BUILDING REGULATION OFFICE

Improving your home to save energy and Better Comfort

Roof Insulation

In a Southern Mediterranean climate like that in Malta, insulating the roof is beneficial throughout the year. This measure keeps heat from passing through the roof and enables the home to remain cooler in summer and warmer in winter. This measure is particularly cost-effective if it is installed during construction.

The insulation is ideally placed between the concrete slab and the roof screed (*kontrabejt*). Roof insulation may consist of expanded polystyrene sheets, extruded polystyrene sheets, wood boards, polyurethane boards or foam sprayed on the roof and so on. Placing insulation below the concrete is also possible but this may sometimes create condensation problems.

The roof of new buildings has to be insulated according to building Regulations (Technical Document F Part 1).

For dwellings which use energy for heating in winter and cooling to create a comfortable environment in summer, insulating the roof during construction is the most cost-effective measure locally. In this case the payback period has been found to be between 5-10 years, depending on the case. If the roof screed (*kontrabejt*) is being replaced, and insulation is installed at this stage the payback period is similar. If roof screed (*kontrabejt*) is replaced in order to insertinsulation, the payback period is longer.

Figure 1 Expanded polystyrene Foam sheet

Lighting

Lighting is one of the major consumers in local buildings. The use of energy efficient lighting is often the most cost-effective measure in a building. Energy efficient lighting may be in the form of fluorescent tubes (sometimes incorrectly referred to as neon tubes), compact fluorescent tubes, LED lights, metal halide and mercury vapour. Halogen lamps are also more efficient than the conventional Incandescent lamps (bulbs), however these are much less efficient than the other types of efficient lighting listed above. The lifetime of energy efficient lamps listed above is much longer than the lifetime of conventional incandescent lamps or halogen lamps. The payback period of replacing existing lighting with energy efficient lighting is typically less than two years and in most cases it is less than 1 year.

Windows and Glass Doors

In Malta's climate, the position of windows and doors is important because they let sun rays enter the building and heat up the space. In winter the sun's rays help by heating up the space. West and East facing windows face the sun for a long interval when this is rising and setting in summer and therefore if left un-shaded the home will overheat. This may be solved by shading in the form of external shutters, vertical fins, screening (*hasira*) or louvers (refer figure 2). Internal blinds or curtains and double glazing will have little effect in this regard as the sun's rays still entered the rooms, and are then blocked inside.

Figure 2 External shading helps the spaces remain cooler by keeping sun's rays from entering inside.For windows and doors facing south the best solution is having horizontal shading over the windows (Refer figure 3). This may be part of the structure (ex. concrete) or made of lightweight materials

such as wood and aluminium. These shades have the ability to block the sun's rays in summer when the sun is high, while letting the sun enter the building when the sun is low in winter, thus heating internal spaces when needed.

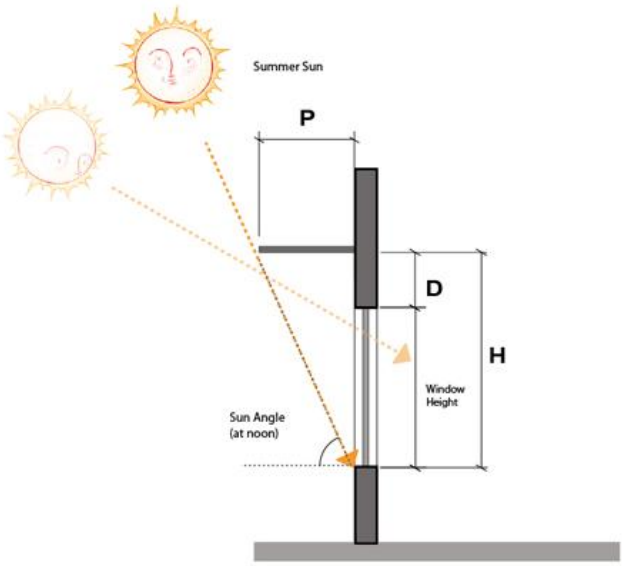

Figure 3 Horizontal shading is ideal for south facing windows

Windows and doors also permit the heat inside to escape the building during winter. The amount of energy lost may be reduced by having double glazed windows, which is nowadays a requirement for new buildings or for major renovations. Wooden or U-PVC windows and doors loose less heat in winter and therefore are able to keep the building warmer. For dwellings which are heated and cooled to a comfortable environment, double glazing was found to have payback periods in the range 6-11years depending on the particular case. Having triple glazing was not found to be a cost-effective measure.

The use of reflective and low-e films or tints on such windows contributes to a better performance by reducing the actual solar radiation gains inside the building, thus reducing the cooling load.

Wall Insulation

Wall insulation should be installed on the external walls. The insulation in walls will decrease the passage of heat across the walls enabling the internal building temperature to be kept comfortable with less energy. Wall insulation can be of various forms like boards or sprayed foam. It can be installed either internally, externally or within the cavity, however for the latter case it is best to be carried out during the construction stage, as it would be much more difficult to carry out at a later stage.

Installing wall insulation on the internal side will result in obtaining the required internal temperature quicker than if installed externally. Positioning insulation internally may cause water condensation.

Placing insulation externally keeps the internal temperature more stable after heating/cooling is turned off. The effectiveness of wall insulation depends also on the building type, as various building types have different external wall ratios when compared to the roof. The larger the external wall area of the building compared to the roof area, the higher the rate of heat loss that will occur through the walls. Installing wall insulation is less cost-effective than roof insulation and hence should not be considered prior to installing roof insulation.

External Shading Devices

External shading devices are installed in conjunction with glazing apertures in order to control sun radiation. Various types of external shading devices exist, among which are horizontal or vertical louvers, canopies, shutters, overhangs, vertical fins, awnings, trellises, light shelves, natural landscape features (eg: trees). On South facing facades it is best to use horizontal types of shading devices, while on East and West facades it is best to use vertical types of shading devices. North facing facades are the least exposed to direct solar radiation, and hence these shading devices are least effective on this orientation. The whole concept behind these shading devices is to keep the direct solar radiation out of the building, thus decreasing the cooling load during summer. Certain devices (generally the fixed type, like fixed louvers) may increase heating load during winter, unless they are specifically designed not to do so. Overhangs are designed in such a manner as to block direct sun rays during summer while letting the same rays into the building in winter. Adjustable louvers can be adjusted according to the season. Trellises are structures which permits deciduous vegetation (ex: vines) to grow on it, hence blocking direct sunlight during the summer period, while allowing sunlight to get in during the winter period, when heating is required. Light shelves are similar to horizontal overhangs which reflect sunlight into the building, and hence provide for a deeper penetration of lighting within the building. Natural landscape features like trees provide shading, while improving the quality of the building through landscaping. Such natural landscape features however provide for poor control and are mostly best suited to provide shade for East and West facing window orientations as these are the most difficult orientations to provide for shading control.

Furthermore to the above, automated systems exist in order to provide for better control and more efficient use of the shading device, thus obtaining the best performance of the system.

Photovoltaic (PV) Panels

PV's use solar radiation to generate electricity and can be either connected to the grid or act as standalone systems when coupled with appropriate battery storage. The Maltese climate with its substantial amount of sunny days per year makes the use of PV's very attractive. Various types of PV panels exist, among which are monocrystalline, polyscrystalline and thin film PV's. These may vary in colour and in the amount of area they need, to produce the same amount of electrical power (Watts). The optimal position for Malta is South facing tilted at an angle of 30 degrees (Refer figure 4).

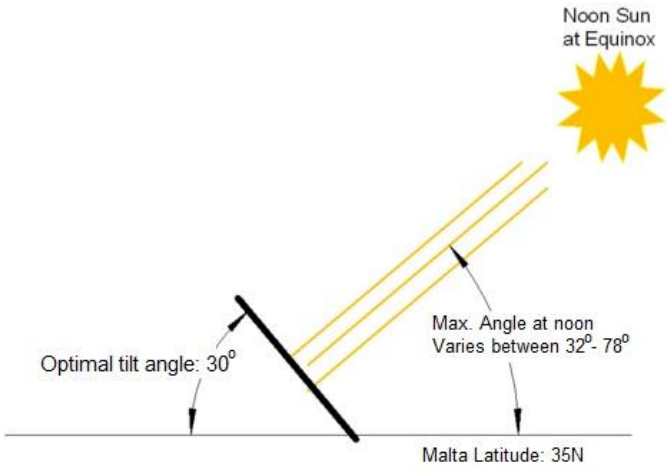

Figure 4 Optimal tilt angle for Malta

They can also be made to track the sun in order to increase the efficiency of the system. With systems tracking both the sun's angle and orientation, the panels may be made to produce 30-40% more energy. Shading reduces the efficiency of the device considerably. If there is the possibility of shading, specific advice from the EPC assessor or other professional is highly recommended.

Figure 5 Photovoltaic Solar panels integrated within the building

In some cases, these systems have also been designed to function also as shading devices for windows, or surface mounted on facades, even though the latter are the least efficient given that the angle of installation is very high. These systems can be integrated within the building design or mounted on a structure to be inclined to an appropriate angle. PVs on a roof or walls have the further benefit of shading the roof/wall from the sun.

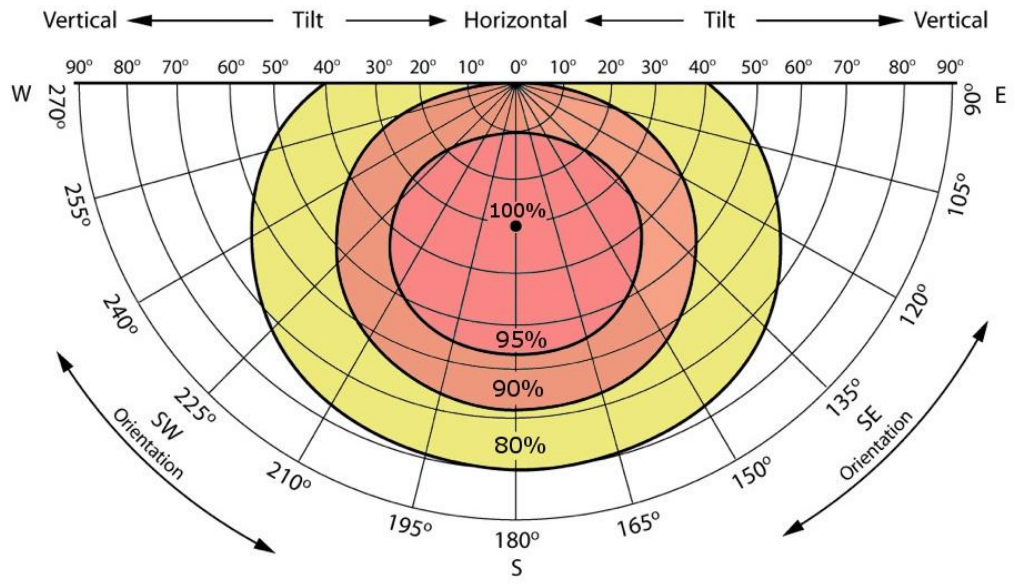

Figure 6: Solar Generating Potential according to PV tilt and Orientation for Malta

Solar Water Heaters (SWH)

Solar Water Heaters use solar radiation to heat water during the day and storing it for use during the night. There are two types of solar water heaters: flat plate collectors and evacuated tube type. Evacuated tube collectors are more efficient but flat-plate collectors have been shown to be satisfactory in the Maltese climate and do not overheat excessively. They are generally installed at an inclination of 45 degrees and facing South for the best output, however as long as they are facing South the tilt may be increased slightly up to 60 degrees to improve efficiency in winter when hot water is needed most.

Insulating the hot water pipes leading to the taps improves the efficiency and is not costly. As for PVs, they can be installed at any floor level where solar radiation is present. Shading results in decreased efficiency but this is not as detrimental as for shading on PV systems. As long as water storage is placed at a level above the solar panel a pump is not required, even if the tank is not placed directly over the panel. A solar water heater has a high efficiency per unit area when compared to PVs. They have been shown to have a payback period of 5-7 years depending on use pattern. Grant schemes are issued periodically for the installation of solar water heaters by the Malta Resources Authority.

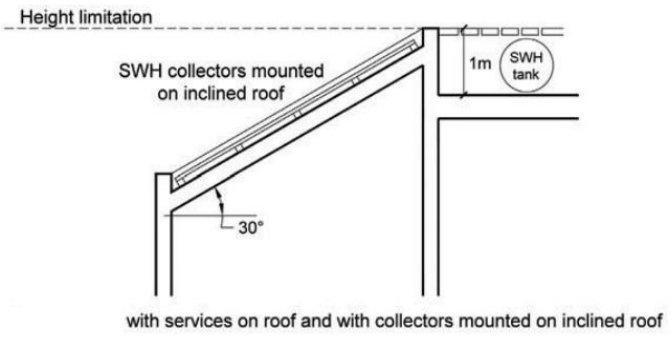

Figure 7 Example Integrated Solar water heated as illustrated in MEPA guidelines

Micro Wind Turbines (MWT)

These are small wind turbine units generally installed on roofs and come in various designs and dimensions. They are most appropriate to be used in areas where a good and constant wind flow is present and in general are not cost-effective in urban areas and low-lying terrain. Obstructions disrupt the wind flow considerably. In rural areas where it is possible to install a turbine at some height above the ground they may be cost-effective.

Fireplaces

There are various fireplace designs to adapt to any architectural style of a building and use various fuels such as firewood, wood chip, wood pellets, LPG, ethanol and bio-ethanol. Some of the heat escapes through the chimney or flue, although this could be minimized by having the chimney pass through rooms which also require heating and possibly attaching metal fins to the exterior of the flue such that heat radiates to these other rooms.

Wood, wood pellets or wood chip from cultivated forests where this is being replaced is a form of renewable energy source. It has been shown that this form of heating is less expensive than heating with LPG or direct electrical heating in Malta, and this together with the possibility of giving better comfort, architectural design possibilities and being less impacting on the environment.

Reflective Surfaces

Reflective paints or coats can be applied on roofs, walls and other elements to increase the ability of a surface to reflect the sun's rays, which would eventually have been partially emitted inside the building. This hence reduces the energy needed for cooling. Coatings are generally white or silver in colour, however other colours may be found on the market. The effectiveness of this measure on the global energy consumption is dependent on various aspects, including the shape of the building.

Notwithstanding, this can also result in an increase in the heating requirement. These have been shown to be particularly cost-effective in Malta.

Heat Pumps

Heat pumps are devices such as air-conditioners and refrigerators which use energy to produce cool air by 'separating' it from hot air. These devices are generally more efficient than using the energy directly for heating by a factor of 2.5 to 5. This means that they use 60%-80% less energy for heating. Air-conditioners may be fixed speed or be fitted with an inverter. The latter enables the motor to work at a slower speed and in general is much more efficient. The best efficiency is achieved if the temperature is set at a comfortable temperature (ex. 25^{O}C in Summer, and 20^{O}C in Winter) thus allowing the system to work at partial load.

Heat pumps are also used to heat water for use in the kitchen and bathrooms. These are similar to the electric hot water systems with tanks commonly used in local homes. Heat Pump systems are much more efficient than these systems and may reduce energy use for hot water by 60-80%. The installation of such a system is an ideal solution to save energy for hot water, where installing a solar water heater is not possible. The payback period for such a system is in the region of 7-10 years depending on use patterns.