Metal structures for Micro Concrete Roofs

Kurt Rhyner

It is usually believed that a metal structure has a longer life than a timber structure. However, this is not always the case, and it is necessary to know the different options possible with metal structures. On the whole, two elements are considered in popular houses: the steel bars that are used to reinforce concrete and the roll formed profiles, popularly known as «purlins" or "C-sections». A material rarely used, but that can be very advantageous, is the square tube, both roll formed (industrial tube) or hot formed (structural tube).

All these elements have to be painted twice with anticorrosive paint and, after welding, screwing or bolting them, it is also necessary to retouch the points twice as well. In areas of salty air (sea) or aggressive gases (sulphur near active volcanoes), perhaps this is not enough to guarantee a long life. Under such conditions, it is necessary to close the tips of the tubes so that they do not oxidize from inside.

The picture above shows a bar structure (it is important to highlight that it was made in a factory and is of unusually good quality): The beams are placed at a distance of 75cm and bars of 3/8" are used as battens. These bars deform with the weight of the tiles and the finished roofs is irregular. This solution becomes more expensive than using C-section and tubes.

DEFICIENT SOLUTIONS

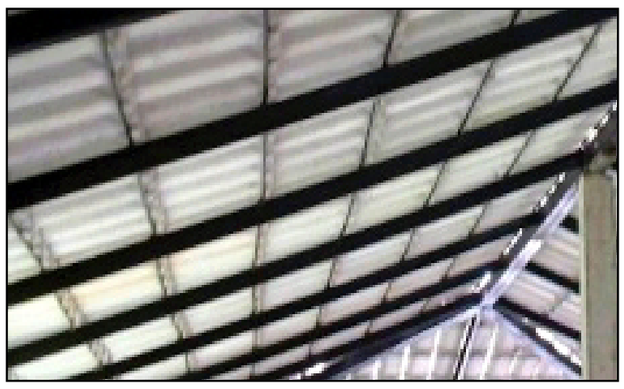
When we build a roof, we assume that the carpenter knows about roofs and that he is an expert in his craft. The same may not be true when we entrust a similar structure to a welder. The art of metal roof structures is still new and usually the welder does not know how the tiles have to be placed. Accustomed to produce roofs for galvanized iron or aluminum sheets, he is not aware of the requirements of a tile roof, either a microconcrete or a traditional one.

We have observed many faulty roofs made with welded bars or with C-sections, where more material than necessary has been used and a mediocre result obtained. For example, the beams made of steel bars welded together are hardly ever straight and, therefore, the roof ends up being uneven. Usually bars are used as battens to support the tiles and they will always bend with the weight.

TECHNICALLY CORRECT AND ECONOMIC SOLUTIONS

To analyze a roof, we have to go from top to bottom, since the most important thing is that the tile is correct placed and is waterproof. Steel bars are not a good solution as battens, as they usually arrive at the construction site bent, and can never be straightened really well, and placed on the beams they will deform by their own weight. In order to guarantee a satisfactory roof, the beams should be placed at very short distances, which implies great expense.

Some kind of tube (either industrial or structural) appropriate as a batten usually can be found in every country. These tubes are straight and behave better behavior than bars. They are not always more expensive (in El Salvador, for example, a 1" industrial tube is cheaper than a ½" bar), and even when they are, it often is more economical because there can be wider spaces between the beams.



This picture clearly shows the deficiency of the bar battens. Even on beams of «C-sections", it is difficult to obtain straight lines, apart from the fact that the weight of the tile makes the bar bend.

It is very difficult to provide recipes without a specific calculation of the case, but we can give some guidelines to determine the dimensions you should use. Having an exact plan and the product specifications of your country, we would try to give you more precise advice.

You can use the following chart to calculate how wide apart the beams can be so that the tubes do not bend under the load of the tiles MCR over it can cover:

- ¾" industrial tube with a 1mm-gauge profile covers up to 1.25 meters
- 1" industrial tube with a 1mm-gauge profile covers up to 1.50 meters between supports
- ¾" structural tube with a 1.5mm-gauge profile covers up to 1.75 meters
- 1" structural tube with a 1.5mm-gauge profile can cover a span up to two meters

Anyway, if you are in doubt, you can place a tube on two supports, lay tiles over it and then, by using a string, check whether the tube does not deform. A deformation up to 1/200 will not cause problems. This means that, in a span of two meters, the tube can deform up to 1 centimeter without consequences.

For the sloped beams, "cold formed C-sections" are preferable. These elements are straight and easy to manage. They can be either welded or bolted. The tubes that will be used for battens can also be screwed or welded. There are different profiles and though quality does not vary much from one product to another, the gauge of the profile does. For the calculations below, we used 1.5mm-gauge profiles, which are predominant in Central America.

The following chart shows what profile can be used according to the distance between the beams (that is to say the span covered by each batten) and the distance between supports (room size):

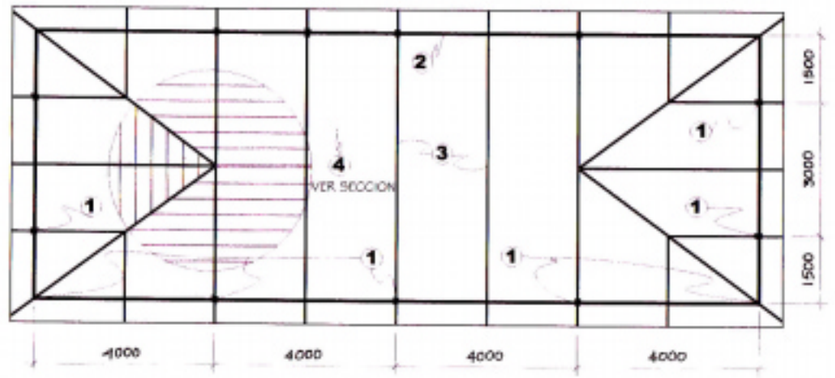
Distance between supports	Spacing between beams	Height of the profile
2.00m	up to two meters	3" (80mm)
2.50m	up to 1.75 meters	3"
	2.0m	4" (100mm)
3.00m	1.25m	3"
	1.50 to 2.00m	4"
3.50m	up to 1.75m	4"
	2.00m	5" (125mm)
4.00m	up to 1.5m	4"
	1.75 to 2.00m	5"

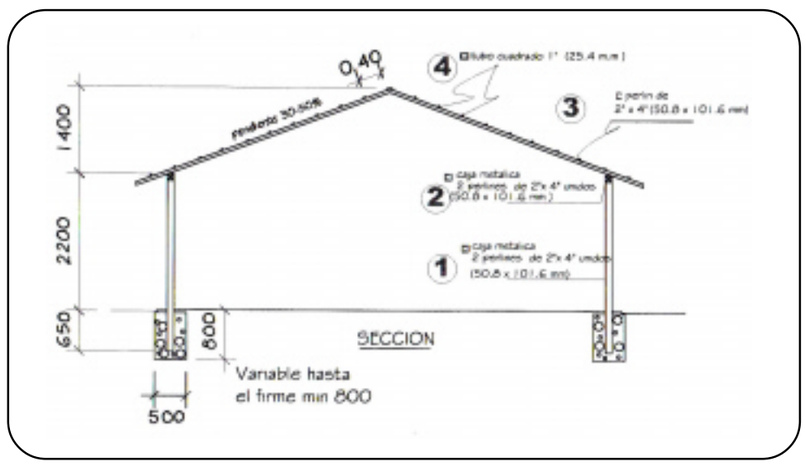
A PRACTICAL EXAMPLE

The plan shows a metal structure designed for a four-pitch roof of 6x20m. As battens we use 1" structural tube. In this way, beams can be spaced at a distance of two meters and we have to use 4" profiles.

The four-pitch roof (or three, in a smaller house) not only looks good, but also provides a much more solid structure than a double pitch roof, especially advantageous in earthquake-prone areas, as it more rigid.

PLANTA DE TECHO





PERFILES