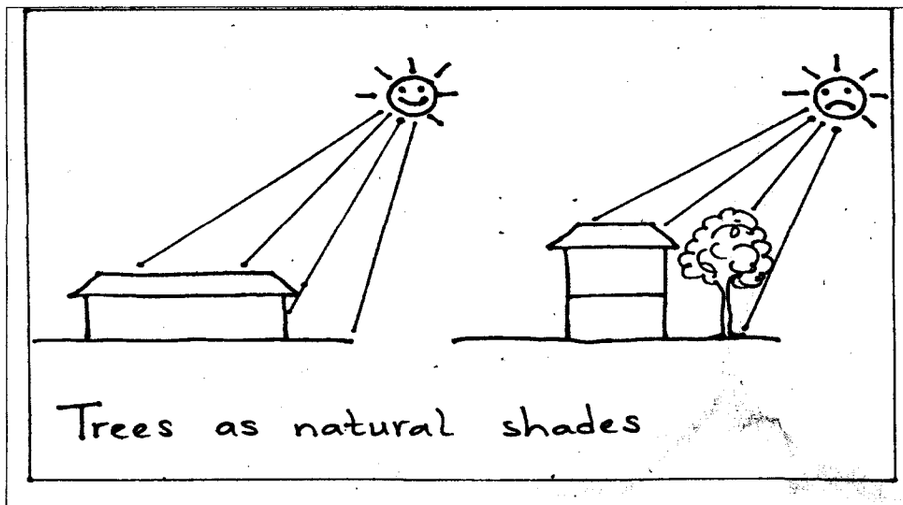
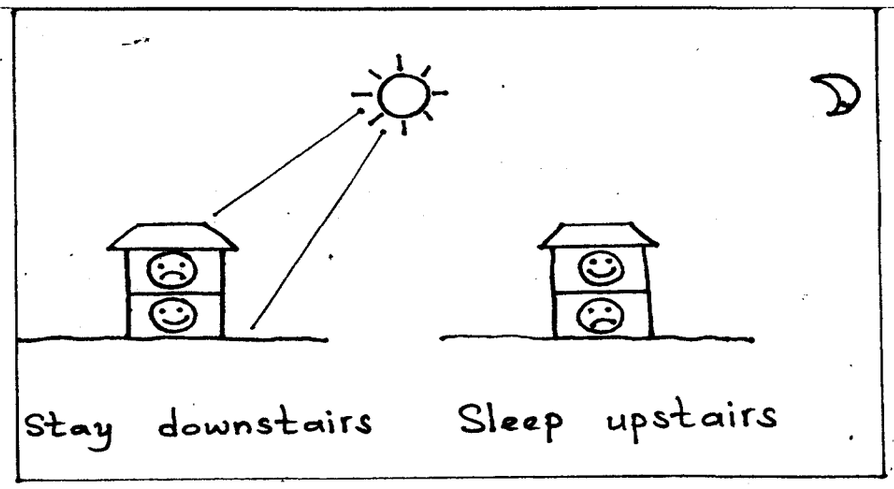
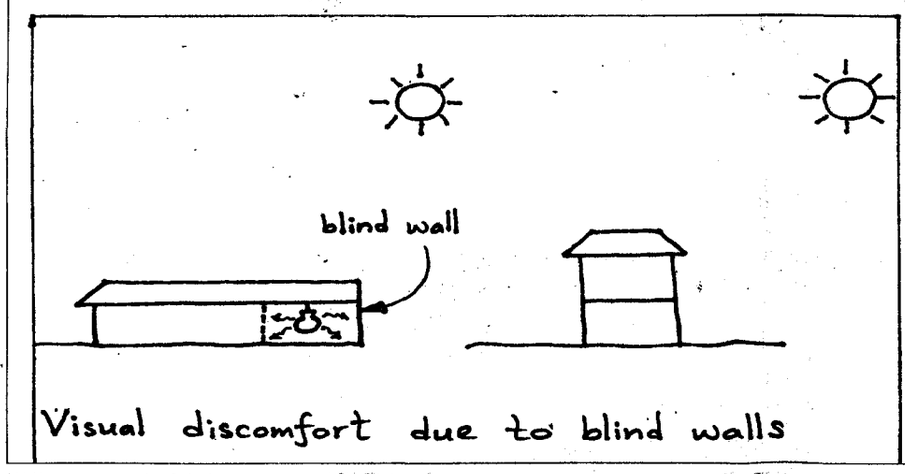
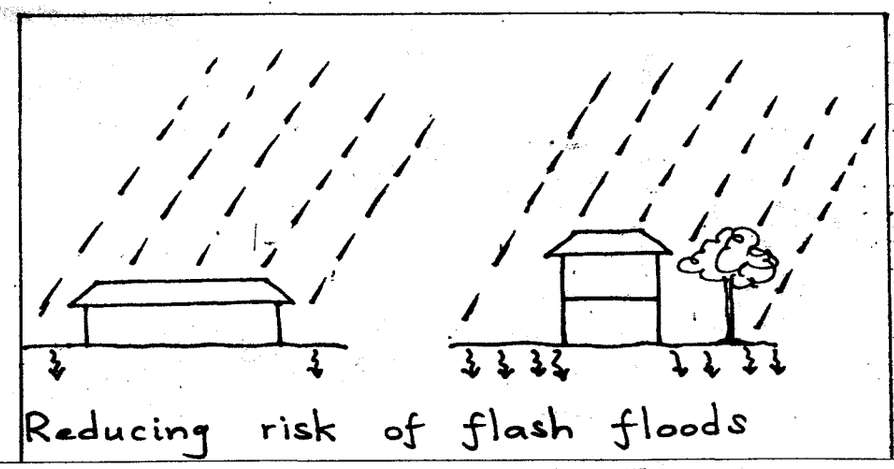
Why houses should go up?

by Asitha Jayawardena









So you're going to build a single storey house on your fifteen perch land? Three bedrooms? How about going for a two-storey house? That is, going up rather than spreading sideways. There are advantages!

A house should be comfortable to its occupants — both thermally and visually. But comfortable houses do not occur by accident; they have to be designed with passive solar techniques. If a house is not comfortable, its occupants will achieve comfort through active means. For example, if the interior is too hot, fans can be used — even air-conditioners. If the interior is gloomy during daytime, artificial lighting is a solution.

These active methods can provide comfort but at a comparatively higher cost. Therefore cheap but effective passive techniques should never be overlooked. The plus point of the two-storey house is that its passive performance is much better than an equivalent single-storey counterpart.

Shaded

Heat enters a building across its external surfaces; that is, the external walls and the roof. During the daytime the external walls facing east receive direct sunlight only upto about 11.00 a.m.; those facing west, only from about 1.00 p.m. The roof, however, is directly exposed to the sun throughout the daytime. By constructing a two-storey house, the roof area can be reduced while keeping the floor area the same, thus reducing external heat gains. In the two-storey house the upper floor protects the ground floor from the sun; in other words, the 'roof' of the downstairs (ie the upstair slab) is shaded. Therefore, the downtairs of the two-storey house is cooler than a single-storey house.

Trees, if strategically located, would provide shading to windows and walls. The afternoon sun falling on the western walls is quite undesirable as the environmental temperature is also high then. Natural shading of this wall using trees would therefore be an effective measure for comfort. However, presence of trees near a house is not so healthy for the foundation; therefore, when building a single-storey house on a small plot of land, it is common practice to cut down most, if not all, of the trees.

However, when the plan area is much smaller than the floor area of the house, as in the case of a two-storey one, a spacious garden would be available for planting trees. Moreover, a garden with trees is not only pleasant to the eye but also helps to keep the air clean.

Cool night air

Across glass solar radiation penetrates instantaneously; across walls, however, it will take several hours for heat to travel from the external surface of the wall to the internal surface. The length of this time lag depends on the wall material and thickness. For a nine-inch-thick brick wall, it is about seven hours. Therefore, when heat finally reaches the indoors, it would be night time; then the outdoor temperature would be lower than that indoors.

To cool the indoors at night, the best way is to allow the cool night air into the house. However, for reasons of safety, the occupants would be reluctant to keep the windows open at night — especially if the house is a single-storey one. On the other hand, if the house is two-storey, with the bedrooms upstairs, this reluctance would be less.

Dr. M. T. R. Jayasinghe and Dr. R. A. Attalage of Moratuwa University have shown through research that Sri Lankans can be comfortable at higher temperatures if some ventilation is provided. For example, he who is comfortable at 250C without much ventilation is likely to be uncomfortable at 290C. However, if some ventilation is provided, he would be comfortable at 290C as well.

Courtyards promote ventilation. However, due to aesthetic reasons, the occupants would like to have the living room open to the courtyard. Then, due to reasons of privacy, bedroom windows cannot be opened to the courtyard. Moreover, as the single-storey house is rather spread, it is difficult to connect several rooms to the court yard.

The two-storey house, however, makes the maximum use of a courtyard, which can be designed to serve both storeys. Downstairs, the living room can be located next to the courtyard; upstairs, the bedroom windows can be opened to the courtyard.

Therefore the two-storey house provides a complete day-and-night solution to discomfort problem. During the daytime, the occupants would be comfortable in the cool courtyard due to the shaded upstair slab; during the night, they can sleep upstairs with windows open so that night ventilation can cool the bedrooms. Moreover, presence of a courtyard will improve comfort — both day and night.

Common practice to achieve thermal comfort at night is to use ceiling fans or table fans with most of the windows closed. This is not very effective as they can only mix the already available warm air; the slight improvement is due to the forced ventilation produced by them.

Blind walls

When a single-storey house is designed for a small plot of land, a blind wall on one side is very likely in order to save some usable garden space. This practice however results in gloomy interiors, leading to use of artificial lighting during the day time.

In the two-storey house, however, the smaller plan area covers less ground area, reducing the necessity of a blind wall. Moreover, it helps daylight reach most of the indoors so that use of artificial lighting during the daytime can be avoided. Therefore, the two-storey house performs better with respect to visual comfort too.

Use of electric bulbs adversely affects thermal comfort as well. They convert electricity, not only to light but also to heat, raising the indoor temperature.

Flash floods

Land is becoming scarce in and around Colombo. Consequently, most of the land area is already covered by roads, tiles (side walks for example) and roofs of buildings. Since such surfaces are highly impermeable, the rain water falling onto them would not be absorbed. Therefore, after heavy showers lasting for a couple of hours, the drainage network may not be able to cope with such a massive amount of water. The result can be a flash flood, which is not new to Colombo.

Natural ground on the other hand is permeable and therefore is capable of absorbing much of the rain water. Therefore, the burden borne by the drainage network goes down; so does the risk of flash floods. That's why the two-storey house performs better here too; it leads to a spacious garden so that more natural surface area is available for rain water to absorb.

Besides shading walls and windows, presence of trees may lower the water table in the area. Then, rain water can be absorbed into the ground faster — again reducing the risk of flash floods.

The cost

They who decide to build a single-storey house instead of a two-storey one do so often based on the cost. They fear the cost of concrete and reinforcing steel. But the two-storey house brings about cost reductions as well. [illegible] is significant these days. Secondly, the area of the foundation is reduced — sometimes by half. Now, however, the foundation has to carry two storeys instead of one, but this would not increase the cost drastically as increasing the width of the footings at the lowest level is enough to bear the excess loads. Thirdly, only the ground floor area requires a hard earth filling; the upper floor is a reinforced concrete slab.

Moreover, there seems to be unnecessary cost increases due to the normal practice currently adopted in Sri Lanka. Today the common composition of the two-storey house is like this: the upstairs consists of brickwork or blockwork only, with loadbearing walls about nine-inches thick and partition walls half this thickness; the downstairs consists of a reinforced concrete frame (ie beams and columns) with infil brick or block work.

However, in his book "Loadbearing Brickwork Construction for Sri Lanka", Dr. M. T. R. Jayasinghe highlights that a two-storey house can be built without employing a reinforced concrete frame for the downstairs. Then, however bricks should be selected very carefully and construction should be properly done. This condition is very important since most of the bricks available in the market are not of good quality. Several simple tests that can be done at the site itself are available to do a proper selection and also certain quality controlling measures that should be adopted during construction. This way, a cost cut can be achieved without sacrificing safety in return.

If the running costs are considered, the two-storey house (even one consisting of a concrete frame for downstairs) can be cheaper than the single-storey counterpart. The former is likely to be comfortable in itself while the latter demands active techniques, which consume electricity.

That's why houses, rather than spreading s, should go up!