CURRENT PRACTICES ON CEMENT RENDERING IN AUSTRALIA

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Abstract
Cement rendering is widely used in Australia in the construction of new buildings and to rehabilitate the existing old buildings. Rendering buildings are normally carried out by tradesmen with varying degree of experience. The quality of the rendering is significantly varied and failure of render is not uncommon. This paper reports the existing practice of cement rendering in Australia and highlights the factors influencing the causes of poor performance of cement rendering. Interviews were conducted with renders, builders, clients and architects in relation to their experience on rendering practices and the results of these interviews are reported. A case study on the performance of rendered sea wall is reported.

Keywords: cement rendering, cracking, construction practice, finishes, rehabilitation

1. INTRODUCTION
Rendering is a very old method adopted by ancient builders. Egyptians are thought to be the first to use rendering. The pyramids of Egypt contain rendering executed at least 4000 years ago. Rendering is the method of covering different parts of a building with a material to form a durable surface as well as a decorative finish. Cement rendering has become very popular recent times in Australia, not only for new building constructions but also to rehabilitate old residential buildings. The old houses are given a modern make over by rendering the old bricks. This adds value to the house and looks as good as new at a much cheaper price than building a new house.

There are two types of rendering: external and internal. The purpose of external rendering is to cover the surface to enable it to resist atmospheric conditions, particularly the penetration of rain water. Whereas, the internal rendering provides a smooth surface in which dust and dirt cannot lodge. This surface is also not liable to be affected by vermin and forms a good surface for taking paint. The most important consideration in rendering is that it should stick to the background and should continue to do so even when frequent changes of weather occur. Rendering should also be possible to apply during all weather conditions. For economic reasons, the materials adopted and the methods of application should be cheap.

The type of rendering to be used at a particular location will depend upon weather conditions, the rainfall, presence of frost and also the appearance. Workmanship and techniques are the two major factors that impact the quality of the rendering. Although new techniques are introduced, the old ways of rendering are still widely used. If the materials used and the mixing process is not applied properly, defects and problems arise. The weather is a very important factor in cement rendering as it affects the drying process resulting in cracks and weaker render.

The render usually consist of binding materials, fine aggregates and water. In special cases certain additives are added to effect an improvement in the render as far as its adhesiveness, life, etc. are concerned. Portland cement render is a mixture of cementitious materials, sand and water, which can be mixed and hardened by proper curing to form a thin coating having characteristics similar to concrete, and may be applied to most surfaces.

Render is mixed on the job by combining render sand, Portland cement, admixtures and water to result in a mixture with a consistency for either hand or machine application. The main advantage of Portland cement render is its versatility in combination with strength, durability against exterior exposure and moisture on the interior.

2. THE RENDER PROCESS
2.1 Surface preparation
The durability of rendering depends not only on the properties of the mixture itself but also its adhesion with the background. A good
background must be plain enough for suitable application of render and should have enough strength. The usual types of backgrounds that are used for render work are: a) Solid backgrounds include brick-work, concrete blocks, etc. and b) Lathing which include wire meshes, etc.

The normal method of construction of solid background introduces varying amounts of water and as a result needs adequate drying before the application of render is given. Local projections are more serious than depressions and these should be broken before rendering. Depressions can be dubbed out if necessary.

2.2 Application
It is preferable to apply render mix by throwing it with great force against the walls. As this job involves great effort, the mortar is sometimes applied in practice by pressing it thereon. In the latter case adhesion of the render is lesser and the render may also be more porous.

The applied render must be leveled and smoothened. This is done by drawing a screed across the surface after the application of the mix. When it is a backing or an undercoat the surface is scratched with a suitable trowel after the mix has hardened to a certain extent so as to get a good bonding with the coat to be applied later on.

The render should be finished with plastic floats before it had started setting. If it is done too early the binder gets drawn, which results in the cracking of the render. The rendered surface is to be kept moist after application. Slow setting under higher humidity improves the strength of the render.

2.3 Cement Rendering
2.3.1 The mix
Rendering mix containing cement and sand may be used with the addition of lime. Whenever damp conditions are prevalent maximum resistance to abrasion is required, a cement sand mix should be employed. Water repellent agents may be added if excessive dampness is occurring.

Mixes containing sand and cement only have a dry early strength and the drying and shrinkage sets up a considerable stress both in the applied coat and in the background. For this reason the background is to be rigid with sufficient roughness.

These types of render are suitable for application on solid background such as brick work and to suitable finished concrete surfaces. They are not suitable on semi-rigid background. It may be preferable to use a cement lime mix of suitable proportion to improve the working properties of the render. Coloured finish is obtained by the addition of white or coloured cement combined with coloured and graded sand.

2.3.2 Rendering
Before the application of cement render coats on the surface of the background it should be cleaned with water in such a manner that a slight amount of moisture remains on the surface.

The first undercoat is usually of the mix proportion of 1:3 (cement: sand) should be stiff enough to hold to the wall or the ceilings. On soffits the mixture should be each trowelful and using sufficient pressure to force it into key on the background. On walls the mix should be laid in long even spreads upward and across.

The applied render must be leveled and smoothened. This is done by drawing a screed across the surface after the application of the mix. When it is a backing or an undercoat the surface is scratched with a suitable trowel after the mix has hardened to a certain extent so as to get a good bonding with the coat to be applied later on.

The render should be finished with plastic floats before it had started setting. If it is done too early the binder gets drawn, which results in the cracking of the render. The rendered surface is to be kept moist after application. Slow setting under higher humidity improves the strength of the render.
2.3.3 Screeding
The next process is the forming of screeds. The material is laid vertically between the dots in strips which are about 70 mm to 100 mm in width and carefully leveled off with the floats to the thickness of the dots. The wall is now divided by screens into a series of vertical bays. When the screeds are hard enough to withstand pressure at the surface the spaces on the walls are refilled with render and finished to a uniform level and true surface. Similarly careful arrangements have to be made for getting a proper thickness of the surface whenever there are excessive projections.

Before applying the second undercoat, the first coat is swept clean of any dust or loose particles. Screeds may again be formed and material laid in a similar manner. The average thickness of the second undercoat should not exceed 10 mm.

The proportion of the finishing coat may be similar to that of undercoats. Coloured or white cement may however be used only in the finishing coats. The grading of the aggregate should be appropriate for the type of finish desired. No lime is added to mix containing coloured cement.

The proportion of water must be constant for each batch and no additional water is added after initial mixing. The surface is then finished with a float and depressions are filled in. Overworking will tend to bring too much fine material to the surface and should be avoided to reduce the tendency of surface crazing.

3. DESIGN CONSIDERATIONS FOR RENDERING

3.1 Combinations of under-coats and finishing-coats
Under-coats and finishing-coats should have a good relation with each other and also with the background in terms of strength, volume change during setting or afterwards. Bond failure between the successive coats may be caused by the defects in the background or under-coats, presence of unset films of render produced by premature drying, salt formation at interface, excessive relative moisture movement or combination of these. For obtaining a good mix the rendering mix must have definite properties which make it suitable for particular conditions.

Render mixes containing cement, lime and sand have got high workability and therefore are easy to apply. They can be used reasonably after long working time. They have adequate early strength to withstand modern building conditions.

For setting, they need moisture and rapid drying in the initial stages must be avoided. The drying and shrinkage of the first coat must be completed before the second coat is applied to avoid shrinkage cracks.

When the quantity of cement in the render mix is increased the workability of the render is decreased correspondingly. Weaker mixes containing little of cement should not be used as an under-coat. They are useful for application to non-rigid backgrounds. Mixes of lime and cement are not suitable for toweled finished coats as the shrinkage on drying creates a tendency to surface crazing. No render should be permitted to remain under persistent damp condition after it has set as this causes weakness and disintegration.

3.2 Number of coats
For the best work, rendering should be applied in three coats. The first coat is responsible for creating the bond between backing and rendering. Thickness suggested for this coat is about 3mm. The mortar for this coat should be thrown on the surface and should not be worked but left to rest. A sand/cement ratio of 2 is suitable. The second coat is intended to fill up the irregularities on the back of the wall. A thickness of about 9 mm is sufficient for this coat. This surface should be leveled with a trowel. The third coat is usually the skimming coat and mainly serves to give a good appearance.

3.3 Type of surface finish
The usual practice is to produce the smooth finish for internal render work but with special technique a variety of textures can be created. Texture finishing can be obtained in the render itself or by application of a textured paint. Different types of finishing can be given to the external render.

3.4 Resistance to abrasion
As far as the hardness is concerned, cement finishes have the greatest hardness. Addition of lime decreases the hardness, while cement whenever added to the render increases the hardness. Resistance to abrasion is directly
related to the relative hardness as described above.

3.5 Corrosive effect on metals
The corrosive action should only occur during the initial drying periods and subsequently during the periods of heavy condensation.

3.6 Effect of atmospheric conditions
Rendering should not be continued during frosty weather. Suitable precautions should be taken if the weather is very cold. Under hot-dry conditions the applied render becomes dry before the setting has taken place completely.

3.7 Effect of vermin
The liability of render to vermin attack is dependent on the amount of cracking present. Free from cracking or serious crazing apart from that created by the structural movement can be avoided by the use of good workmanship.

3.8 Fire resistance
Application of internal or external render can increase the fire resistance of all structural components. The effect of rendering a 200 mm brick wall is not of much value because without rendering this wall has a good resistance. Render finishes on thinner walls or partitions increase their fire-resistance qualities considerably.

3.9 Acoustical properties
The effect of the render finish on the sound absorption is not significant. Internal render finish of special types may be used to increase the sound absorption.

4. DEFECTS IN RENDERING
4.1 Defects that may cause failure.
The following are the defects which may cause failures in the render surfaces:

1) The backing may move after the rendering is applied due to settlement or due to shrinkage as the water introduced during construction dries out. Similar movement can occur due to thermal expansion. To avoid such problems the background should be allowed to dry completely.

2) Movement can also occur in the render itself because of expansion or by drying and shrinkage. Render containing lots of fine material are liable to high shrinkage. The render movement can be avoided by the use of suitable type of sand which is well graded.

3) The adhesion of the render may not be complete due to the surface of brick-work or concrete not having a mechanically good bond.

4) Failures can occur if suction of the background is not uniform. Absorbing background will suck lots of water from the render itself thereby affecting the strength of the render.

5) Keying between various render coats is also important. The application method of the mix influences the adhesion.

6) Errors in the construction of the building may cause failure. Water may penetrate behind the plaster. Thermal expansion may occur if hot water pipes are present but are not insulated. The column or beam may deflect excessively. The details of construction of doors, windows etc, may be defective leading to the penetration of the moisture.

7) The surfaces to which the rendering is applied may have been inadequately cleaned during rendering.

8) The backing may contain soluble salts and the adhesion may have been lost by their crystallization and expansion.

9) Incorrect working methods may lead to some difficulties. Excessive toweling may cause the binder to come to the surface. The interval between successive applications may be short. The coats may have been too thick.

4.2 Methods to avoid defects in render
In order to avoid defects and improve the overall quality of render, the following issues should be paid attention to:

a) All materials such as cement, lime and sand must be used according to the standards and manufacturer’s instructions.

b) The background should be carefully prepared as to be free of all dust, dirt and loose particles. Holes and depressions should be filled well before the application
of the undercoat. In order to reduce excessive suction and to provide an even suction over the area to be rendered, it is necessary to dampen the background.

c) The thickness of the render is also very important. It is also important to prevent rapid or uneven drying. The undercoat should be allowed to dry out, dust down, and, if necessary to give correct suction, before applying the next coat.

d) Proper render mix proportions are recommended for different backgrounds.

e) The rendering quality may be inspected at the stage when the rendering work is completed and before the final coat is applied.

5. RENDERED FINISHES

External finishes for the walls of the buildings may be given for the purpose of decoration only or may combine with this the function of exclusion of the rain from the walls.

A rendered finish to an external wall is cheaper and can be used over variety of structural materials which may not themselves be suitable for exposure. In making the decision for the selection of a suitable finish, its specifications and colour, the following factors have to be kept in mind: 1) The appearance required; 2) The maintenance necessary for giving the satisfactory appearances; 3) The degree of protection against rain penetration to be provided by the finish; 4) The severity of exposure to atmospheric and climatic agencies affecting durability; 5) The time of year during which the finish is applied; 6) The environment and use of the building; 7) The background materials on which the finish is to be applied; and 8) The cost.

5.1 Types of finishes

a) Pebble-dash: This is the finish in which small pebbles or crushed stones of suitable sizes are thrown on to a freshly applied final coat of mortar and left exposed. The pebbles are sometimes lightly pressed or tapped into the mortar after throwing. It can be suitable for rural area as far as aesthetic appearance is concerned. It can resist good amount of aesthetic deterioration.

b) Rough Cast: this is a finish in which the final coat containing a proportion of fairly coarse aggregate is thrown as a wet mix and is left in a wet condition. The coarseness of the texture depends mainly upon the type and size of the coarse aggregate.

c) Scraped Finishes: In this type of finish the final coat of render, after being leveled and allowed to stiffen, is scraped with a steel straight edge, or a board studded with nails or any other form of tool convenient for this purpose, so as to give a rough surface.

d) Textured Finishes: with the aid of suitable tools ribbed stucco or fan textures can be created in the final coat.

e) Smooth Finish: This type of finish has got a level and a smooth surface.

f) Machine Applied Finishes: A variety of finishes in which the final coat is applied by machine which throws or spatters the material on the wall can be adopted. The machines may be manually operated or mechanically operated and a sort of gun is used to throw out the material.

As far as the aesthetic values are concerned the choice of the type or colour will depend on the circumstances within which the building is to fit in. Pebble dash and rough cast are least liable to change in appearance over long periods. Deposits of dirt from atmospheric pollution are more visible on white and pale colour than on natural grey colour. Dirt also appears badly on heavily textured finishes than on white textured and scraped finish. An external rendering, unless it is painted, should not require any maintenance over a long period of time. If a light-coloured or white-coloured finish is required it may be necessary to provide for painting periodically.

A rendered finish is often required to give protection against rain penetration through a wall. For this reason cracks in the rendering must be avoided as much as possible. Pebble dash or rough cast finishes are most suitable for such conditions. Provided the undercoat is resistant other types of finish may be used.

Eaves protection greatly reduces the amount of rain falling on the wall. Similarly sills made with effective drips may throw away water clearly from the wall and thereby weaker types of rendering can be adopted.

The type of background on which the rendering is to be applied depends on the choice of the materials to be used. For dense and
smooth background mechanical keying is essential. For these surfaces spatter dash treatment can be given or a light mesh be secured to the walls for traditional adhesion.

A crack in dense rendering once formed may allow more water that the one in a porous rendering since rain water runs down impervious surface into the crack. High alumina cement mix may sometimes be useful for greater resistance to the action of the sulphates.

5.2 Materials for external finishes
The grading of the aggregates may be same as for the ordinary renders. Texture finishes require finer sand than the rough finishes. Finer sand is also advantageous for pebble dash as it holds the dry pebble better when thrown.

Binders are usually cement in suitable proportions. The total quantity of the binding agent in the rendered finishes is governed partly by the requirement that the amount of such material shall be just sufficient to fill in the voids between the coarse sand particles. A normal mix contains one part of cement binder to 2.5 to 3 parts of sand. If it is made richer than this there is a risk of cracking. The more leaner the mix the more difficult it is to apply.

The function of the cement is to provide strength and durability. A mix of 1:3 (cement sand) is more than necessary. The use of this mix particularly on rigid backing of lower strength is likely to give rise to cracking. The use of this mix should therefore be restricted to conditions where the background strong and good adhesion can be obtained and also where a very dense and impermeable mix is essential.

5.3 Application of external render
Scaffolding may be needed for applying the external rendering because of the grater height involved. Mechanical keying may have to be given for various surfaces. Old brick-work or poured concrete, should be thoroughly wire brushed and washed down, before any rendering is applied. The surfaces should be covered with a thin layer and no attempt is to be made to level or smoothen the coating.

Undercoats may be applied by throwing the mix or by laying it over the trowel. The thickness of these courses varies on account of the unevenness of the wall but preferably should not be greater than 15 mm or less than 3 mm. When the undercoat has started to harden, it should be scratched to a depth of 3 mm to 5 mm. The undercoat should be allowed to dry as long as possible before any further coat is applied.

The final coat may be laid or thrown while for machine finishes, automatic rendering gun may be used. The thickness of these coats vary between 5 mm to 10 mm. Some machine finishes as thin as 3 mm. The finishing on the outside should be carried out continuously without any break. Suitable curing must be carried out to prevent rapid hardening of the binder and cracking.

6. INTERVIEWS RESULTS
In order to understand the issues related to the performance of renders, interviews were conducted with renders, builders, clients and architects. The findings from these interviews are summarised below:

6.1 Renderers findings
Out of 5 renderers interviewed only 2 had an experience over 10 years, the other three had an experience of between 5 and 10 years. Basically, nothing has changed in the actual rendering process over the years, but some of the tools now used make the process easier, such as steel corners, the square, and the stretchers used to be wood now are aluminium.

As for renderers, who had overseas experience in rendering, everything is the same. In overseas, they used to mix the render mix by hand, in Australia the mixer is used, which is faster and better. Also an air entraining agent is used in the mixes, making the cement render to apply easily on the wall.

On average an experienced renderer can do 35 square metres a day, but this would be a top quality job. The standard thickness used for external rendering 15mm and about 12mm for internal rendering. Depending on the weather, it takes 3 to 4 weeks before a wall can be painted.

In order to assess the render quality, a cement renderer looks at corners especially around the windows. Also with the aid of a stretcher to see how straight the wall is. Further more, the worst thing for a renderer is to fix old render or to render next to old render, because no matter what it will show.

There are two ways of pricing a job, lump sum and by square metre. Factors that can affect the price are: a) access; b) design work-
borders, arches etc., and c) necessity for scaffolding. Factors that can affect the quality of render are: a) not to remix left over cement, and b) not to rush; and c) use the right materials, with the right quantities.

6.2 Builder findings
Two builders were interviewed, they both had over ten years of experience. A cement renderer is chosen to do the job when quoting a job he knows what he is talking about and the price is reasonable. If he is able to details of his previous jobs, then the builder could be able to see the quality of his work.

In a construction project rendering comes when the walls are all completed. The problem a builder faces with renderers is related to the quality of work and coming to the job on time.

Quality is very important, that’s why it is important that the renderer has an experience, uses the right materials and quantities, and doesn’t rush especially when there is design work. The render is checked by assessing how straight the walls are, checking for obvious waves and bumps and that there is no cracks.

The common complaint a builder gets from his clients is when the walls are painted the quality of the render shows and cracks. The common thickness used, about 16mm from outside and 12mm from inside.

6.3 Client findings
After interviewing ten clients who had rendering work done at their houses, the minority were completely satisfied. The problems that some of them had cracks, one client had her windows and doors damaged because the renderer didn’t clean the windows from cement and when it was dry it was very difficult to clean.

Nearly half of them needed to repair the rendering which was very hard and costly, because the damage can’t be fixed one hundred per cent. Most of the clients thought that the price they paid for a rendering job was expensive compared to the quality they got.

6.4 Architect findings
For an architect the final appearance is the most important, this is why they are “fussy” at times especially in projects that have design work such as strips, circular windows, etc. Rendering in particular is very important because it will not be covered, but only painted, and if it is not done properly it can affect the overall look, which is the architect’s main concern.

7. CASE STUDIES
7.1 Rendered Sea Wall: Observations
The sea wall had been cement rendered, in order to improve its appearance. The render on the wall had begun to break down and erode from the wall, exposing the original wall in some locations.

The property faces south east to the Georges River in Sydney, NSW, Australia. On the river frontage is located a buttressed brick/concrete retaining wall which acts as a sea wall defining the property boundary on the south eastern side. The existing wall prior to cement rendering was in sound condition with no obvious structural defects.

The sea wall is approximately 15m long to the river and varies in height from 1.4m on the western end to 3m on the eastern side. It was strengthened by the incorporation of three buttresses on the eastern and three on the western sections of the wall.

The render applied to the wall is performing slightly differently on the eastern and western sections of the wall. The wall is divided into eastern and western sections by the jetty, which intersects the wall at approximately the centre of the wall.

Eastern section of the wall is the area which was badly eroded and the dash coat applied to the wall prior to rendering has been exposed over an area of approximately 2 sq.m. in the two central panels of the wall. The relative strength of the render applied varied generally from harder at the top of the wall through extremely soft on the centre (where erosion had occurred) and then harder again towards the base of the wall.

The softer render in this section of the wall has completely eroded. This soft area has been affected by the action of the waves on the wall at high tide. The tide levels around Christmas are the highest recorded during the year and the soft render had insufficient strength to resist the wave and wind action.
The render, which has not eroded exhibits different degrees of strength. Some sections are hard with hairline cracking, indicating higher cement content to the mix while adjacent sections are softer and easily marked with the point of a screwdriver.

The major problem with the render is the lack of uniformity of the mix and hence the differing performance of the render, so that it exhibits these differing characteristics in areas adjacent to each other.

In a section of the wall there is also no evidence of the use of control joints, to control shrinkage cracking of the render, or potential differential movement of the background material. On the south eastern end of the pool on the vertical face there are two concrete slabs which come together to form a vertical face. At this location it would have been appropriate to provide a control joint in the render to prevent the uncontrolled crack line developing. Again this area of the wall exhibits lack of uniformity in the mix of the render.

There are adjacent rendered areas on the wall, which vary from hard to very soft. The harder areas of render exhibit minor degrees of hairline cracking, indicating high cement content. Adjacent areas, showing no hairline cracking, are of different colour and are relatively soft and easily damaged, when the surface is lightly scratched.

There is also a lack of control joints in this section of the wall. Here an uneven longitudinal crack has developed in the step in the wall, just above the buttresses where a control joint should have been placed.

7.2 Failure of render
There are two major causes of the break down of the render and its subsequent erosion from the wall:

a) Lack of uniformity in the mix proportions. It appears that the render mixing was carried out by hand which led to an uneven mixing of materials used and hence variation in the strength of the render, between adjacent sections of the wall. The other alternative is that the batch proportions were varied for each mix, or that a larger quantity of render was mixed, the initial proportion applied and the mix continually remixed with additional water and then next section of render applied. Any of these two causes would lead to weaker and softer areas of render being applied adjacent to stronger and more serviceable render on the wall.

b) This is related to the above discussion however it also appears that the cement content used in the mix was not uniform throughout the different batches made. For a render of this type where the wall is exposed to salt spray and wave action from the river, a mix proportion 1:0.5:4.5 (cement : lime : washed sand) should have been used. It is essential that the mixing is then carried out in a methodical manner, carefully paying attention to accurately batching the materials and sparingly adding the water to the mix to achieve a stiff mix suitable for the toweling.

From an examination of the sand used in the render it appears that the correct grain sized sand has been used for a surface coat. The volume of cement used appears to have varied significantly and has been unevenly distributed throughout each mix and the different mixes produced. This has led to a significant variation in strength and durability of the render.

7.3 Other factors
There are other factors which can affect the strength of render and since the rendering is now completed, it was not possible to assess if these factors had some impact on this particular work. However, since these factors are important they are listed here. It is possible that these factors could also have contributed in some degree to the loss of strength of the render. These factors which can affect the strength of the finished render are:

a) The use of pigments to add colour to the render should not exceed 10 % of the mass of the mix. There was reasonable colour variation in the finished render was observed. This is also an indication that the mix proportions were not controlled adequately or the mixing provided was not uniform to ensure homogeneity of colour as well as texture and strength.

b) The use of admixtures, such as air entraining agents, to improve the workability of the mix can also lead to serious loss of strength and bond in the render.

c) To provide adequate curing and protection of the render once applied. This is particularly the case of external rendering in an exposed area, such as with this sea wall. The wall is exposed to early morning sun and extreme wind
velocities particularly during southerly and north easterly winds. During application and curing the mix should not be allowed to dry out quickly. The applied render should be kept damp for a minimum period of two days to ensure adequate strength is attained. Obviously this comment applies also to tidal impacts and wave action which is possible on the eastern section of the wall. Render should be applied to give maximum curing before high tide and protection should also be provided from any wave action to ensure render is unaffected by sea water washing against the newly applied render.

d) The use of brickies sand or (fatty) sands should also be avoided, as this will lower the strength and durability of the render. It will also cause higher rates of shrinkage of the render leading to cracking and a slow down in the setting of the render. Sand should be washed, clean and of finer grade for surface coating. The grading of the sand used appears satisfactory although it is very difficult to assess if a (fatty) sand has been used. The only other concern with the rendering is that at two or three locations the render is (drummy) indicating that it has not bonded to the surface of the wall. This may be due to poor preparation or the presence of dirt or loose material on the underlying surface. These areas are not extensive but could subsequently crack and cause the render to break away from the wall.

7.4 Rectification
This is a difficult task to perform satisfactorily due to the variation in strength and durability of the applied render. The only satisfactory method of rectifying this poorly performing surface is to remove the existing render from the wall and expose and the original surface of the wall. This surface should then be pressure cleaned to ensure that all salt, loose material and dust from the removal process and scrabbling is cleaned from the wall. The dash coat should then be applied prior to re-rendering. Any new render applied over the existing rendered surface will continue to perform poorly in accordance with the variation in strength of the existing rendered finish.

8. CONCLUDING REMARKS
Cement rendering is one of the simple and economical methods used for new buildings to improve its finish. It is also extensively used to rehabilitate existing ageing buildings to improve their service life and to increase the market value of the buildings. Cement rendering, mostly carried out by the skilled renderers, is time-consuming and expensive. However, it is a cost-effective method when compared with demolitions and reconstruction.

The quality and performance of cement rendering are highly dependent on the surface preparation, render mix materials, mixing methods, tools employed, curing, experience of the renderers, and weather conditions. This paper highlighted the cement rendering practices in Australia and discusses the factors affecting the performance of rendering in general and through a case study. Views of renderers, builders, clients and architects in relation to the current cement rendering practices are reported from the interviews conducted in the field. The review of the current practices of cement rendering in Australia highlighted the importance of understanding the factors influencing the quality of rendering including the workmanship.
Current Practices on Cement Rendering in Australia

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A new house with cement rendering
What is cement rendering?

- Traditionally cement rendering is the application of a thin premixed surface of sand, cement and lime to brick, cement, stone or mud brick.
- It is often textured, coloured or painted after application.
- It is generally used on exterior walls but can be used to feature an interior wall.

Type of Renders

- Cement lime render
  (Cement : Lime : Sand)
- Acrylic render
  (Cement : Polymer : Lime : Sand)
- Lime render
- Earth render
Cement Lime Render

- Cement : Lime : Sand by volume (1:1:6)
- Two coating with Portland cement; Final coat with white cement
- Up to 40 mm thickness
- Chicken wire wrapping
- Suitable for severe service condition (driving rain): more waterproof
- Repair to cracked render difficult
- Colour matching is impossible
- Used for centuries
- Rendering can be fine or coarse, textured or smooth, natural or coloured, pigmented or painted
- Different finishes can be created by using different tools such as trowels, sponges, or brushes

Rendering in Australia

- The simple rendering of walls can transform any style of house built of common brick or concrete
- New apartment blocks are now rendered and are aesthetically superior to traditional exposed brick
- Too few new homes in Australia receive this treatment
- Rendering is best done by experienced, licensed professionals
- Good render will last for 15 to 20 years
- Acrylic rendering
  - a polymer additive to the traditional cement, lime and sand mix for enhanced water resistance, flexibility and adhesion.
  - higher enhanced water resistance and strength
  - can be used on a wider variety of surfaces, including concrete, cement blocks, and AAC concrete panelling
Australian Scene: Interview Findings 1/2

- **Renderers Views:**
  - Rendering process has not changed over 10 years
  - New tools make the process easier (steel corners, squares ..)
  - Mixer used for mixing
  - Air-entraining agent used for easy render application
  - Experience render 35 sq.m. per day
  - Standard thickness 15mm (external) and 12 mm (internal)
  - Painting applied after 3 to 4 weeks of rendering
  - Render quality assessment: Look at the corners, straightness of the wall
  - Price of rendering cost depends on: (a) access; (b) design work; (c) necessity for scaffolding

Australian Scene: Interview Findings 2/2

- **Builders Views:**
  - Selection of renderer based on the quality of previous jobs
  - Coming to the job in time

- **Client Views**
  - Minority was completely satisfied with renderer's job
  - Problem related rendering: cracking; finishing
  - Costly repair of render
  - High cost of rendering (labour cost)

- **Architects views**
  - Effect of render quality on appearance
Use of Cement Render to Rehabilitate Buildings

- Cement Rendering is the ideal way to totally renovate the exterior look of any building with a brick face.
- By applying special mortar, the brick surface is transformed into a smooth cement finish which protects the masonry and completely transforms the appearance.
- The effect is striking and takes any 20th Century building and gives it a 21st Century appearance.

Cement Rendering is the ideal way to totally renovate the exterior look of any building with a brick face. By applying special mortar, the brick surface is transformed into a smooth cement finish which protects the masonry and completely transforms the appearance. The effect is striking and takes any 20th Century building and gives it a 21st Century appearance.
This tool operated by hand is used to spray a mix of cement and bondcrete in order to prepare the surface for rendering.
A hawk used to hold the mixture that will be applied on the wall

Tools used for Cement Rendering
a smooth brick surface

surface sprayed with cement to make it suitable for rendering

ideal brick for rendering

Three Cement Render Coats
Cement rendering steps

- Render application
- Trowel on top coat
- Sponge off the finish

Thickness of exterior render

Metal corners
Type of Finishes: Pebble dash

Type of Finishes: Rough Cast
Type of Finishes: Scraped Finishes

Type of Finishes: Textured Finish
Type of Finishes: Smooth Finish

Type of Finishes: Machine Applied Finish
Cracks due to settlement, this is normal

Failure of Cement Rendering - Cracking

Render had to be removed because it did not bind to the background and the surface was drummy

Failure of Cement Render: Debonding to the surface

Render has pilled off as a result of poor surface preparation, the render has not bonded to the background
Incomplete render work

Poor corner finish
a patched up wall which stands out and is hard to cover unless it is smoothed by the painter

an example of good quality render
Using a straight edge it can be seen that the wall is not straight.

Without control joint in render
Conclusions

- Cement rendering is the simplest method
- Suitable for new construction as well as for the purpose of rehabilitation of old structures
- Polymer modified cement render increases the strength and durability of rendering
- Experience is needed to achieve durable and defects free cement rendering
- Selection of materials, surface preparation, proper render application and finishing and curing are essential factors to be considered to achieve successful cement rendering
- Cement rendering could be used under severe environmental conditions in a cost-effective way