Roof

Flat roofs and long span roof construction
LECTURE OUTLINE

1. Introduction
2. Flat roofs
3. Long span roof construction
4. Green roofs
A roof should help in protecting the building against external conditions in order to provide comfort and safety for the building occupants.
Building Engineering Physics investigates the areas of natural science that relate to the energy performance of buildings and their indoor and outdoor environments.
Insulation is therefore important!

U value

The U value is the measurement of heat transmission through a material or assembly of materials. The U value of a material is a gauge on how well heat passes through the material and the lower the U value, the greater the resistance to heat and therefore has a better insulating value.
What is a flat roof?

A roof having a slope of up to $10^\circ$ (about 1 in 6)

UK Codes and standards

Flat roofs are characterised by having a continuous waterproof layer.
Although modern membrane materials are generally unaffected by standing water, it is good practice to design an efficiently drained roof.

The Flat Roofing Association
Roof failure leads to a waste of resources in terms of materials and manpower for remedial work.
Many of the roof problems investigated by BRE in the UK could have been avoided at the design and construction stages if designers and constructors had appreciated fully the limitations of the various design options, and how appropriate each was to the particular building.
It is possible to design flat or low-pitched roofs that will give satisfactory service and acceptable maintenance costs provided that sound design is supported by correct selection of materials and components, and followed by good standards of workmanship during construction and planned inspection and maintenance in service.
ALL THE PROTECTION YOU NEED UNDER ONE ROOF

The National Federation of Roofing Contractors Limited (NFRC) is the UK’s largest roofing trade association, representing over 70% of the roofing industry by value. With a history spanning almost 120 years, NFRC has established itself as the voice of the roofing industry, constantly adapting to change and innovation to ensure its members are at the forefront.

Here you can find:
- Why you should use an NFRC member
- Members in your local area
- How to join NFRC
- Latest news and events

We hope that you will find what you need within our website. If not, please contact us and we’ll do our best to assist.

NFRC has also been given Government approval to run a Competent Person Scheme for Roofing allowing professional roofing contractors to self-certify for Building Regulations for refurbishment work. To find out more information and visit the CompetentRoofers website please click here.

SEARCH MEMBERS

LATEST NEWS

Kemperol is to the Manor Reborn
An Edwardian Manor in Manchester has had its 110-year-old lead flashings ‘replaced’ thanks to the flexibility of Kemperol U616 cold liquid-applied waterproofing membranes from Kemper System.

Oct 19, 2012 Full story

Product Demonstrations by AmpTeam Ltd
Oct 18, 2012 Full story

Health and safety cost recovery schema to start in October 2012
Oct 18, 2012 Full story

Green Deal Quick Guides to download
DECC has released Quick Guides to the Green Deal including Introduction to the Green Deal and how businesses can get involved.
Warm flat roof construction

Cold flat roof construction
Long span roof construction

Categories of buildings

• Large span, low rise buildings
• Multi-storey structures

Can you think of examples of buildings with long span roof construction?
When a beam spans between two simple supports and carries a uniformly distributed load (such as a roof covering) it tends to bend in the centre.
Can a simple span roof support be used for distances in excess of 15m?
In essence, we want to increase a beam’s resistance to bending whilst *minimising the self weight* of the structural member and *maximising its efficiency both economically and structurally*. 
Lattice Beams, Trusses and Girders

Large spans in excess of 25m can be formed using these systems.
Lattice Trusses

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<tr>
<th>Product Range</th>
<th>Diagram</th>
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<tr>
<td>Parallel Beam</td>
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<tr>
<td>Pitched Truss</td>
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<td>Inverted Truss</td>
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<td>Parallel Pitched Beam</td>
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Proprietary sections are manufactured in standardised section sizes, however, these may not be appropriate either in terms of achievable span, or in terms of architectural style.

Therefore, many truss sections are bespoke, or built up specifically for specific building structures.
Can you sketch the truss?

Erection of a steel truss

Can you estimate the length of the roof span?
Cellular and Castellated Beams

![Cellular and Castellated Beams](image)

**Figure 4.9:** Typical cellular beam (Source: Corus Construction)

**Figure 4.8:** Typical castellated beam (Source: Corus Construction)
The use of columns to increase the effective clear span of main roof beams

Umbel or Tree Columns
(Sources- StructureAE & Syska.com)

This can be done by enlarging the area or support positions at the column head.
Purlins or secondary Beams in long span roofs

Load transfer paths are as follows:
roof covering → purlins or secondary beams → roof beams (truss, lattice girder etc.) → columns → foundations.
Space frames (3D trusses)
Suspension Roofs
Roof utilising multiple longspan technologies at Munich Airport
What are the factors that must be taken into account in the design and selection of a suitable roof structure?

- Function of the building
- Span of the roof
- Height of the space
- Aesthetic and design requirements
- Economic considerations
- Construction considerations
- The environment
Green roofs are vegetated layers that sit on top of the conventional roof surfaces of a building.

Green roofs may also include additional layers such as a root barrier or drainage and irrigation systems.
What are the benefits of green roofs?

- Reduce heating and cooling
- Filter pollutants and CO2 out of the air
- Grow fruits, vegetables, and flowers
- Reduce run-off storm water
- Insulate for sound and heat
- Filter pollutants and heavy metals out of rainwater
- Increase wildlife habitat
When considering the installation of a green roof, what design factors should be considered?

- Additional dead weight on the existing or proposed structural system;
- Insulation and waterproofing system;
- Root barrier (typically polythene or PVC);
- Water-retaining layer to reduce quantity of watering required by irrigation or sprinkling;
- Water drainage layer (typically gravel, lightweight aggregate or profiled plastic sheeting);
- Filter sheet to prevent soil and organic material blocking the drainage system (typically polyester or polypropylene);
- Vegetation layer of soil upgraded with organic and mineral additives;
- Planting — the anticipated planting dictates the depth of the soil substrate.
Summary

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Additional resources

Thermal Bridging of an insulated flat roof through the front fascia

www.greenrooftechnology.com/case-studies

Write a 300-word summary in your own words