Oxford Aero Equipment
Sidewiser Hangar

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Note: This report is written for use in the United States. All references to parts and materials assume American sources and prices.

The Concept

The sidewiser hangar is an old idea. The first hangar built by Orville and Wilber Wright was a sidewiser. It was the size of a single-car garage and was so narrow that they had to remove the nose elevator before shoving their 1904 Flyer II inside. The location was Huffman Prairie just outside Dayton, Ohio. Today the site is Huffman Prairie Flying Field on the premises of Wright-Patterson AFB. The sidewiser was a good idea then and it's a good idea today

Figure 1. Wright Brothers' 1904 Sidewiser Hangar

The Oxford Aero Equipment Sidewiser Hangar accommodates two gliders in a steel building of minimal proportions. The floor plan is designed to minimize costs without sacrificing needs or conveniences. In fact, this hangar provides two advantages not found in larger, conventional hangars. First, it makes packing and unpacking the gliders an easy, one-person job. And, it virtually eliminates hangar rash incidents.

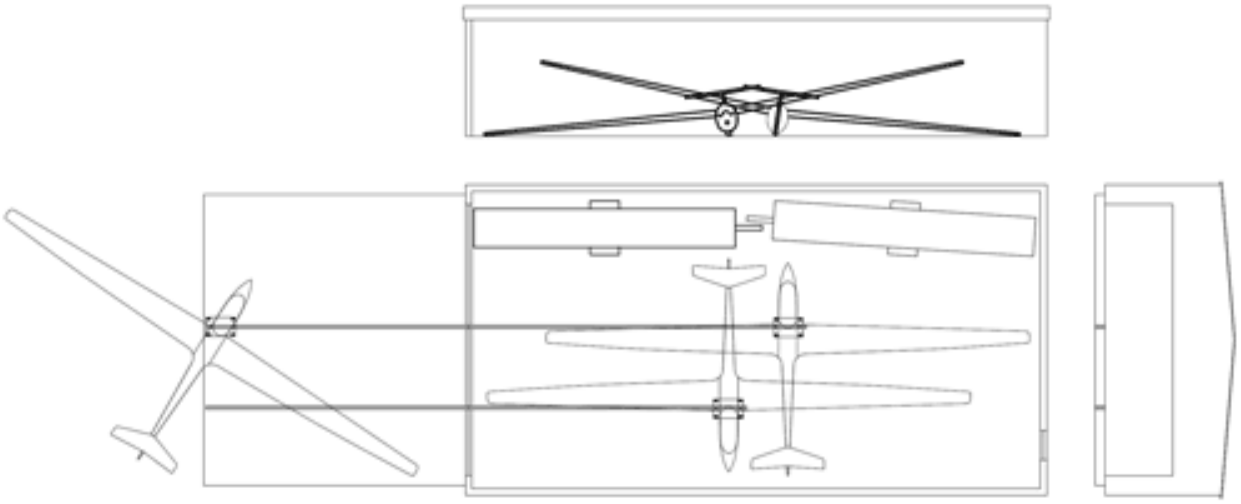


Figure 2. OxAero Sidewiser Hangar

The economy of this design comes from moving the gliders in and out through the narrow end of the building and from configuring the gliders nose-to-tail so that one

wing of each glider passes over the tail boom of the other. This means that the hangar is only 10 feet longer than one designed for a single glider. So, a small increase in cost doubles the capacity and almost cuts the per glider cost in half.

Although its dimensions are small, the sidewiser can also accommodate two glider trailers, a workbench, storage lockers, shelves, lawn mower, a golf cart for glider towing and gliderport transportation, etc.

The use of guided mainwheel dollies permits close packing clearances without increasing the risk of hangar rash incidents. It also greatly reduces the effort needed to pack and unpack the hangar and enables one person to do the work with ease. These are advantages not realized in conventional hangars of larger proportions. With a guided mainwheel dolly, one person does the pushing and pulling while the dolly does the guiding. With this arrangement, clearances of even a few inches are safe.

One question that often comes up is “why isn’t there a back door for the innermost glider?” There are several reasons. First, since it is so easy to move gliders in and out, the effort to unpack and repack the outer glider for access to the inner glider is not onerous. Second, even though the main door is on the end of the building, it is not a cheap item and adding another one would cost about $4,500. Third, at most airports, the path to the runway from the rear of a hangar, if it exists at all, is likely to be a long one, making the additional towing less desirable than ground handling the outer glider. Forth, it removes useable wall space at the rear of the hangar. In the present design, since both gliders transit the same end of the hangar, the inner spaces that are never traversed by a glider can be used for all sorts of storage and work areas. However, it would be wasted space if a glider had to pass over it.

In summary, the OxAero Sidewiser Hangar makes the most of the least floor area while offering greater security for the gliders and convenience for the owners.

The Building

Manufacturers

You can get your metal building from any of several manufacturers. Mostly, those on the web are brokers who subcontract the job to a manufacturer near you. The first sidewiser building was acquired through a metal building broker at a cost of $14,000 delivered.

Basically, the choice comes down to a straight-wall or arch-style configuration. You can save money with an arch-style design, but insulating these buildings is more of a problem. On the other hand, an arch style design may give you a higher

wind loading strength. A straight-wall design was chosen for the first hangar because it met the criteria of the building committee at Memphis Soaring and was easier to insulate.

The simplest way to contact metal building manufacturers is by taking your browser to http://www.oxaero.com/OxAero-Sidewiser.asp and filling out the form on that page. This will ensure that they get the right specifications, that they give you an OxAero Sidewiser discount and that they credit Oxford Aero Equipment with the reference.

Building Size

The smallest practical size for a hangar for 15 meter gliders is 31’ wide by 60’ deep by 11’ high at the eaves. The height and width could be one foot shorter if it were not for the side and overhead clearances needed for a 28’ x 7’ main door. For gliders with winglets it is desirable to have an 8’ high door, since the winglet on the inside wing could strike the top door frame when the outside wing tip is on the ground. A 12’ eave height gives plenty of overhead clearance for an 8’ high door; 11’ will work with a low track-profile door design. The extra height is not necessary if a little care is taken; however, it’s wise to avoid every possibility of damaging your glider.

Specifications

Specifications for a straight-wall sidewiser building are as follows:

Building Type	Gable Symmetrical
Dimensions	Width: 31' Length: 60' Eave Height: 11'
Roof Pitch	1:12
End Wall Bay Spacing	15’ 6” X 15’ 6”
Side Wall Bay Spacing	20 X 20 X 20
Roof Cover	26 Ga Galvalume
Wall Cover	26 Ga Dura-20
Eave Condition	Simple eave trim
End Wall Framed Opening	28' X 7’ for garage overhead door Ensure necessary clearances.
Service Doors	1 3070 M G NL non-insulated
Service Door Location	Rear wall of building 3 ft from right side
Skylights	6 overhead panels
Girts	Flush

These specifications will automatically be sent to several metal building manufacturers when you complete the form on the OxAero web page www.oxaero.com/OxAero-Sidewiser.asp .

The Main Door

The main door opening should be framed 28’ wide by 7’ high for an extra wide garage style overhead door. The actual door would be 28’2” wide by 7’1” high. This allows for a 1” overlap behind the door frame. With a 12’ eave height, you could go with an 8’ high door. In any case, you must be sure you have the requisite overhead and side clearances for your door.

It’s better to know that you have the necessary clearances before erecting the building rather than after. This is the reason a 31’ width and 11’ eave height are specified. The first sidewiser was only 30’ wide by 10’ high. When it came to installing the main door, there was not enough side clearance, so the door width was changed to 27’4 and the door jamb was adjusted inward 4” on each side. This makes clearances too close for comfort if the left-facing glider has a long tail boom or the right-facing glider has a long nose. The design of the dolly allows for lateral adjustments to deal with issues like this, but it would be good to have the extra 4” to work with.

The main door for the first sidewiser hangar cost about $4,500. It’s a Windsor Model 240, with insulation and a heavy-duty electric opener. It’s hard to get door companies to install doors this wide without an opener. They are so heavy that even with large springs they are difficult to open manually. However, chain operated manual openers are available and could save some money if you don’t want an electric opener. Since this door is so wide, each panel has a steel brace running its full width. This makes the door very strong, despite its unusual width. The electric opener operates fast and reliably.

Since the guide channels are recessed into the slab, they do not interfere with the door. However, the channels make inviting rat holes under the door. This problem is solved by placing a short length of 2-by-4 wood in each channel under the door. This works because the channels are formed using 2-by-4 lumber.

The Service Door

A service door is specified for the building. It is best to put it in the rear wall about three feet from the right side. This allows air to flow through the building when both doors are open. Also, it directs the flow past the best location for a workbench, the right rear corner. Another advantage of this location is that a driveway from an access road behind the hangar can end at the rear of the hangar. This shortens the driveway and saves money. Also, there may not be enough land between hangars for a driveway along the side of the hangar.

Insulation

Foam insulation with an R4 rating was chosen for the first sidewiser. It was tempting to spend another $1,000 for 3" soft insulation rated at R19. However, the R4 insulation works very well. So it is questionable whether money spent on more insulation is justifiable.

The foam insulation panels have a tendency to bulge inward if they are not glued to the wall panels. This should be thought of when installing the exterior wall panels. It may be necessary to lean a board against each insulation panel to keep it from pulling away from the outer metal panel before the glue sets.

Ventilation

Even with insulation, at times it will be necessary to evacuate the hot air from the hangar. A good solution is to place one or two thermostatically-controlled power gable vents in the downwind gable. An automatic louver vent should be installed on the outside of the power vent. This type of vent will open automatically by means of the fan pressure. Somewhere at the other end of the building a passive louver vent should be installed to admit cool air when the power vent is operating. This should be an adjustable vent so it can be closed off in the winter months.

Lighting

One nice thing about a small hangar is that it can be adequately lit by fluorescent bulbs mounted on the ridge beam. This is cheaper than halogen lamps to both purchase and to operate. Fluorescent lighting also has the advantage of turning on instantly. You may want to consider placing some fluorescent bulbs over the workbench site on the right wall at the rear corner.

The Slab and Ramp

The Guide Channels

The floor plan in Appendix A shows the dimensions for placing the guide channels in the foundation slab and ramp.

The guide channels are formed by placing straight 2-by-4 beams in the foundation and ramp spaces before pouring the concrete. They must be held in place so they do not change position or float in the wet concrete. Wooden pegs driven into the ground under the channel beams can be used to secure them. The channel beams can be nailed to these pegs.

After the concrete has cured, the channel beams can be removed. This needs to be done without chipping the edges of the channels. A skill saw can be used to make cuts in the beams to loosen them from the channel walls. It does not matter if

several blades are ruined in the process. That's a cheap price to pay for those neat guide channels.

The inner end of each channel is positioned so that the glider is in place when the mainwheel dolly reaches it. Stops are also needed at the outer end of the ramp. One way to make these stops is to end the channel about 3" from the outer edge of the ramp. To prevent water from standing in the end of the channels, short lengths of tubing can be imbedded in the ramp between the channel end and the outer edge. This would allow the channel to drain into the surrounding soil.

The lateral positions of the guide channels are calculated to work for most 15 meter gliders. However, some have unusually long noses or tail booms. This may require adjusting the channel positions if the guide wheel adjustment on the dollies (± 6") is not enough to take care of this. You should measure the distance from the mainwheel to the nose and the tail of your glider to ensure that the dimensions in Appendix A will work for you.

The Foundation Slab

The dimensions of the foundation slab are specified in the building blueprints. The building manufacturer should supply the blueprints before the building is delivered. That will permit the contractor to prepare the foundation ahead of time. Anchor bolts must be imbedded in the foundation. Their locations are specified in the blueprints. If the bolts are not provided early enough, they can be bought locally.

The Ramp

We recommend making the ramp nearly as wide as the hangar. It could be narrower, so narrow that it only supports the dolly wheels and the glider tail dollies. However, the extra width on the left side makes manhandling the trailers much easier. And, on the right side there isn't much to be saved anyway. If the ramp is solid between the guide channels and extends far enough to the sides of the channels, then you will be able to make lateral adjustments in the dolly guide wheel positions without moving the dolly casters off the pavement.

The ramp should extend half a wing span in front of the hangar. This will give plenty of clearance between the inner wing tip and the door jamb. 25' is a good distance for 15m gliders. You may shorten it by 2' and save $200, but you will have to be a little more careful not to bump the door jambs with your wing tips.

You should mark the ramp with arcs from each door jamb. Give them a radius of half the wing span plus 6". As long as the mainwheel stays outside the arcs while pivoting the glider you will be safe. Another precaution you should always take is

to pivot the glider while holding the inner wing tip. This simple precaution will positively eliminate wing tip damage.

The Ramp/Slab Joint

It is important to ensure the contractor does not slope the edge of the foundation slab where it meets the ramp. They often do that in front of garage doors to improve water runoff. You should make sure they do not do this, as it could cause the forward guide wheel of the dolly to scrape the bottom of the channel at that point.

If the slab is flat all the way to the joint, then the forward guide wheel will lift slightly out of the channel as the dolly approaches the slab. After that, it will lower back to the normal depth as the rear wheels approach the slab. However, if a steeper slope is encountered, then the front guide-wheel axle-bolt will ground itself on the bottom of the channel and the axle bolt will bend.

If you fail to prevent this, then you can correct it easily enough by grinding the bottom of the channel in this region so that it parallels the slope of the ramp. Other than this, a slightly steeper slope going onto the slab will have no adverse effects. In practice, it's not a problem and it's hardly noticeable if the dollies have hard wheels.

The Mainwheel Dollies

The Mainwheel Dolly Concept

The mainwheel dollies are the key element in the sidewiser hangar concept. Figure 3 illustrates how the dollies are constructed. A detailed drawing can be found in Appendix B.

The dolly is simple to construct and easy to use. A specially shaped tray captures the mainwheel and holds it off the floor. The tray uses the glider's weight to trap the wheel in a valley without any sort of mechanical lock. Since there is no mechanical lock, there is no need to get down on your hands and knees. This is a great convenience. The tray is designed to require approximately 50 lbs of force to roll the mainwheel into or out of it. In practice, this works well. Also, the tray accommodates a wide range of wheel diameters. The tray should be as close to the floor as possible without scraping it; therefore, the floor clearance is adjustable. This is done by adjusting a pair of J-bolts that suspend the open side of the tray above the floor.

The Basic Dolly

The basic dolly is purchased from an industrial supply company such as, **Global Industrial Equipment** (www.globalindustrial.com). It is then modified for this

use. Modifying an existing dolly saves both time and money. The Global Industrial part number is **WB952166** and the price is about $75.95 plus shipping. This is a basic 3' x 2' angle-iron, open frame dolly with 4" caster wheels. The dolly frame stands 5" high.

The Mainwheel Opening

The angle iron on one of the long sides must be cut sway to provide an opening for the glider mainwheel. This is shown in Figure 3. A skill saw with a metal blade will do the job. Since the dolly is 3' long, the center gap has plenty of side clearance for the undercarriage doors. Since the dolly is 5" high, the undercarriage doors of some glider could contact the dolly frame. In practice this is not a problem as long as reasonable care is taken to center the mainwheel in the dolly tray. As insurance, you may want to pad the cut away corners of the dolly frame.

The Mainwheel Tray

The mainwheel tray is formed from a 17" x 21-1/2" x 3/16" steel plate. Although you can't buy one ready made, any machine shop should be able to make one easily. The cost should be about $80 each. The necessary dimensions for bending the plate are given in Appendix B.

Two 3-1/2" gate hinges and two 3/8" x 5" J-bolts support the tray in the dolly frame. These can be obtained from any hardware store at a nominal cost.

Mounting holes for the hinges are located by placing the hinges and marking through the holes. 5/16" x 3/4" stove bolts are use for these attachments. You will need to waddle out the holes slightly to accommodate the square shanks near the heads of the bolts. In practice, this works well as the square shanks kept the bolts from turning and the round heads give a professional look to finished dollies.

Figure 3. Mainwheel Dolly

Besides the hinge mounting holes, a 3/8” hole is needed on each side of the tray at the high-ridge point about 5/8” from the side. These are for the J-bolt to hook the tray. Corresponding 3/8” holes are needed in the dolly frame for the straight ends of the J-bolts. When the J-bolts are installed, the hooked ends can be bent to close the gap and prevent the tray from lifting out. This can be done with a heavy hammer. Also, the shanks of the J-bolts can be bent towards the tray if the holes in the dolly frame are too far from the tray for the J-Bolts to hang vertically. Nuts above and below the dolly frame secure the J-bolts.

The Guide Wheels

Finally, there are the guide wheel assemblies. These are merely 3” fixed casters that can be found at any hardware store. The axle bolt is removed and replaced with a 7” x 3/8” bolt. This allows the guide wheels to extend below the dollies into the guide channels. Two nuts at the top of the caster frame secure the axle bolt and provide adjustment of the guide wheel height.

The guide wheel should be as low as possible in the channel without the axle bolt striking the bottom. In practice, the wheel will not go all the way down into the channel. However, this is not necessary. Only about half the wheel thickness needs to fall below the slab surface.

To prevent the guide wheel from climbing up the axle, you will need a short length of tubing of some sort. Plastic tubing works well and is cheap.

One guide wheel assembly is mounted to each end of the dolly. Holes must be drilled in the dolly frame for this purpose. Care must be taken to ensure that the upper holes leave enough room on the inside of the angle iron for the nuts.

As much as 12" of lateral adjustment in the glider's position can be achieved by shifting the guide wheel attach points on the dolly. You could drill multiple sets of mounting holes so that adjustments can be made with relative ease as the situation demands. The limits for lateral adjustment are determined by need to keep the dolly's caster wheels out of the guide channels. Remember that the casters swivel, so there must be enough clearance to prevent them from swiveling into a channel.

This makes a case for using non-swiveling casters on the dolly corners. The problem is that read-made dollies of this sort do not come with fixed casters. Furthermore, you cannot change the caster frames since they are welded into the frame. If you want to fix the caster wheels, you could align them and tack-weld them in place. However, it is not clear that this would not end up causing the dolly to fight against the guide wheels. In practice the swiveling of the dolly wheels is not a problem.

Figure 4. Guide Wheel Assembly

It should be pointed out that this guide wheel design is the weakest point of the design. The drop-down axle cannot take a large side force without bending. Therefore you should bring the glider gently to the ends of the guide channel. Alternatively, you could beef up the drop down axle by going to a larger diameter bolt. This would require enlarging the holes in the bracket. However the rubber guide wheel presents a problem. It may be necessary to use a metal wheel that can

be bored to the necessary size, or even to make a set of wheels on a lathe. In that case, they could be cut from plastic.

Other ways of attaching the guide wheel axle bolt to frame can be used. For instance, you could drill a hole in the upper frame surface so that the axle bolt can pass through it and then secure it near the bottom of the angle iron with a U-bolt.

Hard Caster Wheels

There is one last issue with the mainwheel dollies. The rolling resistance of the rubber caster wheels makes heavy gliders hard to push. So, unless your glider is a SparrowHawk or a Russia, you will want to replace the soft wheels with hard ones. This is easy to do and is not expensive. The caster wheel axels are 3/8” bolts, so they can be removed and reinstalled. The only problem is that the nuts are locked by deforming the ends of the bolts. Therefore, a grinder is needed to cut off the ends of the bolts. Then the nuts can be removed. Eight cast-iron 4" x 1-1/4" wheels can be bought from Clarke Casters (www.clarkecasters.com) for $35.84. Their part number is CA0404108. You can order them online. Shipping by UPS Ground for this 15 lb package was only $8.27. This is a good company. They will treat you right.

Procedures

Following are standard procedures for packing and unpacking the hangar:

Packing Procedure

- For the inner glider, remove the outer glider's dolly from the track so it will not interfere with the tail dolly.
- Roll the mainwheel dolly out of the way.
- Bring the glider onto the ramp such that the mainwheel is about 2' on the pavement between the guide channels and about 2' from the guide channel you will be using.
- From the inner wing tip, pivot the glider until it is square with the hangar.
- Place the outer wing tip on the ground and roll the dolly into position, centered on the mainwheel.
- From behind the inner wing root, push the glider into the dolly tray. This should require about 50 lbs of force. A little lifting force at the wing root helps.
- Go to the inner wing tip (inner glider) or outer wing tip (outer glider), level the wings and pull/push the glider into place. Take care not to bang the dolly into the end of the guide channel, as this could bend the guide wheel axles.
- Lower the wing to the ground and secure it with a weight. A shot bag works nicely.
- Chock the dolly with a rubber door stop. This will prevent the glider from rolling inadvertently if you lean on the fuselage. This is especially important when the wings are held level by a tripod or wing tip stand.

Unpacking Procedure

- For the inner glider, remove the outer glider's dolly from the track so it will not interfere with the tail dolly.
- Remove the dolly chock.
- Go to the low wing tip, remove the weight and level the wings.
- Push/pull the glider out onto the ramp, taking care not to bang the dolly into the end of the guide channel.
- Lower the outer wing to the ground. You may wish to secure it with a weight so you can more easily pivot the glider on that wing tip as you roll it away from the ramp.
- Go to the leading edge of the inner wing root and push the glider out of the dolly tray. If you weighted the outer wing tip, you can keep pushing the fuselage in an arc about the wing tip until it's clear of the ramp.

Comments and Advice

Following are suggestions to help you get the most from your sidewiser hangar:

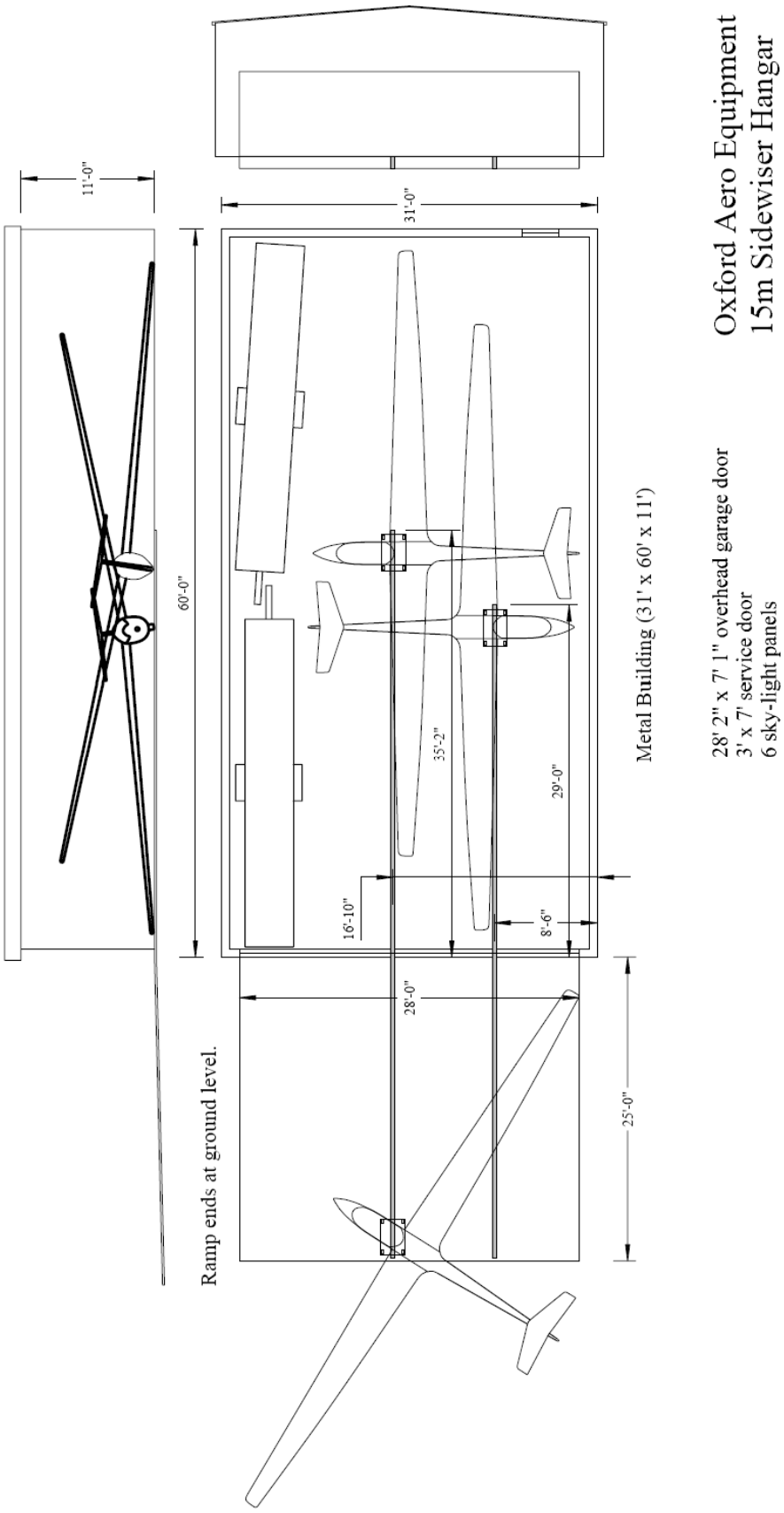
- Never align the glider to the dolly from a position behind the wings as it is difficult to see when the mainwheel is centered on the dolly. If you get this wrong, you may strike a gear door against the dolly frame.
- Always pivot the glider on the ramp from a position at the inner wing tip. This will ensure that you do not strike a door jamb with the wing tip.
- Paint guidelines on the ramp to show where the mainwheel should be when you pivot the glider. These should be arcs centered on each door jamb with a radius of half the wing span plus a margin of say 6".
- Paint marks on the hangar floor to show the nose, tail and wing tip locations when the gliders are properly positioned. These will help you anticipate the channel ends when moving a glider into the hangar. They will also show you where to position the trailers so they will not interfere with the gilders.
- With a 7' door height, take care not to allow the winglet on a high wing to contact the top door-frame. Either remove the winglet or follow a procedure that eliminates this possibility.
- Chock the mainwheel dollies. This will prevent a glider from rolling inadvertently should someone lean against it. This is especially important when the wings are held level on a tripod or wing tip stand.
- Place pieces of carpet over the tail booms of the gliders. This will ensure that they are protected from the overhanging wings. You will probably find that this is not necessary in practice. However, for the type-A personalities among us, this will offer a lot of comfort.
- Take care not to run a dolly to the end of its channel with too much force, as this will bend the guide wheel axle.
- There is a surprising amount of useable storage/work space in this small hangar. This is not immediately apparent from looking at the floor plan. The right rear area in front of the wing of the outer glider is available for storage and work space. Cabinets and shelves can be placed along this wall. A workbench fits nicely in the corner. You may want overhead lighting for the workbench. Items that can sit on the ground and are not tall enough to reach the nose of the outer glider can line the right wall all the way to the main door. There is a lot of floor space near the main door on either side of the outer glider's low wing that can be used for moveable items such as golf carts and lawn mowers. Since these would be removed before extracting a glider, they pose no real conflict. You will be amazed at the amount of usable space there is in this small hangar.

Bill of Materials

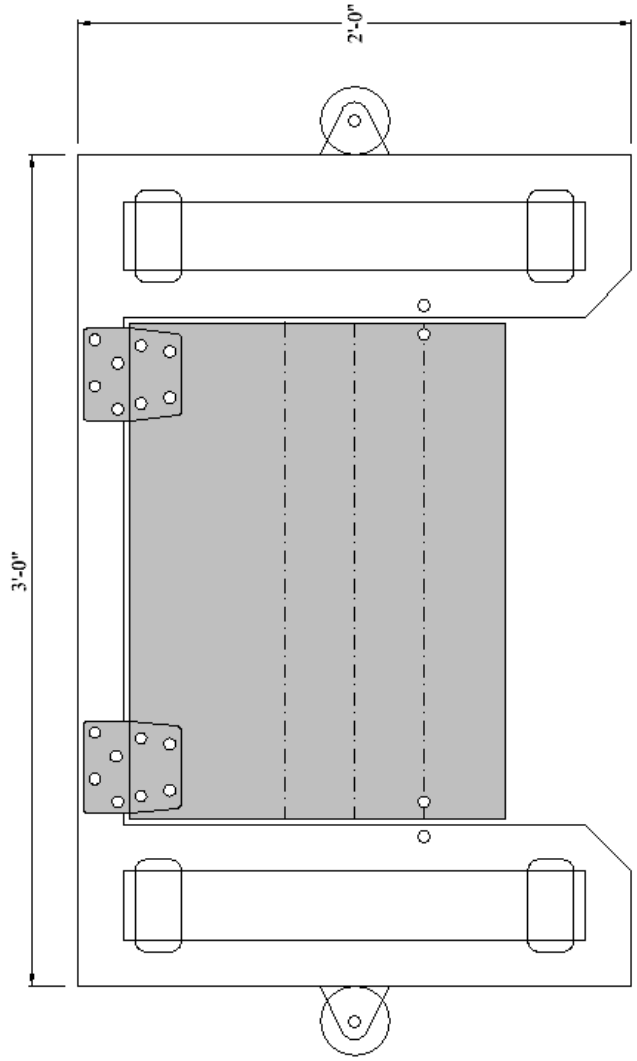
Qty	Description	Source	Each	Total
1	Steel Building - 31' x 60' x 11' Eave Height	U.S. Steel Buildings	15000.00	15000.00
1	28'2" x 7'1" Overhead Garage Door w Electric Opener	Overhead Door Co.	4500.00	4500.00
1	Insulation - R4 rigid foam	Building Supply	600.00	600.00
1	Ventilation - power gable vent + passive vents	Building Supply	200.00	200.00
2	Steel Dolly - Open Deck - 24" x 36" x 4" wheels	Global Industrial - WB952166	75.95	151.90
2	Custom Steel Plate - 3/16" x 17" x 21" w 3 Bends	machine shop	80.00	160.00
8	4" Iron Caster Wheels	Clarke Casters - CA0404108	5.63	45.00
4	Fixed Caster - 3" Dia Wheel	Hardware Store	4.29	17.16
4	Steel bolt - 3/8" x 7"	Hardware Store	1.17	4.68
16	Nuts - 3/8"	Hardware Store	0.11	1.76
16	Lock Washers - 3/8"	Hardware Store	0.07	1.12
4	J-Bolts - 5" x 3/8"	Hardware Store	2.00	8.00
4	Gate Hinges - 3-1/2"	Hardware Store	3.49	13.96
32	Steel stove bolt - 5/16" x 3/4" round head	Hardware Store	0.11	3.52
32	Nuts - 5/16"	Hardware Store	0.07	2.24
32	Lock Washers - 5/16"	Hardware Store	0.06	1.92
1	Slab - 31' x 60'	contractor	6510.00	6510.00
1	Erect Building	contractor	4650.00	4650.00
1	Ramp - 28' x 25'	contractor	2450.00	2450.00
1	Dozier work	contractor	200.00	200.00
1	Sand	contractor	300.00	300.00
			Grand Total	**34821.26**

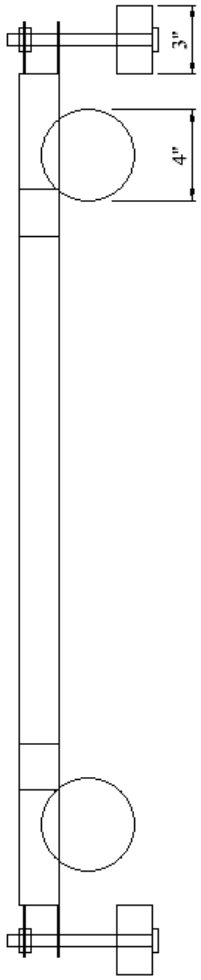
Estimated costs based on first sidewiser hangar in 2005.

Appendix A – Hangar Plan



Appendix B – Mainwheel Dolly Plan





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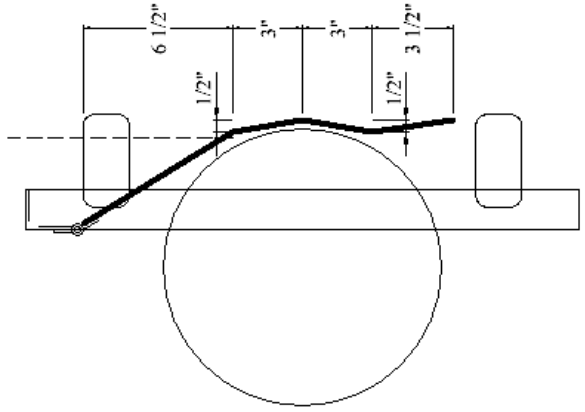
Sidewiser Hangar
Mainwheel Dolly



Mainwheel Tray
17" x 21 1/2" x 3/16"