, mixed with sand',<sup>7</sup> and in Western Australia in 1834 the Bussells used a clay floor for their house at 'Cattle Chosen' on the Vasse.<sup>8</sup> In 1836 Dr Everard's house at Holdfast Bay [Glenelg], South Australia, had a floor of clay rammed hard to make it firm,<sup>9</sup> and in 1843 H B Hughes's 'Bundaleer', station the hut floor was described simply as 'the natural Clay'.<sup>10</sup> According to T M Hocken the 'clean yellow clay' made the best floor at the early settlement of Otago, New Zealand.<sup>11</sup> In the Stony Desert of Central Australia early floors are said to have been simply of trodden earth,<sup>12</sup> and even as late as the 1880s and as close to civilisation as Pitt Town, on the Hawkesbury, a beaten earth floor appears.<sup>13</sup> At about this time, also, a 'clay floor' was laid to the verandah of 'Til Til' station in the Riverina.<sup>14</sup>

It was a common practice water these floors at regular intervals, to help them consolidate. Fairly comprehensive instructions for flooring a tent in earth were given by 'Rusticus' in 1855:

The floor may ...be raised a little above the level of the ground outside, and a strip of broad paling placed all round to keep it in. It may then be covered with a coating of small broken stone, earth and wood ashes, which, if occasionally sprinkled with water, becomes, in the course of a short time, almost as hard and complete as stone.<sup>15</sup>

E S Sorensen spoke of the floor of a typical settler's house being either of slabs or of earth, the latter requiring 'frequent watering to keep it firm',<sup>16</sup> and J F Edey described in the Victorian Mallee, in about 1920, 'whitewashed earthen floors, watered down with washing water and swept until they were hard and almost polished'.<sup>17</sup> But other types of floors were sometimes

<sup>6</sup> David Collins [ed Maria Collins, James Collier], *An Account of the English Colony in New South Wales* (Christchurch 1910 [1798 & 1802; 1804]), p 353.

<sup>7</sup> Peter Cunningham, *Two Years in New South Wales* (2 vols, London 1827), II, p 163.

<sup>8</sup> E O G Shann, *Cattle Chosen* (facsimile, Nedlands [WA] 1978 [London 1926]), p 66.

<sup>9</sup> Charles Everard to his sister, 29 May 1837, SA Archives A290B3, quoted in Penelope Hope, *The Voyage of the Africaine* (Heinemann, South Yarra [Victoria] 1968), p 133; also *Proceedings of the Royal Geographical Society of Australasia (South Australian Branch)*, V, p 77, quoted in Colin Kerr, 'An Exelent Coliney' (Adelaide 1978), p 68.

<sup>10</sup> Kerr, 'An Exelent Coliney', p 144.

<sup>11</sup> T M Hocken, *Contributions to the Early History of New Zealand (Settlement of Otago)* (London 1898), p 100, quoted in C F Cameron, 'State Housing and State Sponsored Housing in New Zealand (MARCH, University of Auckland, 1970), p 50.

<sup>12</sup> Howard Pearce, *Homesteads of the Stony Desert* (Adelaide 1978), p 20; see also p 48

<sup>13</sup> R I Jack, *Exploring the Hawkesbury* (Kenthurst, NSW, 1990 [1986]), p 64.

<sup>14</sup> Peter Freeman *The Homestead: a Riverina Anthology* (Melbourne 1982), p 170, quoting the Til Til station diary for 26 July 1887.

<sup>15</sup> 'Rusticus' [W S Chauncy], *How to Settle in Victoria* (Melbourne 1855), p 23.

<sup>16</sup> E S Sorensen, *Life in the Australian Backblocks* (London 1911), p 25.

<sup>17</sup> John Edey, *From Lone Pine to Murray Pine: the Story of a Mallee Soldier Settler* (Sunnyland Press, Red Cliffs [Victoria] 1981), p 73.

watered simply to relieve the heat<sup>18</sup> (or, we may surmise, to lay the dust), so the practice of watering alone is not a clear indication that the floor is earthen. A beaten earth floor might also be finished with a layer of yellow ochre, as at 'Dalry' in the Yarra Valley in the 1850s.<sup>19</sup>

The best earth floor of course was antbed. When it was first used is unclear, but J G Knight referred to it in the Northern Territory in 1880:

A fair substitute for lime mortar is found in the earth of which the anthills are formed, the ant producing a glutinous substance to bind the earthy particles together. This material, when moistened and beaten up, makes an excellent floor, and answers for bedding brick or stone.<sup>20</sup>

By 1889, when Constance Ellis came across it in Queensland, antbed was well enough established to call for little comment,<sup>21</sup> and in 1895 it was specified that the kitchen floor of the custom house and post office at Hebel be 'laid with puddled ant bed, six inches [150 mm] thick, well rammed hard and laid with an even surface'.<sup>22</sup> In 1913 the Queensland Department of Agriculture said that a floor

May be laid with a cement of white ant hill, or of the ant-bed mixed with cow dung. When this is well puddled with water, and laid on smoothly to a thickness of 4 to 6 in [100-150 mm], it soon hardens and makes a capital floor.<sup>23</sup>

### ***b. puddled floors***

Puddled earth is, after simple trampled ground, perhaps the basic form of earth flooring likely to have been used in Australia, and a description of its use in England survives from 1641. The earth was broken down into a fairly fine consistency, thoroughly watered, left to lie for two weeks, then beaten with flat pieces of wood.<sup>24</sup> In 1841 Robert and Eliza Pohlman made a puddled floor at their 'Glenhope' station in the Port Phillip District [Victoria] reportedly by ramming down wet pulverised clay, covering the black soil upon which the house was built.<sup>25</sup> In later Victoria puddle of an essentially similar

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<sup>18</sup> The Scotts, of Glendon, did this in accordance with the Indian practice with which they were familiar. James Broadbent, 'Aspects of Domestic Architecture in New South Wales 1788-1843' (3 vols, PhD, Australian National University, 1985), II, p 472.

<sup>19</sup> Hubert de Castella [ed C B Thornton-Smith], *Australian Squatters [Les Squatters Australiens]* (Melbourne 1987 [1861]), p 106.

<sup>20</sup> J G Knight, *The Northern Territory of South Australia* (Adelaide 1880), p 27.

<sup>21</sup> C J Ellis, *I Seek Adventure* (Sydney 1981), p 5.

<sup>22</sup> Ian Evans et al, *The Queensland House: History and Conservation* (Flannel Flower Press, Mullumbimby [New South Wales] 2001), p 22, quoting Works Department, Plans and Specifications, Queensland State Archives, WOR/A 1898/2800.

<sup>23</sup> Donald Watson, 'The Queensland House' (Brisbane 1981), p 5.2.

<sup>24</sup> C F Innocent, *The Development of English Building Construction* (Cambridge 1916), p 158, quoting Henry Best's *Farming Book*, as published by the Surtees Society, p 107.

<sup>25</sup> J O Randell, *Pastoral Settlement in Northern Victoria - Volume II* (Burwood [Victoria] 1982), p 124.

description was used for waterproofing dams and, with less elaborate preparations, for purposes where it was not required to be waterproof. Clay was dug from the ground, chopped up and mixed with water, tempered, tipped into place, and thoroughly trodden. If it was really well prepared it became similar to brick earth when ready for moulding.<sup>26</sup> At 'May Downs', inland from Rockhampton, Arthur Mackenzie used puddled antbed: this was apparently in the 1850s, which would make this the earliest reference to the material in Australia.<sup>27</sup>

In a specification for terrace houses in the Melbourne suburb of Elwood in 1854, there was to be nine inches [230 mm] wide of puddling on the outside of the cellar walls, done as the wall rose, 'to be well punned in twelve inches [300 mm] courses and no sand to be allowed to get among the clay'. For the cellar floor the builder was directed to 'Puddle the whole ... with clay well and evenly punned to the thickness of six inches [150 mm] over which spread a layer of sand two inches [50 mm] deep.'<sup>28</sup> Even in 1891 the cellar of 'Benvenuta', Carlton, Melbourne, was surrounded by 230 mm of puddled clay, rammed into place as the wall rose.<sup>29</sup>

### ***c. composite floors***

At 'Merton' in the Hunter Valley, the floor of William Ogilvie's house in 1824 was of pipeclay mixed with powdered earth,<sup>30</sup> but Ellen Ogilvie found it 'very troublesome to keep clean', and it was overlaid with timber a few years later.<sup>31</sup> It seems probable that pipeclay and lime were both used in the floor of G C Hawker's homestead at 'Bungaree', South Australia, in 1842, for his diary records on 28 February that he brought in a load of pipeclay, the following day that he obtained a load of lime, and four days after that 'plaistered the floor of my room'.<sup>32</sup>

For his house at Hahndorf, South Australia, in 1895, Edmund Diderich used clay for the main floor, but in the kitchen he added lime for extra strength.<sup>33</sup> Pipeclay was probably used only when it occurred nearby, whereas lime was a regular article of trade and might be transported a longer distance, especially if the site was near water. Thus the floors of the new huts at McCrae's run, Arthur's Seat, Victoria, in the 1840s, were of lime and clay (and in fact lime was regularly shipped from further down the Mornington

<sup>26</sup> C B Mayes, *Australian Builders' Price-Book* (Melbourne 1862), p 9.

<sup>27</sup> Judith Wright, *The Generations of Men* (Melbourne 1959), p 15.

<sup>28</sup> Russell, Watts & Pritchard, 'Specification for ... dwelling houses ... at Elwood ... for Joseph Docker', 13 December 1854., Manuscripts Collection, State Library of Victoria, pp 1-2.

<sup>29</sup> W S Law, 'Specifications of Residence Drummond St. Carlton for Mrs. L. Abrahams' (Melbourne 1891), p 11.

<sup>30</sup> George Farwell, *Squatter's Castle* (Melbourne 1973), p 54

<sup>31</sup> Farwell, *Squatter's Castle*, p 95.

<sup>32</sup> Colin Kerr, *'An Exelent Coliney'* (Adelaide 1978), p 133.

<sup>33</sup> R J Noye, 'The Old Bush Hut', *South Australiana*, VI (1967), p 16, quoted in Terence Lane & Jessie Serle, *Australians at Home* (Melbourne 1994), p 324.

Peninsula).<sup>34</sup> At Palmerston [Darwin] in 1870 the government resident, Lieutenant Blomfield Douglas, had a hut with a floor 'made of mud, pressed flat, and mixed with gravel, sand and limestone, well rolled till a smooth surface was obtained.'<sup>35</sup>

More elaborate Australian floors presumably derived from the English tradition of using lime, ash and other materials, for which there were countless recipes. Such floors - to synthesise from a number of sources - might in England contain any of the following ingredients in various proportions: loam, sand, quicklime, slaked lime, brick dust, gun dust, anvil dust from a forge, cupola ash, coal ash, oil, stale milk, bullock's blood, and yellow ochre. The ingredients would generally be sifted together, tempered with water, allowed to stand for some days, and tempered again. They might be laid over a base of well consolidated gravel, brickbats or lime core; placed in a 60 to 80 mm thickness; rolled, trodden, beaten or rammed, sometimes at daily intervals for as long as two weeks; possibly screeded with 6 to 13 mm of stone lime mixed with egg white, and/or possibly rubbed with oil, or with a coarse woollen cloth.<sup>36</sup> In South Africa also, an area known to many Australian settlers, flooring made of clay, manure, ox blood and lime,<sup>37</sup> or of clay, fat and cow dung was in use up to the 1840s.

Loudon describes the formation of a 'sound, warm, and durable floor' as follows:

... the ground being well drained, and covered to a depth of a foot [300 mm] with loose stones, lay on these a stratum of a mixture of gravel and newly slacked lime, to the depth of six inches [150 mm]; let this be well beaten, and brought to a perfect level, and after it has dried a week or a fortnight, according to the weather, cover it, to the depth of two inches [150 mm], with a composition of equal parts of quicklime and powdered smithy ashes, brought to the consistency of mortar by the addition of bullock's blood, stale milk, oil, or any other description of greasy matter. As soon as this is laid on, it must be well beaten with the back of a spade, or rolled with a cast-iron roller; after which, if immediately well and long rubbed with coarse woollen cloths, it may be brought to a high polish. The colour, when bullock's blood is used, is at first brown, but after some weeks it changes to a light grey. When yellow ochre is added to the mixture, a Bath stone colour is produced.<sup>38</sup>

<sup>34</sup> Georgiana McCrae [ed Hugh McCrae], *Georgiana's Journal: Melbourne 1841-1865* (William Books, Sydney 1978 [1934, 1966]), p 209.

<sup>35</sup> Harriet Daly, *Digging, Squatting, and Pioneering Life in the Northern Territory of South Australia* (London 1887), p 51.

<sup>36</sup> G S Howard et al, *The New Royal Encyclopaedia Londinensis* (London, in parts from c 1785), sv Floor; William Marshall, *Rural Economy or Yorkshire*, quoted by Innocent, op cit, p 160; Thomas Rudge, *General View of the Agriculture of the County of Gloucester* (London 1807), pp 245-6; *Builder*, VII, 309 (6 January 1849), p 6; 310 (13 January 1849), p 20; 311 (20 January 1849), p 29; Henry Roberts, *The Dwellings of the Labouring Classes* (London 1850), pp 26-7.

<sup>37</sup> Lewcock, *Early Nineteenth Century Architecture in South Africa*, p 160.

<sup>38</sup> J C Loudon, *An Encyclopædia of Cottage, Farm, and Villa Architecture and Furniture* (London 1846 [1833]), §585, p 288.

In Australia the *Settler's Hand Book* recommended a much simpler version, said to be used in Italy: fine clay mixed with the blood of a bullock or other animal, which would become hard, smooth and glistening.<sup>39</sup>

C B Allen's *Cottage Building* is one English source which would have been widely known in Australia, and it describes lime-ash floors. A recommended version is to mix washed sand and lime ashes in a ratio of 2 to 1. After two or three days this mixture would be tempered with hot water, then laid in place to a depth of 80 mm. After a further two or three days it would be hard enough to tread on, and it should now be beaten all over with a wooden mallet to make it completely hard, using a trowel and a little water to keep it smooth.<sup>40</sup> Another work known in Australia, and indeed specifically designed for the use of settlers, was R S Burn's *Colonist's and Emigrant's Handbook of the Mechanical Arts*, of 1854. Burn quotes Henry Roberts's recipe, which was for a mixture of sand and lime-ash in the same proportions and laid in the same thickness, but with the differences that the original mixture was left a fortnight while the lime slaked, before it was tempered and laid, and that it was suggested that the finished floor be rubbed twice over with linseed oil, to give it the appearance of stone. It should be laid on a six inch [150 mm] substratum of well beaten coarse gravel, brickbats and lime core, well beaten, and with tar added if the situation was damp.<sup>41</sup>

Rarely, apart from Cunningham's description of a soil and sand mixture, do we find any indication of precisely what earth was used in Australian floors and how it was treated. John McKimmie of Bundoora, Victoria, spoke of the use of clay mixed with cow dung. The most informative description is in Tucker's *Ralph Rashleigh*, of the floor of a hut on the Hawkesbury in the early 1820s, 'made of cow dung and ashes trod into a solid and firm mass, but ... level and clean-swept'.<sup>42</sup> The cow dung, and apparently the ashes ['fire'] are referred to in the verse:

The old hands told me how to build a clean dirt floor:  
 Beat it hard with spades and tread of feet,  
 Then soak with green cow dung and sweep again.  
 Now sprinkle water, fire, and clear creek sand,  
 And sometimes strew with cool green leaves;  
 Sprinkle and sweep it twice a day  
 Until, clean and sweet and hard,  
 It gleams, black, polished like a board.<sup>43</sup>

<sup>39</sup> *Australian Settler's Hand Book: The Farm, being Practical Hints for the Unexperienced on the most simple and profitable method of cultivating their land: being the result of many years experience in the Colony* (James W Waugh, Sydney 1861), p 12.

<sup>40</sup> C B Allen, *Rudimentary Treatise on Cottage Building* (2nd ed, London 1854 [1849-50]), p 40.

<sup>41</sup> R S Burn, *The Colonist's and Emigrant's Handbook of the Mechanical Arts* (Edinburgh 1854), p 42.

<sup>42</sup> James Tucker ['Giacomo de Rosenberg'] [ed Colin Roderick], *Ralph Rashleigh, or the Life of an Exile* (Sydney 1952 [c1845; 1929]), p 137.

<sup>43</sup> From 'Beaufoy Merlin', by Lindsay Gordon [apparently a modern poet, not A L Gordon], quoted in Eve Pownall, *Mary of Maranoa* (2nd ed, Sydney 1959 [1959]), p 62.

George Morphett's house in North Terrace, Adelaide, of 1841, reportedly had a verandah floor of earth, blacksmith's ashes and lime

In Western Australia thre Rev J R Wollaston, was in 1842:

Laying down a clay foundation for the flooring of our Church; a work of some labour and trouble. Clay binds upon the sand with great firmness; upon this, I shall, by and by, place a coating of lime and ashes<sup>44</sup>

In 1848 Wollaston considered himself fortunate to have met up with a man familiar with the West Indian method, in which a lime floor was 'trodden and rammed, then repeatedly worked and smoothed with sugar water' to produce an excellent floor.<sup>45</sup> In the Windorah area of western Queensland, where tallow was also used in the walls, the floors were of 'ashes and tallow, which set like cement'.<sup>46</sup> Also in western Queensland the local 'kopi' or infusorial earth, resembling gypsum, was used as flooring in 'Roseberth' homestead, and in the same region it was used with limestone in the foundations of 'Cacory' homestead.<sup>47</sup> For a proposed court house in Birdsville the local police magistrate recommended in 1888:

For the verandah floors I think good puddled clay mixed with a certain proportion of sand, lime and manure would be cheapest and most enduring as the sun would cause flooring boards to warp and bend in all directions ...<sup>48</sup>

#### **d. plaster and concrete floors**

Another English type of relevance to Australian practice was the plaster floor. In England it was used especially in the upper storeys of houses, and was valued for its soundproofing and fireproofing qualities. Around Nottingham upper floors were constructed by laying reeds on the joists, optionally coating them with lime to fill in the voids, then placing on them about 50 mm of plaster.<sup>49</sup> Similarly in Leicestershire many upper floors consisted of 50 to 75 mm of well tempered lime plaster over reeds.<sup>50</sup> In the Cotswolds the joists were of timber in the round, and the space between was spanned with interlacing hazel sticks, on top of which was a mixture of clay and chopped straw. This was finished with either a smooth cement face or a layer of oak

<sup>44</sup> J R Wollaston [ed A Burton], *Wollaston's Picton Journal* (U Westen Australia Press, Nedlands [Western Australia] 1975), p 107.

<sup>45</sup> J R Wollaston [ed C A Burton & H U Penn], *Wollaston's Albany Journals (1848-1856)* (Perth 1954), p 65.

<sup>46</sup> E S Sorensen, *Life in the Australian Backblocks* (London 1911), p 25.

<sup>47</sup> Janet Hogan, *Building Queensland's Heritage* (Richmond [Victoria] 1978), pp 101, 103.

<sup>48</sup> Donald Watson, 'The Queensland House' ([typescript report] Brisbane 1981), p 8.8.

<sup>49</sup> Robert Beatson, 'On Cottages', in *Communications to the Board of Agriculture on Subjects Relative to the Husbandry and Internal Improvement of the Country*, vol I (2nd edition, Board of Agriculture, London 1804 [1797]), p 43. See also Edward Dobson, *The Art of Building* (2nd ed, London 1854), p 122.

<sup>50</sup> 'The Influence of Material on Design in Woodwork' in T R Davison [ed], *The Arts Connected with Building* (London 1909) pp 70, 72.

boarding, while the ceiling below was plastered.<sup>51</sup> C B Allen, in his *Cottage Building*, described the use of reeds, rather as in Nottinghamshire and Leicestershire, but suggested that strips of hoop iron would be better.<sup>52</sup> In Australia there is no suggestion that upper floor levels were constructed like this (though the use of Dutch biscuits, discussed below, is somewhat similar), but Mayes's *Australian Builder's Price-Book* of 1862 lists two types of plaster screed, as well as one of Portland cement, suitable for laying on top of what he calls concrete. The first type was a trowelled stucco of lime and hair, and the second was a three to one mixture of Keene's cement (a hard plaster).<sup>53</sup>

When Mayes refers to 'concrete' as the base for a plaster floor he of course does not mean a reinforced concrete slab, such as one might use today, but a primitive material which itself would be not be far removed from traditional English types, such as lime-ash flooring. Joseph Elliott, in Adelaide, had just such a floor of 'what is called concrete, being a composition of three parts sand and one part of lime, which when properly set becomes as hard as a rock'.<sup>54</sup> In 1850 Captain E Y Henderson laid a floor of 'concrete made of hot lime and small stone' in a building at the Fremantle Convict Establishment.<sup>55</sup> In England C B Allen recommended a concrete of gravel, sand, lime and tar, and on top of this a 40 mm screed of good cement.<sup>56</sup> This approaches the character of asphalt (which will be discussed separately below), and something similar was used in Natal - 'well washed gravel, lime and hot gas tar ... in such proportions as will render a black mortar'.<sup>57</sup> It is clear that there is every gradation between the naked earth and the true concrete floor.

A professional plasterer in England described how to lay first 'as a hard bottom, clean gravel, sand, lime and tar, to form a concrete', a word which he probably used in a similar sense to Mayes. One should then:<sup>58</sup>

lay down an inch and a half thickness of good cement, - either Blashfield's No.1 and three of coarse sand, or Atkinson's cement and three of sand, or patent Portland cement and four of clean coarse sand, floated in by a rule on screeds; care being taken to prevent as much as possible the joints from setting, so that it may be one sheet. If the cement set slow, while soft trowel it down, but not when it is setting, or it will injure the face. If set too quick for that, leave it with a rough key, and cover to an eighth inch [3 mm] thick with fine mortar, and trowel it gently before it begin to set. If the floor is not likely to be damp, instead

<sup>51</sup> E G Dawber, *Old Cottages, Farm-Houses and other Stone Buildings in the Cotswold District* (London 1905), p 15.

<sup>52</sup> C B Allen, *Rudimentary Treatise on Cottage Building* (2nd ed, London 1854 [1853]), pp 40-41.

<sup>53</sup> C B Mayes, *Australian Builders' Price-Book* (Melbourne 1862), p 75.

<sup>54</sup> Joseph Elliott, *Our Home in Australia* (Sydney 1984), p 60.

<sup>55</sup> R M Campbell, 'Building the Fremantle Convict Establishment' (PhD submission. University of Western Australia, 2010), p 1.7.

<sup>56</sup> Allen, *Cottage Building*, p 40.

<sup>57</sup> Brian Kearney, *Architecture in Natal* (Cape Town 1973), p 66, quoting *Davis' Natal Almanac* (1864).

<sup>58</sup> *Builder*, VII, 310 (13 January 1849), p 20.



of the gravel, &c., pave it with clean hard brick-bats, half an inch [13 mm] apart, and cover it with one inch [25 mm] of good cement.

Where such floors survive, which is rare enough, they are almost never documented, and it is impossible to determine their composition by looking at them. One example is the men's quarters at 'Werribee Park', Victoria, where the floor is taken to date from some time before 1880, and consists of a 12-20 mm screed, which looks like cement and is laid over sand.<sup>59</sup>

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Information from John Grinpukel, Melbourne Water, 1992.