"The Flat Roof Society"

Last week I was walking through a particularly beautiful corner of Bali when I heard a loud thud immediately behind me. Turning around I was gobsmacked to see a rather large durian sitting on the path exactly where I had passed a split second earlier. My mind raced through horrific thoughts of the spines of the aforementioned durian embedded in my skull and went on to consider the odds based on space and time of such a close shave. Noting my walking speed and the 40 cms between myself and the fearsome fruit, I calculated the length of time (about a gazzillionth of a metric second) that determined my fate between survival or a rather painful ongoing negative survival situation. My respect for durian trees has increased somewhat.

I was reminded that the last time I had been in that area I had come across a lady farmer wearing a yellow site helmet. Now a site helmet on a farmworker is not a common sight so I had asked politely “is your roof leaking?”

“Is my roof leaking?” came the assertive reply, “Are you mad? This is Bali, of course my roof is leaking.”

We parted in a mutual state of bewilderment.

But now, with my recent experience, the vapours of misunderstanding dissipated and the vision of the strangely behatted agroworker (note not aggroworker - she was very polite) made very clear sense.

My original theory of a leaking roof, however, still holds water.

Ever since Adam made the first umbrella out of his figleaf (the only other human on the planet wasn’t bothered - she’d seen it all before anyway) man (and woman of course) has/have known that water has a very distinct tendency to fall out of the sky and, even more distinctly, to flow downhill. We have also been aware that it is nice to avoid falling water when the sky opens and it starts raining cats, dogs and durians (especially durians) or anything else that may fall from the sky - in short we do like to keep dry when it’s peeing down don’t we?

As a result we have a wonderful invention that probably came long before the wheel, we call it a “roof”.

Now my father always used to say that roofs are sloping for a reason. He had a bit of a thing about flat roofs which, in Britain, were made from wooden planks covered by a layer of bitumen saturated canvas known as roofing felt. In the dark days of a British winter these roofs ended up covered in snow and, as inevitably as hangovers follow heavy drinking, such roofs always leaked. People never seemed to learn and my father, being a typical teacher, was determined to spread the word as widely as possible.

In Bali these days, in spite of the Balinese request that all buildings have traditional sloping Balinese roofs, flat concrete roofs have become commonplace and, as it happens, leaks in flat concrete roofs have become almost as commonplace.

Most concrete roofs follow a similar type of construction. A 10 to 15 cm thick slab of
reinforced concrete with a thin 2 to 5 cm thick layer of cement on the top. This cement layer is known as a “screed” and, contrary to popular belief, its purpose is not to waterproof the roof. It is, in fact, installed to provide a smooth sloping surface so the roof will drain correctly towards the drainage points thereby avoiding water “pooling” on the roof.

Flat concrete roofs as they are locally constructed have a number of issues.

The first thing to note is that it is the reinforced concrete slab, not the screed, that keeps the water out. It must be correctly designed and constructed. The walls must be built strong enough to support it. It should also be cast as a single piece of concrete with no joints in it. Any joints in the concrete may be sources of future leakage. The reinforcing steel must be of the correct size and should be correctly placed. It is also very important that the concrete is correctly mixed during construction, not too much water should be added and a vibrator should be used when pouring the concrete to remove any trapped air.

In addition the cement screed often causes problems. Under intense sunshine this thin layer can get very hot while the reinforced concrete of the roof beneath stays cooler. The screed expands more than the concrete and as a result the screed cracks and you will see cracks across the surface of the roof. This cracking also often results in the screed separating from the reinforced concrete beneath.

So now when it rains water can penetrate the cracks in the screed and can travel across the roof between the cement screed and the reinforced concrete and will manage to find any leaks through the reinforced concrete and into the room below.

When repairing a leaking roof the fundamental issue is that it is the reinforced concrete that is leaking and the best approach is to remove the screed and expose the reinforced concrete so that leaks can be found and properly sealed. The screeding can then be replaced.

Correct methods and properly selected materials must be used if we wish to avoid the inevitable desire to put our head in a gas oven at some later stage.

Leaks are most likely to occur through cracks in the reinforced concrete or along joints where two distinct pours of concrete have occurred during construction. The cracks or joints may have opened up as a result of earthquake, ground subsidence, building settlement or possibly flexing of the roof slab either during or after construction.

It is important that the concrete of the roof is cast as a single reinforced slab. This slab forms an integral part of the building structure. The concrete or the reinforcing steel certainly should not be cut or damaged in any way as this can weaken the roof. It should be noted that if water is able to penetrate cracks in the reinforced concrete and comes into contact with steel reinforcing bars, the reinforcing bars may rust and this can cause serious problems further down the track. When steel rusts it expands and this can split the concrete apart.

Obviously we need to correctly identify precisely where the roof is leaking. It may be useful to expose the roof slab from underneath by removing part of the ceiling below to more accurately identify the point of water penetration.

Once found the leak must be fully sealed. This should be done from above - we wish to
prevent water getting in. It is very difficult to effectively seal it from below.

 Attempting to seal the screed is not easy. One crack may be all that is needed to allow water to penetrate under the screeding and from there may be able to reach large areas of the roof underneath. The application of a wash of cement based sealant over the surface of the screed is unlikely to be successful and may create more problems than it solves. Cement based sealants tend to be brittle and when exposed to excessive temperature fluctuations may crack or spall off the screed.

 A membrane system may be used over the top of the screed. Rubber or plastic sheeting are usually a total disaster and should be avoided. Hot tar (bitumen) based systems have been used successfully but are not readily available in Bali.

 There are other waterproofing systems available that may work but most require correct application with attention paid to detail, this is of particular importance if sophisticated modern materials and techniques are to be used.

 At the end of the day everything depends upon the contractor having sufficient knowledge and skill to correctly find the points of water penetration and seal them effectively.

 So I have a flat roof that can’t be sealed, you have torn your hair out, shouted at the missus and kicked the cat, now what can I do? Well you may consider going back to basics and installing a pitched roof over the top. There are several options available from fully pitched tiled roofs to lower profile roofs using zinc alume or Onduline sheeting.

 In Bali there is a notable gap in the range of building contractors available. There are large professional construction companies at one end of the scale and small private builders at the other with few medium scale operators in between. The large contractors are generally very capable however, as we have said, the vast majority of small builders simply do not have the understanding or the supervisory capacity to build reliable flat concrete roofs.

 Are you a member of the flat roof society? It is probably best to keep it simple, respect our Balinese hosts and avoid flat concrete roofs in the first place. Traditional roofs are cheaper, more effective and well within the capabilities of local builders. They are also a lot cooler than pitched roofs which collect a lot of heat which is transferred into the house beneath.

 Take care and keep a weather eye out for durians.

 Phil Wilson