

7.09 Additives and Finishes

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The three decades from 1910 were ones in which an especially large number of cement based products were accepted into the building industry - products whose total consumption of cement was in many cases very small, but whose impact was considerable. There were special forms of cement itself, such as rapid hardening types; there were additives, new in situ applications like sprayed finishes and terrazzo flooring; and individual building products such as asbestos cement sheeting and concrete roof tiles. Only the most arbitrary sampling of this range is possible.

a. cements and additives

'Medusa' was the trade name of a waterproofing compound based upon salts of aliphatic carbolic acids, and it was supplied as a dry powder suitable for mixing with Portland or modified Portland cements.¹ In America a 'Medusa' cement was sold, apparently ready-mixed with the additive,² and similarly a Medusa cement was marketed in Australia by at least 1912.³ In England the Cement Manufacturing Company, makers of Medusa waterproofer, also produced a cement mixture containing it, but this went under the name of 'Aquacrete', and Medusa was also used as an additive to modified cements such as 'Snowcrete'.⁴

Snowcrete was one of the white Portland cements which were made from iron-free raw materials, and thus avoided the grey colour of the standard Portland cement.⁵ It was later sold through the Sydney agents Swift & Co,⁶ and 'Sandusky' cement, of

¹ William Kinniburgh, *Dictionary of Building Materials* (London 1966), p 166. In 1949 it was advertised by the Cement Marketing Co Ltd of London: Oscar Faber & H L Childe [eds], *The Concrete Yearbook 1949* (London 1949), p 974.

² It was said to have all the qualities of standard white Portland cement in addition to being absolutely waterproof due to the addition of 'Medusa Waterproofing Compound' during manufacture: Waldo Bros. and Bond Company, *Building Materials and Construction Equipment* (Boston, no date [c 1920]), p 331; also p 333 for Medusa Waterproofing Compound.

³ *Salon*, 1, 1 (July-August 1912), advertisement p iv.

⁴ Kinniburgh, *Dictionary of Building Materials*, p 166.

⁵ Kinniburgh, *Dictionary of Building Materials*, p 242. See also Faber & Childe, *The Concrete Yearbook 1949*, p 556.

⁶ *Building*, LI, 303 (12 November 1932), p 93. Snowcrete was produced by the Cement Marketing Company of London: Evelyn Drury et al [eds], *Architects', Builders' and Civil Engineers' Reference Book* (London 1950), p 51.

unknown origin, was used on the portico of the St Kilda Town Hall in the 1920s.⁷ The so-called rapid hardening cements, under brand names like Speedite, Quickardo and Rapidard, were produced from the later 1920s either by altering the proportions of the raw mix or by finer grinding of the cement clinker.⁸ Quickardo, the produced by Australian Cement at their Geelong works, was claimed to attain standard twenty-eight day strength in three days.⁹ Another, sold in Sydney in the 1930s, was 'Rapidite'.¹⁰ The main British types were 'Ferrocrete', made by the Associated Portland Cement Co, and 'Ciment Fondu'.¹¹ The converse of the rapid hardening cements was the use of plaster in the mix as a retardant, something which was discovered fortuitously by P A Gibson in the United States.¹²

Ciment Fondu was made by the Lafarge Aluminous Cement Co,¹³ and was also marketed in Australia. It was a high alumina cement which originated in experiments in France in the mid-nineteenth century, but it was not exploited significantly until World War I, when it was used in special defence work, before becoming commercially available in 1918. It was made by fusing a mixture of bauxite and limestone at 1,500° to 1,600°, then grinding it to a fine powder. It developed a high strength within twenty-four hours, and was resistant to sulphate solutions.¹⁴ In the 1950s the Lafarge company were still the manufacturers, and the sole Australian agents were George Wills & Co Limited, of Brisbane, Sydney, Melbourne, Adelaide, Perth and Launceston.¹⁵

In 1935-6 Jack Schott, a chemist at Southern Portland Cement, developed the first low heat Portland cement for the Sydney Metropolitan Water, Sewerage and Drainage Board. This reduced the amount of cracking in mass concrete structures. It was used in the Burrinjuck Dam extensions in 1941; 300,000 tonnes were used for the Warragamba Dam between 1948 and 1955; and it has since been used in most dams throughout Australia.¹⁶ The Mount Frome Lime Co advertised a super-hydrated lime, 'Frolime', as a 'water-tightening agent' in concrete which, it was claimed, gave a more water-resistant product, maintained workability in leaner mixes, reduced handling costs and minimised the need for patching.¹⁷

⁷ *Australian Home Builder*, 15 May 1925, p 66.

⁸ Sara Johnstone, 'Australian Cement industry' (typescript article for a forthcoming publication of the Institution of Engineers, Sydney, 1987), p 5. This is distinct from the category of super rapid-hardening Portland cement introduced in Britain in 1940 to meet wartime needs: Drury, *Architects' &c Reference Book* [1950], p 51.

⁹ University of Melbourne Architectural Atelier, *Bulletin* (Melbourne 1932), p 37.

¹⁰ C E Mayes, *The Australian Builder and Contractor's Price Book* (10th ed, Sydney 1938), p 36.

¹¹ H B Newbold, *Modern Practical Building* (4 vols, London, no date [c1935]), II, pp 122-3. Ferrocrete was later produced by the Cement Marketing Co: Drury, *Architects' &c Reference Book* [1950], p 51. See also Faber & Childe, *The Concrete Yearbook 1949*, p 549, Ferrocrete; pp 564-5, Ciment Fondu; also p 553, lightning High Alumina Cement; p 561, Steelcrete.

¹² E J Hadley, *The White Powder* (New York 1945), p 38.

¹³ Newbold, *Modern Practical Building*, II, pp 122-3.

¹⁴ Kinniburgh, *Dictionary of Building Materials*, p 133.

¹⁵ F W Ware & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (3rd ed, Melbourne 1954), §§ 3/3, 41a/1.

¹⁶ Johnstone, 'Australian Cement industry', p 5; Philip McKay, 'The History of the Cement Industry 1939 to 1977' (mimeographed report for the Cement & Concrete Association of Australia, no place or date), p 29.

¹⁷ *The Eastern Suburbs Builders Handbook and Diary 1939* (Sydney 1939), p 50.

Amongst the concrete additives, 'Pudlo' waterproofer, which had been sold by Concrete Products Co in Sydney before the war, was on sale in Adelaide by the 1920s,¹⁸ and throughout Australia by the 1930s. It competed with Nonporite No 2 and Nonporite No 3 liquid.¹⁹ A whole range of materials for caulking, waterproofing, colouring, hardening and chemical proofing were made by Nonporite.²⁰ Another popular product was 'Colemanoid', a waterproofer and hardener which by the 1930s had been used in prominent works in New South Wales, Victoria, Queensland and South Australia. 'Bondcrete' was a binding and sealing agent, produced in England by British Bitumen Emulsions Ltd of Slough.²¹ By 1936 Bondcrete was being sold in the United States as a plaster which would adhere to concrete, and take a further coat of conventional plaster,²² but it is unclear when it reached Australia. In 1954 G M Skinner Pty Ltd of Sydney, and their agents in other cities, offered a wide range of waterproofers, hardeners, accelerants, plasticisers, air entrainers, colourants and other additives.²³ Nonporite and other firms offered mainly waterproofers, and these for applications not confined to concrete.²⁴

b. terrazzo

Terrazzo was relatively slow to reach Australia. It was a development from a traditional flooring of the Veneto region, in which a mixture of lime, sand and powdered brick was laid on the floor, milled stone chips were pressed into it with heavy rollers, then the surface ground smooth and oiled. It was used at Palladio's Villa Godi,²⁵ and the architect himself said:

I Pavimenti si sogliono fare o di terrazzo, come si vsa un Venetia, o di pietre cotte, ouero di pietre viue. Que i terrazzi sono eccellenti, che si fanno di coppo pesto, e di ghiara minuta, e do calcina di cuocoli de fiume, ouer Padouana, e sono ben battuti: e deusi fare nella Primauera. o nell' Estate, accioche si possano ben seccare.²⁶

[The pavements are usually made either of *terrazzo*, as is used in *Venice*, bricks or live stones. Those terrazzi are excellent which are made of pounded bricks, and small gravel, and lime of river pebbles, or the *paduan*, well pounded; and ought to be made in spring or in summer, that they may be well dry'd.²⁷]

¹⁸ *The South Australian Building & Allied Trades Directory and Register* [Adelaide 1926], pp 6, 25; see also Mayes, *Australian Builders Price Book* (1938), p 167. It was produced in England by Kerner Greenwood & Co of Norfolk: *Architectural Review*, LXXIV, 443 (October 1933), p xxxvii; Drury, *Architects' & Reference Book* [1950], p 56; Kinniburgh, *Dictionary of Building Materials*, pp 212-213.

¹⁹ W L Richardson, *Ramsay's Architectural and Engineering Specifications [Volume 1]* (Melbourne, no date [1934]), p 52.

²⁰ *Ramsay's Architectural Catalogue* (Melbourne 1931), op cit, pp 38-41.

²¹ Kinniburgh, *Dictionary of Building Materials*, p 46.

²² United States Gypsum Company, *A Catalog of Building Materials* (Chicago 1936), p 21.

²³ *Ramsay's Catalogue* [1954], § 11/1.

²⁴ *Ramsay's Catalogue* [1954], §§ 11/2 - 11/6.

²⁵ Witold Rybczynski, *The Perfect House* (New York 2002), p 6. Rybczynski says that this flooring was called *battuto*, but Palladio's own words suggest otherwise.

²⁶ Andrea Palladio, *I Quattro Libri dell'Architettura* (Venice 1570), book, 1 chapter xxii, p 53.

²⁷ Andrea Palladio [translated Isaac Ware], *The Four Books of Andrea Palladio's Architecture* (London 1738 [1570]), book 1, chapter xxii, p 27.

The technique was revived in 1838. In 1850 Antonio Cristolofi established a factory at Padua, and by 1855 he had about fifty-five employees. The material came into general use for the floors of vestibules and other rooms, in the vicinity of Venice and Padua, and even in Dalmatia.²⁸ In 1853 Benjamin Hardinge of Cincinnati received a United States patent for something which sounds very similar, a 'polished concrete' in which were silicates, pebbles, spots of granite, &c, all polished to a smooth surface.²⁹ By 1879 or earlier J & H Patteson of Manchester were producing floor tiles of terrazzo,³⁰ and these, or something very like them, are found on the landing at the entrance of the house 'Bundalohn' in the Melbourne suburb of St Kilda, which dates from 1884-5, and in the basement of the Safe Deposit Building, Queen Street, Melbourne, of 1888-9. In 1901 Pattesons were making what they said was a superior terrazzo pavement, 'marble mosaic adamant', and terrazzo was also produced in England by Geary, Walker & Co of the Westminster Patent Flooring Co, of London,³¹ but no other makers appear in Sears's *Compendium* for that year.

There is a romantic notion that it was the Italians who brought terrazzo to Australia, and that this was some sort of local cultural phenomenon. The reality is that the idea of terrazzo was well established here through British connections, but that Italian migrants took naturally to the trade and made it their own. They had apparently done the same in Britain itself, where one prominent terrazzo company was A Quiligotti & Co.³² There are reported to have been terrazzo workers from Lombardy in Melbourne by 1898.³³ Nothing is known of their work, but terrazzo had already been advocated for local hospitals in 1891,³⁴ and it was used in the operating theatres of the Melbourne Hospital in 1910-13.³⁵ Terrazzo was introduced in the United States at about the same time as in Australia, the later 1890s,³⁶ and seems to have become better known there, even though it did not gain wide acceptance.

In 1914 there seem to have been a number of contractors, and Mayes described the material as a

composition of cement in situ with chips of granite or marble of different colours, and worked into patterns, borders, letters, or elaborate designs, and afterwards ground down to uniform surface when drying.³⁷

²⁸ Théodore Chateau, *Technologie du Bâtiment* (2 vols, Paris, 1863, 1866), II, pp 374-6.

²⁹ *Builder* [UK], XI, 550 (20 August 1853), pp p 532-3.

³⁰ Henry Reid, *A Practical Treatise on Natural and Artificial Concrete* (London 1879), pp 274-6.

³¹ J E Sears [ed], *The Contractors,' Merchants,' and Estate Managers' Compendium and Catalogue* (18th ed, London 1901), p 151.

³² J E Sears & J E Sears [eds], *The Architects' Compendium and Annual Catalogue* (London 1936), p 145.

³³ Celestina Sagazio, *Italian Craftsmanship and Building in Victoria* (Melbourne 1990), p 41, citing a report by the Italian consul, Pasquale Corte, quoted in Tina Cecilia, *We Didn't Arrive Yesterday* (Red Cliffs [Victoria] 1987), p 219.

³⁴ H B Allen, *Final General Report on Hospital Construction and Management* (Melbourne 1891), pp 9, 17, which discusses the 'marmor-terazzo' flooring at Hamburg and Middlesex hospitals.

³⁵ Nigel Lewis & Associates, *Queen Victoria Medical Centre* (South Yarra [Victoria] 1985), p 51.

³⁶ W C Johnson, 'Terrazzo', in T C Jester [ed], *Twentieth-Century Building Materials* (Washington [DC] 1995), p 236.

³⁷ Mayes, *Australian Builders Price Book* 1914), p 238.

Terrazzo was still sufficiently little known in 1916 for G A Taylor, who had seen it in America, to feel obliged to explain the term ('a composition of waste pieces of marble and cement ground and polished').³⁸ However, by 1925 it was appearing as a standard finish in bathroom and porch floors in some speculative housing.³⁹ This is consistent with the fact that its general acceptance in the United States is said to date from the 1920s.⁴⁰

Granolithic flooring (which will be discussed below) and terrazzo, were now to become the special province of immigrant Italians. Many worked at a backyard scale, but the leading Melbourne contractors were all founded more or less by Italians: De Marco Brothers was established in about 1920,⁴¹ and in 1922 Umberto [Albert] and Amadeo Del Fabbro, with another Italian, established the mosaic and terrazzo business of Zoz-Del Fabbro, until Umberto moved to Adelaide in 1925.⁴² The Federation Granolithic Company of Beniamino Braida followed in 1925; the Anglo-Italian Granolithic Company of Beniamino Bortolussi in 1927; and the Genoa Terrazzo Company of Giuseppe Cinquegrana and Peter Verrelli at an unspecified date,⁴³ but before 1928.⁴⁴ In Sydney the rather non-Italian sounding firm of Holdsworth, Macpherson & Co were terrazzo workers and marble merchants,⁴⁵ but were challenged by Melocco Brothers,⁴⁶ who would in due course become major interstate producers of mosaic and terrazzo pavements as well as fibrous plaster ceilings. Pietro [Peter] Melocco reached Sydney in 1908, already with some experience as a mosaicist and marble worker in the United States, and after a brief period as an employee he established his own workshop. His much younger brother Antonio [Tony], who had married in Paris, joined him in 1910. The third brother Galliano [Galli] joined the business only in 1926, and soon moved to Brisbane to open a branch there.⁴⁷ In Brisbane the Marbcrete Coy Ltd. had already been advertising by 1922 as workers in terrazzo and mosaic, and cited amongst their work the Stuartholme Convent, St Martin's Hospital, the Mater Misericordia Hospital, and other buildings.⁴⁸ In Adelaide Umberto Del Fabbro's business prospered, but he was an active fascist and was interned in 1940. After his release he rebuilt the business, and in the 1960s had 120 employees.⁴⁹

By the 1930s the Anglo-Italian Granolithic Company was also producing a material called 'Marblite' in thin sheets, up to 1.2 x 1.8 metres, for use on walls instead of

³⁸ G A Taylor, *There! A Pilgrimage of Pleasure* [Sydney 1916], p 64.

³⁹ *Australian Home Builder*, 15 July 1925, p 57.

⁴⁰ Johnson, 'Terrazzo', p 234.

⁴¹ Sagazio, *Italian Craftsmanship*, pp 41-2.

⁴² Carmel Floreani, 'Umberto Primo (Albert) Del Fabbro (1899-1978)', in Christopher Cunneen [ed], *Australian Dictionary of Biography Supplement 1580-1980* (Melbourne 2005), p 99.

⁴³ Sagazio, *Italian Craftsmanship*, pp 41-2.

⁴⁴ J S Gawler, *The Architects' and Builders' Index (Victorian Edition)* (Melbourne 1928), p 27.

⁴⁵ *Building*, 12 October 1922, p 112.

⁴⁶ *Building*, 12 October 1922, p 143.

⁴⁷ Catherine Kevin, 'Pietro Olivo (1883-1961), Antonio Nicholas (1886-1946) & Galliano Eugenio (1897-1971) Melocco', in Christopher Cunneen [ed], *Australian Dictionary of Biography Supplement 1580-1980* (Melbourne 2005).

⁴⁸ *Architect and Builder's Journal of Queensland*, September 1922, p 10 (a reference kindly supplied by Michael Kennedy).

⁴⁹ Floreani, 'Umberto Del Fabbro', p 99.

tiles.⁵⁰ The Genoa Terrazzo Co of Melbourne achieved a substantial scale of operation,⁵¹ as did De Marco Bros, who in 1925 completed the 'terrazza' paving of Queen's Walk, Melbourne, and went on within a few years to employ fifty or sixty men on terrazzo and mosaic work, as mentioned above. Other firms had been started, as they pointed out, by De Marco's former employees.⁵² By the later 1920s they could cite work in mosaic, terrazzo, ironite or granolithic for Myers, London Stores, the Children's Hospital and St Mary's Catholic Church, West Melbourne.⁵³ In 1938-9 they undertook a substantial terrazzo contract for the Australia Hotel, Melbourne.⁵⁴ The Federation Co was responsible for the flooring of the Royal Melbourne, Prince Henry's and Royal Children's Hospitals. In the decade around World War II some elaborately decorative terrazzo was produced in New South Wales, in as many as five colours, separated by brass strips, and in both curvilinear and rectilinear designs.⁵⁵

An Italian migrant in what might be thought of as the second wave was Oswald [Osvaldo] Rigutto, who had been trained at the Spilimbergo school of mosaic before emigrating to Australia. He was apprenticed to Colloretti & Sons of Melbourne for eighteen months, working terrazzo for the T & G Building, and was then with the builders Morris Plotkin, and Mardegan & Negri, before setting up in the firm of L & R Rigutto Ltd in 1934.⁵⁶ Another of the migrant Italians was Gio Batta Stella, who in about 1955 invented and successfully marketed a portable terrazzo floor polishing machine, of which hundreds were ultimately sold for use all over Australia. He also developed non-portable machines - jenny linds and floats - for factory use. However the jenny lind was a machine in established use for stucco polishing⁵⁷ and it is not clear what if any improvement was effected by Stella. Prominent Melbourne firms after World War II, other than De Marco, do not seem to have been specifically Italian. They included Picton Hopkins & Son, who were long established plasterers, and Durex Terrazzo & Paving, who at least advertised 'Continental craftsmanship'.⁵⁸

In the late 1940s Frank Mingarelli came to Australia from Modena, northern Italy, recognised an opening, and began manufacturing terrazzo tiles in Carlton. His business succeeded, and it was turned into a family company, then in 1956 moved to Moorabbin.⁵⁹ Despite this success, Mingarelli's tiles cannot have been widely known,

⁵⁰ Royal Victorian Institute of Architects, *Journal*, XXXI, 3 (July 1933), advertisement p iii.

⁵¹ *Ramsay's Catalogue* (1931), p 68; for an equivalent conspectus of terrazzo in Britain see J E Sears & J E Sears [eds], *The Architects' Compendium and Annual Catalogue* (London 1936), pp 141 ff.

⁵² *Australian Home Beautiful*, 15 September 1925, p 66.

⁵³ *Australian Homes* (Melbourne 1927), p 52.

⁵⁴ *Hotel Australia Melbourne, 1939* (Melbourne 1939); 'Hotel Australia, Collins Street', *Journal of the RVIA*, XXXVII, 7 (September 1939), pp 191-201. See also *Ramsay's Catalogue* {1949}, §§ 28/11, for some other prominent jobs up to that time.

⁵⁵ Patrick Van Daele & Roy Lumby, *A Spirit of Progress: Art Deco Architecture in Australia* (Sydney 1999), pp 102-3, illustrate striking examples at Commonwealth bank branches at Bondi Beach and Roseville, both of about 1936, and the former Bowery Coffee Shop, Newcastle, of 1944.

⁵⁶ Notes supplied by Mr Oswald Rigutto by courtesy of his grandson, Joseph Princi, 1993.

⁵⁷ E G Warland, *Modern Practical Masonry* (London 1929), fig 66 & p 15.

⁵⁸ *Ramsay's Catalogue* {1949}, §§ 22/12, 28/13.

⁵⁹ *Port Phillip / Caulfield Leader*, 16 August 1999, p 32.

for in 1959 terrazzo tiles were advertised as being newly available.⁶⁰ The uniform mixing of the colour was such an important aspect of terrazzo manufacture that in Britain it was usual to mix it in a special machine which had a lifting as well as a rotating movement,⁶¹ but if anything of this sort was used in Australia it has yet to be reported.

c. hardened pavings

At the Great Exhibition of 1851 C K Dyer had shown his 'patent metallic cement',⁶² and this may be the ancestor of 'Metalcrete' concrete hardener. This was claimed to produce dust-proof and waterproof floors, was apparently a product of the Klein Manufacturing Co of the United States. It was sold early in the 1920s by the Melbourne agents Rosenfeld, Hillas & Co Pty Ltd,⁶³ by Rosenfeld & Co of Sydney, and by Clarkson Ltd of Brisbane. It was described as:

a metallic compound of uniform quality and composition, made of carefully selected metal particles, pulverized and chemically treated, which expand on coming into contact with the moisture of the concrete, and hermetically [seal] the pores or voids, thus producing a dense surface that will withstand the hardest usage.

A colourless liquid under the same brand was designed for application to existing concrete floors that were 'wearing and dusting'.⁶⁴

'Patent granolithic paving' was reported in Australia in 1887 (in the stable floor at a Randwick villa),⁶⁵ and granolithic paving, stair treads, &c, were available in England by 1901 as a matter of course rather than as a novelty.⁶⁶ Granolithic paving is made of Portland cement and granite or other rock chips,⁶⁷ or in Australia more commonly bluestone chips, finished with 1:1 mix of stone dust, and steel trowelled to give a durable finish.⁶⁸ When thoroughly set it may be ground, preferably with rapid-cutting abrasive stones, then the exposed voids are filled with creamy grout, and the surface is ground again to remove the film, then polished.⁶⁹

⁶⁰ *Australian House and Garden*, July 1959, p 14, cited in Peter Cuffley, *Australian Houses of the Forties and Fifties* (Knoxfield [Victoria], 1993), p 86.

⁶¹ B H & R G Knight, *Builders Materials* (London 1948 [1939]), pp 172-3.

⁶² Great Exhibition of the Works of Industry of all Nations, 1851, *Official Descriptive and Illustrated Catalogue* (3 vols, London 1851), I, p 135.

⁶³ *Everyman's Home*, II (October 1922), p 51. See also Waldo Bros, *Building Materials*, p 333.

⁶⁴ *Building*, 12 October 1923, p 38, p 13.

⁶⁵ *Australasian Builder & Contractor's News*, 21 May 1887, p 31.

⁶⁶ J E Sears [ed], *The Contractors,' Merchants,' and Estate Managers' Compendium and Catalogue* (15th ed, London 1901), p 151.

⁶⁷ W Verrall, *The Modern Plasterer* (2 vols, London, no date [1935]), II, pp 79-81; see also p 200. Verrall specifies granite, while a later publication calls for a 3/8 or 1/4 inch [9.5 or 6.5 mm] crushed rock aggregate and a natural or crushed rock sand, in the ratio of 1:2:2, cement: aggregate: sand, by weight: Cement and Concrete Association, *Finishes for Interior Concrete Floors* (London 1949), p 4.

⁶⁸ F Wentworth & W L Richardson [eds], *Ramsay's Architectural and Engineering Catalogue* (Melbourne 1949), § 28.21.

⁶⁹ Cement and Concrete Association, *Finishes for Interior Concrete Floors*, p 5.

Precast granolithic paving had been used in the courtyard and possibly the vestibule, of the Land Administration building in Brisbane, of 1901-5. The vestibule was originally specified as encaustic tiles, but the courtyard was designed from the outset to be of grano:⁷⁰

The pavement in the courtyard shall be laid on a 3 inch bed of sand, with granolithic, silicated slabs, 2 inches thick, composed of one-part cement to three-parts granite chippings ... floated off with a steel trowel to a hard and smooth face corrugated or indented with the brass roller ...

Granolithic was again used in 1907 at the Shenton Park Hotel, Perth.⁷¹ In the following year the Commercial Hotel at Fremantle was rebuilt to the design of J McNeece with granolithic work as 'a feature of the contract', being used for the yards and rights-of-way, the floors of kitchens and outhouses, and the 'granolithic and iron' pillars supporting the verandah.⁷²

In Melbourne there was by 1908 a Granolithic Patent Paving Coy, and William Sim of South Melbourne was advertising Innes's Granolithic Paving.⁷³ The Granolithic Patent Company, of which A H and George Vincent were the proprietors, cited amongst their work 'the best and largest paved area in Australia', the cab yard at Spencer Street Station, as well as other examples of footpath pavements and factory and garage flooring.⁷⁴ By 1913 the Permasite Company of Melbourne was advertising granolithic flooring in addition to its more specialised products (discussed below).⁷⁵ 'Ironite' paving was a variation on granolithic, in which the bluestone topping was replaced by 'Ironite',⁷⁶ the precise nature of which is unclear. Listed in Jeffries's *Australian Building Estimator* in 1907,⁷⁷ and by 1908 W H Hughes & Co had laid about two thousand square metres of Ironite coping at Central Station. Ironite granolithic, of a red colour, was used extensively in the Melbourne Hospital of 1910-13.⁷⁸ Granolithic and Nepeonic finishes were also advertised by W H Hughes & Co.⁷⁹ By 1913 Ironite Pavings Limited had an office in Sydney and a branch in South Melbourne.⁸⁰

⁷⁰ Specification of 1900, quoted in Allom Lovell Marquis-Kyle, *Treasury Buildings Group Conservation Study* (3 vols, Brisbane 1992), II, pp 107, 120.

⁷¹ Ian Kelly, 'The Development of Housing in Perth (1890-1915)' (MArch, University of Western Australia, 1991), p 202, quoting W Fairweather's contract ledger, 1907-1917 (location not specified), p 102.

⁷² *Western Australian Mining, Engineering and Building Journal*, XII, 294 (29 August 1908), quoted in Grant Adams, 'Western Hotels 1890-1918' (elective dissertation, School of Architecture, University of Western Australia, 1982), pp 9-10.

⁷³ J M, H E & J M Coane, *Australasian Roads* (Melbourne 1908), advertisements p xxiii.

⁷⁴ *Cazaly's Contract Reporter*, XXIV, 25 (23 June 1908), p 98.

⁷⁵ *The Architectural Students Annual* (Melbourne 1913), p xxvi.

⁷⁶ Wentworth & Richardson, *Ramsay's Catalogue* (1949), § 28.11. It is unclear whether this has to do with 'Ironite' later sold by the Ironite Co Ltd of London, which appears to have a pro-waterproofing additive; Drury, *Architects' & c Reference Book* [1950], p 161.

⁷⁷ Walter Jeffries, *The Australian Building Estimator* (Sydney 1907), p 202.

⁷⁸ Lewis, *Queen Victoria Medical Centre*, p 51.

⁷⁹ C E Mayes, *The Australian Builders & Contractors' Price Book* (7th ed, Sydney 1908), p xxxvi.

⁸⁰ *Salon*, I, 1 (July-August 1912), advertisement p ii.

'Arkalite' [*sic*] was mentioned briefly by Jeffries in 1907, as a paving costing about the same as Ironite,⁸¹ and it was used in the Anglican Cathedral, Brisbane, in about 1904-8, coloured red and grey.⁸² By 1908 the Patent Asphaltum Co of N.S.W. was advertising Patent Arkilite Flooring (in red and grey) and Arkilite steps and nosings, the latter said to be cheaper and far more durable than those of marble or slate. The advertisement was directed solely to the Sydney market.⁸³ These materials were obviously cement based, but they are otherwise hard to distinguish from the magnesite and other products discussed below, especially given that one of them, Aegypto Jointless Sanitary Flooring, was also sold by the Patent Asphaltum Co. According to Mayes, writing in 1914, Ironite, Arkilite, and similar cement composition paving, such as Steelite, Oronite and Xylite, had been used in Australia for many years, especially for outside work.⁸⁴ By the 1930s Nonporite were marketing Metalcite Floor Hardener' for application to existing concrete floors,⁸⁵ and in 1936 'Skelithic', an Australian-made steel floor surfacing compound, was available through a number of concrete flooring contractors.⁸⁶

d. Benedict Stone

In city building exteriors glazed terra cotta cladding was challenged by 'Benedict Stone', a concrete cladding block which could be produced in a variety of colours by crushing and recombining natural rock. This was one of a range of cast stone products which began with the siliceous stone developed by Frederick Ransome in the 1850s, but which came to make use of Portland cement exclusively. The Usonian James Benedict founded the Benedict Stone Company in 1919 with a plant in West Chester County and an office in New York, but moved to Chicago in the 1920s.⁸⁷ The material was selected in 1924 for Soldier Field, Chicago, by Holabird and Roche, and this was to be the most famous example of the product. In 1927 thirty-four United States producers of such materials formed the Association of Cast Stone Manufacturers, and it does not appear that Benedict Stone (now of Chicago) was at this stage very distinctive.⁸⁸ In 1930 Benedict formed a partnership with the Dextone Company for the manufacture of decorative cast stone work,⁸⁹ and his product evidently ceased to be a distinct entity, though it had been supplied to more than a hundred businesses in the United States.

Benedict Stone appears to have been first made in Brisbane in 1922 at a plant managed by William Brown, who had been twelve years with the parent company in

⁸¹ Jeffries, *Australian Building Estimator*, p 203.

⁸² Information from Roy Green, of Cost Management Services Pty Ltd, Brisbane, March 1993.

⁸³ Mayes, *Australian Builders Price Book* (7th ed, Sydney 1908), advertisement p iv. There is also a reference in the text p 159, to Arkilite tiles - presumably those identified simply as 'concrete tiles' in the advertisement.

⁸⁴ C E Mayes, *The Australian Builders & Contractors' Price Book* (8th ed, Sydney 1914), p 237.

⁸⁵ Richardson, *Ramsay's Specifications*, 1, p 62.

⁸⁶ *Journal of the Royal Victorian Institute of Architects*, XXXIV, 4 (September 1936), p xlii.

⁸⁷ P H Simpson, *Cheap, Quick, & Easy* (Knoxville [Tennessee] 1999), p 128.

⁸⁸ A B Cowden & D P Wessel, 'Cast Stone', in T C Jester [ed], *Twentieth-Century Building Materials* (Washington [DC] 1995), pp 87-91.

⁸⁹ Simpson, *Cheap, Quick, & Easy*, p 128.

America,⁹⁰ and an early example is 291 Queen Street, Brisbane (now Newspaper House) of 1931. Benedict Stone was also made in Sydney at the Granville works of Goodlet & Smith, who had entered an agreement in 1927 with Benedict Stone Ltd, USA, by which they were to produce the material under licence, with 15% of profit going to America. By October 1927 it was beginning to be used, and in the next few years it appeared in prominent works like the new offices of the Sun newspaper, and war memorials for Granville RSL, and Blackheath Memorial Park. The Sydney Benedict stone company succumbed to the depression and went into liquidation in 1931, but the product was still being advertised in 1933.⁹¹

In Brisbane the Roman Catholic Archbishop, James Duhig, was planning the construction of his Cathedral of the Holy Name, to the design of the Sydney architects Hennessy & Hennessy. Jack Hennessy prevailed upon Duhig to sign a contract with a company, Concrete Constructions Ltd [CCL], which had an interest in Benedict Stone. Duhig had seen the material in the United States in 1926, notably at Soldier Field, and after some initial reluctance he became a convert. Hennessy sent the engineer A S MacDonald to America to investigate the process, and MacDonald came back with a recommendation that Duhig establish a Queensland company to obtain the licence and to make Benedict Stone locally. This was done upon the basis that Duhig or his nominee would provide the capital for the factory, and would pay 5.4 pence per cubic foot in royalties to the parent company. Works were established in Light Street, and were opened by the Governor on 9 August 1929. The American company sent out an engineer, William Jackson Brown of Baltimore, to manage the plant. But by the time the first block of Benedict stone was laid, late in 1929, both Duhig and CCL were under stress, and the ultimate result was that the Cathedral project foundered.⁹²

Benedict Stone continued to be manufactured in Brisbane, where it was used for the Shell Building,⁹³ and the Tattersall's Club extension of 1939.⁹⁴ Australia-wide it was used especially in the various offices of the Colonial Mutual Life Assurance Co designed by Hennessy & Co. One of the best examples is at 41-49 King William Street, Adelaide, of 1935-6.⁹⁵ Another was built in 1936 at St George's Terrace, Perth, but demolished in 1980,⁹⁶ and there were others at Wellington, New Zealand, and Durban, South Africa. The Prudential Building at Wellington, of 1934-5 (assuming that this is not the original CML Building) is clad in Australian sandstone with Benedict stone dressings.⁹⁷ The Smith & Caughey Building in Auckland of 1929, by Roy Lippincott, looks as if the dressings at least are of Benedict Stone. The Australian Catholic Assurance Building at 120-6 Queen Street, Melbourne

⁹⁰ *Architect and Builder's Journal of Queensland*, 22 September 1922, p 32 (a reference kindly supplied by Michael Kennedy). As the company was formed only in 1919 this cannot be strictly true, but it may be that Brown had been employed by Benedict previously.

⁹¹ A W Johnson, 'Goodlet and Smith Ltd. Brickworks, Roofing Tile Manufacturers, Cement Works & "Benedict Stone" Manufacturers. Granville, N.S.W. (1886-1982)' (3 vols, major project for Historical Archaeology II [University of Sydney] 1982), p 9.

⁹² T P Boland, *James Duhig* (St Lucia [Queensland] ?DATE), pp 229, 233-4, 239-41.

⁹³ Florence Taylor, *A Pot Pourri of Eastern Asia* (Sydney 1935), p 47.

⁹⁴ This was by the architects T R Hall and L B Phillips, and the Queen Street façade was credited to the 'Benedict Stone Plant': *Building*, 23 December 1939, p 23.

⁹⁵ Susan Marsden et al [eds], *Heritage of the City of Adelaide* (Adelaide 1990), p 95.

⁹⁶ Ian Molyneux, *Looking Around Perth* (East Fremantle [Western Australia] 1981), p 63.

⁹⁷ Information from Julia Gatley and Greg Bowron, of the Historic Places Trust, Wellington, 1996.

(completed in 1936) was again by Hennessy & Hennessy, and was clad in Benedict stone from the Brisbane works, which was graded from a pink colour at the bottom, to a warm buff at the top.⁹⁸

In Sydney, Asbestos House in York Street, the headquarters of James Hardie & Co, was reportedly clad in cement tile with a glazed finish,⁹⁹ but I have not established which product this is. After World War II a product of this character was available in Western Australia, 'Spuncrete' concrete tiles, which were made at Welshpool with English white cement, aggregate and pigments, spun at a high speed to throw out the excess water in the mix, and to maximise the density.¹⁰⁰

e. rendered finishes

The companies marketing J F Golding's expanded metal in the United States were promoting its use as lathing for the walls of houses in the 1890s. In what they called 'Cementine' construction a conventional timber frame was built and covered in rough sheathing. It was desirable to line this with 'inexpensive oiled roofing paper', and then light timber furring strips were nailed on at 300-400 mm centres, and onto these the expanded metal was fixed in horizontal strips. The cement mortar was applied to this in any desired finish. By 1896 it was claimed that twenty or more such houses had been built in different places, and one elaborate example, which had stood for two years, was F Tiedeman's house at St George, Staten Island, NY, designed by Paul Kuehne.¹⁰¹ This was to become a well established technique in the United States,¹⁰² and it had been used for exterior walls in Canada before the Great War.¹⁰³ Meanwhile the same construction, or something like it, had already reached Australia, for in November 1896 there was advertised for sale a house at Phillip Island, Victoria, made of expanded metal, plastered inside and cemented outside.¹⁰⁴ Another building system using roughcast on a timber frame seems to have been developed by the Melbourne architect H D Annear, and used in his houses at Eaglemont from 1903 onwards.¹⁰⁵

By 1910, however, the idea of applying a cement stucco to chicken wire on a timber frame had been adopted by the local architect Harry Marks at Toowoomba,

⁹⁸ *Modern Store*, I, 10 (January 1937), pp 12-15; *Age*, 8 December 1936 [np].

⁹⁹ As advised by Michael Bogle, 2003.

¹⁰⁰ Royal Australian Institute of Architects WA Chapter, *Exhibition 1949 Catalogue* (Perth 1949), p 47.

¹⁰¹ *Expanded Metal and its Uses in Fire-Proof Construction* (Chicago 1896), pp 80-83.

¹⁰² Atlas Portland Cement Company, *Concrete Construction about the Home and the Farm* (revised ed, New York 1909 [1905]), p 156; *Sweet's Architectural Catalogue* (17th ed, New York 1922), pp 251-3. Some of Sears Roebuck's houses at about the time of the Great War were finished in 'Stonekote', 'more commonly known as cement plaster', which seems to be a textured cement finish, usually over a timber frame: Sears, Roebuck and Co, *Modern Homes* (Chicago, no date [c 1910]), pp 19, 42, 7, 96.

¹⁰³ Steel and Radiation Ltd, *'Steelcrete' Expanded Metal and 'Klutch Bar' Concrete Reinforcement* (Toronto, no date [c 1910]), p 116.

¹⁰⁴ This was 'The Den' on Marsh Road, Cowes: *Argus*, 7 November 1896, p 2.

¹⁰⁵ Harriet Edquist, *Harold Desbrowe-Annear: a Life in Architecture* (Melbourne 2004), pp 62, 71, 72.

Queensland,¹⁰⁶ and this, while not important in its own right, was a harbinger of 'Gunite' and other such methods used at later dates.¹⁰⁷ In Tasmania Bernard Walker's house 'Wylam' at Sandy Bay, Hobart, of 1916, was followed by a number of houses after World War I in using stucco over either wooden lathing or chickenwire.¹⁰⁸ By the 1920s this stucco on chickenwire was widely used in rural Victoria,¹⁰⁹ and cement over wire netting, is said similarly, to have been used for Spanish bungalows in New Zealand in the 1930s.¹¹⁰

In Australia generally the technique was known as 'Conite', an American name which may or may not have been used at the outset. In 1947 the Victorian Housing Commission reported that Conite on 'a special wire mesh', and finished in white cement, was proving very successful, especially in northern areas, and had been used at housing estates at Wangaratta, Dimboola, Shepparton and Mildura.¹¹¹ Clifford Lloyd described Conite on the basis of United States practice: first of all wires were stapled horizontally across the studs at nine inch (225 mm) intervals, then stout building paper was laid over these, then wire netting was fixed over that, presumably also by stapling. The cement render was placed over this, and the sand required by the American specification was translated into Melbourne terms by Lloyd as two parts of Frankston to five parts of Cardinia Creek or Kooweerup sand, passed through a 1/8th inch (3 mm) sieve. Some architects, according to Lloyd, sought to improve the system by using expanded metal rather than netting, but this was not as good because it required more joints, and the extra stiffness was unnecessary. In America, according to Lloyd, 'many of the film stars' palatial homes are built of this ...¹¹² In New Zealand a similar effect was produced by the use of 'Steeltex', an imported reinforcing mesh with a kraft paper backing, used as a base for stucco finishes.¹¹³

In 1910 J James & Co of Sydney were the sole agents for 'Metal Ladder Tape', which was, as the name implied, a strip of metal like a ladder, which was tensioned vertically and horizontally in intersecting strips, and concrete cast around it to create internal partitions. It was reported to have been used in a block of flats at Neutral Bay.¹¹⁴ By 1914 C E Mayes's price book was describing other forms of stucco walling based upon tension members or upon metal framing rather than timber. One was Macintosh's 'Tangent' process, in which a diamond wire mesh was stretched from floor to ceiling, such that the diamonds were two feet high by six inches wide [600 x

¹⁰⁶ Morag Papi, *James Marks and Sons, Architects, Toowoomba* (no place or date [?Brisbane]), pp 47, 53.

¹⁰⁷ Papi, *James Marks and Sons*, p 32.

¹⁰⁸ Barry McNeill, *JArchitecture from the Edge* (North Hobart 2002), p 52.

¹⁰⁹ For example, a number of buildings on the property 'Ercildoune', Burrumbeet, and 'Mundarra Park' homestead, Edenhope, of 1926 (the latter reported by Tanya Hancock, 1997).

¹¹⁰ Michael Fowler & Robert Van De Voort, *The New Zealand House* (Auckland 1983), p 31. It is not clear whether this assertion is based only upon the evidence of a house on Waitemata Harbour which is illustrated, but if so it is suspect. The house is not Spanish in form, but only in its textured stucco treatment, and there is no indication that the date has been established at all. Martin Hill, *Restoring with Style* (Wellington 1985), p 72, discusses the 'Spanish Mission Bungalow' of the period 1931-5, which has a stucco finish, but does not state what it covers.

¹¹¹ Victoria, Housing Commission, *Ninth Annual Report of the Housing Commission of Victoria for the period 1st July, 1946, to 30th June, 1947* (Melbourne 1949), p 12.

¹¹² C Lloyd, *Help for Home Builders* [Melbourne 1957], pp 26-7.

¹¹³ C F Cameron, 'State Housing and State Sponsored Housing in New Zealand' (MArch, University of Auckland, 1970), p 91.

¹¹⁴ *Building*, 12 December 1910, p 12.

150 mm]. Onto this mesh, in the version illustrated by Mayes, were fixed horizontal panels of 'Keylock Lathing', a patent perforated metal sheet, and then both sides were rendered and plastered, typically to an overall thickness of two inches [50 mm]. This could clearly be used only to fill panels within an existing frame.¹¹⁵

Outbuildings of this construction have been located by Peter Marquis-Kyle at 'Tarong' homestead near Kingaroy, Queensland, apparently built in 1911 to the design of the British architect Hubert Thomas. He reports that the core is something resembling one inch [25 mm] pitch corrugated steel sheet, perforated with large holes, and placed with the corrugations running horizontally. These are stiffened at corners, jambs and pilasters by means of small rolled steel angles running vertically, and wired to the corrugated sheets. Both sides are rendered with cement mortar to a thickness of about 40 mm, or rather greater where the vertical angles are placed.¹¹⁶

Yet another method was described Mayes in 1927:

Where space and weight are a consideration, thin, light and solid partitions on Steel Lathing can be used and fastened to 1/4 in. or 3/8 in. [6.5 or 9.5 mm] W.I. vertical rods or angle steel, spaced about 1 foot apart, tautly fixed and hooked into eye bolts screwed into ceiling and floor joists; plastered on both sides with a finished thickness of 2 in. [50 mm], forms a very light, yet exceedingly strong, rigid, and practically fire and vermin proof wall, the combined steel and plaster work forming a monolithic slab able to withstand any reasonable pressure or thrust, in partitions from 14 ft.¹¹⁷

This is very similar to the 'Steelcrete' concrete construction used by L M Perrott, and discussed above. It seems to be the material known in Queensland as 'reinforced stucco', which was used for houses in the 1920s and 1930s. It is shown in the drawings for the Gayndah Hospital in 1923. In the external walls it is used, of necessity, between vertical studs, but in the internal partitions it is entirely self-supporting. Three inch [75 mm] strips are fixed to the floor and ceiling, and 3/8 inch [9.5 mm] rods run vertically between them at one foot [300 mm] intervals. Those at corners and edges of openings have threaded ends, and are taken right through the timber stops and secured with nuts. 24 gauge [0.6 mm] metal lath is attached to the rods, and the whole is plastered to an overall thickness of 2 1/4 inches [57 mm].¹¹⁸

At a more vernacular level 'petrified hessian' was used. At Renmark, South Australia, Dorothy Roysland's family managed to turn hessian bags into something more substantial:

The walls of the rooms were all made of wheat-bags nailed to wooden supports. We children had to cut through the twine stitching on these bags, give them a good shaking to get rid of any loose pieces, then lay them out lengthways and sew them together until we had an area big enough to cover one wall. When the

¹¹⁵ Mayes, *Australian Builders Price Book* (1914), pp 240-1.

¹¹⁶ Peter Marquis-Kyle, Brisbane, email letter of 14 July 1998.

¹¹⁷ C E Mayes, *The Australian Builders & Contractors' Price Book* (9th ed, Sydney 1927), p 316.

¹¹⁸ Department of Public Works [Queensland], 'New Maternity Ward. Details', 20 August 1922. Detail kindly supplied by Michael Kennedy, Brisbane. According to Stephen Murray of Brisbane, 1991, the material was built up to 100 mm thick (twice the thickness described by Mayes) on a base of vertical and horizontal rods.

entire wooden frame was covered, the iron roof was put on, and then we painted the walls with a mixture of lime and cement. This dried very hard, making the hessian firm and rigid. Next we made another mixture of lime and cement, but this time with much less cement in it, and painted the walls again. When this second coating had dried the walls were a nice whiteish colour.¹¹⁹

This is the material more formally known as petrified hessian. As R V F Eldridge described it in 1937 it was not made with wheat bags but with fresh jute hessian, available in bolts fifty yards [47 m] long and six feet [1.8 m] wide, and the 12¹/₂ ounce weight was recommended as being open enough to allow the cement wash to pass through, and strong enough to hold up in lengths of three metres or more. Eldridge recommended a wash using only cement, no lime.¹²⁰ A more durable version had the hessian placed over chicken wire on a timber frame, and then impregnated with the cement. This material lost ground partly because of the advent of asbestos cement, and partly because of the shortage of wire during World War II, but by about 1950, in view of the even more severe shortages of other building materials, Eldridge was advocating its revival.¹²¹

In 1951 the booklet *Cement and Concrete for the Handyman*, by 'Domus', gave detailed instructions for the use of cement painted hessian or bags for the construction of poultry houses. The technique had been used extensively before the War, it was said, but its value was now better appreciated. Any jute bags or hessian could be used, but loose wove hessian, '12¹/₂ oz', or chaff bags were best, because the open texture allowed the wash to penetrate. The studs or rafters should be spaced so far as possible to conform to the width of the hessian or bags. Horizontal joints in the fabric should be overlapped and sewn with twine. The material was pulled tight over the frame to avoid sagging, and would tighten even more once it was moistened. An even stronger job could be done by tacking wire netting or similar material onto the frame (but under the fabric).¹²²

The Spanish Mission and other styles fashionable between the wars encouraged the fashion for textured stuccoed surfaces on external walls, and by 1931 the Australian Cement Manufacturers' Association was promoting a whole range of these - Spanish texture, Californian texture, Modern American, English cottage, Italian travertine and Italian texture.¹²³ Even before the Great War the 'Herringbone Lathing House', apparently of cement render trowelled onto metal lath, was advertised by C P Curlewis & Co of Sydney.¹²⁴

¹¹⁹ Dorothy Roysland, *A Pioneer Family on the Murray River* (no publication details cited), pp 16-18, quoted in John Archer, *Building a Nation* (Sydney 1987), pp 151-2.

¹²⁰ R V F Eldridge, *Concrete and Cement Work* (Melbourne, no date [1937]), p 29.

¹²¹ [R V F Eldridge], 'Petrified Hessian', in W A Shum [ed], *Concrete, Mud, Stone and How to Use Them* (Melbourne, no date [c 1950]), p 21.

¹²² 'Domus', *Cement and Concrete for the Handyman* (Melbourne 1951), pp 90-92.

¹²³ *Ramsay's Catalogue*, p 192; also *Textures in Stucco* (pamphlet no 11 of the Australian Cement Manufacturers' Association, Sydney, no date), passim, which describes 'colonial' in addition to the other six textures, illustrating what is clearly an American not an Australian colonial house. Eldridge, op cit, p 21, illustrates a variety of unnamed textures.

¹²⁴ Mayes, *Australian Builders Price Book* (1914), advertisements p 38.

Exposed aggregate, which is the reverse of a rendered finish, was used to great decorative effect in the Shrine of the Sacred Heart, Washington, in the 1920s. Here it seems to have been something like a fine gravel in various colours, rather than the actual aggregate of the concrete, and it was said to be produced by 'a new technique'¹²⁵ which involved spraying the surface with water and brushing it.¹²⁶ It is unclear whether this type reached Britain, much less Australia. Exposed aggregate in what became the more normal sense is a coarse material, though not necessarily the principal aggregate of the concrete behind, became a popular external surface after World War II. It was achieved by a variety of means - tooling, picking, scrubbing, sandblasting, and surface retarding - to remove the surface of the concrete and make the aggregate visible.¹²⁷ It was more popular in Australia as a finish for pre-cast panels than for in situ concrete.

f. Gunite

Carl E Akeley of Chicago obtained a United States patent in 1908 for a machine which applied a wet plaster mix by the force of compressed air. The rights to this were acquired in 1910 by the Cement Gun Company of Allentown, Pennsylvania, and the 'cement gun' was launched in 1912.¹²⁸ The cement-based material was known as 'Gunite', and dry sand and cement were discharged under pressure, and sprayed with water as they passed from the gun to the point of placement. The resultant concrete was claimed to be 20% to 70% stronger than if it had been hand placed, and it could be built up in layers to any required thickness.¹²⁹

The generic term in the United States came to be 'shotcrete', embracing Gunite and other dry systems, as well as wet mix systems in which all the solids and water were combined before application. The wet mix type was the less popular, until in the 1950s a new device which could which could effectively apply the wet mixture, the 'True-Gun', was put onto the market.¹³⁰ The Cement Gun Company was succeeded by the Allentown Pneumatic Gun Company, also of the eponymous Allentown, and this company is said to have remained the sole supplier of the cement gun,¹³¹ though in overseas references the Ingersoll-Rand gun is often named. The Ingersoll-Rand gun was demonstrated at the London Building Exhibition of 1930, and attracted the interest of Europeans such as the Dutch architect J J P Oud.¹³²

¹²⁵ Portland Cement Association, *Concrete in Architecture* (Chicago 1927), pp 12-19.

¹²⁶ Portland Cement Association, *Concrete in Architecture*, p 56.

¹²⁷ K Hajnal-Kónyi & H Tottenham, 'Concrete', in Eric de Maré [ed], *New Ways of Building* (London 1958 [1948]), p 40.

¹²⁸ A T Sullivan, 'Shotcrete', in T C Jester [ed], *Twentieth-Century Building Materials* (Washington [DC] 1995), p 103.

¹²⁹ F S Onderdonk, *The Ferro-Concrete Style* (New York 1928), p 44.

¹³⁰ Sullivan, 'Shotcrete', p 103.

¹³¹ Sullivan, 'Shotcrete', p 104.

¹³² Bridget Jolly, 'Solomit in Australia and its European Context' (PhD submission, University of South Australia, 1998), p 74, ref J J P Oud, 'Het Bouwen van Woningen in [Gewapend] Beton. II', *Bouwkundig Werkblad*, XLI, 23 (5 June 1920), p 135. CHECK: is this right - I had written 'Weekblad'.

Gunitite was used for the first time to encase structural steel at Central Station, New York, of 1903-13, and subsequently at the Bronx Terminal Market.¹³³ It was also used for reinforced floor and roof slabs, fire curtain walls laid on steel mesh, and for stucco on hollow tile or on wood or metal lath.¹³⁴ It was used to face the Solomit walls of Le Corbusier's Pavillon de l'Esprit Nouveau at Barcelona, of 1924-5,¹³⁵ and at this time was already under consideration in Britain,¹³⁶ where it came into use in about 1925.¹³⁷ The first British handbook of the company appeared in 1934, and Gunitite was used for lining the Mersey Tunnel and encasing steel at the White City Stadium.¹³⁸ By the 1960s the British companies using the process were the Cementation Co Ltd of London; Whitley, Moran & Co Ltd of Liverpool; the Cement Gun Co Ltd; and the Concrete Proofing Co Ltd. The normal mixture was cement and sand in the ratio 1:3, with the minimum of water, and it was applied using a pressure of 35-40 psi [240-280 LPa].¹³⁹

'Gunitite' could be placed even on chicken wire to create a cladding which was claimed to be earthquake resistant and/or easily repairable. This was a major feature of its marketing in Los Angeles, where the trademark consisted of the words 'Gunitite Quake-Resisting Reinforced Veneer'.¹⁴⁰ For this reason it was possibly more widely used in New Zealand than in Australia. There 'Steeltex' steel lathing to carry rendering was marketed by Winstones, the building suppliers,¹⁴¹ though whether used for rendering generally or for Gunitite in particular, I cannot say.

By 1919 Gunitite had been used at the Newport Power Station in Melbourne, and it was also the basis of a new system of house construction. Gardner, Waern & Co used a patent system of reinforcement which they called Gawco, said to resemble a giant bedstead. A steel frame was constructed with rods, presumably vertical, at four foot [1.2 m] intervals. Heavy netting was fixed to this, and then sprayed with the cement gun. Hollow walls were made with two leaves of 1½ inches [40 mm] and a space of six inches [150 mm] between.¹⁴² The local council approved the construction of such a building at the corner of Cubitt & Harcourt Streets, Richmond, Melbourne. It seems certain that this is the system of construction elsewhere referred to as 'Garwen'.

¹³³ *American Architect*, 3 June 1925, cited in F E Kidder & Harry Parker, *Kidder-Parker Architects' and Builders' Handbook* (18th ed, New York 1931), p 917.

¹³⁴ Kidder & Parker, *Architects' Handbook* (1931), pp 917-8.

¹³⁵ Jolly, 'Solomit in Australia', p 72.

¹³⁶ R B White, *Prefabrication* (London 1965), p 85.

¹³⁷ Hajnal-Kónyi & Tottenham, 'Concrete', p 35.

¹³⁸ Elton Engineering Books, *Catalogue Number 12* (London 1997), p 17, notes on the 3rd edition of the handbook: Concrete Proofing Co., *Gunitite. A Handbook on Cement Gun Work* (3rd ed, London 1956).

¹³⁹ Kinniburgh, *Dictionary of Building Materials*, p 126. See also Faber & Childe, *Concrete Yearbook 1949*, p 711, the Cementation Co; pp 712-3, the Concrete Proofing Co; pp 714-17, Whitley Moran.

¹⁴⁰ Reproduced in Stefanos Polyzoides et al, *Courtyard Housing in Los Angeles* (Berkeley [Cal] 1982), p 208.

¹⁴¹ So I am advised by Jeremy Ashford of Auckland.

¹⁴² *Argus*, 21 May 1919, p 11.

Knox Schlapp & Co of Melbourne had been the Australian agents for a cement gun before World War II,¹⁴³ and Gunitite was used during the war, for example in the construction of the Brisbane Graving Dock of 1942-4, where it was applied to the sandstone sides to eliminate the need for heavy concrete walls.¹⁴⁴ After the War Gunitite was used in 1948 to repair the reinforced concrete jetty at Auckland Point, Gladstone, in Queensland,¹⁴⁵ and it was also in use in Tasmania during this period to protect timber piles from marine borer.¹⁴⁶ However, there seems to have been no Australian cement gun company until Cement Gun Pty Ltd. was formed in 1949 by John Lysaght (Aust.) Pty Ltd in conjunction with the Cement Gun Co. Ltd of London, who had the established expertise.¹⁴⁷ In the post-war period Gunitite high velocity pneumatically sprayed concrete was extensively used for such purposes as repairs to existing brick and concrete, protective coatings for steel, and specialised constructions such as chimney stacks and swimming pools.¹⁴⁸

By the 1950s there was a rival system, 'Guncrete', which was marketed by Roof & Building Services Pty Ltd of Sydney and Brisbane.¹⁴⁹ In 1958 it was reported that a scientist (who had formerly been Chief Engineer of the Guided Weapons Division of the English Electric Co) had established a firm in Melbourne, called Morag, which would build houses of sprayed aerated cement, as well as manufacturing articles of fibreglass.¹⁵⁰

g. metal lathing

After World War II there was a revival in Australia in the use of cement on lathing of various sorts, such as a wall built up of corrugated iron, chicken wire and cement rendering which, according to Kenneth McConnel in 1947, obviated the necessity for a frame.¹⁵¹ One extraordinary product was "'Twello" Bricanion', a mesh of what was described as rustproof wire, into which calcined clay studs were solidly pressed, to create what was supposedly a perfect base for rendering.¹⁵² It appears that something very similar to this had been available in New Zealand as early as 1918.¹⁵³ 'Bricanion' seems to have been a British product, or at least one used in Britain, but the source of the 'Twello' is unclear. Verrall's *Modern Plasterer* explains:¹⁵⁴

¹⁴³ B S El-Hazouri, 'The development of reinforced concrete in New South Wales, 1918-40' (M Eng Sc, UNSW 1985), p 11.

¹⁴⁴ 'Brisbane Graving Dock', *Constructional Review*, XVIII, 8 & 9 (December 1945/January 1946), p 22.

¹⁴⁵ *Commonwealth Engineer*, XXXV, 2 February 1948, pp 271-4.

¹⁴⁶ *Commonwealth Engineer*, XXXV, 1 March 1948, pp 313-5.

¹⁴⁷ *Lysaght Venture* (Sydney 1955), pp 83-4. For the English company, see Drury, *Architects' & Reference Book* [1950], p 68.

¹⁴⁸ Mayes, *Australian Architects Price Book* (1951), op cit, advertisements, p 44. See also *Ramsay's Catalogue* [1954], § 3/5.

¹⁴⁹ *Ramsay's Catalogue* [1954], § 3/4.

¹⁵⁰ *Cross-Section*, no 67 (1 May 1958), p 2.

¹⁵¹ Kenneth McConnel, *Planning the Australian Homestead* [Sydney 1947], p 117.

¹⁵² Phillip Mayes, *The Australian Architects, Builders and Contractors Price Book and Guide* (11th ed, Sydney 1951), advertisements p 76, & pp 382-3. This was marketed by Emm Yannoulatos (Overseas) Pty Ltd, of Sydney.

¹⁵³ Jeremy Ashford of Auckland advises that he has seen an advertisement of that date, but he does not recall that the product name was the same.

¹⁵⁴ W Verrall, *The Modern Plasterer* (2 vols, London, no date [1935]), I, p 135.

Bricanion is a new type of metal lathing, consisting of a square-meshed iron wire netting encased in brick earth: in other words, it is a peculiar form of reinforced brick fabric. The brick earth is not applied in continuous sheets or strips, but as small crosses, with rebated sides, at the intersections of the wire mesh. Thus each cross is a separate unit, and the sheets remain wonderfully flexible after they have been kilned under careful heat control.

Something very similar was being marketed in England in the 1950s by W H Colt (London), as 'Colterra', also a wire mesh in which were engaged porous 'clay crosses'.¹⁵⁵

Younger architects were even more creative than this, usually to the lasting regret of their client. Kevin Borland won a special prize in the RVIA Age Small Homes competition for his design of house no. T2128: a rectangle spanned by five principal steel beams, over which was draped light steel reinforcing mesh to form four 'cradles', restrained by steel gusys at either end.¹⁵⁶

Light steel reinforcing mesh is draped between the steel beams and hessian is laid in the mesh. ... The surface is then built up of two applications of cement render, sandwiching another layer of steel and reinforcing. Aluminium is laid on top in bitumen, as a weather seal.

This was supposed to be a reinforced concrete roof such as an amateur could build in easy stages, and without the need for formwork. It was not explained how the amateur was to organise the junction of the walls and windows with the cradles, nor yet what would happen to the cement render when the draped skin distorted due to loading or thermal movement.

Borland's Rice house at Eltham, designed with the engineer Bill Irwin in 1952, was a combination of a draped structure of this type with a multifoil parabolic cluster of the form which became known as the Ctesiphon arch.¹⁵⁷ The name was taken from the Sassanid palace of Ctesiphon, which used a parabolic arch form (though in quite a different way, for compression arches and vaults built of mud brick). Then it was apparently at Borland's instigation that Robin Boyd designed the first unequivocal Ctesiphon arch building, a house and shop for W Wood, in the Melbourne suburb of Jordanville, in 1952-4. A series of parabolic timber arches were erected, canvas was drawn over them, and three inches [77 mm] of concrete containing some reinforcement was laid on top. The timber arches were removed, and could be re-used. What was created was therefore a shell concrete structure like a parabolic Nissen hut, but corrugated on an enormous scale. Indeed, at Jordanville two arches were used in parallel, joined like Siamese Twins.¹⁵⁸ The double arched shape had been foreshadowed by Harry Seidler in his Williamson house, Mosman, Sydney, of

¹⁵⁵ Drury, *Architects' &c Reference Book* [1950], pp 784-5; Kinniburgh, *Dictionary of Building Materials*, pp 105-6.

¹⁵⁶ *Age*, 19 October 1953.

¹⁵⁷ Robin Boyd, *The Puzzle of Architecture* (Melbourne 1965), p 111; Winsome Callister, 'The Dialectic of Desire and Disappointment', *Transition*, 38 (1992), p 79.

¹⁵⁸ Geoffrey Serle, *Robin Boyd: A Life* (Melbourne 1995), p 134; Vanessa Bird et al, 'Chronological List of Works by Robin Boyd', *Transition*, 38 (1992), p 202.

1951, but that was apparently executed in conventional shell concrete, doubtless under the influence of Felix Candela.