Sundance Supply - Framing Guide
To order Polycarbonate & Install system see - sundancesupply.com

Note: We do not sell framing or ridge flashing material, shop local.

Introduction: Focus is on wood framing, but frames can also be fabricated from steel or aluminum. Layout is the same for all frame types.

Select Polycarbonate: Web site has full information on polycarbonate. Options range from 6mm 2-wall to 25mm 5-wall. The thicker the sheet the higher the insulation and strength. Thick sheets require less framing to support the load. Ultimately the frame supports the load. Polycarbonate is simply a sheet that gets fastened to the frame.

Clear offers maximum light and heat transmission, best for for greenhouses and solar applications. Note that clear is not 100% optically clear. The channels in the polycarbonate diffuse the light, offering even lighting. Bronze and white (also called opal or ice) reduce light and heat. See web site for light transmission. White is more opaque and is often used to hide dirt that may accumulate on the roof or images that are behind the polycarbonate. White also reflects the suns rays & will not accumulate heat the way bronze can. Bronze will reduce light and heat, but is most often an esthetic choice. Bronze expands & contracts more & may create noise on large sheets.

Install System Selection: See below and web site or Install Guides of the Cap & Trim and Base & Cap Systems to determine which system is best for your application.

Both Systems use 8 ft. U-Profile to close ends of sheet and 8 ft. Corner on wall and roof corners. Splice as required. Main difference is how the sheets are joined. Both Systems also use gasket washer screws to attach through the sheet. Screw locations include perimeter of roof or wall area, body of sheet and along both surfaces of Corner Trim.

Cap & Trim System

- Cap available in 8 ft. lengths only. Simply splice to do longer runs.
- System most often used on smaller projects with Stud & Rafter framing.
- Lower cost option. - Polycarbonate set directly on framing.
- Greater care required for a watertight installation.

Base & Cap System

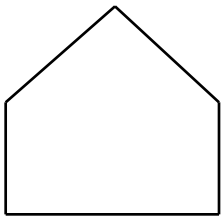
- Base & Cap available in 24 ft. and 8 ft. lengths.
- System can be used on Purlin & Girt or Stud & Rafter framing.

(horizontally running roof purlins & wall girts are set on outer surface of trusses)

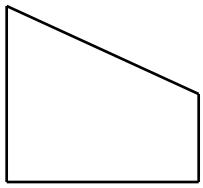
- Higher cost option. - Greater installation flexibility.
- Polycarbonate sits on Base Extrusion at critical sheet joining location.
- Easier watertight installation.

Base & Cap includes screws to attach Base to Frame & Cap to Base. Order screws for perimeter of roof or wall area, body of sheet and along both surfaces of Corner Trim.

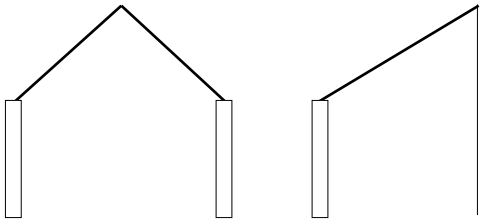
Typical Projects:



Greenhouses &
Pool Enclosures

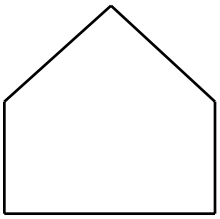


Sunrooms

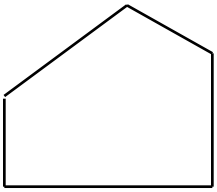


Covered Walkways, Skylights,
Patio Covers, Canopies, etc.

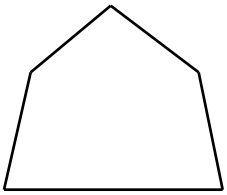
Styles:



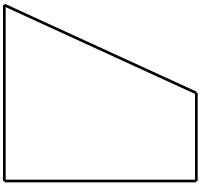
Conventional
Freestanding



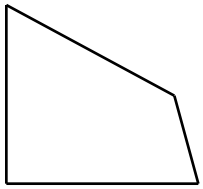
Solar Style
Freestanding



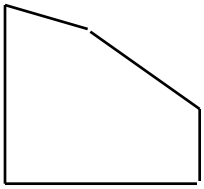
Gambrel Roof
Freestanding



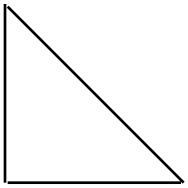
Conventional
Lean-To



Solar Slope
Lean-To



Double Slope
Lean-To



Single Slope
Lean-To

Solar Siting: Position structure with long wall facing true south. True south typically a number of degrees east or west of magnetic south. A compass indicates magnetic south. For locations that are positioned along a imaginary line running from Chicago, IL to Tallahassee, FL, magnetic south is true south. If your location is east of this line, true south is west of magnetic south. For locations west of this line true south is east of magnetic south. In Bangor, ME, true south is 20 degrees west of magnetic south. In Vancouver, WA, true south is 20 degrees east of magnetic south.

If structure orientation within 45 degrees of true south & roof pitch minimum of 4/12 (18 degrees) it will function well as a solar collector. Check for obstructions that cause shade as sun passes overhead. Deciduous trees offer shade during warm months and let in the sun during cooler months. When tracking the sun's path keep in mind that the path is low in the winter and high in the summer. Refer to solar reference books should you wish to be more exacting than these rule-of-thumb guidelines.

Building Permits: It is best to call your local building department before you build. Small freestanding greenhouses usually do not require a permit. Attached models typically require a permit, especially if there is access to the house. Generally these permits are easy to obtain. The information the building department requests will help you make certain your design is sound and inspectors can also be helpful.

Wood Framing: Lumber is an excellent framing material for structures covered with polycarbonate. Redwood, cedar & cypress are rot resistant. We highly recommend sealing high moisture areas of the frame with satin marine grade spar or exterior varnish. This commonly available finish will protect the moisture prone areas, such as top and bottom plate, and any area where polycarbonate sheet comes in contact with the wood frame. This decreases possible wood rot, eliminates wood discoloration and creates barrier between chemicals in pressure treated and polycarb. The smooth, nonporous surface is ideal for placement of a thin coat of ArmorAll, to be placed on areas of frame that come in contact with the polycarbonate, just prior to installation of the sheet. ArmorAll will assist in the free expansion & contraction of the polycarbonate, decreasing possible movement noise.

If you desire a painted frame select dry lumber. Prime and paint on one coat of high quality semi-gloss paint. The semi-gloss provides for easy cleaning. Also, the smooth, nonporous surface is ideal for placement of a thin coat of ArmorAll, to be placed on areas of frame that come in contact with the polycarbonate, just prior to installation of the sheet. Let dry thoroughly, lightly sanding between coats. Assemble frame and apply final coat. White is highly reflective and best for greenhouse use. Make sure to paint butt ends of boards prior to assembly of frame. Select straight kiln dried lumber.

Frame Design for Cap & Trim System: The simplest way to frame for the multi-wall polycarbonate is to set studs and rafters 24-1/8" on-center. This dimension will allow for a slight gap between sheets, required for fasteners and sheet movement. The first & last framing member positioning should be 24-1/8" from outside of framing to center of 1st or last rafter or stud. This lines up the outside edge of the first and last sheets with the outside edge of the first and last rafters and studs.

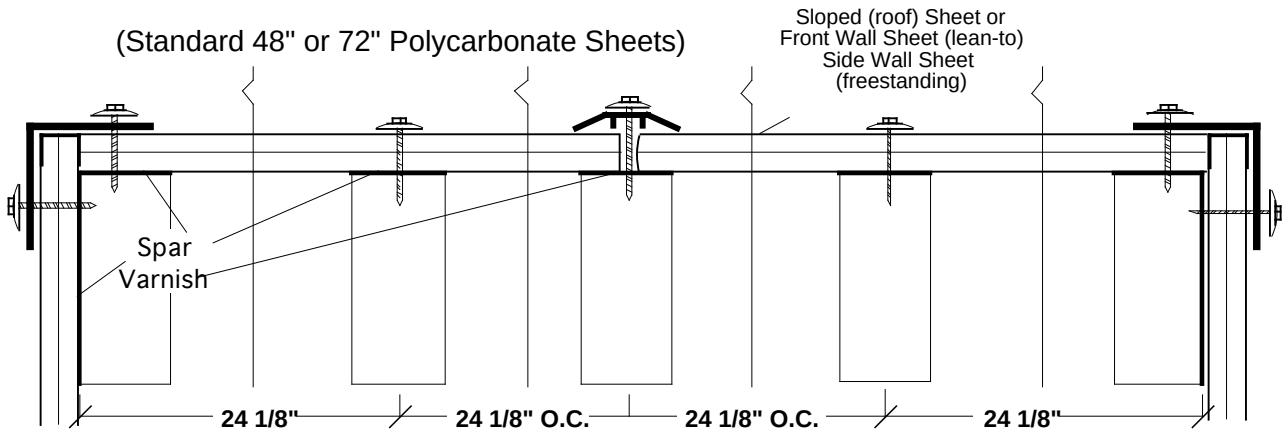
For small greenhouses, frame lumber is typically 2x3's or 2x4's. On larger structures and in areas with high snow loads, take care to make roof framing strong enough to support the load. To decrease rafter size, incorporate a brace or truss in your design, see next page. On long rafter runs, install blocking to keep the rafters straight. Hold blocking 3/8" back from the inner surface of the sheet, allowing for movement of condensation past blocking (see following charts and diagrams).

On large structures designer may want large rafters and studs positioned further apart. Set intermediate rafters & studs 48-1/4" on-center. The first & last framing member positioning should be 48-1/4" from outside of framing to center of 1st or last rafter or stud. Use 48" wide roof sheets, as it is difficult to reach fastening points with 72" sheets. Blocking that supports the sheet is required. To allow for the movement of condensation past blocking set our neoprene spacer at the center of blocking. Select lumber with less height than surrounding frame material and set the blocking back from the outer surface of the adjoining rafter (see following charts and diagrams).

In either case polycarbonate sheet must be supported on all 4 edges with min. 1/2" of sheet bearing on frame. When using sheets that are cut along the width, and no longer have a rib at the edge, position so first rib is supported by a minimum of 1/2" of frame.

The chart on next page provides guidelines for blocking spacing. The chart is provided to address roof snow & wind load, but may also be used as a guide for wall design.

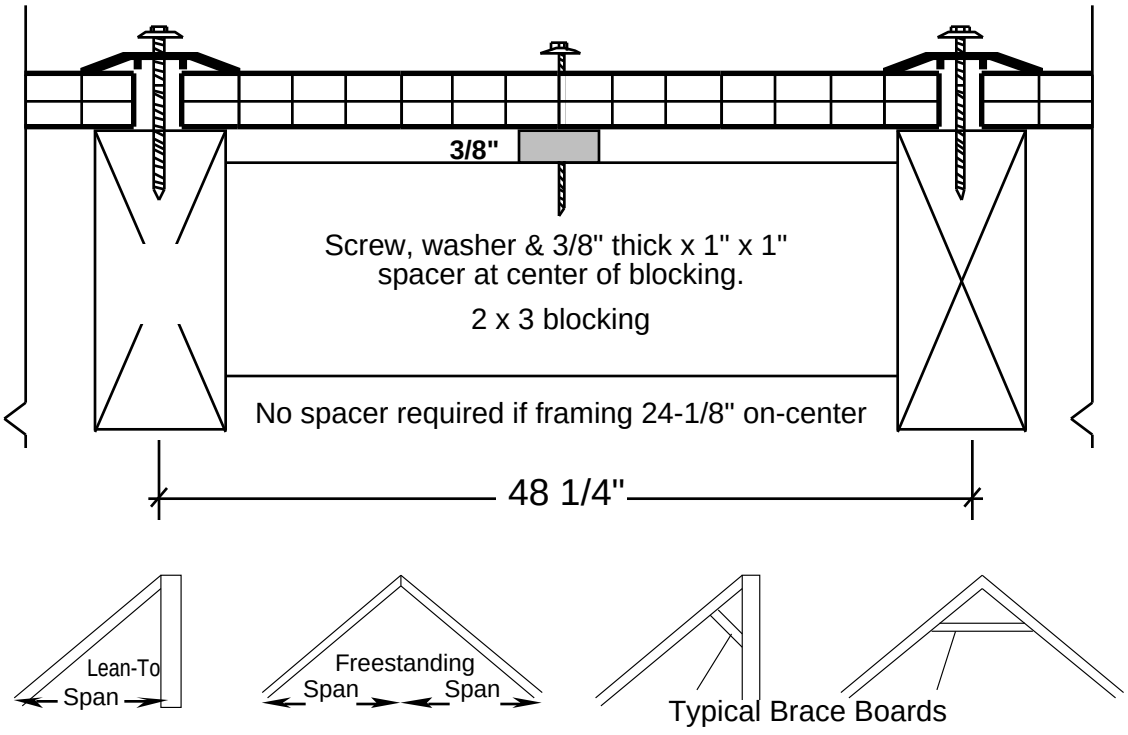
Typical Framing Layout For Cap & Trim Over Wood Frame



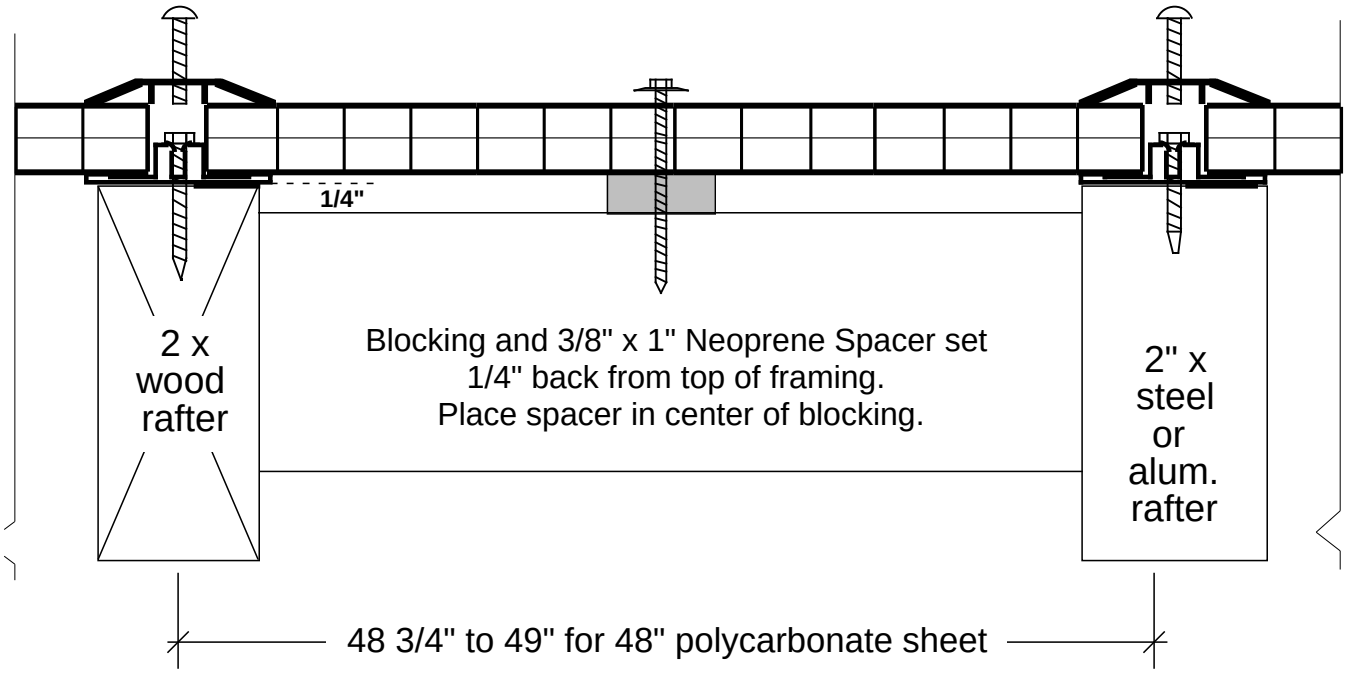
End wall framing determined by wall size. Maintain 1/4" space between sheets. Place studs as needed.

		Blocking Spacing		
Sheet Thickness	**Rafter Spacing**	**35 lb. load**	**45 lb. load**	**60 lb. load**
8mm	24-1/8"	not needed	every 8 ft.	every 6 ft.
8mm	48-1/4"	every 2.5 ft.	every 2 ft.	do not use
16mm	24-1/8"	not needed	not needed	not needed
16mm	48-1/4"	every 4 ft.	every 3 ft.	every 2.5 ft.

Load For Blocking & Rafter Spacing: Load is live (wind & snow) & dead (weight of rafter and what lies on it). 35 lb. is for areas with no snow, little wind. 45 lb. is areas of normal wind & snow. 60 lb. loads, high wind and snow. Roof slopes over 30 degrees (7/12 pitch) the roof span may be increased or rafter size decreased due to a decrease in snow load from the steep slope. Speak to building department for snow load adjustments.



Frame Design for Base & Cap & System: System may be placed on **vertically running rafters and studs (see below).** Dimension from outside of structure to center of first or last framing member and Base is 48-1/2". Dimension between Intermediate framing members and Base is 48-3/4" to 49". Blocking as shown below, when 48 3/4" to 49" spacing used.



Intermediate 48-3/4" to 49" Spacing

			Blocking Spacing	
Sheet Thickness	**Rafter Spacing**	**35 lb. load**	**45 lb. load**	**60 lb. load**
8mm	48-3/4" to 49"	every 2.5 ft.	every 2 ft.	do not use
10mm	48-3/4" to 49"	every 3 ft.	every 2.5 ft.	do not use
16mm	48-3/4" to 49"	every 4 ft.	every 3 ft.	every 2.5 ft.
25mm	48-3/4" to 49"	every 5 ft.	every 4.5 ft.	every 3.5 ft.

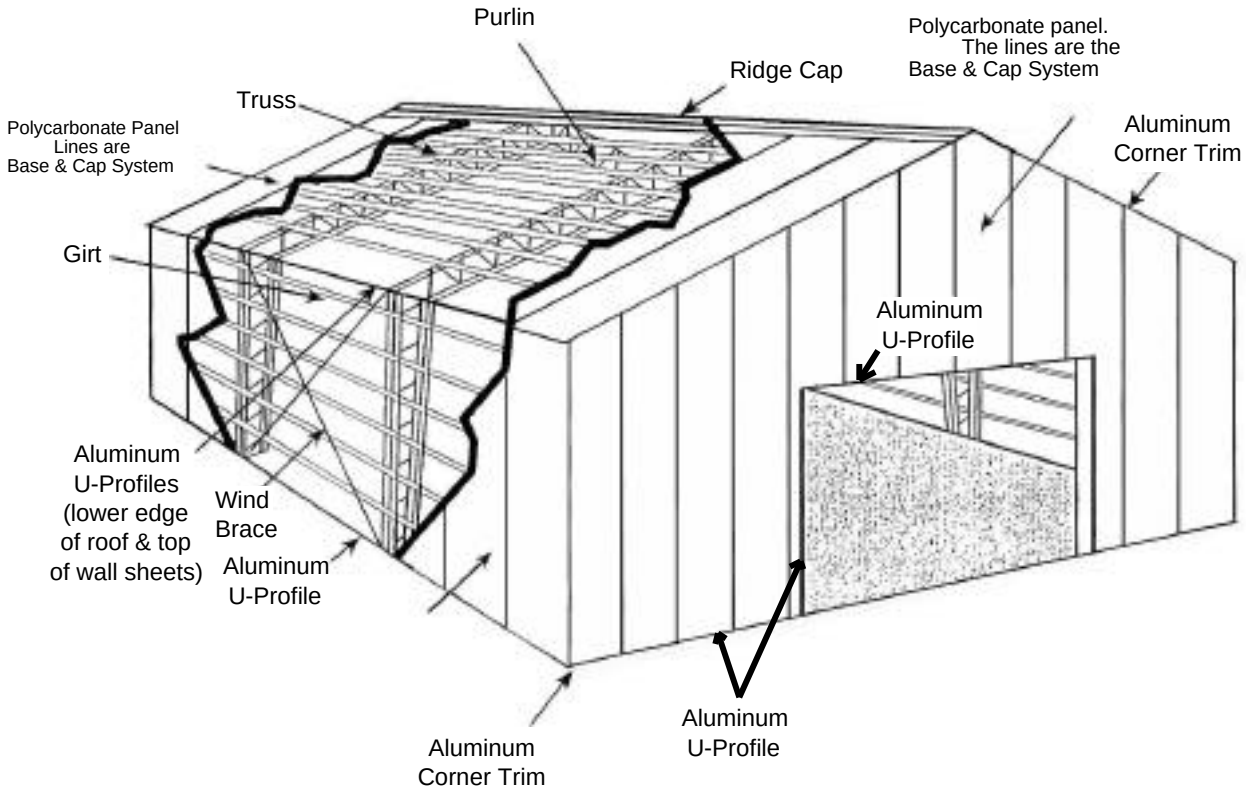
You may also position a rafter or stud between the members (as noted below). Use care to position framing so dimension from outside of structure to center of first or last framing member and Base is 48-1/2". See chart below for blocking placement.

Intermediate 24-3/8" to 24-1/2" Spacing (spacer not required)

			Blocking Spacing	
Sheet Thickness	**Rafter Spacing**	**35 lb. load**	**45 lb. load**	**60 lb. load**
8mm	24-3/8" to 24.5"	not needed	every 8 ft.	every 6 ft.
10mm	24-3/8" to 24.5"	not needed	every 10 ft.	every 8 ft.
16mm	24-3/8" to 24.5"	not needed	not needed	not needed
25mm	24-3/8" to 24.5"	not needed	not needed	not needed

Load For Blocking & Rafter Spacing: Load is live (wind & snow) & dead (weight of rafter and what lies on it). 35 lb. is for areas with no snow, little wind. 45 lb. is areas of normal wind & snow. 60 lb. loads, high wind and snow. Roof slopes over 30 degrees (7/12 pitch) the roof span may be increased or rafter size decreased due to a decrease in snow load from the steep slope. Speak to building department for snow load adjustments.

Base & Cap System may be placed on **horizontally running roof purlins and wall girts.** These horizontally running members are fastened to exterior of trusses or rafter and posts, see below. At corners place blocking between purlins or girts for sheet to rest on. Make sure top surface on this vertically running blocking lines up with otter surface of purlin or girt



Dimension from outside of structure to center of 1st or the last Base is 48-1/2". Place intermediate Base 48-3/4" to 49" on-center. Base will span between purlins, but use care to space purlins to support the load.

Recommended Loading lbs./sq. ft. 48" wide Sheet

Purlin Spacing	**48"**	**45"**	**42"**	**36"**	**30"**	**28"**
8mm Poly	15 lbs.	20 lbs.	25 lbs.	30 lbs.	35 lbs.	40 lbs.
10mm Poly	20 lbs.	25 lbs.	30 lbs.	35 lbs.	50 lbs.	60 lbs.
16mm Poly	30 lbs.	35 lbs.	40 lbs.	50 lbs.	65 lbs.	75 lbs.
25mm Poly	45 lbs.	52 lbs.	60 lbs.	70 lbs.	80 lbs.	90 lbs.

Load For Purlin & Girt Spacing: Load is live (wind & snow) & dead (weight of rafter and what lies on it). 35 lb. is for areas with no snow, little wind. 45 lb. is areas of normal wind & snow. 60 lb. loads, high wind and snow. Roof slopes over 30 degree, 7/12 pitch, roof span may be increased or rafter size decreased due to a decrease in snow load from the steep slope. Speak to building dept. for snow load adjustments.

Loads Defined: Structural Loads are stresses to structure from external or internal forces.

• Dead loads are gravity loads that are constant throughout the structure's life. These include equipment such as fans, suspended heaters & plants suspended from frame.

• Live loads are temporary, such as snow loads and wind loads.

• Snow loads are determined by factors influencing snow & ice accumulation on the structure. Snow loads vary considerably by geographic location. Ask your local bldg. dept. for snow load in your area. (12 inches of light, fluffy snow or 2 to 4 inches of heavy, wet snow = about 5 lbs per sq. ft.)

• Wind loads come from any direction but usually hit side walls at a perpendicular angle.

Wind pressures assuming an 8 ft. wall height, enclosed structure. Figures in lbs. per sq. ft. (+) is positive pressure against structure (-) is negative pressure pulling on the polycarbonate. **Figures are worst case, stating pressure on corners of walls & lower edge of roof, where wind hits strongest.**

Wind Speed/mph	85	90	100	120	130	140	150	160
Roof	+14	+14.5	+14.8	+15.4	+16.8	+19.6	+22.4	+26.6
	-46.2	-51.8	-63	-91	-107.8	-124.6	-142.8	-162.4
Walls	+18.2	+21	+25.2	+36.4	+42	+49	+56	+64.4
	-23.8	-26.6	-33.6	-49	-57.4	-65.8	-75.6	-86.8

Screws with 3/4" sealing washers are to be set at corners of glazed areas and every 1 ft. on-center. Cap and Corner receive screws at ends of each Trim piece and every 1 ft. on center. At -60 lbs. increase screw attachment pattern from every 12" on-center to every 10", -90 lbs. every 8" and -115 lbs. every 6". For placement of screws in body of sheet see Polycarb. Position & Attach. page in Install Manual of polycarbonate install system chosen . In winds of 100 mph and over decrease distance between screws.

• Combination loads are common. A snowstorm may include high winds.

If bldg. dept. says design for a 45 lb. snow load & a 90 mph wind, snow will effect the roof and wind will mainly effect walls (with 26.6 lb. load). To safely design your roof framing, take the 45 lb. snow load, add 14.5 lbs. for positive loading effect the wind may have on the roof. Design for a 60 lb. load.

Important Note: Above information sourced from American Forest & Paper Assoc., greenhouse sources and input from a structural engineer. Always get confirmation from local bldg. dept. before construction. Sundance Supply provides the skin material (polycarbonate plus attachment aluminum & hdwr.) and related technical information. We provide helpful design tools, but do not take responsibility for the structural integrity of your frame.

Large Span Wood Framing Systems:

Laminated Timber Beams (glulams) are an excellent choice for large span (width) sunrooms, greenhouses, pool enclosures and other structures

These manufactured wood products are made by stacking, gluing and clamping layers of sawn lumber. For example, a standard size glulam of 3" wide x 5-1/2" high will consist of 4 layers of sawn lumber, laid flat. The end result is a structural member with a bending strength approximately double that of the equivalent size commercially available solid sawn timber. Much improved shear strength is also realized with this structural wood product. Common wood species used are douglas fir or larch & pine.

To determine size timber size refer to Recommended Spans for Rafters, see following page. From this chart estimate timber size. Keep in mind, laminated timbers are approximately twice as strong as dimensional lumber of the same size. Now run design by your bldg. dept. for their approval. If you are a builder, designer or architect refer to appropriate load chart resources available to you.

For joints and connections we suggest using structural connectors engineered for this specific purpose. For an excellent selection of connectors see the Simpson Strong-Tie web site at strongtie.com or visit your local lumber yard for a catalog.

For photos and a general overview of glulams see the Unadilla Laminated Products web site at unalam.com. For a more in depth coverage of glulams visit a local lumber yard that caters to professional builders. They typically deal with a number of major laminated timber manufacturers and will have access to product literature and design guides.

Metal Plate Connected Wood Roof Trusses can be used to span large width structures, such as freestanding greenhouses and pool enclosures. Trusses are made from dimension lumber and metal connector plates.

Pre-fabricated trusses have revolutionized residential roof framing over the last three decades. Today, over 75 percent of all new homes are constructed with trusses. Trusses are lightweight and no on-site assembly is required.

Main disadvantages of trusses are that the triangular pattern of 2 x 4's is not as attractive as conventional lumber or glulam rafters, the structure occupies more overhead space and trusses block more light. To increase reflected light, and help the trusses blend into a clear or white polycarbonate roof, paint the trusses white. To minimize noise from sheet movement use flat paint on surfaces facing polycarbonate.

Advantages are lower cost and installation is quick, making large span wood frame greenhouses and pool enclosures possible for those with more modest budgets.

We suggest nominal 4 ft. spacing to create an open effect, but nominal 2 ft. spacing is also ok. Refer to the system you wish to use for exact spacing and blocking requirements. If using the Base & Cap System one may also set trusses further apart and place horizontally running purlins and girts on top of trusses. Always present your design to the building department for final approval.

RECOMMENDED SPANS FOR RAFTERS

2 and 4 ft. spacing is common when covering frame with 4 ft. widepolycarbonate. Refer to Cap & Trim or Base & Cap framing instructions for exact framing dimensions.

Load shown in lbs./sq. ft. **Spans** increased by incorporating a brace board that attaches to corresponding rafters, or wall of adjoining structure, creating a strong truss.

Spacing	Load	2 x 3	2 x 4	2 x 6	2-(2 x 3's)	2-(2 x 4's)	2-(2 x 6's)	4 x 4
2 foot	35 lb.	4'7"	6'6"	9'6"	6'5"	9'3"	13'5"	8'9"
	45	4'1"	5'8"	8'4"	5'10"	8'0"	11'10"	7'7"
	60	3'6"	4'11"	7'3"	5'0"	7'0"	10'3"	6'8"
4 foot	35 lb.	3'2"	4'7"	6'8"	4'7"	6'6"	9'5"	6'2"
	45	2'7"	3'8"	5'11"	3'8"	5'2"	8'4"	4'11"
	60	2'0"	2'9"	4'4"	2'10"	3'10"	7'3"	3'8"

Maximum allowable spans apply to #2 Douglas fir or larch with roof slope of (7/12 pitch) or less. For steep roof slopes refer to bldg. dept. for deductions in snow load and rafter size.

Table may be used for other species & grades of wood, adjust the spans as follows.

For these grades & species span may be increased by the following percentages:

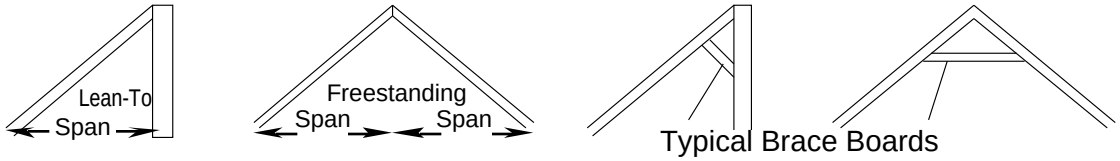
Douglas fir or larch, select structural: increase 20%
Southern pine, select structural: increase 18%
Calif. redwood, clear select structural: increase 36%
Calif. redwood, #1: increase 36%
Douglas fir or larch, #1: increase 10%
Southern Pine, #1: increase 7%
C. Redwood, select str.: increase 18%
Western cedar, select str.: increase 2%

For the these grades & species span may be decreased by the following percentages:

Southern pine, #2: decrease 2%
Western cedar, #1: decrease 6%
Hemlock or fir, #1: decrease 2%
Spruce, #1: decrease 9%
Calif. redwood #2: decrease 2%
Western cedar #2: decrease 14%
Hemlock or fir #2: decrease 11%
Spruce #2: decrease 16%

(Source: Add-On Solar Greenhouses & Sunspaces by Andrew M. Shapiro)

Note: Cypress is similar in strength to douglas fir. Consult with your source for exact figures.



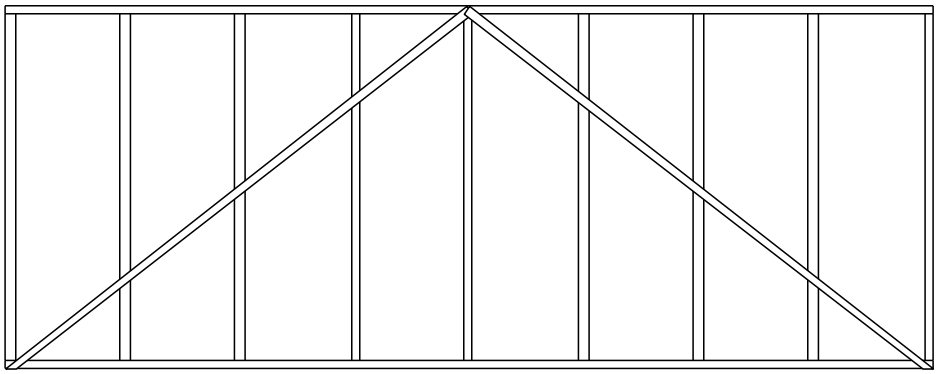
Typical Brace Boards

Diagonal Bracing: To eliminate racking of a wood structure, conventional construction methods incorporate diagonal bracing and/or a skin material with shear strength (such as plywood). Greenhouses are covered with glazing materials that are great for letting in the light, but offer no shear strength. It is wise to use some method of diagonal bracing on, at least, the end bays of freestanding greenhouse side walls (front walls of attached greenhouses) and also on roofs in extreme high wind areas.

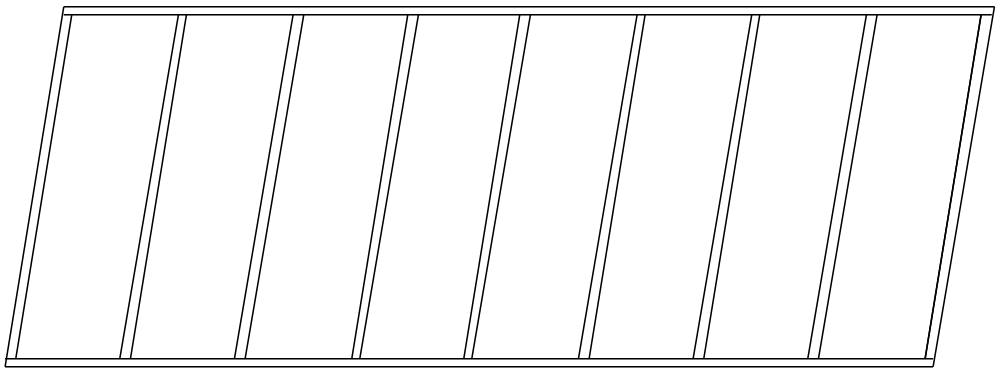
To maximize light transmission and minimize installation time we suggest using light gauge steel Wall Bracing Straps, as manufactured by Simpson Strong-Tie (#WB) and other structural connector manufacturers, using similar product numbers. These 1-1/4" wide x 9' 6" long straps are manufactured from galvanized steel. Numerous holes are punched in the strap, providing for simple and quick attachment. You may choose to paint these prior to installation. White blends well with clear polycarbonate. Position on exterior surface of frame, as shown below, and then install the polycarbonate.

These structural building components are recognized by your local building department. If the building department questions you about diagonal bracing, bring the structural connector product literature along with your plans.

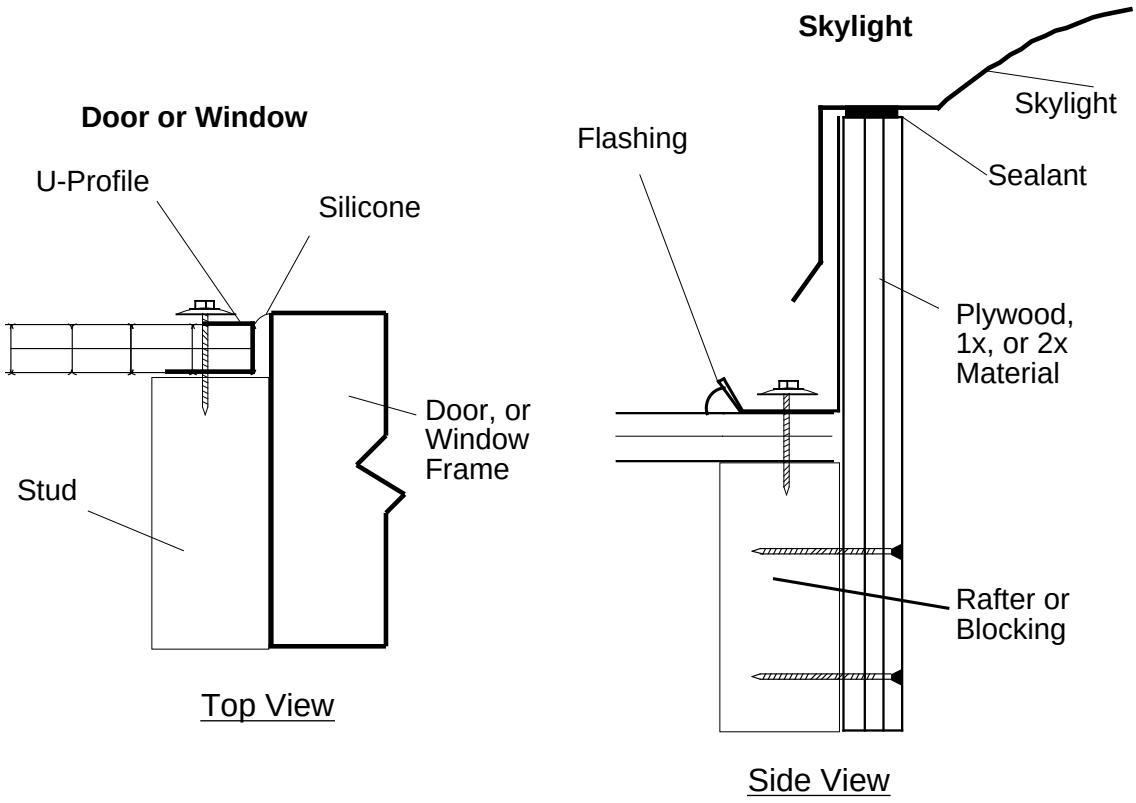
Stud wall with steel Wall Bracing Straps in place.



Stud wall where raking has occured.



Window, Door & Skylight Details: Installing polycarbonate sheet adjacent to these building components is a straightforward process. Refer to drawings below for examples of common installation techniques. A greenhouse typically does not include skylights and windows, but a sunroom often does. Doors are most often purchased from a lumber yard or home improvement center. Select one that is appropriate for your application. A wide selection of doors are available. Common choices are wood entrance doors with 1 large lite of glass, many small pieces of glass, combination storm doors and patio doors. Some builders will construct a door frame and cover the frame with polycarbonate. Select option best suited to your needs & skill.



Pop-On Polycarbonate Panels Framed with U-Profile:

Pop-on panels are an easy way to enclose screen porch, sunroom or greenhouse walls during the winter. Come spring store the panels and let the breeze move through.

Panels may also be used for sliding panel doors or interior windows. Use metal, wood or plastic track for the top and bottom of the panels. Track must be purchased locally.

8mm and 16mm Polycarbonate Panel Fabrication - <u>For Pop-On Panels Only</u>

• Cut the polycarbonate sheet to required size.

• Do appropriate measurements and angle cut the U-Profile so that a neat miter joint is created at the corners. It is best to have the inside base of the U-Profile snugged up tight against the sheet. This will create a more rigid panel, plus a tight and strong miter joint.

• Starting about 1" from the corners, place 3/8" self-drilling screws through the short leg of the U-Profile and into the polycarbonate sheet. Screws are provided free with U-Profile order. The screw will easily move though the U-Profile and penetrate into the polycarbonate, creating a tight fit. Continue placing screws about every 12" along the extrusion. Repeat for all U-Profiles.

Pop-On Panel Installation:

• Drill 1/16" weep holes in the bottom edge of the lower U-Profile for moisture release.
• Position panel so framing members are behind long leg of U-Profile. Begin securing panel to frame by placing clips close to corners & every 12" on-center. Clips required along top, bottom and sides of panel as shown below. Once you have set the clips you are done with that panel.
• When using 48" wide sheets space framing members (where sheets will meet) a minimum of 48-1/2" on-center. This will allow sufficient room for the clips (if clips are offset).