BETTER BUILDING

PROTECTING AND INSULATING ROOFS

1928

The roofs of modern houses differ little from any of those produced in the last 20 years. The timber trussed rafter system remains the most commonly used form of structure although the traditional 'built on site' roof is still employed by some builders. The most recent changes in the design of trussed rafter roofs has been an increase in the roof angle from the very flat pitches used during the 1970's. The completely flat roofs, which were used on porches, dormer windows, and garages, have generally been designed out of modern roofs although the flat roof is often retained on blocks of flats. The thermal insulation standards for all roofs have been increased and in most cases roof ventilation is now required to prevent condensation forming in the roof void. In this article Trevor Higgs, HBF Building Consultant considers most of the new developments in both the design and construction of roofs.

Insulation and ventilation of pitched roofs

The thermal insulation requirements for domestic pitched roofs have been increased on several occasions since the introduction of the national Building Regulations in 1965. The last amendment to the Regulation was in April 1982 when the "U" value for the roofs of all dwellings was reduced to 0·35W/m²°C. In the vast majority of houses the insulation material is placed directly on the ceiling boards which produces a cold roof space. 100mm of glass fibre or mineral fibre insulation is usually sufficient to meet the requirements of the Building Regulations. Another material which can be used is blown cellulose fibre an insulation material which has been developed from waste paper. A fire retardent is added to the material to produce a safe, fire proof, product. Various forms of loose granular plastics can also be used as insulants.

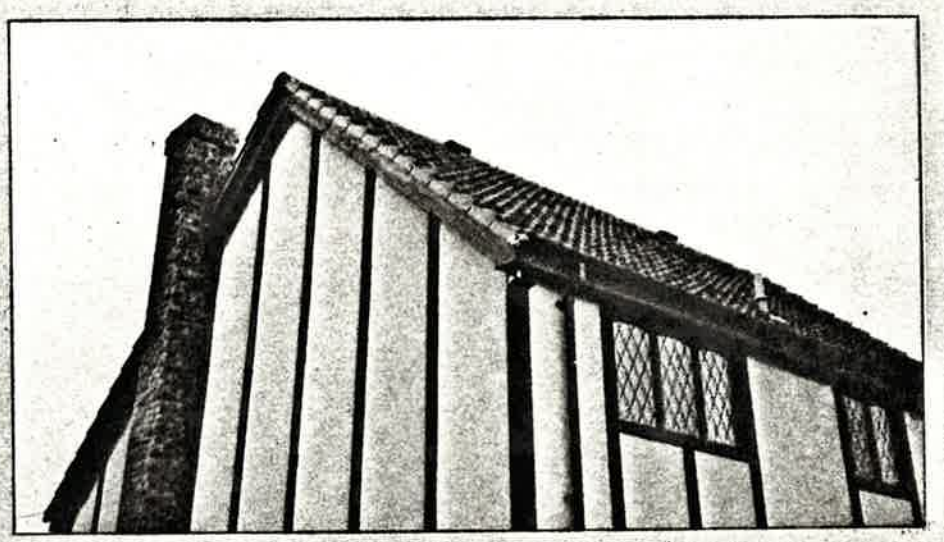
It is possible to provide the thermal insulation directly below the roof sarking or as part of the sarking. This method of insulation has the advantage of providing an insulated roof space which the owner can use. A similar form of roof insulation must be employed in "chalet type" houses and mansard roofs. The most difficult problem produced by these forms of construction is how to achieve the required levels of ventilation to prevent condensation from forming on the underside of the sarking felt. Before considering this problem let us look at the ventilation of normal pitched roofs.

The amendment to the Building Regulations in 1982 introduced for the first time a specific requirement for roof ventilation as a protection against the risks of condensation. The rates of ventilation chosen were those stated in the British Standard BS 5250 "Control of condensation in dwellings". The air void above the thermal insulation must now be ventilated to the outside air, the Regulations give various levels of ventilation which allow the designer some freedom as to how he meets the basic criteria. A total ventilation area of 0·003 times the plan area of the roof is the basic requirement. The ventilation area should normally be distributed equally on each side of the building. Care is also required when positioning the ventilation openings to ensure that no dead air pockets occur. An alternative approach is to use a continuous gap of 10mm at both eaves on pitched roofs above 15 degrees. The gap should be increased to 15mm on lower roof pitches. The actual ventilation openings are normally provided in the soffit boards. It is however important to ensure that an air space is provided between the tiles and the top of the external wall as there is a danger that the insulation material may prevent air flow at this point. The third alternative method of providing the openings is with special ventilating tiles. Care is required to ensure that the free air space in the tiles does achieve the required ventilation level.

Air movement

Recent testing has shown that the ventilation of the roof space is improved considerably by the addition of ridge ventilators. The combination of eaves and ridge ventilation helps to provide air movement during days when there is no wind. When only eaves ventilation is used this depends upon windy conditions to be effective. The ridge ventilators produce air movement by a chimney effect, the warm air from within the house rises up through the ridge openings and pulls air into the roof through the eaves openings.

The mansard and chalet roof system as discussed above still require ventilation above the insulation. The air space above the insulation should be 50mm deep and ventilation openings should be positioned at both the eaves and the ridge. An alternative solution, as used in Scandinavia, is to use a moisture permeable sarking so that the moist air can penetrate easily. To be totally effective an air space should be provided below the tiles. A space 25mm deep is sufficient and this space can be formed by the use of counter battens below the main tile battens.



Modern Dry Verge System.

Flat roofs

The traditional flat roof used in the United Kingdom has the waterproof layer applied directly to the deck struc-

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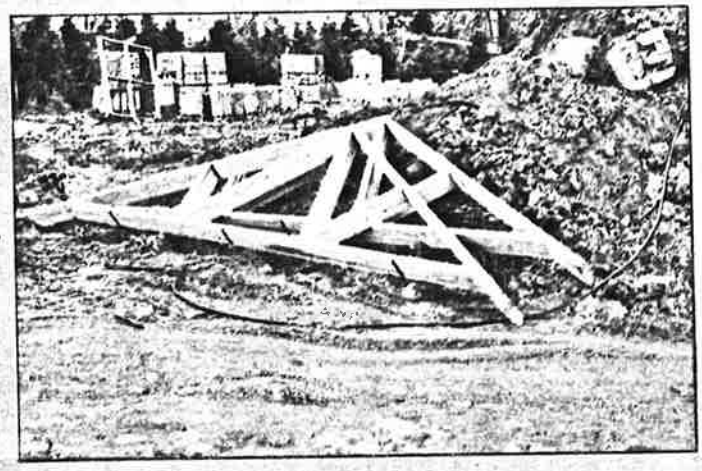
ture and insulation positioned on top of the ceiling, this type of roof is a cold roof. Ventilation is required to protect the roof against condensation, but the actual amount of ventilation should be higher than in a similar size pitch roof. The current recommendations for flat roof ventilation are for either a 25mm gap each side of the roof or alternatively a ventilation area equal to 0·004 times the plan area of the roof.

In practice it is essential to ensure that good cross ventilation of each roof void is achieved and that the depth of the void is at least 50mm. These dimensional limitations mean that other forms of flat roof construction which do not require ventilation are now becoming more popular with housebuilders.



Damage can result from the poor storage of Trussed Rafters.

The warm roof system uses thermal insulation above the deck structure and the condensation is prevented by the use of a vapour barrier bonded to the decking. A wide range of insulation boards are available for this type of roof. Some of the plastic based insulation requires the first layer of bitumen felt to be partially bonded to the insulant since the plastics are subject to high thermal movements. Other materials such as cork have the advantage of a low coefficient of thermal expansion.

The most important development in flat roofing over the last few years is the inverted roof system. In this system a low water absorption insulation board is positioned on top of the waterproof layer. The major advantage of the inverted roof is that condensation problems do not occur because the temperature of the waterproof layer is above the dewpoint temperature of the moist air rising from within the building. Special care is required with this form of roof when designing and constructing the drainage, upstands and other details. It is good practice to increase the height of all upstands by the thickness of the insulation plus the thickness of the weighting material, this normally produces an increase in height of 100mm.

The roof structure of pitched roofs

The structure of modern pitched roofs is based upon the use of factory made timber roof trusses at 450mm or 600mm centres. At present the design of the timber trusses is based upon British Standard Code of Practice CP 112 Part 3. In April 1985 a new standard was issued which will eventually replace CP 112, the new document is BS 5268 British Standard "Structural use of timber, Part 3, Code of practice for trussed rafter roofs". Until the new Building Regulations are issued at the end of 1985 the builder may use either of the above codes.

The new code is of considerable importance to the builder because the construction of the whole roof is considered. Section seven is particularly important since it contains advice for the builder on handling, storage, and erection of the trusses. Advice is given on the accuracy of the roof installation and there is a suggested erection procedure for domestic size roofs. The storage of trussed rafters should normally be in the vertical position on bearers located at the points of support. If the trusses are supported horizontally they should be kept clear of the ground on bearers located at every joint. Information is also provided on the installation of the tiling battens, water tank supports, and the construction of the roof access hatch.

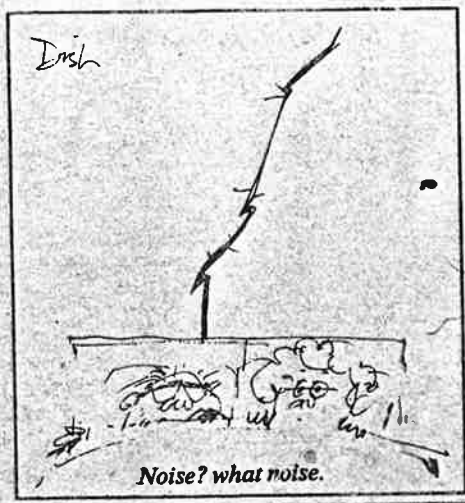
The major part of the code is concerned with the design and manufacture of the trussed rafters. A new method of design is provided. This was considered necessary because of new recommendations on the design of compression members. The design section also contains advice on permanent bracing systems. Standard bracing details are provided for normal size domestic roofs. For larger roofs or roofs in areas of the country with very strong winds the bracing system must be designed by an engineer. The standard bracing system can be applied to all types of properties and includes ceiling bracing as well as diagonal bracing along the sloping section of the roof. Bracing details for monopitched roofs are provided in addition to those for duopitched roofs. This new code of practice is essential reading for all housebuilders using trussed rafter roofs.

Roof finishes

The roof finish to pitched roofs has remained unaltered for many years. The normal options include concrete or clay tiles, or slates in both natural materials and man made replacements. In recent years new lightweight steel tiles have also become available. The major developments in roofing have been associated with the ridges and the verges. New systems are now available for the dry construction of both these items. The dry systems offer a more reliable installation against the problems of wind uplift. The tile manufacturers have also developed methods of incorporating the roof ventilation in either the ridge systems or within the roof tiles.

In flat roofing, new roofing felts have been developed which are more durable. These felts can withstand greater extensions before they split. The life expectancy of the roofing system is greater than the normal BS 747 felt system and it is possible that life of at least 30 years will be achieved. The other new development in flat roofing is the single layer system. In the majority of these systems a plastic membrane is loosely laid on the roof structure with all the lap joints fusion welded. All single layer systems require a very high standard of workmanship if a 100% waterproof layer is to be achieved.

Although the construction of domestic roofs has not developed in a dramatic way, like other parts of the building I hope that I have shown that some progress has been made. The new trussed rafter code may produce some changes in the way the builder constructs a roof. Future roofs should be better braced and should be stronger, there will however be an increase in the cost of construction.



Noise? what noise.