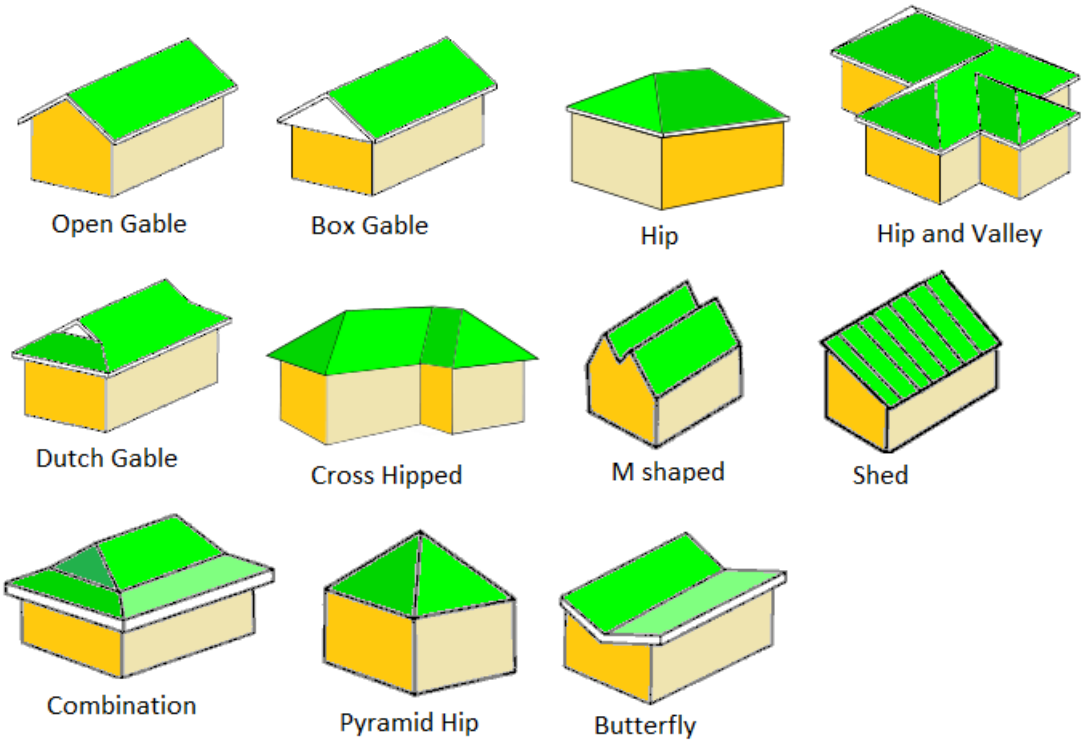
GUIDELINES FOR ROOF DESIGN

Contents

ROOF TYPES

There are many different types of roof. However, for our purposes we will be looking at the most common designs and those that deal with metal roofing.



When designing a roof, the proper type of roof must be chosen for the job.

Usually the Client will have an idea of what they want, however, as the roof specialist it is our duty to advise the owner on the best options and practices to ensure that the roof provided is

1. Structurally sufficient
2. Durable
3. Watertight
4. Reliable – long lasting
5. Aesthetic

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ROOF TYPE	PROS	CONS
Gable	Gable roofs will easily shed water and snow, provide more space for an attic or vaulted ceilings and allow more ventilation. Their inherently simple design makes it easy to build them and cheaper than more complex designs.	Gable roofs can be problematic in high wind and hurricane areas. If the frames are not properly constructed with adequate supports, the roof can collapse. If there is too much of an overhang, winds can create an uplift underneath and cause the roof to detach from the walls.
Hip	Hip roofs are more stable than gable roofs. The inward slope of all four sides is what makes it sturdier and more durable. They are excellent for both high wind and snowy areas. The slant of the roof allows snow to easily slide off with no standing water. Hip roofs offer extra living space for vaulted ceilings or an attic. They also provide more ventilation and ability to make additions, such as dormers or a crow's nest.	Hip roofs are more expensive to build than a gable roof. It's a more complex design that requires more building materials. Also, additional seams can make it easier for water leaks to form if a roofing system is not properly installed. Proper construction and maintenance is a must to prevent minor issues from turning into major problems.
Combination	Using a variety of roofs adds architectural interest to a house. It's also a great way to use the best type of roof for each section of the home.	The more complex the design, the more expensive it will be. Adding different pitches and roof types will require more building materials and labor costs. Joining different roofs always adds valleys and ridges. These are the weakest areas of the roof where water can pool and leak.

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ROOF SLOPE

- A roof with a pitch of less than 20^{o} is highly vulnerable to uplift forces. It is recommended that a pitch of 20^{o} to 40^{o} be used. The ideal angle for design against class 3 hurricane winds is 24^{o}.
- The ability to reduce uplift forces is affected by the shape of the roof. The following roof types are listed in descending order of their effectiveness in reducing uplift forces:
    - Hip
    - Gable
    - Shed

EAVES

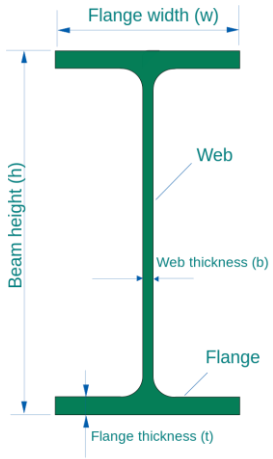
- Eave overhangs experience high local pressures and, where possible, should be kept to a maximum of 3ft (measured horizontally from the external walls).
- Where buildings have covered patios or verandas, their roof should be separate structures so that in the event of high winds, the large overhangs may cause loos or damage to the smaller roof without compromising the integrity of the main roof.
- It is necessary to provide ample support at eaves ends and ridges due to high localized pressures at these locations.

RAFTERS AND BEAMS

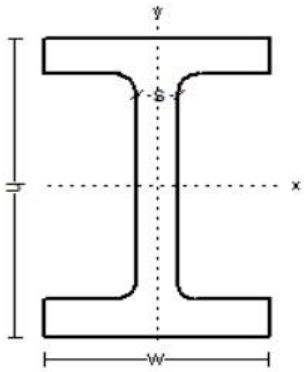
Steel rafters are the best option because of their strength and longevity. The cost of a steel roof frame is also comparable to that of a timber frame, which makes it the best option for small buildings (when inland).

I-beams are known as Wide Flange beams, hence the beam size is written as W (height)x(mass per length).

The different parts of a Wide Flange beam are as follows:



Hence a W4x7.7 beam indicates an I-section 4inches high and 7.7lbs per foot. The following table gives the dimensions for common beam sizes:



Designation	Dimensions					
Imperial *(in x lb/ft)*	Depth h *(in)*	Width w *(in)*	Web Thickness t_w *(in)*	Flange Thicness t_f *(in)*	Sectional Area *(in^2)*	Weight *(lb/ft)*
W 8 x 67	9.00	8.280	0.570	0.935	19.7	67
W 8 x 58	8.75	8.220	0.510	0.810	17.1	58
W 8 x 48	8.5	8.110	0.400	0.685	14.1	48
W 8 x 40	8.25	8.070	0.360	0.560	11.7	40
W 8 x 35	8.12	8.020	0.310	0.495	10.3	35
W 8 x 31	8.00	7.995	0.285	0.435	9.1	31
W 8 x 28	8.06	6.535	0.285	0.465	8.3	28
W 8 x 24	7.93	6.495	0.245	0.400	7.1	24
W 8 x 21	8.28	5.270	0.250	0.400	6.2	21
W 8 x 18	8.14	5.250	0.230	0.330	5.3	18
W 8 x 15	8.11	4.015	0.245	0.315	4.4	15
W 8 x 13	7.99	4	0.230	0.255	3.8	13
W 8 x 10	7.89	3.940	0.170	0.205	2.9	10
W 6 x 25	6.38	6.080	0.320	0.455	7.3	25
W 6 x 20	6.20	6.020	0.260	0.365	5.9	20
W 6 x 16	6.28	4.030	0.260	0.405	4.7	16
W 6 x 15	5.99	5.990	0.230	0.260	4.4	15
W 6 x 12	6.03	4	0.230	0.280	3.6	12
W 6 x 9	5.90	3.940	0.170	0.215	2.7	9
W 5 x 19	5.15	5.030	0.270	0.430	5.5	19
W 5 x 16	5.01	5	0.240	0.360	4.7	16
W 4 x 13	4.16	4.060	0.280	0.345	3.8	13

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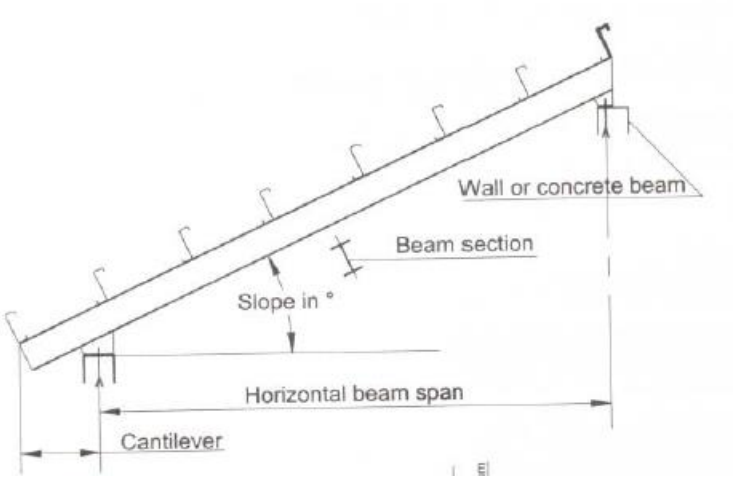
It should be noted that whilst a small beam size may be sufficient for support of the roof sheets and purlins, there are other factors to consider when choosing a beam size for a roof. These include:

1. Uplift (created when winds blow across the roof) – uplift forces are usually stronger that the weight of the roof itself.
2. Axial forces – these occur in the direction of the span of the member and occur due to slope of the roof.
3. Vibration – the beam will not break from the forces it is subjected to, however, it will vibrate under the load.
4. Suspended ceilings – these add additional weight onto the frame.

For small buildings, TTBS requires that frames/rafters should be placed at a maximum of 14ft apart (along the length of the roof). The size of the section is to be chosen depending on the length of the beam required. The following tables give general guidelines for choosing the section based on the span measured horizontally.

<u>For shed roofs</u>:



Rafter	Horizontal Beam Span
W4x7.7	13 ft
W5x10	17 ft
W6x12	23 ft
W8x13	24 ft

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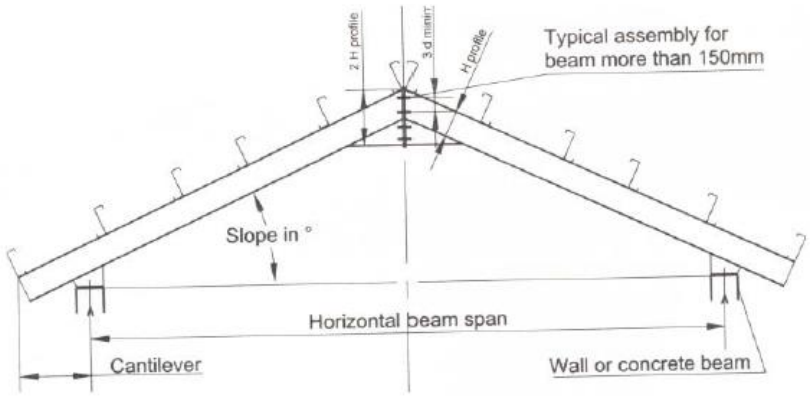
For Gable and Hip Roofs:



Rafter	Horizontal Beam Span
W4x7.7	13 ft
W4x13	18 ft
W5x10	16 ft
W6x12	20 ft