2.3.9 Building services systems 2

Standard Assessment Procedure (SAP)

SAP (Standard Assessment Procedure) calculations are used to standardise the assessment of the energy performance of dwellings so that like for like comparisons can be made nationwide. They are based on:

- the energy cost rating adjusted for floor area on a scale of 1 to 100 (lower ratings = higher running costs)
- CO_2 emissions adjusted for floor area (the Environmental Impact rating or EI rating) and the Building Emission Rate (BER) expressed in kg/m²/year
- the Target Fabric Energy Efficiency (TFEE) – the minimum energy performance requirement (kilowatt-hours per m² per year). This is a measure of the efficiency of the building fabric, based on U-values, air tightness and thermal bridging – the parts of the building that lose heat.

SAP assessments are a requirement for all new-build, domestic properties in England and Wales under Part L of the Building Regulations. A home must achieve a SAP 'Pass' before it can be legally offered for rent or sale.

SAP calculations consider a wide range of factors, including:

- construction materials and thermal insulation of the building fabric **(**U-values)**
- air leakage, ventilation equipment and solar gains
- efficiency and control of heating systems
- type of fuel for space and water heating, ventilation, and lighting, and use of renewable energy technologies.

U-values are used to measure how well a material can resist heat flow. The lower the U-value, the more effective the material is at preventing heat transfer. The U-value is the inverse of a material's thermal resistance, or R-value. The total U-value of a composite construction, such as a cavity wall, can be accurately determined from the thickness and area of each component.

Thermal characteristics

The thermal characteristics of buildings can be controlled to moderate external environmental conditions and maintain internal conditions using a combination of thermal mass, thermal insulation, as well as active, passive, and hybrid building services systems.

Thermal mass is the ability of a building's structure to absorb and store heat. It can reduce the energy required for cooling and heating:

- Solid masonry structures and concrete provide good thermal mass.
- Steel frame structures are not good at storing heat because of the high conductivity of steel.
- Timber frame structures are lightweight and provide low thermal mass.

Active building services include boilers and chillers, mechanical ventilation systems and electric lighting.

Passive building services make use of natural sources of heating, cooling, and ventilation, including, solar radiation, cool night air and air pressure differences. Passive design is based on the principles of achieving and maintaining acceptable internal environmental conditions whilst minimising energy use. It will involve design considerations on orientation and may take advantage of solar gains using measures such as thermal mass of solid materials (used to store heat), glazing specifications that limit heat loss and use of controllable external shades. Limiting heat loss will need to be balanced against the control of ventilation. This will be based on natural ventilation where possible and may involve measures that prevent conditioned air from leaving the building, or for capturing heat from air.

Drivers for the use of passive design in Wales include an increasing awareness of environmental responsibilities among the population, and government initiatives to improve housing/well-being in Wales.

Barriers for the use of passive design in Wales include the unsuitability of current housing type in terms of age, and size, such as terraced and prefabricated structures.

Social and economic factors within some areas of Wales may affect its suitability for widespread use as low-income households/social housing occupants are unlikely to be able to afford passive design features.

An indifferent attitude amongst owner/occupiers towards passive design is also a barrier.

Hybrid services systems use active systems to assist passive measures, including heat recovery ventilation, solar thermal systems, and ground source heat pumps.

Building Information Modelling (BIM)

BIM integrates structured multi-disciplinary data to produce a digital model that is managed in an open cloud platform for real-time collaboration. It is used throughout the lifecycle, from planning and design to construction and operation in use.

The main benefits of using BIM include:

- stakeholders' understanding of projects because images and visualisations can be created at early stages prior to any construction being undertaken
- coordination between consultants on a project by drawing together all the information to check that differing elements do not clash
- conflict resolution because it means that conflicts can be resolved before construction
- timeline sequencing to determine key project milestones and dates
- support for Lean Construction Techniques
- accuracy of measurement and standardised Bills of Quantities for cost control
- facilities management to provide a building that meets the end users' needs including handover documents that are accurate and digitally available.