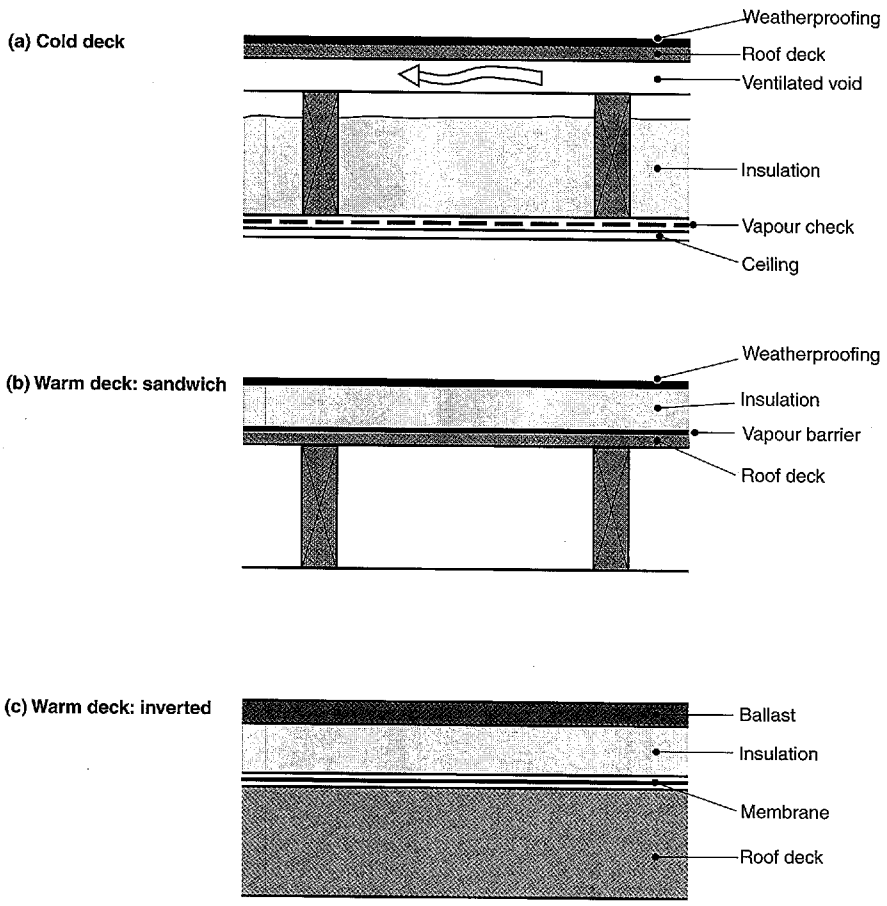

Figure 1 Generic flat roof construction types

inverted roof deck is so-called because the weatherproof layer, which also acts as the vapour control layer, is not in its usual position (see Figure 1(c)), being placed beneath the thermal insulation and ballast.

3.2 Structural design methods

An increasing number of design tools have been available to the engineer through codes of practice for the structural use of timber. The basis for design, up until recently, has always been Permissible Stress despite the trend towards Limit State Design adopted in codes of practice for other materials. One of the initiatives from the European Community (EC) in 1985 was to provide a new set of standards (Structural Eurocodes), technically harmonising codes from all members of the EC* as an aid to lifting barriers to trade in the community. The timber Eurocode is a Limit State Design document which is currently released as a Draft for Development (DD ENV 1995-1-1) and may be used instead of the British Permissible Stress based code of practice BS 5268-2. Other supporting European Standards for wood-based products are BS EN 636, covering the requirements for the use of plywood under various conditions, and BS EN 1058, which gives the method of calculation for determining the characteristic values for use in design.

In the interim period before 2005, when UK codes are due to be withdrawn, the designer has a choice of using a Permissible Stress or Limit State Design code. Although for simple elements permissible stress calculations are quicker, limit state calculations allow an alternative basis for analysis with flexible load combination rules. Many designers will probably opt for using current British Standards at present, but as supporting European material and product standards are introduced the use of Eurocodes will increase.

*All the countries in EFTA and the European Union – 18 national standards bodies

Deck type	Advantages	Disadvantages
Cold deck	Low-tech insulation materials may be used and are easily positioned. The overall depth of roof construction is reduced by placing insulation between joists. Any remedial repairs may be carried out easily.	Sufficient ventilation is required. Leaks in the waterproof membrane may go undetected as water will be trapped above the vapour check. The uninsulated roof deck is more susceptible to temperature-induced movements.
Warm deck: sandwich	The plywood decking is contained within the insulated building and is not subject to temperature extremes. A good vapour check is relatively easy to achieve. Services may be routed through the roof void without penetrating the vapour barrier.	High thermal stress in the weatherproof membrane arising from a low rate of heat transfer through the underlying insulation. Local roof traffic could cause damage to the waterproof membrane if insufficient support is offered by the insulation. Both a vapour check and waterproof membrane are required.
Warm deck: inverted	Components of the roofing system are all protected from extremes of temperature by the top ballast layer. Services may be routed through the roof void and are insulated from the cold. The waterproof layer is protected from roof traffic.	The decking may become chilled by rainwater percolating below the insulant, causing condensation on the underside of the plywood decking. Roof dead weights are greatly increased by the use of ballast above the insulation. Span-to-depth ratios will be reduced for structural roofing members. If ballast is used for the top layer, increased drainage may be required to avoid blockages.

3.3 Service loads

One of the basic functions provided by roofs and their component materials is to resist any loads applied, from the outset of construction and throughout its useful life. Both dead loads (material self weights) and imposed loads (any other loading that may be envisaged throughout the building life) must be considered during the design stage of the roof structure. The type and intensity of both dead and imposed loads applied to the plywood in roof constructions will vary depending on its usage and the type of construction envisaged.

For all types of pitched roof construction, be it trussed rafter or others, the plywood has very good structural characteristics for provision as sarking board. In this instance, the plywood's function is to stiffen the roof structure and resist longitudinal loading to the gable ends of the building (ie wind loads). Plywood decking in flat roof construction adopts a similar role in bracing roof members and resisting horizontally applied loads by membrane action, but also transfers vertical roof loads (both dead and imposed) to the supporting joists.

Dead weights of roofing material may be easily calculated from manufacturers' specifications or taken from the unit weights given in BS 648 (Schedule of weights of building materials). The effect of live load on the roofing structure and components must also be considered from the following:

- **People**
  Two main categories of roof access are provided in BS 6399-1 for determining the loads due to people: general cleaning and maintenance access provided, and general access not provided. BS 6399-1 should be consulted for roof with access for specific usages.
- **Wind**
  This load effect is derived in a similar manner to snow loads in that a basic wind speed is first determined and then adjusted using various coefficients to derive the design wind speed. The coefficients account for topography,