“Do You Feel Like A Banana?”

We hear that the some people have been patenting human genomes. Does this mean that the creator doesn’t hold copyright on his/her creations any longer?

Our eyebrows raise in exasperation, a sigh leaves our mouths and the inaudible words “anything to make a quid, they’ll be patenting the cutting of toenails next” drift aimlessly across the room and out the open window. At least oxygen is still free but for how long?

Scientists also tell us that we share half of our DNA with bananas and we must pose the obvious question - which half? At times we have to wonder if it is our brains, we certainly seem to have a few Banana Republicans around at the moment.

Recently the news has been full of serious earthquakes in different parts of the world and we are familiar with images of buildings that have collapsed or fallen over. Indonesia is a very earthquake prone and Bali is considered as a higher risk area.

If your house is designed and built to proper structural engineering design principles and standards then your house should be safe, sadly many houses are designed and built according to designs that may or may not follow sound structural engineering design.

Probably one of the most common, and worrying, shortcomings I see on a daily basis are buildings with poorly designed structures or even no structures at all.

Of course there will always be risk in any building however, a well built structure, even when damaged in natural disasters, can often survive such forces and often means the difference between life and death.

Unfortunately, just as some people wear uncomfortable high heeled shoes for the sake of fashion (it’s the banana DNA you know), many people are apparently willing to forsake sensible structural design for the sake of clean building lines.

Nowhere is this more evident than in the design of structural building columns.

What do we mean by structural columns?

Structural columns are vertical reinforced concrete columns that stand on the foundations and support a building, they hold up walls, floors and roofs and, when combined with reinforced concrete beams, they form a strong frame that enables the building to withstand some pretty destructive forces such as floods, strong winds, earthquakes, landslides and ground subsidence.

Conventional building columns in houses are typically 20 cms by 20 cms square which is wider than the average wall. In recent years building designers do not want structural columns protruding from walls and ruining the clean look of their buildings and so they have taken to using “skinny” columns in their designs that are rectangular (wide and thin) so they can be hidden in the walls. “Skinny” is of course a technical engineering term. Many villas in Bali are being built this way with skinny columns that are typically 15 cms thick by 30 cms wide.
To structural engineers this is a major concern. To understand why let us look at the fundamentals of reinforced concrete design.

It is the combination of concrete and steel that gives enormous strength to reinforced concrete. The concrete is hard and cannot be compressed but it is brittle and will crack easily. The steel holds the concrete together, it will not stretch or break easily. When we combine the two we have a very strong material as long as the steel is correctly designed and positioned inside the concrete.

![Concrete Floor Diagram]

The position of the steel is very important. In a reinforced concrete floor we use two separated layers of horizontal steel bars embedded in the concrete. Now if we put a weight on the floor the floor will attempt to sag but to do this the upper steel bars will have to compress or crumple and/or the lower bars will have to stretch or break.

If the two layers of steel are close together the amount that the steel bars have to be compressed or stretched to allow sagging is small and the floor will not be very strong but if we increase the distance between the layers of steel the amount of stretching and compressing of the steel needed to allow sagging is far greater - the floor will be much stronger.

The steel we use is designed to be strong enough so it will not break or stretch and the concrete is designed to be thick enough to hold the steel rigidly in place and not crack.

If we consider the same effect in a concrete column we can see that the strength of the column is very much determined by the size of the steel bars and how far the bars are apart within the concrete.

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In most circumstances columns hold things up, they only have to support weight, however there are many circumstances (such as during earthquakes) when there are sideways forces on columns and so they must be able to resist cracking or bending.

It is easy to understand that if we make a concrete column with a single bar of steel up its centre the column will easily bend and crack.

If we put four (or more) steel bars in the form of a square down the centre of the column, just like the floor, in order for the column to bend some bars will have to be compressed while others will have to stretch or break and the further apart the bars are (while still encased within the concrete) the more the column will withstand bending.

Normally we make columns square because this gives the column equal strength in all directions (directions A and B in the diagram).

However if we make a column rectangular, ie. wide but not very thick so we can hide it in a wall the column may have high strength along the direction of the wall (direction A) but not at right angles to the wall (direction B). A typical modern rectangular “skinny” column may be 30 cms wide but only 15 cms thick making it considerably weaker in direction B.

To compensate for the weakness of skinny columns designers may place rectangular columns at right angles to each other in different parts of the building this is, however, no substitute for using square columns. They also tend to put six steel bars rather 4 in skinny columns which does help but these are usually smaller diameter to try and fit them in the concrete. As any engineer will tell you, you only have to reduce the diameter of a steel reinforcing bar a very small amount to considerably reduce its strength.

Unfortunately skinny columns have other serious shortcomings.

1. Oxygen in the air can penetrate concrete to a distance of 6 or 7 cms and oxidise (rust) the reinforcing steel. It is recommended that reinforcing steel in structural concrete is covered by a layer of a minimum of 6cms to prevent the steel from rusting. This is particularly important within say 50 kls of the sea owing to the salt in the air. If our column is only 15 cms thick and we have a 6cm covering of concrete over the steel this leaves us only 3 cms to place our 2 layers of steel bars. Clearly it is impossible to build a 15cm thick
concrete column with sufficient concrete covering to adequately protect the steel reinforcing bars.

2 A typical wall is only 15 cms thick and has a layer of plaster (cement render) probably around 0.5cm thick which covers the wall to smooth it out, this render is applied to both the column and the bricks or cement blocks that form the wall between the columns. To achieve this the columns may be made even thinner, we are now down to 14cm thick columns.

3 Casting concrete columns is not easy because the concrete has to be poured from the top down into the formwork - usually a 3 meter deep "mould" made from plywood. The concrete should not be too wet and the small stones in the concrete must get past the reinforcing steel bars on their way down. The concrete should be vibrated during the process to make sure the concrete gets to the bottom of the mould and that any airgaps have been filled. This is difficult enough with a square column but much more difficult with a 15cm thick column. Skinny columns often suffer from poor construction.

If you want make sure your building is safe in earthquakes it is best to use square columns.

So how do we get around the design issue? If we construct the walls so the inner surface of the walls are level with the inner surface of the columns then the internal walls of the building can be clean with no columns protruding into the rooms. This leaves the columns on the outer surfaces of the walls and this conforms with traditional Balinese design principles in which the columns are in integral feature of a building. This complies with the request from our Balinese hosts that buildings incorporate elements of traditional Balinese architecture in them.

My mind drifts back to Banana DNA, could eating a banana be considered a form of cannibalism?

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