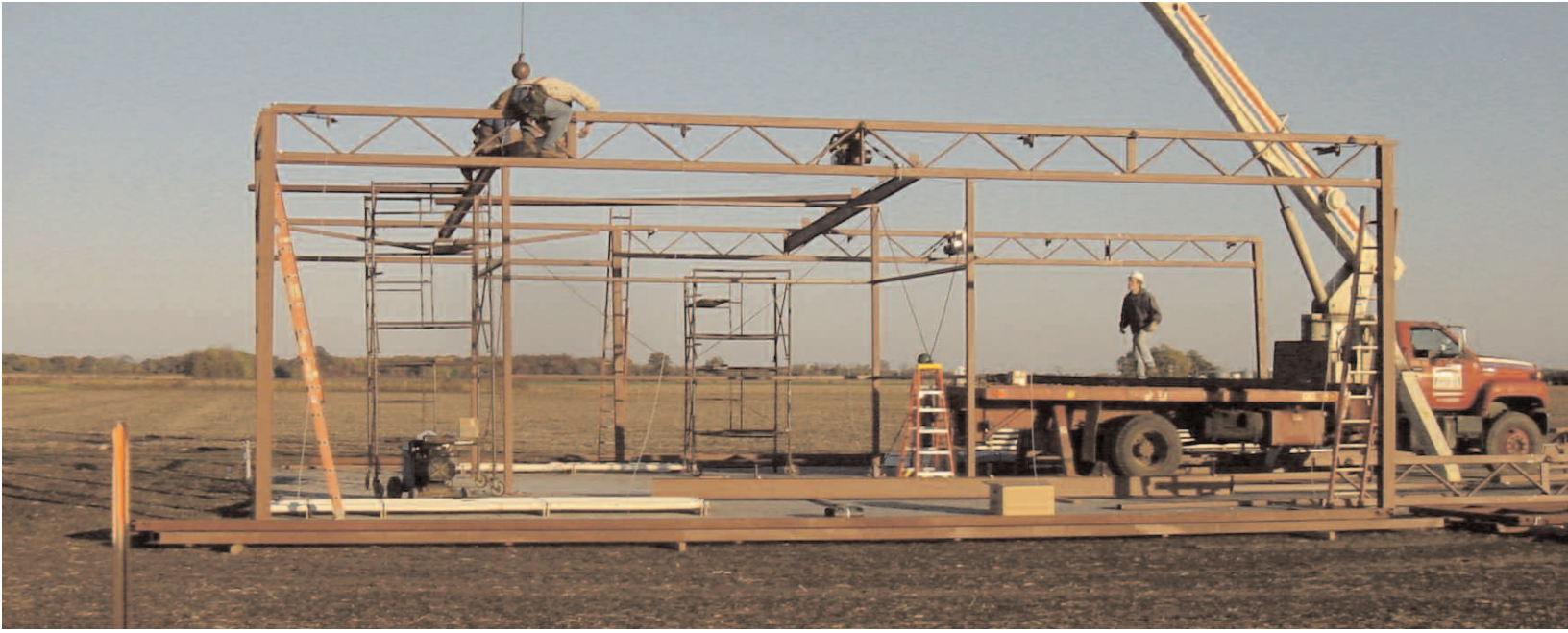


Everything You Need to Know Before You Buy or Build an Aircraft Hangar.

ERECT-A-TUBE INC.

Table of Contents

Introduction

Congratulations! You have taken an important step in becoming more informed about the components and construction of aircraft hangars and door systems so that you can buy or build the one that best meets your needs.

Erect-A-Tube, Inc. with corporate offices based in Harvard, Illinois, has more than 40 years experience in the design and manufacture of aircraft hangars and door systems. Our company has acquired a wealth of information working with numerous municipal airports, pilots, builders, developers, contractors and engineers to build thousands of aircraft hangars across the United States and Canada.

This reference guide is intended to provide you with a basic understanding and insight into the pre-engineered metal building industry and what to expect in your search for aircraft hangar manufacturers. It also provides information on the airport environment and definitions you will need to know.

Ultimately, we hope this guide will help you make well-informed decisions on the road to constructing your hangar. Please note this booklet is not intended to offer you critical information on construction details, interpretation of building codes, construction techniques or related matters.

You may have additional questions after you read this guide. Experienced professionals at Erect-A-Tube — many of whom are pilots — can answer your questions and also provide additional information to help you make the right decisions.

We will be continually improving and updating this guide, and would greatly appreciate your feedback and input. Please contact us at 1-800-624-9219 or send your comments to info@erect-a-tube.com. Be sure to visit us at www.erect-a-tube.com to learn more about Erect-A-Tube and our quality aircraft hangars and hangar door systems.

Section 1:
Airport Environment

Analyzing the market

Whether you are an airport owner or someone who has an interest in developing hangars, determining the marketplace is the fundamental starting point.

Common questions in determining the market:

- Is there a need or demand for hangars?
- Does the airport have a waiting list of aircraft owners wanting a hangar?
- What are the rental rates of the hangars?
- What is the aircraft population within the area?
- Are there other airports within the vicinity? What are their rental rates? Do they have a waiting list?

Some excellent websites to use in gathering data for your research:

- www.airnav.com
- www.faa.gov

Once you have initially determined the market needs, putting together cost estimates is the second step to see if the project will really fly. Your analysis should include:

- Lease term and lease cost of the airport land
- Installing ramps and taxi lanes (if required by the airport)
- Bringing the utilities to the hangar site
- Hangar costs
- Construction costs
- Sales/use taxes
- Financing
- Vacancy factors
- Property or possessory taxes
- Maintenance

Owning and operating hangars versus developing

For the airport, owning hangars can be an excellent source of revenue. In addition, each state's Department of Transportation may have grants or participatory funding to help offset the cost of infrastructure and the cost of hangar construction. Recently, the Federal Aviation Administration (FAA) announced that it will provide funding for hangar construction. Although there are caveats to this program, funding is available for most airports.

For the private sector, owning and operating hangars can be a good investment if all of the costs can be met. An alternative is to develop and sell hangars as condominiums. This type of development can benefit the airport as well as those investing in their hangars.

Land leases

The term for the land lease is determined by the airport owner. On average, the leases are 25 to 30 years in length. Many land lease agreements allow for term extensions at the option of the tenant. Although the majority of the negotiations are done at the airport management level, final approvals must be granted through the municipality that sponsors the airport, such as a city or county government.

The lease rate is also determined by the airport owner on the basis of a square-foot measurement. Some airports just lease the land under the hangar footprint. Others include an additional 10 to 15 feet outside the building perimeter. Some larger airports will require the tenant to lease entire plots of land that encompass some or all the infrastructure.

Factors that should be addressed prior to leasing the parcel:

- Lease term and extensions
- Lease rate
- Determining the right location for the hangar
- Providing access to the taxi lanes and runways
- Drainage compliance
- Location and extension of the utilities
- Obtaining FAA Approval (see FAA 7460)

Airport minimum standards

The “Airport Minimum Standards” is the set of rules or policies that have been established by the airport owner regarding the minimum criteria that must be followed. Within this document, there will be a section that pertains to hangars. If the airport has established minimum standards, these standards should be referenced in the land lease. These standards may specify the building use group; building specifications; aesthetic criteria such as colors, roof pitch; and specific building guidelines, as well as the approval process.

Some common terms:

- (ALP) Airport Layout Plan is the plan of the airport showing the layout of existing and proposed facilities.

- (BRL) Building Restriction Line identifies suitable building locations on the airport.

- Distances between rows of hangars:
    - FAA recommended formula: Door width X 1.5 + 20 feet.
      Example: 40’ (door width) X 1.5 + 20 feet = 80 feet.

- FAA 7460: This is a reporting form that must be submitted and approved by the FAA prior to construction. This form details the location and height of the hangar to determine if any design corrections are required prior to construction.
  Refer to: www.faa.gov/forms/faa7460-1pdf

Section 2: The Pre-Engineered Building Market

Determining the differences — doing your homework

Some pre-engineered building manufacturers offer aircraft T-hangars and Consecutive Rectangular hangars; but the fact is there are only a select few manufacturers which offer the hangar and hangar door as an integrated system. Therefore, you need to do your homework.

The pre-engineered building market is very homogeneous. Although most metal buildings may look the same from the outside, unless you really inspect each manufacturer's product, it will be difficult to determine the quality differences between products. As with most purchases, it pays to understand the differences. Once the hangar purchase is made, any sacrifice in quality becomes apparent and lives on throughout the life of the product. Making the right choice returns dividends for many years through reliability, product longevity and ease of operation.

At the end of Section 4 "Hangar Doors" there is a checklist. This checklist is important because it considers items that, as a buyer, you should look for as you compare building and hangar door systems.

Post-and-beam design

Post-and-beam has long proven itself as a superior construction design for T-hangars and Rectangular hangars. This design combines a stronger, more durable structure, providing equal distribution of roof loads and maximum design flexibility for a variety of hangar models.

- Deflections are held to a minimum tolerance in comparison to a cantilever frame
- Utilizes smaller frame size
- Provides for lighter piers/foundation design, without any kick-out load
- Designed to carry both bi-fold and bottom rolling door systems

Single source is better

Erect-A-Tube's hangars and hangar doors are designed and manufactured as an integrated system providing single-source responsibility. This integrated system eliminates the design and assembly issues which can occur between matching various suppliers and their different configurations.

The advantages of an integrated hangar and hangar door system:

- Reduces labor costs to construct hangar
- Building header is structurally designed to carry the door system, roof system and their respective reactions and loadings
- Field modifications and welding are not required to adapt the door pick up points and bracing

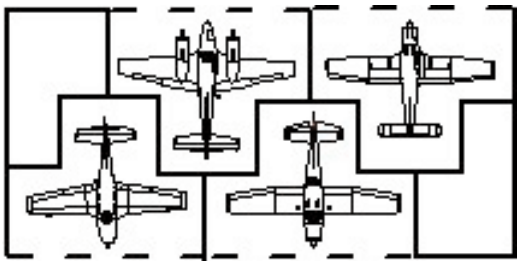
Section 3: Determining the Correct Hangar

The first step in designing your hangar is to determine what will be the largest aircraft to be stored. In turn, this will dictate the size of the door opening. Next, determine the type of hangar door to be installed. The hangar door has its own set of criteria in order to properly integrate into the building. Once you have gathered this information, only then are you ready to establish the hangar specifications.

T-hangars: Nested versus standard configuration

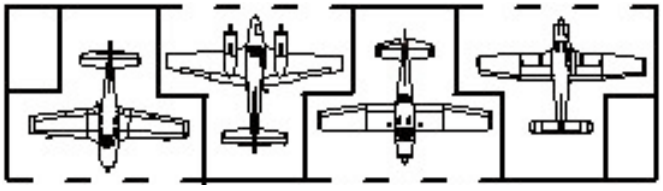
This configuration nests the tail section into the center of the structure. The overall length of the hangar is reduced, potentially saving on taxi lanes and ramps.

Figure 1



The standard configuration is sometimes called “stacked” because the unit depth is equal to the building width and the units are stacked together. Since the hangar width is narrower, it is also longer than the nested configuration thereby requiring longer taxi lanes on both sides of the hangar.

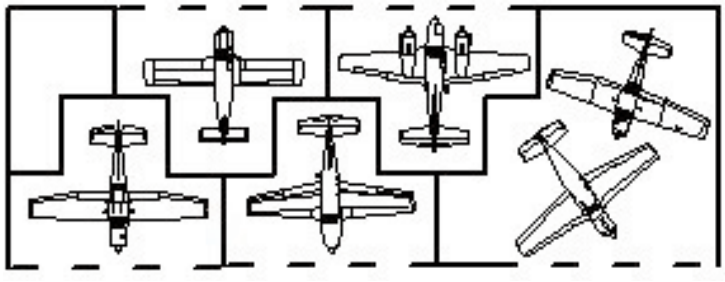
Figure 2



JetPod modification

This is a modification to the end unit of a nested T-hangar that allows for the storage of two or more aircraft depending on the hangar model.

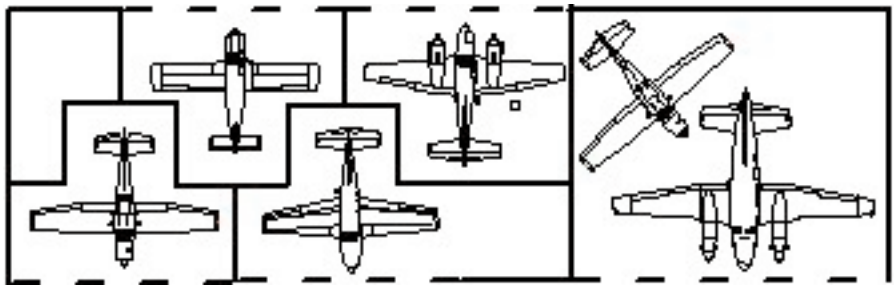
Figure 3



Clear span end unit

This is a modification that allows a rectangular clear span unit to be attached to the ends of the T-hangar. The clear span unit can be sized for any aircraft.

Figure 4



Rectangular clear span hangar

Floor area and height are the crucial elements for clear span hangars. The amount of clear floor area will dictate the amount of storage area within the hangar. Familiarity with the types of structural framing and the installation of the secondary members (i.e., wall girts) will result in the maximum floor storage space.

The two types of structural framing commonly used in pre-engineered buildings are the tapered rigid frame and the open-webbed truss with straight column.

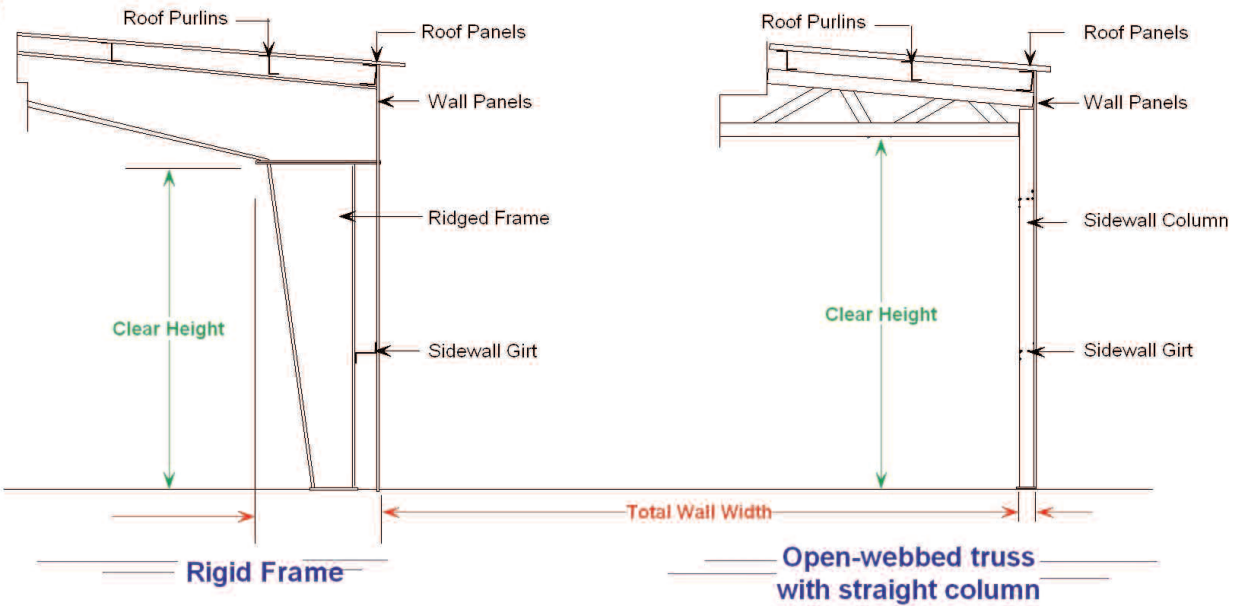
Rigid frame:

- Has tapered frame with haunch that restricts usable floor space
- Requires field welding of pick up points, bracing and door hinges when attaching a bi-fold door or bottom rolling door system
- Limited door size in endwall when utilizing tapered frame
- Exterior wall girts are mounted outside of steel frame line, shrinking usable square footage of building (A typical 50’ wide building could only accept a 45’ door system)
- Rigid frame may restrict wingspan on inside of building
- Creates kick-out load on foundation. Additional rebar and concrete required to hold frames at base

Open-webbed truss with straight column:

- Provides greater interior usable space
- No kick-out load at base of columns
- Flush wall girt design maximizes hangar width
- Can maximize door opening. (Typical 50’ building provide 49’6” clear door opening)
- Maintains clear width throughout depth of building

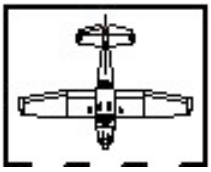
Figure 5



Individual

An individual hangar is specifically designed to house one aircraft.

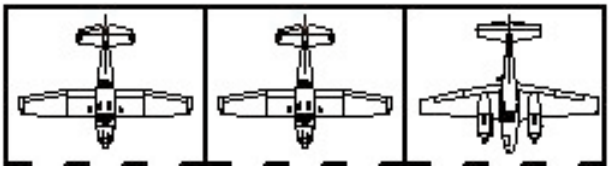
Figure 6



Consecutive rectangular

Consecutive Rectangular hangars are designed similar to T-hangars but are rectangular in shape. Each hangar is an individual unit separated by partitions. Typically, all the units face one direction.

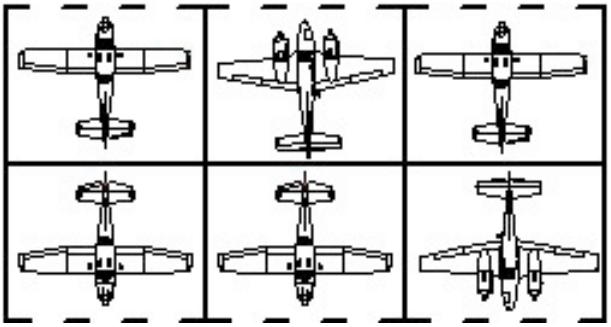
Figure 7



Back-to-back

The back-to-back hangar design consists of putting two rows of Consecutive Rectangular hangars together providing access on both sides of the structure.

Figure 8



Design versatility

Erect-A-Tube aircraft hangars are designed to meet your specific requirements. We offer individual hangars, T-hangars, Consecutive Rectangular hangars, JetPod modifications, various options and custom designs.

We are the leader in hangar design versatility.
Give us a call today! 800-624-9219.

Section 4: Hangar Doors

The hangar door is what differentiates an aircraft hangar from a typical metal building. It is the most significant piece of equipment that makes a building function properly as a hangar for aircraft. Whether bottom-rolling doors or electric bi-fold doors are selected, each has its own specific requirements that will affect how the hangar project is designed. It is important to choose a supplier that manufactures the door system and hangar as an integrated product.

Bottom rolling doors

There are two types of doors in this category. The first is a sliding door. This door system is supported from the top via a trolley that is inserted into a track system. The bottom of the door is guided through a series of intermittent door guides secured to the floor in the door opening. This is the same door system that is used on agricultural barn doors.

The second type, which is preferred, is the bottom-rolling door. This door system is designed with the weight of the door panels on the bottom rollers. The door system rolls on an embedded track and is guided by door guides at the top. A quality bottom-rolling door system should have door rollers that are eight inches in diameter. The larger the door roller, the easier the door will move. In addition, there should be ample weather stripping around all sides of each door panel.

Bottom-rolling doors have specific requirements in order to work smoothly. It is important to control the building deflection or movement within the tolerances of the top guides. It is also important to have an adequate foundation for the door track.

Electric bi-fold doors

For T-hangars, Consecutive Rectangular hangars and large bulk storage hangars with door openings under 80 feet wide and 20 feet clear height, the electric bi-fold door system is the most economical door system to have on a hangar. All of the extra components required for bottom- rolling doors, such as the additional foundation requirements, the door pockets, the bottom track system and the header/soffit above the door, by far offset the cost of the electric operator. Bi-fold doors offer complete utility for T-hangars and Consecutive Rectangular hangars. The bi-fold door system on all units can open and close without encroaching on the adjacent hangar space, which is not always the case with a bottom rolling door.

Electric bi-fold doors are designed to act as a movable wall system while still capable of handling various wind conditions in the closed position. The door system is attached to the header system with several hinge pick up points. While in the closed position, the door is latched to the vertical door columns and utilizes a cane bolt pin at the center of the door that drops into a socket embedded in the foundation.

The location of the door operators, their features and how they attach vary by manufacturer. Some operators are mounted on the door truss, while others are mounted on the door frame. In either case, there should be consideration given to the location of the operator and evaluation to the design features of each model, such as:

- What are the electrical requirements?
- Are the door operators pre-wired to the push button station?
- What safety factors are incorporated into the door system?

    - Are the door motor and gearbox integrated to provide a direct-drive system?
    - Does the door operator have safety shields for protection from moving parts?
    - Is there a safety override switch?
    - Do you need to step over operator components when entering the hangar?
    - What is the designed safety factor of the lift cables?

Checklist for success

Your research should include obtaining answers to the following important questions:
(Note: These are also areas where some manufacturers attempt to reduce their costs while potentially sacrificing quality.)

- ✔ What are the exact building dimensions?
- ✔ What is the clear wing depth dimension?
- ✔ What is the clear tail bay width dimension?
- ✔ What is the clear overall unit dimension?
- ✔ Is the eave the correct height to provide the proper clearance for the hangar door?
- ✔ Whose hangar door is the building manufacturer supplying?
- ✔ Who is responsible if the door and building do not align properly?
- ✔ How is the door being supported?
- ✔ What is the size of the door jamb column?
- ✔ Where is the hangar door operator mounted?
- ✔ How much weather stripping is provided by the door manufacturer? Where is it located?
- ✔ What are the specifications of the walk door used in the hangar door?
- ✔ What structural components are used in fabricating the hangar door?
- ✔ Does the hangar door require diaphragm action from the sheets to hold the door together?
- ✔ How many wall girts and partition girts are included in the building price?
- ✔ What is the lap length of the roof purlins?
- ✔ How many bolts are used for the purlin connections?
- ✔ Are clips provided to prevent the roof purlin from rolling?
- ✔ What is the tensile strength of the exterior wall and roof sheeting?
- ✔ How many anchor bolts per column?
- ✔ What is the sheeting warranty?
- ✔ What is the paint warranty?
- ✔ Can the structure stand alone without the need of diaphragm action from the exterior sheets?

Section 5:
Sheeting Options

Sheet gauges

Industry standards for exterior sheeting are 26 gauge. The purchaser has the option of colors for the roof and exterior wall panels. Typically, the roof sheeting is Galvalume and the exterior walls and door sheeting are in a color finish. There are full arrays of colors available. Warranties range from 20-30 years.

Partitions and upper partition trim

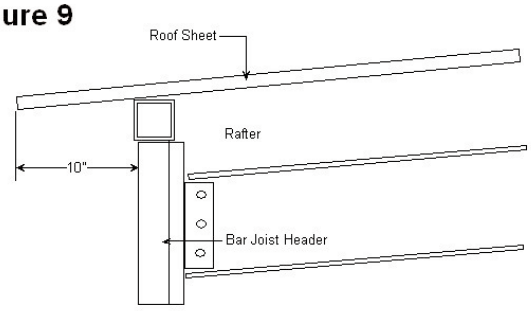
Partition walls are normally specified for 29 gauge Galvalume sheeting. The upper partition trim refers to the trim piece that fits between the top of each partition sheet and the roof purlin.

Section 6:
Roof Overhangs, Gutters and Downspouts

Roof overhangs

Standard roof overhangs on hangars without gutters range 10” - 12” from the centerline of the steel building frame. Overhangs beyond 12” may have special code considerations for safety purposes.

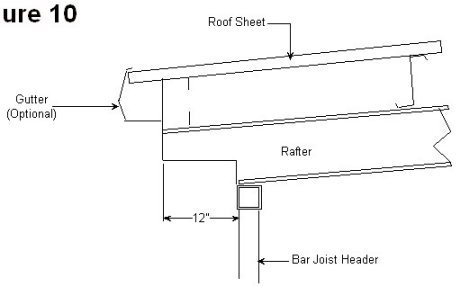
Figure 9



Standard Detail

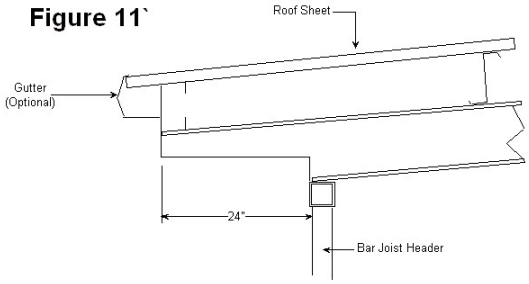
Other overhang designs are shown below:

Figure 10



12" Structural Overhang

Figure 11`



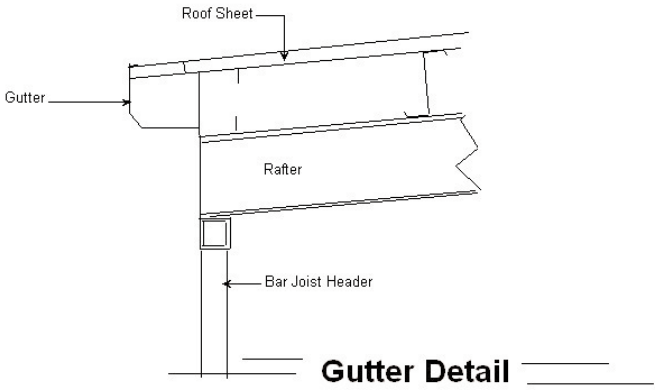
24" Structural Overhang

Gutters and downspouts

Requirements for a typical installation:

- Eave height of the building is raised to provide clearance for the gutter above the bi-fold door system
- T-hangars with bi-fold doors will have downspout drops only at the corners
- The gutter is sloped to divert the water toward each end of the building
- Eave height is not raised when accommodating bottom-rolling door systems
- Gutters are not typically recommended in cold weather states due to potential snow and ice build-up

Figure 12



Section 7:
Building Codes

Prior to the year 2000, there were several building codes that could have been adopted by any given state. Some states would then amend that code to meet their specific requirements or historical criteria. Recently a new building code, The International Building Code (IBC), has been established in order to create uniformity. The latest edition is 2006.

To have your structure priced accurately, the following is required:

- Name and year of model building code
- Ground snow load. Is it reducible?
- Roof live load
- Collateral load
- Seismic zone
- Wind speed
- Exposure rating
- Is building heated?

Section 8: Foundations

Foundation design by local engineer

A local engineer is recommended to design the foundation for your aircraft hangar project. The local engineer is familiar with the local building codes, soil conditions and is generally required to inspect and oversee the foundation installation process. In order to design an appropriate foundation, the following information is considered:

- Topography of site
- Geotechnical data
- Column reactions
- Anchor bolt layout
- Stamp and seal of a state professional engineer

Sloping the floors

Keeping water away from the building is a key element in any building process. Aircraft hangars are no different. When constructing aircraft hangars, two primary areas to address are:

- The ramp pitch on the outside of the hangar
- The floor slope on the inside

Airport engineers recommend the ramp slope away from the building be a minimum of 1% to a maximum of 2% on grade. This allows the water to drain away from the building, yet still enables the pilot to move the aircraft into the hangar easily.

In addition to the ramp, consideration must be given to the floor slope of the hangar. Appropriate design considers the amount of ramp and floor slope, while addressing the ease of aircraft movement.

Moving Forward

Buying or building an aircraft hangar entails many considerations. Careful planning and thorough research are essential. Erect-A-Tube is well prepared to answer your questions and help you make the right decisions. Please contact us at 1-800-624-9219 or info@erect-a-tube.com. To learn more about Erect-A-Tube, Inc. and our quality aircraft hangars, visit us at www.erect-a-tube.com.

The Erect-A-Tube Story

Erect-A-Tube has a long and distinguished history in the aircraft hangar and hangar door business. We are the original developer of the electric bi-fold door system and are known throughout the general aviation industry for our high-quality, state-of-the-art products and superior service.

From our corporate headquarters in Harvard, Illinois, we design and fabricate general aviation facilities for the smallest single-engine aircraft to large corporate facilities for business jets.

We have more than 40 years of experience in the business and over 16,000 hangar units in operation in all 50 states. Erect-A-Tube is the industry leader, developing superior aircraft hangars and hangar door systems.

We are committed to our customers as well as the airport and aviation industry. Half of our marketing dollars are spent supporting state aviation organizations, national and regional efforts of the American Association of Airport Executives (AAAE), Aircraft Owners and Pilots Association (AOPA), Experimental Aircraft Association (EAA), National Business Aviation Association (NBAA) and FAA regional events, to name a few.

No other aircraft hangar and door manufacturer offers more combined resources and expertise than Erect-A-Tube, Inc. Contact us today!

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