Building a Heated and Insulated Bat-Box

my own experience.

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I have made a photographic record of my own experience of building a heated and insulated bat-box to the design principles outlined here. I made some mistakes; I have recorded these (marked with ###), as I went along, in the hope that others can avoid making the same mistakes and thus benefit from these experiences.

1. **Side pieces for Roost Box:**

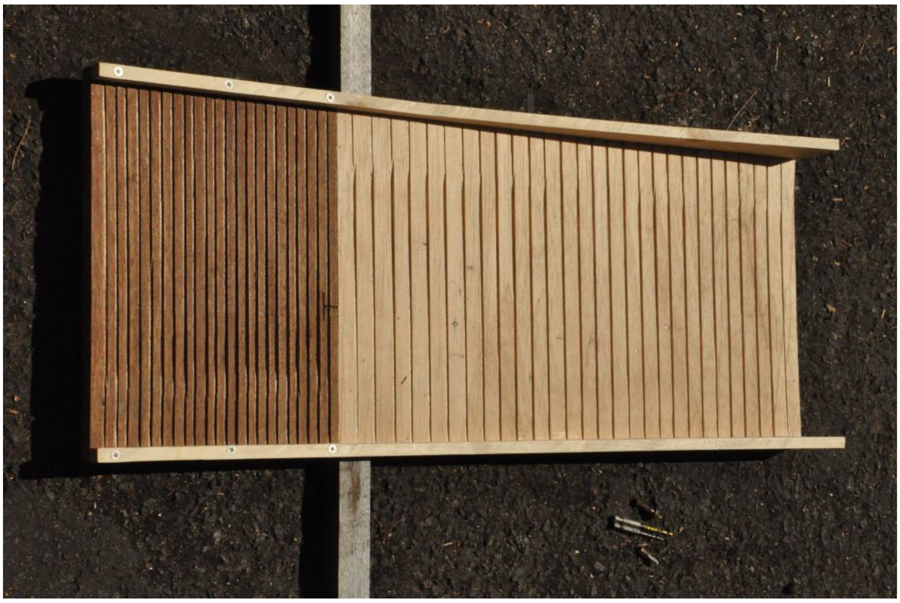
These were cut using an electric sabre saw. The narrow parts on the left define the width of the entrance slot at the bottom of the roost-box.

Note that there is a smooth curve rather than a sharp angle between the slope of the front wall of the roost-box and the vertical entrance.

2. **The Landing Board:**

The board started life as a cheese-board that had a cheese-wire set in a slot. The cheese-wire had broken and repair attempts had failed, so it was cut down to make the landing-board. The grooves were cut using a compound mitre saw with the depth stop set to the required depth. The horizontal travel of the saw-blade was not sufficient to cut the whole groove and so the landing-board had to be turned round and the grooves extended to cover the whole width of the board.

3. **The Ladder Grooves on the back wall of the Roost Box:**



Here the landing board has been attached to the sides of the roost box with stainless steel screws, panel pins and bat-friendly PVA glue. The ladder grooves have been cut into the 6mm ply for the back of the roost box using the depth stop on the compound mitre saw. The horizontal travel of the saw-blade was not sufficient to cut the whole groove and so the panel had to be turned round and the grooves extended. The back of the roost-box has been attached to the sides of the roost-box with stainless steel screws, panel pins and bat-friendly PVA glue.

4. **Hanging Perches:**

Here the front wall of the roost-box has first been coated on the inside with PVA glue diluted 1:1 with water to ensure that bat poo would not damage the wood. It has been attached to the sides and holes have been drilled through both front and back walls for the cocktail-stick perches. Cocktail sticks have been posted through both walls of the roost-box and glued with bat-friendly PVA glue at both ends of each stick.

5. **The finished Roost-Box:**

The top has been attached to the roost-box. The cocktail stick ends have been cut flush with the panels with a chisel and the excess glue removed with an orbital sander.

The parts shown in red in the description are now complete.

6. **Sides of Heater Enclosure:**

The sides of the heater enclosure were cut from whitewood with an electric sabre saw. The dimensions provide a 6mm gap for the heater foil, and an extension of 5 cm above the roof of the roost box for the electrical connections.

In the next photograph, the sides have been attached to the roost-box, but the front and back of the heater enclosure are not yet in place. You can see the 6mm gap that has

been provided for the heater elements, also the 5cm space at the top of the roost box for the electrical wiring. I put a 2cm wide strip of ply-wood across the bottom of the heater space so that it would be totally enclosed.

7. **Completed Heater Enclosure:**

Here you can see the sides of the heater enclosure with front and back attached. The 6mm gap for one of the heater elements is visible as is the 5cm space for wiring above the top of the roost box.

If I had been doing this again, I would have provided more than 5 cm at the top for the wiring as I found that I was tight for space once the tube for the cables was installed and the wiring terminals attached to the sides.

I also made a drop-in lid for the heater enclosure which I forgot to photograph

This completes the parts shown in blue in the description.

8. **Insulation Enclosure:**

The insulation enclosure was made of 10mm marine quality plywood.

This photograph shows the bottom of the insulation enclosure. This was made in two parts so that they could be assembled around the bottom of the entrance slot for the roost space. Dowels and bat-friendly PVA glue were used to join the two parts and to attach them to the base of the roost-box.

9. **Electrical Wiring inside the box:**

It was necessary to complete the electrical wiring inside the heater enclosure at this point, as the clear plastic tube for the wires had to be fed through the insulation material and out through the bottom of the insulation enclosure.

In this photograph you can see one of the heater elements is in position, the other is awaiting the arrival of the connection kit. The clear plastic tube is just visible at the top, and the telephone extension wire to extend the temperature sensors has been terminated and fed through the tube.

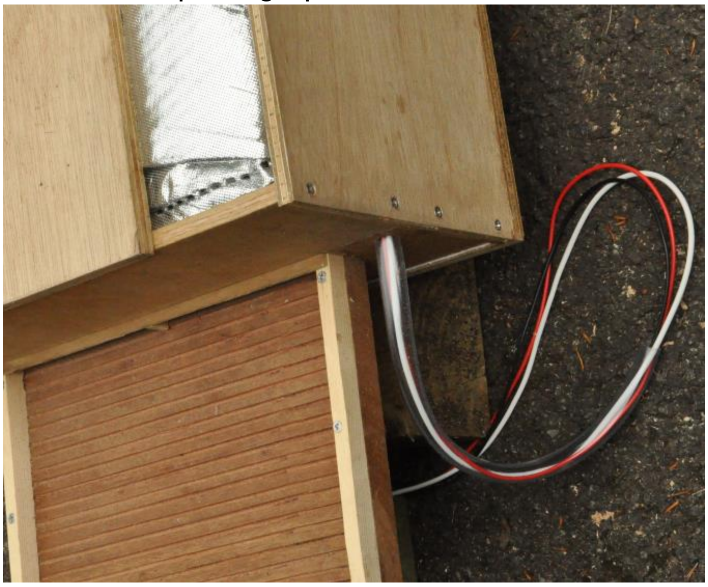
When I purchased the heater panels on line from the Germany-based supplier, I did not know that it would be difficult to make the connections onto the other half of the heater element. I wrongly assumed that the copper power strips would be easily accessible; they are not. I had to go back to the supplier and they were able to provide an additional connection kit, but I had to pay an extra shipping fee (which cost more than the terminal kit) and to wait six days to receive the kit, which delayed completion of the build. Anybody using this proposal should make his needs plain to the supplier when ordering so that a single delivery would suffice.

On the left of this photograph you can see the cable tube has been led down the outside of the inner layer of insulation and out through a hole drilled in the bottom of the insulation enclosure. All of the wires have been fed through this tube, but not yet connected to the heater connectors, visible at the far side of the heater enclosure.

I should have installed the temperature sensors at this point, as they were more difficult to install once the insulation box was completed.

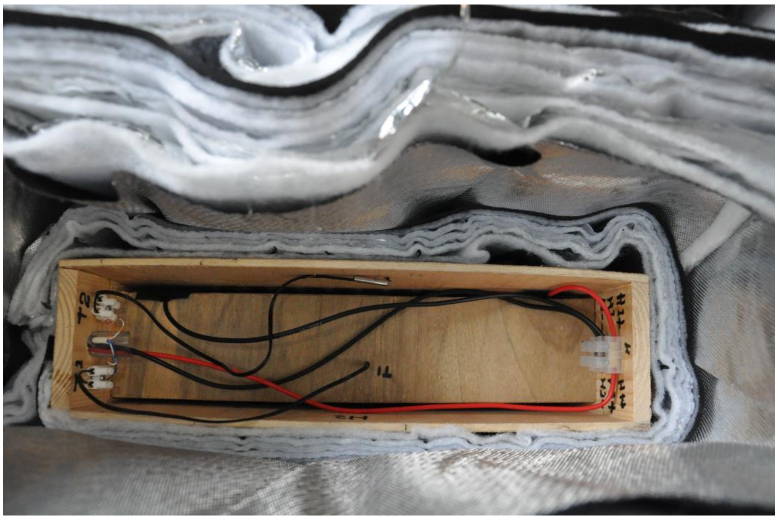
The photograph on the right shows the clear plastic tube emerging from the bottom of the insulation enclosure. The sides and back have been screwed and glued into place but the front has still to be attached.

The next photograph shows the electrical connections in the top of the heater enclosure. The two temperature sensors are installed and connected, but, at this point, I am still waiting for the heater connection kit for the second heater element.



Note that the insulation material is loose and not compressed. The outer layer of insulation extends to the top of the box, but the inner layer goes only to the top of the heater enclosure.

I have marked each of the electrical connectors with their function so that any future person working on this system (including me, as I can easily forget what I have previously done) can more easily understand what is going on.



The temperature sensors are thermistors with one wire marked with tiny white printing, (so small that I cannot read it even with a magnifying glass), the other wire is plain. Polarity must be observed and maintained for the thermistors, so I have connected them to the telephone wire so that the wire with white writing goes to the telephone wire with white stripes, and the unmarked wire goes to the telephone wire with dark stripes.

Finally the insulation enclosure was clad in western red cedar cladding which is weatherproof.

10. Support Brackets

I cut two pieces of scrap angle steel to support the bat-box against the gable-end wall of the house. You can see them in the photographs below. I cut them to protrude 11 cm from the edge of the finished bat-box. This was because I had some blocks of wood of this size that I could use to support the box whilst working on them once the brackets were attached.

The photograph on the left shows the detail of a rebate that I cut in the cladding to ensure that the steel supported the base directly under the marine ply back wall of the insulation enclosure. Here the bat-box is on its side with the landing board to the left of the picture and the rear surface on top.

The photograph on the right shows the detail at the top bracket, where I cut a rebate in the marine plywood roof rather than cutting into the cladding and the marine plywood back. This was far more complicated and time consuming to do, but by the time that I realised my mistake, it was too late to go back and change.

I attached some lead flashing to the top bracket at this point, bent over to shed rainwater over the upstand of the lead on the roof.

11. The Roof:

The under-side of the roof and the upper edges of the insulation enclosure and cedar cladding were provided with some self-adhesive rubbery foam draught-excluder to seal the insulation enclosure, as any external air transfer could seriously compromise the insulation efficiency.

The roof was provided with a piece of whitewood that dropped into the recess of the marine plywood insulation enclosure. This avoided the complication of a hinge.

I had some lead flashing left over from a roofing job a few years ago. I cut pieces off the roll and folded joints along the down-slope. The back had an upstand to go under the bent over lead attached to the upper bracket. The weight of the lead would ensure that the roof would not blow off even in the most severe weather. The edges of the lead were bent over to form a skirt to prevent rain going behind the cedar cladding. Enough space was left between the lead and the cladding that someone replacing the lid can feel for proper alignment of the lid and box.

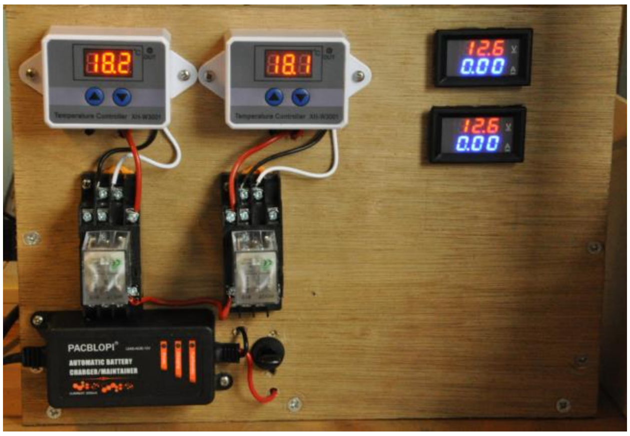
I should have realised sooner, but at this point I discovered that the whole box was extremely heavy, even without the lid. I could hardly lift it. I had to use a sack barrow to take it from where I had been building it to the gable end of the house, and I had to set up a pulley system to lift it into place. The pulley system I used halved the effort I needed to exert, but even so, gripping a 6mm polypropylene rope with enough force to support the weight was a struggle. With hindsight, I should have used a winch to lift it into place.

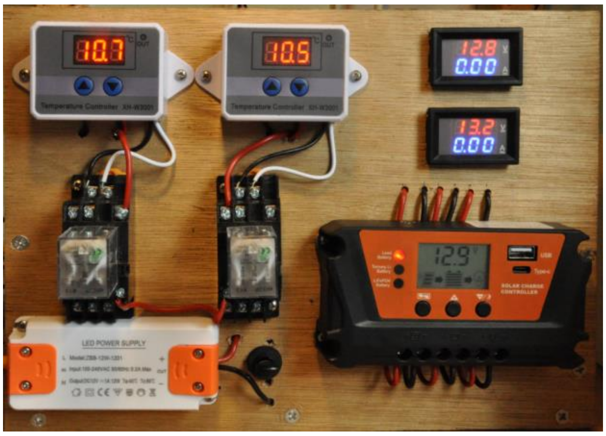
12. Electrical Control Panel:

I constructed a free-standing panel 30cm wide and 23cm high with some scraps of 10mm marine plywood left over from construction of the insulation box. There was a platform at the back wide enough to hold the battery, and supports to maintain a right angle between the vertical and horizontal parts.

I used temperature switches that were wired with the relay contact internally connected to the +ve supply line; it would have been better if there were volt-free contacts available. As a consequence, I had to install two additional relays so as to have the two contacts in series. There was no easy means of knowing, from the Internet description, that the two outputs could not be series connected. The two relays each take about 30mA when energised which means an additional unnecessary load on the battery. The relays I purchased have a green LED that lights up when the relay is energised, providing an additional indication of what is happening in the circuit, so I mounted these below the corresponding temperature switches.

In the photograph, T1 is on the left, indicating the roost-box internal temperature, and T2 is on the right, showing the temperature at the top of the heater enclosure. This summer, (August 2025), for a few weeks the temperature settings were initially 12°C for the roost box and 16°C for the heater enclosure. This was so that I could check the correct operation of the heater control circuit. These were changed to 2.0°C and 2.5°C once these checks had been satisfactorily completed.





At the bottom on the left of the left-hand image is a mains powered battery charger and maintainer.

I had intended to power this only when the solar panel was not supplying sufficient power to keep the battery sufficiently charged, and to unplug it from the mains when not required. However, I found that when it is unplugged, but still connected into the 12v circuit, it lights up the LEDs on the front, and draws about 60mA.

I also found that the use of a battery charge controller was required, and that alternative power sources going into this needed to be isolated from one another by diodes to prevent a reverse current going through the alternative sources. The mains charger and maintainer was replaced by a 12v DC regulated power supply. The diodes can be seen on the back-wiring photograph below, using two additional terminals added to the bottom of the block on the left. The effect of the diodes is that the supply that has the higher voltage will be the one that the charge controller selects.

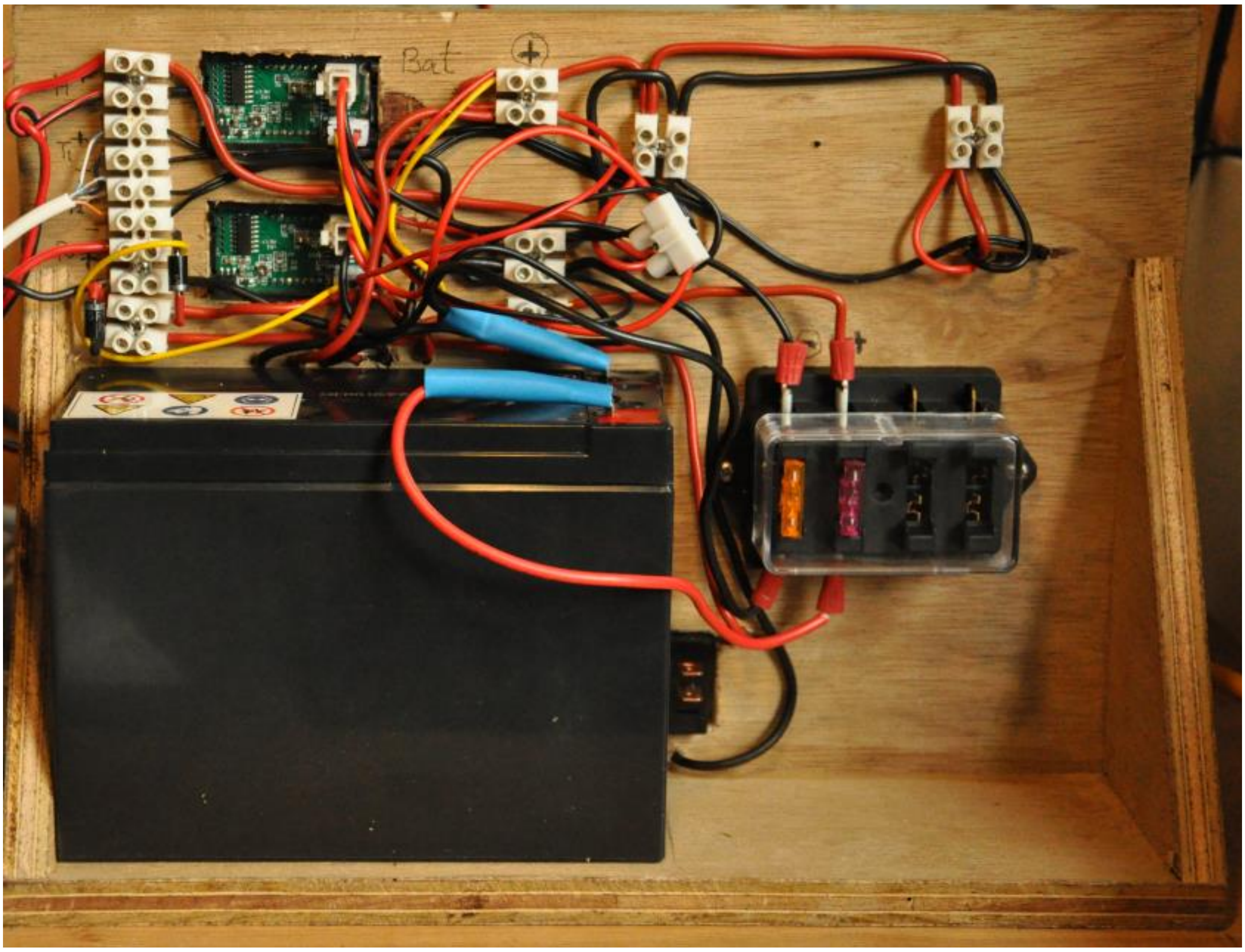
On the right of the images above I have mounted a pair of combined volt and amp meters. The upper one monitors the power delivered from the battery, and the lower one monitors the power it is receiving.

Unfortunately, they do not display negative current. I had wanted to use one to monitor the power from the solar panel. Again, this was an Internet purchase, and this limitation was not clear from the product description.

The next photograph shows the wiring at the back of the panel. The top 8-ways of the connector block on the left take all of the wires from the grey connector box mounted just below the bat box. These pass through a hole in the house wall, then down through the ceiling of the room below and through a miniature trunking to the control panel. The top pair has the connections to the heater in the bat-box. The next four are the T1 and T2 sensor connections, (via a 4-way telephone extension cable), and the terminals 7 and 8 carry the power from the solar panel. Terminals 9 and 10 carry the power from the 12v DC mains power supply. The isolating diodes mentioned above are visible at the bottom of the 10-way terminal block, (close to the yellow wire). One diode is connected from terminals 7 to 9 to isolate the power from the solar panel, the other is connected from terminal 10 to 9 to isolate the power from the mains power supply.

The battery is guaranteed to be leak-proof and is one designed for powering a mobility scooter. I am intending to build a plastic box to contain it for reasons of safety, but have not done this yet. I have some Perspex and some solvent adhesive and will cut it for an exact fit.

To the right of the battery is a fuse-box. Both fuses are in the battery circuit, one on the +ve side and the other on the –ve side, to protect against every possible short-circuit fault. The switch in the charger circuit is close beside the battery on the right.



13. Installation:

The bat-box was mounted on the gable end of the house facing a little east of due south.

Above the bat-box is a 12v 25W solar panel (right-hand image below), which should provide enough power, (except during prolonged heavily overcast conditions in winter), to provide all of the power needed for the whole system. An assessment of this will be done through the first year, and, if necessary, a bigger solar panel or additional renewable power sources will be installed.

I initially installed a smaller 5W solar panel, (left image), but I found that even during the summer, this was not sufficient to keep the battery charged as I had not known how much power the temperature switches, relays and combined amp and volt meters and charge controller would consume between them.

Below the bat-box you can see the small grey weatherproof connection box that connects all of the external wiring into the control panel. The red/black cable from the solar panel is also connected into this grey box.

There is a 20mm hole in the back of this grey box, fitted with a rubber grommet through which all of the wires, including the wires from the solar panel, pass into a hole drilled through the house wall. This grommet provides a weatherproof and insect-proof seal for the hole in the wall.

14. Observations:

I have often noticed, early in the morning, that the roost-box temperature is often 1-2°C warmer than the heater enclosure. I believe that this indicates that bats have recently come home to roost after an energetic night hunting insect prey and that this temperature rise is caused by excess body heat as they digest their food and go to sleep. I believe that their body temperature drops as they sleep, and that hibernation is not an on-off state but that they have a metabolism that allows a wide range of body temperatures whilst sleeping. Their sleep temperature responds to their ambient conditions to minimise any wastage of the energy that they have stored as body-fat. To fly, however, they need to be fully up to temperature, (about 39°C probably).

15. Future intentions:

I intend to install a trail camera to record bats entering and leaving the bat box, and will post some video on the web-site once I have some.