Underfloor Heating

There are two main forms of active background heating (piped water and direct electric) that can be built into the building structure (walls and floors). This short over-view of the issues will concentrate on heating systems within a poured concrete floor.

In general, only "low-grade" (i.e. 20 to 30 degrees C) heat is used in background heating systems included in building structures. Such heating systems can be a very efficient way to heat a building if properly designed. Design factors need to include what energy sources are to be used how their energy can be made available as heat and, especially for ground or basement-floors, the effectiveness of sub-floor thermal insulation (the efficiency of which is vital).

The source of the heat is ideally a combination of solar and geo-thermal with a top-up from an efficient gas heating system, with water in embedded plastic pipes distributing the heat through the floors (and, sometimes, walls). The overall energy efficiency of such a system over, say, a 15-year period, can be very high maybe reaching over 75% including constructional and transport energy (over 90% on a day-to-day basis). Electricity *can* be used as the "top-up" source, but this will significantly lower the overall energy efficiency. The more electricity that is needed, the lower the overall energy efficiency - dropping to about 30% if only electrical power is used.

The advantage of a piped water system is that the water-heater power source can be changed at any time without major constructional changes to the building. The disadvantage is that it needs plumbing and it is a more expensive capital cost than merely embedding wires into the concrete.

Electricity is a very inefficient form of energy to use for space heating. In most countries, including the UK, conventional electricity generated by fossil fuels and nuclear power is less than 40% efficient - i.e. 60% of the original energy is lost as waste low-grade heat to the atmosphere, without allowing for the energy used in the construction of the power stations, etc. Added to this is an extra loss of about 7% due to power losses in the electricity distribution system. So, only about 33% of the original energy ends up available in the final-user building. This obviously does not apply to Hydro-electric or Wind-electric generation which are much more efficient but only make up a small percentage of most countries' electricity generation capacity. All nuclear plants have shown an overall energy-balance loss by the time they are fully decommissioned.

In some situations direct electrical under-floor heating is still being chosen, this is especially the case where only small areas need to be heated. Where this is the case, the electromagnetic fields they generate need to be considered. The UK Government current has set up a formal senior stakeholder consultation process, under the Department of Health, looking at future advice of public exposure to power-frequency electric and magnetic fields (EMFs). Powerwatch is a member of this group and we believe that it is most likely to advise that building wiring should be designed to minimise public exposure to EMFs. There are likely to be changes to the UK Wiring Regulations. ***In view of this we strongly recommend that all new installations are designed to minimise public exposure to power-frequency EMFs.***

There are two main types of electric heating cable suitable for burying in a concrete floor - single core and twin-core. There are also screened and unscreened versions available. The illustrations below are based on ELECTRA product literature, though there are a number of other manufacturers that also make suitable cables.

Screened cable includes an earthed metal braid inside the outer covering of plastic. This earthed braid 'catches' the electric field given off from the cable, which is important for EMF reduction.

The single core cable needs connecting to the electricity supply at both ends - see Figure A, below. This causes a current-loops and generates high magnetic fields (EMFs), often well above the 0.4 microtesla associated with the development of childhood leukaemia. **It should not be used in residential** or other buildings where members of the public will spend much time.

The twin-core cable has the outward (phase) conductor and the return (neutral) conductor inside the same piece of cable - see Figure B. This causes the magnetic fields to cancel out fairly well and is suitable for use in residential building from an EMF point of view.

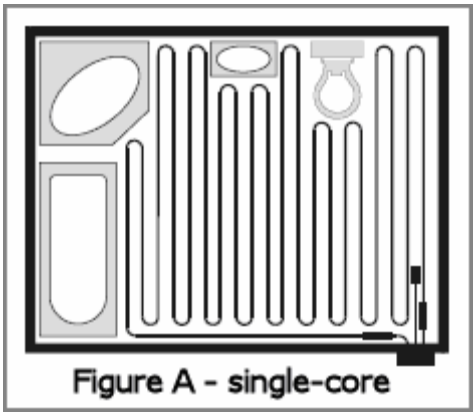

Figure A - single-core

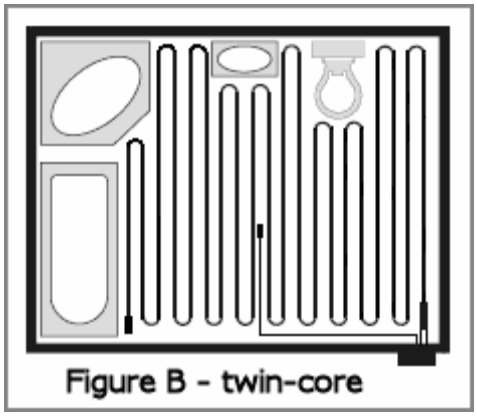

Figure B - twin-core

So, to summarise our view of under-floor heating:

1. Piped water systems are an excellent modern energy efficient under-floor technique.
2. Primary heat sources should be solar and geo-thermal.
3. Additional "top-up" heat from gas or multi-fuel boiler using recyclables.
4. Only use electricity to "top-up" heat when there is no viable alternative.
5. For small internal areas, direct electrical heating can be appropriate.
6. Only twin-wire (single-end power connection) cables should be used.
7. The heating cable must have an internal, earthed, electrical screen.