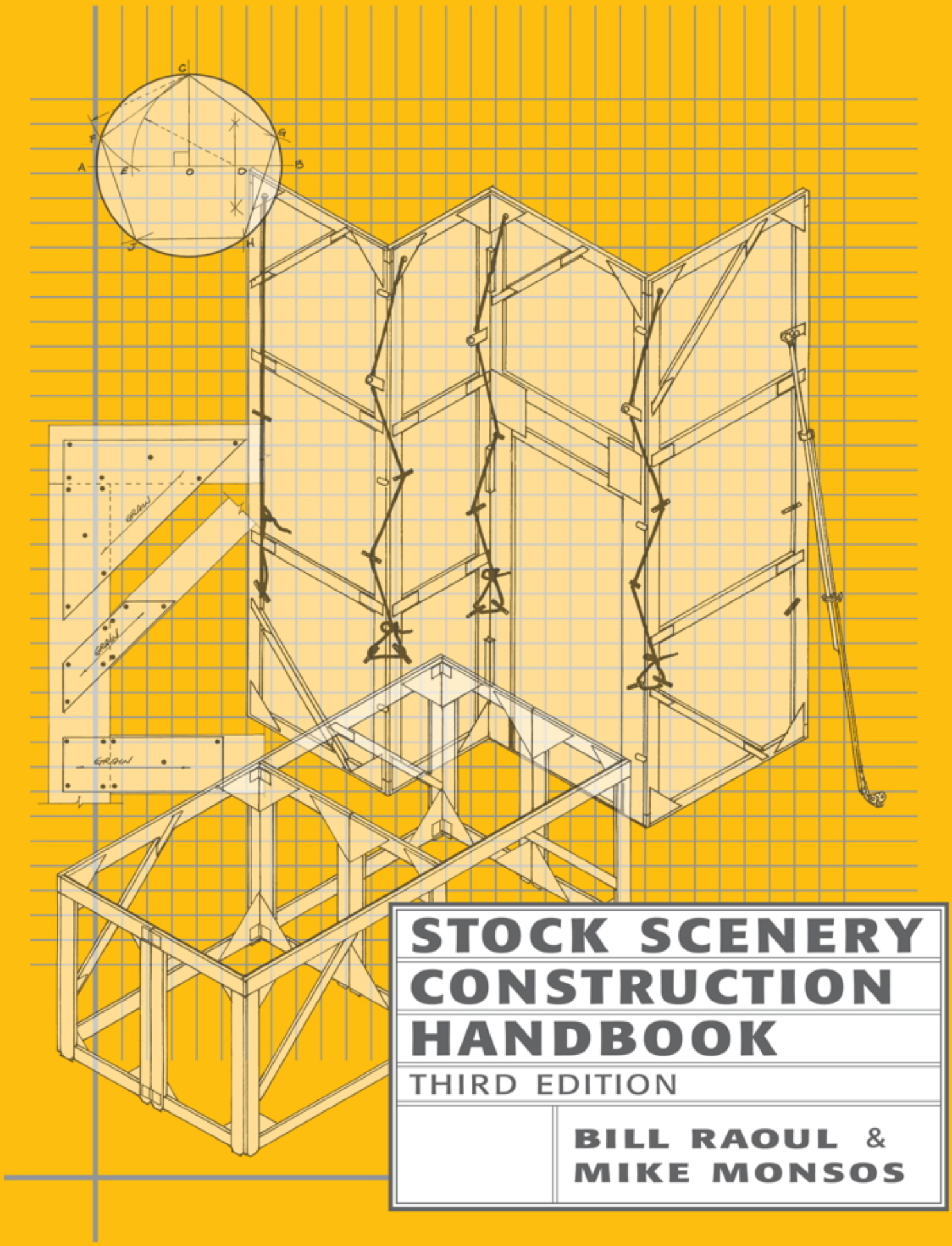

STOCK SCENERY CONSTRUCTION HANDBOOK

THIRD EDITION

BILL RAOUL &
MIKE MONSOS

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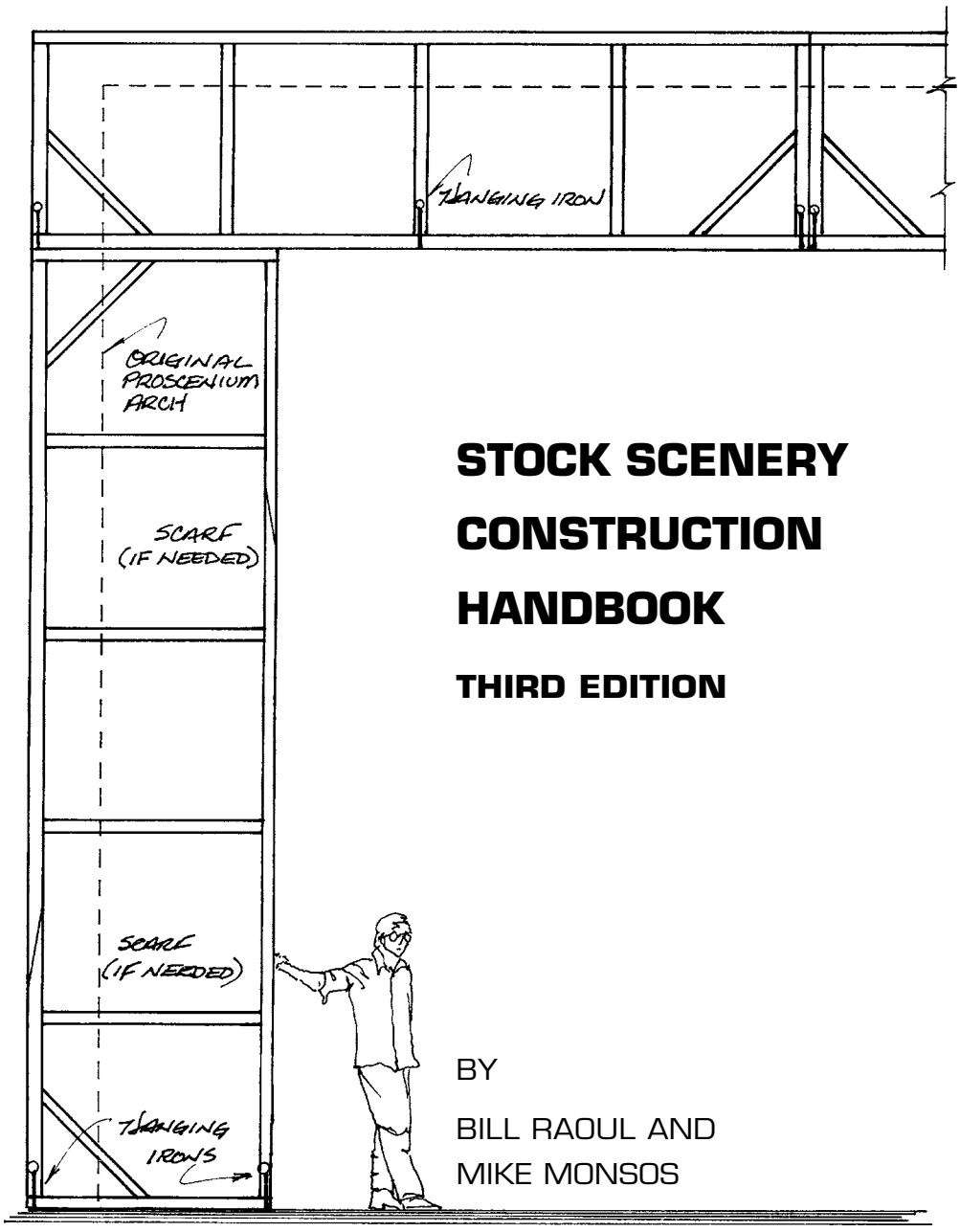

STOCK SCENERY CONSTRUCTION HANDBOOK

THIRD EDITION

BY

BILL RAOUL AND
MIKE MONSOS

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DRAWINGS

PREFACE

Bores can be divided into two classes: those who have their own particular subject, and those who don't need a subject.
—A.A. Milne

Scenery construction must certainly qualify as a subject, but I sincerely hope my digestion of it will not land me in either of Mr. Milne's classes. For more than thirty-five years I have found scenery construction fascinating, frustrating, and even baffling, but, at the same time, exciting and very satisfying. It is a subject in constant change, as is the rest of the theatre. I have also noticed that the more things change, the more they seem to stay the same. That, of course, has changed my thinking.

To some, the techniques and methods presented here will appear old-fashioned and outmoded. I can only counter with an acquiescent nod and hope if they ever need to get back to some of the basics, I don't bore them. There is nothing more instructive than observing the past, and if this handbook becomes something of a history of yesterday's techniques and methods, I have at least succeeded in preserving part of our theatrical heritage. But I truly believe it is more.

In this time of world waste, conspicuous consumption, and increasing shortages, we have a responsibility to conserve and reuse. Fortunately, our recycling plant is the theatre, and we all know it must reflect the times.

Before I bore you with my soapbox, let me say my thank yous to the hundreds of talented people who have been my co-workers. Their training methods, skills, and thoughts have been diligently collected and stored. Many of their wonderful ideas have metamorphosed to the point of nonrecognition, but, originally, I stole them nonetheless.

This book is now a fourth overhaul of what began as classroom handouts. They were gathered into a slim volume called *Flat Frame Construction*, which grew into a larger handbook, *Stock Scenery Construction,* which bears some youthful resemblance to the present tome.

Paul Carter, author of the invaluable *Backstage Handbook*, has my thanks for connecting me with publisher David Rodger, whose patience and help have been most appreciated. Stacia Graham, whose fleet fingers typed many a draft, deserves my grateful thanks. Carol Morris, whose red pen flowed around many an indefinite pronoun and dangling thought, certainly clarified many of the muddier passages. However, none of them knows, as I so gratefully do, how much we must all thank Tim Paul for his uncountable hours as proofreader, gentle suggester, and astute critic. The remaining errors must be his, but I will gladly assist him in correcting them if you will be so kind as to point them out.

My thanks ultimately go to my colleagues in the Department of Drama/Dance, and to those within the University of Montana who so graciously granted me the sabbatical leave which enabled me to rework this information.

SECOND EDITION NOTES

Second printings and second editions are both gratifying, but while the first is a mark of popularity, the later must admit the need for change. To the many people who have contacted me with kind comments, insightful suggestions, and reprimands for omissions, I am extremely grateful. Most users praised the limited scope of this handbook but had specific queries that I have tried to answer in the expanded sections on drops and hardwall scenery with related items. The number of questions specifically about paint and not the techniques of using it per se were surprising and prompted the new final chapter. To those who wanted a section on steel and metal construction I can only apologize for my lack of knowledge and urge them to seek those answers from a qualified source. However, my limited experience leads me to believe metal shops and woodshops need to be separate areas. The droppings on the floor and particulates and fumes in the air are not compatible. Metal is, however, an excellent scenic material and often perfectly answers the scenery demand of cost vs. weight vs. strength.

Again I must thank those same people who facilitated the first edition for their continued support…with the possible exception of the sabbatical committee…and if reception of this edition is as positive, who knows? They say: "Third's a charm!"

THIRD EDITION NOTES

Books are the quietest and most constant of friends; they are the most accessible and wisest of counselors, and the most patient of teachers.
—Charles William Eliot

Bill Raoul has been my friend, mentor, teacher, and critic for over thirty years now. So when he asked me if I would accept the task of creating the next edition of this gloriously useful book, I had to consider what this book meant to me personally. I learned to build scenery from this book. I have absorbed its thought process of evaluating the pros and cons of stock scenery. It taught me to appreciate the history of scenic carpentry and the methods of construction that have been passed down to us. It informs my understanding of why we make certain choices in the shop.

I decided that, yes, I did want to help keep this important book current so new generations of students can learn from it the way I had. And I want to honor the education I received at the University of Montana under Bill.

PART 2 • FLATS

STOCK SCENERY

What is stock? Mr. Webster defines it as something "used or employed for constant service; kept in stock; as a stock size." If we may define "in stock" as meaning "on hand" and "stock size" as a "standardized size," we are close to a good definition for stock scenery. Indeed, stock scenery is designed with the specific goal of being able to keep it on hand and re-use it, thus gaining significant savings of time, money, and personnel.

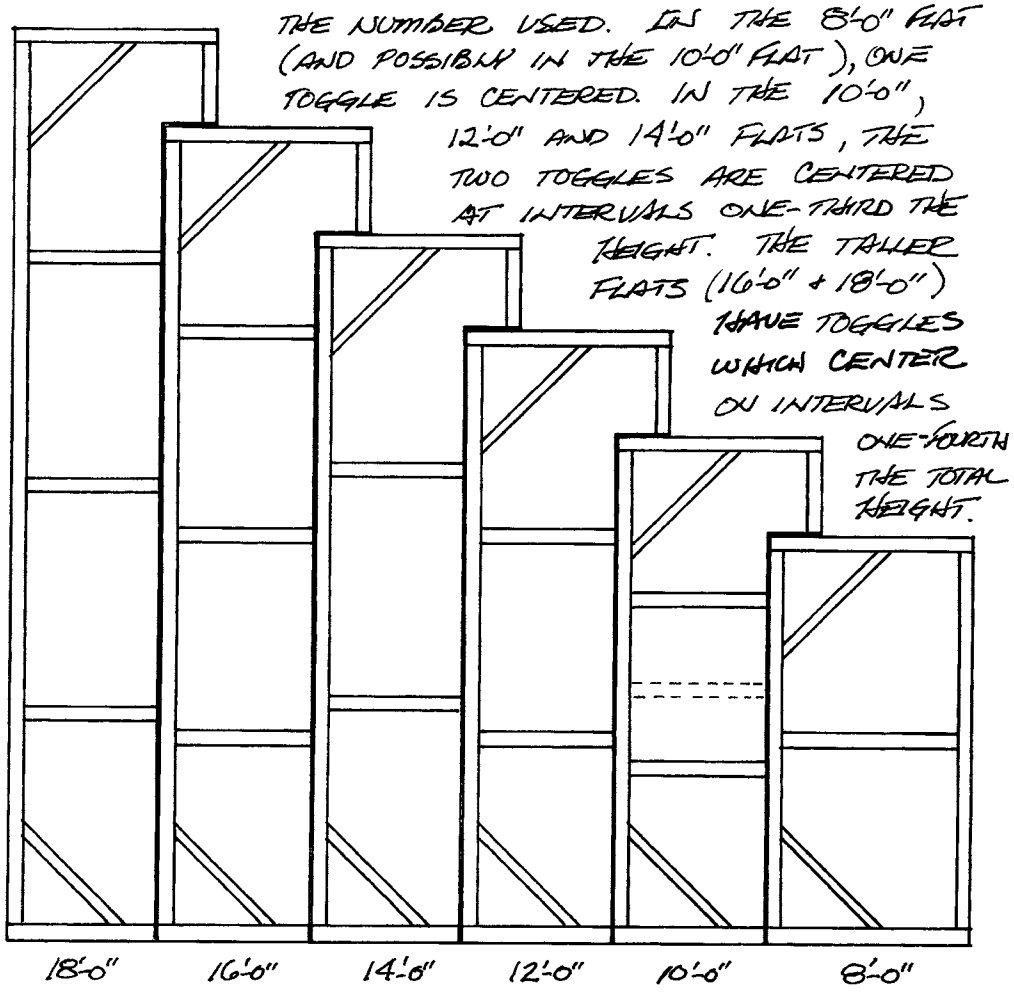
When scenery becomes stock, we have combined more than nouns, verbs, and adjectives—we have consolidated our thinking. Scenery can no longer be designed for a specific production and then be discarded so the process may begin anew. This type of wanton consumerism is rapidly becoming outmoded in all aspects of our society. This does not mean designs for a production must be compromised or be inappropriate, but in the design process some practical restrictions must be applied. No designer quibbles about the director, the script, shape of the theatre, the building period, size of crew, budget, limited tech and dress period, or the many other restrictions he or she inherits. Bitch and moan, yes, but quibble, never! Asking a designer to work with and utilize stock scenery is but one more limitation added to the stack. If we believe that nothing is more detrimental to an artist than total freedom, it stands to reason that stock limitations should help the design. But in all seriousness, working with stock scenery does not have to be a limitation. The creative recycling can actually assist a clever designer and allow more time for other aspects of the production. This, of course, assumes the stock is well planned.

The stock scenery discussed in this book breaks down into four basic categories: flats, draperies (or soft scenery), platforms (with ramps), and stairs. Obviously, theatre-in-the-round has little use for flats per se, but a proscenium theatre would, as might the thrust. All three utilize platforms and steps. Unfortunately, for those not needing flats, I have included in the section on flats some of the determining factors for building stock scenery for all three categories.

Stock scenery takes time and money to build, and the decision to use stock scenery should be made carefully and with buy-in from technical directors, designers, directors, and everyone else whose jobs will be affected. Make sure all are aware of the limitations,

COMMON HEIGHTS OF STOCK FLATS DWG. 2-1

BELOW IS AN EXAMPLE OF A 4'-0" STANDARD FLAT SHOWN IN SIX COMMON HEIGHTS. THE PLACEMENT OF THE CORNER BRACES REMAINS CONSTANT. THE MAJOR CHANGES CONCERN TOGGLE PLACEMENT... AND THE NUMBER USED. IN THE 8'-0" FLAT (AND POSSIBLY IN THE 10'-0" FLAT), ONE TOGGLE IS CENTERED. IN THE 10'-0", 12'-0" AND 14'-0" FLATS, THE TWO TOGGLES ARE CENTERED AT INTERVALS ONE-THIRD THE HEIGHT. THE TALLER FLATS (16'-0" & 18'-0") HAVE TOGGLES WHICH CENTER ON INTERVALS ONE-FOURTH THE TOTAL HEIGHT.

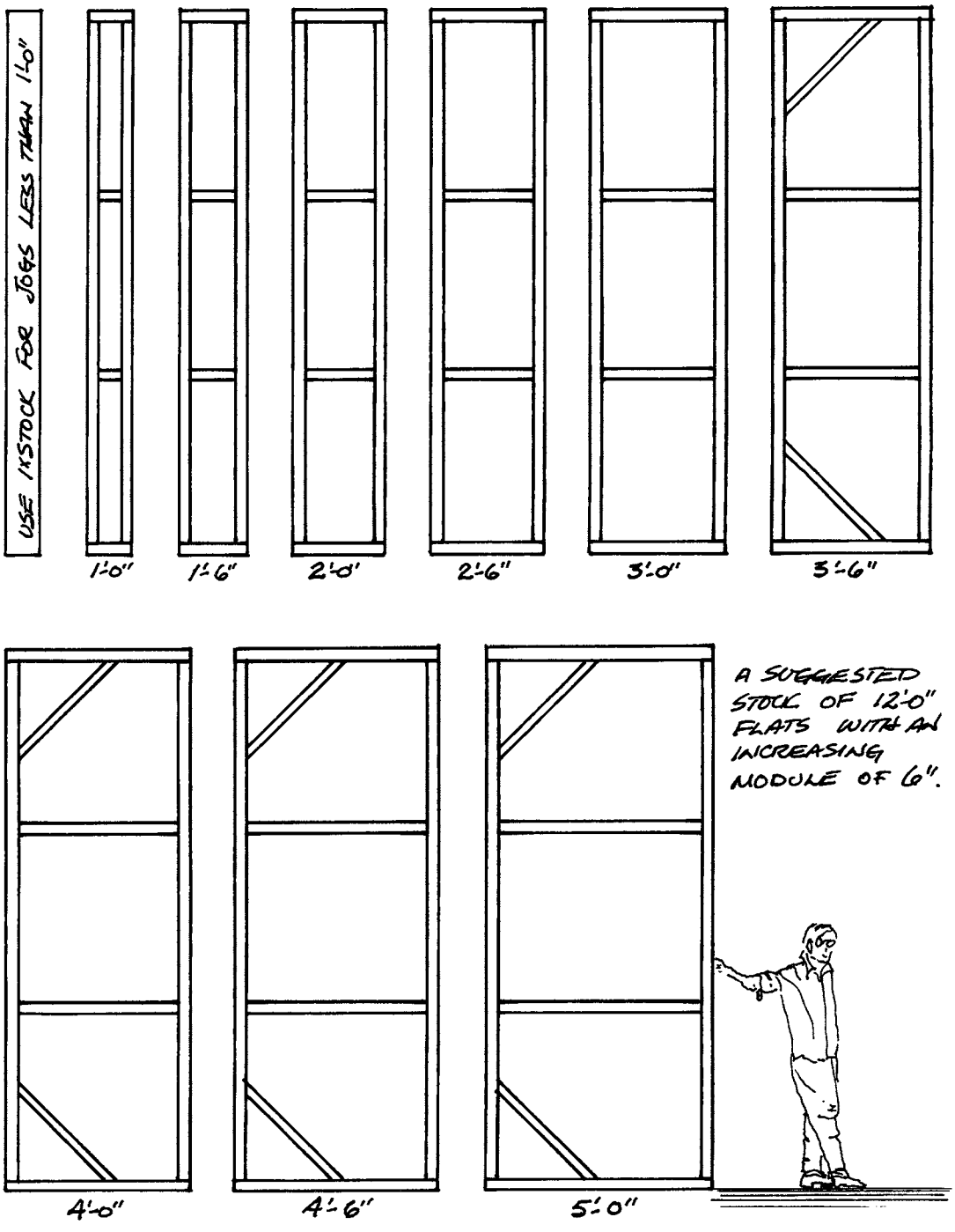


THE FOUR TO SIX RULE

GENERAL RULE OF THUMB FOR TOGGLE PLACEMENT:

HORIZONTAL MEMBERS DO NOT NEED TO BE CLOSER THAN 4'-0" APART BUT SHOULD NOT BE FARTHER APART THAN 6'-0". SPECIFIC OR UNUSUAL USE CAN VARY THE "RULES."

A SUGGESTED STOCK DWG. 2-2



as well as the advantages. Certain types of plays benefit from settings made from stock flats. I do not necessarily mean box sets, even though that is the most common type. If a good percentage of the productions can utilize stock flats, the chances are also good that the theatre can save in the long run by building a stock of flats.

There are many factors to consider if a stock is going to be built. The first is the theatre itself. What is the proscenium width, height, and its relationship to the floor space? A flat which works proportionately to these should be determined (see Drawing 2-1). What is the depth of the stage, and what is its wing space? What is the access to the stage (shop door, winding stairs, etc.), and where is the offstage storage area? Some theatres have very low ceilings over the stage, or they have draperies which are dead hung to a very low trim. Often the draperies can be raised but usually not the ceiling.

Equally important is the storage space. Stock flats spend more time offstage than on. To be effective, storage must handle many times the number of flats which could be used in a single production. If space does not exist, seriously reconsider building a stock of flats. Storage is a major limitation of stock.

The shop area is important. As discussed earlier, flats require a certain amount of floor space to be built. Though it is true that stock flats can relieve the burden upon a shop, this is true only after they are built. There are few shows, also, which will not have additional flats built for them, which could then become a part of the stock. It is, however, a rare shop which cannot build a flat! A reasonable collection of power tools greatly facilitates flat construction but is not necessary.

Budget is often considered all important. Remember that a budget is nothing but priorities with backing. Shift accordingly. Stock scenery is not cheap to build. It only becomes economical after it has been paid for and can be used again. Because a well-built flat can be utilized dozens of times before it needs recovering, and the frame can last many coverings, the possibilities of reuse are great. But the initial outlay is large.

Labor must be considered. If there is a skilled crew in the shop, they would probably rather build most shows from scratch, as is usually done in professional situations. However, in the nonprofessional theatre, the designer, technical director, and crews would often rather spend their time on a few detail pieces and are more than willing to accept the shell of a box set, already built and ready to paint. But is there sufficient staff and crew to build the stock, handle the stock in set-ups, shifts, and strikes? Are there people to properly return the stock to storage? Don't get discouraged, the worst is yet to come.

Time, of course, is decidedly related to using stock flats. Like money, it takes a lot of time to build a good stock, but little to use it afterwards. This gives the paint crews more time to do a better job and frees the designer and set dressers to spend extra hours adding the finishing touches. The technical crew can concentrate on building those elements which will be added to the set or which will play in conjunction with it. The tired old song, "Time is Money," hits the ear with a sour bleat to any exhausted technician who knows a truer lyric, "Money is Time."

Stock scenery is also affected by the age of the people using it. Grade school children

certainly cannot be expected to handle stock flats which are 16′-0″ high. They shouldn't handle any scenery if they have not developed good reflexes and coordination; it is not only dangerous, but shortens the life of the scenery.

Another important factor is the availability of materials. Lumber is commonly available in lengths up to 16′-0″ long. It is possible to get longer pieces, but the cost is usually prohibitive. Another factor is the very popular 4′-0″ × 8′-0″ size of plywood. If platforms are being planned with the stock flats, 4′-0″ (or divisions and multiples of it) is a common size. Some of the more subtle determining factors are door openings, which are 28-36″ wide by 6′-9″ to 7′-0″ high. This affects movement of the scenery and will also affect the flat which contains a door opening.

In summary, the determination of the sizes for stock flats, platforms, and stairs is one which must come from weighing all the factors and setting priorities. Some common flat heights usually start at 8′-0″ and continue (often in 1′-0″ intervals) to 16′-0″ (see Drawing 2-1). The most common flats seem to be 12′-0″ or 14′-0″ high. Widths are usually based on a module (see Drawing 2-2); 6″ seems to give a satisfactory width change, although 3″, 8″, and 9″ are also used. Some theatres have no width restrictions. Widths usually start with flats which are 1′-0″ wide and increase on the module chosen. 4′-0″ seems to be the most common width, probably because many people choose to build wider flats from a combination of two or more smaller ones. Flats much wider than 5′-0″ often create a storage problem. The old law of no-wider-than 5′-9″ still holds, but for different reasons. We seldom need to clear the opening in a boxcar door while touring, but an economical muslin width is 72″, and the problems in handling flats increase as they get wider.

It is a rare theatre indeed which can afford to have more than one height of stock flats. Theatres usually pick the most practical height and occasionally will have a small stock of shorter flats which serve as backings for doors, windows, etc. Platforms and stairs also need to conform to specific regulations, which will be discussed later.

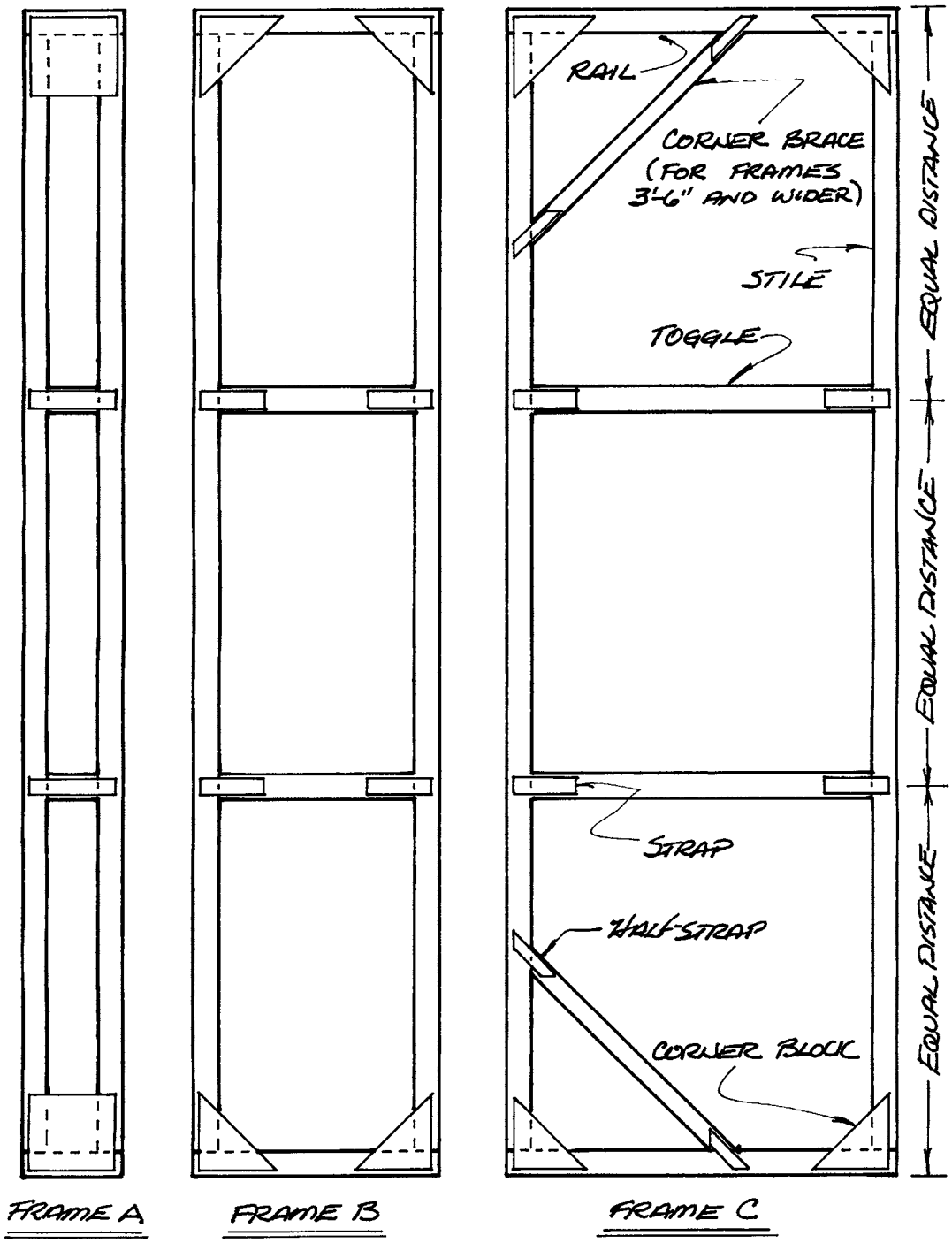
FLAT FRAME COMPONENT PIECES

There are only four basic parts to a standard flat frame (see Drawing 2-3). They are the rails, stiles, toggles (sometimes called toggle boards or toggle rails), and the corner braces.

The rails are the horizontal top and bottom pieces in the frame. The stiles (note spelling) are the outside vertical members of the frame. The names come from architectural frames like doors and windows into which secondary members are tenoned. On older doors, the stiles go from the bottom to the top. This gives a strong edge and prevents the bottom rail of the door from being broken off when it is kicked. The stiles in a standard flat frame are always inside the rails. If this were not so, the end grain of the stiles would split apart when the frame is dragged on the floor. Therefore the length of the protected stiles is the height of the frame minus the width of two rails.

The toggles are placed in the frame to keep the stiles at their prescribed distance.

STANDARD FLAT FRAMES DWG. 2-3



They were originally tenoned also, but today with the widespread use of plywood blocks to fasten flat pieces together, there are very few shops left which still use these exacting methods (see Drawing 2-6). The derivation of the word "toggle" is unclear, but it probably comes from the verb "to toggle," which means to fix or fasten in the manner of a pin (like the toggle bar on the end of a watch chain, which is inserted into the button hole). Don't ask how it got to be an internal "rail."

Toggles are always fixed in the same place in the same height of stock (see Drawings 2-1, 2-2, and 2-3). Usually, they are centered on some specific measurement which is determined by the height of the flat. However, exceptions do exist. For example, when hanging a cornice on a set, an additional toggle could be placed near the top rail to help hold it. If there are often chair rails on sets, a toggle at the necessary height from the floor could be added. These odd toggles could affect the placement of the other toggles. A good rule of thumb for toggle placement is to have one at least every six feet from another horizontal member, but it is not necessary to have one any closer than 3′-0″ from another horizontal member. Close to 4′-0″ is a safe choice, but, again, need is often a deciding factor (see Drawing 2-1).

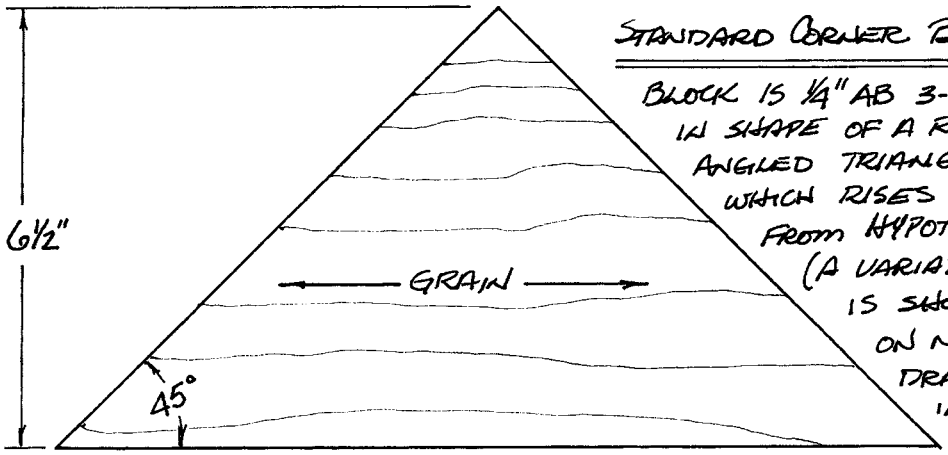
Rails, stiles, and toggles are made of 3″ wide stock. The corner brace is a piece of 2″ stock which is 3′-0″ long with a 45-degree cut placed on each end, like part of a picture frame. The corner brace is used to help hold larger flat frames square. Two corner braces are placed in every flat that will accept them. The braces are always contiguous to one stile. It does not matter which stile, as long as they remain consistent within one height of stock. For the sake of sanity, in this book braces are always placed touching the left stile. Corner braces can be made ahead of time in quantity, often from tailing strips remaining from 1× stock after it has been ripped down for another piece. This will use up scrap, cut down on waste, and speed construction.

PLYWOOD FASTENERS

Rails, stiles, toggles, and corner braces butt up against each other in the frame. The butt joint is held together by specially made ¼″ 3-ply fasteners. There are three stock shapes made up in quantity and stored for use as needed (see Drawings 2-4 and 2-5). The corner block (a block is a large piece of material laid over a joint) holds the corners of the frame. The strap (a narrow piece laid over a joint) holds the toggle to the stile, and the half-strap holds the corner brace to the rail and stile. All plywood pieces should have their grain running at a right angle to the joint for maximum strength. Never have a joint fastened with the grain running parallel to it, because it will probably break.

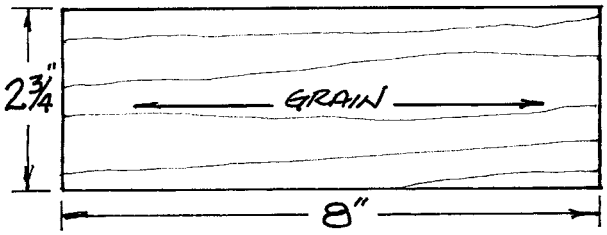
CORNER BLOCK

The corner block is best made by ripping a 6½″ × 8′-0″ strip of ¼″ 3-ply. Then, with the chop saw set for 45 degrees, cut across this strip. Flip the strip over and move it along the fence until the first cut reaches the blade. Pull the saw again, and the result will be a



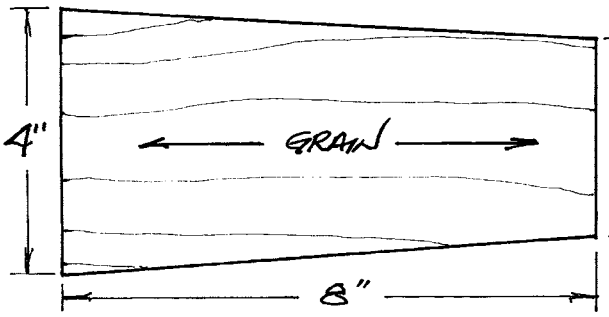
STANDARD CORNER BLOCK

BLOCK IS ¼" AB 3-PLY IN SHAPE OF A RIGHT-ANGLED TRIANGLE WHICH RISES 6½" FROM HYPOTENUSE. (A VARIATION IS SHOWN ON NEXT DRAWING).



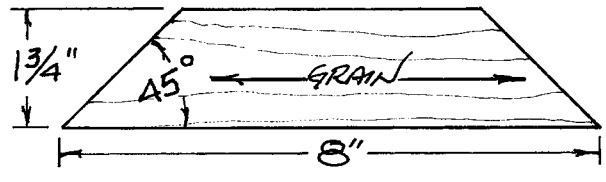
STANDARD STRAP

STRAP IS ¼" AB 3-PLY WHICH IS 8" LONG AND AS WIDE AS TOGGLE STOCK MINUS ¼".



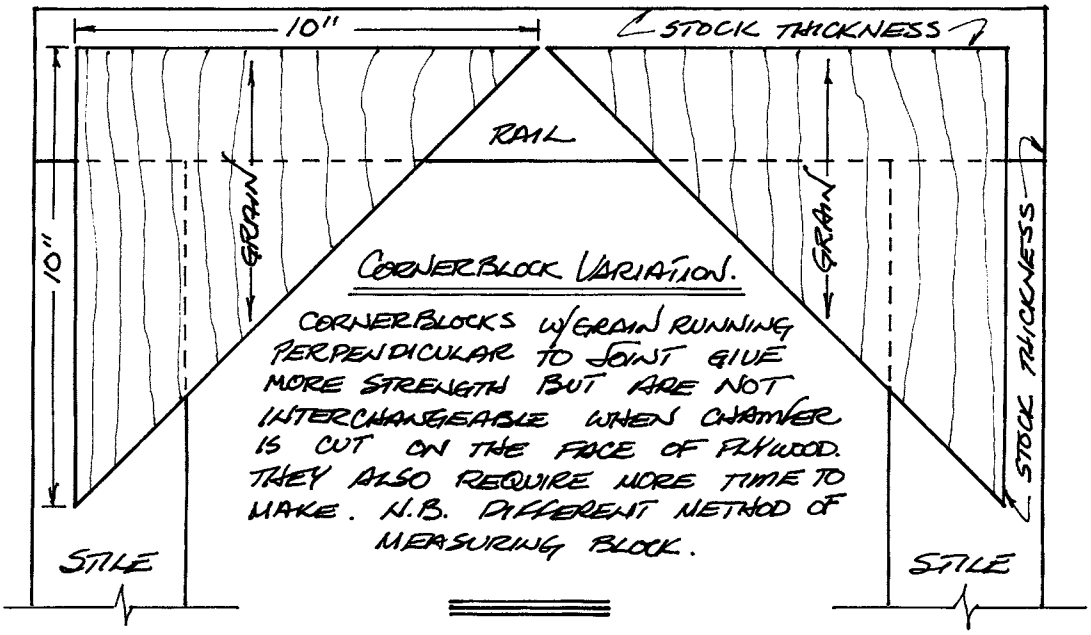
STANDARD KEYSTONE

KEYSTONE IS KEYSTONE SHAPED STRAP OF ¼" AB 3-PLY. (STRAPS REPLACE KEYSTONES IN THIS BOOK).



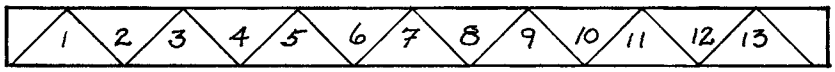
STANDARD HALF-STRAP

½-STRAP IS A TRUNCATED RIGHT TRIANGLE. IT IS 8" LONG AND AS WIDE AS CORNER BRACE STOCK MINUS ¼".



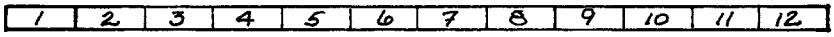
CORNER BLOCK VARIATION.

CORNER BLOCKS W/GRAIN RUNNING PERPENDICULAR TO JOINT GIVE MORE STRENGTH BUT ARE NOT INTERCHANGEABLE WHEN CHAMFER IS CUT ON THE FACE OF PLYWOOD. THEY ALSO REQUIRE MORE TIME TO MAKE. N.B. DIFFERENT METHOD OF MEASURING BLOCK.



YIELD: 91 BLOCKS PER 4×8 SHEET ¼" AB 3-PLY

CORNER BLOCKS: RIP 6½" × 8'-0" STRIP OF PLY AND CUT AS DRAWN.

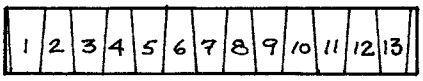


YIELD: 192 STRAPS PER 4×8 SHEET ¼" AB 3-PLY

STRAPS: RIP 2¾" × 8'-0" STRIP OF PLY AND CUT AS DRAWN.

YIELD: 350 ½-STRAPS PER 4×8 SHEET ¼" AB 3-PLY

½ STRAPS: RIP 1¾" × 8'-0" STRIP OF PLY AND CUT AS DRAWN.



YIELD: 143 KEYSTONES PER 4×8 SHEET ¼" AB 3-PLY.

KEYSTONES: RIP 8" × 4'-0" STRIP OF PLY. N.B. GRAIN MUST RUN PERPENDICULAR TO THE 4'-0" CUT. CUT AS DRAWN.

LAYOUT AND CUTTING METHODS FOR PLYWOOD FASTENERS—

corner block (see Drawing 2-5). Repeat the cut, flipping the strip each time, until it is all cut into corner blocks.

STRAP

The strap is a piece of ¼″ 3-ply which is 8″ long and as wide as the toggle stock minus ¼″. The minus ¼″ prevents the edge from overhanging the toggle and snagging anything. In this book, because toggles are 3″ wide, straps are 2¾″ wide. The grain must run the length of the strap, so rip a piece of ¼″ 3-ply 2¾″ × 8′-0″ long. Set the chop saw for a straight cut (90 degrees), and cut the strip into 8″ straps. A stop block clamped to the fence 8″ from the blade will speed up this step by allowing you to move the plywood quickly to the stop and not measure each time. Don't bang the stop or it could move. Do not try to cut more than one strap at a time The cut pieces can flip up into the blade or slip and slide and create inaccurate cuts.

HALF-STRAP

The half-strap is as wide as the corner brace stock minus ¼″. Therefore, in this book, they are 1¾″ wide. The half-strap measures 8″ on the long side and has a 45-degree angle cut on each end. A stop block clamped to the fence of the chop saw (with the arm swung over to a 45-degree angle) will aid in cutting these pieces also.

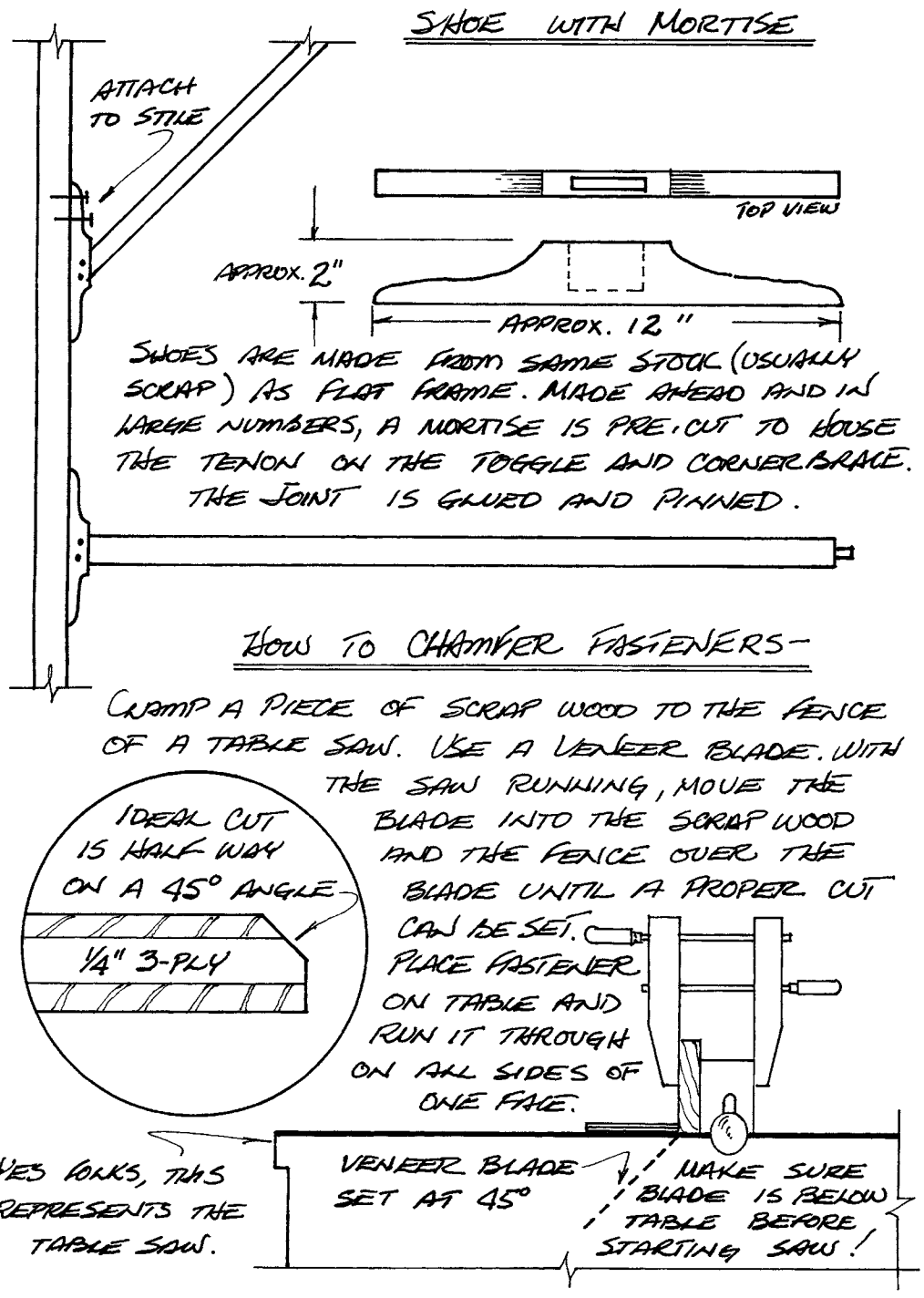
KEYSTONES

Keystones are seldom used today, though their added strength might sometimes warrant it. They are more time-consuming to make and the yield per sheet of plywood is less than that of the strap. Strength loses to cost and weight. Mostly cost.

CHAMFERING FASTENERS

All plywood fasteners should have a ⅛″ chamfer on the face edge (see Drawing 2-6). This is a bevel cut which eliminates splinters and lessens the chance of snagging costumes or soft scenery. The chamfer also makes the flat frame easier to handle because the edges are smooth and eliminate any danger of tearing the covering when the flats are stored.

Chamfering the fasteners, while a tedious process, is well worth the time. A small plane is ideal to chamfer irregular blocks and straps made for special applications or adaptations to stock fasteners, but it is far too time-consuming for the thousands of pieces necessary to build a stock of flats. An easy method is to use the table saw. Clamp or bolt a piece of 1× stock to the fence on the saw. Put a veneer blade in the saw. Crank the blade to a 45-degree angle and lower it below the table's surface. Move the fence, with the 1× stock on it, up to the blade opening. Turn on the saw. Carefully raise the blade and cut into the 1× stock on the fence. By adjusting the fence and the blade, a relationship can be established which will allow you to pass a piece of ¼″ 3-ply across the angle blade and get an ⅛″ chamfer. Workers doing the chamfering should switch duties periodically, because the work can become hypnotizing and therefore dangerous. Chamfering


SHOE WITH MORTISE
ATTACH TO STILE
TOP VIEW
APPROX. 2"
APPROX. 12"
SHOES ARE MADE FROM SAME STOCK (USUALLY SCRAP) AS FLAT FRAME. MADE AHEAD AND IN LARGE NUMBERS, A MORTISE IS PRE-CUT TO HOUSE THE TENON ON THE TOGGLE AND CORNER BRACE. THE JOINT IS GLUED AND PINNED.
HOW TO CHAMFER FASTENERS-
CLAMP A PIECE OF SCRAP WOOD TO THE FENCE OF A TABLE SAW. USE A VENEER BLADE. WITH THE SAW RUNNING, MOVE THE BLADE INTO THE SCRAP WOOD AND THE FENCE OVER THE BLADE UNTIL A PROPER CUT CAN BE SET. PLACE FASTENER ON TABLE AND RUN IT THROUGH ON ALL SIDES OF ONE FACE.
IDEAL CUT IS HALF WAY ON A 45° ANGLE
1/4" 3-PLY
YES LOOKS, THIS REPRESENTS THE TABLE SAW.
VENEER BLADE SET AT 45°
MAKE SURE BLADE IS BELOW TABLE BEFORE STARTING SAW!

also ties up the saw, so this work should be done when there is a lull in the schedule. A what? In the what?

Always hold the plywood fasteners back ¾″ (or stock thickness) from the outside edge of the frame. This clearance allows one flat to butt flush against another and make a smooth corner (see Drawing 2-48). The fasteners can also act as stops. On the inside openings (like doors and windows), you should also hold the fasteners back to allow a piece of 1× stock to be placed on edge for a thickness or reveal if desired (see Drawings 2-13 and 2-19).

It is interesting to know that before the age of plywood, scenic carpenters made their fasteners of thin wood which had linen duck glued to both sides to strengthen it. They were then nailed over the frame joints, which were usually mortised and tenoned or doweled.

STANDARD FLAT CONSTRUCTION

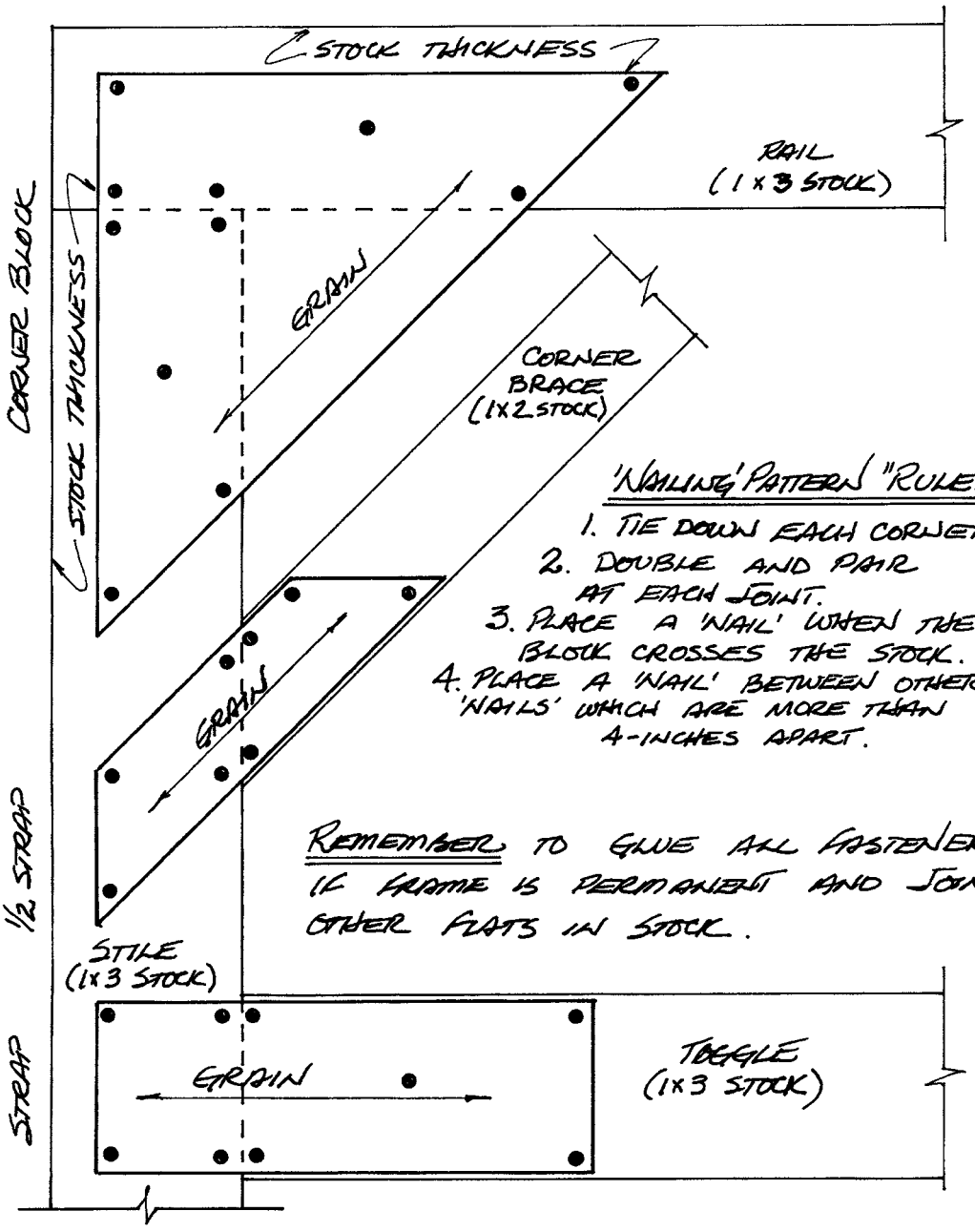
All flat construction is based on the standard flat (see Drawing 2-3). This is one of the best examples of cost vs. weight vs. strength. When vertical, the flat frame is very strong. It is weaker when placed on its side because the ends of the rails are exposed to the floor and can be split apart. When leaning or suspended horizontally, the frame is at its weakest because the plywood fasteners are taking the stress. Flats should be used vertically, if possible.

To build a 4′-0″ × 12′-0″ flat like Frame C on Drawing 2-3, follow this procedure: Rip the stock to a true 3″ and cut two stiles 11′-6″ long. Unless you are using perfect wood, it is advisable to test each piece as it is ripped. Hold the piece at one end and raise it up. Allow it to drop down. This should put enough bounce and shock through the piece to break it at any weak place. It is better to find weaknesses at this point and not after the frame is complete. Always cut the longest pieces first, and then the shorter ones can be cut from the scrap. Next cut two rails 4′-0″ long and then two toggles 3′-6″ long. Pull two corner braces from the stockpile and get four corner blocks, four straps, and four half-straps.

Now you are ready to assemble the unit. The first thing to know about building flats is to make sure they end up square. Flats that are even slightly off will torment you for their entire life, as they will never line up well with other flats and will constantly misbehave. Flats can be assembled with a number of different fasteners in a number of ways, but there is only one correct outcome: square, strong, and straight.

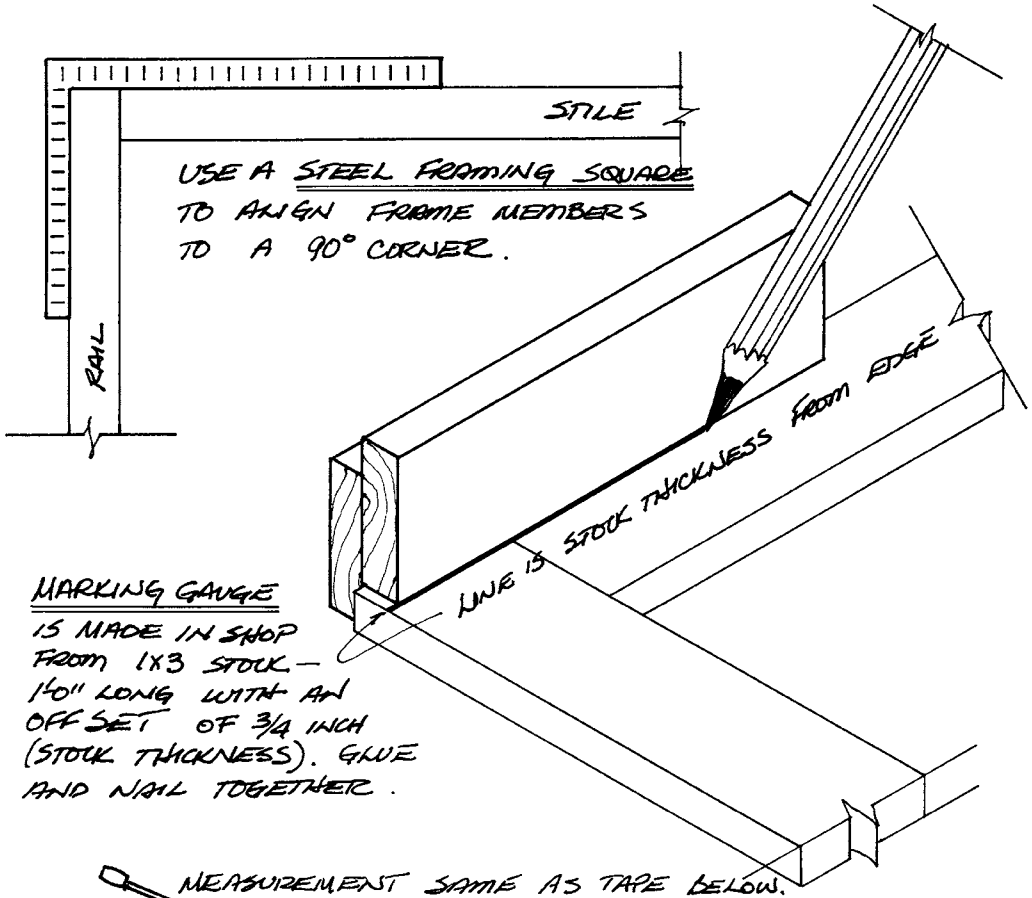
A large worktable is ideal for building flat frames, but the floor will do. Place the pieces in approximate position. Take one rail and butt it against the end of one stile. Now take a marking gauge (see Drawing 2-8) and, with it securely against the edge of the frame, scribe a pencil line along the outside of the frame. This will leave a line ¾″ in from the outside edge on the face of the 1 × 3 stock. This line in all four corners of the flat determines the placement of the plywood fasteners. If they were closer to the edge,

NAILING PATTERNS DWG. 2-7

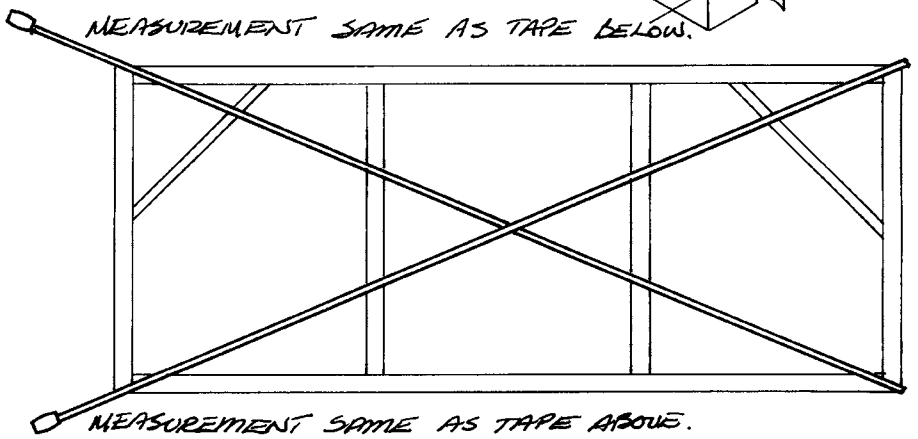


THE NAILING PATTERN "RULES" WORK FOR NAILS, SCREWS OR STAPLES AND WILL PROPERLY HOLD ANY FASTENER REGARDLESS OF SIZE OR SHAPE. IT'S ALMOST COSMIC!

MEASURING AND MARKING DEVICES DWG. 2-8



MARKING GAUGE IS MADE IN SHOP FROM 1x3 STOCK — 1'-0" LONG WITH AN OFFSET OF 3/4 INCH (STOCK THICKNESS). GLUE AND NAIL TOGETHER.



MEASURE A FLAT FRAME ON THE DIAGONAL TO CHECK FOR SQUARE. IF THE MEASUREMENT IS THE SAME, THE FRAME IS SQUARE. (1/4" DIFFERENCE IS O.K.)

another frame could not butt smoothly against the 1 × 3, and if they were farther away, they would not act as stops for the butted flat.

Next, take a framing square and place it at the corner of the flat frame (see Drawing 2-8). If the flat is square, (which it probably will be if all cuts were square and all joints tightly butted), proceed. If it is not square, it needs to be squared up and the pieces held in place before applying any plywood fasteners. One truing technique is to rack the frame into square and hold it square by driving a few 6d duplex nails through the frame and into the worktable or floor. Be sure to place the nails away from where the corner blocks will be placed. This method is most helpful when you are fighting a particularly stubborn board, but it is not very time efficient. A second method is to use corrugated fasteners on the joints to temporarily hold the pieces in place while you complete the construction. These two methods slow the building process, but in many situations, especially learning ones, it is important to know the frame is accurate before continuing with the plywood fasteners.

The most reliable and efficient method of keeping the flat square during construction is paying attention to the details of the assembly process. Start in a corner with the rail and stile carefully positioned. Use a framing square to ensure the right angle. You have already marked a line ¾″ from the edge. Glue the back of a corner block, and set it in line with the pencil marks. At this point, you are working with the plywood fastener that wants to slide around a little because of the wet glue, two pieces of 1× that may or may not stay in place, and the framing square. To avoid having multiple objects loose and causing a ruckus, forget about the stile and the framing square for a minute and just line up the corner block with two perpendicular pencil lines at the end of the rail. Using the nailing pattern shown in Drawing 2-7, attach the corner block to the rail with staples, screws, or for the real old timers, clout nails. Now, square the stile to the rail using the framing square. Make sure the corner block fastened to the rail aligns with the pencil line on the stile, and finish stapling, screwing, or nailing the fastener.

Moving in a circle around the flat, attach corner blocks in the same way as the first one to each of the corners of the flat. Now that the outside frame is completed, measure and place your toggles based on the spacing you prefer, keeping in mind that toggle placement, like most scenery, should follow the rule of cost vs. weight vs. strength. Assuming a spacing of 4′-0″ on a 12′-0″ flat, center the toggles on the 4′ pencil marks. Then, after using the marking gauge to mark ¾″ in from the outside of the stile, position the plywood straps and attach both ends of the toggles to the stiles with them. Corner braces will help keep a flat square over its lifetime and will add additional stability for the joints. Place the corner brace's ends equidistant from a corner and attach with a half-strap. Don't forget the glue or the ¾″ marking gauge.

After all the joints are fixed, double-check the frame to make sure it is square. The fastest way to do this is to measure it diagonally (see Drawing 2-8). Take a steel tape and place one end on the corner of the frame. Move to the opposite end of the frame and take a diagonal measurement. Repeat the process on the other diagonal. The mea-

surement will be the same if the frame is square. If the difference is no more than ¼″, it is probably not worth trying to correct. However, if it is more, take the framing square and check the corners of the square. When you find the error, it is still not too late to correct because the glue has not set up yet. Remove the necessary fasteners and throw them away. Knock the frame into square and put new fasteners down because they will hold better, not having been banged up in removal. It is advisable, if using nails, to drive them in only part way, leaving the head about ¼″ up until the frame has been checked on the diagonal. Any error is easier to repair if you can pull out the nails. If an electric or air powered stapler is being used, there is no such thing as half-driven, but the hold is still easy enough to break before the glue sets.

As can be seen in standard flat frames (see Drawing 2-3), the methods for Frame B would be the same as for Frame C except that there are no corner braces. Frame A would require special blocks be made for it, top and bottom. When you make special blocks, make sure the grain on the ¼″ 3-ply runs across the joint and that stock thickness is allowed on the edges. Chamfer the block before attaching it. Use the same nailing pattern rules for tying it down (see Drawing 2-7). The straps can be specially made and chamfered, or stock straps could be cut to butt together in the center of the toggle.
As simple and basic as the steps are for building standard flat frames, they must be mastered. Everything else in flat frame construction (stair carriages, parallel platforms, et al.) is based on them, either as they exist or in a variation.

EXTRA-TALL FLATS

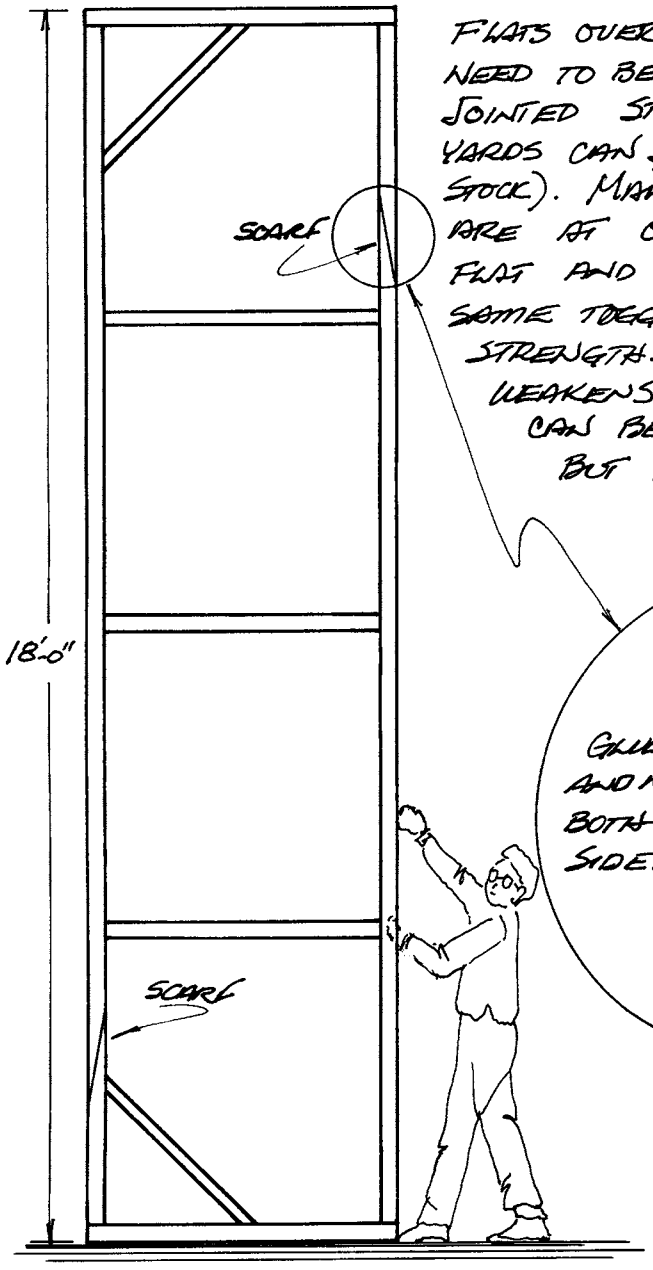
There are situations when oversize flats are needed (see Drawings 2-9 and 2-10). These will need to be built with scarf joints. The most common uses for these extra-tall flats made with scarf joints are for tormenters, hard legs, and false prosceniums.

Construction methods are the same for these tall buggers as for the shorter flats. The exception is the flat with tapered stiles (see Drawing 2-10) This involves the thinning or narrowing of the stile, which removes excess weight at the top of the flat and thus lessens wobbling when the frames are moved.

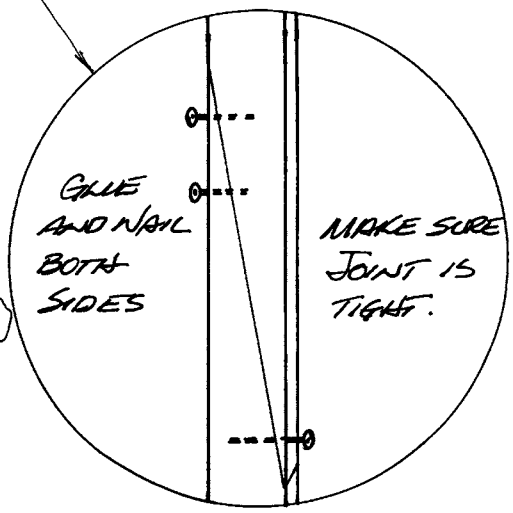
When tapering a stile, use a portable circular saw, or carefully feed the stile through the table saw. Cut the taper on the inside edge of the stile. Make sure that there are no metal fasteners (nails, staples, screws) holding the scarf joint until the tapering is completed, or you will be replacing saw blades. It is possible to attach the scarf after the line has been snapped to determine the cut.

Either a face scarf joint or an edge scarf joint (see Drawing 1-4) can be used for making the long stile. The edge joint is easier to cut but does not have quite as much strength as the face joint because there is not as much surface to glue together. Both joints can be reinforced with a plywood block held back stock thickness from the outside edge. For additional strength in the joint, using biscuits and a plate joiner will increase the surface area to be glued, resulting in a much stronger bond.

EXTRA-TALL FLATS–1 DWG. 2-9

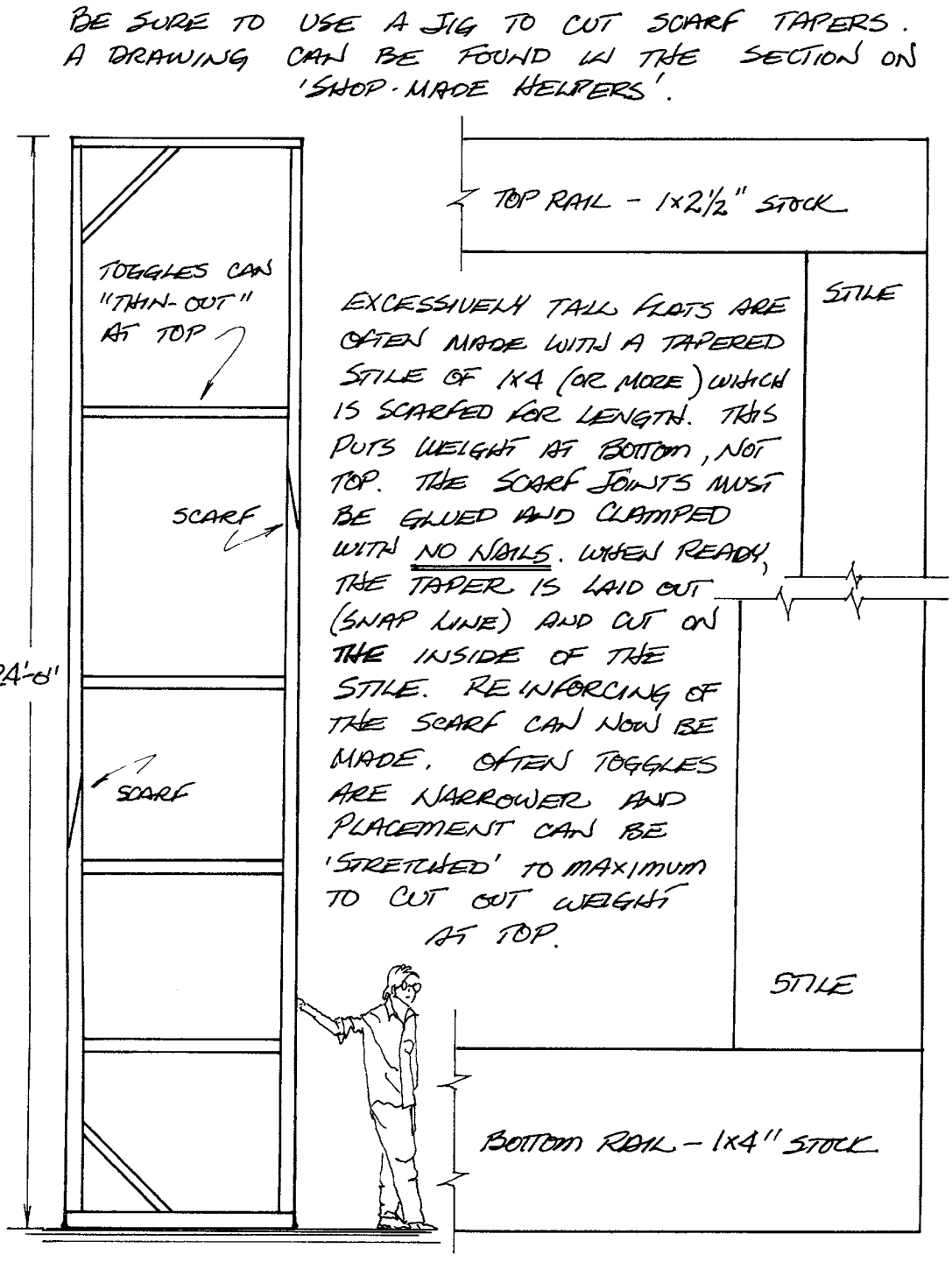


FLATS OVER 16'-0" HIGH USUALLY NEED TO BE MADE WITH A SCARF JOINTED STILE. (SOME LUMBER YARDS CAN $PECIAL ORDER LONGER STOCK). MAKE SURE SCARF JOINTS ARE AT OPPOSITE ENDS OF THE FLAT AND NEVER BETWEEN THE SAME TOGGLES FOR MAXIMUM STRENGTH. IF SCARF JOINT WEAKENS, A ¼" PLYWOOD STRAP CAN BE ATTACHED OVER IT, BUT THIS IS CHEATING.



MAKE SURE JOINT IS AT LEAST 12 TO 18 INCHES LONG. BE SURE TO USE SCARF JIG SO ALL PIECES WILL MATCH.

EXTRA TALL FLATS–2 DWG. 2-10



Rails can be scarfed in a similar way for headers or the tops of a false proscenium. For one-shot uses, it is sometimes advantageous to build a plug and batten it to a stock flat for extended height (or length). A dutchman (see Drawing 2-54) will hide this indiscretion. Details follow.

THE FALSE PROSCENIUM

When the theatre's proscenium, the architectural frame which separates the auditorium from the stage proper, is quite large, designers will often choose to decrease the opening with a smaller inner (or even outer) framework and thus decrease the amount of scenery needed to fill each setting. This false proscenium commonly echoes the original but could be shaped or decorated for a special production. Regardless, the false proscenium usually requires oversized flats. The two drawings (2-11 and 2-12) show false prosceniums created with specially built flats and created from stock flats and plugs.

If a performance space is being created in a room and a proscenium is being made, perhaps one of hardwall construction (see Drawing 2-61) would be a preferable solution.

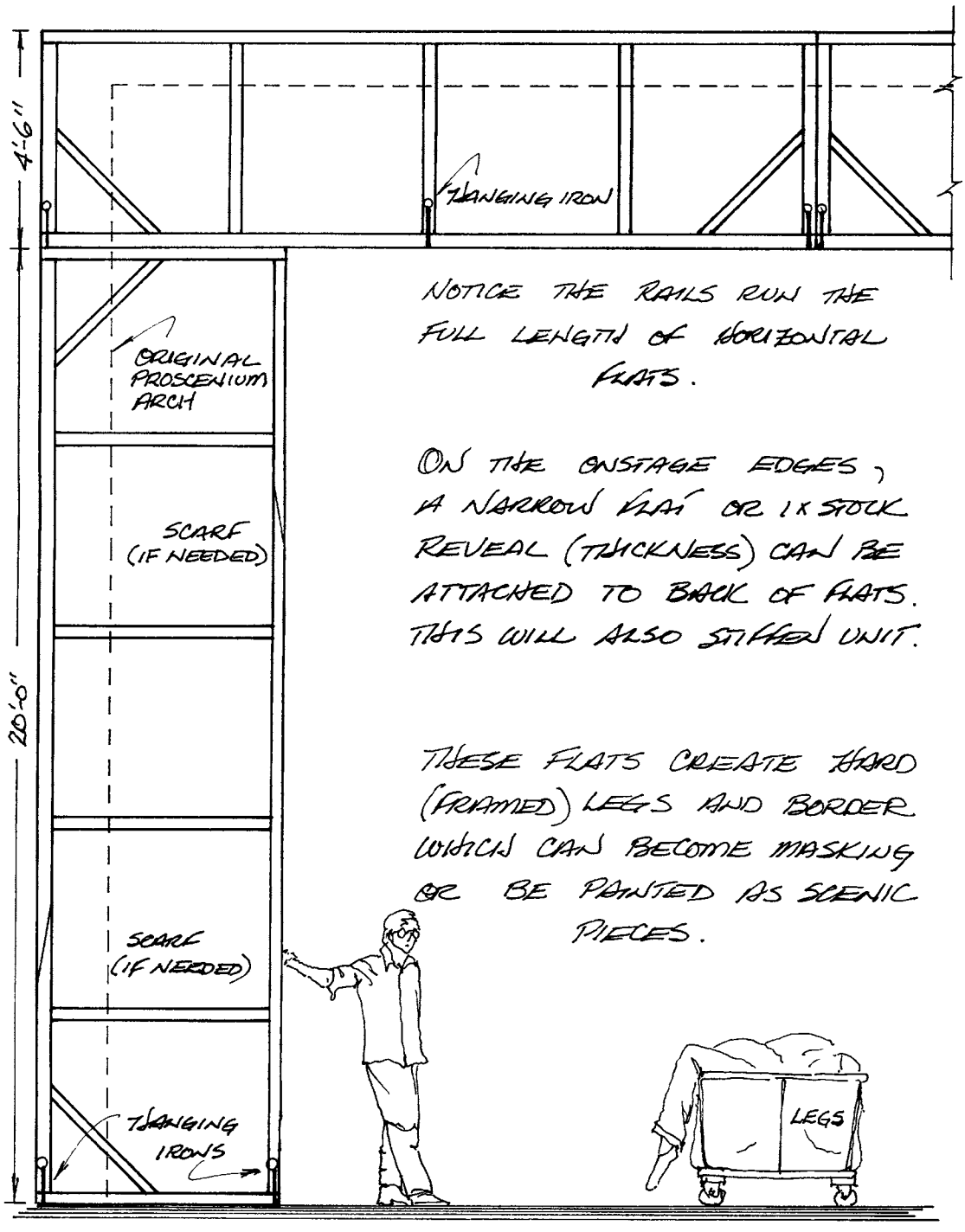
WINDOW FLAT

Flat frames designed to house windows (see Drawing 2-13) are built on the same principles as standard frames. The drawing shows the most basic of window openings. Notice the placement of the horizontal battens which determine the opening. For this example, special blocks must be cut to tie the upper window batten and the toggle to the stiles. Cut these from ¼″ 3-ply and chamfer the edges. Make sure that the grain runs perpendicular to the joints. The lower window batten can be fastened using corner blocks because it is necessary to hold the blocks back ¾″ (or stock thickness) from the edge of the opening as well as from the outside of the flat frame. This eliminates making a special narrow strap. The additional vertical batten below the window will take the added weight of the actors climbing through this opening. Notice that only the top corner brace will fit this particular frame; therefore, only one brace is used, but it is still on the agreed side.

A variation on the window flat (see Drawing 2-14) is the hinged two-fold window. This type is built when large picture windows are needed, not an uncommon occurrence in modern plays. The stiles are broken in the single flats, but when the unit is hinged together with 2″ backflap hinges on the face, it is again quite strong. This two-fold can be folded for storage, requiring less space. Note that the toggles are set to align with standard flats of the same height. This helps the open two-fold to be attached to other flats. In the Drawing 2-14, the lower corner braces will just fit if they are set under the corner blocks. They can be glued and nailed through the block with an additional strap needed for that joint. The Drawing 2-16 shows another window variation.

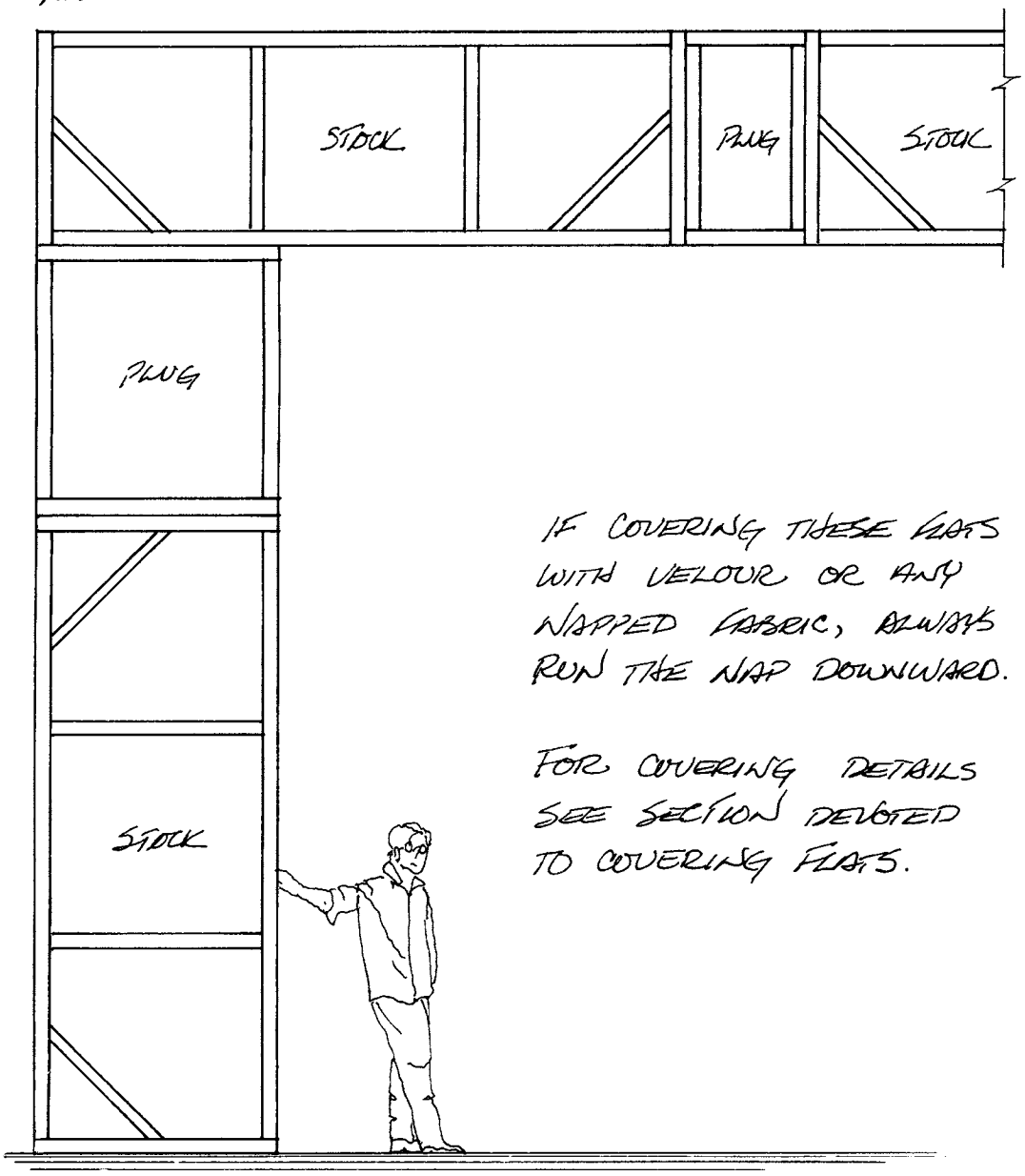
Windows can also be created using standard stock flats and building plugs to go between them (see Drawing 2-15). This is often a good solution when an unusual opening

FALSE PROSCENIUM–1 DWG. 2-11



FALSE PROSCENIUM–2 DWG. 2-12

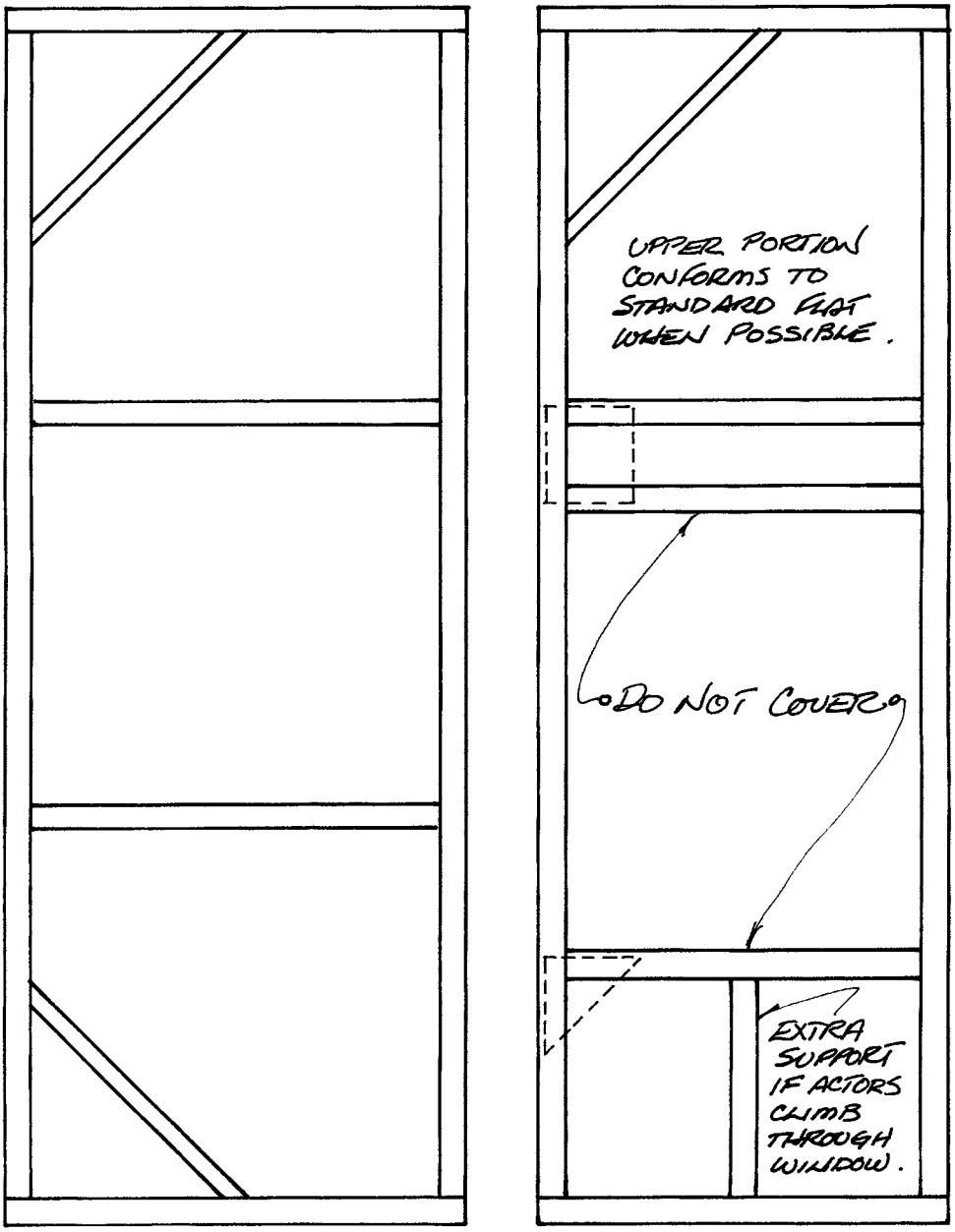
STOCK 12-FOOT FLATS FORM THE BASIC UNIT – PLUGS ARE ADDED TO ACHIEVE DESIRED HEIGHT & WIDTH.



IF COVERING THESE FLATS WITH VELOUR OR ANY NAPPED FABRIC, ALWAYS RUN THE NAP DOWNWARD.

FOR COVERING DETAILS SEE SECTION DEVOTED TO COVERING FLATS.

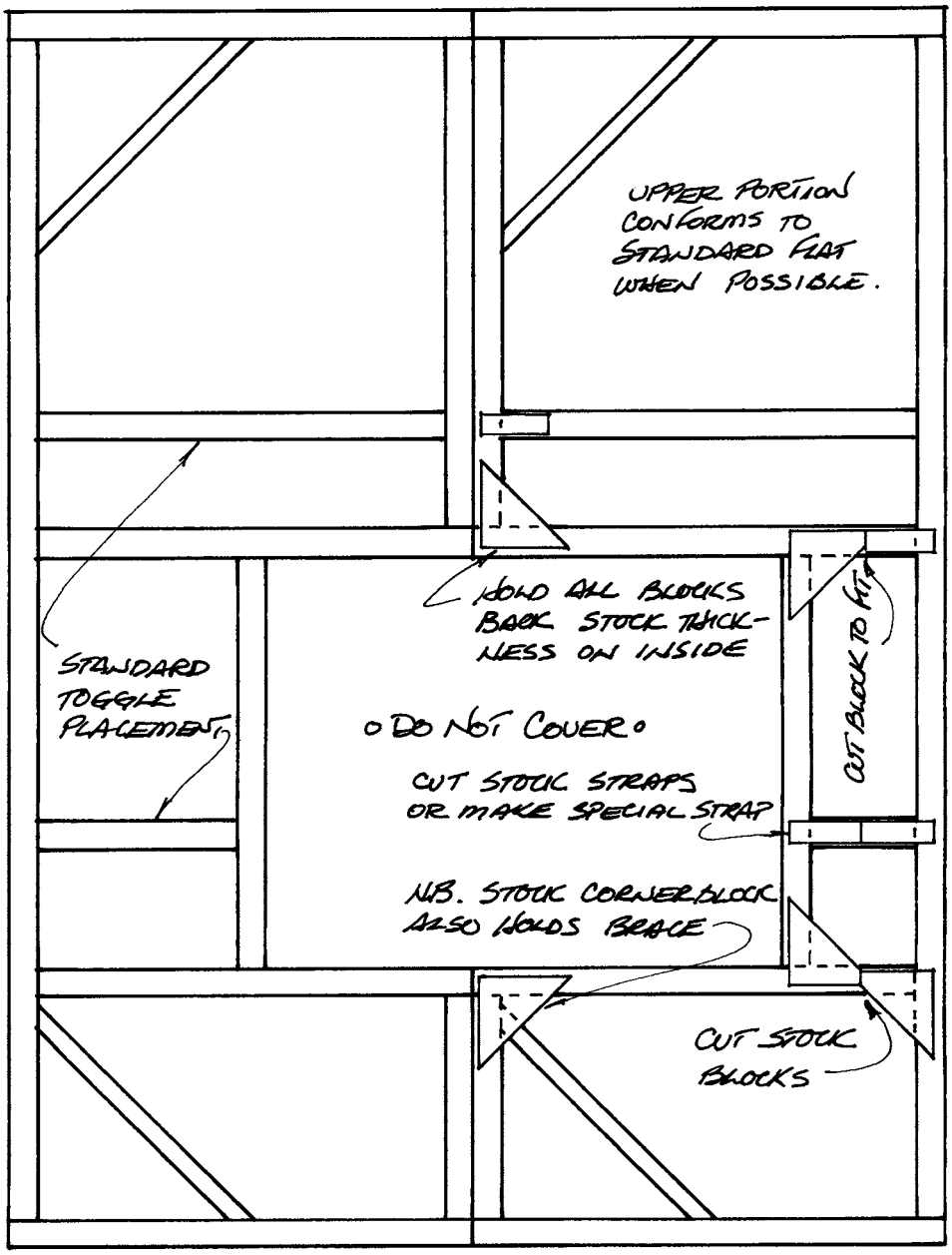
WINDOW FLAT FRAME DWG. 2-13



STANDARD FLAT SIMPLE WINDOW FLAT

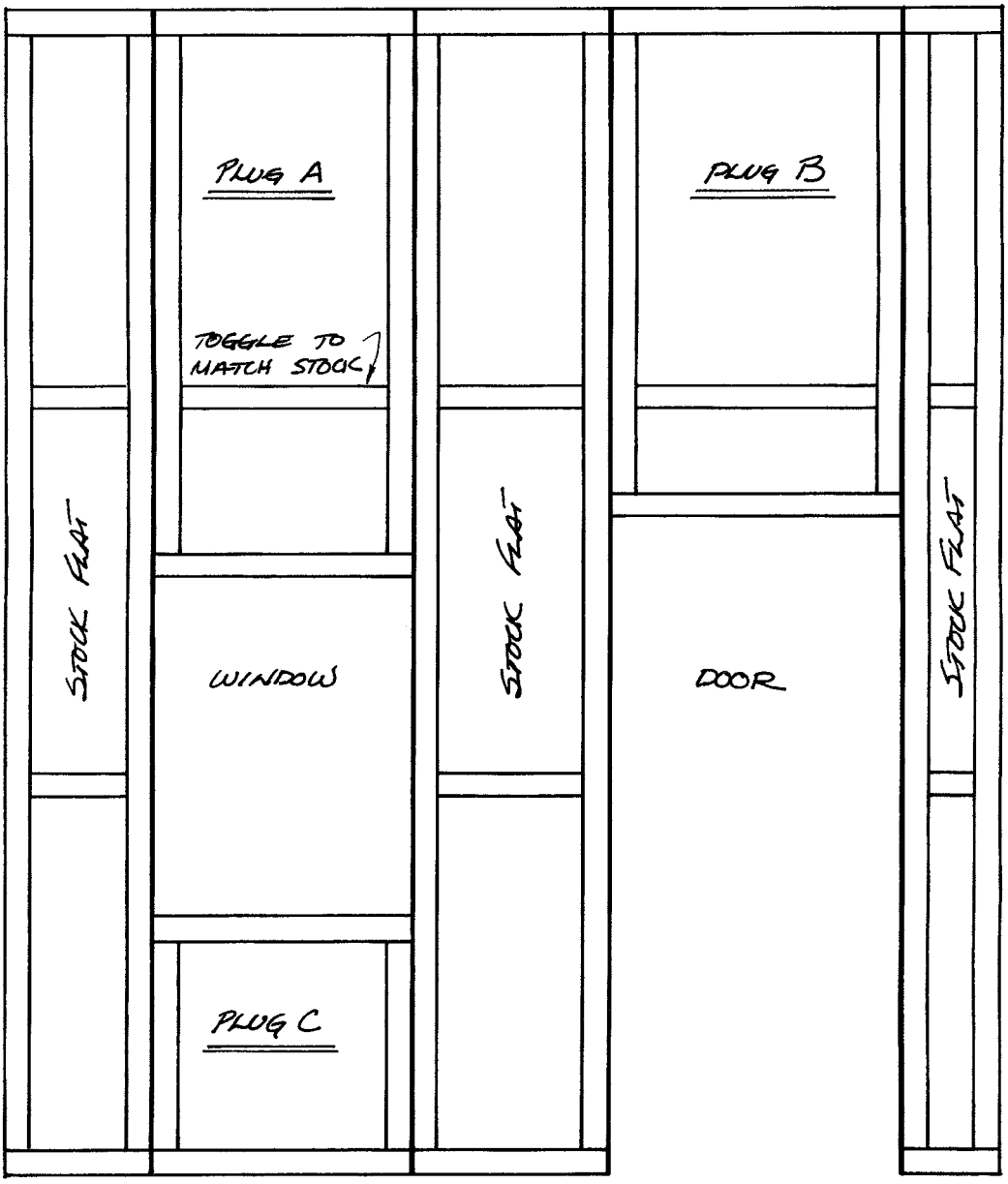
NOTICE THE FASTENERS ARE HELD BACK STOCK THICKNESS FROM INSIDE OF OPENING TO FACILITATE LATER ADDITION OF REVEAL IF SO DESIRED.

OVERSIZED WINDOW UNIT DWG. 2-14



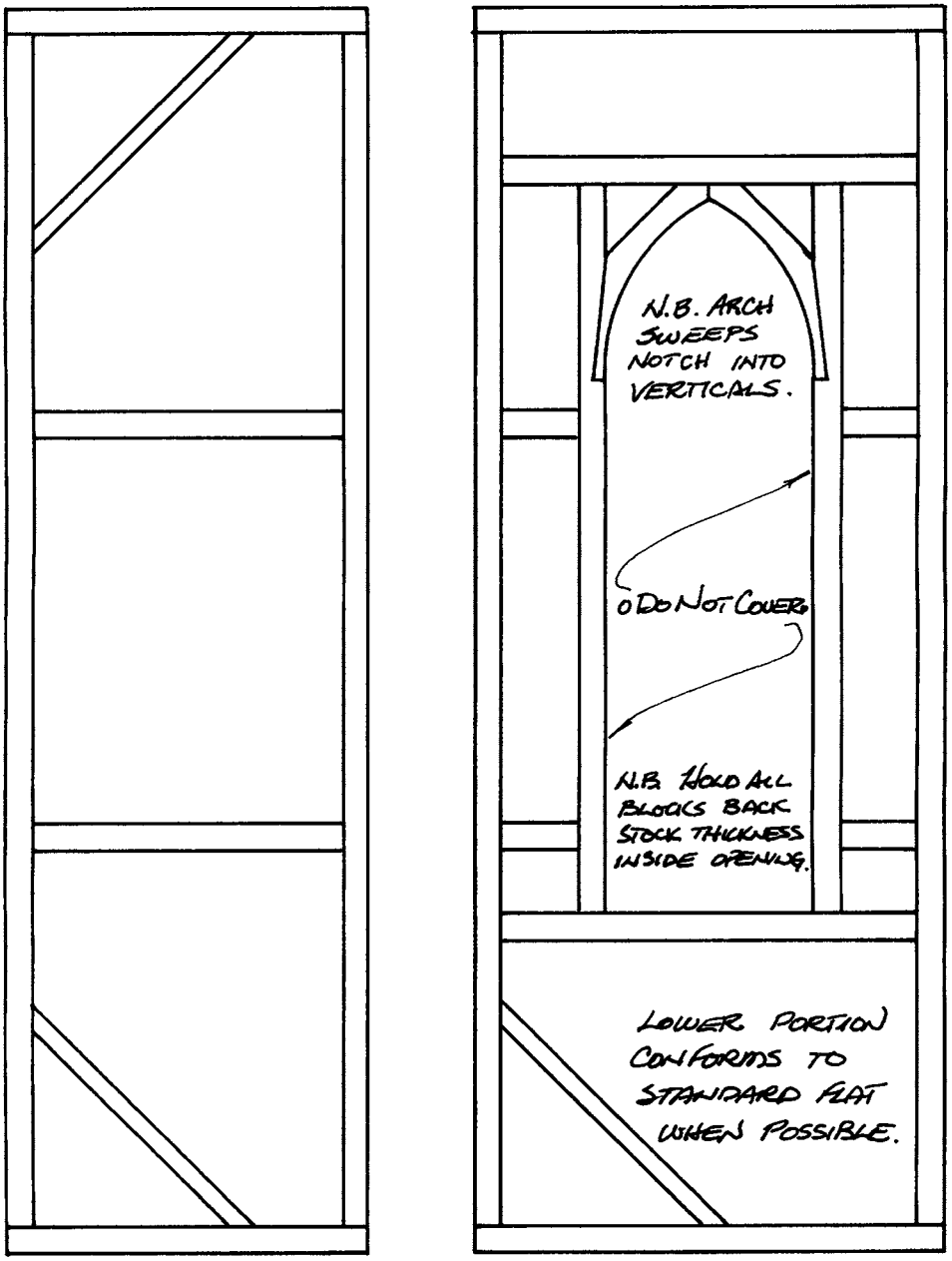
THESE FLATS WOULD PROBABLY HINGE TOGETHER ON FRONT AND FOLD FOR STORAGE. WHEN OPEN THEY WOULD STIFFEN W/KEEPER HOOKS AND BATTEN.

OPENINGS MADE WITH FLAT FRAME PLUGS DWG. 2-15



THIS WALL IS CREATED WITH STOCK FLATS AND THREE SMALL FLAT PLUGS. THE WALL WOULD BE DIFFICULT TO MOVE, ESPECIALLY THE DOOR, UNLESS A TEMPORARY SILL WERE HINGED INSIDE.

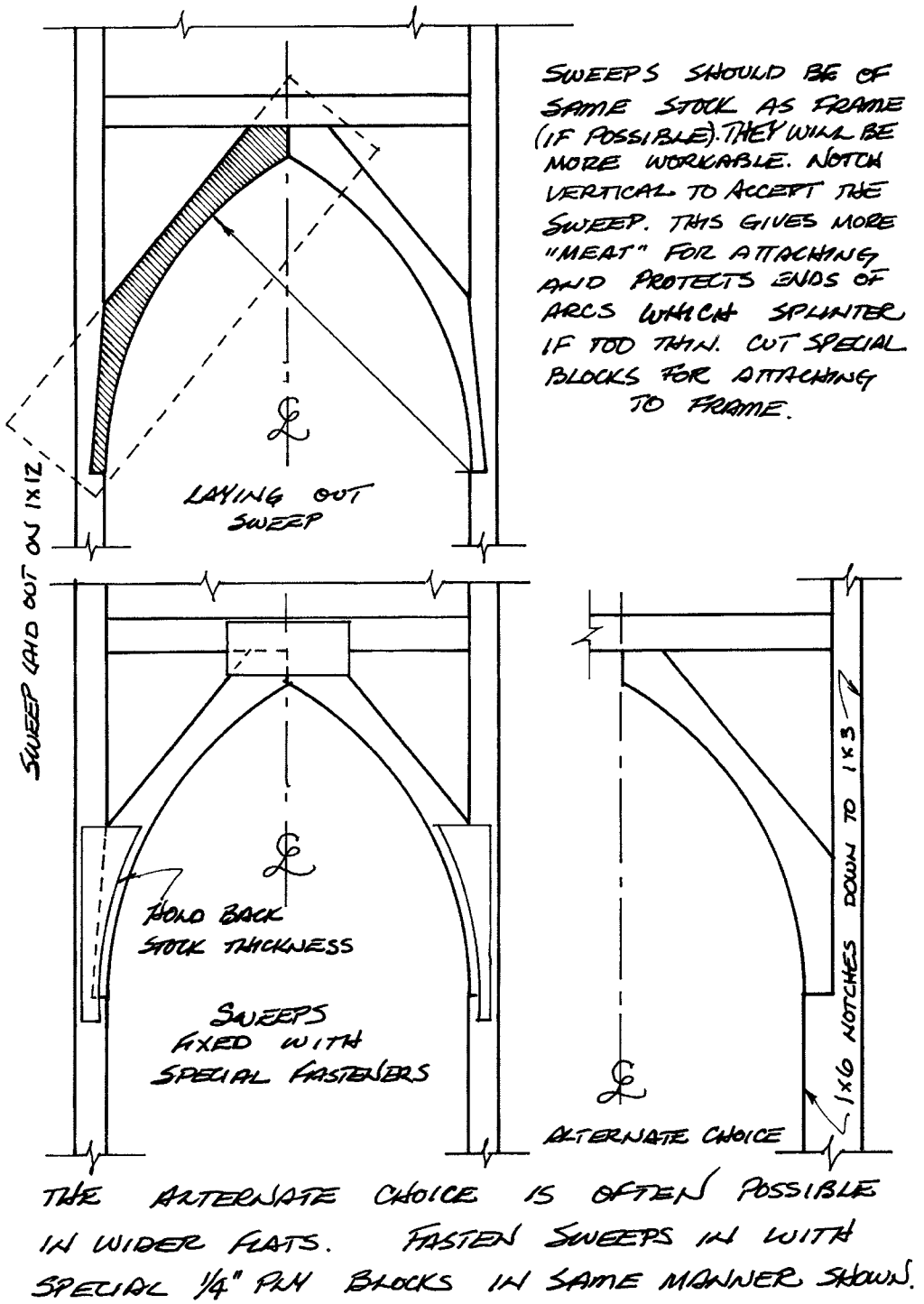
WINDOW WITH ARCH DWG. 2-16

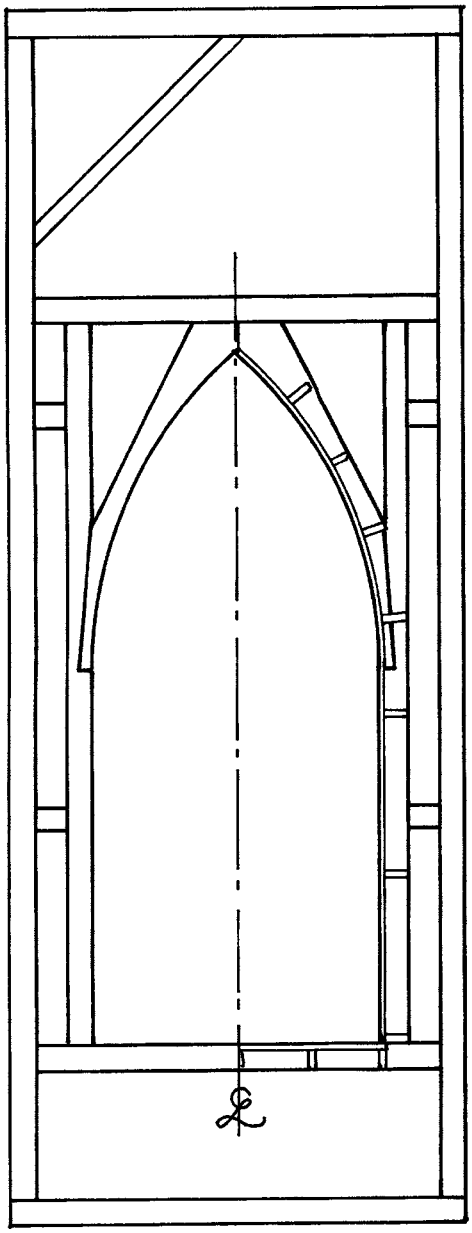


STANDARD FLAT ARCH WINDOW FLAT

METHODS FOR DEALING WITH SWEEPS IS DETAILED IN NEXT PAGE OF DRAWINGS.

SETTING IN SWEEPS DWG. 2-17



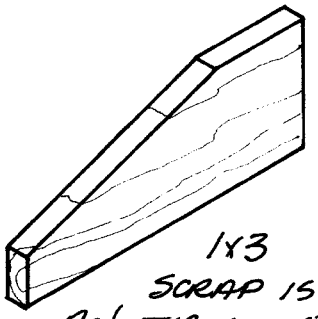


REAR VIEW

SIDE VIEW.

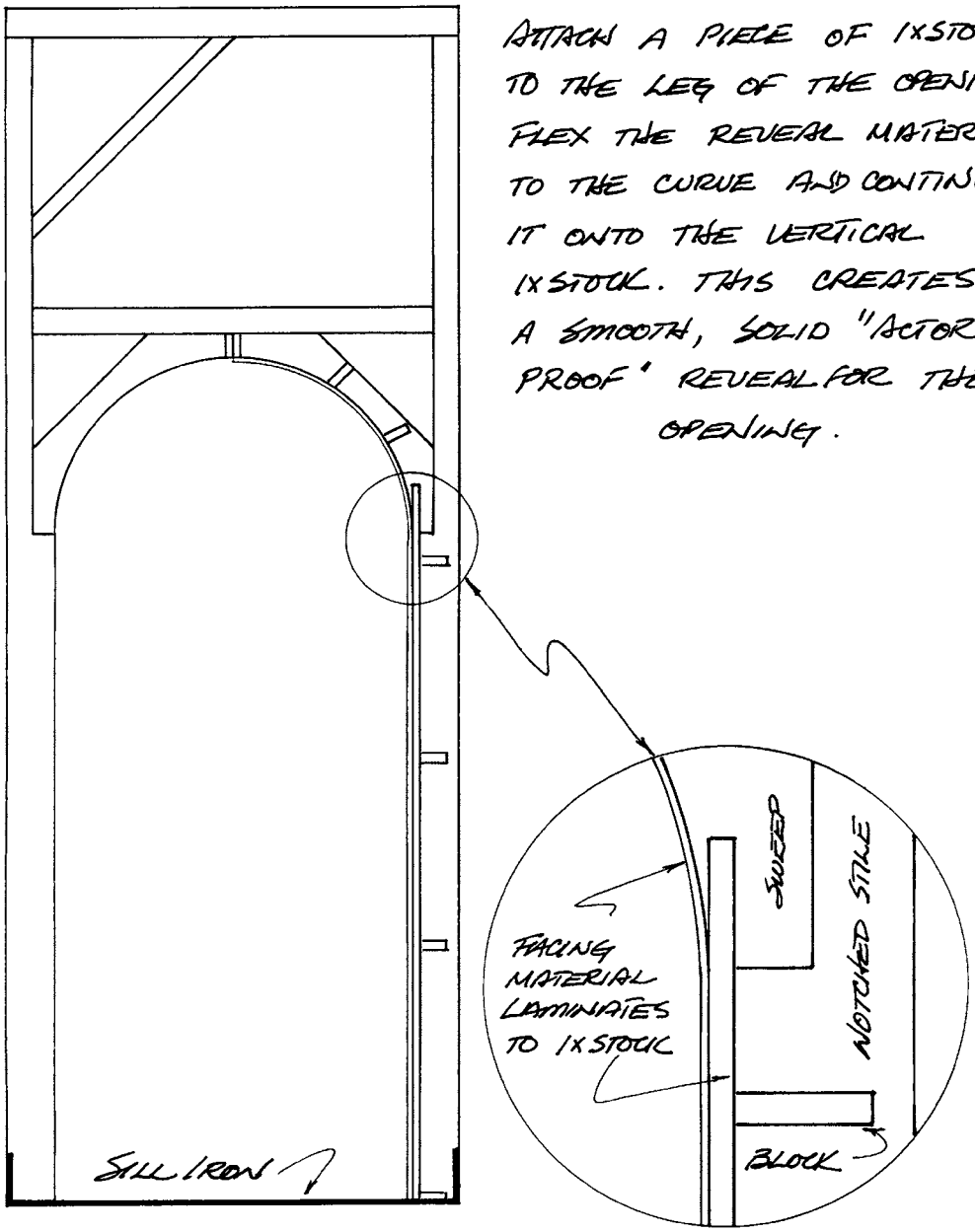
WHEN A FLAT FRAME OPENING MUST HAVE A REVEAL OR A REALISTIC THICKNESS WHICH DOES NOT NEED TO SUPPORT GREAT WEIGHT OR ABUSE, THE BLOCK METHOD IS AN EXCELLENT SOLUTION.

THE BLOCKS ARE TAPERED TO PREVENT "SNAGGINGS" AND ATTACH TO THE FLAT FRAME.



1x3 SCRAP IS AN EXCELLENT SOURCE FOR THE BLOCKS ... AND IT KEEPS THE FLOOR MUCH CLEANER.

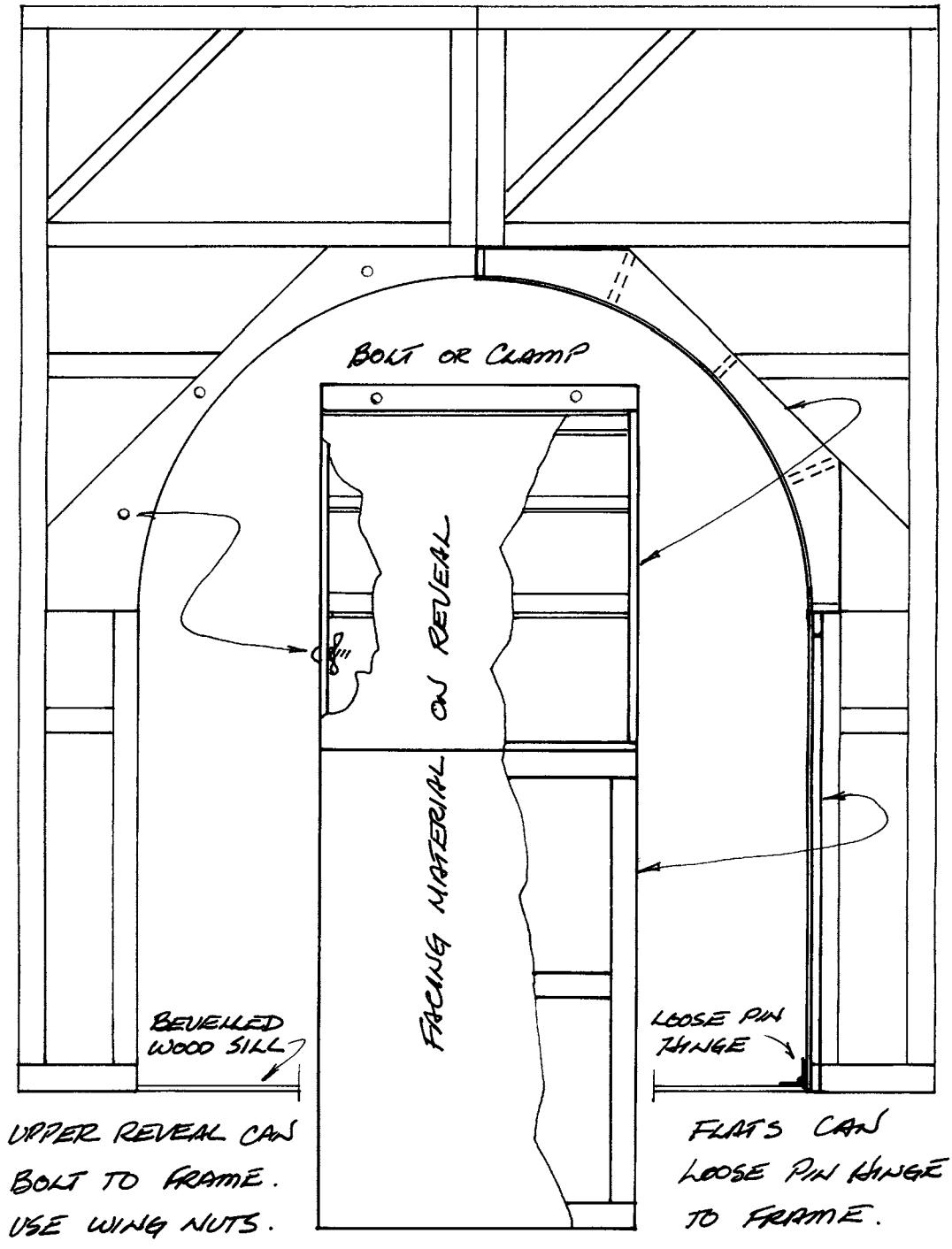
MANY MATERIALS MAKE EXCELLENT REVEALS... 1/8" UNTEMPERED HARDBOARD, "E-Z" CURVE AND 1/8" OR 1/4" PLYWOOD. RIP TO WIDTH AND ATTACH.



ATTACH A PIECE OF 1X STOCK TO THE LEG OF THE OPENING. FLEX THE REVEAL MATERIAL TO THE CURVE AND CONTINUE IT ONTO THE VERTICAL 1X STOCK. THIS CREATES A SMOOTH, SOLID "ACTOR-PROOF" REVEAL FOR THE OPENING.

SOME SHOPS WILL TAKE THE 1X REVEAL TO THE TOGGLE ABOVE THE ARCH AND BOX ACROSS THE TOP PROVIDING GREATER PROTECTION FOR THE CURVE.

REVEALS–2 **DWG. 2-20**



is demanded, because it takes less time to build a plug than a whole flat. Plugs can be saved to be reused, but they can also multiply and bury you. The major disadvantage to building openings with plugs is that it takes more time to assemble the unit, batten it together with standard flats, and conceal the additional cracks where they butt.

The window itself can, like a door, be either dependent or independent, depending on whether or not it is a framework which is removable from the flat. The construction of the removable frame is like that of an independent door unit (2-25 and 2-26). The shape should adjust. The variety of windows in this world makes it more difficult to standardize their size and shape than for doors, but certainly some common dimensions should be predeterminable to limit stock.

ARCH FLATS

The arch flat (see Drawings 2-16 through 2-20) differs in construction only in setting the sweeps into the frame. Great care must be taken to have the sweep fit tightly into the space cut away to receive it. The more slop there is in the fit, the weaker the joint.

Try to cut the sweeps from 1× stock if possible, because it is the same thickness and weight and will have the same working quality as the rest of the frame. However, ¾″ plywood can be used if the sweep will not fit on 1× stock, but it is much heavier, and the plies tend to separate when cut into narrow strips.

For best results, build the frame of the flat first, and then loft up the sweeps full scale for a pattern (see Drawing 2-17). You can adjust a paper pattern far more easily and cheaply than you can wood.

Notice that the sweep is set into the stiles with an angled cut. This cut gives maximum strength and surface area to attach the special blocks. Never cut into the stile more than halfway or you will be building a collapsing flat with irregular fold-lines. It is always better to increase the width of the stile if the sweep is being set into it, but this is not always possible.

DOOR FLATS

The door flat (see Drawings 2-19, 2-22 through 2-24) involves additional planning and care in execution. Because the bottom rail of the flat is broken or removed completely, allowing the stiles to extend to the floor, a piece of strap iron must be fixed to the bottom. This not only protects the end of the stiles but prevents the legs of the frame from pulling apart when the flat is moved (see Drawing 2-19, 2-21 through 2-24). The best iron to use is 3⁄16″ or ¼″ thick by ¾″ or 1″-wide flat steel. This mild steel is available from most hardware companies or a local steel yard and is sold in 20′-0″ lengths. It can be worked with a hacksaw, drill, and metal bits.

DOOR SIZES

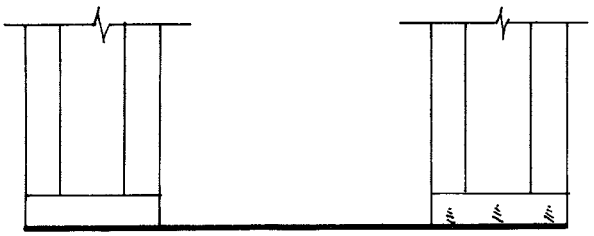
The average modern door opening is about 6′-9″ high and ranges from 2′-4″ to 3′-0″ wide. If you are building stock flats and will use independent doors which set into the openings (see Drawing 2-25 and 2-26), the height and width of the frame opening must be increased to accept it.

The height of the door flat is affected by the thickness of the sill iron and must be adjusted accordingly at the bottom of the frame so the toggles and top will match the other frames in the stock. If a bent sill iron or a saddle iron is used, remember to drill and countersink the holes before bending or welding. Working the irons is very difficult once they are bent. Both the bent sill iron and the saddle iron must be let-in (notched into) the frame. This is done most easily with a saber saw. If you do not shorten the stiles, the bottom rail pieces need to be ripped narrower for the straight sill iron. The saddle iron is the easiest to make accurately, but you must have welding equipment or access to a place that can do it for you, such as a machine shop or auto repair garage. The bent sill iron must be accurately measured and carefully bent. This takes no special equipment except a vise, but it requires considerable care to keep the bends in the same plane as the rest of the iron and to maintain the correct measurements. If the iron is the wrong size or twisted, it will probably warp the flat frame and make it difficult to fit doors into it. If an iron bends or becomes twisted once it is installed, replace it, or actors will trip on it.

It is best to center a door opening in a flat frame. This equalizes the stress in the frame (see Drawing 2-22). It is also better to avoid using the same 1 × 3 for the stile of the flat and the door (see Drawing 2-23). This stile takes quite a beating, and the 1 × 3 leaves little meat for attaching a door casing or trim (see Drawing 2-25). However, when neither can be done, the strength of the frame is not affected too greatly. Notice how, though not structurally necessary, the wider stile is notched back above the additional batten in the Drawing 2-22. The wide stile could continue to the top rail (see Drawing 2-24). It is notched back primarily to keep the top of the frame consistent with the other flats and to cut down on additional weight. Top-heavy flats are difficult to move. The special ¼″ plywood blocks (see Drawings 2-23, -24 and -28) should have the grain perpendicular to the joints butting to the outside frame.

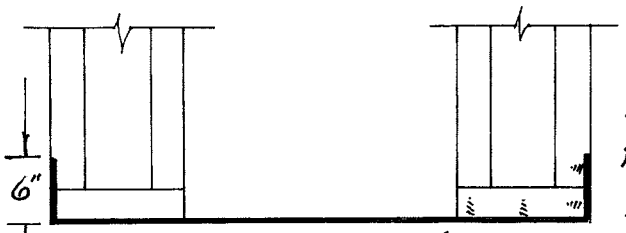
The door opening in Drawing 2-27 presents a combination of interesting problems. Like the hinged window flats, this unit is face-hinged with 2″ backflaps. Because the legs of the opening could break if there were no sill iron, a modified saddle iron is placed at the bottom. Note that there are pivots in the iron so it can fold with the flat. Extra care must be taken when this unit is folded for storage, because undue pressure on the iron can bend it out of shape. Because of this weakness, these flats are often stored upside down.

Note how the corner block is used on this particular sweep, thus saving the time required to make special fasteners. The corner blocks at the bottom of the frame are cut so they butt together in the center and save the addition of a special block there also. The rest of the construction on the frames is quite standard.



FLAT SILL IRON

THOUGH SIMPLE, REQUIRING ONLY COUNTERSUNK HOLES AND SMOOTHED ENDS, IT CAN ONLY MOUNT TO A RAIL.

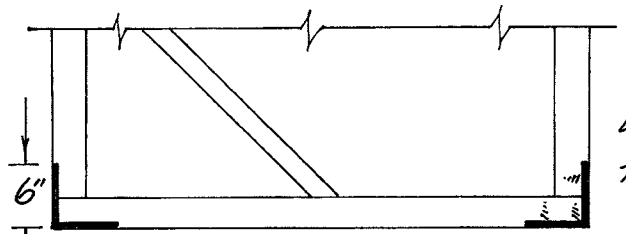


BENT SILL IRON

BETTER THAN BENDING IS WELDING ON THE UPRIGHTS. BE SURE TO DO ALL DRILLING FIRST.

SADDLE IRON

SADDLE IRONS CAN HAVE ONE OR TWO UPRIGHTS HOLDING STOCK. BE SURE TO DRILL, THEN WELD.

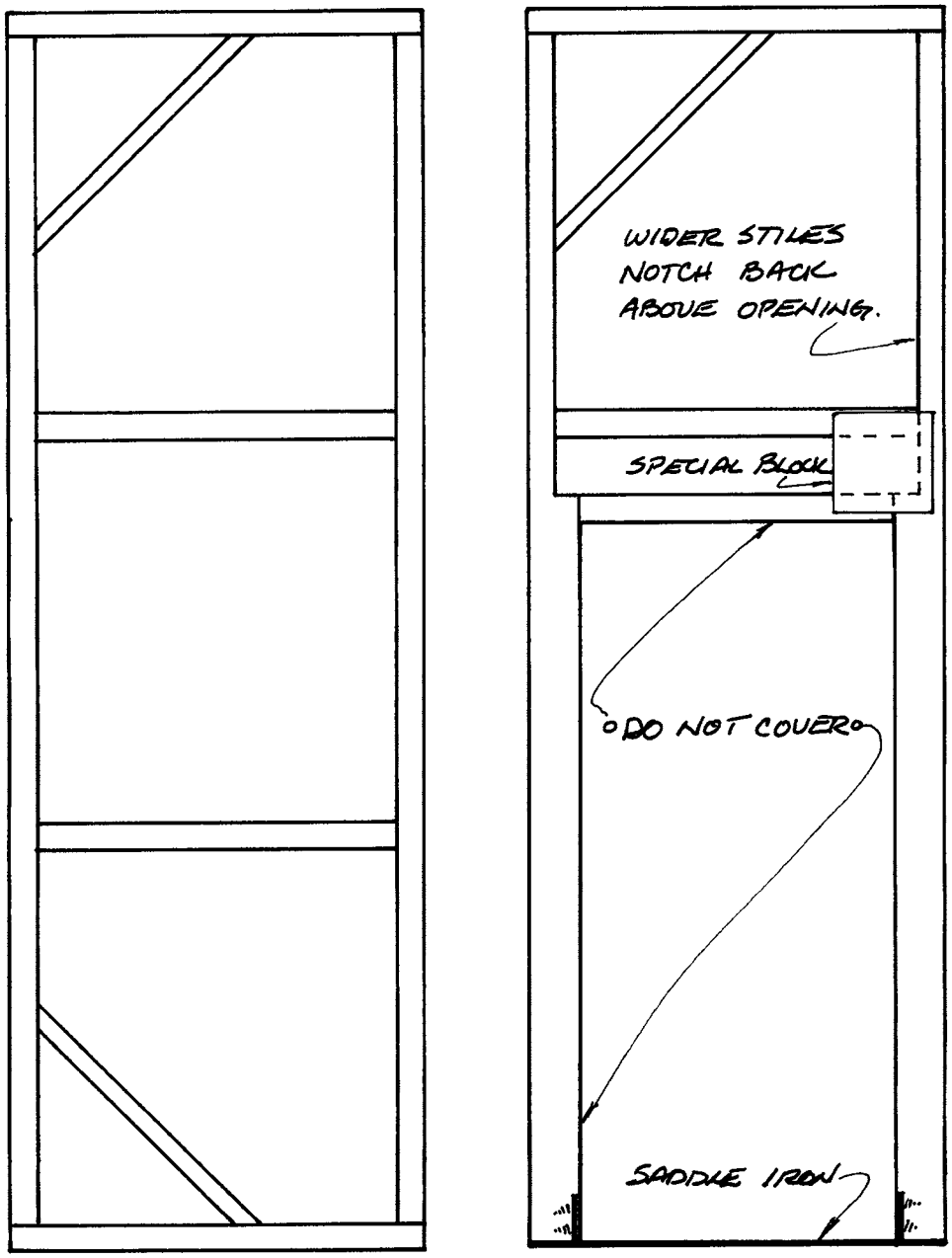


"TROUPING" IRONS

HANDY FOR ANY SCENERY WHICH IS DRAGGED ABOUT, THESE CAN BE BENT OR WELDED.

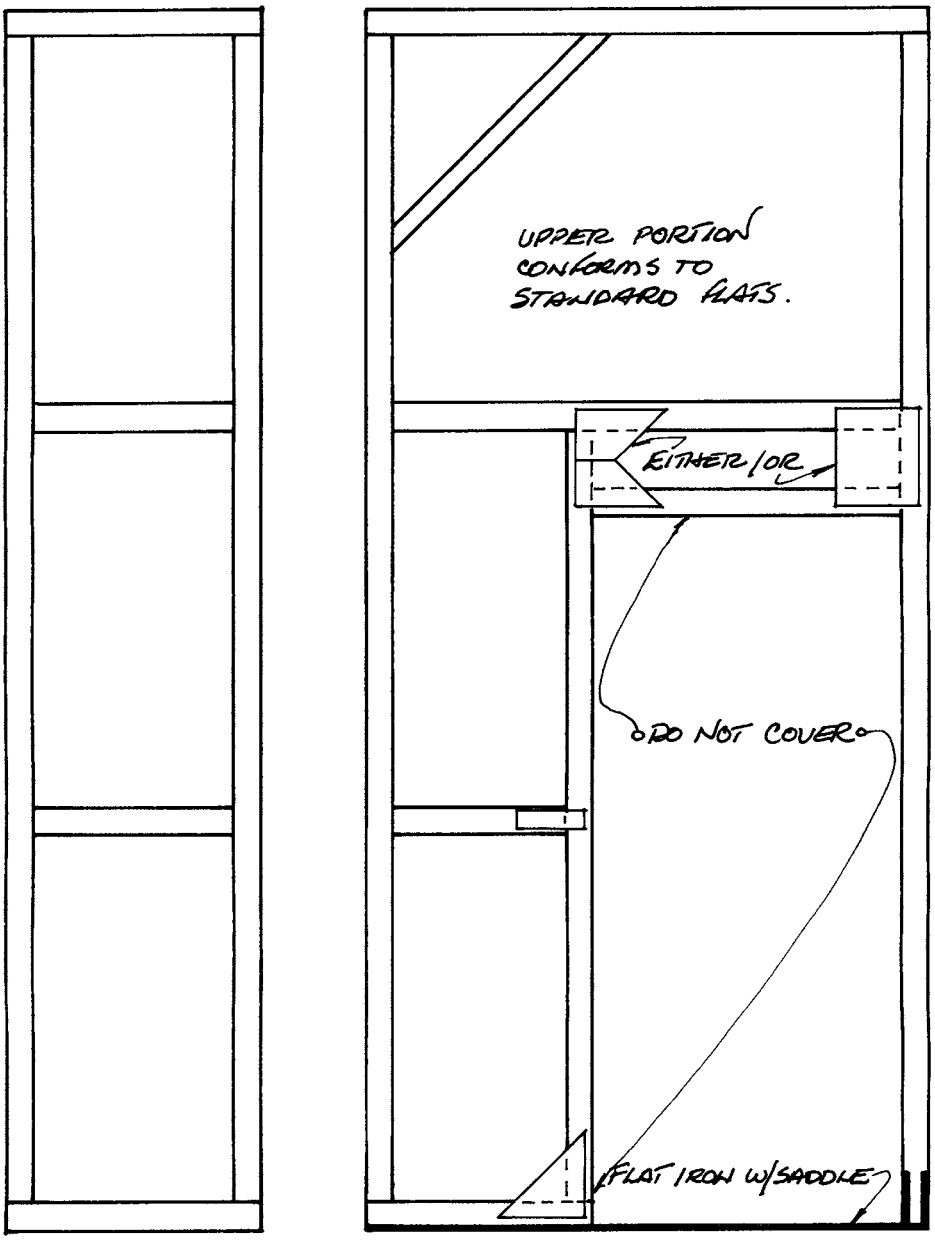
OF COURSE THE EXAMPLES ABOVE CAN, AND ARE, USED IN VARIOUS COMBINATIONS AS DEMANDED BY THE SITUATION. ALWAYS BE SURE TO DRILL AND COUNTERSINK SCREW HOLES FIRST, THEN WELD.

DOOR FLAT FRAME–1 DWG. 2-22



THE SPECIAL BLOCK ABOVE THE DOOR IS NOT ALWAYS NECESSARY. IT DEPENDS ON STANDARDIZED TOGGLE PLACEMENT.

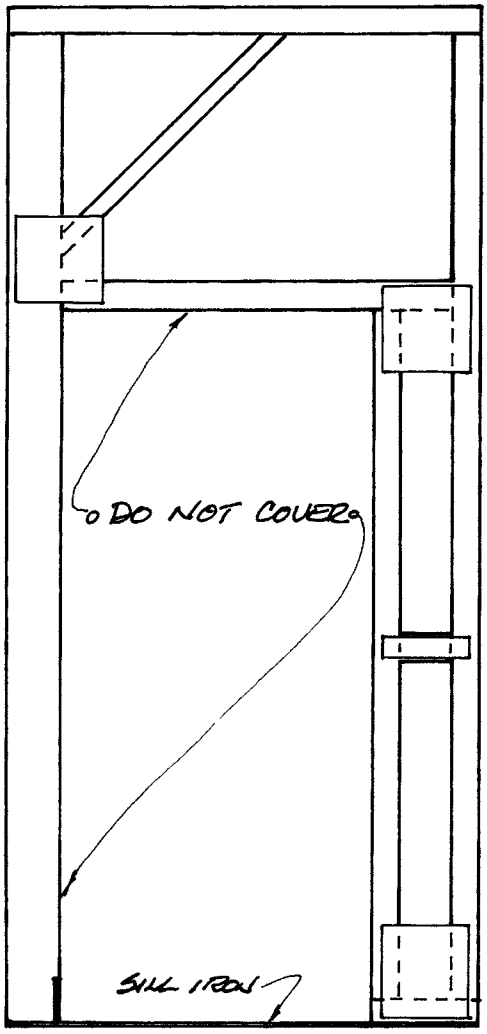
DOOR FLAT FRAME–2 DWG. 2-23

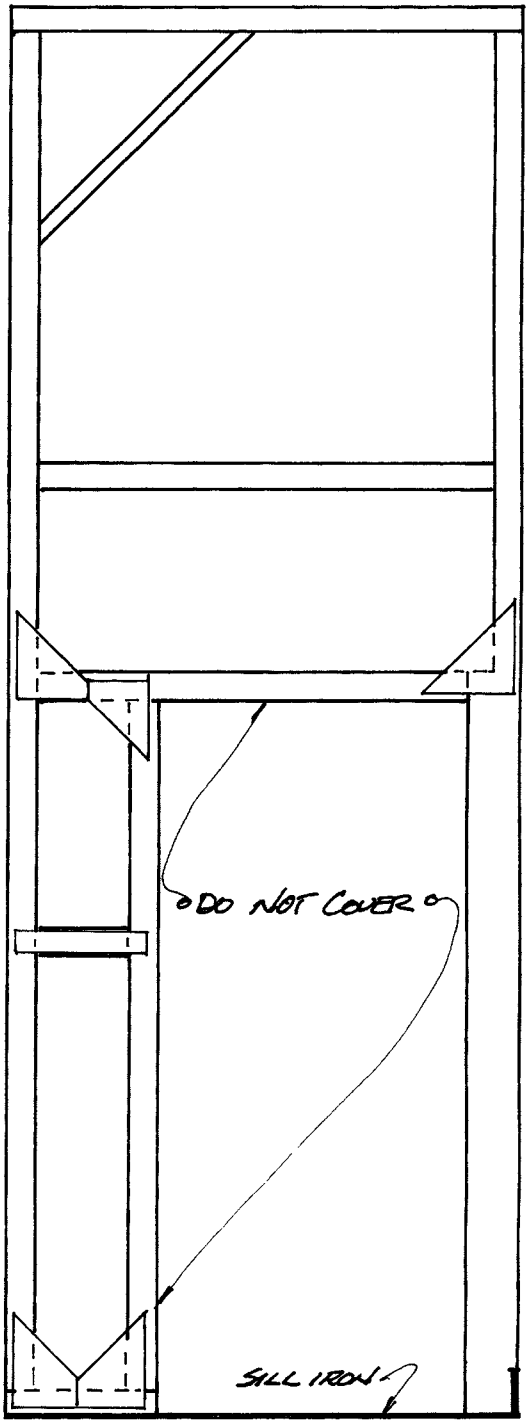


N.B. FASTENERS ARE HELD BACK STOCK THICKNESS IN OPENING.

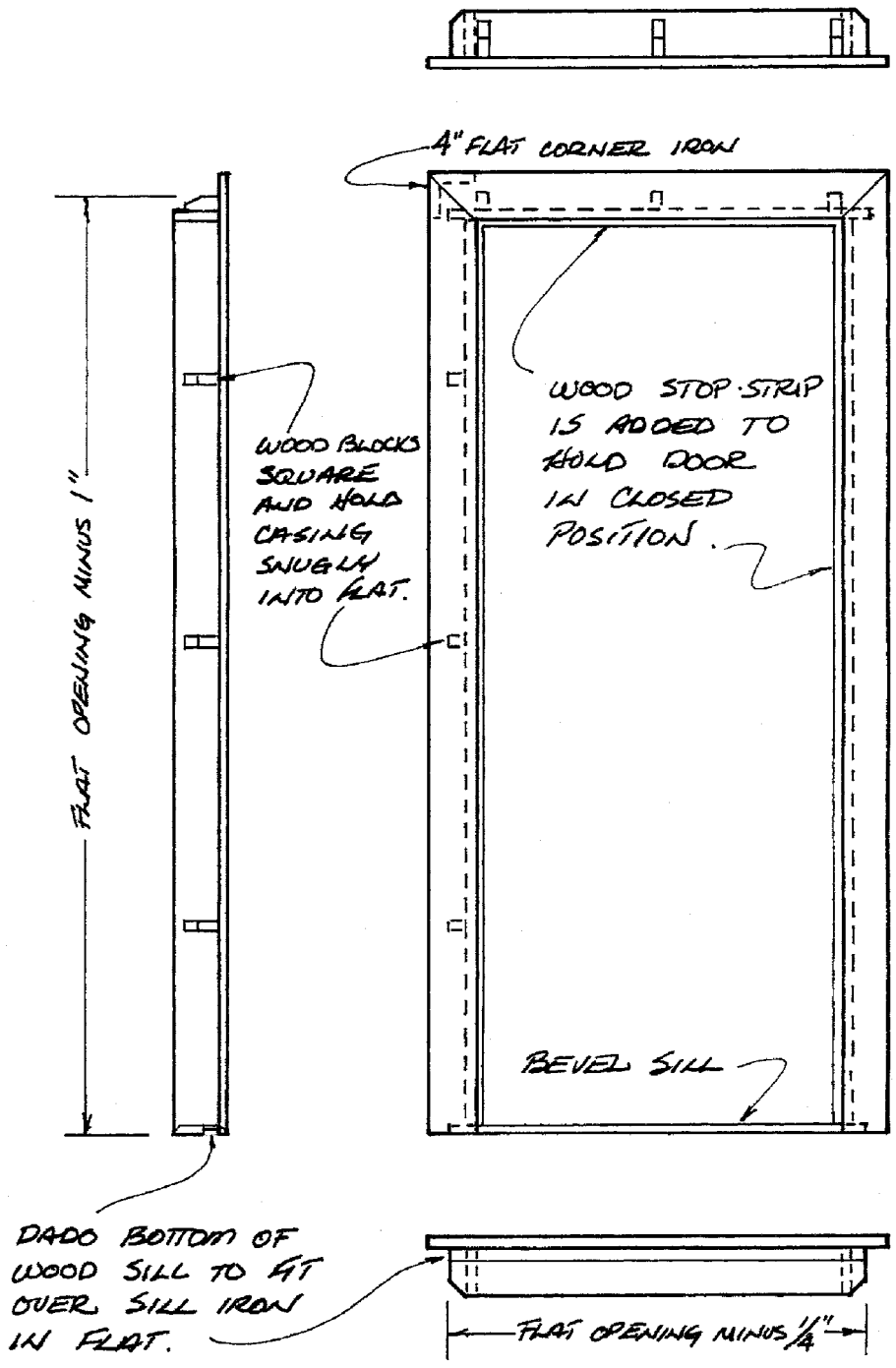
DOOR FLAT FRAMES–3 DWG. 2-24

A STANDARDIZED 3×7 DOOR OPENING IN A 10'-0" AND 14'-0" FLAT SHOWS OTHER VARIATIONS USING BOTH STOCK FASTENERS + SPECIAL BLOCKS.

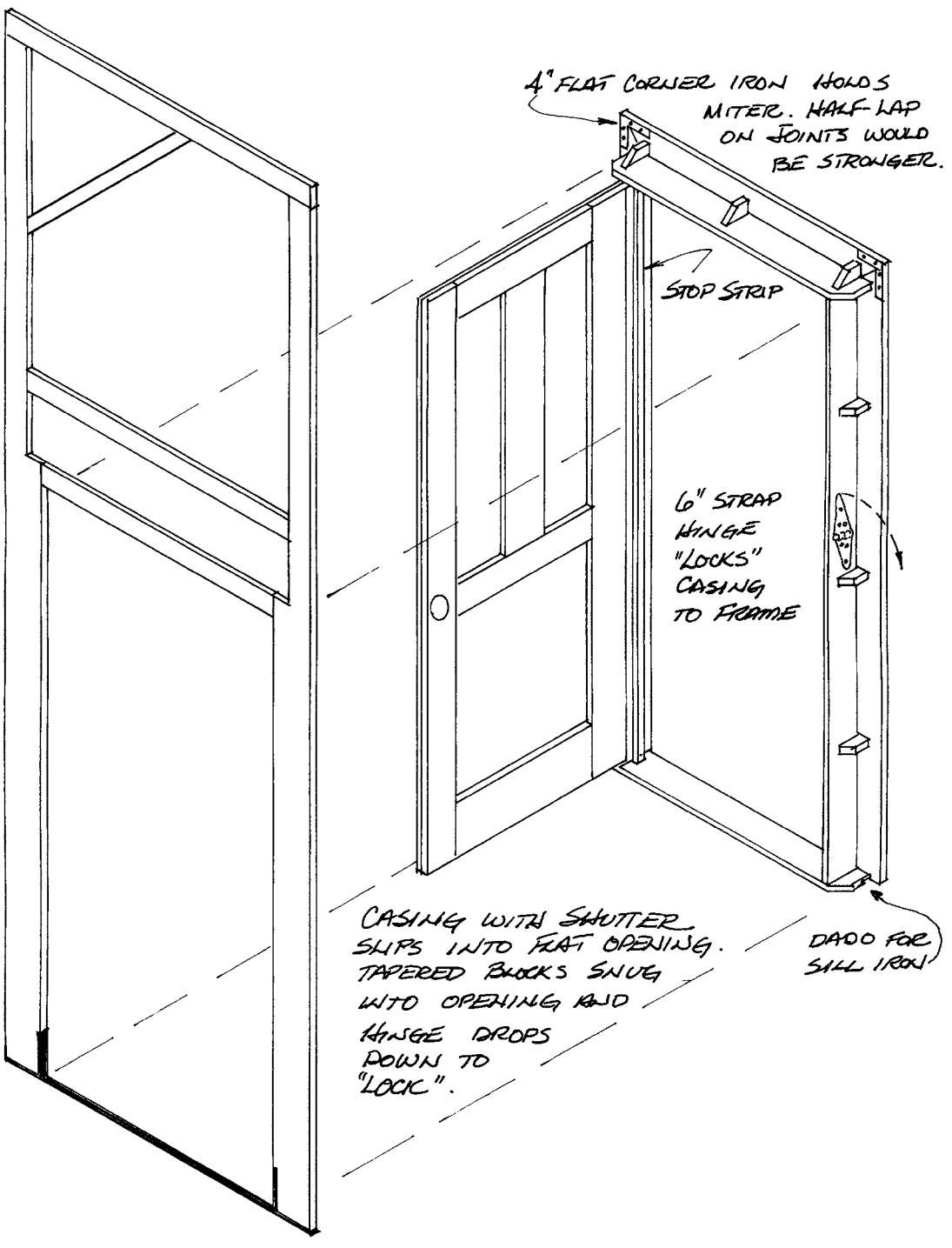




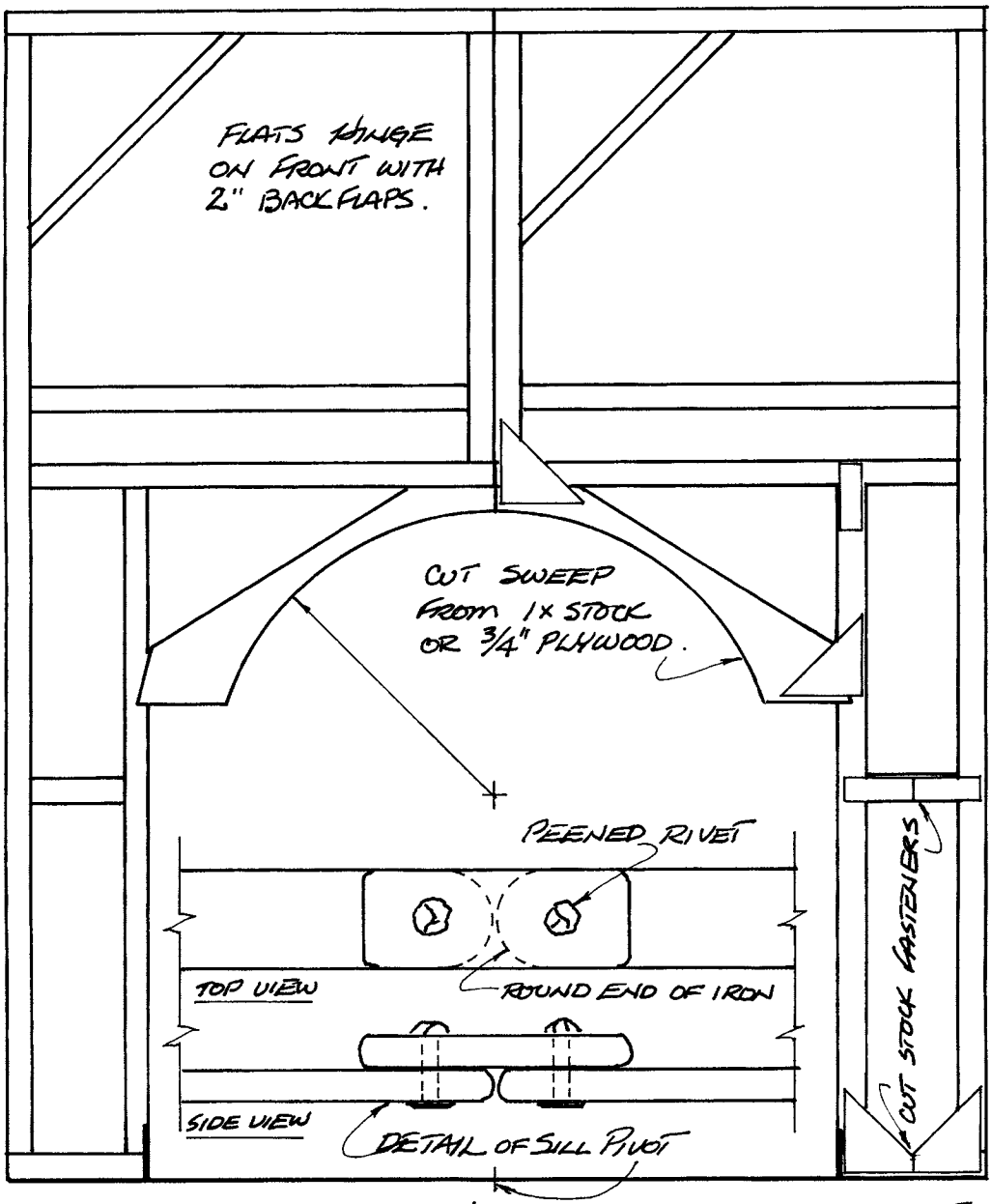
DOOR CASING DWG. 2-25



STOCK DOOR UNIT DWG. 2-26



FOLDING DOOR UNIT DWG. 2-27



IT MIGHT BE POSSIBLE NOT TO USE A SILL IRON AT ALL. REPLACE IT WITH A PIECE OF 1x3 WHICH IS HINGED IN THE CENTER AND TEMPORARILY ATTACHES TO THE LEGS OF THE FLAT WITH LOOSE-PIN HINGES.

Door openings can also be made with flat frame plugs (see Drawing 2-15). Indeed, this is sometimes the best solution for openings of unusual size or design. For normal stock use, however, a door flat is preferable because it is in one piece and therefore stronger.

FIREPLACE FLATS

The fireplace flat (see Drawing 2-28) is a variation on the door flat. Usually an elaborate mantel piece is placed before the opening in front of the flat, and a backing made of plugs is placed behind (see Drawing 2-42). However, make sure to hold all blocks back from the edge around the opening, in case a reveal is necessary. Sometimes fireplace flats are made by placing a plug in the upper part of a door frame. This is a workable solution if you don't need many fireplaces in shows. The plug can be lowered and become a window, if budget constraints force you to build a minimal number of pieces.

IRREGULAR FLATS

Irregular flats are built using the same principles as standard flats. They have rails on the floor, stiles rising off them, and toggles and corner braces as necessary. The major difference is that the rectangular shape is often tossed to the wind. Thus, angles must be cut in the 1× stock, and the plywood fasteners must be specially made and chamfered for many of the joints (see Drawing 2-29).

Any time you deviate from using standard flat frame components, you increase the construction time. Building an entire show of irregular flats takes tremendous time, and, because such flats are rarely reusable, there is no way to prorate the resulting expenditure. The cost of building this disposable scenery is great, so don't say you haven't been warned!

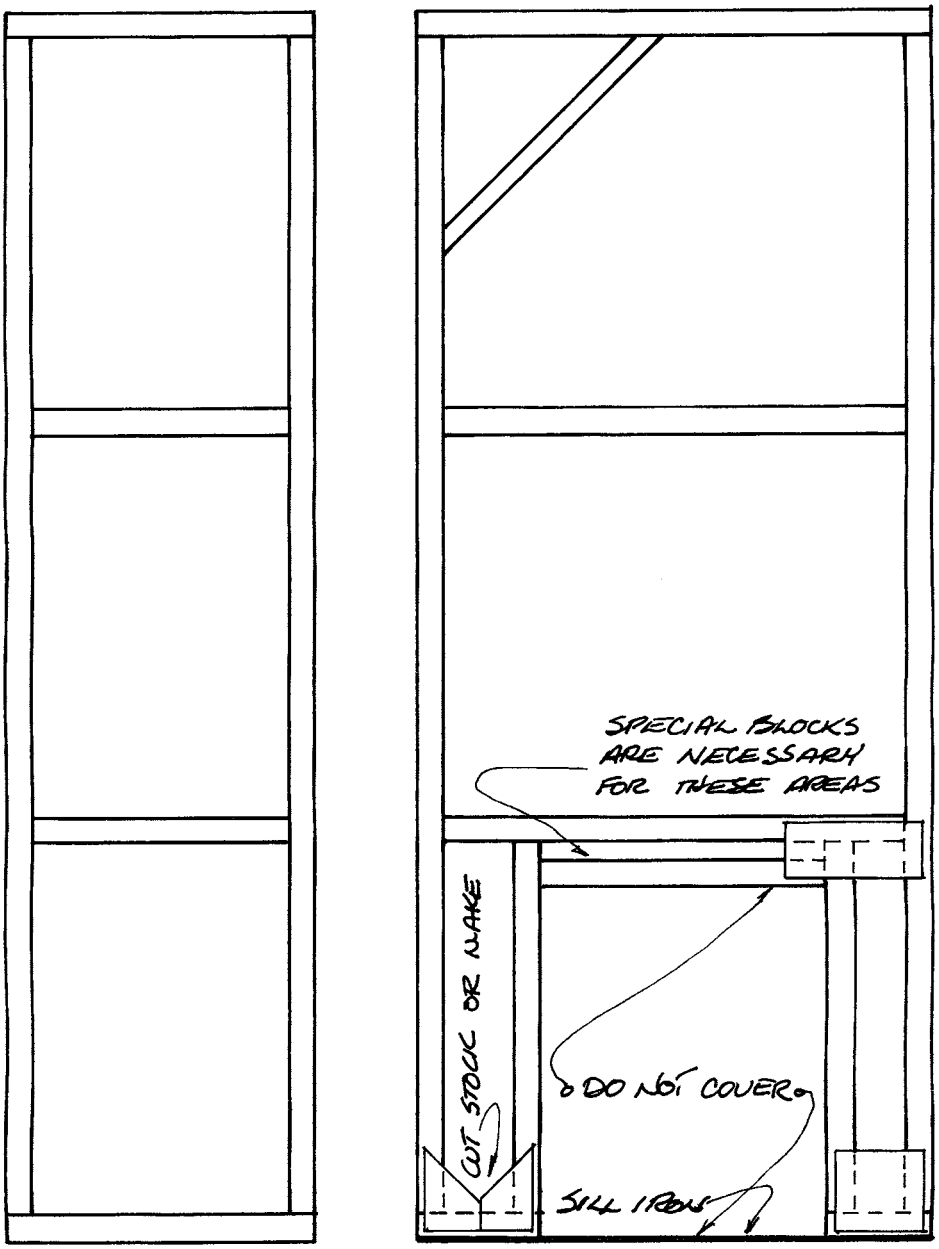
WHISKEY STICK

The whiskey stick (see Drawing 2-29) will greatly aid in making and cutting unusual angles. It is made of three pieces of 1× stock carefully laminated so the edges are all flush. The base should be about 8″ long and the tongue about 16″ long. Vary the size to suit your needs. To mark the cutting line, overlap the 1× stock at the desired position. Place the stick's base against the bottom piece of wood and the tongue on the top piece to be marked. Scribe a line and cut the piece on the mark.

PROFILE FLATS

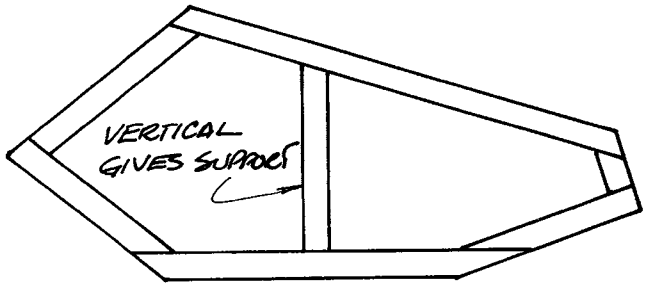
Any flat which has its edge altered to mock a given shape is a profile flat (see Drawings 2-30 and 2-31). The easiest way to achieve this effect is to use ¼″ 3-ply, which is still called profile board in some shops, though in days of old a profile flat was made with thin pieces of wood scrimmed with linen. Whenever possible, adjust a profile piece so a

FIREPLACE FLAT DWG. 2-28



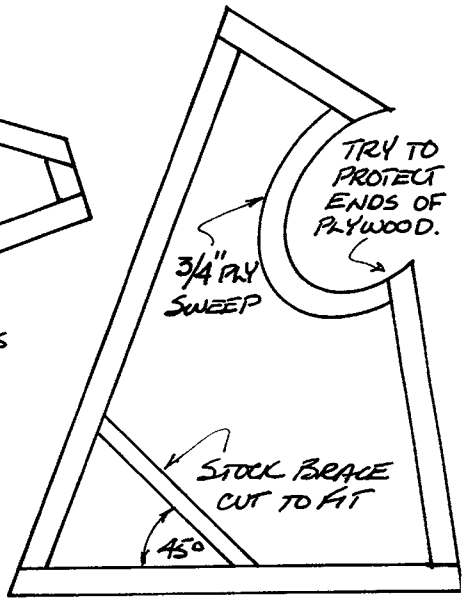
HOLD BACK FASTENERS FROM OPENING FOR REVEAL.
SILL IRON KEEPS LEGS TOGETHER WHICH IS MORE THAN...

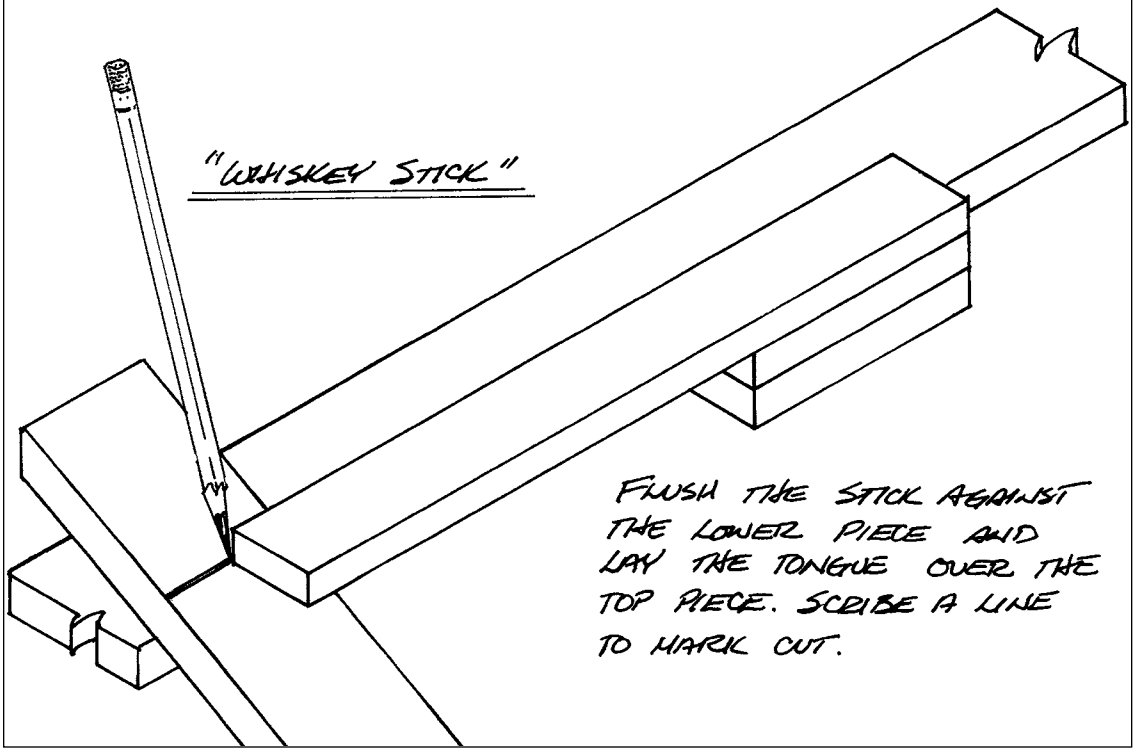
IRREGULAR FLATS DWG. 2-29



WHEN BUILDING IRREGULAR FLATS TRY TO KEEP A 'RAIL' ON THE FLOOR AND HAVE THE 'STILES' RISE OFF IT. N.B. PLYWOOD EDGES NEED PROTECTION.

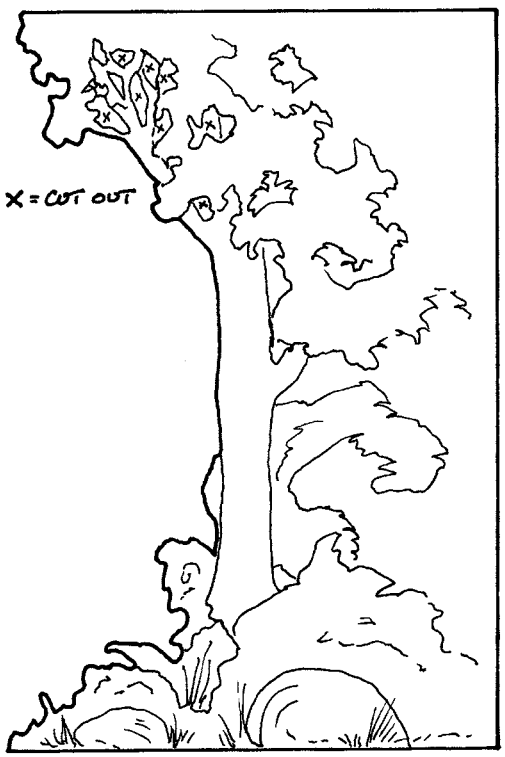
SPECIAL BLOCKS & STRAPS WILL BE NEEDED .. CHAMFER EDGES.



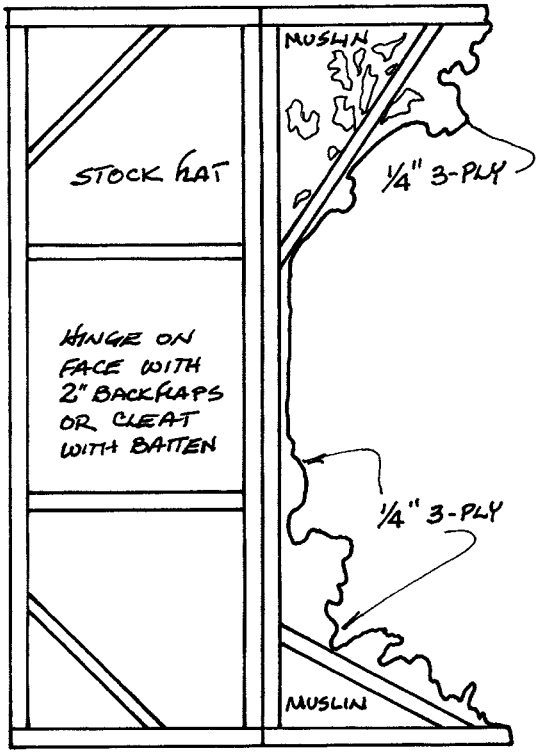


FLUSH THE STICK AGAINST THE LOWER PIECE AND LAY THE TONGUE OVER THE TOP PIECE. SCRIBE A LINE TO MARK CUT.

FLAT WITH PROFILE DWG. 2-30

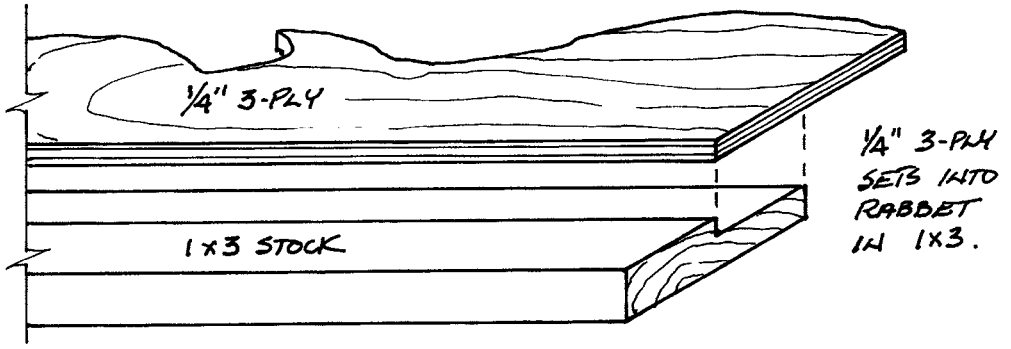


FRONT ELEVATION

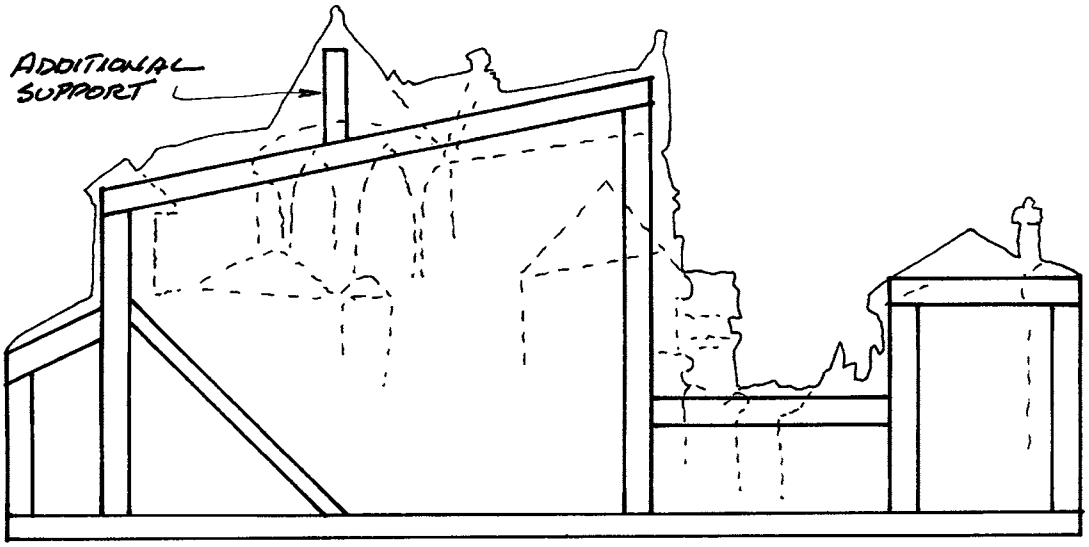


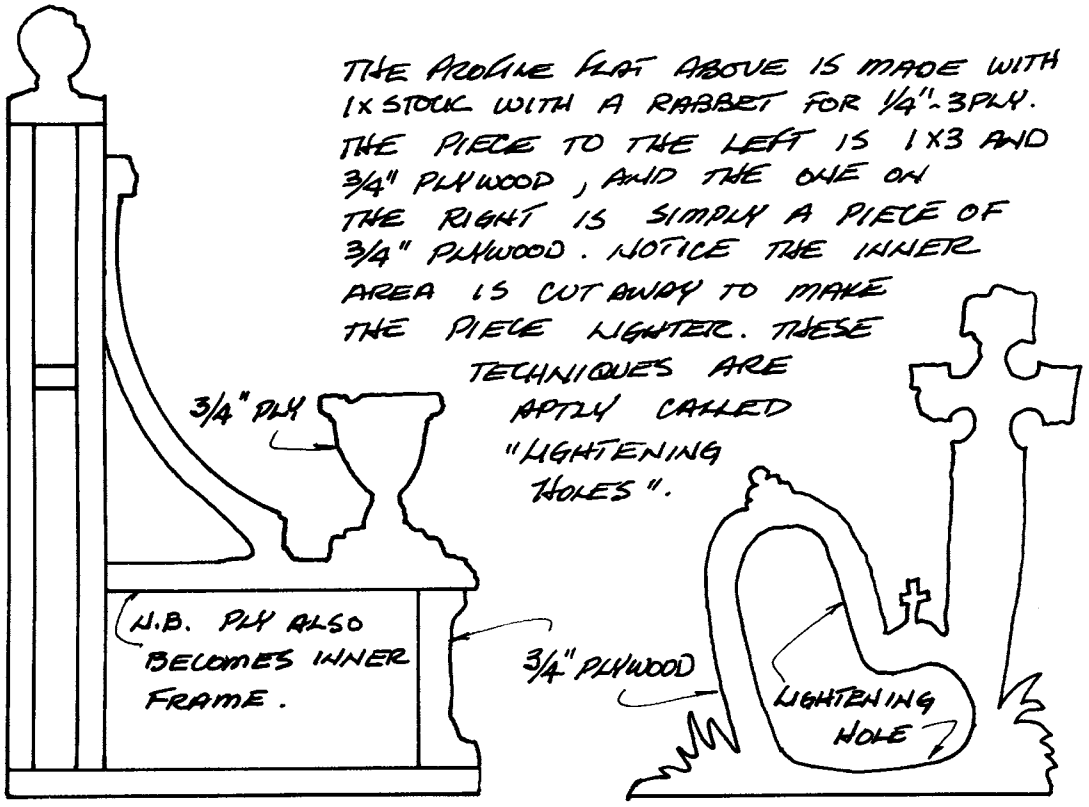
REAR ELEVATION

CONSTRUCT PROFILE FRAME USING STANDARD METHODS BUT UTILIZE 1X STOCK WITH A 1/4" x 1 1/2" RABBET (A STEP-SHAPED RECTANGULAR RECESS CUT IN EDGE). WITH FRAME TOGETHER INSERT 1/4" 3-PLY PROFILE INTO RABBET. COVER WITH MUSLIN.



IT IS CHEATING, OF COURSE, BUT YOU COULD LAMINATE 1/2" STOCK (PLANE DOWN TO SIZE) OR WORSE, 1/2" PLYWOOD TO THE BACK OF THE PROFILE AND CLEAT IT TO THE FLAT.


ADDITIONAL SUPPORT


THE PROFILE FLAT ABOVE IS MADE WITH 1x STOCK WITH A RABBET FOR 1/4"-3PLY. THE PIECE TO THE LEFT IS 1X3 AND 3/4" PLYWOOD, AND THE ONE ON THE RIGHT IS SIMPLY A PIECE OF 3/4" PLYWOOD. NOTICE THE INNER AREA IS CUT AWAY TO MAKE THE PIECE LIGHTER. THESE TECHNIQUES ARE APTLY CALLED "LIGHTENING HOLES".
3/4" PLY
N.B. PLY ALSO BECOMES INNER FRAME.
3/4" PLYWOOD
LIGHTENING HOLE

standard flat can be incorporated to save time and money. If not possible, irregular flats can be built.

Some profile flats are worth keeping in stock, especially skylines and trees. These can be used as backing to give a finished touch to the set.

To build a profile flat it is necessary to place a rabbet (note spelling) in the face of the 1 × 3 (see Drawing 2-30). A rabbet is a groove or slot which is designed to accept another piece of material, in this case the ¼″ 3-ply. The rabbet is set halfway into the 1 × 3 stock allowing the plywood to be flush with the face of it. Build the frame with the rabbeted stock on the edges to be profiled, using plywood fasteners on the back as required. Then set in the profile pieces of ¼″ 3-ply. When the unit is completed, cover the entire face with muslin and glue it down to all edges and around all openings which will be cut away. The surface now has the same qualities as a standard flat and can be painted as desired. If holes need to be cut into the muslin, be certain to do this after the unit is painted. Large holes may need netting (see Drawing 3-12).

SAWHORSES

I have included this section on sawhorses here (rather than in the Shop-Made Tools section) because these sawhorses are so handy when covering flat frames. These are the greatest horses a shop could own. They weigh very little, open easily, and collapse quickly for storage. They are not good building surfaces for heavy hammering. But for just about everything else they are ideal.

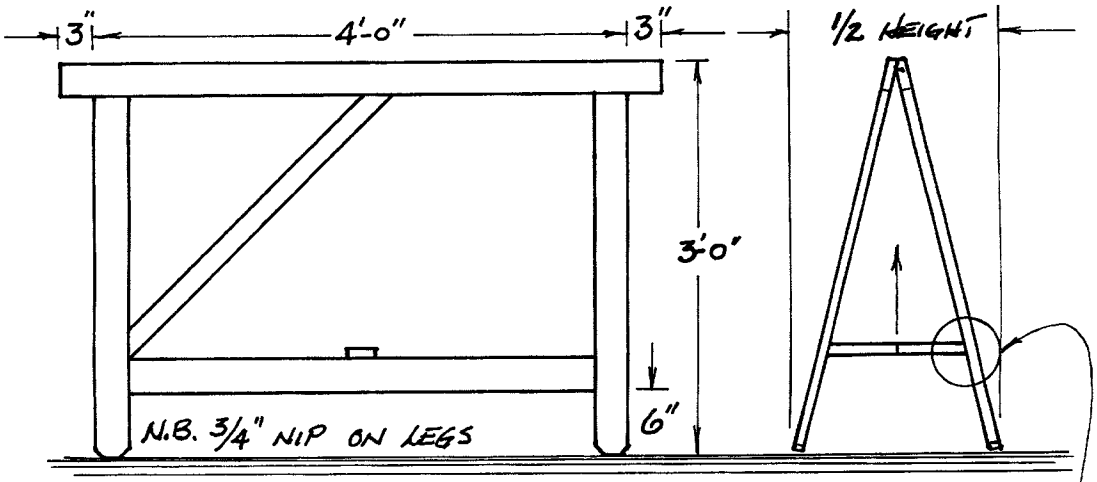
As indicated in the Drawings (2-32 and 2-33), the frame is a variation of the standard flat. The dimensions given in the drawing are for a useful horse but can be adapted to suit need.

The top rail is like any top rail (though extended), but the stiles do vary. Inasmuch as the stiles go to the floor and the end grain is against it, the ends are nipped off at a 45-degree angle (see Drawing 2-34). This prevents any splitting of the stile when the horse is dragged along the floor. The toggle is placed 6″ off the floor, to be clear of scrap and make it easier to reach under the stretcher bar with your foot to lift and close the horse. The corner brace can be a stock one which is cut down to fit.

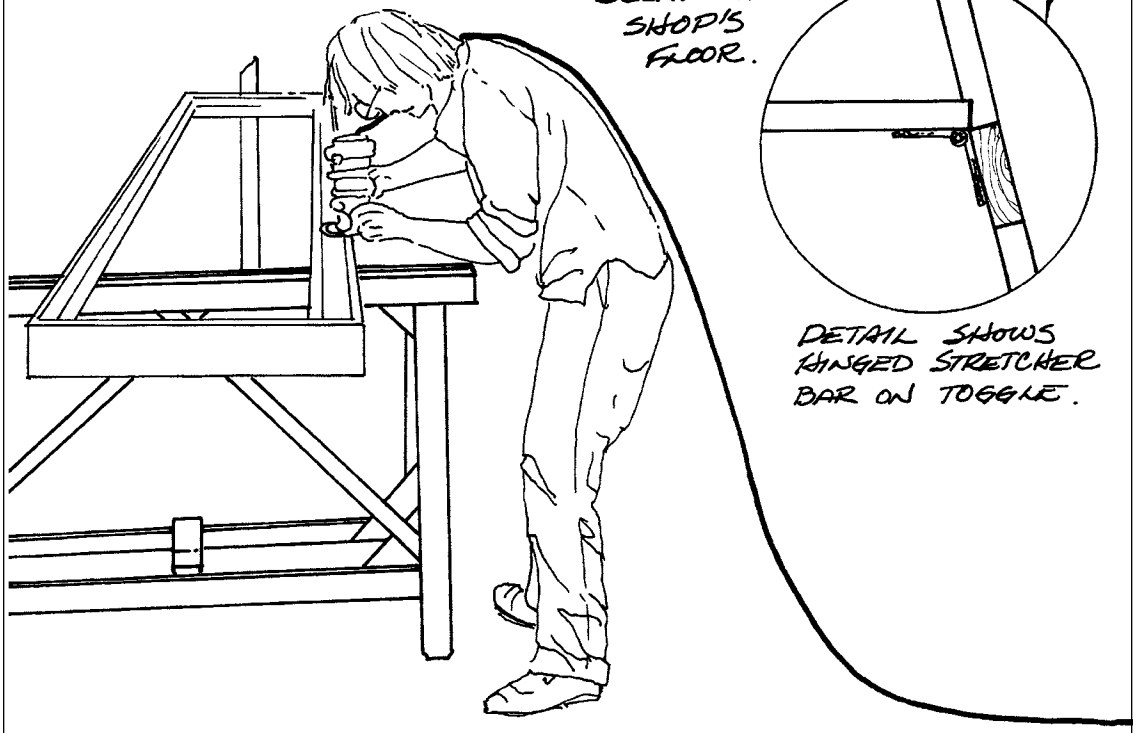
The corner blocks are flushed to the edge because it is not necessary to butt anything to these frames. Note that the toggle is held with corner blocks as well. One end of the corner brace is also attached this way. The blocks give a stronger joint and reduce frame sway.

To put a horse together, build two frames as drawn. Use glue under all plywood pieces. Lay out the two finished frames, rail against rail, with the plywood fasteners up (see Drawing 2-33). When completed, the corner braces will automatically go in opposite directions to give maximum support. Place a 2″ backflap hinge on the rail, centered over the stiles. Center the barrel of the hinge on the crack. If the corner blocks are correctly beveled, the barrel will nestle down into the valley between them. Attach the hinge with two 1″ #8 or #9 flat-head wood screws. One 3⁄16″ flat-head stove bolt in each flap will

SAW HORSES–1 DWG. 2-32

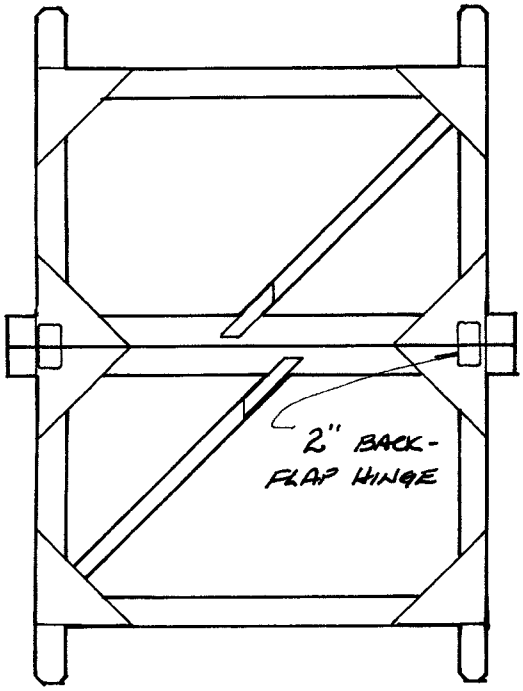


A TYPICAL FRAME FOR A FLAT-FRAME FOLDING SAW HORSE IS DRAWN ABOVE. THE NEXT PAGE OF DRAWINGS GIVES MORE DETAILS. NOTE RAISED TOGGLE WHICH ALLOWS EASY REACH FOR FOLDING AND IS ABOVE SCRAP ON SHOP'S FLOOR.



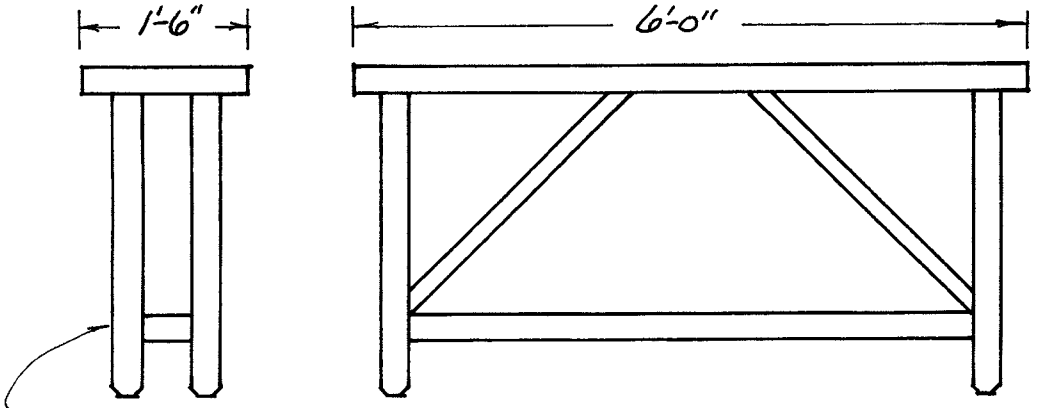
DETAIL SHOWS HINGED STRETCHER BAR ON TOGGLE.

SAW HORSES–2 DWG. 2-33

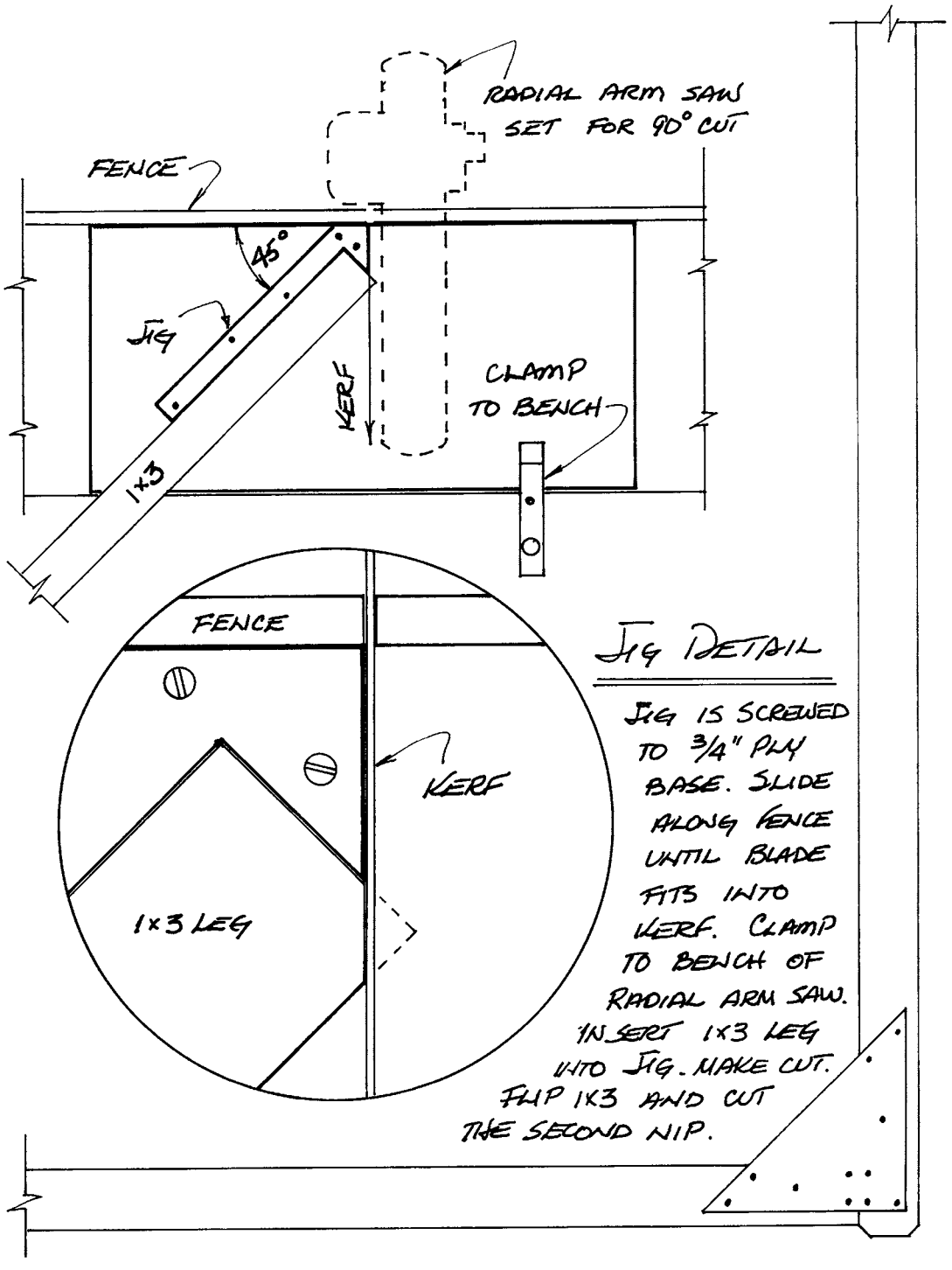


TO ASSEMBLE SAW HORSE, BUTT TWO FLAT FRAMES TOGETHER. PLACE A 2"-BACK FLAP HINGE (CENTERED ON STILE) OVER BLOCKS AND SCREW IT DOWN. ONE 3/16" STOVE BOLT IN EACH FLAP WILL ADD EXTRA STRENGTH IF HORSES ARE GOING TO BE "RODE HARD AND PUT UP WET." WHEN HINGED, STAND UP AND OPEN LEGS (ONE-HALF HEIGHT IS STANDARD) TO MEASURE FOR HINGED SPREADER.

OTHER SIZES CAN BE BUILT AND ARE OFTEN VERY USEFUL. SHOP USE AND PRODUCTION DEMANDS WILL CERTAINLY DICTATE SOME NEEDS



LEG NIPPING JIG DWG. 2-34



really make it strong. Place the nut on the outside of the frame and pull it into the wood until it is flush, then break or cut off the excess bolt. File down any rough remains.

After the top hinges are mounted, stand the horse up on its feet and spread the frames apart until the distance is half the height of the frame. Now, measure the inside distance between the two toggles; this will determine how long the stretcher bar will be. Halve the distance and cut two pieces of 1 × 3 this length. Hinge the stretcher bar together with a 1½″ backflap hinge. Place another 1½″ backflap at each end of the stretcher bar on the same side as the first hinge, with the barrel centered on the end of the 1 × 3. Attach them in the same way. Now, center the stretcher bar between the toggles. Raise the 1 × 3 on the stretcher so the bottom of it is flush with the top of the toggle and the flap of the hinge is resting on the inside of the toggle. Attach the other flap of the hinges temporarily (small clamps or duct tape work well). Make sure the horse will close by lifting up in the center of the stretcher bar and moving the frames together. If it doesn't fold smoothly, adjust the stretcher bar to allow it to do so. Bolt the hinges in place when it folds correctly.

Eight to twelve horses should suffice for starters, but they are easy to build if more are needed.

COVERING FLAT FRAMES

Covering the flat frame is the final step in construction. The task is neither difficult nor tricky, but it requires practice because you must work quickly.

THE MYSTERIES OF MUSLIN UNRAVELED

Muslin is an undyed, plain-weave fabric made with carded cotton yarns containing characteristic slubs, specks, and impurities. Muslin for covering flats must also be unbleached and not flameproofed when purchased or it will not shrink properly.

Because muslin is unbleached and undyed, the cotton fibers have been subjected to a minimum of shrinkage, but when sized will, therefore, shrink on the flat frame, forming a tight skin of cloth.

Plain weave fabrics are the simplest of woven goods. The warp threads (those parallel to the woven edge of the cloth or selvage) and the weft threads (those passing from selvage to selvage) are alternately passed over one another. This weave makes a cloth which has good, stable strength both parallel and perpendicular to the selvages. It also will stretch easily and greatly on the bias, or diagonal of the weave, a trait which makes it useful for covering spherical surfaces.

Carding is done after cleaning and picking the raw cotton. It is the first step used in aligning the fibers into a loose strand which will become the spun yarn used in weaving the muslin. The yarn could be further refined by combing which removes shorter fibers, aligns the remaining fibers and creates a smoother and stronger yarn.

Muslin is sold by weight in ounces per yard and by the thread count. The textile industry has divided cloth into four main categories: light, medium, heavy, and very

heavy. The weight of one square yard of fabric is the determining factor. Most muslin is a medium weight fabric (heavier than 3.5 ounces but less than 8 ounces). The thread count ranges from 112 to 200 threads per square inch. Sizing made of various glutinous materials is added to muslin with lower thread counts to fill the voids in the weave. This greatly increases the muslin's weight but not its strength or ability to hold paint and become opaque.

Muslin sheeting with higher thread counts is often called percale and is usually woven with the more refined combed yarns, which allow a closer weave.

Unbleached muslin is available in various widths. Narrow pieces 39½″ wide (that dreaded meter we won't recognize) are not uncommon in fabric stores. Theatrical supply houses commonly carry muslin in widths of 60″, 72″, and 80″. Wider pieces are also available, and at one time could be found in 30′-0″ widths, ideal for translucent drops. The cost usually increases dramatically in extra-wide pieces.

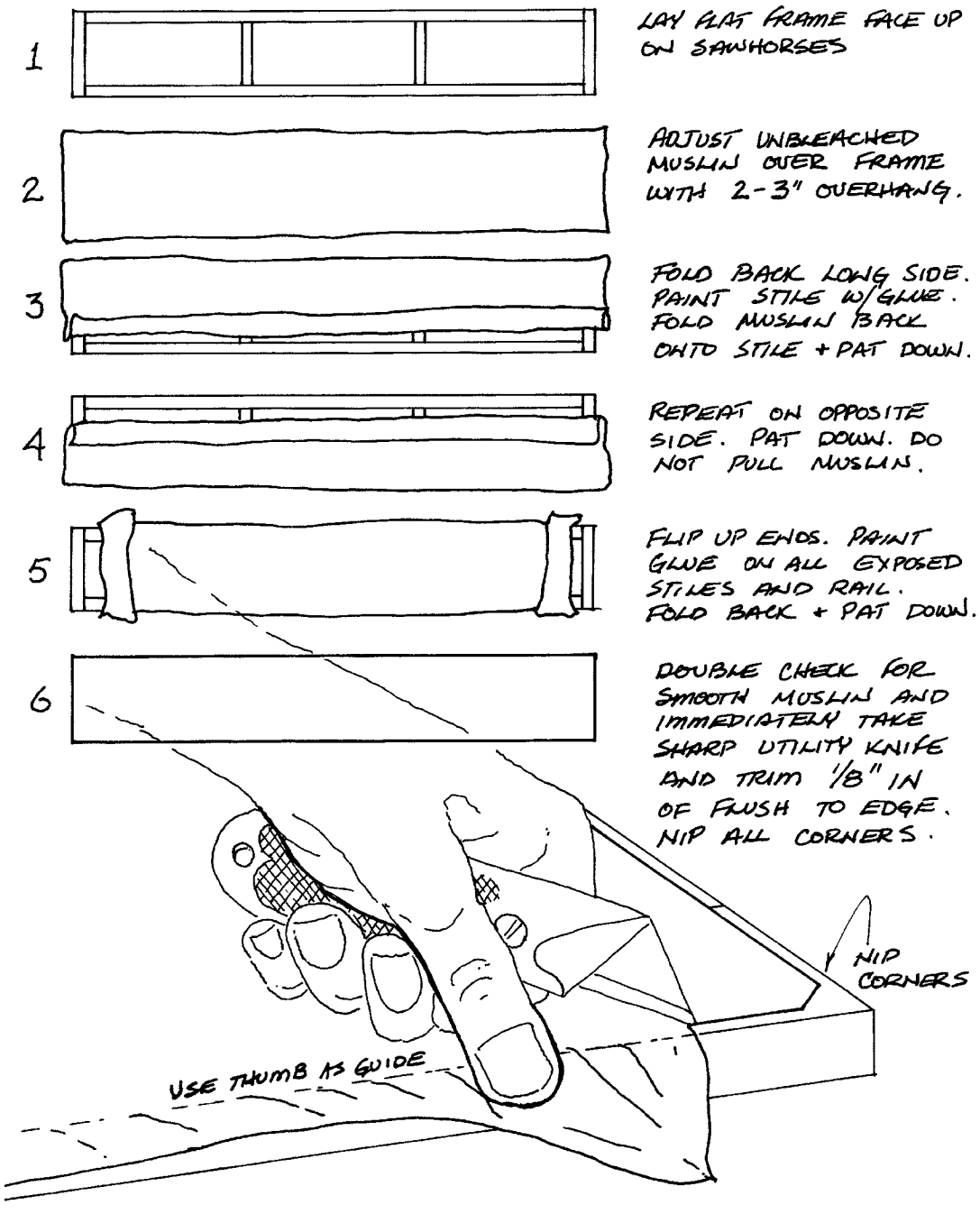
GLUE

There was a time when it was necessary to tack or staple the flat covering in addition to gluing it to the frame. This tacking was necessary because the glues were very water-sensitive, and when the flats were scrubbed after each show to remove the old scene paint, the glue would soften on the frame and only the tacks held the covering until the glue could reset. Today's synthetic glues, such as the popular white glue (PVA or polyvinyl acetate) and yellow glue (aliphatic resin), are much stronger, easier to use, and much more waterproof than the older, animal compound glues. These factors, combined with declining use of powdered scene paint with a water soluble binder, have practically eliminated the need for tacking or stapling.

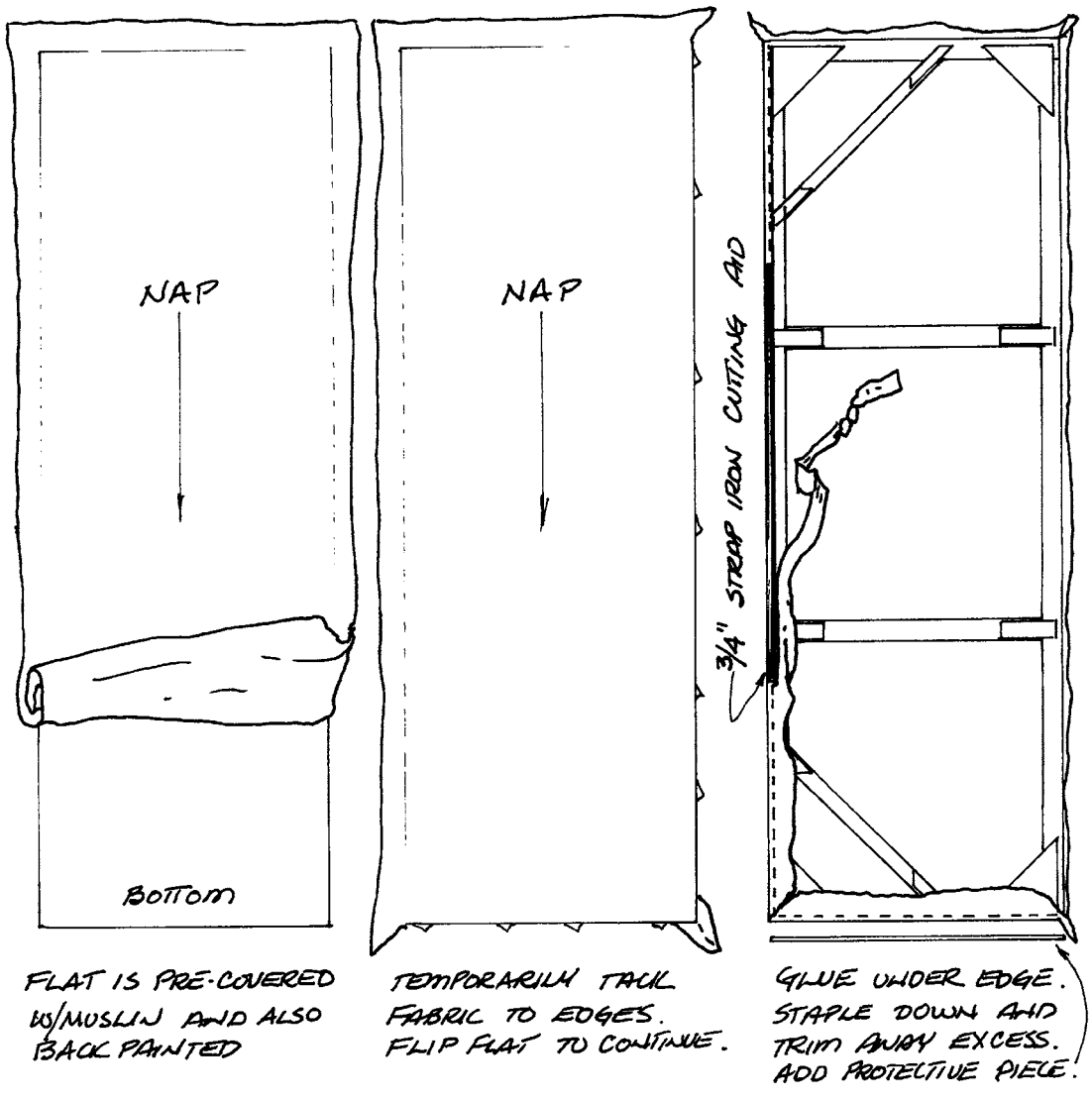
LAYING OUT THE MUSLIN

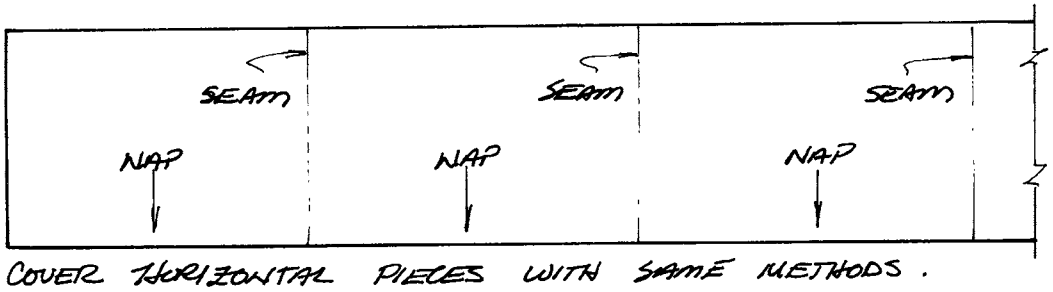
The actual covering job is quite simple (see Drawing 2-35). Use white glue (as above) to which enough water has been added to allow it to "tack through" the muslin. To test, paint some glue onto a board and take a scrap of the covering muslin and pat it down on the glued surface. Just a bit of the glue should seep through. If you feel no tackiness, add a bit more water. Continue testing until you feel the glue. No formula can really be given because the glue will vary as will the weave of the muslin. Place the frame on the sawhorses; make sure it is dust-free. Lay the muslin on the frame, allowing 2″ to 3″ overhang on all sides. Never use the woven edge or selvage because it will shrink differently and show. Smooth out the muslin and get rid of any large ripples or puddles. On some irregular flats it helps to place a few temporary staples at strategic spots to hold the unbleached muslin in place while working. Tear off all excess muslin, leaving only a few inches overhang. This makes it easier to manage and avoids getting the glue on the excess fabric, keeping it usable for future projects.

COVERING FLATS DWG. 2-35



COVERING FLATS WITH SPECIAL FABRICS DWG. 2-36





GLUING THE FRAME

Glue one edge at a time. Start with a long side of the frame and flip back the muslin, exposing the wood. Using a 3″ brush, quickly apply a liberal amount of the thinned glue to the frame. Make sure the frame is covered and the glue is evenly spread. Now flip the muslin back onto the glued frame and pat it down with your hand. You should be able to feel the glue just start to seep through the muslin. This tack-through assures you that the muslin will bond, because the glue is now into it. It should not be necessary to stretch the muslin tightly or pull it in any way. In fact, if unbleached muslin is too tight, it can warp the frame when it shrinks after it is sized. If you must lift the muslin to correct a bubble or some mistake, make sure there is fresh glue under the spot when you put it back down. Also, make sure that the muslin glued to the frame is smooth and flat. With patience you can flatten almost any ripple or bump on the frame. If there are ripples or slight pulls in the center of the flat, ignore them, because they will disappear when the flat is sized. In fact, the unbleached muslin can sag many inches and still shrink tight.

When the first side is glued and patted smooth, go to the opposite side, smooth out the muslin, flip it back, and glue away. Flip it back onto the glued frame, pat it down, and smooth it out. Next do the ends of the frame. Do not glue the covering to the toggles or corner braces, only to the outside members of the frame. This allows the muslin to shrink into a smooth surface over the entire frame. Never apply glue to the top of the muslin. It can cause shiners and glue burns, which will affect the painted surface.

TRIMMING THE MUSLIN

As soon as the muslin is smoothed down on all members of the frame, get a sharp utility knife and trim away the excess materials (see Drawing 2-35). Hold the knife firmly in your hand, and with your thumb as a guide along the edge of the 1 × 3, cut in ⅛″ from the edge. This is done to protect the covering from being rubbed and peeled off. With your other hand, gently pull away the waste strip as it is cut. Be sure to nip the muslin in the corners, because the corner of the frame wears down more quickly and is more likely to expose the fabric to friction. This trimming must be done before the glue dries so that the cloth will bend into the groove in the 1 × 3 left by the knife. It is also easier to release the excess scrap before it has dried to the frame.

There are shops which prefer to trim the muslin flush with the edge of the frame. The argument for this is that with proper handling, edges of the frame are not abused and the muslin will not lift. It is also stressed that the ⅛″ indented cut shows in smaller theatres and is ugly. It is debatable which method is preferable, inasmuch as both do the job, but still nip the corners.

When covering flat frames with openings such as windows or doors, three different methods can be used. The first is to lay the muslin on the entire frame as with a standard flat and glue a long side down. Now ease the rest of the muslin toward the glued edge by gathering it up accordion fashion until it has exposed the internal parts of the frame which need to be glued. Glue them and quickly and carefully lift the muslin and lay it

over the newly glued parts. A second person can make this step easier. Once the internal pieces are glued and patted smooth, proceed as with a standard flat.

The second method is to cover the outside of the frame first and then cut away the muslin inside the opening, allowing some overhang. Lift the muslin around the opening carefully and apply glue to the frame. Lower it and pat it smooth.

The third method is to use smaller pieces of muslin and glue them to the frame around the opening. This often requires some overlapping of muslin, which might show from the front row, but it is certainly economical. It is often the best way to cover the legs on door flats. Purists will shudder at the third method, but they are notoriously wealthy.

Irregular or profile flats present no new problems. Just remember to try to glue down the long side first and then the shorter ones. In working with irregular shapes, be careful not to pull the muslin on the bias to smooth it down or it will ripple. Bias ripples tend to increase instead of tightening up when the frame is sized. Trim irregular flats in the same manner as standard frames.

Once the frame is trimmed, let it sit until the glue has set. If you must move it, carefully lift the flat and store it vertically until the glue has dried. The glue sets in about fifteen minutes. Store the frame with the muslin side out and exposed to the air. Don't stack newly covered flats together or they may stick. Drying takes several hours, depending on the weather and who has applied the glue. It is best to wait overnight before sizing, because if the glue is still wet, the sizing will shrink the muslin and it will pull off the frames! It must then be recovered . Store muslin scraps for covering narrow pieces and making dutchmen (see Drawing 2-54).

SIZING

When completely dry, the flat is ready to be sized. Sizing will remove any looseness in the covering, draw it tight, and prepare the surface for painting. The best size to use is wall size. It is also the cheapest. Wall size is available from paint and hardware stores and is sold as a primer for walls which will be papered. Make doubly sure you get a 100 percent natural wall size and not one which is vinyl or plastic or "new and magic." Using the instructions on the package, mix the size with cold water. When mixed, add additional water equal to the amount already used. This will dilute the size to a workable solution. It is best to let the size sit and cook for several hours before using. This does not mean to heat it. A few dollops of paint can be added to color the size to help see it when it is on the muslin. If the size is too hot (thick and sticky), add a little more water. Paint in on with a large brush, forcing the solution into the fabric, and, as if by magic, the muslin will shrink up. After it has dried, the flat is ready to be flameproofed, back-painted, and primed. Will this never end? Some suggestions for flame retardation treatments are offered in the section on Soft Scenery.

Be sure to clear the toggles and corner braces before back-painting. Clearing refers to unsticking the covering from the frame members which are not glued to it, but which are stuck because of the binder in the size or paint.

BACK-PAINTING

Back-painting serves many purposes. It opaques the muslin and stops light from bleeding through from behind and silhouetting the frame. Back-painting also helps stop bounce light backstage because of its dark value. It also acts as a flame retardant. A back-painted flat looks better, which is important, but aesthetics are difficult to defend.

Back-paint should be a medium to dark grey and can be mixed specially or made by boxing together all the leftover paint from previous shows and tinting or shading this scrap paint to approximate the desired grey.

Back-painting is the final step necessary to give the flat, and all scenery, a finished and professional touch. When the back-paint is dry, again clear the toggles. This will leave horrendous bumps on the front, but they will re-tighten when the front is primed. The primer coat fills the muslin and prepares a workable surface for the scenic artist. When dry, the flat is ready.

The pride of accomplishment in delivering a well-built flat cannot be stressed enough. Simple as it may seem, you will earn the undying gratitude of the painters who will transform the surface, as well as other technicians who will handle it later.

HARD-COVERED FLATS

Just to add to the confusion, sometimes it is advantageous to build hard-covered flats. These are standard flat frames which are covered with solid, rigid material like plywood, paneling, plastic, etc. (Drawing 2-37). Perhaps the flat needs the rigidity for molding or perhaps it must realistically take the abuse of having objects thrown at it or it can't jiggle when someone climbs through a window. Regardless of the intended abuse, the flat thus made is now hard-covered with a board and not soft as with muslin. The surface is often treated with the same covering material as the standard flats with which it is being used, so it will blend in. The hard-covered flat is often marginally thicker than the standard flat.

Some shops make hard-covered flats without plywood fasteners. The frame is built face up and held to shape with corrugated fasteners. A covering sheet of ¼" panel (plywood, hardboard, etc.) is then glued and attached to the front. When finished, it is the same thickness as the flat.

Hard-covered flats should not be confused with hardwall flats (see Drawings 2-55-61), which are constructed differently.

STORAGE

As mentioned before, flat storage is extremely important. Install a good storage rack for the flats. The finished frames should be stored vertically, face to face and back to back. This lessens warping and protects the covering. A flat which leans at an angle too long will permanently warp and is then difficult to use effectively.

The rack illustrated in the Drawing 2-38 is a simple design and can easily be adapted for any height or width stock. It is only a suggested design, and any suitable rack could be built. Constructed of 2 × 4, 1× stock, and plywood, this particular rack is independent (self-supporting and self-standing) and eliminates the need to anchor into the wall or floor. However, it could easily be adjusted and modified to a permanent installation.

Note that there is less than 2′-8″ between the verticals forming the storage bays. This prevents too many flats from leaning and resting against themselves, making it difficult to move them without a great deal of shuffling. Flats of the same height and width should be stored next to each other. This eliminates any unnecessary stress in their frames and allows easy inventory of stock.

Again, let me stress that sufficient storage facilities be built along with the stock flats. The best flats can be ruined and rendered useless if not stored properly.

MOVING FLATS

It is always safer to move scenery, especially flats, with one person unless it is easier and safer to use two. Phew! If you think that is confusing, try three people.

Flats are more awkward than heavy; one person can easily raise a flat (Drawing 2-39). Start by lifting from the center to relieve some of the strain in the frame. By moving to the rail and placing a toe at the base, you can grab forward as far as it is comfortable and then lift and (sorta) sit back. A second person can help with the initial take-off by lifting the other end. Once the flat is standing, and assuming the sit was only sorta, move to the edge. Stand to the side of the flat. Grab with one hand high and the other low. Be sure this is comfortable and the stretch is not too great. Next, lift the frame a bit from the floor and walk as normally as possible, keeping the side of your body to the flat. Because your hands and the back corner of the flat form a triangle, you can easily maneuver the piece. You will soon learn to stoutly refuse offers of help as workers try to raise the back corner, disengaging your control. With a bit of practice, moving flats becomes a bravura performance of technical expertise. It's easy, too.

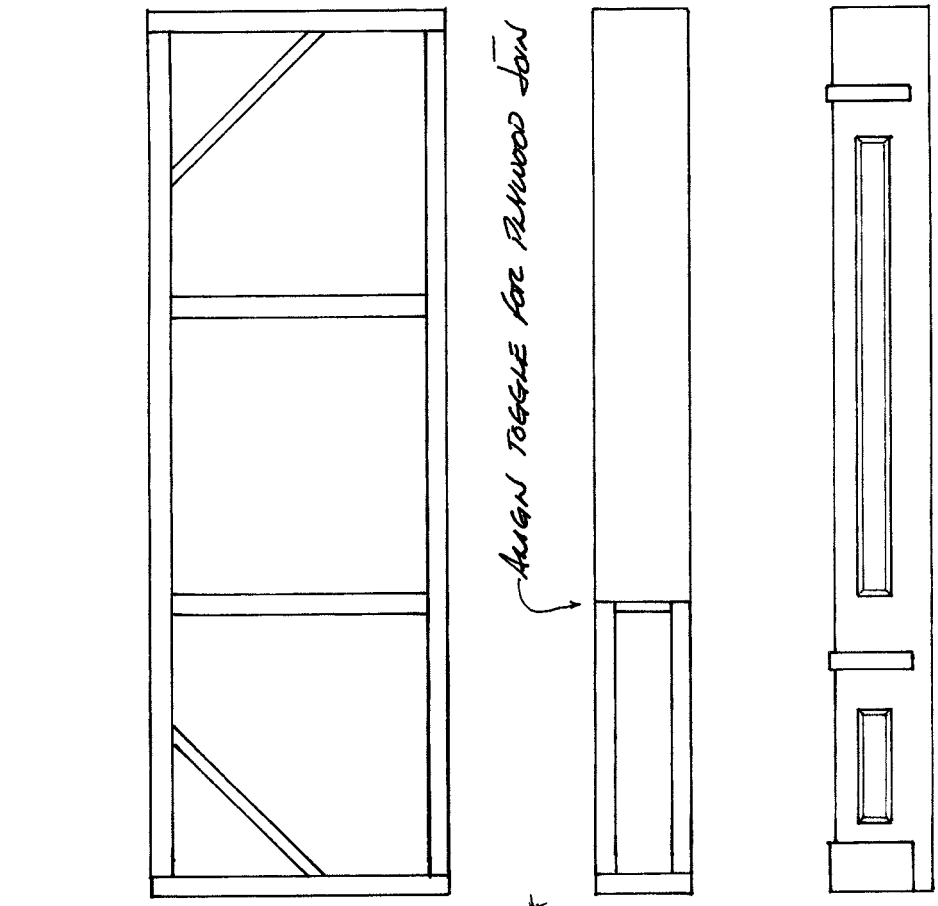
On excessively tall flats, a second person can help steady the unit by attaching an adjustable stage brace through an eye near the top of the frame.

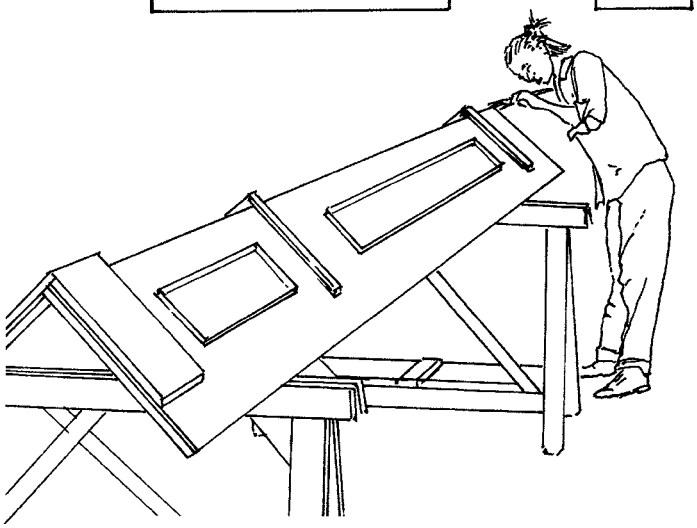
To lower flats, simply let them float to the floor (see Drawing 2-39). This assumes a clean floor, flats without openings (they float damn fast), and a courtesy call of "Clear, please." Be sure to foot the bottom. Always float a flat so its face lands on the floor.

JACKS

A jack is a flat frame brace which, when attached to a piece of scenery, holds and stabilizes it, usually by anchoring it to the floor (see Drawing 2-40). Jacks can vary in size as needed but should continue to the top of the piece of scenery in case there is need of bracing there. The rail seldom needs to be more than one-quarter the stile's height and

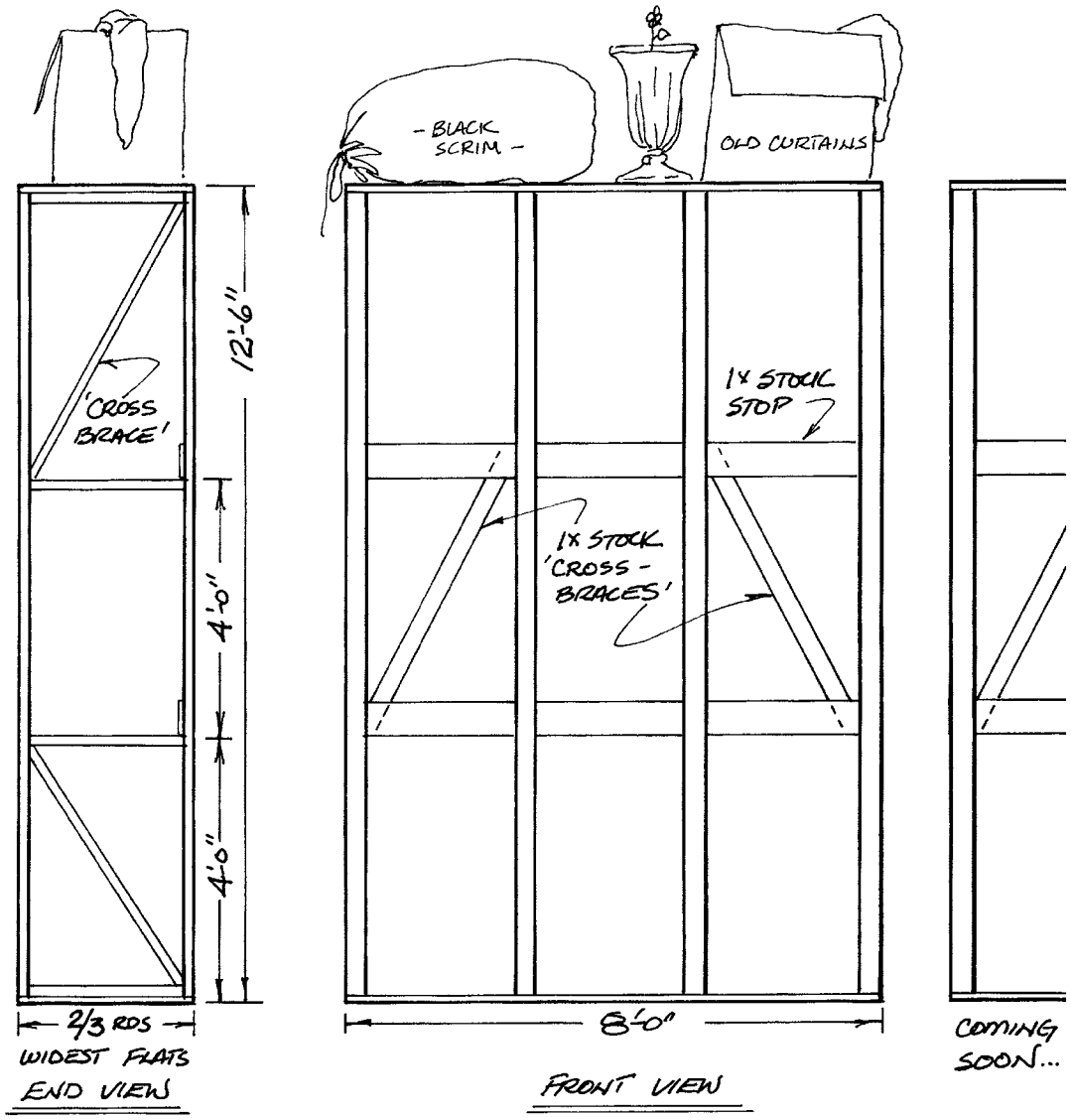
HARD-COVERED FLATS DWG. 2-37





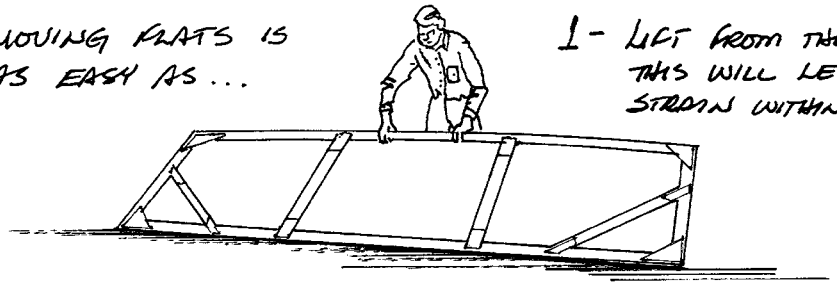
HARD COVERED FLATS ARE USUALLY COVERED WITH A PANEL BOARD OF SOME SORT, OFTEN 1/8" OR 1/4" PLYWOOD. THIS MAKES A THIN FLAT WHICH WILL ACCEPT 3-D TRIMS. THE COVERING IS USUALLY SCRIMMED WITH MUSLIN TO MATCH SURFACES OF OTHER FLATS.

A STORAGE RACK FOR 75+ FLATS — DWG. 2-38



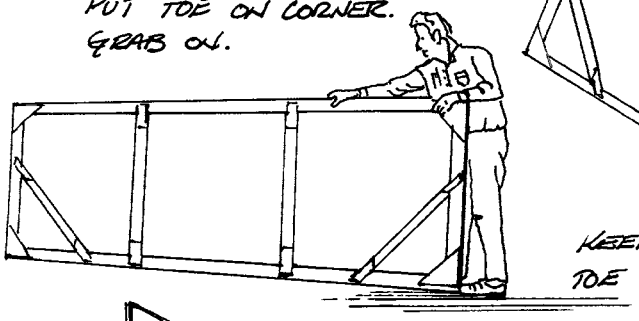
THIS DRAWING IS BUT A SUGGESTION FOR A SELF-STANDING, EASY-TO-CONSTRUCT STORAGE RACK FOR A STOCK OF 12'-0" FLATS. THE BASIC UNIT IS MADE FROM 2×4S (UGLY STUFF) WITH A 3/4" PLY BASE AND TOP. ADJUST TO FIT YOUR STOCK NEEDS.

MOVING FLATS IS AS EASY AS . . .

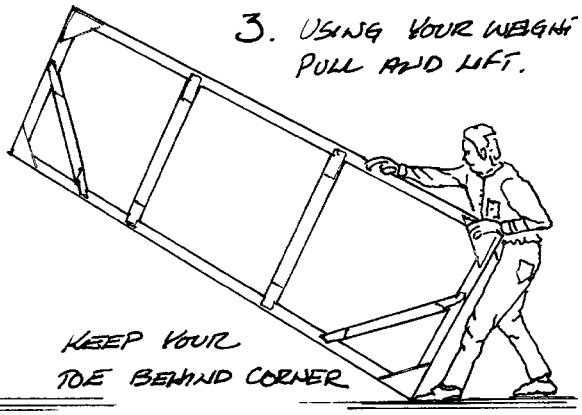


1- LIFT FROM THE CENTER. THIS WILL LESSEN THE STRAIN WITHIN FRAME.

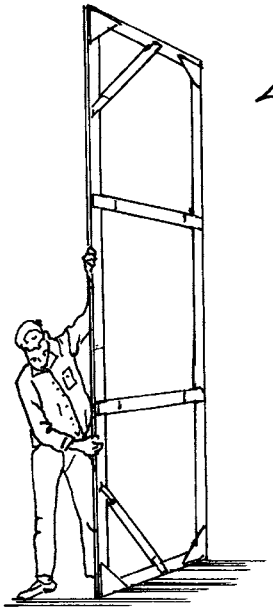
2. MOVE TO SIDE AT END. GET SLIGHTLY BEHIND. PUT TOE ON CORNER. GRAB ON.



3. USING YOUR WEIGHT PULL AND LIFT.

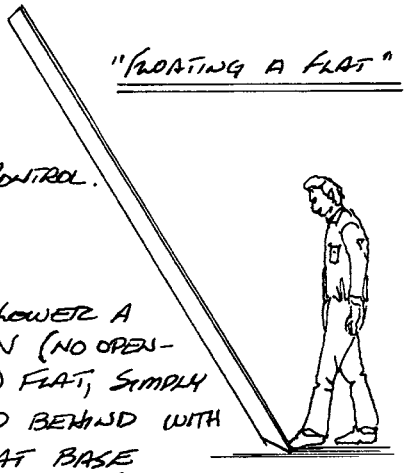


KEEP YOUR TOE BEHIND CORNER



"RUNNING A FLAT"

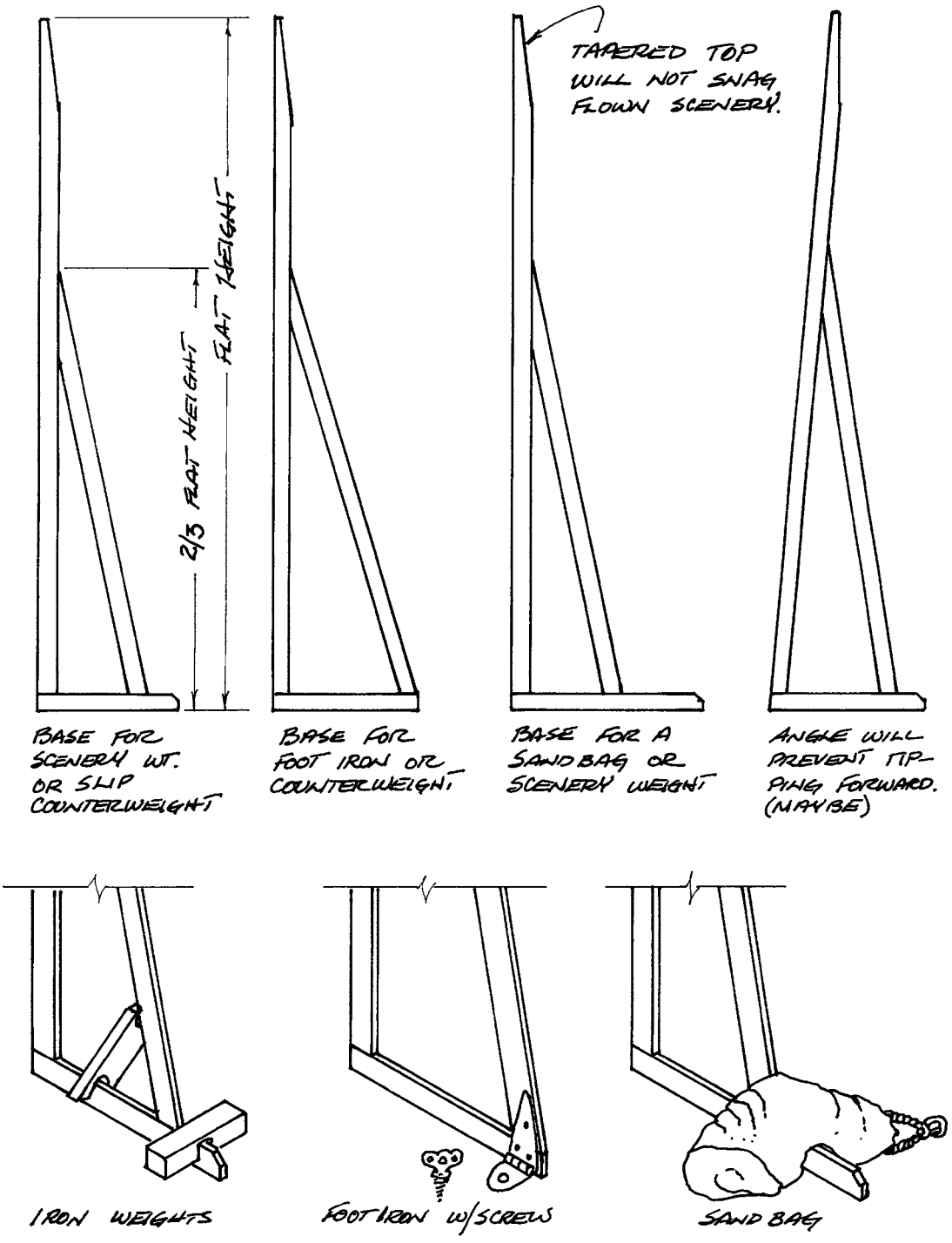
4. WHEN FLAT IS STANDING MOVE TO SIDE AND W/ONE HAND HIGH . . . ONE HAND LOW, LIFT AND WALK. DO NOT LIFT BACK OR YOU LOSE 3-POINT CONTROL.



"FLOATING A FLAT"

5. TO LOWER A PLAIN (NO OPENINGS) FLAT, SIMPLY STAND BEHIND WITH FOOT AT BASE AND LET IT FLOAT.

JACKS AND HOLDING METHODS DWG. 2-40



can usually be somewhat less. The drawing shows that the vertical stile and horizontal rail are both 1 × 3, as is the corner brace. The brace need only extend about two-thirds the height of the stile, as the 1 × 3 is on edge and will not bend easily. A piece of 1 × 2 can be used for the corner brace in smaller jacks.

It is recommended that the stile and rail be nipped off on the exposed end (as shown) to lessen the chances of catching or snagging either actors or other scenery—particularly scenery—because it is expensive to replace.

A good rule of thumb is to hold the plywood fasteners back the stock thickness (¾″) to allow for the possibility of butting the jack to the edge of a flat. Hold the fasteners back on the rail also, so you can attach a 1× stock cleat to the floor and butt up against either side of the jack. Attaching the jack to the cleat on the floor results in a secure brace.

The Drawing 2-40 shows a few of the many common and often ingeniously simple ways of securing jacks to the floor if you cannot use screws.

When building several jacks for a long unit, remember to R & R (reverse and repeat) the jack during construction so the plywood fasteners will alternate sides and allow flush fits as desired.

Jacks are usually attached to scenery with 2″ backflap hinges. These can be either tight-pin or loose-pin hinges. However, jacks can also be anchored with screws or, if necessary, nailed to the scenery.

FASTENING FLATS

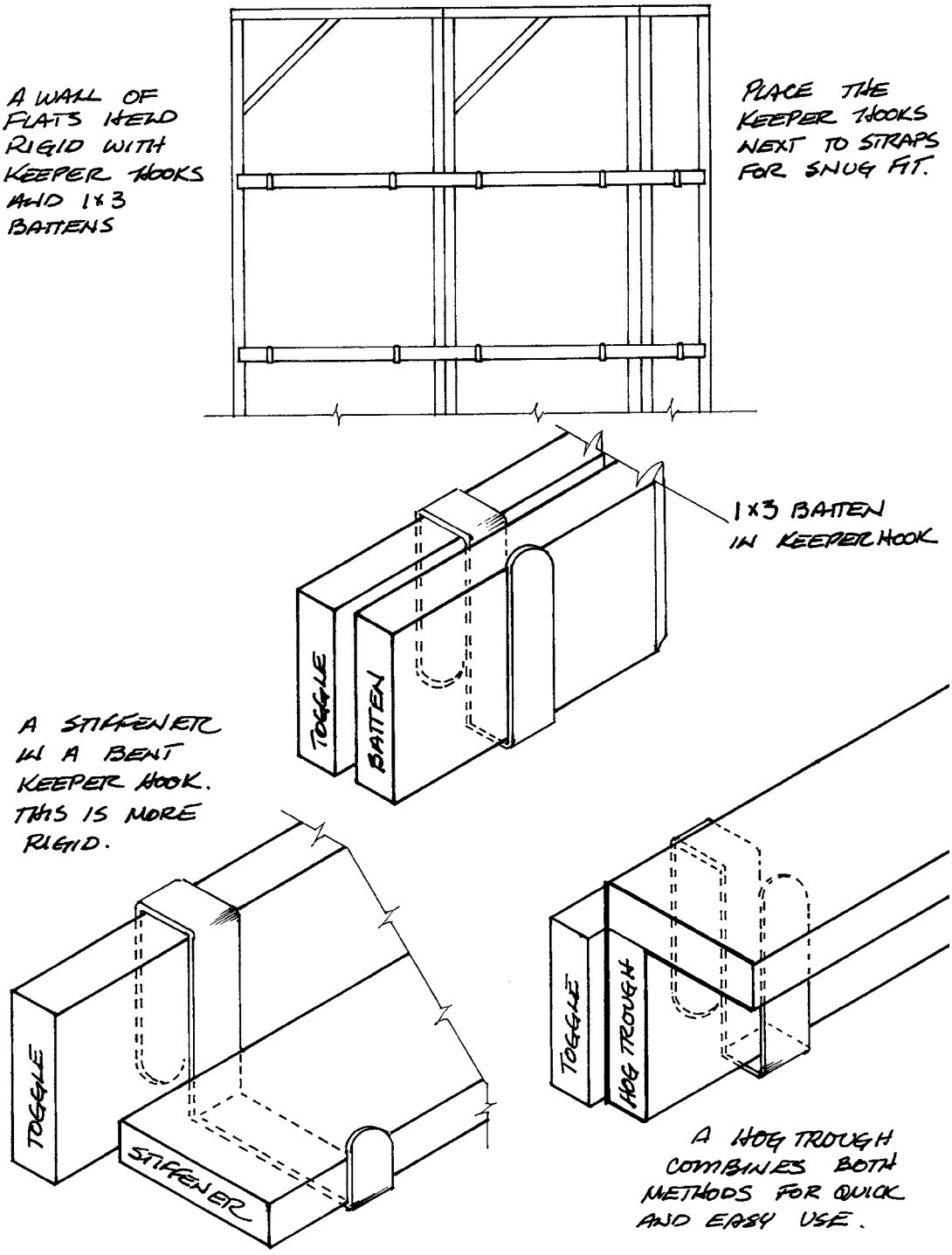
There are several methods of joining flats together. The most useful are battening, hinging, and lashing.

BATTENING

Battening flats assures a certain amount of rigidity and is the most common way of creating a wall of more than one flat. When the derivation of batten is known, it can be more easily understood. Batten originally meant a strip of sawed lumber used for flooring or nailing across other pieces to cover a crack. We still have board-and-batten houses and can batten down the hatches. Battens in the theatre can mean many things, including a small piece of 1 × 3 inserted between toggles or stiles for holding pictures (see Drawing 2-45). It can be a piece of 1× stock or a laminated 1 × 3 used to hang drops on (hence any pipe which has scenery, draperies, or lights hanging on it). It is also a strip of 1 × 3 attached across a wall of flats to hold and stiffen them together. This particular batten, usually 1 × 3, is either permanently or temporarily held against the flats (see Drawings 2-41, 2-43 and 2-44).

To batten flats, place them face down on a well-swept floor. Align the bottom rails. Place 1 × 3 battens face down across the rails and toggles. The batten should be at least 1″ shorter than the flats on each end to allow another flat to butt against the wall or to attach a jack. This clearance also moves the end of the batten onto the plywood fastener

KEEPER HOOKS AND BATTENS DWG. 2-41



and eliminates a possible protruding hook which could snag on something. The batten can be screwed down with 1½″ #8 or #9 flat-head screws or with self-starting drywall screws with their nonslip Phillips head. There should be two screws secured into each end of the batten and at least one screw secured into each stile the batten crosses. If the batten is not able to be attached over a plywood fastener at some point, a block of ¼″ plywood should be inserted between the flat frame and batten to eliminate the chance of warping by keeping the batten on the same plane.

When a wall is battened, carefully raise it by using sufficient workers to walk it up so it is standing vertically. Have one or more persons at the bottom to foot the unit and enough people to lift the top and walk along the stiles with their hands, raising the unit. Do not let too much bend occur or the battens can loosen.

Duplex nails can be used to attach the battens, but they do not hold as well as screws. The second head of the nail also protrudes, and this can snag scenery or costumes. In addition to these problems, the abuse given to the frame when the nails are hammered in weakens it. Duplex nails are, however, very fast to drive, and the second head facilitates quick removal.

Flats which are battened should be tightly lashed first (details follow) to help hold them in place while the battens are being applied. If there is no lash hardware, clamps can be used as needed and removed after battens are affixed.

Battens can also be hinged on the flats. This allows the 1 × 3 to be on edge or at a right angle to the frame, and it gives greater stiffening power. When this is done, either 2″ tight-pin or loose-pin backflaps can be used. The 2″ backflaps are placed on the top of the batten with at least one hinge per flat. The weight of the batten will hold it at a right angle to the frames. Again, it is best if the battens can run over the rails or toggles (see Drawing 2-44).

Battens are also placed on the back of flats with keeper hooks to stiffen them temporarily (see Drawings 2-41 and 2-44). This is usually done for sets which must shift and strike quickly. When temporary battens are used, the flats should be face-hinged with 2″ backflaps. This hinged joint is covered with a dutchman when the flats are painted (see Drawings 2-55 and 2-56). The keeper hooks are placed on the toggle and often on the top rail. These hooks are available from theatrical supply houses, or they can be homemade if you have a metal shop and lots of patience.

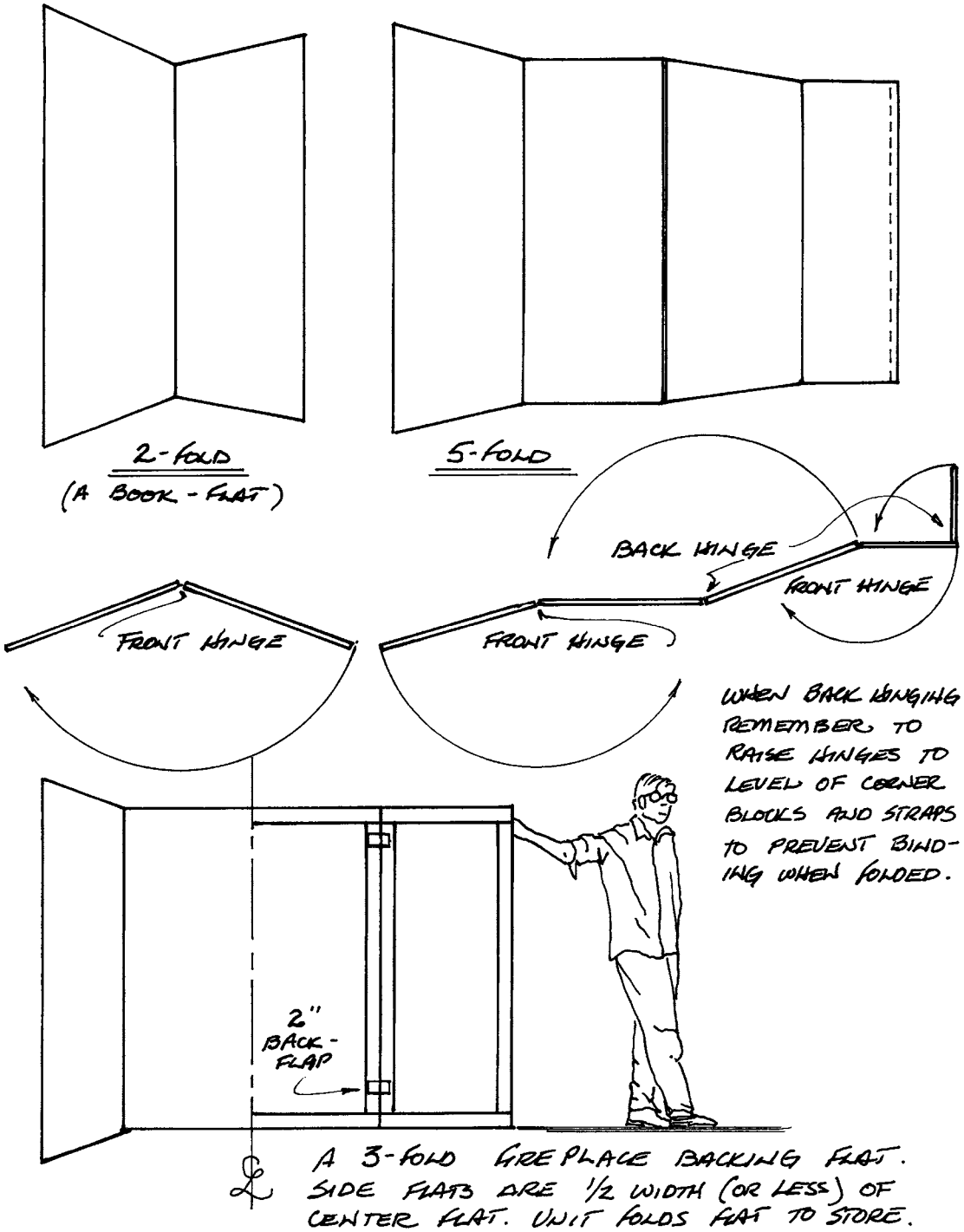
HINGING

Hinges are used to connect flats into large wall units which must fold for strike or storage. The flats can be hinged on the face or back.

When the flats are hinged on the front, they can easily fold into compact units. However, when they are back hinged there must be ¼″ blocks under the hinges if folding is desired. This prevents the flats binding against the plywood fasteners, which causes the hinges to bend, the screws to pull out, and the frame to split.

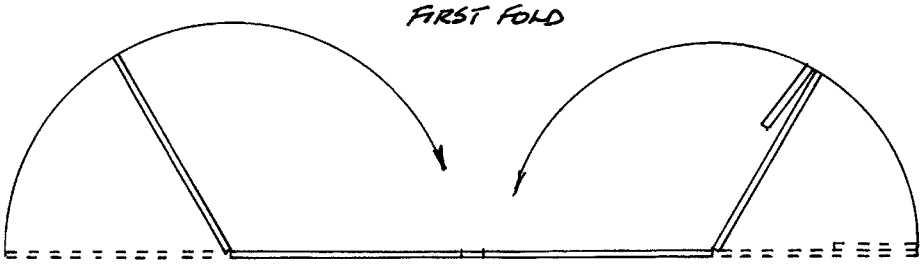
Always use enough hinges to keep the flats together and to prevent them from warp-

FOLDING FLATS DWG. 2-42



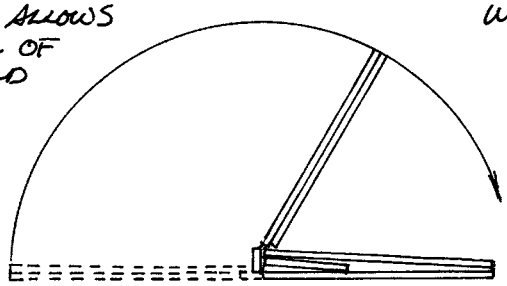
THE TUMBLER IN ACTION DWG. 2-43

FIRST FOLD



SECOND FOLD

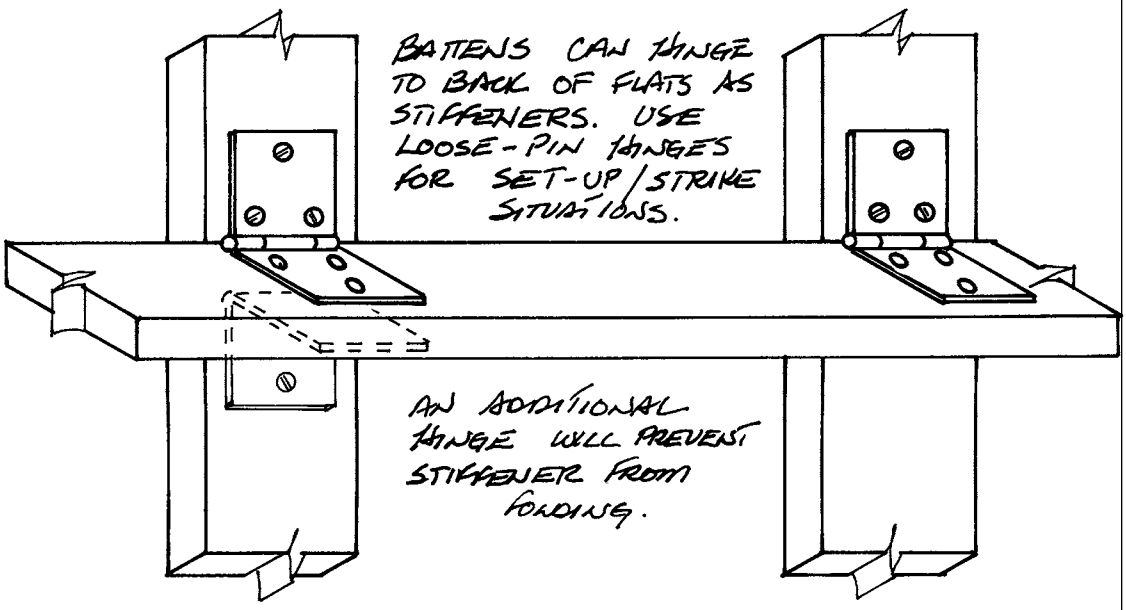
THE TUMBLER ALLOWS A LONG WALL OF FLATS TO FOLD COMPACTLY. THIS IS USEFUL FOR QUICK CHANGES & TOURING.

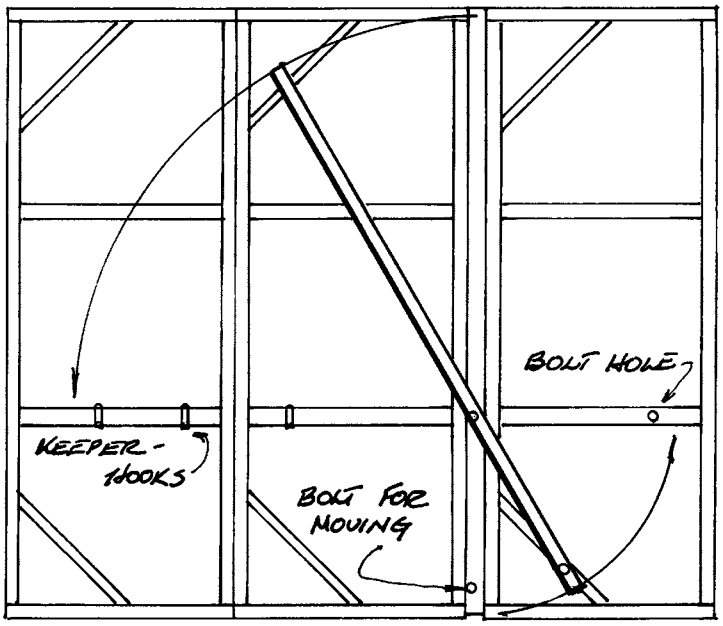


THIRD FOLD

WARNING: AN OLD, HEAVILY PAINTED FLAT CAN BECOME VERY HEAVY AND 4 OR 5 WEIGH A LOT! CAN IT BE MOVED? IN GOD WE TRUSS.

...AND MORE BATTENS DWG. 2-44





A "PERMANENT" BATTEN IS BOLTED ONTO TUMBLER. IT PIVOTS INTO KEEPER HOOKS AND IS FIXED WITH A BOLT.

ing away from each other. Usually, if hinges are placed about 6″ from the top and bottom rails, the ends of the flat are securely held and there is little chance of splitting the ends of the wood in the frame with the screws. Additional hinges on the stiles aligned to the toggles are usually sufficient. The toggles also distribute any stress throughout the frame. As a bonus, this automatically places all hinges in line with the others, which makes them less offensive if they show.

When two flats are hinged (usually on the face) and the unit folds together, it is called a two-fold. A three-fold contains three hinged flats, a four-fold, four, and so on. Remember that a 4′-0″ × 12′-0″ flat with several coats of paint can easily weigh 30-40 pounds. The total weight, if too great, can seriously hamper striking an easy-to-move wall section.

A two-fold unit of stock flats can always fold face-to-face if hinged properly. However, on three-folds and larger groupings, the flats can force a bind on the hinges when they try to fold together. To prevent this, a tumbler (sometimes called a wooden dutchman or jigger) is inserted between the flats to create an area for the thickness of the folded flats and to prevent binding (see Drawings 2-43 and 2-44).

A tumbler is a piece of 1× stock (usually 1 × 3) as wide as needed to clear the thickness of all the folded flats and to hold the flap of the hinge. It is inserted between the two flats where binding would occur. The tumbler is hinged with 2″ backflaps to each of the flats, using the same hinge placement as the regular folding pieces as much as possible.

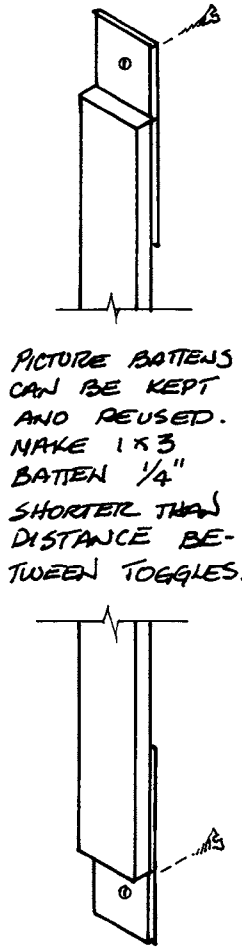
Important! Remember to make the tumbler ½″ shorter than the flats and to raise it that much from the floor. This prevents it from dragging when the folded flats are moved, which could split the tumbler and shudder the unit so much that the hinges could loosen. Remember also that the tumbler adds extra width to the wall of flats and that this difference will possibly need to be compensated for elsewhere.

PICTURE BATTENS

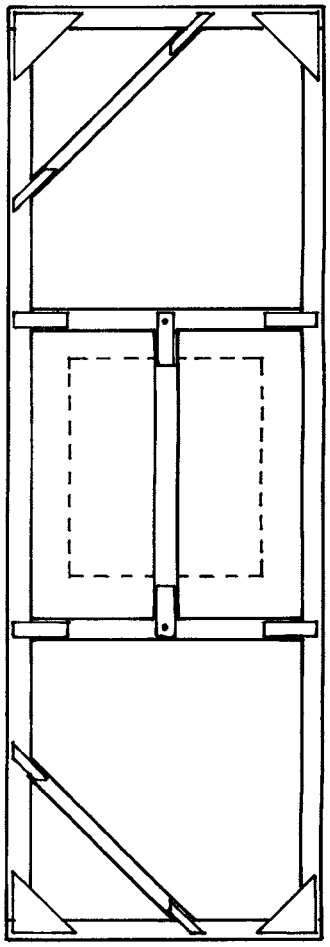
Picture battens (see Drawing 2-45) are necessary when an object needs to be attached to the front of a muslin-covered flat. It is a vertical piece which can be standardized because toggle placement is standardized. Simply slip it between the two toggles and screw it into place. It will not only hold the picture but support the bottom of it and keep it from denting into the flat.

If you are attaching anything which must be electrified (a sconce, clock, plug box, etc.) which must pass through the flat, make sure it passes through the picture batten also. This will hold the weight and prevent any tearing of the muslin. If possible, cut an × shape in the muslin and pass the cable or plug through to the back. If the muslin must have a large hole cut into it, tape the piece removed onto the back of the flat so it can be replaced after the production has completed its run (see Drawing 2-54 and related text for details).

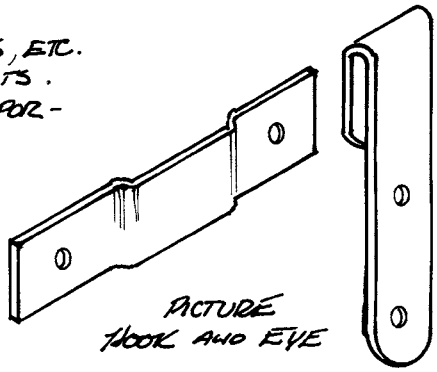
PICTURE BATTENS DWG. 2-45



PICTURE BATTENS CAN BE KEPT AND REUSED. MAKE 1×3 BATTEN 1/4" SHORTER THAN DISTANCE BETWEEN TOGGLES.



HEAVY PICTURES, WALL SCONCES, ETC. CAN BE A PROBLEM WITH FLATS. A PICTURE BATTEN WHICH TEMPORARILY SCREWS INTO TOGGLES WILL HOLD WEIGHT AND PREVENT BOTTOM FROM "DENTING" INTO FLAT. THE PICTURE HOOK MOUNTS TO OBJECT AND EYE SCREWS INTO PICTURE BATTEN.



PICTURE HOOK AND EYE

LASH HARDWARE

The principle of lashing flats is quite basic. It involves temporarily tying two flats together by crisscrossing a lightweight line around metal cleats and fixing the taut line in a knot (see Drawings 2-46, 47 and 48).

Placing lash hardware on a set of stock flats allows quick, easy makeup of wall areas to match a floor plan. It is also one of the fastest methods of striking one set and erecting another for a multi-set show. Lash hardware is, however, expensive. If cost is a problem, determine for each individual show whether or not lash hardware would be advantageous to use. However, whether or not the hardware is permanently placed on the stock flats (an ideal situation), it is an indispensable aid to the technical staff. A certain amount of each type of hardware should be stocked for those occasions when its use will more than pay for itself.

Usually a worker can throw a lash line and fix the two flats without assistance (see Drawing 2-49), although sometimes awkward or oversized flats require help. Lashing may seem an impossible task at first, but with a little practice the job becomes easy. To lash, align the two flats and hold them with your left hand. In your right hand take the lash line and pull it taut. Then quickly whip the line to the left with a flick of the wrist, releasing the tension on it so it can bow out and slip behind the top lash cleat. Almost immediately, as the line slips behind the cleat, pull it tight, and the line will drop behind the cleat and hold in place. Then whip the line behind the next cleat down and pull it tight. Repeat until you have passed the line behind each cleat. Now pass it around the tie-off cleat, continuing the crisscrossing, and pull the line tight with both hands. Place it around the second tie-off cleat and tie it off (see Drawing 2-47). A good lashing is done quickly and quietly (and after a lot of practice). If you're left-handed, I'm sorry.

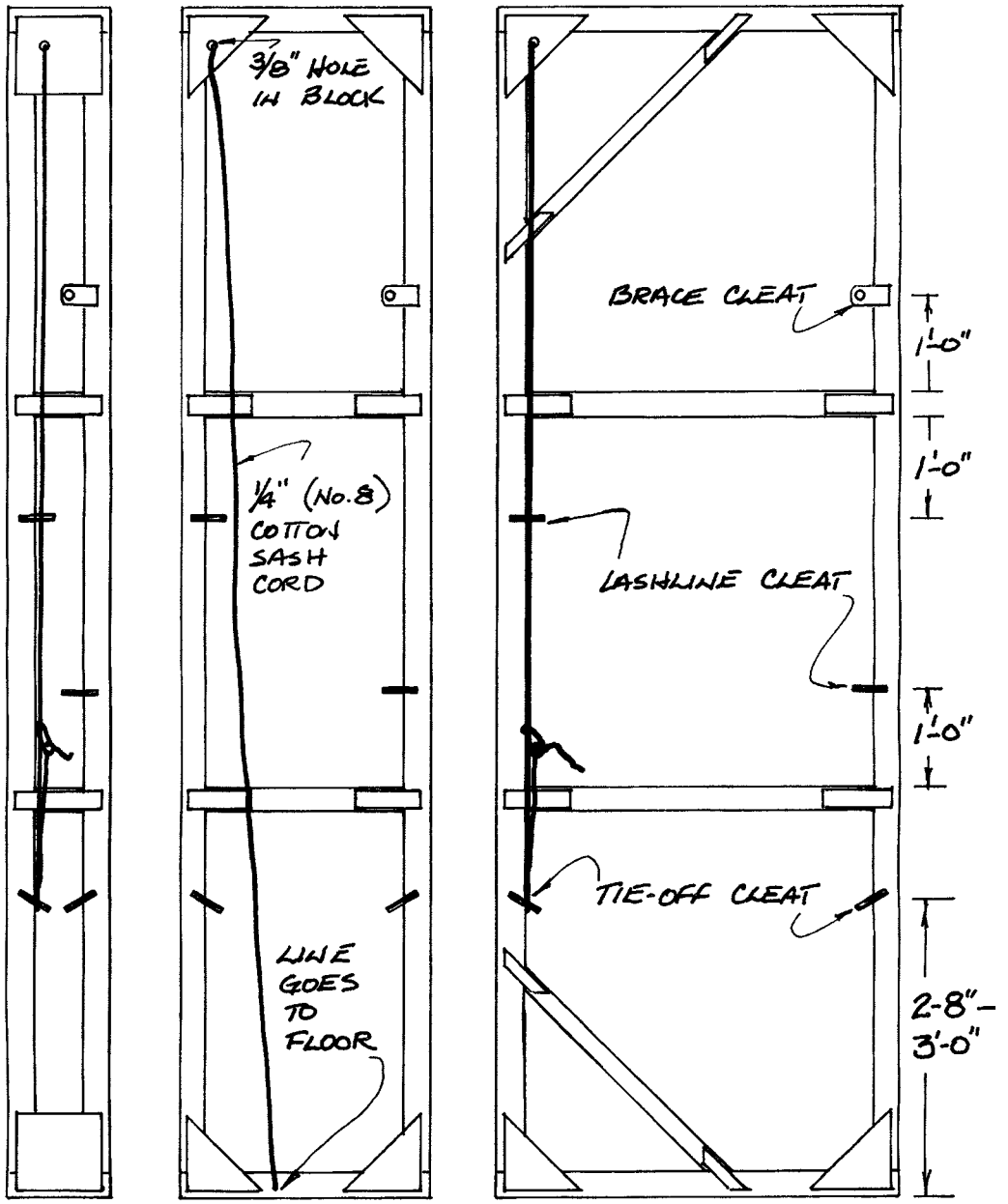
THE LASH LINE

The best lash line is ¼″ braided cotton rope (#8 sash cord). It can be purchased at any hardware store. The line is anchored at the top of the flat on the same side as the corner brace. This is important because the first throw of the line is the most difficult and the first lash cleat is opposite the starting point of the line, which would place it away from the corner brace and free of any additional obstructions which could hinder the throw.

The lash line is attached through the corner block. To make the hole for doing this, place a block of 1× stock under the corner block and drill a ⅜″ hole about 1″ from the butt of the stile and rail. The 1× stock block will prevent the plywood from splintering when the drill passes through it and also will protect the covering of the flat. After the hole is in, pass the line through it and pull the end out from behind the corner block. Tie a figure eight knot (see Drawing 2-51) and then pull the rope back to snug the knot behind the hole. In the event there is no corner block, a Wise eye cleat can be used (see Drawing 2-50).

The lash line should be pulled to the bottom of the flat and then cut off. It should never be longer than the flat, to prevent tripping on it when the flat is moved. If the line

LASH HARDWARE PLACEMENT DWG. 2-46



THE "FOOT ABOVE / FOOT BELOW" RULE WORKS WELL FOR ALL FLATS WHICH HAVE TWO OR MORE TOGGLES. FOR FLATS WITH ONE TOGGLE ADDITIONAL CLEATS ARE USED.

is shorter than the flat's length, it will be difficult (often impossible) to make the lash and have enough rope to tie it off.

CLEAT PLACEMENT

A good and workable rule is to place lash cleats 1′-0″ above and 1′-0″ below each toggle (see Drawing 2-46). Attaching the cleat with this pattern, starting with the first cleat opposite the corner brace and the next opposite it, etc., places the lash cleats between two and three feet apart. This makes a good solid lash (see Drawings 2-47 and 2-48). This rule would, of course, have to be adjusted if there is unusual toggle placement or none at all.

If you are placing lash hardware as a permanent part of your stock, you should exchange a stage brace cleat for the lash cleat which is about two-thirds of the way up the flat. This brace cleat allows any flat to be braced instantly with an adjustable stage brace without adding a cleat. The brace cleat is a workable substitute for the lash cleat and also saves money by not doubling up on hardware (see Drawing 2-48). Make sure that the lash cleats work down the flat on alternate stiles. Once the pattern is established, the placement becomes stock in order to interchange flats and still make the lash. Do not allow variations without a specific reason.

The tie-off cleats are placed on each stile of each flat. They are the same height. They should be at a height which is conducive to tying the knot; 3′-0″ from the floor is a good height. However, if short people will be using the stock, you could drop to 2′-8″, but no lower or the lash line runs out before the knot can be tied.

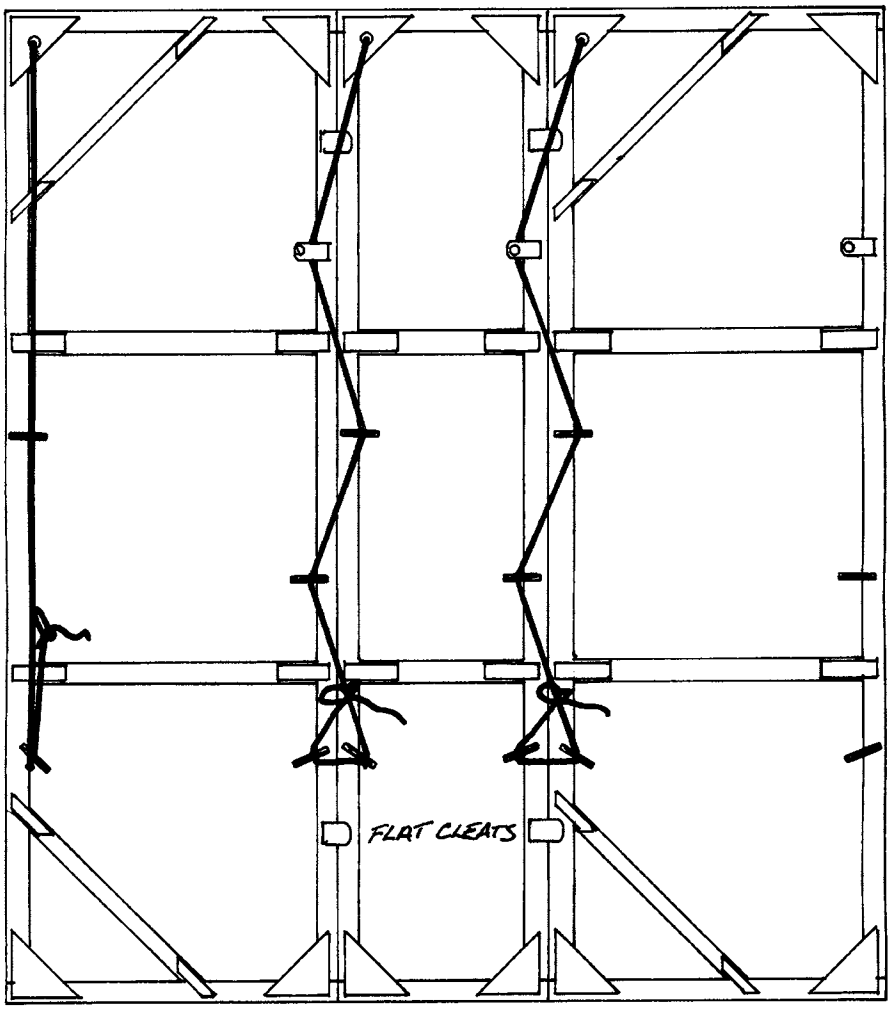
Hammering large nails (or driving screws) into the inside edge of the stiles to make inexpensive lash hardware is a poor practice. The muslin is constantly bruised when the line is passed around the nail, but a bigger problem is the tendency for the frame to self-destruct when lashed. The nails and screws often split the stiles because of tension from the lash. This occurrence is not economically sound. The extra dollars for the lash hardware are better spent here than for other purposes. It is also expensive to rebuild flats constantly.

Regardless of whether or not you plan to place lash hardware on your stock, make sure that all corner braces are on the same stile and all toggles are at the same height within your chosen size of stock, because they are also used for other types of fastening.

TYPES OF LASH HARDWARE (SEE DRAWING 2-50)

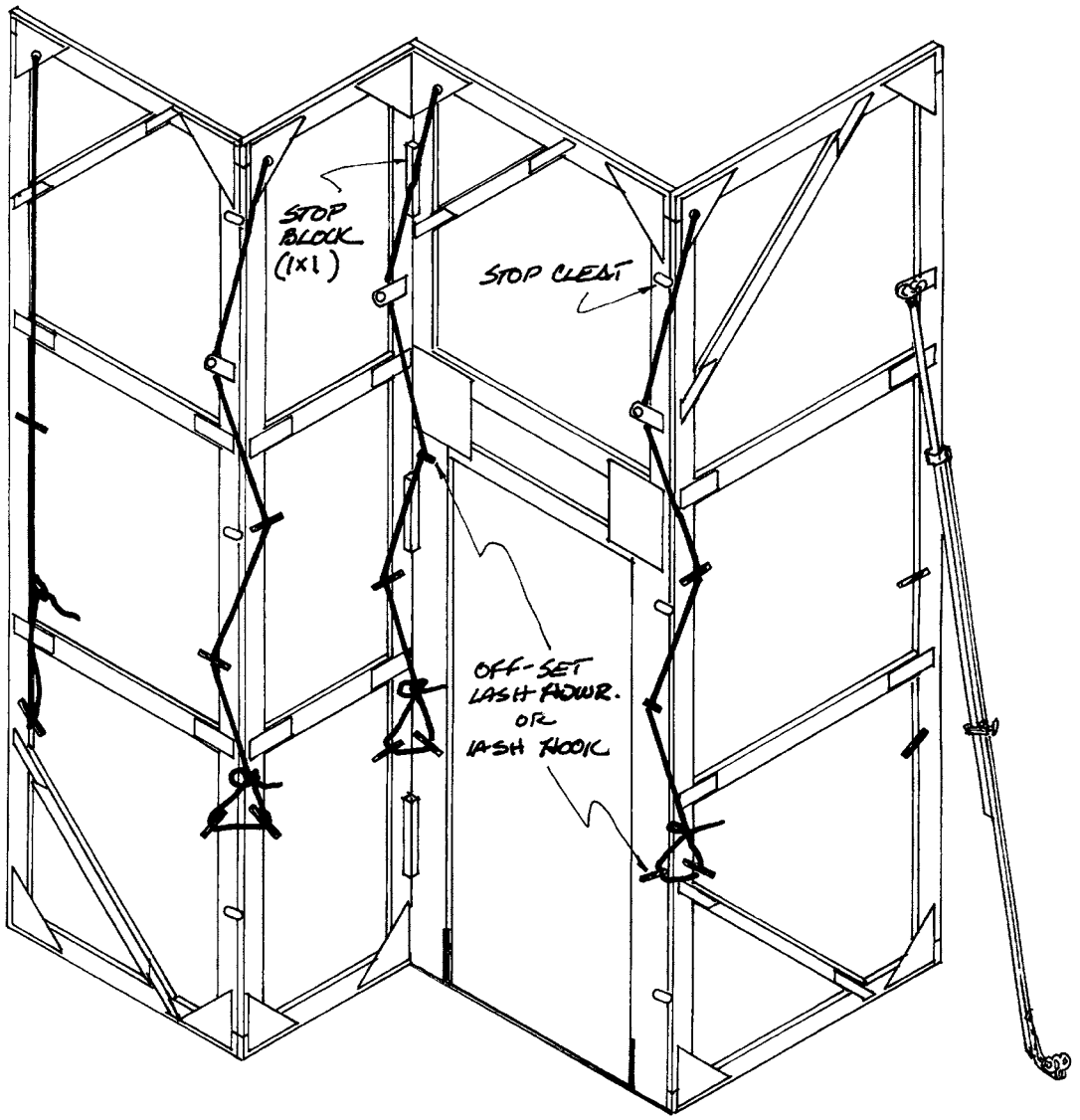
A *Wise Lash Line Eye Cleat* is more expensive than a hole in the corner block. To attach the Wise cleat to the stile, lay it on the inside edge, and with a hammer drive the chisel-pointed extension into the edge of the stile, and then screw it down to the face with a ¾″ #8 or #9 screw. While this cleat can be difficult to find these days, it is indespensible when there is no corner block which can anchor the lash line, most commonly when a short piece of scenery is lashed to a taller one. It is not advisable to nail the lash line to the stile because the wood may split and weaken the frame. The lash line is attached by

A WALL OF LASHED FLATS DWG. 2-47



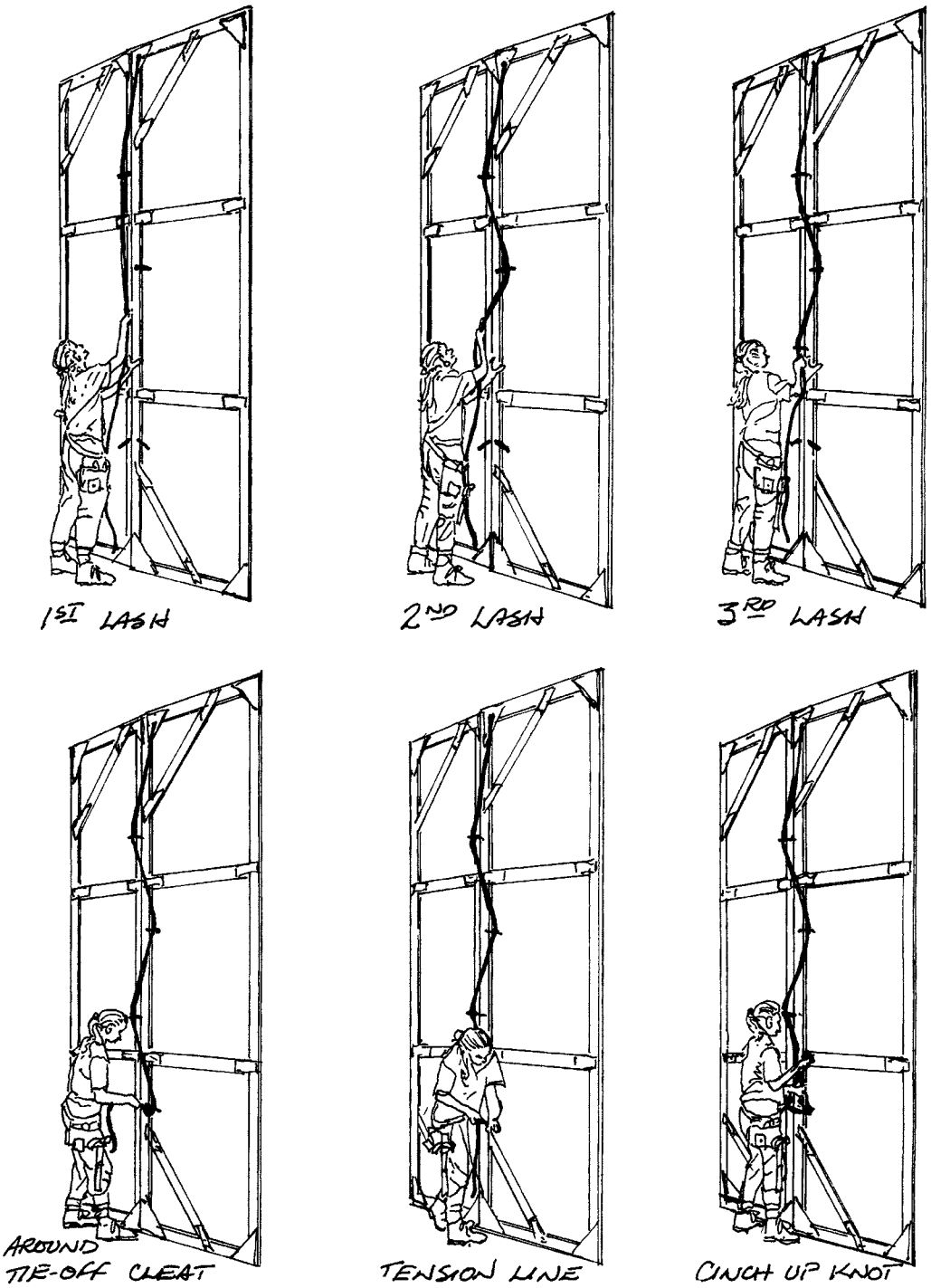
ONCE THE FLATS ARE LASHED TOGETHER, THEY NEED A BATTEN ON EACH TOGGLE. THESE MAY BE HELD IN PLACE WITH KEEPER HOOKS. NOTE THE FLAT CLEATS WHICH HELP PREVENT THE FLATS FROM SLIPPING. OF COURSE, IT IS MUCH EASIER TO SIMPLY SCREW BATTENS OR HOG TROUGHS TO THE TOGGLES OR RAILS, BUT LASHING WORKS WELL FOR QUICK CHANGES.

INSIDE AND OUTSIDE LASHES DWG. 2-48



AN OUTSIDE LASH CAN BE DONE WITHOUT STOP CLEATS BUT THEY DO HELP HOLD THE CORNER FIRM. THE STOP BLOCKS ARE NECESSARY FOR AN INSIDE LASH BECAUSE THE FLAT TENDS TO RIDE OVER THE CORNER BLOCKS. NOTE: THE WIDE STILE OF THE DOOR REQUIRES SPECIAL LASH HARDWARE.

THROWING THE LASH LINE DWG. 2-49



passing it through the eye and tying a figure-eight knot in the end (see Drawing 2-51).

The *Lash Line Cleat* is the least expensive of all lash cleats and also the least sophisticated. The cleat sits on the back face of the stile and is screwed down with four ¾″ #8 or #9 screws. Make sure it is at least flat stock thickness (¾″) from the outside edge, so it won't interfere with another flat abutting . This cleat tends to fray the lash line and is not a good permanent installation.

The *Improved Lash Line Cleat* is just that; it will not fray the rope because its edges are rounded, although it can stick up and possibly scar other flats in storage. It is applied in the same manner as the unimproved lash line cleat but is more expensive.

The *Wise Lash Line Cleat* is perhaps the best and, of course, the most expensive cleat. Place it on the inside edge of the stile and pound with a hammer until the chiseled point underneath is driven into the stile. Then screw one ¾″ #8 or #9 screw into the countersunk hole. It is the fastest lash cleat to install, and it is easiest to whip the lash line around. This lash cleat is quite strong and secure.

The *Round Lash Line Cleat* is a good buy. It can be attached to the flat with ¾″ #8 or #9 screws. It can be used for lash cleats, and, if slanted downward at 30 degrees, it makes an excellent tie-off cleat (see Drawing 2-51). There is the added advantage of having to stock only one item for both jobs. It is available in two lengths, but the longer cleat is generally more useful.

The *Offset Round Lash Line Cleat* is used when there is no flat frame to allow the lash line to pass behind the cleat. This is most commonly used with jogs made of 1× stock and with stiles on some door flats or on certain window flats (see Drawing 2-48).

The *Towel Lash Line Hook* is designed to be screwed into the edge of the stile and become a tie-off cleat. It can also be used in some situations where the offset round lash line cleat (above) is used, but it is difficult to throw the line around the hook. The hook will snag on other flats if mounted on the face of the stiles, because it does protrude.

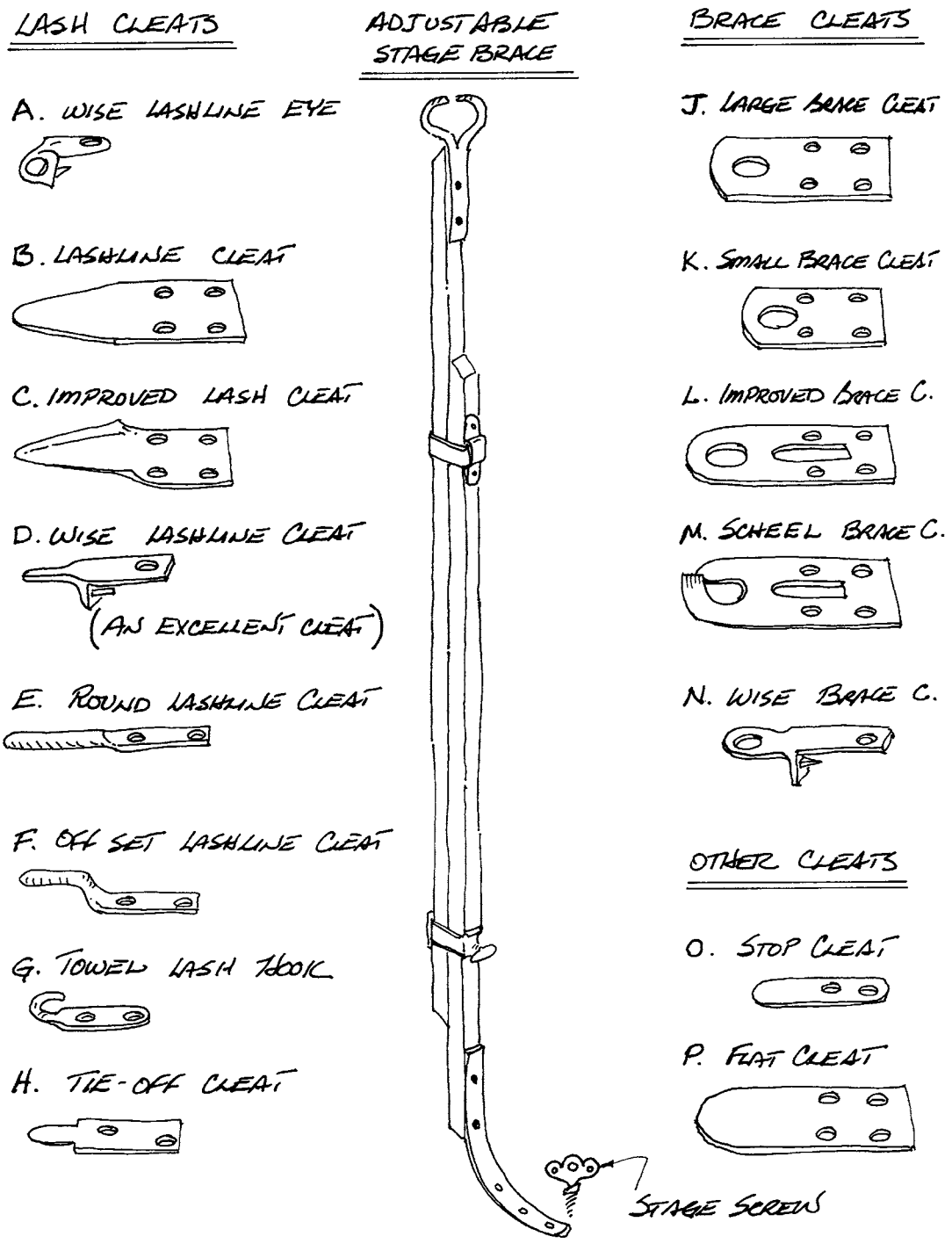
The *Tie-off Cleat* is placed on the back face of the stile. It faces inward and is matched on the opposite stile. It is screwed down with two ¾″ #8 or #9 screws.

It is possible to make all your own hardware from ¼″ × ¾″ sill iron. Cut the iron into 4″ pieces and round off all edges on a bench grinder. Drill two 3⁄16″ holes about 1″ apart near one end and countersink them for a #8 or #9 screw. Mount the hardware on the stile for lash cleats and tie-off cleats. However, unless you have a great deal of time and energy, it is not practical to construct your own hardware because commercially manufactured hardware is usually superior to homemade.

The brace cleats in Drawing 2-50, J, K, L, and M are all basically the same.

The *Scheel Brace Cleat* (M) is the best and well worth the extra money. It allows the stage brace hook to easily slip into the hole and then lock the other hook into the slot. Attach this cleat (and the others) to the back of the stile with ¾″ #8 or #9 screws. Make sure all cleats are set back stock thickness (¾″) from the outside of the stile to allow one flat to butt smoothly against another.

The *Wise Brace Cleat* is driven into the edge of the stile like other Wise cleats. Unlike


LASH CLEATS
A. WISE LASHLINE EYE
B. LASHLINE CLEAT
C. IMPROVED LASH CLEAT
D. WISE LASHLINE CLEAT
(AN EXCELLENT CLEAT)
E. ROUND LASHLINE CLEAT
F. OFF SET LASHLINE CLEAT
G. TOWEL LASH HOOK
H. TIE-OFF CLEAT
ADJUSTABLE STAGE BRACE
STAGE SCREW
BRACE CLEATS
J. LARGE BRACE CLEAT
K. SMALL BRACE CLEAT
L. IMPROVED BRACE C.
M. SCHEEL BRACE C.
N. WISE BRACE C.
OTHER CLEATS
O. STOP CLEAT
P. FLAT CLEAT

the other Wise cleats, the brace cleat does not seem to be superior to its competitors' products.

The *Stop Cleat* is screwed to the back of a flat with the rounded edge extending past the flat approximately ¾". It acts as a stop for another flat which will butt up against it (see Drawing 2-48). To prevent a potential snagging problem, the stop cleats should be removed when the show is struck and the flat is put back into storage.

The *Flat Cleat* is used when nothing else is available or nothing else will do. It is useful to help temporarily hold step units to platforms. Stop cleats will usually do the job, and it is not necessary to own a single flat cleat.

Stop Blocks (see Drawing 2-48) are made in the shop of 1 × 1 stock. They are usually about 1'-0" long and are temporarily screwed to a flat to prevent it from slipping when butted with another. There is no reason why these blocks can't be saved and reused like other hardware.

NAILING FLATS

The 6d duplex nail seems excellent for temporarily attaching flats in a rigid position. However, constant use of these nails (or any nails) will eventually weaken the wood. Try to use nails only when essential and not as a quick solution which could be better handled with screws, hinges, or lash hardware. The flat frames will last longer and remain stronger without nails.

FRENCH FLATS

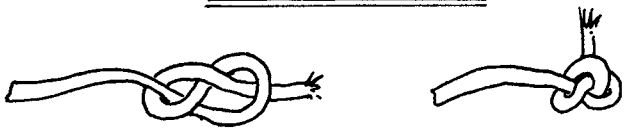
French flats are a battened wall of flats that fly in and out. Why "French"? I have no idea, except perhaps like a French scene, they indicate some change. Drawing 2-52 shows a group of flats. For clarity, the battens across the rails and toggles are not drawn. Note the unit is lifted from the bottom and not pulled from the top. This greatly reduces the stress and strain within the frames and avoids the guillotine effect (do you suppose that's why they're French?). Some of the many pieces of hardware available from any good theatrical supply house are shown in Drawing 2-53.

FLYING SCENERY

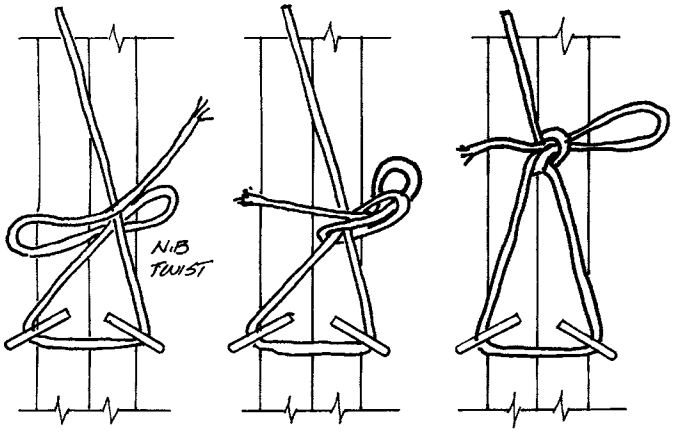
Just in the time since this book was first published, 1990, rigging scenery to fly has changed dramatically. Most of the change was dictated by changes in the scenic elements being flown. Flown scenery originally consisted of muslin drops and wooden battens. We have evolved today to a theatrical environment where almost everything gets hauled up overhead—chandeliers, cars, people, articulating scenery—all of which weigh considerably more than a cut drop with scenery netting. Consequently, the rules have changed. In today's scenic environment, flying scenery requires specialized training, equipment, and tools, all of which are beyond the scope of this book. Other books, such as *Stage Rigging Handbook* by Jay Glerum, are essential additions to your bookshelf if you intend to fly scenery successfully and safely.

FIGURE 8 KNOT

USE IN THE TOP END OF THE LASH LINE TO HOLD ROPE BEHIND 3/8" HOLE IN CORNER BLOCK OR IN LASH EYE.



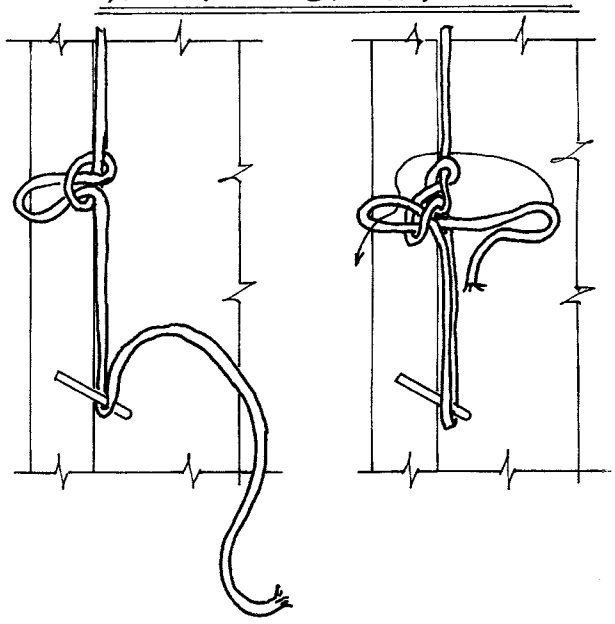
TIE-OFF KNOT



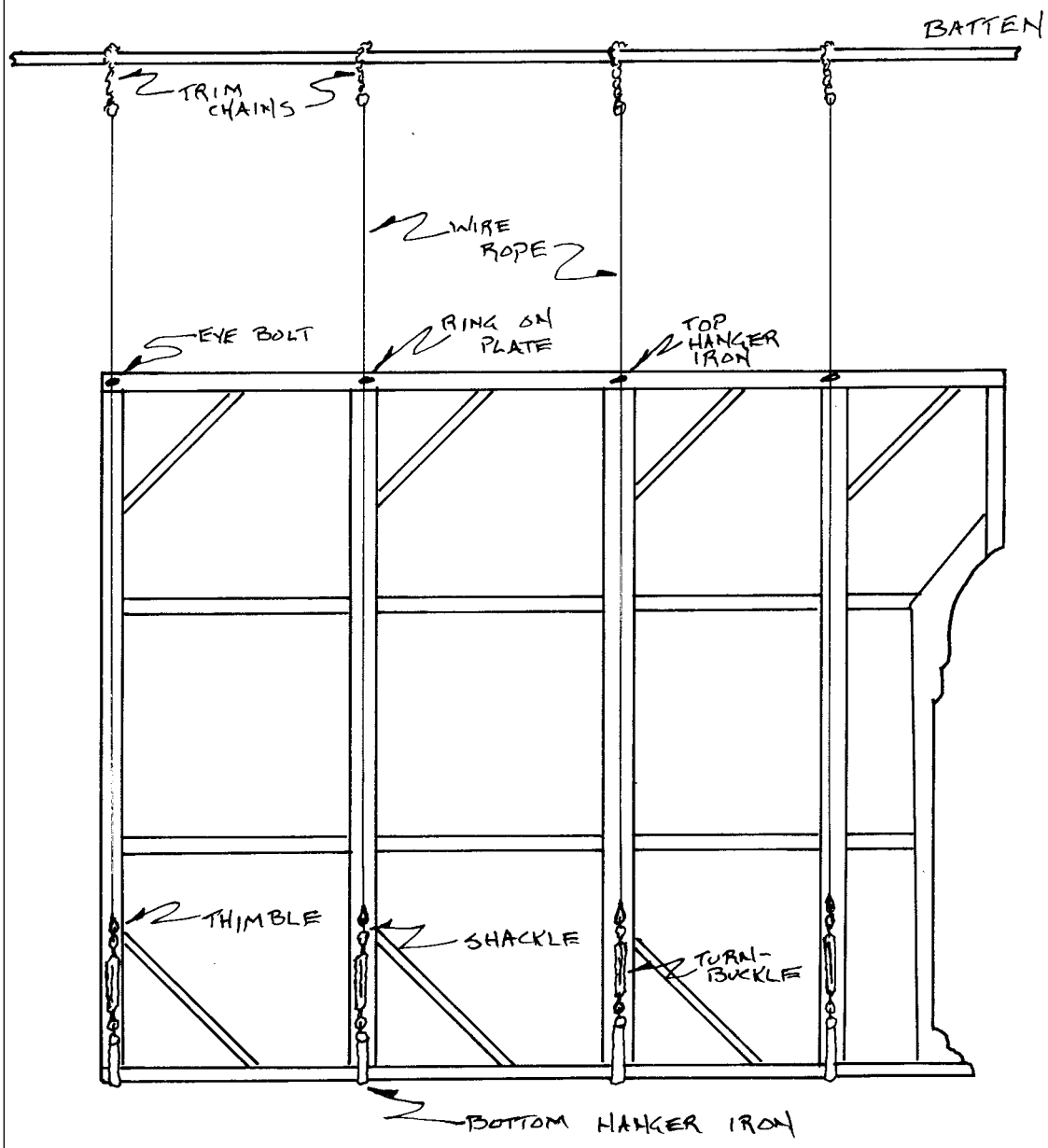
THIS KNOT WILL GIVE GREAT TENSION ON THE LASH LINE BUT WHEN THE END IS PULLED WILL QUICKLY AND COMPLETELY UNTIE. NOTE TWIST IN FIRST LOOP.

LASH LINE STORAGE KNOT

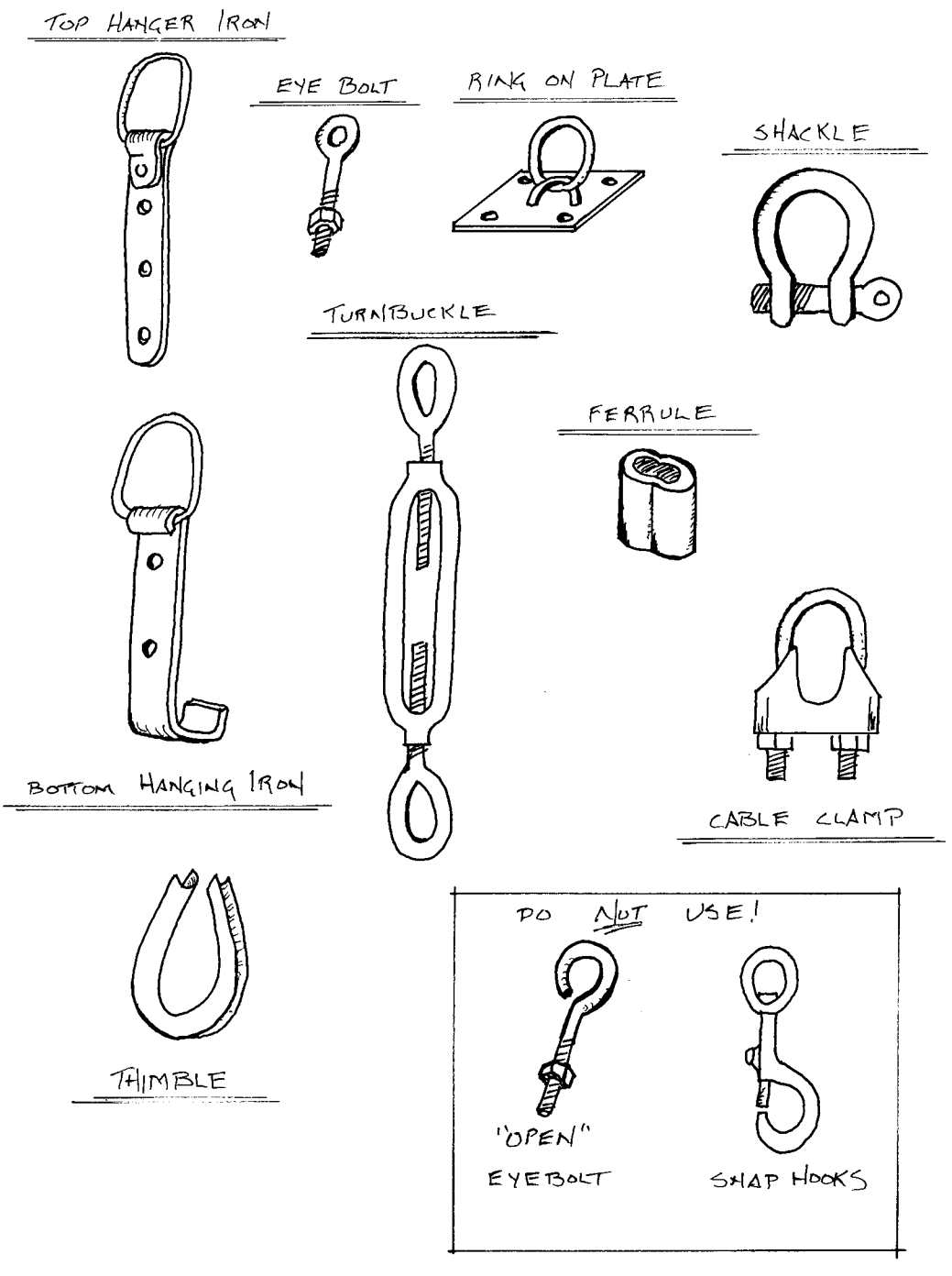
THIS KEEPS THE LOOSE LASH LINE AT WAIST HEIGHT AND OFF THE FLOOR OR FROM FANING ABOUT. IT COMPLETELY UNTIES WHEN PULLED.



FRENCH FLATS DWG. 2-52



SOME HARDWARE USED IN FLYING DWG. 2-53



DUTCHMEN

A dutchman is the cloth strip which is affixed over a crack or cracks created when two flats or flats and a tumbler are joined (see Drawing 2-54). It is as wide as the distance between the outside edges of the two stiles. This is usually 6″, but with a 1 × 3 tumbler it would be 9″. The stiles can be useful guides to make sure the dutchman is running straight on the flats.

Dutchmen are usually made by tearing strips from the muslin left over when covering flats, but new muslin can, of course, be used. Always remove the selvage; it shrinks differently and leaves a visible line. Roll each dutchman for storage. It is also easier to remove the stray strings when dutchmen are rolled.

It is efficient to use the primer or base coat paint to attach a dutchman. Never glue a dutchman unless it is to be permanent. There is sufficient binder in the paint to hold dutchmen, even for most touring situations.

To apply the dutchman, start at the top of the flat and paint a wide stripe covering the stiles from the top down as far as is easily reached. Let the dutchman unroll, and paint the back of it the same distance. Place the two painted surfaces together. Make sure the dutchman does not extend over the top of the flats or it risks being pulled off if the flats are folded or if it snags on something. Recharge the brush, and paint the top of the dutchman. Before continuing be sure to brush away from the center of the dutchman to help blend the fringes or frayed edge into the flat.

Now, lift the remaining part of the dutchman up over the painted part and paint the back of it. Paint another stripe on the flat, and put the two painted surfaces together. Again, paint over the top and brush the fringe away from the center. Continue down the flat until the dutchman is completed. The dutchman should stop about an inch from the floor. If it is longer, cut it off with a pair of scissors. Do not use a utility knife or the like because the blade might snag in the wet cloth and pull the freshly applied dutchman from the flat. Always trim dutchmen immediately, however, so you don't catch the loose tail with the ladder and unleash the expletives. Do not disturb the flats—don't move them or even slide them about—until the dutchman is completely dry. If necessary, by using similar methods, dutchmen can be put on flats which are lying on the floor (see Drawing 2-55). Simply walk on the stiles or place a board across the flats to support your weight. You can use a roller to cover the stiles and back of the dutchman. With help, lift, turn over the painted dutchman, and lay it over the stiles. Roll over the top to paint it down. A brush in a bamboo (see Drawing 8-5) can also make quick work of a dutchman on horizontal flats.

New or raw muslin flats need a new or raw dutchman. Old flats need a well-used dutchman. This is a subtle clue to save dutchmen when striking a show. Dutchmen can be carefully removed and rolled for reuse. The dutchmen should be pried from the flat at one end and pulled from the flats as close to the surface as possible (see Drawing 2-55). This lessens the chance of pulling up the muslin covering.

On raw muslin dutchmen, a second coat of paint is usually needed after they have

dried. This is a primer which will help it blend into the flat surface when the whole unit receives its base coat. A well-applied and primed dutchman is virtually invisible when the flats are painted.

Where, you may ask, does the word "dutchman" come from? After exhaustive research, I answer, "Beats me." Dutch has had a meaning of being fake or cheap, which certainly could never apply to anything theatrical, and a "Dutchman" is a stick which is placed between the outer logs of a load to keep the inner logs from rolling off. (A tumbler is sometimes called a wooden dutchman.) I have been told by an old stagehand that the dutchman was named after the patches on the pants of poverty-ridden scene painters, most of whom were Dutch. I find but faint credence in the story.

Probably an acceptable etymological explanation comes from an older meaning of "dutchman," which was a contrivance to hide or counteract defective work (as an odd piece inserted to fill an opening or a paste mixture to fill cracks in marble).

PATCHING FLATS

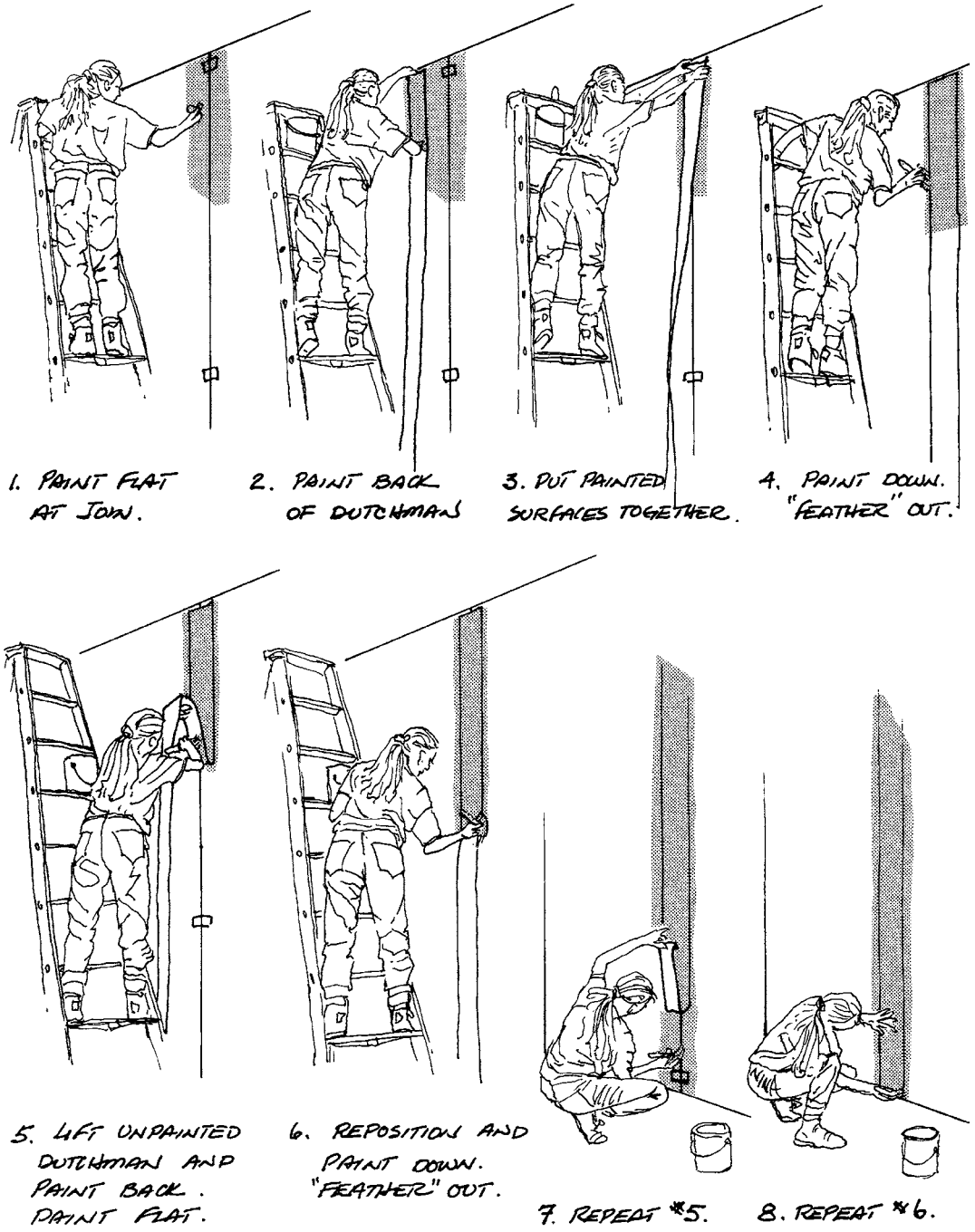
The goal in patching a flat is to leave the surface with no trace of the wound. The most common damage seems to be a tear which occurs when the flat falls on a sharp object or a sharp edge runs through the surface. This not only separates the cloth but also stretches it. Have someone behind the flat hold a board to the back or lay the flat face up with a board the correct thickness to keep the surface on the same plane as the face of the frame. Push the damaged muslin back into place. Secure the tear with masking tape, trying to mesh the fringes of the rip. Once taped smooth, move the board to the front and glue the patch on the back. The patch should be about the same age as the flat. This age refers to the number of coats of paint, etc. on the muslin. Old flats or dutchmen may be a good source for the patch. Cut the patch bigger than the tear and round the edges to prevent curling. Put glue on the patch and press it against the flat. The board in front will prevent undue stretching. Smooth out any wrinkles and excess glue. Let it dry thoroughly. If any stretch or sag is left, spritz the back with hot water. It should re-activate the sizing and shrink tight. Remove the tape when the patch is completely dry.

Holes which need mending can have a plug of muslin, roughly the same age as the flat, inserted in the hole and then be repaired as described above. It is always wise to save the cloth removed when the hole is cut. Tape it to the back of the flat until repair time. Emergency repairs can be done by holding a board to the front and taping the back. Make sure, however, this temporary patch is replaced with a properly glued one before the next paint job.

HARDWALL SCENERY

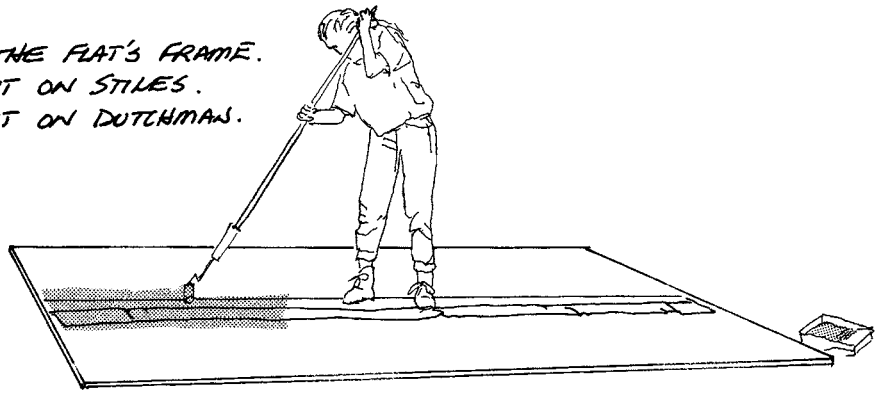
If you are planning a hardwall stock for theatre or television, follow the rules discussed for flats. These may help determine some of the limitations. What is seen on television is

PAINTING ON A DUTCHMAN – 1 DWG. 2-54

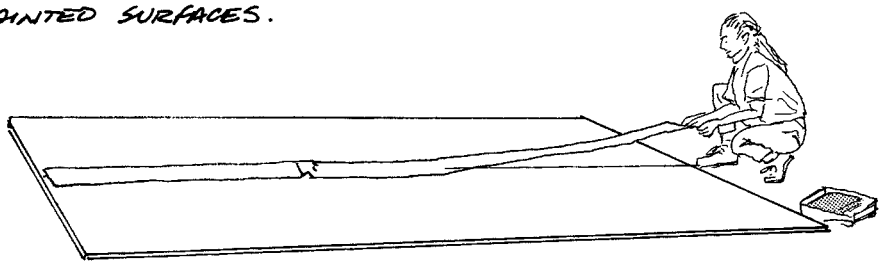


PAINTING ON A DUTCHMAN – 2 DWG. 2-55

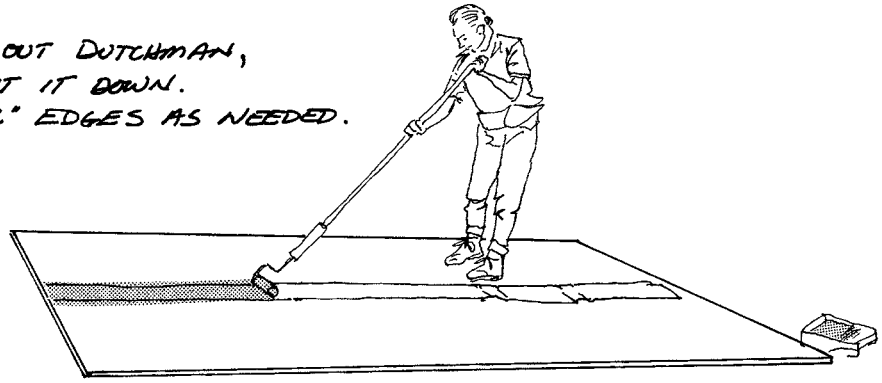
1. WALK ON THE FLAT'S FRAME.
   ROLL PAINT ON STILES.
   ROLL PAINT ON DUTCHMAN.



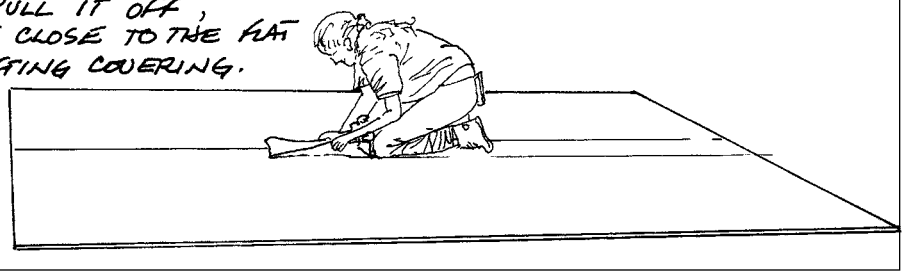
2. FLIP DUTCHMAN OVER AND
   ALIGN PAINTED SURFACES.



3. SMOOTH OUT DUTCHMAN,
   AND PAINT IT DOWN.
   "FEATHER" EDGES AS NEEDED.



TO REMOVE A DUTCHMAN,
CAREFULLY PULL IT OFF,
KEEPING IT CLOSE TO THE FLAT
TO AVOID LIFTING COVERING.



limited by the eye of the camera, not to mention the person who is using it. The camera can control visual height, but beware of the old rule of 8′-0″ being enough for television scenery. It really limits the types of shots available; 10′-0″ is a better minimum height for most situations.

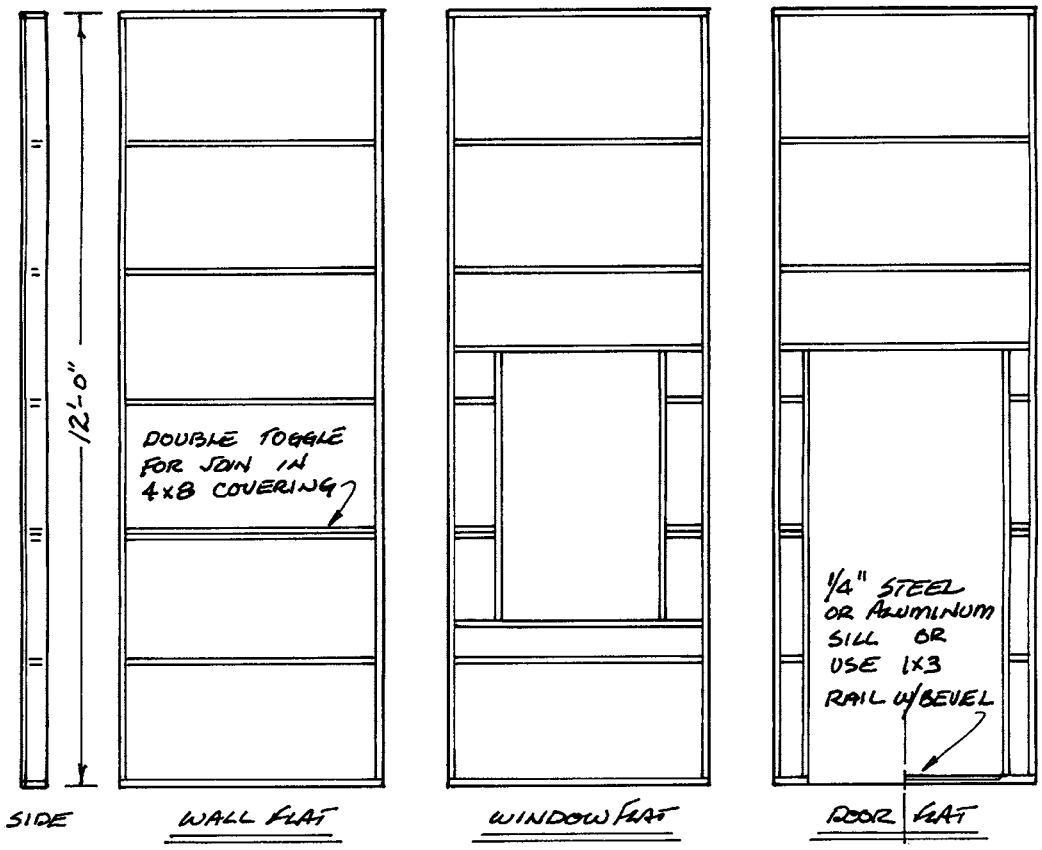
Construction techniques are variations on standard flat frame methods. The frame is merely on-edge and not flat (see Drawings 2-56 and 2-57). Notice that the toggles can be narrower and allow scenery with moldings on the face to stack tightly and safely (see Drawing 2-60). This is also handy for permanent pictures and dressings and is especially good in situations where studio space is limited and many shows must be set up and struck.

Many covering materials are available on the market other than the popular ¼″ plywood. Some which come to mind are ⅛″ veneer, textured hardboard panels (brick, plaster, etc.), hardboard panels or other veneer types with wood finishes, Upsonite paperboard, and thin particle board. It is also good to scrim the hardwall by gluing muslin over the plywood, which hides the wood grain. Hardwall flats are ideal to accept textures, wallpaper, and other realistic treatments.

When hardwall units are designed wider than covering materials (4′-0″), many shops build them using methods common to house construction. Of course the 2 × 4 stud is replaced by a more svelte 1 × 3, and the drywall used throughout houses is banned in favor of much lighter materials. As seen in Drawing 2-58, the top and bottom rails are still separated by stiles. The addition of vertical studs are derived from the construction trades. While uprights are certainly not required on 2′-0″ centers, the additional studs do give good support to a wall unit. The horizontal toggles must be staggered to attach easily—again a technique found in house construction. The common use of pneumatic staplers has evolved a method for toggle attachment which allows continuous alignment. The toggle is placed face to face against the stud and stapled through into the upright. It is then pulled down and wedged against the next vertical. The flexibility of the wire staple acts as a hinge. The other end is stapled through the next stud or stile. While this is certainly not structurally the strongest joint, it does do the job, i.e., keeps the verticals the prescribed distance, and it gives additional support to the covering material. There is little chance of the bent-staple joint pulling apart, because the covering material is applied over the joint. A bit of care and practice can make an acceptable joint with no shiners from the staples.

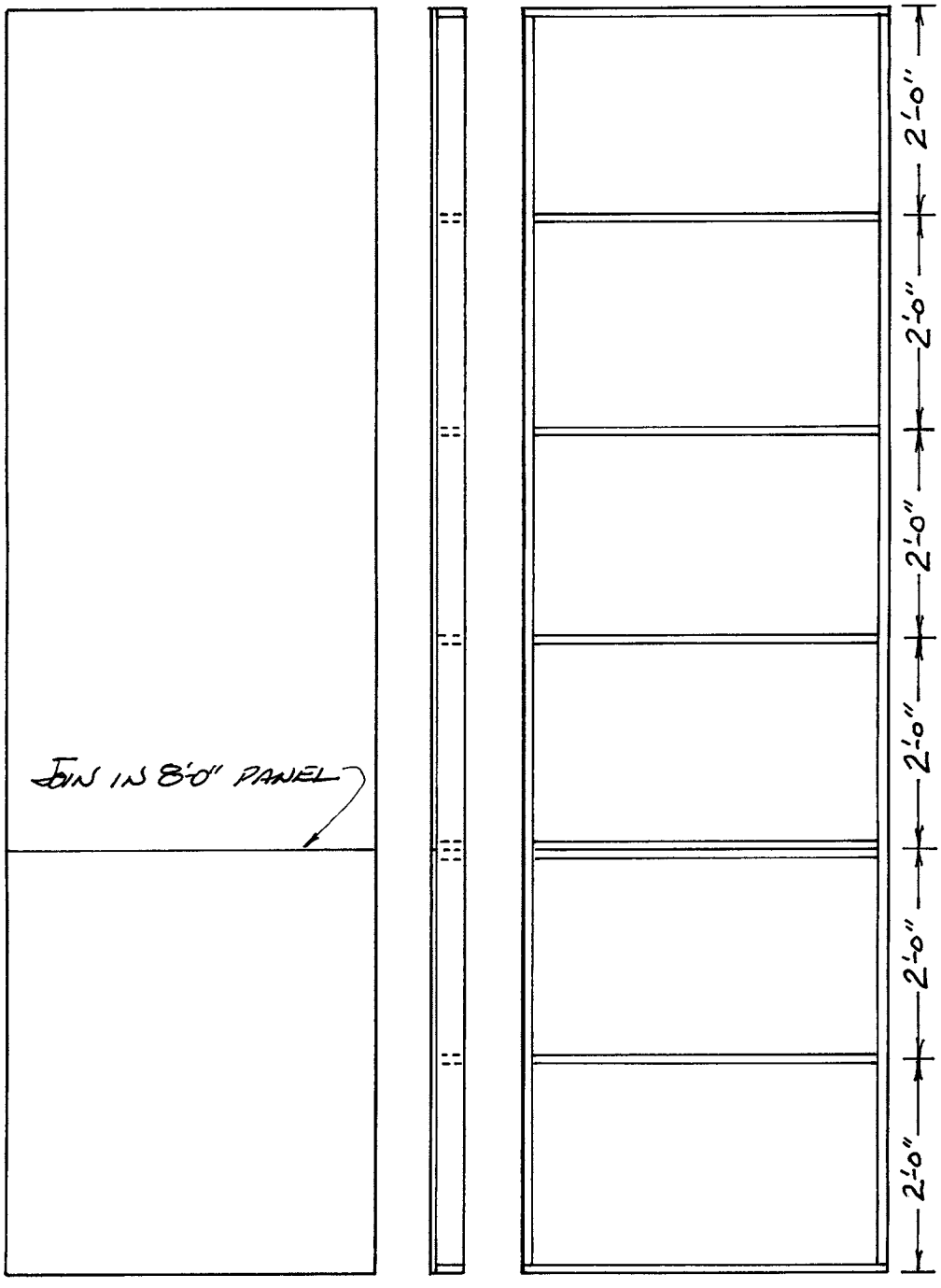
Hardwall flats which have unusual openings (see Drawing 2-58) can be made easily by inserting matched ¾″ plywood pieces (or 1× stock if it works) flush to the front and back of the frame, with the desired shape cut out of them. Connect these pieces with a narrow plywood or veneer strip. Glue and attach the facing material to the frame. Using a router with a self-plunging piloted panel bit, drop through the covering within the opening, and the bit will guide the router around the faced edge. It will neatly trim the covering material flush to the facing material.

Hardwall lends itself to curved surfaces (see Drawing 1-59) which are either convex

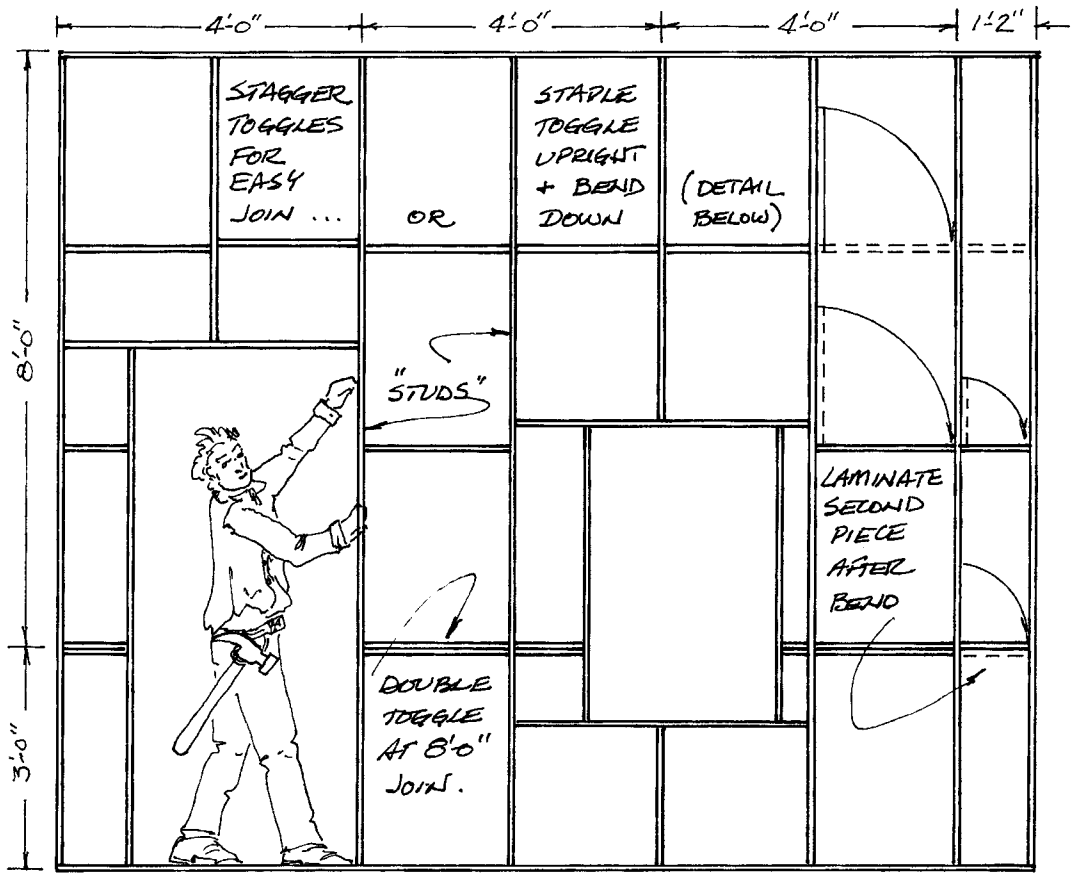


HARDWALL SCENERY, ONCE THE BUTTRESSED BACKING OF FILM AND TELEVISION, IS BECOMING INCREASINGLY POPULAR IN THEATRE. IT IS DURABLE, STABLE AND OFFERS AN EXCELLENT SURFACE FOR HEAVY TEXTURES, WALL PAPER, MOULDINGS, ETC. HARDWALL, HOWEVER, IS MORE EXPENSIVE THAN CONVENTIONAL FLATS, HEAVIER, BULKIER TO STORE AND INSIDIOUSLY MARRIED TO THE 4x8 SHEET OF CONSTRUCTION PANEL.

TYPICAL HARDWALL FLAT — DWG. 2-57

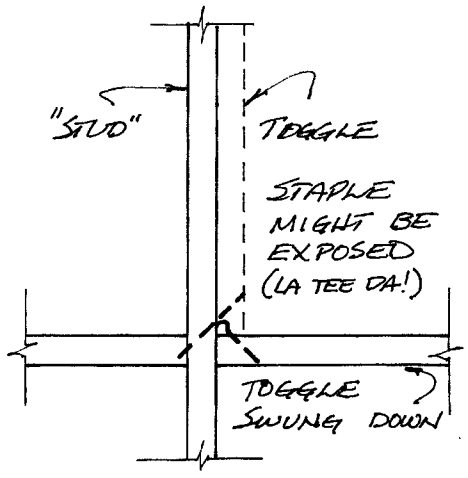


THE FRONT, SIDE AND BACK OF A 3'-6"x12'-0" FLAT.

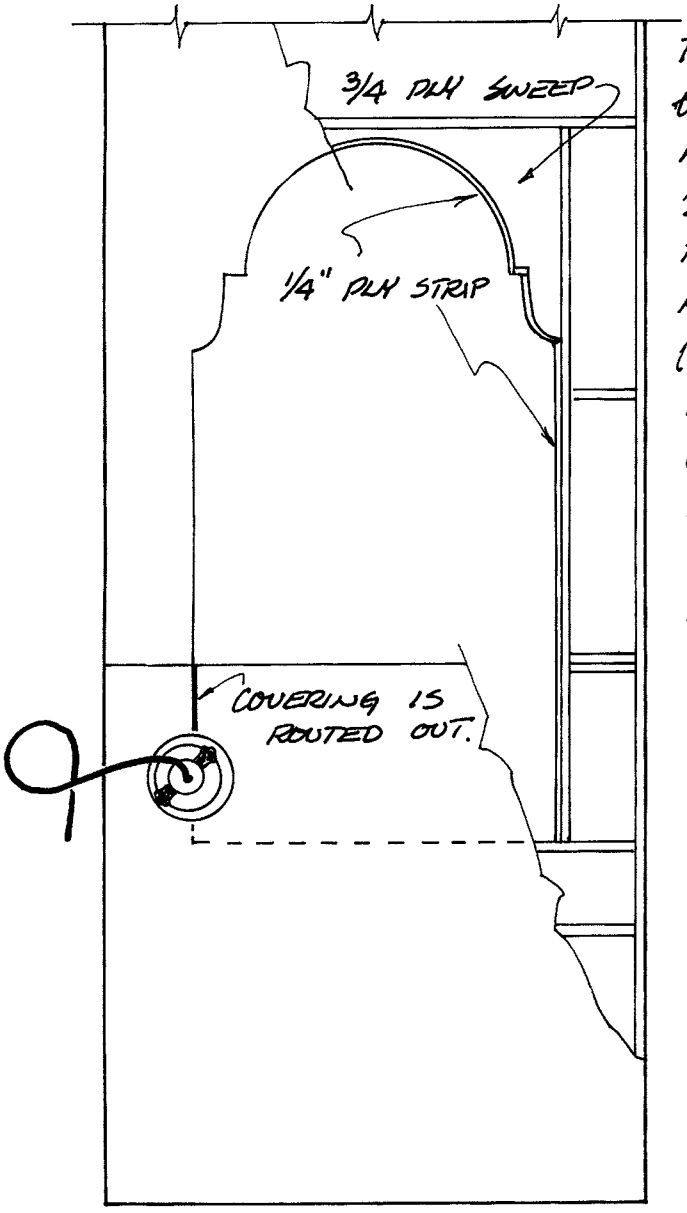


A 13'-2" x 11'-0" "STUD" WALL WITH FRAMED-IN OPENINGS

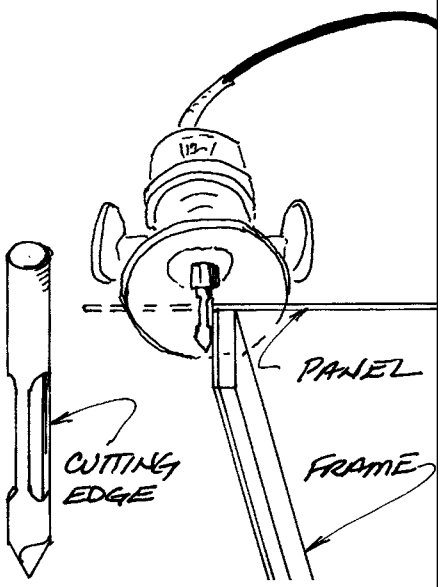
HARDWALL UNITS WIDER THAN 4x8 SHEET STOCK MAY BE CONSTRUCTED AS ABOVE. NOTE 2'-8" SPACING ON UPPER TOGGLES TO LESSEN TOP WEIGHT. "STUDS" ARE SPACED EVERY 2'-0" TO ALIGN WITH COVERING MATERIAL. ADJUST TO SUIT WHIM OF DESIGNER OR OTHER PERVERSITY.



HARDWALLS WITH UNUSUAL OPENINGS DWG. 2-59



HARDWALL FLATS WITH UNUSUAL OPENINGS ARE MADE W/A 3/4" PLYWOOD 'SWEEP' FRONT AND BACK. THEIR EDGES ARE CONNECTED W/1/4" PLY (WHICH CAN EXTEND DOWN SIDES). AFTER COVERING UNIT W/PANEL THE OPENING IS ROUTED OUT. THIS LEAVES A SMOOTH INSIDE EDGE.



A SELF-PLUNGING PILOTED PANEL BIT (WITH CARBIDE CUTTING EDGE) IS GUIDED ON FRAME AND TRIMS THE PANEL.

or concave. The success of any curved surface depends greatly on the covering material and the number of people available to help bend the flat sheet to the frame.

Hardwall flats are not quite as easy to join as standard flat frames, but as Drawings 2-60 and 2-61 show, some fairly basic solutions are available, many of which can become stock with the flats.

The hardwall false proscenium (see Drawing 2-65) is a slightly heavier version of a simple hardwall flat. These prosceniums are often used for permanent installations when a season or years of use will subject them to long-term wear and tear. The vertical legs of the false proscenium can attach to the floor with lag screws (Yikes! Not in the stage floor!!!) or by other secure method (mastic, double-faced tape, weight) while the top can bolt into the header piece.

The header in the drawing is hung by cable which is attached to the bottom of the frame so it is lifting the piece, not pulling it from above and thus pulling it apart. The aircraft cable which is passing through the frame can be replaced by chain or any other secure material, but the turnbuckles should remain to allow any subtle trimming required.

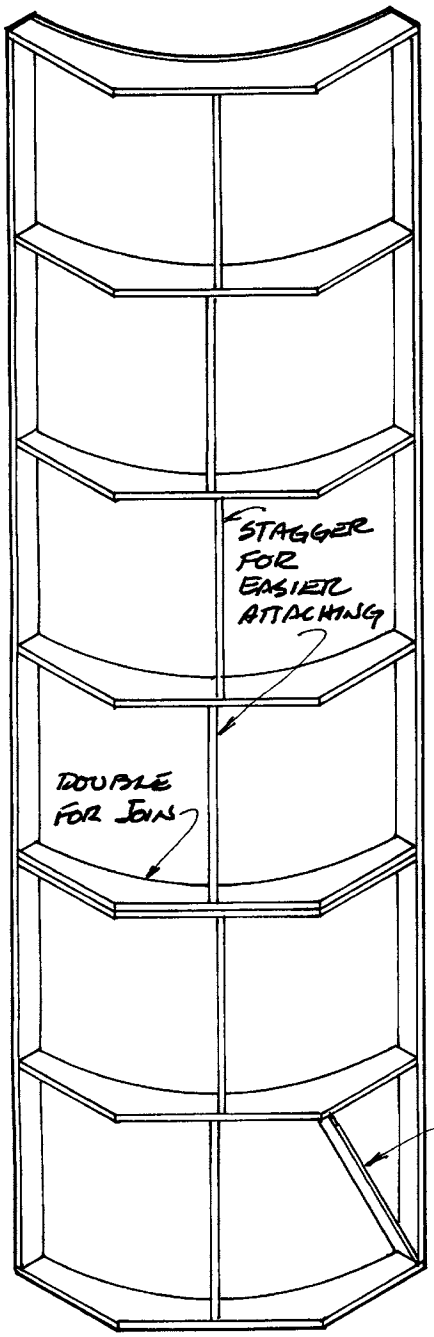
The flat hinged to the edge could readily be made of additional pieces of hardwall but may be a cheaper solution. You may not even need it. The drawing indicates the frame to be 1 × 6, but that, too, is easily adjusted to suit the particular need of the situation. The wider material is really for visual bulk and not for strength—the sheet of plywood provides that. The framework is merely holding the plywood together. Indeed, the ⅜″ plywood only provides a more solid surface and no real additional structural strength.

False prosceniums can be covered with many materials, but they are often treated with a slightly textured fabric to help soften the surface and absorb any stray light which might hit it. The section on Soft Masking may have some useful hints about materials, and Drawing 2-36 on covering flats with outrageously expensive fabrics may also be useful. However, false prosceniums have been covered with burlap (watch out for unsightly wavy patterns in the weave and when stretching it); others have been covered with dark-napped carpet made for automobile floors and even grass matting which has been painted. Some are originally covered with a textured panel, while others have been covered with muslin to kill the plywood grain and then painted to match the interior of the theatre. Need is the mother of necessity; the inventive grandchildren will follow.

Most jacks for hardwalls are a variation on those for normal flats. However, a fairly common variety includes a jack with horizontal members lapped on the frame and extended to slip inside the unit and attach to the stiles or studs (see Drawing 2-61).

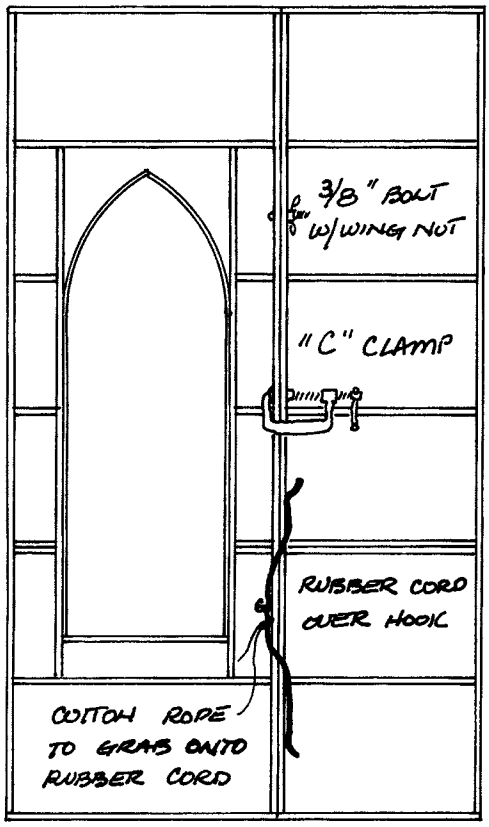
Two flat frame jacks commonly used with hardwalls are shown in Drawing 2-63. These attach to the ends of a hardwall wall unit. Both are quite stable, especially with the addition of some weight, either a sandbag or stray counterweight. The hinged jack is especially useful in crowded studios but is also handy in shops and paint areas where space and traffic patterns can put those of the studio to shame.

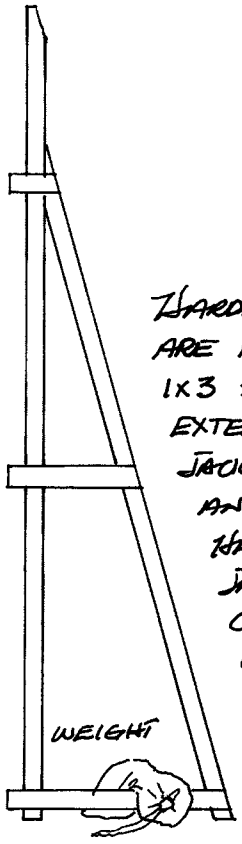
The rolling jack (see Drawing 2-64) is a shop-made substitution for a commercially available jack that has pneumatic pumps to lower casters and thus raise the wall unit for



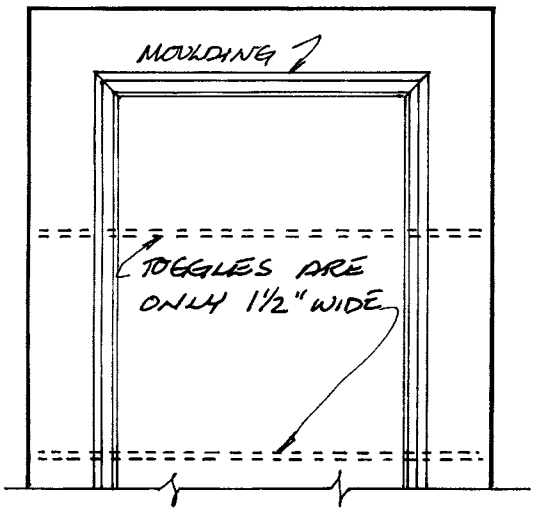
KEEPING IN MIND THAT PANEL STOCK (ESP. ¼" PLYWOOD) BENDS MORE EASILY IN THE 4'-0" DIRECTION, PLAN SWEEPS WHICH DO NOT EXCEED THIS MEASUREMENT. SEPARATE THE SWEEPS (WHICH HAVE BECOME TOGGLES) WITH STILES AND VERTICAL BATTENS. GLUE AND FORCE THE COVERING PANEL TO THE SWEEPS. THIS IS MORE EASILY DONE IF THE BACK OF THE SWEEPS ARE FLAT. IT IS POSSIBLE TO STAND INSIDE THE CURVE TO FORCE IT TO THE SWEEPS OR PUT SANDBAGS, ETC. INSIDE. FOR TIGHT CURVES, "E-Z" CURVE OR EVEN LINOLEUM MAY BE A USEFUL CHOICE. HOWEVER, NEITHER HAS THE STRENGTH OF ¼" PLY.

JOINING AND JACKING HARDWALL DWG. 2-61





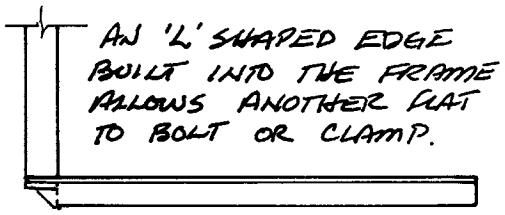
HARDWALL JACKS ARE BUILT FROM 1X3 STOCK. THE EXTENSIONS LAP JACK FRAME AND EXTEND INTO HARDWALL FRAME. JACKS CAN CLAMP, BOLT OR HINGE TO FRAME.

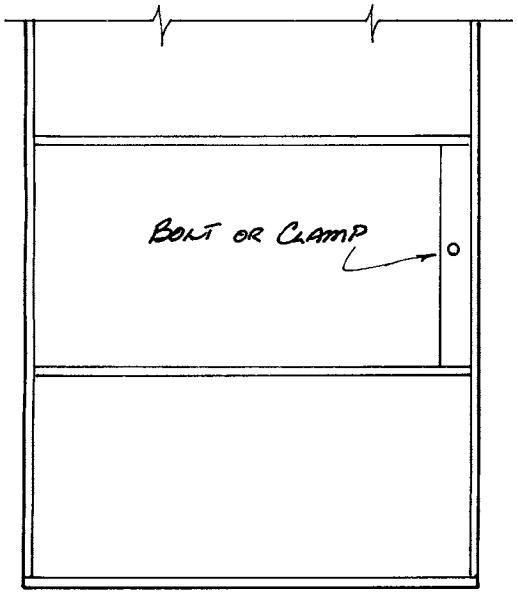


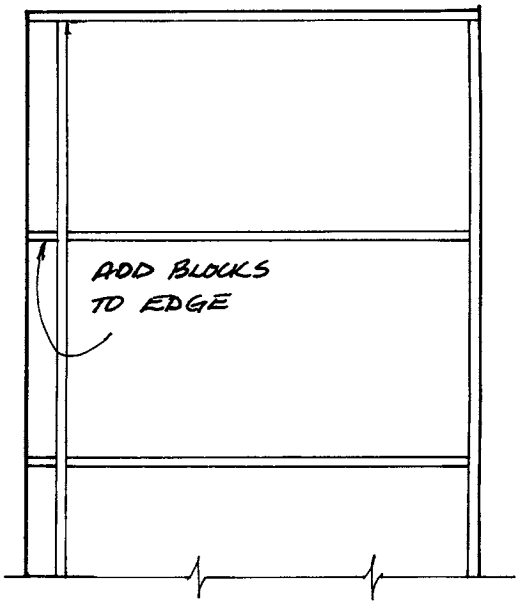
HARDWALL UNITS WITH PERMANENT MOULDING (BAND OR ORCHESTRA SHELLS) OFTEN HAVE THE TOGGLES NARROWER THAN OUTSIDE FRAME. THIS PROVIDES A SAFE 'POCKET' FOR THE MOULDING WHEN STORED.

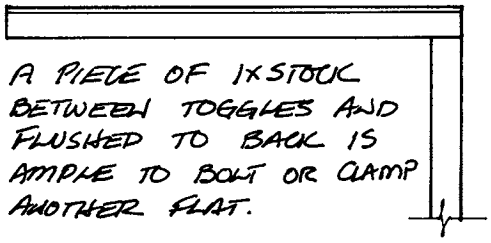
HARDWALL BUTTS DWG. 2-62

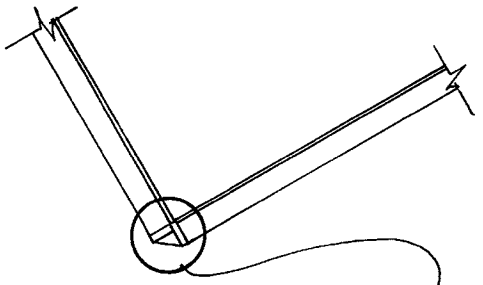
HARDWALL FLATS PRESENT UNIQUE PROBLEMS WHEN BUTTED TOGETHER. HERE ARE SOME ANSWERS FOR BOTH INSIDE AND OUTSIDE CORNERS.



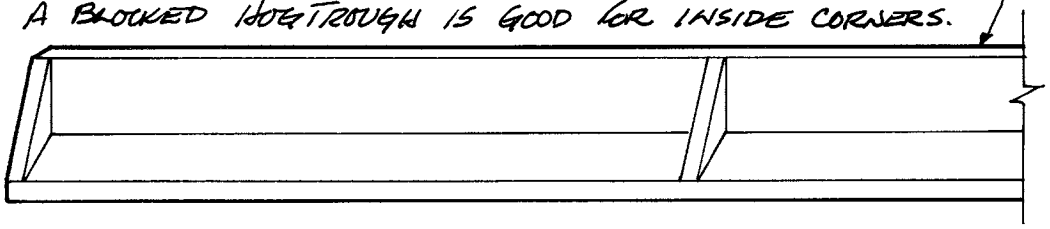




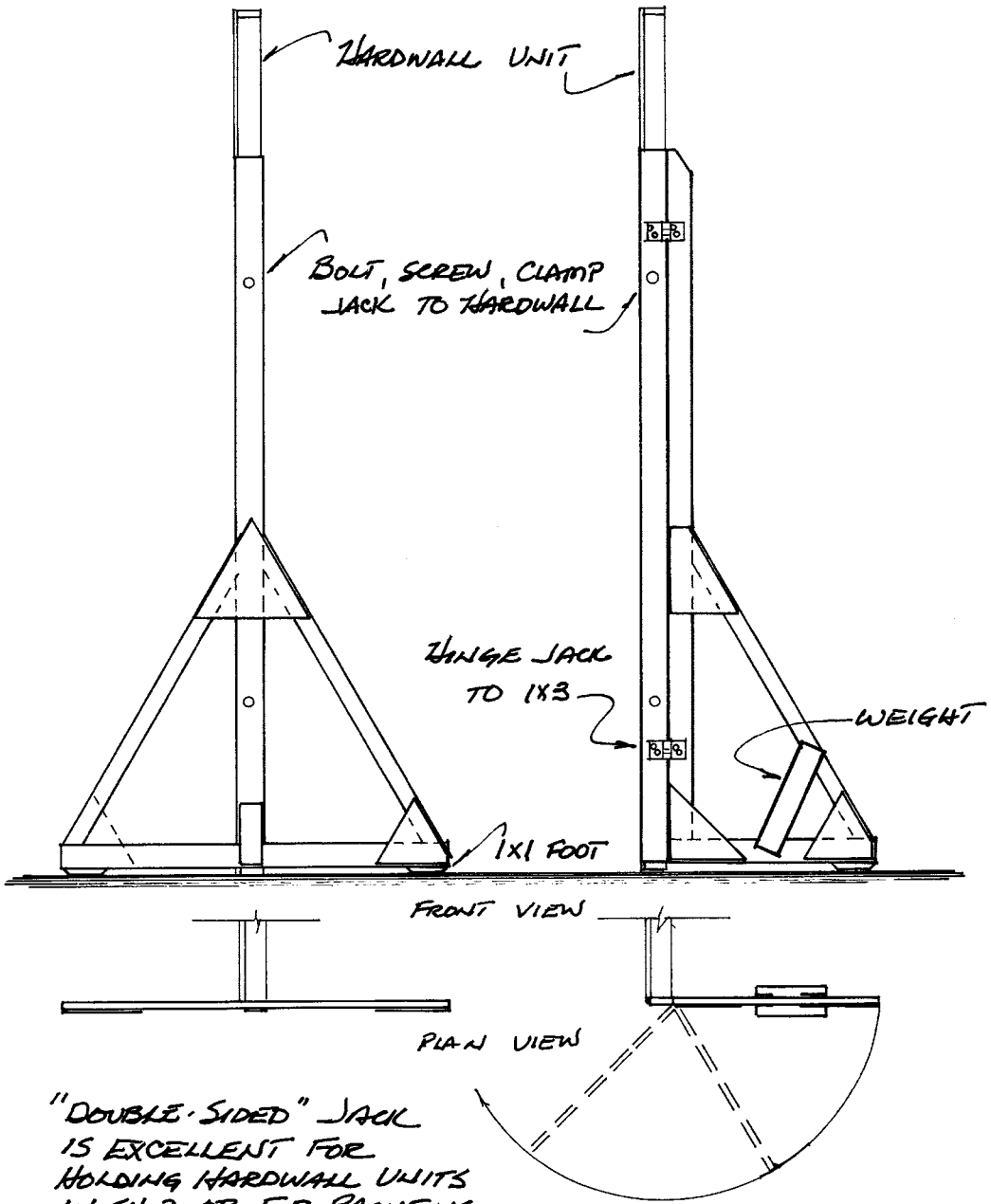




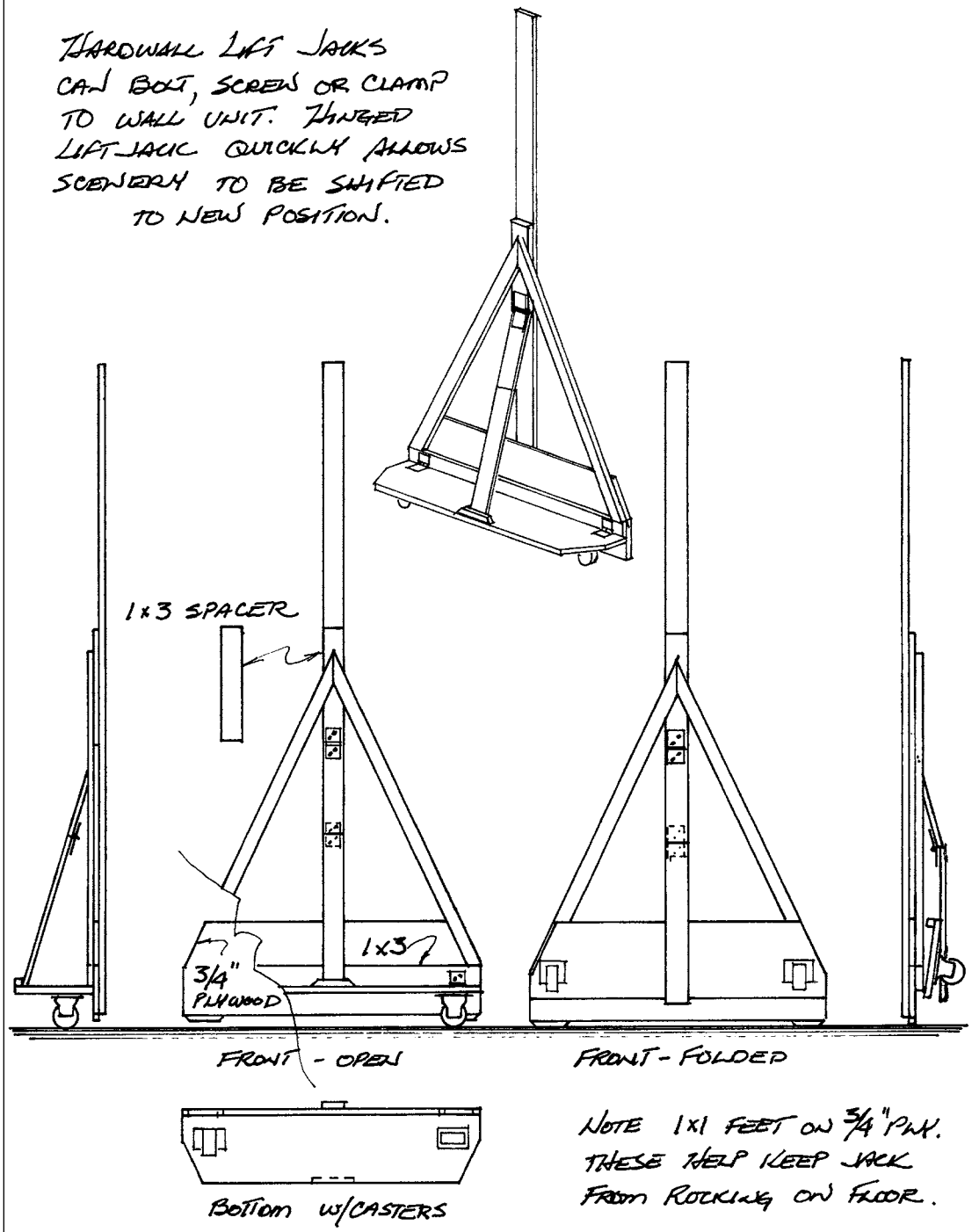
A BLOCKED HOG TROUGH IS GOOD FOR INSIDE CORNERS.



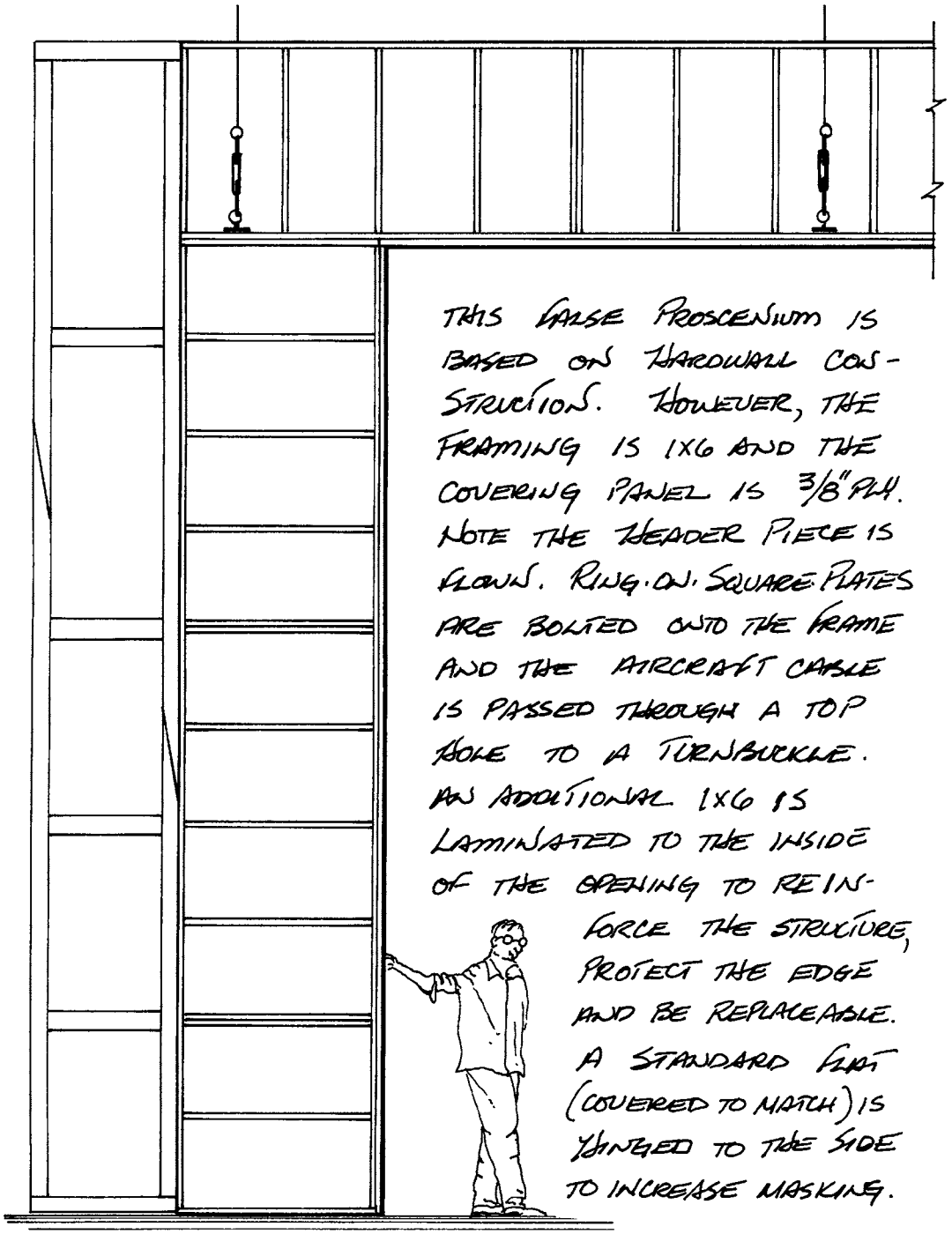
HARDWALL JACKS – 1 DWG. 2-63



HARDWALL JACKS – 2 DWG. 2-64



A HARDWALL FALSE PROSCENIUM DWG. 2-65



THIS FALSE PROSCENIUM IS BASED ON HARDWALL CONSTRUCTION. HOWEVER, THE FRAMING IS 1X6 AND THE COVERING PANEL IS 3/8" PLY. NOTE THE HEADER PIECE IS FLOWN. RING-ON SQUARE PLATES ARE BOLTED ONTO THE FRAME AND THE AIRCRAFT CABLE IS PASSED THROUGH A TOP HOLE TO A TURNBUCKLE. AN ADDITIONAL 1X6 IS LAMINATED TO THE INSIDE OF THE OPENING TO REINFORCE THE STRUCTURE, PROTECT THE EDGE AND BE REPLACEABLE. A STANDARD FLAT (COVERED TO MATCH) IS HINGED TO THE SIDE TO INCREASE MASKING.

easy shifting. Basically a lift jack, the unit requires only the hot air of a stagehand. Note the manner in which the layers are laminated. The 1 × 3 vertical which ultimately attaches to the hardwall unit is laminated to the back of the piece of ¾″ plywood. The horizontal 1 × 3 laminated to the front of the ¾″ plywood is placed above the hinged board with the casters. Thus, it is lifted by the casters. In turn, because it is laminated to the plywood and the 1 × 3 vertical, it will transfer the lift to the hardwall unit without the hinges being stressed. The diagonal braces rest on the horizontal 1 × 3 and attach to the ¾″ plywood and to the vertical through a ¾″ spacer which keeps them in the same plane. The folding hinged support also attaches to the ¾″ spacer. A standard l × l × 6″ tapered foot (see Drawing 4-27) makes an ideal stop. Because the folding support is hinged on the front at the top and on the back at the break, it will lift out of the way for lowering the caster board and set into place against the cleat.

The addition of a tie-line on the 1 × 3 vertical will allow the folding support to be tied against the unit and hold everything together.

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This book is all about the basics—flats, platforms, ramps, steps, curtains, drops, paint.

If you've never built scenery, this book will show you, in easy-to-follow steps, how to do it right the first time.

If you are an experienced builder, you will want to keep this book handy just in case you forget the answers to questions like:

- On an inside opening in a flat, what is the correct set back for plywood fasteners?
- Should fresh muslin always be used for a dutchman?
- What solvent will get dried paint out of a paint brush?

This third edition has been updated throughout by Mike Monsos, professor of Scenic Design/Technology at University of Montana, Missoula.

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