

Case Study - Heating a Medieval Church

St Teilo's Church at the Museum of Welsh Life at St Fagans Museum near Cardiff

History

St Teilo's, 'yr hen eglwys ar yr morfa'; 'the old church on the marsh', was originally sited at Llandeilo Tal-y-bont on the flood plain of the Llwchwr close to Pontarddulais. Flooding on spring tides eventually made the church essentially unuseable and it was abandoned for a newer (early C18th!) church in the town. The Museums and Galleries of Wales acquired this lovely church in a semi-derelict state in 1985 and have painstakingly rebuilt it over the last 5 years using traditional materials and skills at the Museum of Welsh Life at St Fagans. During dismantling of the church whilst the interior lime-wash was being removed, some original wall paintings dating back to the C15th or earlier were found; since most churches were decorated in this way prior to the Reformation, the Museum has decided to complete the church as it might have been in 1520, some 20 years prior to the Reformation. The church will have a medieval style earth bank surrounding the graveyard.



EAST ELEVATION



WEST ELEVATION

The Heating Project

Because the church is intended as an authentic record of how St Teilo's Church might have been in 1520 it was inappropriate to have radiators or heating equipment visible in the church or to have boiler flues nearby. Furthermore, the ethos of museums is to preserve artifacts for future generations and that includes the environment, so an environmentally-friendly solution was sought to have minimum impact on the church building and minimum impact on the environment. Thus underfloor heating was chosen inside the church and a geothermal heat pump for the heat source; this technology takes solar energy collected by the ground into the church using a heat pump (pretty similar to the pump in your refrigerator which takes heat out of the fridge to cool it down and dumps the heat via a small radiator at the back of the fridge into your kitchen). The advantage is that for every 4 kilowatts of heat you pump into the building, you only pay for one! Hence the saving on energy use and carbon load to the atmosphere. This technology is available for use on domestic houses too, particularly for new build and renovation and is now a more appropriate technology (and ultimately a cheaper option) than boilers. It has been used in Europe for many years now (see main website for more information).



The Technology

Green Dragon submitted a tender which used shallow heat collection rather than boreholes in a way to make their layout compatible with the Museum's objectives and for the underfloor too. Boreholes are effective, but expensive solutions. We proposed an electronic system to allow detailed monitoring of the heat pump in action. The data will soon be available to visitors to the church to see a renewable energy source in action.



The heat loss from the church was estimated to be 28kW to maintain a minimum 15C inside with -2C outside due to the natural materials and build technique having very poor insulation properties compared to modern domestic requirements.

We chose a 28kW twin scroll compressor heat pump manufactured by Kensa Engineering in Cornwall which was installed with six 50m 'slinky' trenches to collect heat from the ground (underground collection coils are shown in the bottom of a 2m trench). The underfloor has over 1km of heating pipe laid as 14 separate zones to maximise flow rates (pipes can just be seen below the nearly completed flagstones). Temperature is controlled by a main space remote thermostat and pump cycling by a programmer. Both weather compensation and night set-back are available and to protect the green oak roof trusses, a humidity sensor can override the thermostat if humidity falls below about 60% RH.



The heat pump is located in a separate enclosure which will be built into the bank; the enclosure will be finished in stone and limestone slate to look like a building of the period. All services and hot water pipes are carried in an insulated channel underground and through the church walls below ground level. The church is due to open in 2007 - go and see for yourself!