A Finn House, Libel, Leusden

5th – 8th June 2006

The Property

Set in the suburbs of Leusden, this beautiful traditionally built wooden "Finn House" is situated in a wooded area. The accommodation comprises 4 bedrooms, spacious living rooms, a sauna and balcony's at the front and rear. It has an internal volume of 750m³ with an additional 250 cubic metres created in the insulated cavity. The construction is of external solid pine walls 14cm thick, off a concrete foundation.

The problem

An infestation of Hylotrupes bajalus (House longhorn beetle), has been active for sometime within the matrix of timbers in numerous areas throughout the property, both internally and externally. The beetle has the ability to eat the heart out of timbers without any visible signs, it is only when the oval shaped external holes (6-8mm) appear, that the infestation is generally noticed.

It is often the case at this stage, that the property has suffered severe structural problems, however in this instance this was not the case. Some stress fractures were evident on the solid pine sections; these however, were in this condition when the client moved in.

Figure 2, looking at a roof truss in the loft, shows a rare example of the larvae tunnel when it breaks through the surface.
These two tracks are nearly 5mm in diameter.

Figure 2

The Solution

All insects die when subjected to extremes of heat. The longhorn beetle & its larvae are no exception; they will die when subjected to temperatures of 54 ºC for a minimum of 2 hours. The heat needs to penetrate deep into the fabric of the building, killing the insects and larvae in all stages of their growth, therefore both the time & temperature related to conditions within the matrix of the host materials; they **do not** refer to air temperature. For this effect to take place, the Dryair system has to raise the air temperature to at least 70c and in many instances much higher.

DRYAIR used a 180-EU heater with six PHE 25-EU heat exchangers to generate enough heat to raise the entire building temperature to 54 ºC and hold it for a minimum of 2 hours to ensure complete eradication of all the long horn beetle.

Accurate monitoring and recording was needed to ensure the temperature had been achieved in the coldest areas and in the centre of the thickest timbers. A remote monitoring system (RMS) was used with seven probes measuring both temperature and RH in the seven coldest, thickest and worst affected areas. The probe locations are marked in the **Page 3 floor plan.**

A large percentage of the long horn beetle had entered the timber from the outside so it was imperative that the outside of the house was heated to the same temperature as the inside. Wood is an excellent insulator; therefore the solution was to heat the internal & external sections of the structure. This was done by wrapping the entire house with an insulating layer to create a void that could be heated; in this instance foil backed bubble wrap was used.

Figure 3. Viewed from the front. The insulating layer was attached to the soffit boards, supported at the balcony and sealed at the floor. An access flap was created by the front door. To gain entry with-out loosing heat.

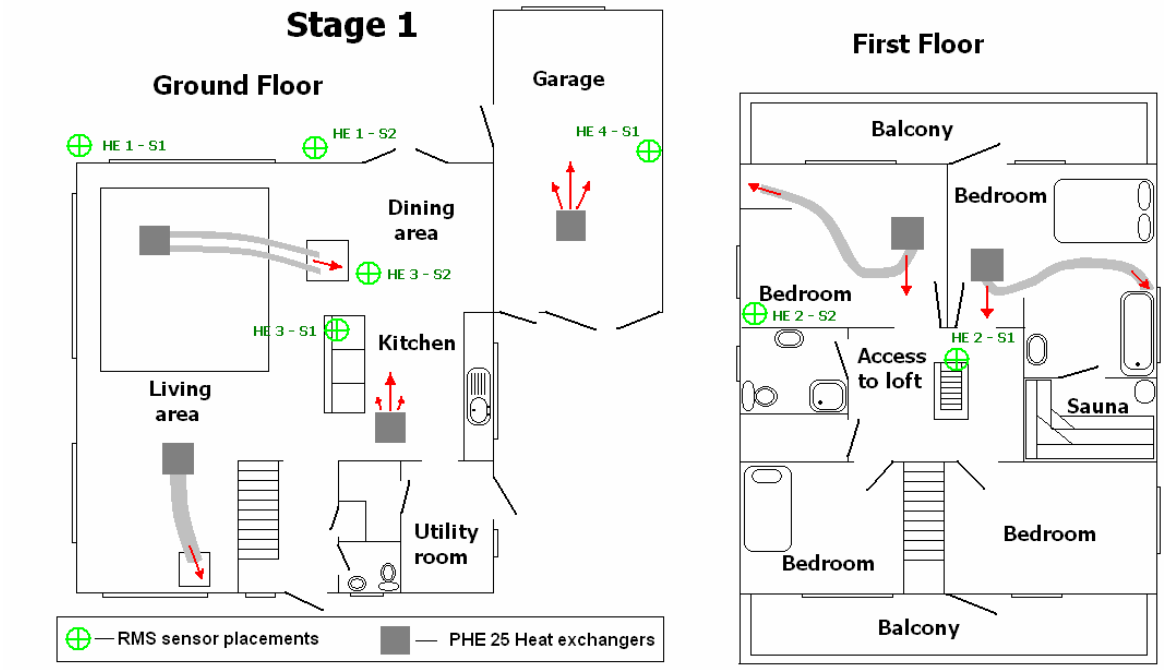
Figure 3

The heat was applied in two stages;-

Stage 1

The Dryair heat exchangers were placed in various locations around the house:-

- One in the garage (approximately 90m³)
- Two on the first floor with some ducting to target the under-eve areas and
- Three on the ground floor with ducting into the sub-floor. (a total area of 750 m³)



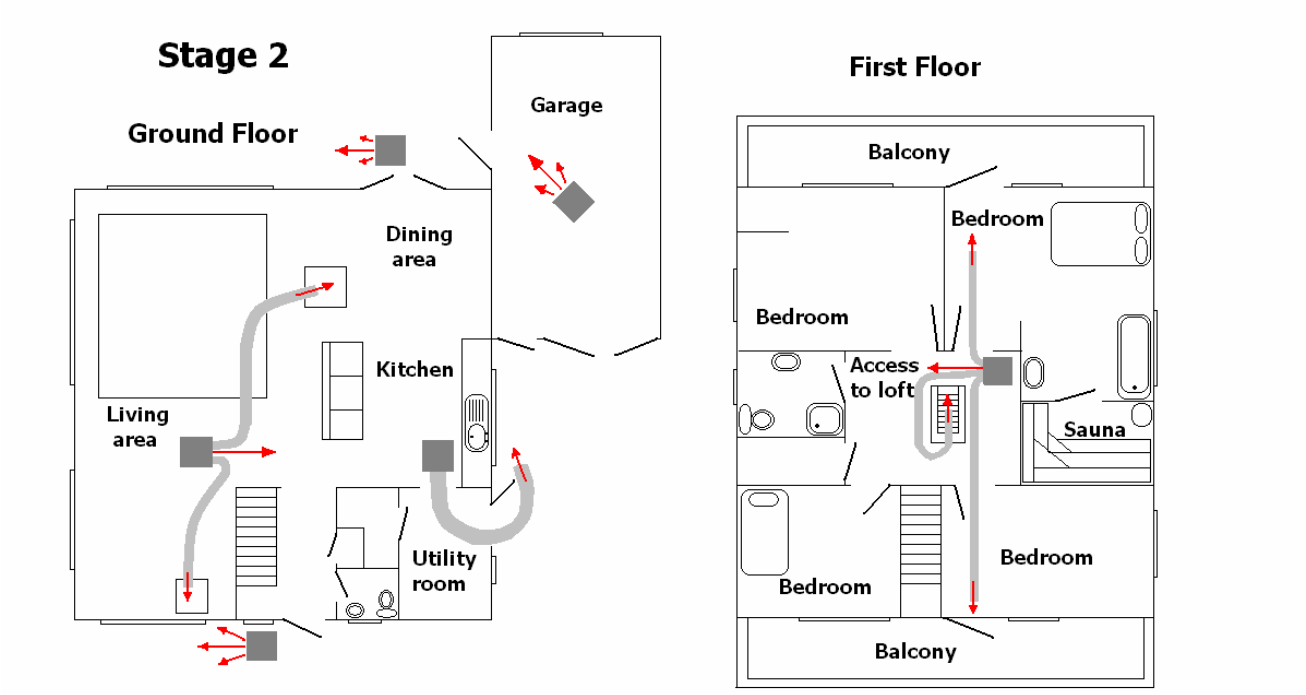
The Dryair system ran for 24 hours in stage 1, by then, a temperature of 64 ºC had been achieved in some of the walls, with an average temperature of 48 ºC in the rest of the house.

Readings were taken from the RMS system which confirmed the on-site examination. The heat had penetrated deep into the fabric of the building from the inside but was not going to go much further until an equal amount of heat could be applied from the outside.

RMS sensor placements

- HE1 - S 1 = Temp / RH sensor in the outer wall
- HE1 - S 2 = Temp / RH sensor in the cross-connection outside
- HE2 - S 1 = Temp / RH in the loft roof beam
- HE2 - S 2 = Temp only sensor in the 1st floor, in a gap between the cavity walls
- HE3 - S 1 = Temp / RH sensor in the cross-connection in the house
- HE3 - S 2 = Temp / RH sensor in the basement
- HE4 - S 1 = Temp / RH sensor in the cross-connection in the garage

Stage 2



Heat needed to be moved into the insulated area around the outside of the house, giving a total area of 1000m³. All the doors and windows were opened to allow free movement of the hot air, and the heat exchangers were moved to different locations.

- The one in the garage was angled to force heat outside.

- The one of the two in the living room was moved outside the back door, the other was re-positioned and ducted to send heat into the under-floor voids and maintain temperature down stairs.

- The one in the kitchen was turned and ducted to push heat out of the kitchen door.

- One of the two from upstairs was positioned outside the front door and the remaining one upstairs was moved and ducted to force air around the 1st floor area and into the loft.

The heat build-up in stage 2 was slower than in stage 1, this was due to the larger volumes of air being heated and the exterior void of the building being much colder than the interior.

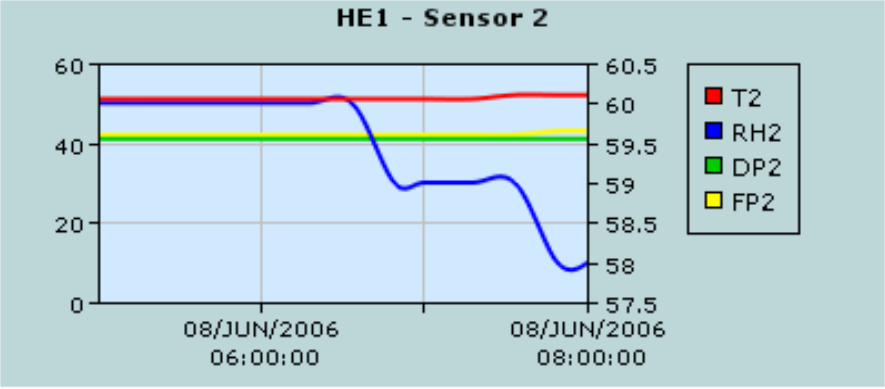
Over the next three days, the RMS system continued to show a steady rise in temperature in all the locations and by the afternoon of the 4th day the readings showed that a temperature of 55 ºC had been reached and maintained for over 2 hours in all monitored areas, meaning effectively that all insects and larvae would now be dead.

The Dryair system was packed up and was off site 2 hours later.

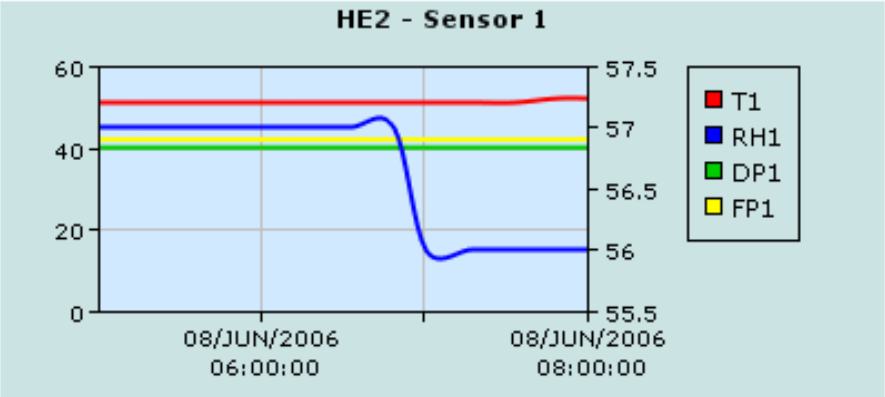
The RMS probe graphs

These graphs show the last four hours of data from some of the probes in the floor plan shown on page 3.

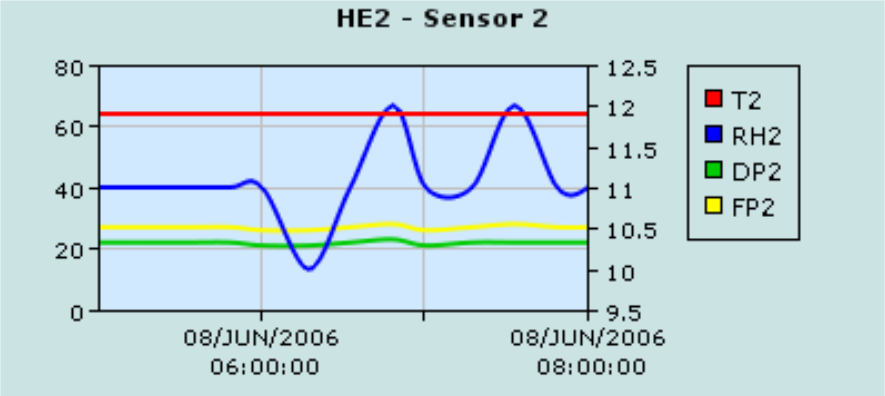
The lines of importance are; - Red showing temperature in ºC. Blue showing RH in % and Green showing dew point.
The scales are;- on the left, Temperature and on the right, RH



HE1 - Sensor 2 = Temperature / RH sensor in the cross-connection outside. Near the back door



HE2 - Sensor 1 = Temperature / RH in the roof beam in the loft



HE2 - Sensor 2 = Temperature only sensor in the gap between the cavity walls on the 1st floor