**South Coast Holiday House – ENERGY UPGRADE RECOMMENDATIONS**

Prepared by Andy Lemann.
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These recommendations are given with the long-term view of improving the comfort, durability and energy performance of the house over many years. The goal being to make the house as comfortable and energy independent (although still tied to the grid) as possible in a cost-effective way that maintains the overall character of the place. The house is currently let out as a holiday rental but the long-term goal is for the owners to live here permanently so low maintenance, renter durability and long-term energy costs and carbon emissions are important issues as well as the ability to keep the house comfortable during hot, bushfire times when opening the windows can create asthma problems.

The biggest problems identified by the owners are:

1. The upstairs bedrooms get very hot in the summer and lack effective cross-ventilation.
2. The west wall gets too hot to touch at times in the summer.
3. In bushfire times the house has to be kept closed due to asthma issues and can become unbearably hot.
4. The house is drafty in winter.

Other issues of concern found during the inspection:

- The house is potentially susceptible to termite invasion.
- There is a moisture/rot problem developing along the east wall (behind the TV).
- The gutters need to be kept clear of leaves.
- The downpipe at the south end of the west wall is not properly connected.

The following recommendations are listed generally in order of priority although this may change as time goes on and other priorities present themselves.

1. **Maintenance and Durability Issues**
    a. Remove stored items, gravel, black plastic and leaf litter that are hiding the edge of the slab to allow effective inspection for termites.
    b. Keep the area around the foundations of the building as clean and dry as possible.
    c. Meet with the termite inspector. Discuss the susceptible areas of the house and ask for his/her recommendations as to what to do. If they seem reasonable, follow them. If not, find a new inspector
    d. Gutters – arrange for the gutters to be cleaned every three months. If this proves to be too often then try every six months.
    e. Downpipe – reattach the downpipe to the gutter and secure it with a screw or two.

Downpipe disconnected

2. **Heating/Cooling Downstairs**
    a. Clear the downstairs floor slab (move the bed, etc) to allow as much sun to shine on it as possible during winter days. The concrete will soak up this heat, store it, and release it again during the night to keep the downstairs space warm in winter.
    b. Extend the curtain rod along the west wall so that the curtain can be drawn fully away from the window to allow maximum winter sun to come in.
    c. In summer keep the curtain closed during the day to prevent sun hitting the slab. At night open the windows and curtains to let the slab cool as much as possible.
    d. Add a shade structure to shade the windows and as much of the paving in the north/west corner as possible. But make it so the shade-cloth can be easily removed in winter to allow the sun onto the floor slab.
    e. When living permanently in the house, consider removing the sliding screen doors in the winter time (both upstairs and downstairs). They dramatically reduce the amount of heat that can soak into the floor.

Security screens reduce solar heat gain to slab. Very apparent when you feel the temp of the slab.

    f. Don't plant trees (especially evergreens where they might block winter sun from getting in through the windows (use moveable shade structures instead so that you have control over when the sun comes in or not).

3. **Heating/Cooling Upstairs**
    a. Reconfigure the shade structure over the stairs on the north side of the house so that it can be removed in winter and provide better shade to the walls and windows (plus the deck) in the summer.

Winter shading of the living room by the shade sail on the north side of the house. Good in summer, bad in winter.

b. Deal with the west wall. This will involve the following:
    i. Remove the timber cladding from the upper section of the wall;
    ii. Replace the window in the north bedroom with a double-glazed, Low-E casement (side hinged) window and move it further to the south plus add another small casement window to the west wall of the south bedroom (near the north end) to encourage summer cross-ventilation through these bedrooms;
    iii. Fur-out the lower portion of the west wall to allow for insulation and over-cladding (no need to remove the exiting cladding from this part of the wall);
    iv. Thoroughly insulate the west wall and cover with Hardie-wrap (reflective breathable sarking);
    v. Add horizontal battens to create an air space;
    vi. Clad with vertical, light-coloured, corrugated Colorbond cladding allowing for air to enter at the bottom and exit at the top. The light colour will reflect more heat and the air space behind the vertical corrugations will act like a chimney, drawing in cooler air at the bottom and exhausting hot air out the top. This will require some careful detailing and flashings. I'm happy to work in collaboration with the builder to figure out the exact details.
    vii. During the process of dealing with the west wall, install conduits to allow for the (eventual) replacement of the existing water heaters in the hidden space in the downstairs bathroom) with one or two heat pump water heaters to be placed on the west side of the house where the air is warmer. These will be set on a timer to run between 10am and 4pm when the solar power system is producing energy and when the air temperature around the water heater(s) is warmest. This makes them operate more efficiently.
    viii. Also plan for the future installation of a solar power system on the west half of the roof including the route for wiring to the meter box as well as location of future batteries, etc.

c. East wall - slight rot problem. There is currently a minor rot problem developing along the outside of the east wall of the upstairs portion of the house (behind the TV). It appears that a treated pine 'beam' has been installed to try to deal with this issue in the past. The 'beam' is actually making the situation worse by trapping moisture at the bottom of this wall.

Rot under east wall of house as seen from below.

Treated pine 'beam' used to hide the rot problem.

I suggest that, at the same time as dealing with the west wall you also do the following:

i. Remove the cladding on the section of east wall behind the TV;
ii. Repair any rot damage present and install flashing(s) as necessary to ensure that water is directed well away from this area and to prevent the problem recurring;
iii. Consider replacing the window with a tall, double-glazed, double-hung window that would allow better ventilation but not block the passageway when open. (Just be aware that sliding and double-hung windows do not seal as well as awning (top-hinged) or casement (side-hinged) windows;
iv. Plan for the installation of a reverse-cycle, mini-split air-conditioner with the indoor unit located above the TV so that it can blow conditioned air towards the bedroom area. The outdoor unit can be placed almost directly below this (where the rubbish bins currently live) which is in close proximity to the meter box for supplying power.
v. Install insulation, sarking and Colorbond cladding (I don't think it's necessary to create the air space for cooling any of the other walls apart from the west one).

d. Reverse-cycle A/C – once the east and west walls have been dealt with, install a mini-split reverse cycle A/C system as described in (iv) above. Be careful that the contractor does not try to sell you one that is way too big, remember

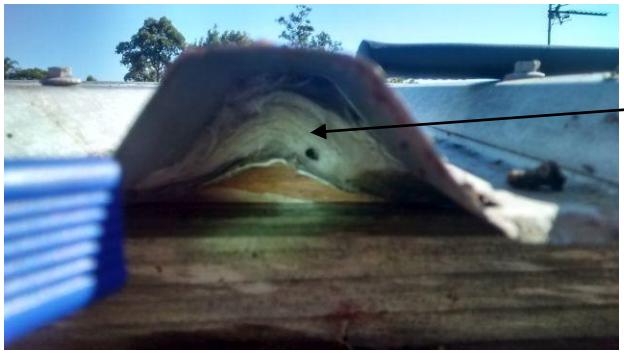
that it needs to be sized correctly for the long-term heating/cooling load which will get lower and lower as time goes on and further work is done on the house. My guess is that something like a 5kW system will be plenty.

Suggested location for outdoor unit.

e. As time goes on and as finances dictate, the other walls and windows of the house can be upgraded in a similar fashion to (a) and (b) above.

**4. Roof and Solar System**

a. As far as I can tell without taking the house apart, the roof is constructed with a 50mm Solomit straw insulation panel (possibly about R1 insulation) and on top of that are 45mm timber battens screwed down to the roof beams. I can't tell if there is insulation between the battens but there is certainly 'anti-con' blanket on top of the battens and directly underneath the roof metal. This adds a degree of insulation to the roof and helps prevent condensation forming under the roof metal. My guess is that this construction gives the roof an insulation level of about R2-2.5. Ideally in this climate I would like to see 3.5 or better however, as we saw with the IR camera, the roof is performing significantly better than the walls at the moment.



Anti-con blanket under roof metal and above straw roof panels.

b. So I recommend that the east and west walls be dealt with first, then in summer we look again at the roof with the IR camera to decide whether it is worth adding more insulation to the roof.

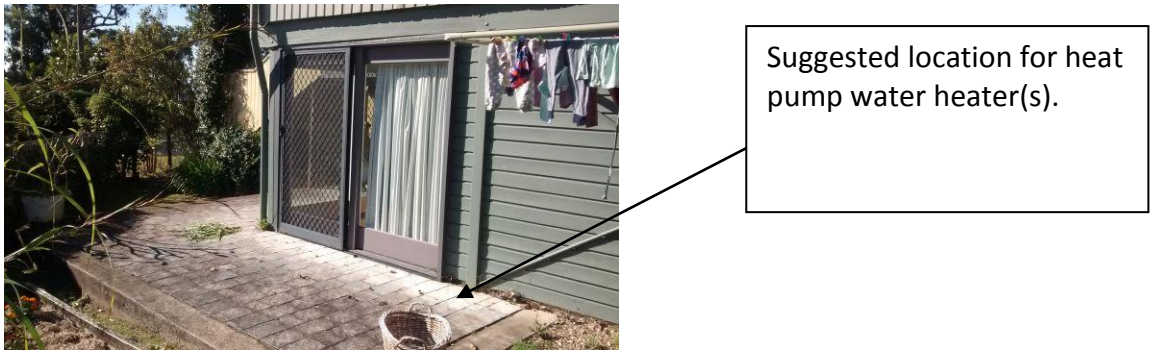
c. If it proves to be necessary, the easiest way to do that would probably be to lift the metal roofing, add 50-100mm of foam insulation on top of the timber battens, then re-lay the metal roofing using longer screws and with anti-con blanket underneath.

d. Once the roof has been completed (or we decide it is okay) then I recommend installing 2-3kW of solar panels with Enphase micro-inverters on the west side of the roof with the intention of adding more panels as time goes on.

e. The micro-inverter system performs better under partial shading (which you will get from the trees on the north side of the house) and is very easy to expand as the need arises. It's a very simple matter of adding more panels with micro-inverters. Plus, once you have internet at the house, the Enphase system will give you very detailed monitoring of your solar power system.

5. **Insulate Under the Floor**
    a. A good portion of the floor under the kitchen/dining/living area is exposed and easily accessible. This part of the floor can and should be insulated. This could be done at any stage however I would wait until after the east wall have been repaired, the A/C system has been installed, and any conduits, etc that might be required for the solar power system wiring have been put in place.
    b. The portion of the floor that separates the upstairs bedrooms from the flat below is a) less important from the heating and cooling perspective and b) trickier to deal with because it is covered with gyprock. However at some point this may need to be insulated for sound purposes. When that time comes be sure to run the pipework necessary for the new water heater(s) – see below.

6. **Heat Pump Water Heater**
    a. As mentioned above, the hot water for the house is currently heated by two, small, electric-resistance water heaters hidden behind a cupboard in the downstairs bathroom. This seems to function reasonably well and has the advantage of allowing one or both of these systems to be turned off when the house is unoccupied or partially occupied. The disadvantage is that electric-resistance heating is very inefficient. Plus the small size of the two tanks would not allow them to be placed on a timer to coincide with power production from the solar system. When hot water is used at night they simply don't store enough hot water to last through until the sun starts shining on the solar system again.
    b. In the long run (perhaps when you are ready to occupy the house permanently) it will make sense to replace these with either one or two (two would give you the advantage of (a) being able to turn one or both off when they're not required and (b) being able to run them separately in the event that you are living in one part of the house while renting out the other part) heat pump water heaters with a decent amount of storage. These are much more efficient than resistance water heaters and, with enough storage, can be used to heat water while the sun is shining on the solar panels on the roof. This is a great way to use and store your own solar power.




c. Plus, heat pump heaters are more efficient when the air around them is warmer. So by locating them on the west side of the house they can be run during the day when the air in that area is warmest. In this way they will run very efficiently using power directly from your solar system.

**7. Cooking**

a. Currently the most efficient ways of cooking with electricity are by using induction cooktops, microwaves and slow-cookers.
b. Ikea sells very cost-effective induction cooktops although these may be tricky for renters (maybe not).
c. Microwaves are great for defrosting, reheating and preparing food for further cooking. They use much less power for certain tasks than standard stoves and cooktops.
d. Slow cookers are great because you can set them up in the morning to slow cook all day using a small amount of power from your solar power system.

**8. Batteries and Electric Vehicles**

a. While they don't make economic sense at present, it's only a matter of time before home battery storage systems and electric vehicles become common place and financially viable.
b. As work progresses on the house, bear in mind that you may want to add a substantial amount of extra solar for the purpose of charging home and/or car batteries.
c. This may also require extra bits of infrastructure (like car chargers and battery enclosures) so it's a good idea to think about where these might be located and how wires can be run to those locations.

**Please note:** these recommendations are provided to the best of my knowledge and experience based on a visual inspection of the house and brief discussions with the owners. They are not intended as a detailed or comprehensive solution and must be taken as suggestions only. Each recommended action will require more detailed investigation and planning to determine viability and installation issues that might affect the cost-effectiveness of any action. I am happy to consult further on the detailed implementation of each action however I also encourage you to seek further opinions and professional advice before implementing any of the above recommendations.