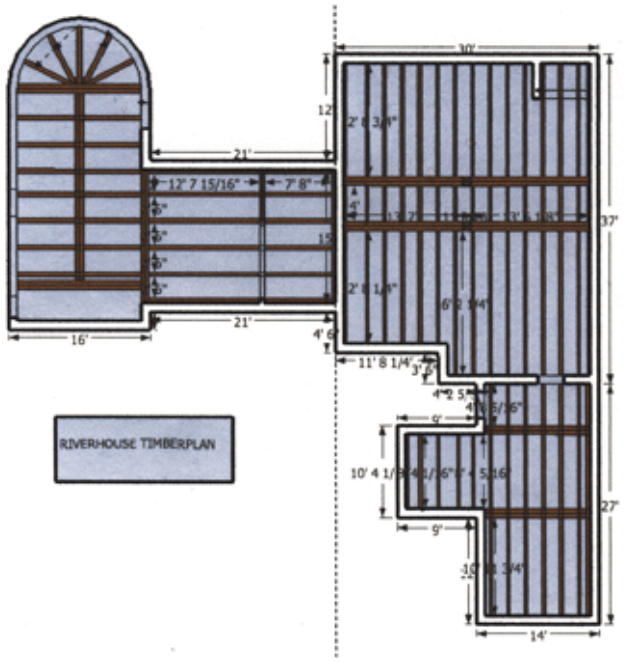
On the Beam

Our drainage and foundation are in, the floor is poured, and the ICF walls are filled with concrete. Now we can turn our attention to the earth-sheltered roof. Because most of our house is covered with earth three feet thick, something strong has to support the roof.



Of course the placement of the beams was crucial to the whole project and our engineer did the required calculations and drew up this timber diagram for us.

The first requirement is an accurate calculation of the weight of the soil—not as easy as it sounds because soil weight depends on many variables such as the type of soil (clay has smaller particles and is therefore heavier per volume than sand) and, of course, the moisture content.

Slightly moist topsoil typically weighs 650 kg per cubic metre, so we have about 60 metric tons of weight spread out over the whole roof on a dry day (and that weight could be multiplied two or three times after a rain), which is much more than I would like to fall on me. So we needed something strong to hold up the roof.

That something is Douglas-fir beams from British Columbia that are nearly a century old, since fir was the structural steel of the first half of the 20th century.

Douglas-fir is not a true fir (that's why the name is correctly hyphenated) and has been a taxonomic nightmare for those trying to settle on a genus name. After changing names on numerous occasions the present scientific name Pseudotsuga menziesii now uniquely belongs to Douglas-fir, and the common name honours David Douglas, the Scottish botanist who first introduced it into cultivation at Scone Palace in 1827. To make things even more complicated, two different varieties of the species are recognized. There is coast Douglas-fir, and blue Douglas-fir.

When architects and engineers look for the best in structural timber, their first choice is often Douglas-fir. It is universally recognized for its superior strength-to-weight ratio, its excellent nail-holding and fastening capability, and its superior performance record against wind, storms and earthquakes.

In strength properties, Douglas-fir has the highest ratings of any western softwood for extreme fibre stress in bending; tension parallel-to-grain; horizontal sheer; compression perpendicular-to-grain and compression parallel-to-grain.

It also has the highest modulus of elasticity (E) values of all North American softwood species. E is the ratio of the amount a piece of timber will deflect in proportion to an applied load. This reflection of stiffness is one of the most important considerations in the design of floors and other horizontal systems. Douglas-fir is often selected for four- and five-storey timber frame buildings.

Because of its physical working properties and dimensional stability, many builders worldwide prefer Douglas -fir for framing timbers. The final plus for us was to use beams reclaimed from the first airplane hangers built in Ottawa, at what was then called Hunt Club airfield in the 1920s.

At 46 cm high, 15 cm thick and 5.5 metres long, the beams each weighed about 2,500 kg, so they were loaded and unloaded with a backhoe.

The external ICF walls filled with concrete made an excellent support for our beams, so we formed beam pockets to receive them by making boxes slightly larger than the ends of the beams and placing them in the empty walls before pouring the concrete.

After the pour, the boxes were removed which left pockets to receive the beams.

One of those pockets was commandeered by a mother robin who built a nest, laid her eggs, and raised a clutch of chicks before she moved on and we removed her nest to put in the beams.

Four of the beams were doubled, which were perfect for the Great Room with the curved northern end that is shown on the left-hand side of the framing diagram. These beams had to support the second story office where our desks in the curved end will look upriver at the rapids. You can get a sense of the massive size of these beams below as Susan stands at the construction bar waiting for her drink.

Of course, the beams had to be planed, slightly sanded, and cut to fit the dimensions of the house. This was work for a crew of two for about a week, then the framing began with the beams lowered into place with a crane. Each one was uniquely fitted to its beam pockets and the panoramic photo below taken from the east shows the beams in place. Before you send in comments, though, note that the actual ceiling is level, not as shown by the wide-angle lens.

Next time I will provide more detail about the beams, corbels, and the decking above the beams that forms the interior ceiling.