Abstract: The present invention relates in a first part to a fibre cement lining board for use as a replacement to building wrap which can be used to form a sub wall on the outer surface of a wall frame, and to building wall structures and methods of constructing buildings using these particular lining boards. The invention also relates to a new method of constructing framed dual skin walls using the lining boards, particularly brick or masonry veneer walls, and to the wall structures formed by that method.

Title: FIBRE CEMENT LINING BOARD AND USES THEREOF
FIBRE CEMENT LINING BOARD AND USES THEREOF

FIELD OF THE INVENTION

The present invention relates in a first part to a fibre cement lining board for use as a replacement to building wrap which can be used to form a sub wall or inner skin on the outer surface of a wall frame, and to building wall structures and methods of constructing buildings using these particular lining boards. The invention also relates to a new method of constructing framed dual skin walls using the lining boards, particularly brick or masonry veneer walls and to the dual skin wall structures formed by that method.

The inventions have been developed primarily for use in the domestic building field and will be described hereafter in reference to such applications. However, it will be appreciated that the inventions could readily be adapted for use in commercial building construction if required.

BACKGROUND OF THE INVENTION

One major limitation impacting on construction costs and total construction times, particularly in the domestic dwelling market in Australia and New Zealand, is the general need with all conventional methods of dual skin framed building construction, that is frame structure plus separate veneer or cladding, to fully complete the external envelope of a building to a stage referred to generally as "lock up", prior to commencing the internal lining work and fit out.

For example, with a typical brick veneer structure, once the foundation slab or blockwork is complete, the wall, floor and roofing frames will first be erected. This may include the step of applying structural bracing sheets, if the frame structure requires strengthening of this form. The wall and the roof frames will typically then be covered in an appropriate moisture management barrier in the form of paper or foil building wrap or sarking membrane prior to erecting the external brick wall and applying the selected roof covering. As these membrane materials are not particularly wind tolerant, they are generally only applied just prior to the outer brick work being erected and immediately prior to the roofing battens being applied to the roofing frame.
In some instances, the final roofing material, be it tile or metal roofing sheets and the like, are not installed until the outer brick work skin has been fully erected. Depending on the availability of the brick layers and other relevant tradesmen, it is not unusual to see building frames exposed to the elements for fairly long periods, which can result in deterioration of the structural frame. Even where the roof is installed shortly after the building frames are erected, there can still be significant delays before the protective outer brick wall is finished and "lock up" can then be achieved.

Similar comments apply in relation to most of the more commonly used domestic dwelling construction techniques for framed structures that traditionally use weather resistant membranes which are finished with an outer panelized or plank formed cladding material.

It is object of the present invention to provide one or more building solutions that overcome or ameliorate the above discussed disadvantages, or which at least offer a useful alternative.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided an outer frame lining board in the form of fibre cement sheet having a thickness of around 3 - 4mm which is sealed on at least one major face.

Advantageously, it has been found that a fibre cement sheet of this thickness offers a cost competitive alternative to building membranes which is still easy to handle, yet strong enough to also provide a weather barrier and security barrier sufficient to achieve "lock up".

Preferably the fibre cement sheet forming the lining board is configured by method of manufacture, composition, structure or treatment, or any one or combination of these, to meet the local applicable standards in respect of at least air and moisture barriers. In other embodiments the fibre cement sheet may also be configured to meet other standards requirements in relation to bracing characteristics as would apply to rigid sheathing.
In one preferred form the outer frame lining board includes integrally formed markings to assist with alignment of fasteners with standard stud spacings and the like and/or to facilitate easy and accurate cutting and sizing of the sheets. This marking may be in the form of a grid pattern that is printed on or formed in the surface of the board.

Ideally, the board is also marked to distinguish the lining board as a product originating from the applicant or one of its subsidiaries. In one form the board is distinguished at least in part by use of a colored sealant that preferably results in a wash of a green hue.

According to a second aspect of the invention there is provided a method of construction of a framed dual skin wall structure including the steps of:

- erecting a structural wall frame in situ;
- applying a face sealed fibre cement lining board to fully cover and seal the outside of the wall frame excluding window and door openings and other designed penetrations, the rigid lining board being sealed on at least one major face;
- applying a sealed roof or roof cover;
- closing off the designed penetrations to achieve a sufficiently sealed building envelope to achieve "lock up"; and
- subsequently constructing the external masonry wall or cladding and/or commencing the internal fit out..

Preferably, the fibre cement lining board has a thickness of around 3 - 4mm.

In one form the framed wall structure is a brick or masonry veneer structure. In other forms the framed wall structure relates to walls having some form of panelised or plank style outer cladding.

According to a third aspect of the invention there is provided a framed wall structure made in accordance with the method of the second aspect of the invention.
DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a cut-away perspective view showing part of a brick veneer wall structure in accordance with a third aspect of the invention, incorporating the preferred outer frame lining board in accordance with the first aspect of the invention;

Figure 2 is a cut-away perspective view showing part of a plank clad wall structure in accordance with a third aspect of the invention, incorporating the preferred outer frame lining board in accordance with the first aspect of the invention;

Figure 3 is a perspective cut-away view showing a typical outer frame lining board layout as applied to a timber frame.

Figure 4 illustrates a typical lining board vertical on-stud jointing arrangement on a timber frame;

Figure 5 shows a typical lining board vertical off-stud jointing arrangement on a timber frame;

Figure 6 shows a typical lining board horizontal joint with flashing arrangement on a timber frame;

Figure 7 shows a typical lining of the board external corner joint arrangement on a timber frame;

Figure 8 shows a typical lining of the board internal corner joint arrangement on a timber frame;

Figure 9 is a perspective part view illustrating an outer frame board external corner to horizontal joint arrangement;

Figure 10 is a perspective part view illustrating a typical pipe penetration through the outer frame lining board;
Figure 11 illustrates preferred flashing tape arrangements around window, door, meter box and other penetrations;

Figure 12 is perspective part view illustrating a typical apron flashing arrangement;

Figure 13 is a perspective view illustrating a typical flashing arrangement at a junction between a balustrade and a wall; and

Figures 14 and 15 are each cross-sectional views of the lining board, frame and foundation detail.

Referring to Figure 1, there is shown a perspective cut-away view of part of the brick veneer wall structure 1 according to the invention. The wall structure incorporates an outer frame sub wall 2 formed from a series of lining boards 3 secured to the structural frame 4.

In the preferred form, the outer frame lining board 3 comprises a fibre cement sheet having a typical thickness of between 3 and 4 mm, which in the preferred form is around 3.5 mm, and which is sealed on at least one major face 5. The fibre cement sheet consists essentially of cement or a calcium silicate formed by the chemical reaction of siliceous and a calcareous material, reinforced by fibres. Process aids, fillers, and pigments which are compatible with fibre-reinforced cement may be added. The exact composition, method of manufacture and/or method of treatment or coating of the fibre cement sheet will be selected to meet the requisite performance characteristics of the final lining board.

In the preferred form, it has been found, quite surprisingly that a 3.5 mm thick cellulose fibre reinforced cement sheet coated on the outer face and all edges with a Siloxane Sealer, which reacts with the Fibre Cement board to form a Silicone resin seal on the surface of the sheet, results in a lining board which is easily handled and relatively inexpensive. It also readily meets with various New Zealand standards relating to both sheathing boards and to rigid air barriers, such as AS/NZS 2908, and the provisions of the New Zealand Building Code Clause E2 External Moisture (including the requirements of Table 23 of E2-AS1) and is suitable for use in very high wind speed zones as specified in NZS 3604.
In this regard the preferred lining board of the applicant has been tested to comply with the performance requirements of the New Zealand Building Code (NZBC) and has been BRANZ appraised.

In a preferred form, the lining board 3 also includes various markings on the sealed surface 6 to assist with alignment and spacing of fasteners with standard stud spacings etc and/or to facilitate easy and accurate cutting and sizing of the boards. The markings may be printed on or formed into the surface of the board. In one form the pattern may be in a grid form such as that shown in the drawings, which includes vertically extending grooves that can also assist in the drainage of moisture from the outer sealed surface of the board.

Ideally, the board is also marked to distinguish the lining board as a product originating from the applicant or one of its subsidiaries. In the preferred form the board is distinguished at least in part by use of a coloured sealant. In the preferred form the colour tint provides a wash of a green hue across at least a portion of the board surface. A tint providing standard colour readings on an L*a*b scale of DL-0.33; Da -0.46, Db 0.18 would provide a suitable green hue.

Turning next to Figure 2, there is shown a cut-away perspective part view of an alternative clad wall structure 7 that also uses the preferred lining boards 3 of the invention, to which an exterior cladding in the form of weather board planking 8 is applied. While Figure 2 shows a structure whereby the cladding is secured directly over the lining boards, in other structures battens (not shown) are first applied over the lining boards and the cladding is secured to the battens. Similarly, the cladding may be in other forms such as panellised cladding rather than the planking that is shown. Regardless, it will be appreciated that the installation process for securing the lining boards 3 to the underlying structural wall frame 3 is substantially the same for all dual skin wall structures and this procedure is described in more detail here after.

However, prior to describing detailed installation procedures, it is worth providing an overview of the lining boards and systems/methods of the inventions. In this regard, the advantages of the lining boards and systems of the invention are numerous. Firstly, the lining boards, when appropriately installed, eliminate the need to apply any form of building wrap. Furthermore, they can in many instances also simultaneously remove the
need for structural bracing boards or, alternatively, be used solely as a highly durable but relatively low cost bracing boards. Whilst rigid air barriers have been used in commercial buildings systems, these have all been too heavy and expensive for use in the domestic market, particularly when compared to the cost of using building wrap. The fact that such a thin fibre cement based lining sheet can be so versatile in terms of function and structural capabilities, as well as handlability, has been surprising. Also, as alluded to above, the new lining board also readily facilitates a radical change to local domestic dual wall framed building construction methods that can significantly reduce total construction times and associated costs. It can also reduce the number of site inspections required during the construction process.

In this regard, the new lining board enables a builder to erect a cost effective sub-wall directly on to the frame which, in combination with the installation of doors, windows, penetration covers and appropriate flooring and/or roofing, is capable of fully protecting the outside envelope of a dwelling. This means that a building can reach an effective "lock-up" stage early in the construction process, so that work on the interior can commence before the outer wall, be it cladding or brick etc, is even started. This also means that a single building inspection can be booked for both final internal and external sign off. In New Zealand, the product and method of the invention proposed for launch has been appraised by the relevant authorities and approved to allow exposure of the installed lining sheets to external elements for 90 days. This means that delays in installation of the final outer wall structure will not in turn delay interior fit out work. In addition the product is resistant to fire and damage from moisture, particularly when installed as prescribed. It is also rated for very high wind speed zones.

What is important in the construction method of the invention is that the lining board meets the relevant air barrier standards and is installed in a manner whereby the building envelope around the frame is appropriately sealed and secured. To this end each of the panels must be adequately sealed at adjacent edges and at boundaries with various wall openings and penetrations.

While there may be a number of ways in which this can be achieved, preferred methods of installing the lining panels 3 will now be described with reference to Figures 3 to 16.
Firstly, a structural wall frame 4 must be provided in accordance with the relevant local standards or comply with a specific engineering design requirements. For example, for the New Zealand market for which the products and systems have originally been designed, the stud spacing and nogs spacing must not exceed 600 mm centres and 1200 mm centres respectively. A minimum of 45 mm wide stud is required at the lining board vertical joints for jointing on stud. The framing will of course also need to be suitable for installing the selected exterior cladding in the event that a cladding material is to form the final outer wall skin.

The lining boards 3 will then need to be selected and, if required, cut to fit the wall or fit around a wall opening. In the preferred form, the lining boards have a grid formed into the surface of the boards which makes it easier to accurately cut the boards using a score and snap knife. It is important that the lining boards be fitted with the sealed grid marked surface facing away from the frame 4. Fixing and sealing then follows as described below.

Figure 3 shows the general board to frame layout with the numbered arrows indicating the Figure reference where various features are shown in more detail. Where the lining board is intended for use as a general rigid air barrier to replace flexible building wrap material, there is an option to form vertical joints on or off the stud and methods for doing this will be described hereafter. However, where the product is used to achieve structural bracing, or edges of the lining board must be supported and fixed to the framing. In this regard, any vertical joints must be formed on the studs ideally with a gap of 1-2 mm maximum between the lining boards.

As indicated above, there are two options for vertical jointing of the lining board in general applications, on stud jointing and off stud jointing.

The on stud jointing is achieved by forming the joint on a stud 10 as shown in Figure 4. As indicated a gap 11 is provided between the two lining boards 3 and the lining boards are preferably nailed to the stud with nails 12 as shown. A tape 13 is then applied to cover the nails 12 and gap 11 along the full length of the board edges.
OfF stud jointing is preferably achieved by using a uPVC jointer 15 to form the lining board vertical joint away from the stud as shown in Figure 5. The jointer 15 is then fixed to the bottom and top plates and to the nogs/dwangs.

Horizontal joints may be flashed using a uPVC horizontal flashing 16 of the kind shown in Figure 6. Typically, a minimum gap of 15 mm is left at the floor joist or is specified by the project engineer. When jointing in the middle of a floor height, a 10 mm minimum gap is usually recommended. In this regard, the horizontal edges of the lining board 3 should not be fixed into the solid timber floor joists 17. The flashing should ideally be lapped by 35 mm minimum on both sides of the joint as shown in the drawings.

Internal and external corner joints can be sealed using a 75 mm wide sealing tape as shown in Figures 7 and 8. Furthermore, when using uPVC horizontal flashing 16, the internal and external corner flashing joints must also be sealed using a 75 mm minimum width joint sealing tape 18 as shown in Figure 9. All penetrations such as pipe penetrations through the installed lining boards 3 must also be properly sealed using a flexible flashing tape or sheet 19 as shown in Figure 10. Ideally, a 100 mm minimum cover flashing is maintained over the lining board 3 around the penetration with a minimum of 25 mm of flashing tape 19 extending over the pipe 20.

To achieve an adequate seal at the junction with a soffit, the lining board ideally needs to extend up to the top of the top plate or go past the top plate.

In order to provide full weatherproof sealing to the finished building envelope, it is important that exposed timber framing around the window, door, meter box and other penetrations be covered with a suitable flashing such as a 100 mm wide flashing or sealing tape 21 as shown in Figure 11. Furthermore, the flashing tapes around the window, door, meter box and other penetrations must be lapped over the lining board 3 by, ideally, at least 50 mm.

An appropriate apron flashing arrangement is shown in Figure 12. In this configuration, a flashing tape 19 is applied to the apron upstand 23 of the apron flashing 24 over the lining board 3.

Similarly, junctions between ballustrades and walls need to be appropriately flashed and an example of how this can be achieved is shown in Figure 13. In the illustrated
example, flexible flashing tape 19 is dressed up and adhered to the lining board 3 behind the battens 26.

In most installations, the lining boards will be required to extend below the bottom plate 28 by around 15 mm minimum to form a drip edge. In certain applications, it is recommended that the lining board maintain a 100 mm minimum clearance between the bottom edge of the board and finished ground as shown in Figures 14 and 15. It is also recommended that when the bottom edge of the panel 3 is cut on site to suit the site requirements, the cut edge should be sealed with an appropriate primer or sealer. Naturally, the adjacent finished ground site must slope away from the building in accordance with the relevant building code requirements. It is important that the lining board is not installed in such a way that it may remain with contact with standing water. In structures where the lining boards 3 are being installed as bracing, all board edges must be supported by the underlying framing. The particular installation requirements will depend on relevant local building codes and the particular form of lining boards. In preferred forms, the lining board, the outer face will be marked to indicate appropriate fixing centres.

While the examples discussed above all relate to timber framed wall structures, it will be appreciated that the inventive concepts can also be applied to steel frame structures with appropriate adaptations with lining board fasteners and spacings as may be required.

Once the lining boards have been installed as discussed above, the builder has the option of sealing the roof or applying a roof covering and taking required further steps necessary to achieve "lock up" without needing to start on the outer brick veneer or cladding skin. This enables early commencement of the internal fit out which leads to the advantages discussed above. The external skin, be it brick or cladding etc, can then be erected in the usual manner and in accordance with site specific conditions.

The numerous advantages of the preferred fibre cement lining board are discussed in detail above, but can be summarised as being cost effective, light and easy to handle, multi-purpose (air barrier, bracing, moisture control, structured sub-wall etc), easy to cut and fix and easily identified by the selected colour which is distinctive in the local market.
Similarly, the advantages of the new method of dual skin framed wall construction, whether using the preferred lining board or an alternative, are clear and represent a very significant move forward over local prior art construction methods.

While the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.
THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. An outer frame lining board in the form of fibre cement sheet having a thickness of around 3 - 4mm which is sealed on at least one major face.

2. An outer frame lining board according to claim 1 wherein the fibre cement sheet forming the lining board is configured by method of manufacture, composition, structure or treatment, or any one or combination of these, to meet the local applicable standards in respect of at least air barriers.

3. An outer frame lining board according to claim 1 or claim 2 wherein a surface of the outer frame lining board includes markings to assist with alignment of fasteners with standard stud spacings and the like and/or to facilitate easy and accurate cutting and sizing of the sheets.

4. An outer frame lining board according to claim 3 wherein the markings are integrally formed.

5. An outer frame lining board according to any one of the preceding claims wherein the board is distinguished at least in part by use of a coloured coating.

6. A method of construction of a framed wall structure including the steps of:
   erecting a structural wall frame in situ;
   applying a face sealed fibre cement lining board to fully cover and seal the outside of the wall frame excluding window and door openings and other designed penetrations, the rigid lining board being sealed on at least one major face;
   applying a sealed roof or roof cover;
   closing off the designed penetrations to achieve a sufficiently sealed building envelope to achieve "lock up"; and
   subsequently constructing the external masonry wall or cladding and/or commencing the internal fit out.

7. A method of construction of a framed wall structure according to claim 6 wherein the wall structure is a brick or masonry veneer structure.
8. A method of construction of a framed wall structure according to claim 6 wherein the wall structure has a panellised or plank style outer cladding.

9. A method of construction of a framed wall structure according to any one of claims 6 to 8 using a face sealed fibre cement lining board in accordance with any one of claims 1 to 5.
Fig. 10
INTERNATIONAL SEARCH REPORT

International application No. PCT/7AU2009/000684

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.
E04B 1/00 (2006.01)  E04C 2/00 (2006.01)
E04B 2/72 (2006.01)  E04G 21/28 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPDOC, WPI- IPC: E04C 2/-, E04B 2/-, E04G 21/- and Keywords: lining, wall, cement, protect, air, curtain, frame, construct, flash, sheath, clad

Google Patents- Keywords: method, construction, lining, board, cement, cladding, frame, protect, wall, barrier, cladding

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>X</td>
<td>US 6516580 B1 (MAIETTA) 11 February 2003 See Abstract, Figure 2, column 6 lines 39-40, column 7 line 43-column 8 line 21</td>
<td>1, 6-9</td>
</tr>
<tr>
<td>A</td>
<td>US 6745531 B1 (EGAN) 8 June 2004 See whole document</td>
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Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

Date of the actual completion of the international search 30 June 2009

Date of mailing of the international search report 7 July 2009

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Form PCT/ISA/210 (second sheet) (July 2008)
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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</table>
This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. [ ] Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

This International Searching Authority found multiple inventions in this international application, as follows:
[see supplemental sheet]

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. [ ] As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.
This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

In assessing whether there is more than one invention claimed, I have given consideration to those features which can be considered to potentially distinguish the claimed combination of features from the prior art. Where different claims have different distinguishing features they define different inventions.

This International Searching Authority has found that there are different inventions as follows:

- Claims 1-5 define an outer frame lining board comprising a fibre cement sheet. It is considered that the sheet being sealed on at least one major face comprises a first distinguishing feature.
- Claims 6-9 define a method of construction in situ comprising the steps of applying a face sealed fibrous sheet to the outside of a frame. It is considered that the method involving closing any possible gaps to properly seal the building then subsequently constructing the exterior or completing the internal fit-out comprises a second distinguishing feature.

The applicant is hereby notified that no international search report

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

The only feature common to all of the claims is use of a fibrous cement sheet that has been sealed on a major face. However this concept is not novel in the light of the boards disclosed in US 6516580 (MAIETTA) or US 6745531 (EGAN) both of which are disclosed in the International Search Report.

This means that the common feature can not constitute a special technical feature within the meaning of PCT Rule 13.2, second sentence, since it makes no contribution over the prior art.

Because the common feature does not satisfy the requirement for being a special technical feature it follows that it cannot provide the necessary technical relationship between the identified inventions. Therefore the claims do not satisfy the requirement of unity of invention a posteriori.

However it is considered that search and examination for the second invention will not require more than a negligible search effort over that for the first invention, and therefore an additional search fee was not requested.
This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX