



# Synseal Conservatory Training



## Conservatory Roof Design Guide



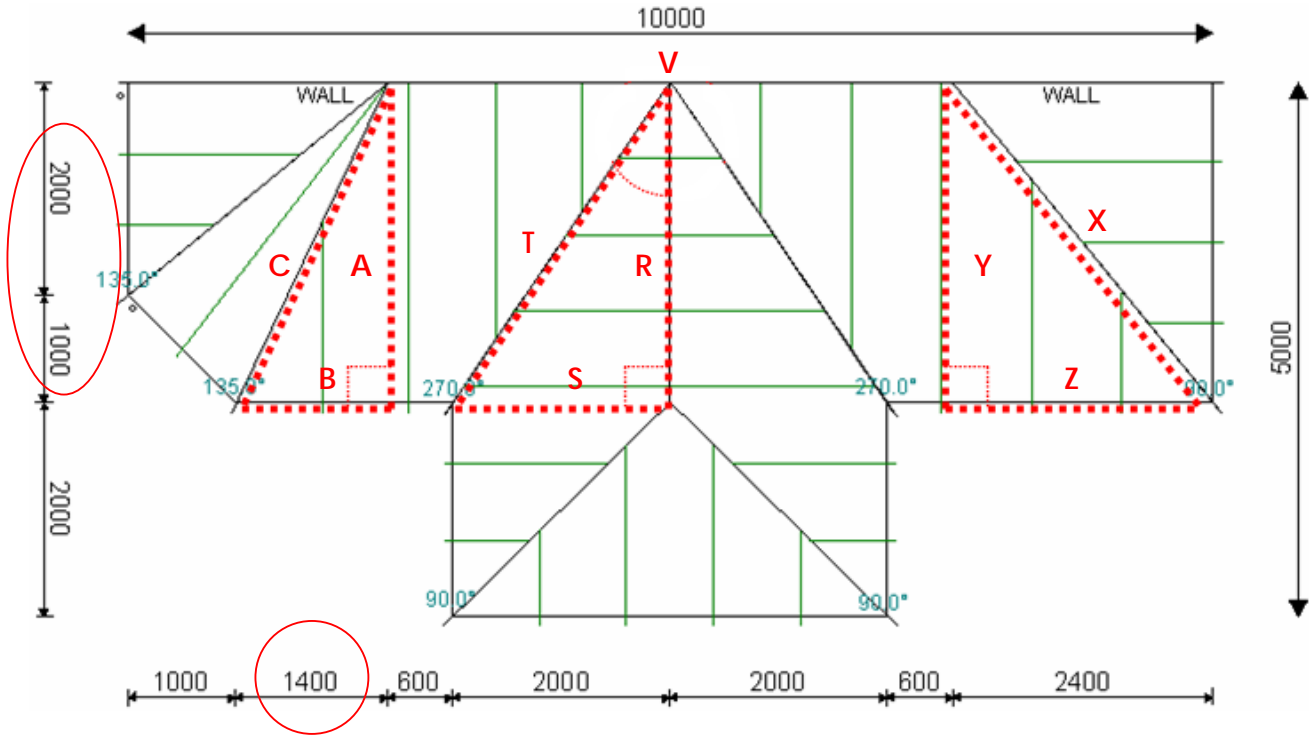
## SYNSEAL CONSERVATORY TRAINING

# CONSERVATORY ROOF DESIGN GUIDE

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# SYNSEAL CONSERVATORY TRAINING

## Calculating Roof Dimensions using Basic Trigonometry



### Calculating a Single Victorian Hip Length on Plan:

$$\text{e.g. } A^2 + B^2 = C^2$$

$$3000^2 + 1400^2 = 10960000$$

The length of C (Victorian Hip on Plan) is the Square root of  $C^2$

$$\text{e.g. } \sqrt{10960000} = 3311\text{mm} = C$$

### Calculating a Single Georgian Hip Length on Plan:

$$\text{e.g. } Y^2 + Z^2 = X^2$$

$$3000^2 + 2400^2 = 14760000$$

The length of X (Georgian Hip on Plan) is the Square root of  $X^2$

$$\text{e.g. } \sqrt{14760000} = 3842\text{mm} = X$$

### Calculating a Valley Length on Plan:

$$\text{e.g. } R^2 + S^2 = T^2$$

$$3000^2 + 2000^2 = 13000000$$

The length of T (Valley on Plan) is the Square root of  $T^2$

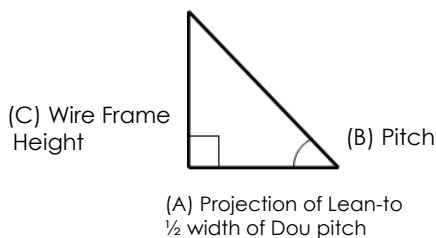
$$\text{e.g. } \sqrt{13000000} = 3606\text{mm} = T$$

### Calculating a Valley Angle on Plan:

$$V = \frac{S}{R} = \text{INV TAN}$$

$$\text{e.g. } \frac{2000}{3000} = 33.7^\circ$$

### Calculating a Wire Frame Height:



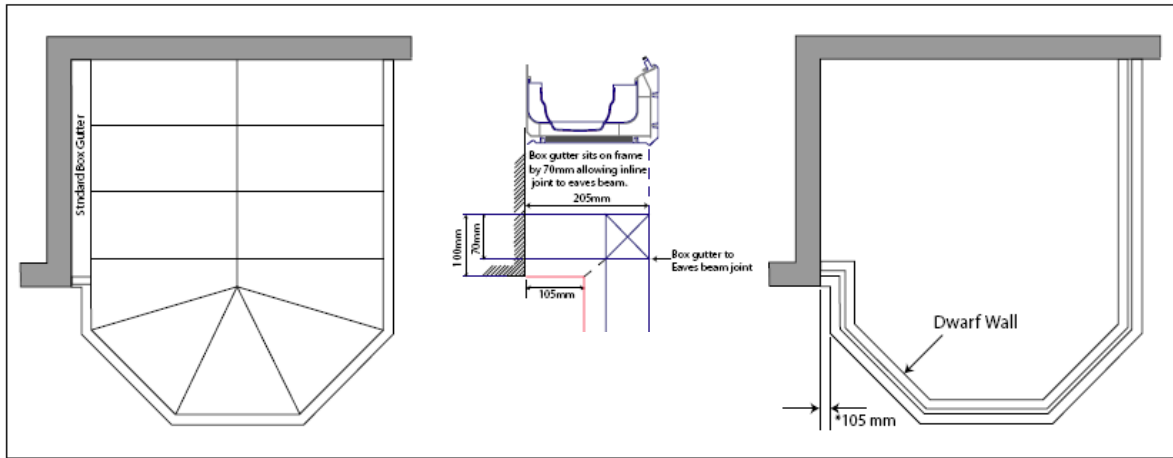
$$(C) \text{ Wire Frame Height} = (A) \text{ Projection} \times (B) \text{ Pitch TAN}$$

$$\text{e.g. } 1500\text{mm} \times 25^\circ$$

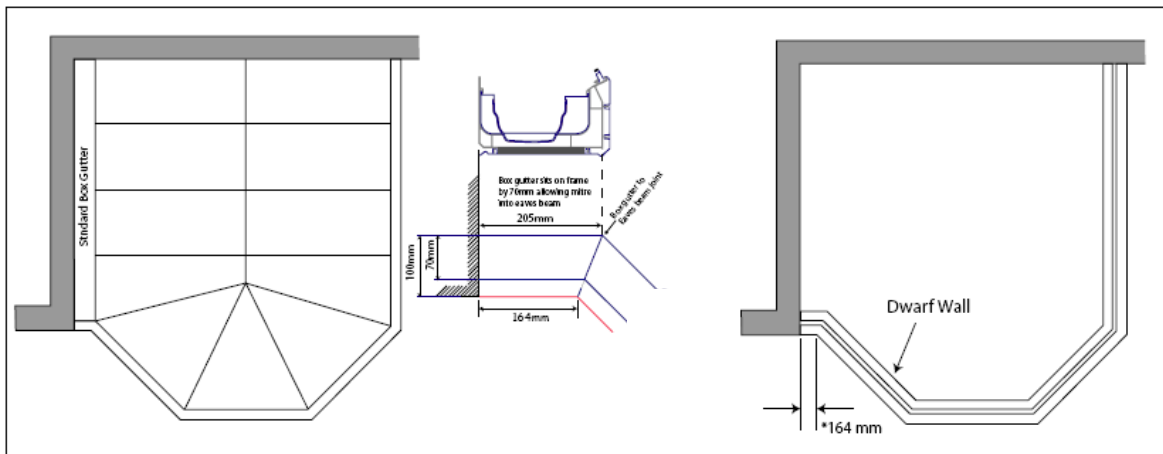
# SYNSEAL CONSERVATORY TRAINING

## Box Gutter Roof Designs

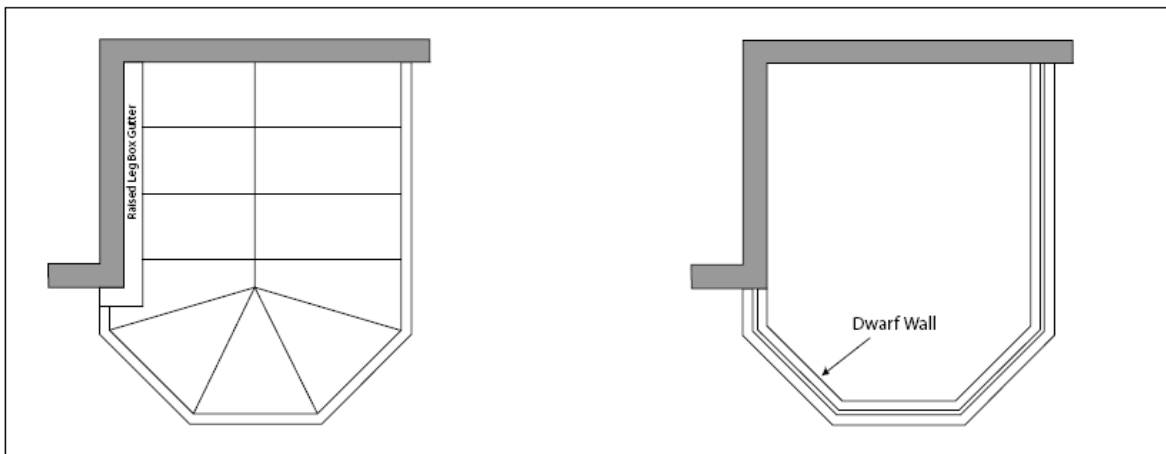
### Victorian Box Gutter Base Setting Out



Standard detail - eaves beam gutter runs in line with standard box gutter



Standard detail - eaves beam gutter runs into standard box gutter via gutter bend



Non standard detail - eaves beam gutter runs into raised (high edge) box gutter via gutter bend profits from increased conservatory floor area

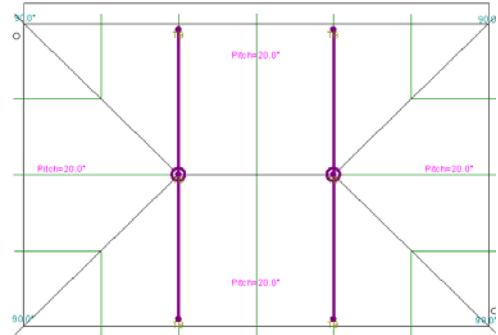
*\*dimension increases by soffit depth when box gutter is on a fascia board*

# SYNSEAL CONSERVATORY TRAINING

## Box Gutter Roof Designs cont...

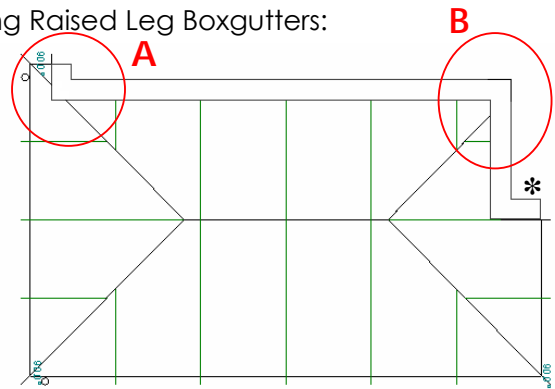
These are the guidelines for designing Double Hipped to Boxgutter Roofs:

- Design must inc a Tiebar below each finial point, or at least a single central Tiebar in cases where only one rafter strikes the ridge.
- Minimum ridge length is 140mm
- Pitch range is 15° to 35°
- Minimum recommended pitch is 20°



These are the guidelines when designing roofs containing Raised Leg Boxgutters:

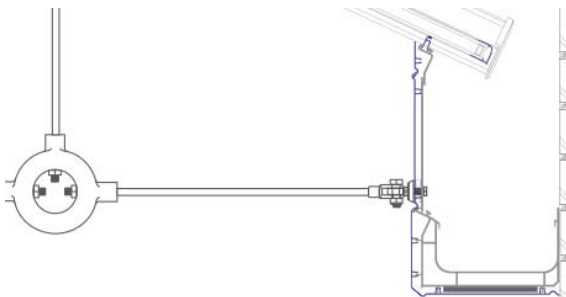
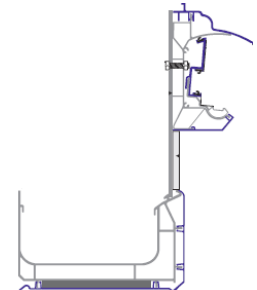
- There is a minimum & maximum height for a Raised Leg Boxgutter which ranges from **170mm to 500mm** (inc 118mm eaves beam). This height will be dependant on both the roof pitch and size of the boxgutter return (from the corner of the brickwork to inside frame). Below is a guide to show the minimum & maximum returns \* in relation to the pitch of the roof.



- When designing roofs containing Raised Leg Boxgutters ensure that the corner of the raised leg does not dissect a hip bar (see A above), as this creates an area which cannot be glazed. This does not affect a hip that is cut and finished short (see B above).

Roof Pitch	Min Return *	Max Return *
5°	385mm	2395mm
10°	90mm	1960mm
15°	0mm	1200mm
20°	0mm	800mm
25°	0mm	600mm
30°	0mm	400mm
35°	0mm	300mm

- When designing Lean-too roofs with Raised Leg Boxgutters at the rear, the same 500mm maximum height limitation still applies. The minimum height is different in this situation and must be at least 285mm (310mm for Ali Top Caps), which allows enough room for the wallplate to be attached to the raised leg section without hitting the un-even internal surface of the boxgutter.

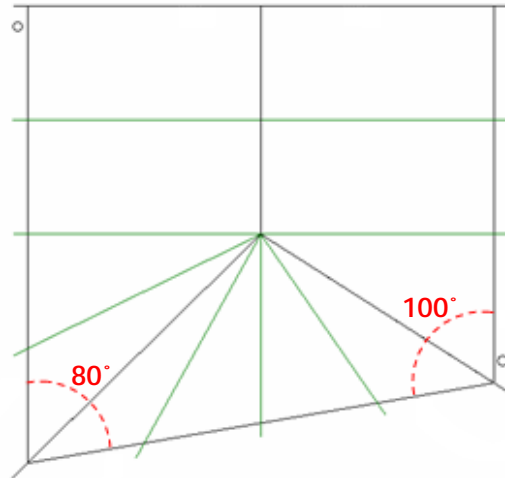
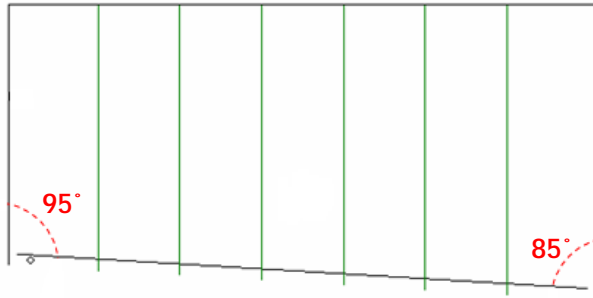


- Tiebars can be attached to the raised section of the boxgutter providing that it returns towards the ridge more than a fourth of 1/2 of the overall width providing the ridge is central, otherwise the distance from the centre of the ridge to the point where the boxgutter meets the eaves beam.

e.g. 3000mm width halved = 1500mm divided by 4 = 375mm min Boxgutter Return inc 205mm

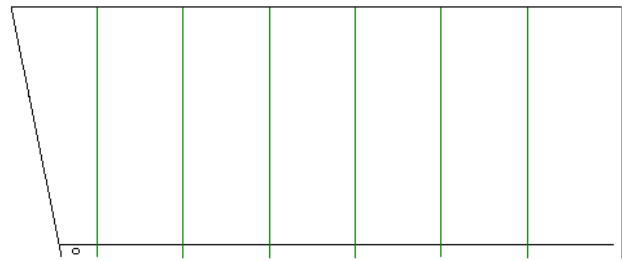
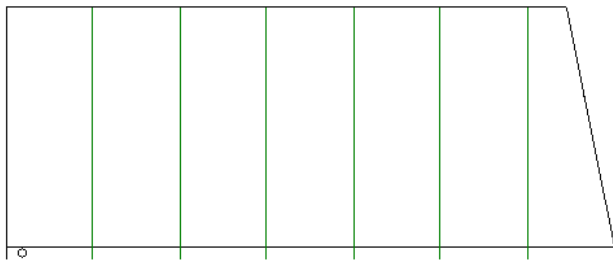
# SYNSEAL CONSERVATORY TRAINING

## Out of Square Roof Designs



These are the guidelines when designing roofs that are Out of Square:

- Roofs that are designed out of square result in rafters and glazing twisting from end to end. As a result these roofs should only be manufactured in 25mm Polycarbonate. **Roofs glazed with 35mm polycarbonate or Glass Units should only be manufactured with the approval of the Synseal Conservatory Roof Technical Department.**
- There is a limitation to how far rafters and glazing can twist before manufacture becomes impossible. This limitation is also dependant on where the rafters are located within the roof, rafters that attached to the radius end can twist further than those attached to a ridge/wallplate. As a result **ridge or wallplate sections (as shown in the top left) can have only a 5° taper, while radius end section (as shown top right) can have up to a 10° taper.**



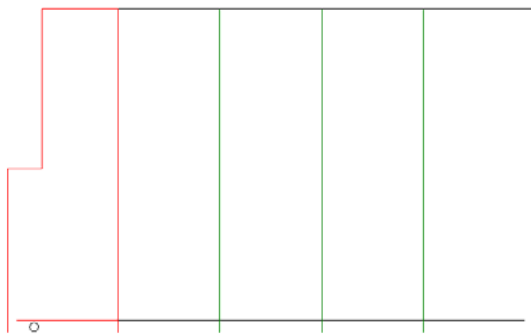
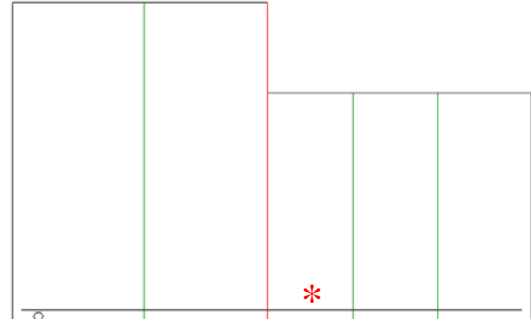
- Roofs that are designed with end rafters positioned out of square as shown above are **not subject to the same limitations**, as in these cases the twist is only present on the end rafters themselves and the glazing is unaffected. The designing of these roofs is subject only to the rafter position limitations rather than the base angles, which can be lower than 80° and greater than 100°. This is providing that the end rafter do not dissect any of the other rafters and that the outer rafter spacing ranges within 200mm – 1200mm (1400mm in polycarbonate).
- In both of these cases the end rafters will not fit flush against the host wall or on the head of a raked frame, as a result of being in twist. **Extra lead flashing or cladding will be required during the installation of these conservatory roof designs.**

# SYNSEAL CONSERVATORY TRAINING

## Cut Out Roof Designs

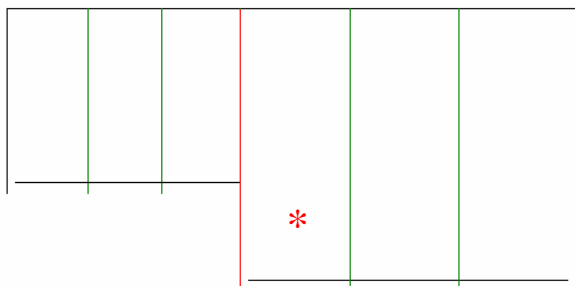
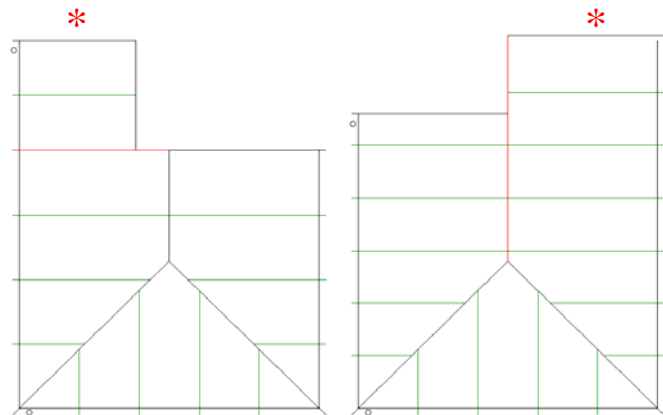
These are the guidelines when designing roofs that contain cut outs:

- Roofs designed with large cut outs must contain a full length transom bar position against the side of the cut out as indicated here in red. This is to ensure correct drainage of the bar into the conservatory guttering. When dealing with rafter centres, **ensure to offset the spacing\* by 30mm to allow for half of the rafter thickness.**



- Roofs designed with smaller cut outs which are contained within the first or last rafter spacing and which do not dissect any other transoms, can be manufactured using a “**Welded Z Shaped**” end rafter. Equal rafter spacing can be maintained in the majority of these cases.

- Dou Pitch roofs designed with cut outs are subject to the same rules detailed above, unless the centre of the ridge can be lined up with the corner of the cut out, creating a seamless joint with the wallplate at this point.
- Roofs of this design must have a Tiebar if a frame is located in the far top corner \*



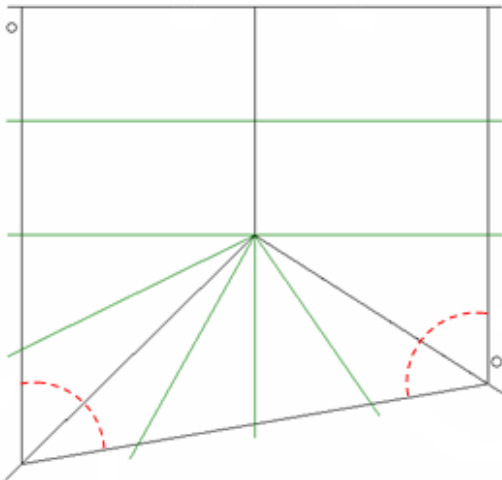
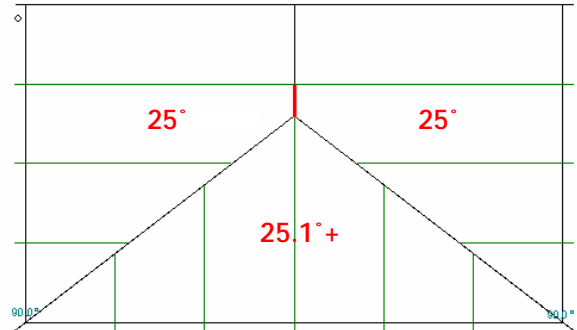
- Roofs designed with cut outs located at the eaves or front end of the roof must have a full length of Modified End Rafter, inputted as a standard Transom Bar positioned against the side of the cut out. Once again to ensure correct drainage into the guttering. When dealing with rafter centres, **ensure to offset the last spacing\* by 30mm to allow for half of the rafter thickness and the frame thickness.**

# SYNSEAL CONSERVATORY TRAINING

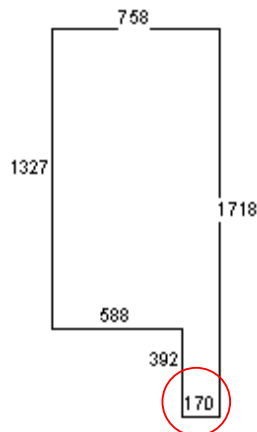
## Glass Roof Designs

These are the guidelines for designing roofs to take Glass Units:

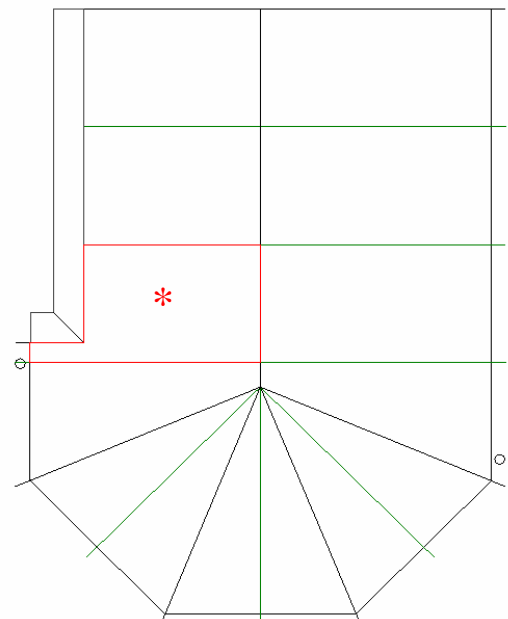
- Edwardian roof designs which are glazed with glass units must use the Non Standard XRE4 Radius End, in the event of **any amount of pitch difference** over the hip bars.
- The distance from the last pair of supporting transom to the end of the ridge as indicated here in red, must be **no more than 350mm** when designing Edw/Victorian roofs without Tiebars.



- Due to the twisting nature of both the bars and glazing on “**Out of Square**” roof designs, manufacture of these style roofs in order to take glass units **must only be agreed with the approval of the Synseal Roof Technical Department.**



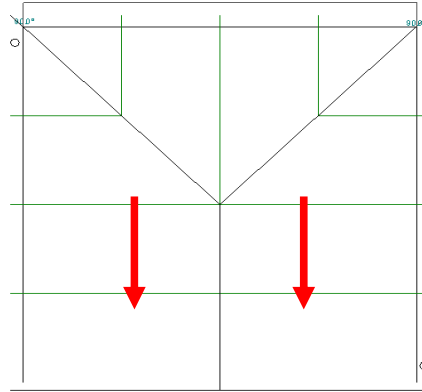
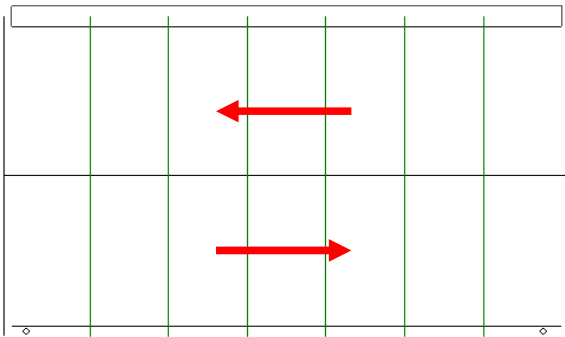
- Due to the toughening process, Glass units have a **minimum width of 170mm**. As a result, when designing roofs that contain a Raised Leg Boxgutter, the rafter spacing\* closest or containing the boxgutter return may need to be changed to meet this limitation.
- This shape unit is not possible at any size in 6mm Laminated Glass, therefore roofs that contain either **Raised Leg Boxgutters or Welded End Rafters must only be designed in 4mm Toughened Glass.**





# SYNSEAL CONSERVATORY TRAINING

## Unstable Roof Designs & Sky-Lites



When designing Conservatory Roofs, consideration should be given to the stability of the structure you intend to create. The 2 designs above are typical “Unstable Designs” that must only be manufactured with the understanding that the **Conservatory may require** supplemental support e.g. Brick Piers or Wind Posts etc, **which are additional to the Tiebars** specified in the Structural Information Guide. In extreme cases some designs may require a Portal Frame structure.

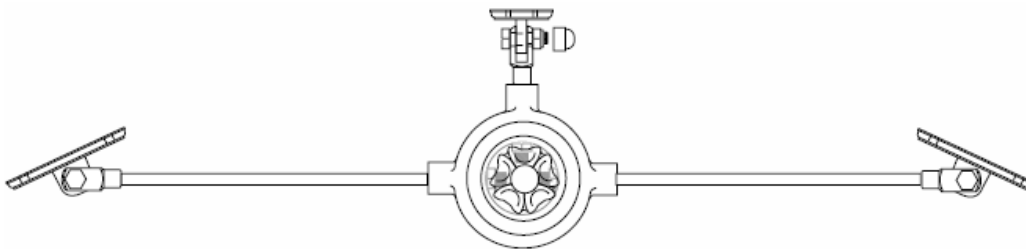
The **Double Ended Gable design** (shown top left) incorporates a ridge with no vertical support, which will result in possible “side to side” movement in the ridge.

The **Gable Back to Boxgutter design** (shown top right) incorporates the force of two hips pushing towards the gable front encouraging the ridge to move forward.

As the **Freestanding design** is installed away from the house wall without the use of a boxgutter or apex, the conservatory will lack this crucial support.

Freestanding roofs can be utilised to suit a **Sky-Lite situation**. Unlike Freestanding designs these roofs will not require any additional support or Tiebars, providing they are fixed down to a solid base rather than windows. Sky-Lites which are supported by windows, such as a Lantarn design must still have Tiebars and in these situations there are limitations to the overall sizes. It maybe necessary to increase the width or pitch of the roof to make room for fitting Tiebars

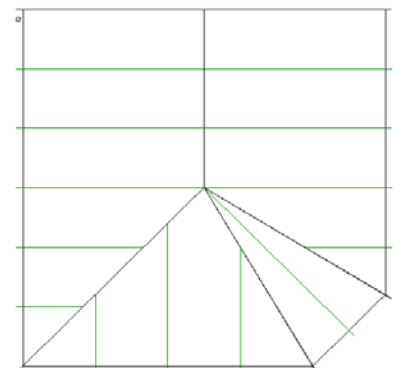
Pitch	Roof Width
15	1873
16	1773
17	1685
18	1605
19	1534
20	1469
21	1411
22	1357
23	1307
24	1262
25	1219
26	1180
27	1143
28	1108
29	1076
30	1045
31	1016
32	989
33	963
34	938
35	914



## Un-Symmetrical Roof Designs

When designing roofs with an **Offset Ridge**, the un-symmetrical nature of the design caused by the ridge not being positioned centrally will mean that Tiebars should be included in the majority of cases regardless of the Standard Tiebars Rules.

**Hybrid Edwardian** roof designs (as shown here) have the same un-symmetrical nature due to the presences of a single Victorian section to only one side. These designs should also include a Tiebar in the majority of cases regardless of the Standard Tiebars Rules.

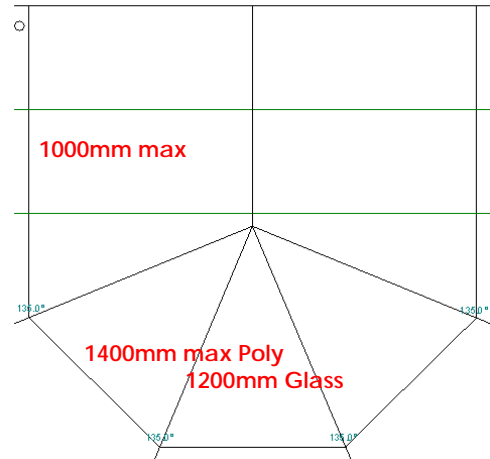
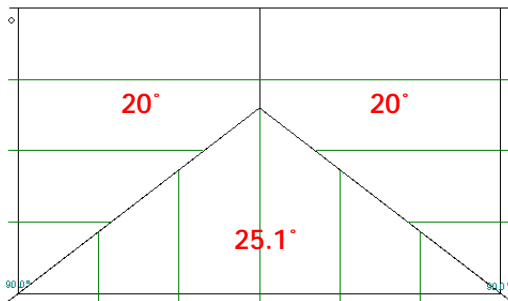


# SYNSEAL CONSERVATORY TRAINING

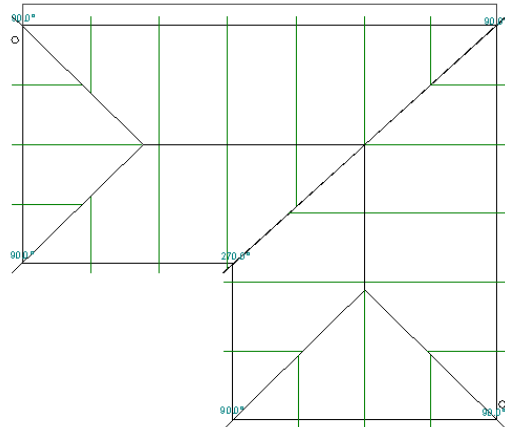
## Rafter Positions

When designing Conservatory roofs, one of the most important decisions to make is the number and positions of the rafter spacing. The guidelines for Rafter Positions are as follows:

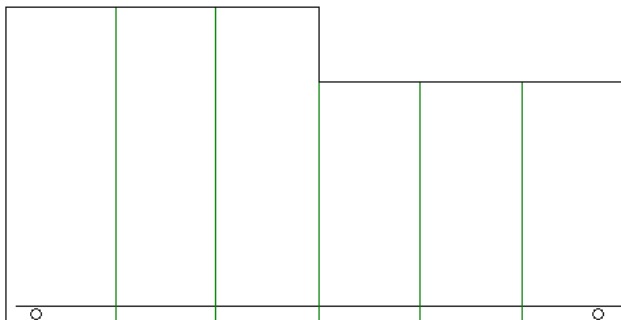
- Rectangle Rafter Spacing have a standard of 800mm with a range 200mm to 1000mm
- Triangle Rafter Spacing can go up to 1400mm glazed in polycarbonate and 1200mm glazed with glass.



- Edwardian Roofs designed with a **greater than 5° pitch difference** over the hips bars require a central rafter positioned in the front section.



- Rafters must be positioned to line up with the centre of a floating ridge to allow the use of 5 Way Tie bars when designing **P/T shapes to Boxgutters**.

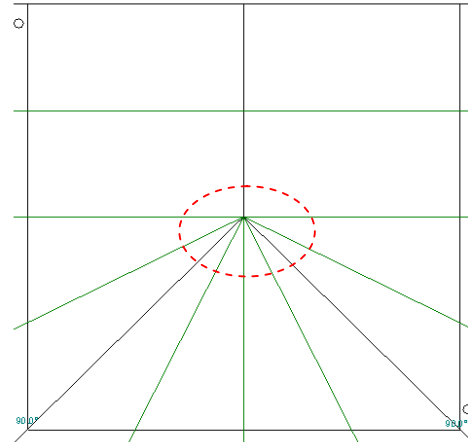
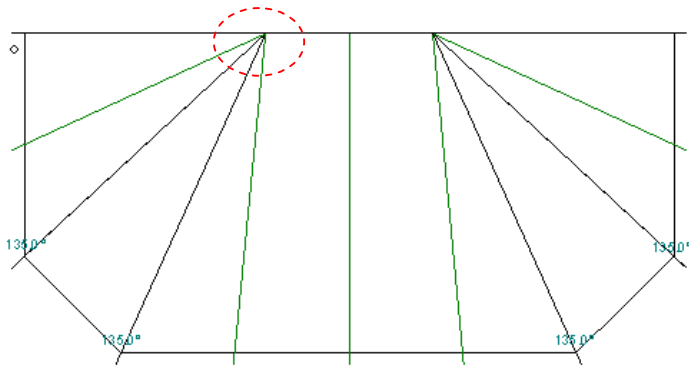


- Roofs designed with **Cut Outs** require rafters positioned to ensure a continuous length of rafter, positioned directly beside the cut out running the full projection, from back wallplate to front eaves beam

- Finally, all rafter spacing are subject to the "Synseal Conservatory Roof Structural Information Guide" which must be referred to at all times and determines the maximum rafter spacing based on Overall Dimension and Bar Specification.

# SYNSEAL CONSERVATORY TRAINING

## Rafter End Prep Limitations



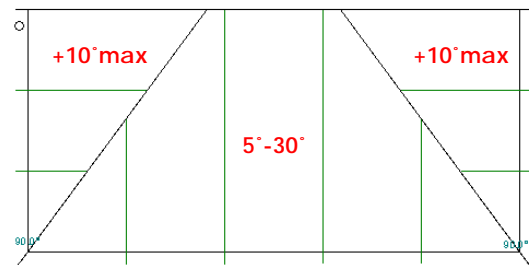
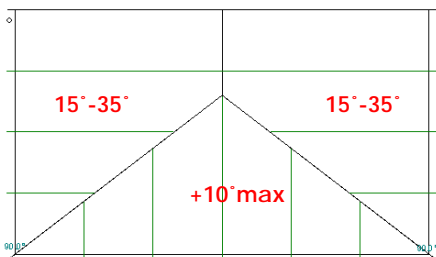
When designing Roofs that incorporate “**Splayed Rafters**” (angled rafters all attached to the radius end as shown above). There is a limitation to the angles that must be cut on the top end of the rafters, as a result of all the bars meeting at the radius end. This limitation is 5° and can be checked on the “**Roof End Prep details**” document accessed through the “**Doc**” screen with in First Degree. (as shown to the right)

ProdCode	Description	Lbl	Side	L	Stop	L	Slide	R	Stop	R	Drill	LR/RT
XRC25-567	25/25mm Rafter/No Top Cap	P3	0.0°	0	12.2°				45			
X35T1-650	35mm Light Transom	P3	0.0°	0	12.2°				10.3			
X35T1-650	35mm Light Transom	P4	12.2°	100	8.9°				10.4			
XRC25-567	25/25mm Rafter/No Top Cap	P4	12.2°	43	8.9°				46			
X35GHI-230	35mm Light Geo Hip	P5	8.9°	100	8.9°				100	0.0,18		
XRC25-567	25/25mm Rafter/No Top Cap	P6	8.9°	94	12.2°				90			
X35T1-650	35mm Light Transom (bell)	P6	8.9°	104	12.2°				100	0.0,23		
XRC25-567	25/25mm Rafter/No Top Cap	P7	12.2°	93	12.2°				9.3			
X35T1-650	35mm Light Transom (bell)	P7	12.2°	103	12.2°				10.3	0.0,25		
X35T1-650	35mm Light Transom (bell)	P8	12.2°	100	8.9°				10.4	0.0,23		
XRC25-567	25/25mm Rafter/No Top Cap	P8	12.2°	90	8.9°				9.4			
X35GHI-230	35mm Light Geo Hip	P9	8.9°	100	8.9°				100	0.0,18		
X35T1-650	35mm Light Transom	P10	8.9°	104	12.2°				100			
XRC25-567	25/25mm Rafter/No Top Cap	P10	8.9°	46	12.2°				4.3			
X35T1-650	35mm Light Transom	P11	12.2°	103	0.0°				0			
XRC25-567	25/25mm Rafter/No Top Cap	P11	12.2°	45	0.0°				0			

## Roof Pitch Range inc Pitch Difference Limitations

The guidelines for Roof Pitch and Pitch Difference Limitations are as follows and are dependant on the roof style:

- **Mono Pitch** (Lean-to design) have a standard pitch of 5° and a range between 5° to 30°
- **Hipped Lean-to** have a 15° standard pitch.



- **Dou Pitch** (Edwardian/Victorian design) have standard of 25° and a range between 15° to 35°

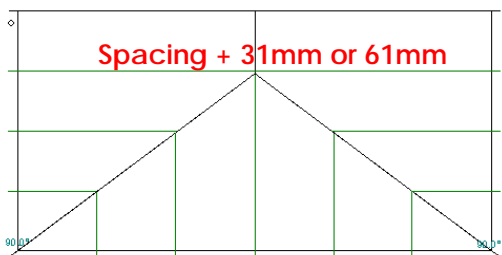
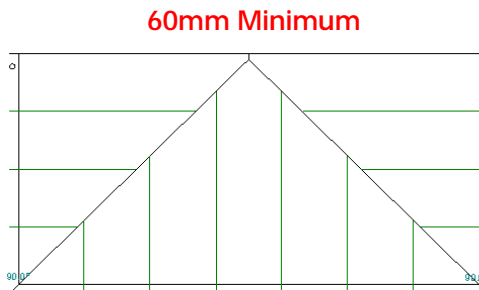
- The **Pitch Difference Limitation** is 10° over a single hip bar on both Mono and Dou style roofs.

# SYNSEAL CONSERVATORY TRAINING

## Ridge/Wallplate Lengths

The guidelines for the ridge lengths are as follows:

- Single Edw/Victorians designs must have a ridge length of at least **60mm** in order to incorporate the End Rafterers.



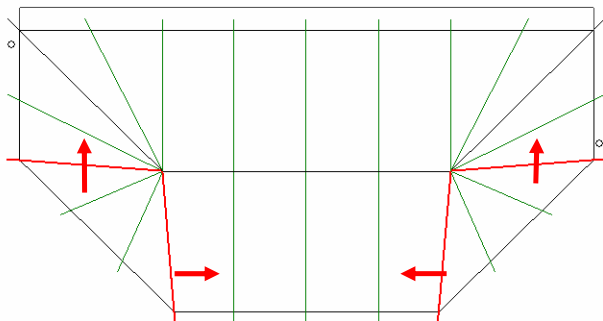
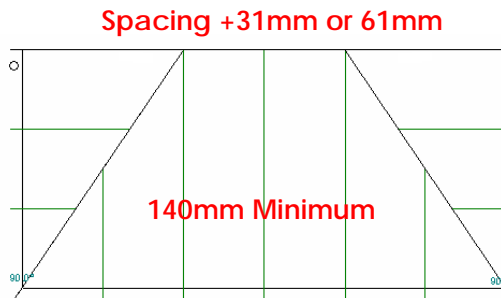
- Ridge lengths must be **extended to accommodate a pair of supporting rafters** in situations where ridges longer than 60mm are required. The length must be either 31mm longer than the spacings leading up to the last pair of supporting rafters or line through exactly.

In the event of a Tiebar being reqd then the 31mm is extended to **61mm** to allow enough room on the ridge for the Tiebar bracket. In some cases it may still be possible to fit a Tiebar in situations where the last pair of supporting rafters line through exactly with the end of the ridge, using the **XTBRC1 (Tiebar to Radius End Connector)**.

Side Section Pitch	Front Section Pitch
15° to 23°	a 10° Pitch Difference
24°	15° to 27°
25°	15° to 27°
26°	16° to 28°
<b>26.1° to 35°</b>	<b>Not Possible with XTBRC1</b>

**NOTE:** The XTBRC1 will only work correctly if the roof pitches fall into the above table

- Hipped Lean-to designs have similar rules regards the wallplate length in cases where rafters are positioned on each end of the wallplate. The wallplate length should match exactly the size of the rafter spacing or plus 31mm (**61mm if the rafters are bolstered**)



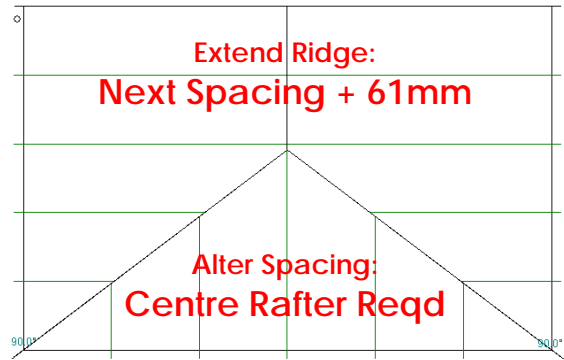
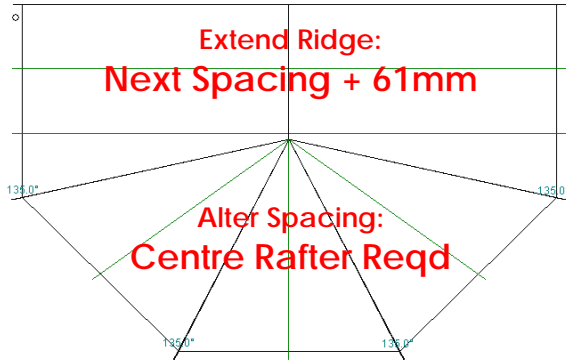
- In some designs such as wide fronted Victorians to boxgutter, the position and length of the ridge may need to be altered due to the direction of the hips bars. The direction of these hips must not run backwards to the eaves beam from the point of origin or radius end, as shown in the design to the left. In these cases the ridge length must be shortened and even offset to ensure the hips are no more than 90° to the eaves beam.

# SYNSEAL CONSERVATORY TRAINING







## Wide Span Roofs – Edwardian & Victorian Roofs over 6000mm wide or 5000mm in Glass

The guidelines for Wide Span Roofs are as follows:

- Wide Span Roof must have a ridge which is supported at the Radius End with a pair of Transoms. In most cases this will require the Ridge to be extended to the next rafter spacing plus 61mm to allow for a Tiebar.



- Rafter Spacings in the front facet must also be altered in a Wide Span situation, to ensure that there is always a Center Rafter which will run up to the Ridge and Radius End at 90° to the Front Eaves Beam. This will supply further support to this critical area.
- All Tied Rafters must be upgraded one Bar Spec where possible. (Tied Rafters can not be Bolstered)
- When designing Wide Span Roofs, due to the huge amounts of thrust being applied down the length of the Hip Rafters, consideration must be given to the Eaves Corner Connection as well as the Radius End and Ridge. To add support to this critical area, extra Internal Eaves Cleats must be added to each of these corner connections along with the correct fixing screws as detailed below (One Cleat and four Screws per corner)

	Part Reference	Description	Image	Qty. Req.
Georgian	XSC2-90	90° internal eaves beam to eaves beam bracket		2
	XM48-12	external eaves beam bracket screws / ridge carriage self drilling screws		8
3 Seg Vic	XSC2-135	135° internal eaves beam to eaves beam bracket		4
	XM48-12	external eaves beam bracket screws / ridge carriage self drilling screws		16
5 Seg Vic	XSC2-150	150° internal eaves beam to eaves beam bracket		6
	XM48-12	external eaves beam bracket screws / ridge carriage self drilling screws		24

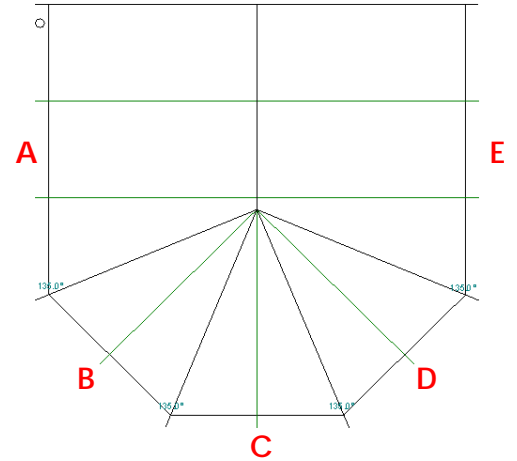
- Wide Span Roofs must only be designed as standard single hipped Edwardian and Victorians. Gable, Double Hipped, Hybrid and Out of Square Roof Designs should only be manufactured with the approval of Synseal Conservatory Technical.

# SYNSEAL CONSERVATORY TRAINING

## Number of Down pipes

The guidelines for the number of down pipes is as follows:

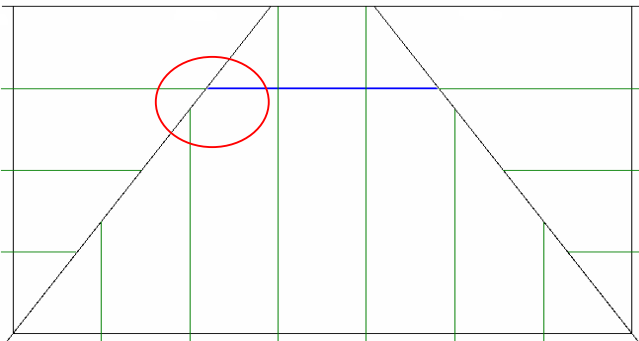
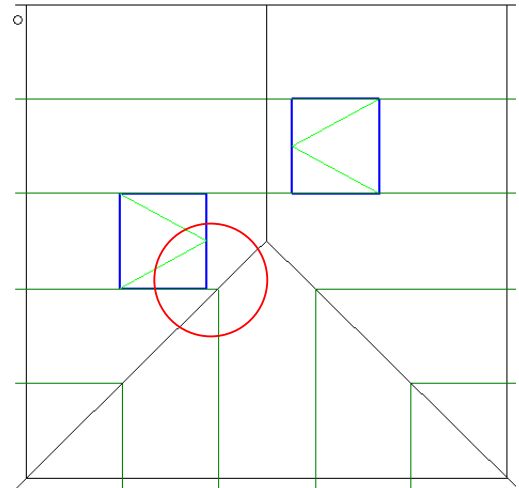
- One down pipe per 12 metres of eaves beam and gutter.  
e.g.  $A + B + C + D + E = \text{Result} \div 12,000 = \text{DP No.}$
- A minimum of two down pipe for roof designs that incorporate Boxgutters or Valleys



## Roof Vents and Muntin Bar Positions

These are the guidelines when designing roofs that include roof vents:

- The polycarbonate size for above the vent is **200mm as standard with a minimum requirement of 100mm** to ensure that the opening vent doesn't interfere with the ridge.
- Vents which are positioned on jack rafters are subject to the same 100mm limitation at the point indicated on the drawing to the right.
- The Roof Vent width must always span the full width of the rafter spacing to ensure that the vents are supported by the rafters.
- The Roof Vent height is **800mm as standard with a minimum of 500mm and a maximum of 1050mm**
- The polycarbonate sizes for below the vent have a **minimum requirement of 150mm** to ensure vent doesn't interfere with the eaves beam.



- Muntin bars are used to join two sections of glass together in the event that the full size exceeds the maximum size possible for manufacture. These should be positioned either centrally (creating two units of equal length) or positioned to line up with jack rafters for aesthetical reasons. **Muntin bars should be used in the larger units only, smaller units should be made whole wherever possible.**

Max Glass Sizes:

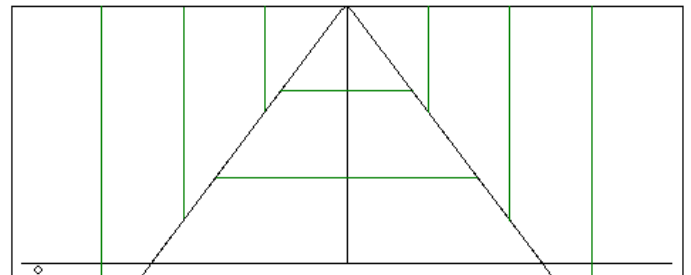
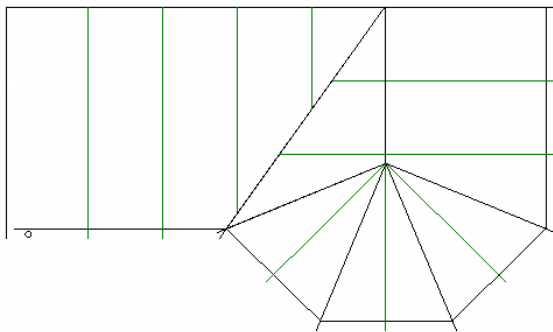
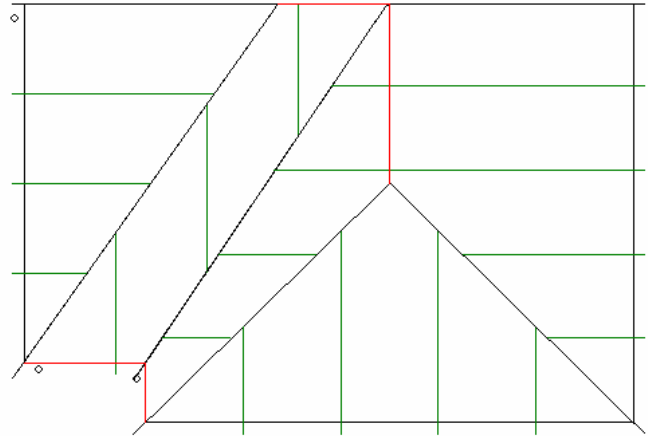
6mm Toughened / Laminated	4mm Toughened / Toughened
Up to 600mm wide – 2800mm max length	Up to 600mm wide – 3000mm max length
Up to 650mm wide – 2700mm max length	Up to 650mm wide – 3000mm max length
Up to 700mm wide – 2600mm max length	Up to 700mm wide – 3000mm max length
Up to 750mm wide – 2500mm max length	Up to 750mm wide – 3000mm max length
Up to 800mm wide – 2400mm max length	Up to 800mm wide – 3000mm max length
Up to 850mm wide – 2300mm max length	Up to 850mm wide – 3000mm max length
Up to 900mm wide – 2200mm max length	Up to 900mm wide – 2800mm max length
Up to 950mm wide – 2100mm max length	Up to 950mm wide – 2600mm max length
Up to 1000mm wide – 2000mm max length	Up to 1000mm wide – 2500mm max length

# SYNSEAL CONSERVATORY TRAINING

## Valley Return Limitations

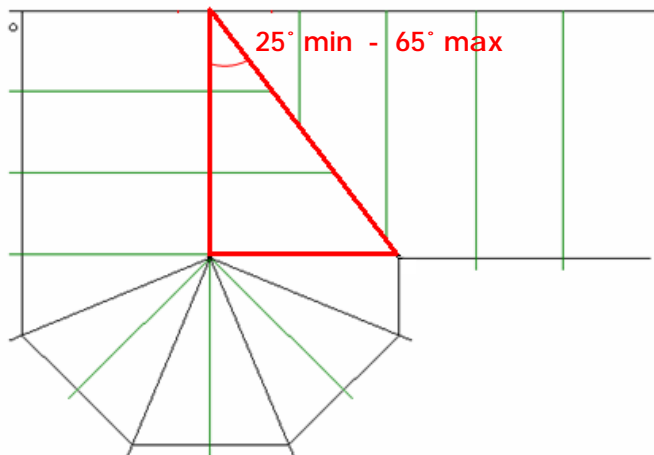
These are the guidelines for the Valley Return, which should be considered when designing any roof containing a valley:

- There is a **minimum length of 305mm** required at each of the 4 points highlighted in red on the roof design shown to the right. This is to ensure that there is enough space for both the valley body and wings at either end and the required gutter corners.



- Zero Return or Inline roof designs are also possible as shown above

## Valley Angle Limitations



These are the guidelines for the Valley angle which should also be considered when designing any roof containing a Valley:

- The angle created between the ridge and the valley (shown on the roof design to the left) **must be with in the range of 25° to 65°** to ensure that the valley overhang doesn't overshoot the guttering.

The Valley Angle is dependant the width of the Edw/Victorian section and the depth of the lean-to section. Full details on how to calculate the valley angle in on page 3.

# SYNSEAL CONSERVATORY TRAINING

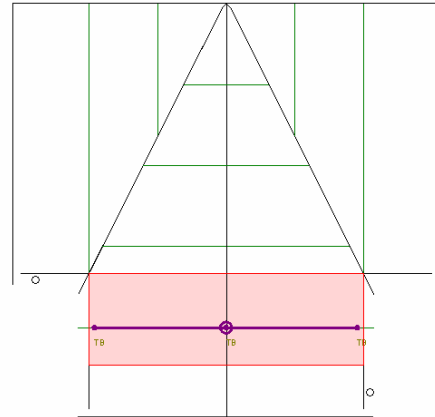
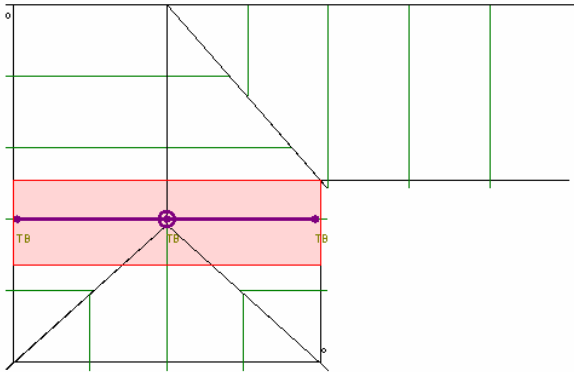
## Tie Bars on Standard P/T Shape Roofs

These are the guidelines for deciding where to fit Tie Bars on Standard P/T Shape roofs.

**All P/T Shape roofs require at least one Tie Bar**, but due to the varied nature of these roofs, there are 3 possible areas where Tie bars can be positioned. The details and rules for using these positions are detailed below in the preferred order, the first of which should be used wherever possible. The second and third options should only be used as alternatives if the previous option is not feasible:

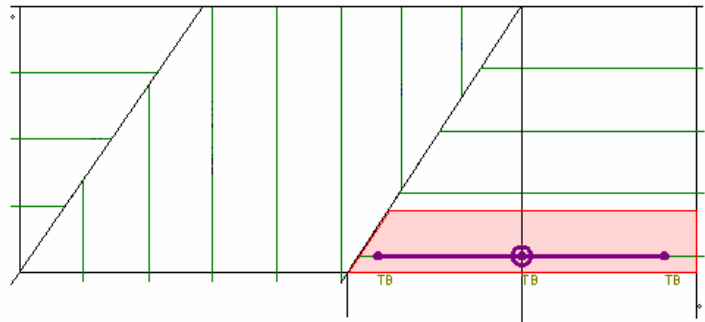
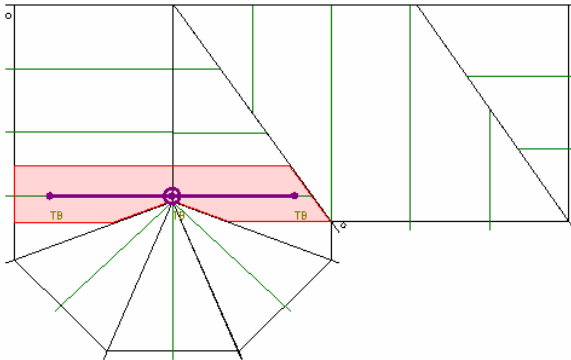
- **Edw/Victorian section spanning from Eaves to Eaves.**

In this situation the tie bar position must be no more than 1000mm from the return of the eaves beam, as indicated here in red.



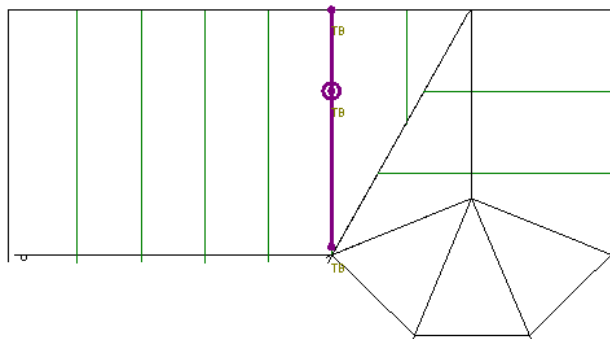
- **Edw/Victorian section spanning from Eaves to Valley.**

In this situation the tie bar should be positioned in line with the front edge of the lean-to section or within a fourth of the lean-to projection, as indicated here in red.



- **Lean-to section spanning from Wall to Valley.**

In this situation the tie bar should be positioned in line with the return of eaves beam and is only permitted if the Edw/Victorian section is within the standard tie bar rules.

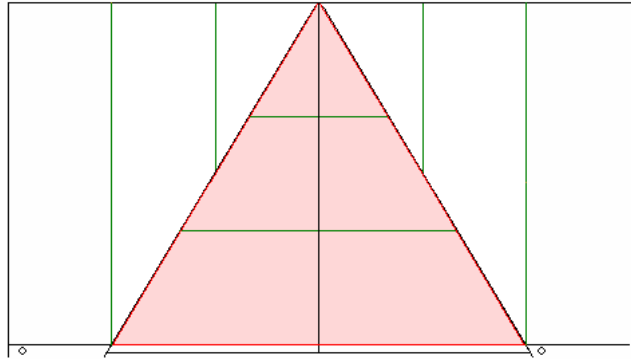




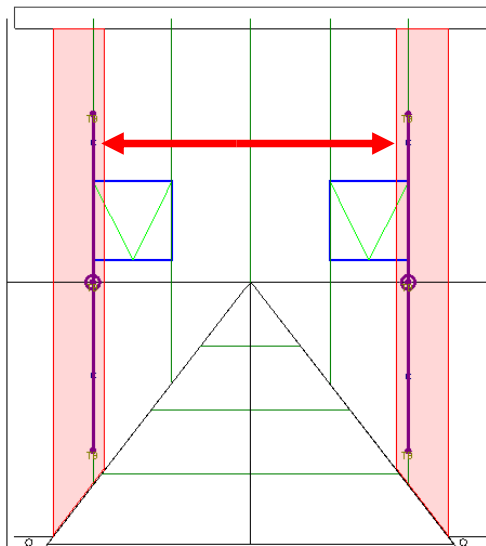
# SYNSEAL CONSERVATORY TRAINING

## Tie Bars on In-Line T Shape Roofs

When designing In-Line T Shape roofs with gable fronts, the guidelines for fitting Tie bars is slightly different from that of standard T shape designs:



- In-Line T Shape roof designs **only require Tie Bars** in the event that the Gable section of the design (indicated above in red) exceeds the existing Tie Bar rules for standard Gable designs. In the event of a Tie Bar being reqd, it must be position in accordance with the "Edw/Victorian section spanning from Eaves to Valley" rule detailed on page 15.
- Due to this Tiebar rule, **all In-Line T Shapes must be designed using the "Gable Support System"**. As the gable support system inc "Infill Wedges" that work only on pitches 25° - 35°, customers must be informed that they must manufacture their own infill wedges in the event of requesting a pitch outside this range.



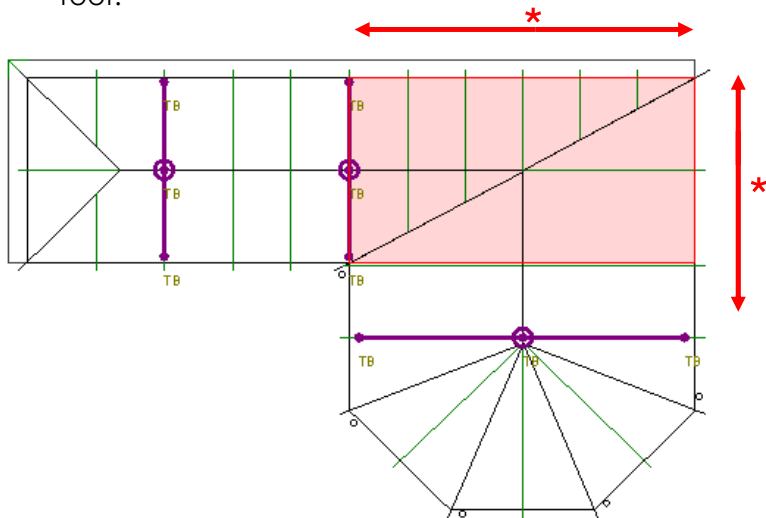
- In-Line T Shape to Boxgutters designs **must always have at least one Tie Bar in each of the back sections**. The position for these Tie Bars must be in accordance with the "Edw/Victorian section spanning from Eaves to Valley" rule detailed on page 15. In addition the distance between these Tie Bars must also not exceed that of the existing Tie Bar rules, as indicated above. Finally the front Gable section will follow the same rules as the standard In-line T Shape designs, making Gable Support a must.

# SYNSEAL CONSERVATORY TRAINING

## Tie Bars on P/T Shape Roofs to Boxgutter

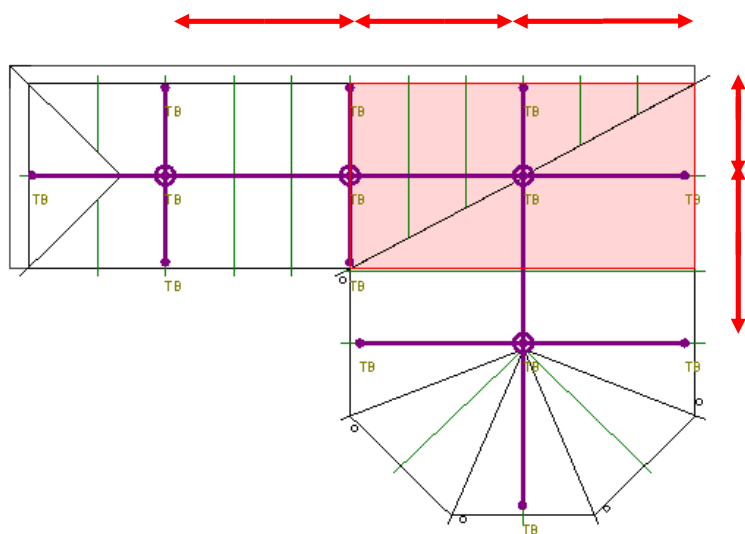
These are the guidelines for deciding where to fit Tie Bars on P/T Shape to Boxgutter designs:

As with standard P/T Shape roof designs, Tie Bars must be included but due to the varied nature of the these roof designs, the location for these Tie Bars may change drastically from roof to roof.



- The size of the area surrounding the corner of the floating L Shaped Ridge, as indicated here in red, must be taken into account when deciding where to fit Tie Bars. Ideally a single Tie Bar should be positioned on both the front and inner edge of this red area, lining up directly at the point where the valley meets the corner of the eaves beam.

- Additional Tie Bars must be included at each end of the ridge as close to the final point as possible. The existing Tie Bar positioned on the edge of the red area can be moved along the eaves beam and into this position in accordance with the **“Edw/Victorian section spanning from Eaves to Eaves”** rule detailed on page 15.
- Additional Tie Bars must also be included if the distance between the existing Tie Bars and the outer edge of the red area\* exceeds the maximum distance between Tie Bar rule. The existing Tie Bars positioned on the edge of the red area can be moved onto the valley in accordance with the **“Edw/Victorian section spanning from Eaves to Valley”** rule, in order to decrease this distance.



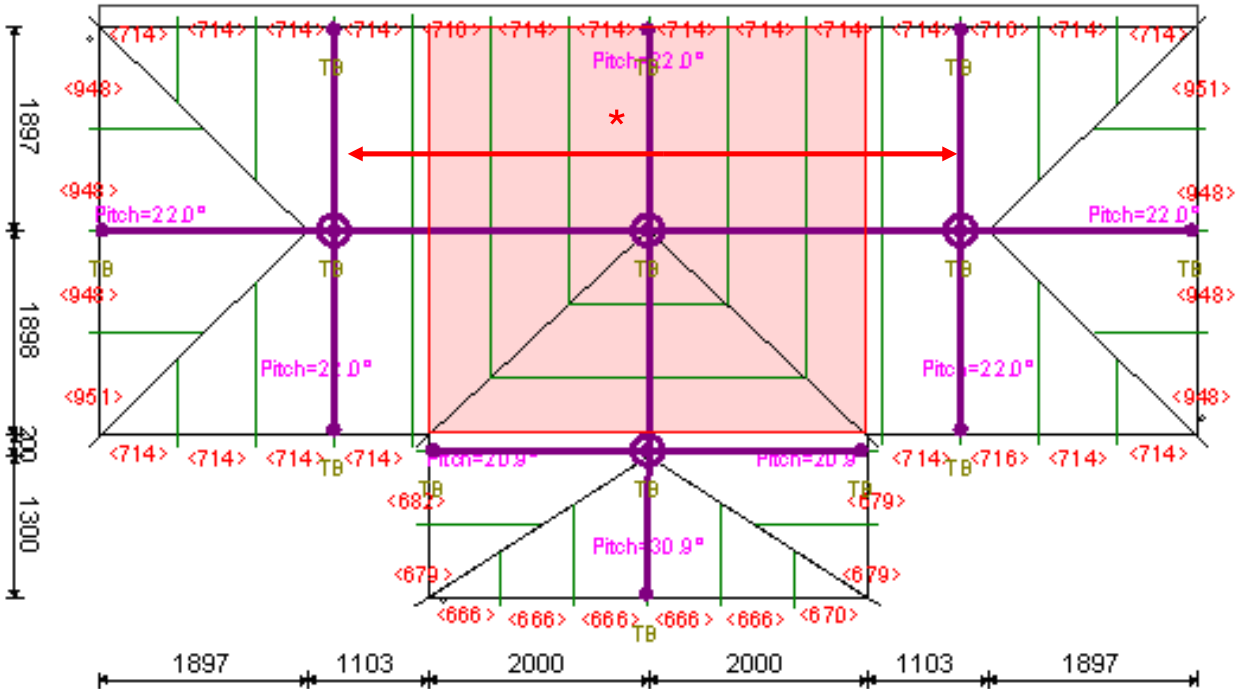
- In the event that the red area exceeds the maximum distance between Tie Bars, and additional Tie bars can not be correctly positioned. Shown here is a **5 Way Tie Bar system**, which can be included to Tie rafters that line through with the corner of the ridge as shown here.
- Finally check to ensure that the distance between any of the Tie Bars is in accordance with the existing maximum distance between Tie Bar rule.

# SYNSEAL CONSERVATORY TRAINING

## Case Studies – Complex Designs Explained

On the following pages will be found a number of Complex Roof Designs, below each of these designs will be a case study, explaining certain aspects of the design such as Tie Bar Positions, Roof Pitch and Rafter Position etc.

### Case Study 1 – T Shape to Boxgutter. Glazed with 35mm Polycarbonate



Valley Angle -  $2000 \div 1898 = \text{INV TAN } 46.5^\circ$

**Tie Bars** – The most ideal position for Tie Bars would be on both side edges and the front edge of the red area, resulting in all 3 tie bars lining up at the point where the valley meets the eaves beam. The 1<sup>st</sup> & 2<sup>nd</sup> Tiebars with in the back section have been moved out along the eaves in order to fit to rafter closest to the radius end, with in 1000mm of the return of the eaves beam. The 3<sup>rd</sup> Tiebar within the front section has been moved forward along the eaves due to rafter spacing, once again this is with in a 1000mm of the return of the eaves beam and is the preferred position. The distance between the 1<sup>st</sup> and 2<sup>nd</sup> Tiebars\* 714mm x 8 = 5712mm which is greater then 4000mm, the maximum distance between Tiebars allowed for a 3000-4000 Edw/Victorian span. Due to the rafter spacing and the size of the red area it will not be possible to add additional Tiebars to bring this distance with in 4000mm without positioning the Tiebar more then a fourth up the valley. As a result a final Tiebar has been positioned running through the centre of the roof to create a 5 Way Tiebar System which reduces the distance between Tiebars to 714mm x 4 = 2856mm.

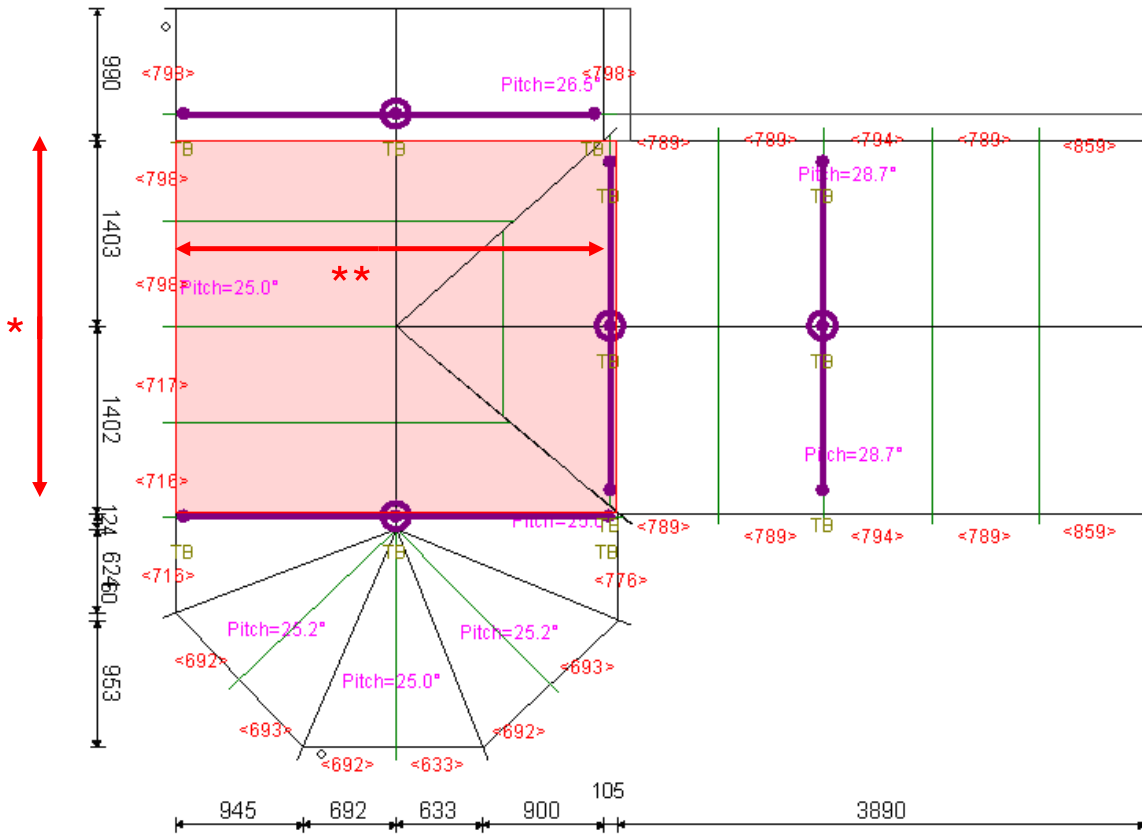
**Pitch** – In order to achieve the 3<sup>rd</sup> Tiebar position with in the front section, it will be necessary to extend the virtual ridge to meet the tied rafter plus 61mm. The roof pitch has then been dropped from the standard pitch of 25° to reduce the pitch difference over the hip bars in the front section to be with in the 10° limitation. As a result the pitches calculate to 20.9° - 30.9° on the front section and a pitch of 22° on the back section.

**Rafter Position** – Due to the pitch difference over the hip bars on the front section exceeding 5°, it has been necessary to position a central rafter lining through with the vertical ridge.

# SYNSEAL CONSERVATORY TRAINING

## Case Studies – Complex Designs Explained Cont...

### Case Study 2 – T Shape to L Shape Boxgutter. Glazed with 24mm Glass Units



Valley Angle –  $1403 \div 1638 (633+900+105) = \text{INV TAN } 40.9^\circ$

**Tiebar** – The most ideal position of the Tiebars would be the top and bottom edge and right hand edge of the red area, resulting in all 3 tie bars lining up at the point where the valley meets the eaves beam. The 1<sup>st</sup> Tiebar in the back of the Victorian section has been moved up along the eaves beam, with in 1000mm of the return of the eaves beam due to the spacing of the rafters.

The 2<sup>nd</sup> Tiebar in the front of the Victorian section has been moved just in front of the edge of the red area, once again due to the spacing of the rafters. This position is also with in 1000mm of the return of the eaves beam and as close to the radius end as possible.

The 3<sup>rd</sup> Tiebar on the side section has been moved back very slightly onto the valley, due to the spacing of the rafters. This position is as close to the edge of the red area as possible without being more than a fourth up the valley.

Additional or 5 Way Tiebars will not be necessary on Victorian section as the distance between the 1<sup>st</sup> and 2<sup>nd</sup> Tiebars\*  $798\text{mm} + 798\text{mm} + 717\text{mm} + 718\text{mm} = 3031\text{mm}$  is with in the maximum of 3100mm for a 3000-4000 Edw/Victorian span. The same can be said of the distance from the outer edge of the red area to the 3<sup>rd</sup> Tiebar\*\*  $945\text{mm} + 692\text{mm} + 789\text{mm} + 789\text{mm} = 3215\text{mm}$  which is with in the maximum of 3600mm for a Up to 3000mm Edw/Victorian span.

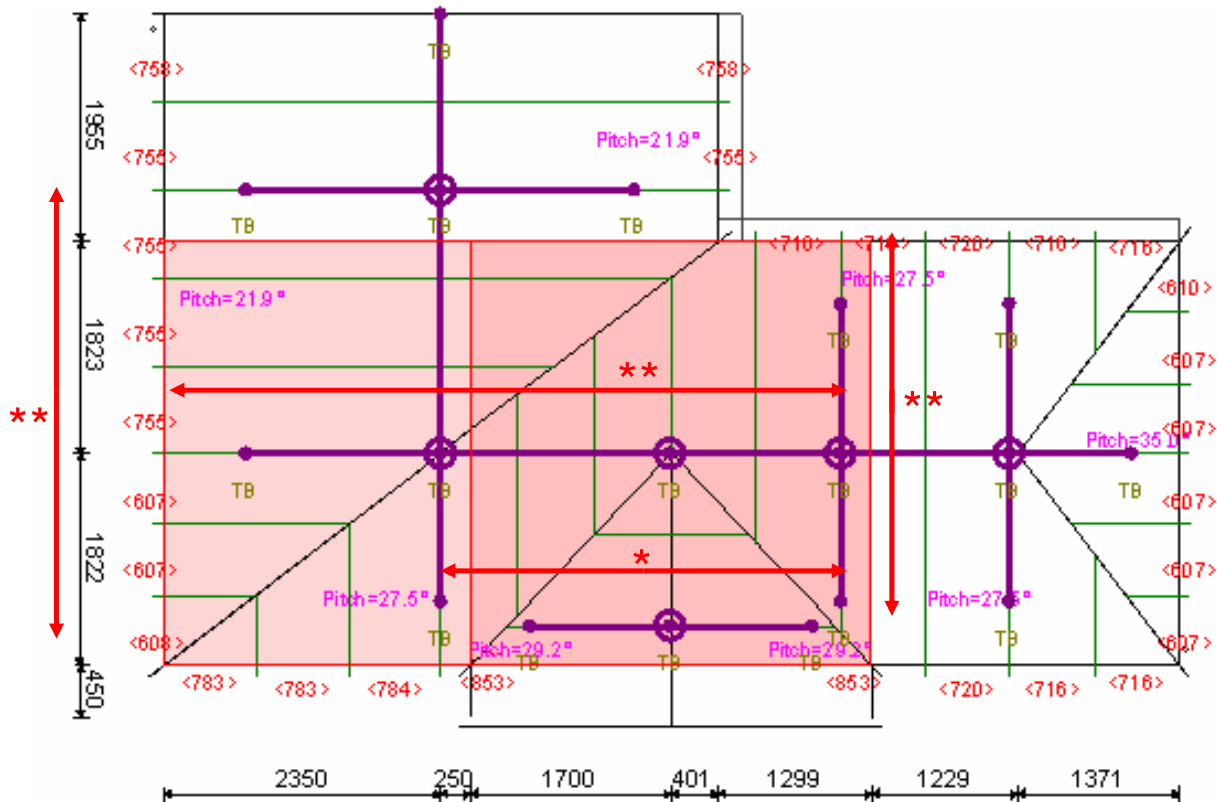
Additional Tiebars will be necessary on the side section as the distance between the 3<sup>rd</sup> Tiebar and the gable section  $789\text{mm} + 789\text{mm} + 794\text{mm} + 789\text{mm} + 789\text{mm} = 3950\text{mm}$  exceeds the fore mentioned maximum of 3600mm.

**Pitch** – The pitch in the Victorian section has been set at the standard of  $25^\circ$  to ensure that all other section are greater rather then lower then this standard pitch. A pitch of  $25^\circ$  or greater is even more imperative on the side section, as this section includes the Gable Support System.

# SYNSEAL CONSERVATORY TRAINING

## Case Studies – Complex Designs Explained Cont...

### Case Study 3 – T Shape Gable to L Shaped Boxgutter. Glazed with 35mm Polycarbonate



Valley Angle – 1<sup>st</sup> Angle in back section  $1823 \div 2351$  ( $250+1700+401$ ) = INV TAN 37.8°  
 2<sup>nd</sup> & 3<sup>rd</sup> Angle in front section  $1700 \div 1822$  = INV TAN 43°

**Tiebar** – The ideal Tiebar positions would be the bottom, right & left hand edge of the **darker** red area, resulting in 3 tiebars lining up at the point where the 2 valleys meet the eaves on the front gable section. The 1<sup>st</sup> Tiebar in the front gable section has been moved up slightly onto the valley, due to the rafter spacing. This position is as close to the edge of the **darker** red area as possible without being more than a fourth up the valley.

The 2<sup>nd</sup> Tiebar on the left hand section has been moved out along the eaves, with in 1000mm of the return of the eaves due to rafter spacing. This position is as close to the edge of the **darker** red area as possible, but as this position is in-line with the corner of the virtual ridge, there will be no alternative but use a 5 Way Tiebar System for this design.

The 3<sup>rd</sup> Tiebar on the right hand section has also been moved up slightly onto the valley, due to the rafter spacing. This position is as close to the edge of the **darker** red area as possible, but without being more than a fourth up the valley and has been chosen even though the next spacing to the right is Eaves to Eaves and with in a 1000mm of the return of the eaves. This makes the front gable section possible by reducing the distance between the 2<sup>nd</sup> & 3<sup>rd</sup> Tiebar\*  $250\text{mm} + 1700\text{mm} + 710\text{mm} + 710\text{mm} = 3370\text{mm}$  with in the maximum of 4000mm for a 3001-4000 Edw/Victorian span, doing away with need for a central 5 Way Tiebar. An additional Tiebar will also be necessary on the right hand side section to be positioned as close to the radius end as possible.

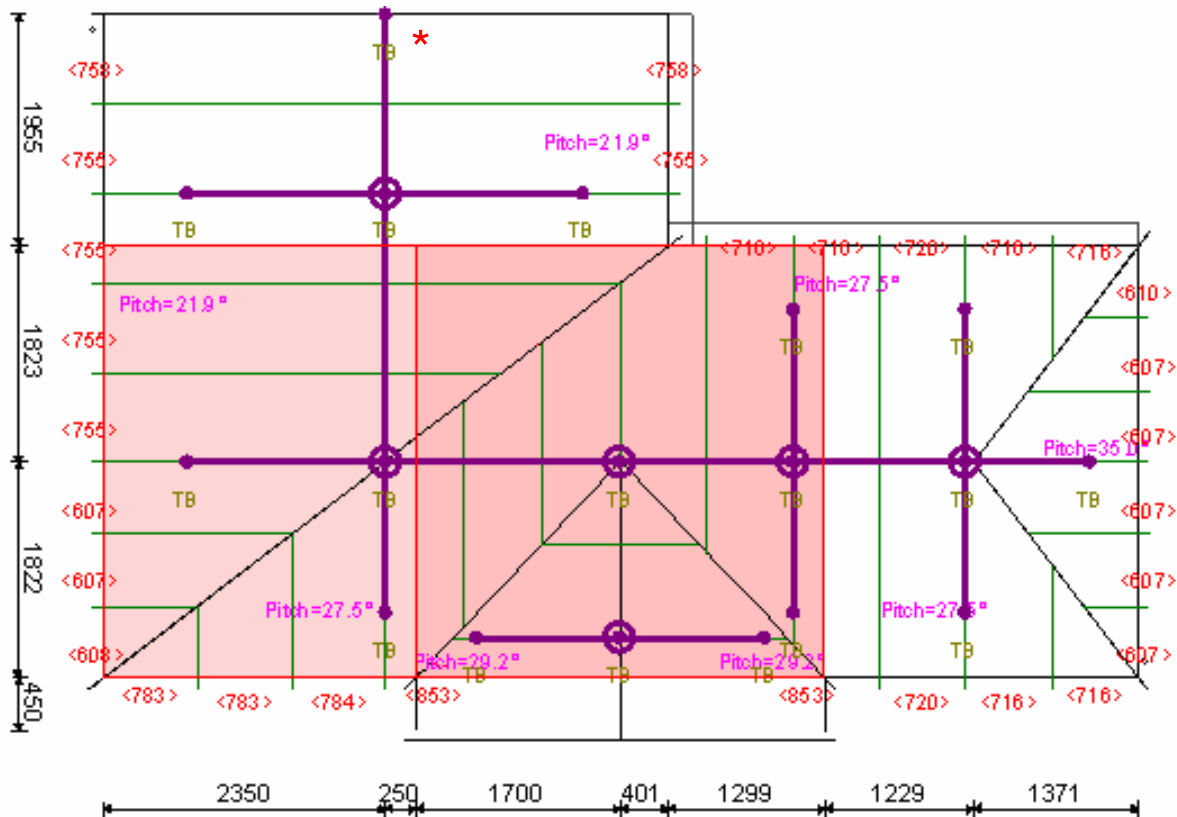
A final addition Tiebar will also be necessary with in the back section as close to the edge of the red area as possible, lining up at the point where the valley meets the boxgutter. As this area is supported by the house wall via a boxgutter, the eaves to eaves 1000mm rule can be flexible to enable Tiebar positions such as the fore-mentioned 3<sup>rd</sup> Tiebar.

The positioning of the 5 Way Tiebar system, will reduce the distances between the Tiebars and the outer edges of the red areas\*\*, which all must be with in the maximum of 4000mm for a 3001-4000 Edw/Victorian span.

# SYNSEAL CONSERVATORY TRAINING

## Case Studies – Complex Designs Explained Cont...

### Case Study 3 – T Shape Gable to L Shaped Boxgutter. Glazed with 35mm Polycarbonate



**Tiebar Wall Plate bracket (XTBWP)** must be supplied in order to anchor a Tiebar in the event of a 5 Way system meeting the house wall\*, for example with in the apex of the back gable section against the house wall on the above design.

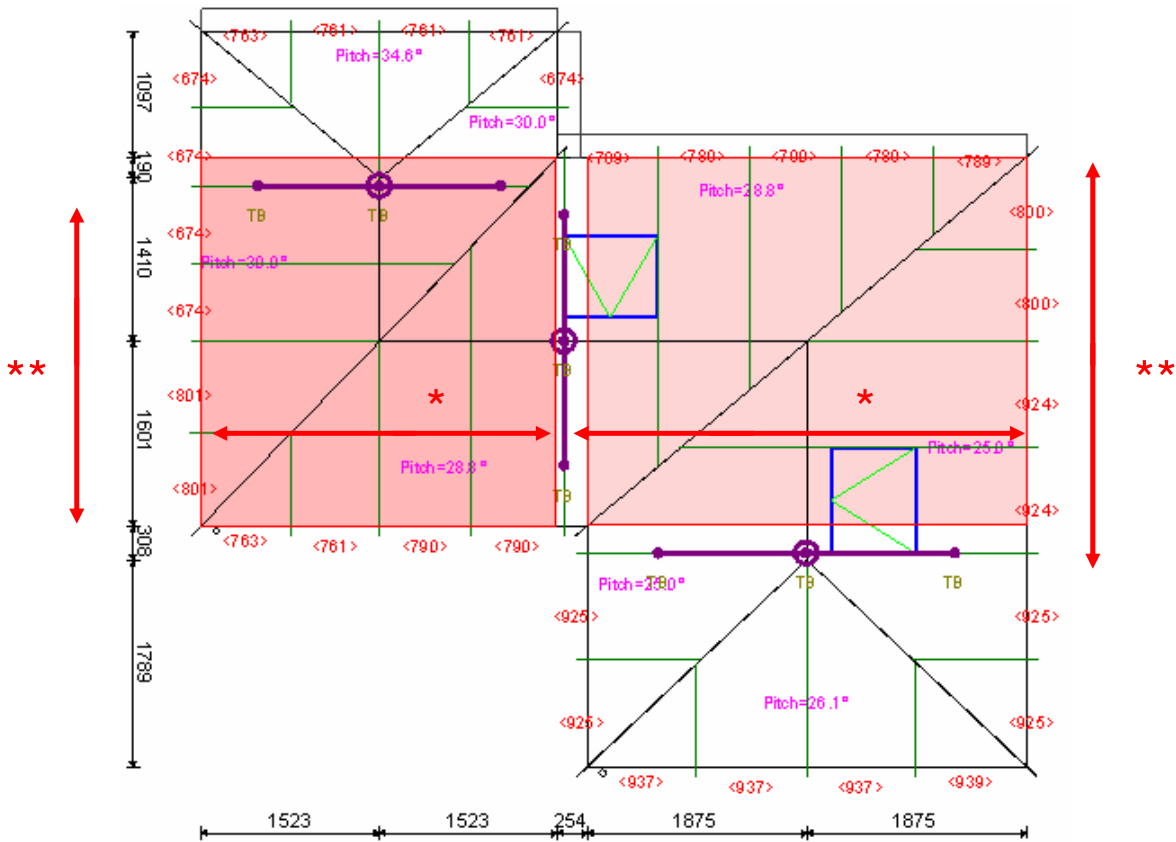
**Pitch** – In order to achieve the additional Tiebar position under the radius end on the right hand side it has been necessary to extend the horizontal ridge to meet the tied rafter plus 61mm. As a result, the lowest pitch on the left hand section has been dropped from the standard of 25° to 21.9° in order to bring down the pitch on the far right hand section to with in the 35° maximum allowed for a duo pitch roof.

**Rafter Position** – Due to the pitch difference over the hip bars on the right hand section exceeding 5°, it has been necessary to position a central rafter lining through with the horizontal ridge.

# SYNSEAL CONSERVATORY TRAINING

## Case Studies – Complex Designs Explained Cont...

### Case Study 4 – Z Shape to Boxgutter. Glazed with 35mm Polycarbonate



**Valley Angle** – 1<sup>st</sup> Angle in back section  $1523 \div 1600 (190+1410) = \text{INV TAN } 43.6^\circ$   
 2<sup>nd</sup> Angle in front section  $1875 \div 1601 = \text{INV TAN } 49.5^\circ$

**Tiebar** – The ideal Tiebar positions would be both the top and right hand edge of the darker red area, and the bottom and left hand edge of the lighter red area. This will result in 2 tiebars lining up at the point where the valley meets the boxgutter and 2 tiebars lining up at the point where the valley meets the eaves beam. The 1<sup>st</sup> Tiebar in the back section has been moved up slightly onto the valley, due to the rafter spacing. This position is as close to the edge of the **darker** red area as possible without being more than a fourth up the valley.

The 2<sup>nd</sup> and 3<sup>rd</sup> Tiebars in the middle section have been merged into one, as there is single rafter positioned with in 1000mm of both edges of red areas, and the return of the eaves beam and boxgutter. This single position is also made possible as the distance from this position to the outer edge of both red areas \* 789mm x 5 = 3945mm and 763mm + 761mm + 790mm + 790mm = 3105mm are within the maximum of 4000mm for a 3001-4000 Edw/Victorian span.

The 4<sup>th</sup> Tiebar position in the front section has been moved down along the eaves beam, with in 1000mm of the return of the eaves beam due to rafter spacing or as close to the red area as possible. Finally there will be no need for additional or 5 Way Tiebars as the distance from the Tiebars to the outer edge of the red areas \*\* 801mm + 801mm + 674mm + 674mm = 2950mm and 800mm + 800mm + 925mm + 925mm = 3450mm are within the maximum of 4000mm for a 3001-4000 Edw/Victorian span. Plus the 1<sup>st</sup> and 4<sup>th</sup> Tiebars are also positioned as close to the radius end as possible.

**Pitch** - The pitch in the front section has been set at the standard of 25° to ensure that all other sections are greater rather than lower than this standard pitch. Both sections of vertical ridge have been extended resulting in a pitch in the back section of 34.6° and 26.1° in the front section. This is to make the 1<sup>st</sup> and 4<sup>th</sup> Tiebar positions possible.



All information in this manual is provided for guidance only.

Synseal Extrusions Ltd cannot be held responsible for the way in which the information in this manual is interpreted.

We reserve the right to alter specifications and descriptions without prior notice as part of our policy of continual development.

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