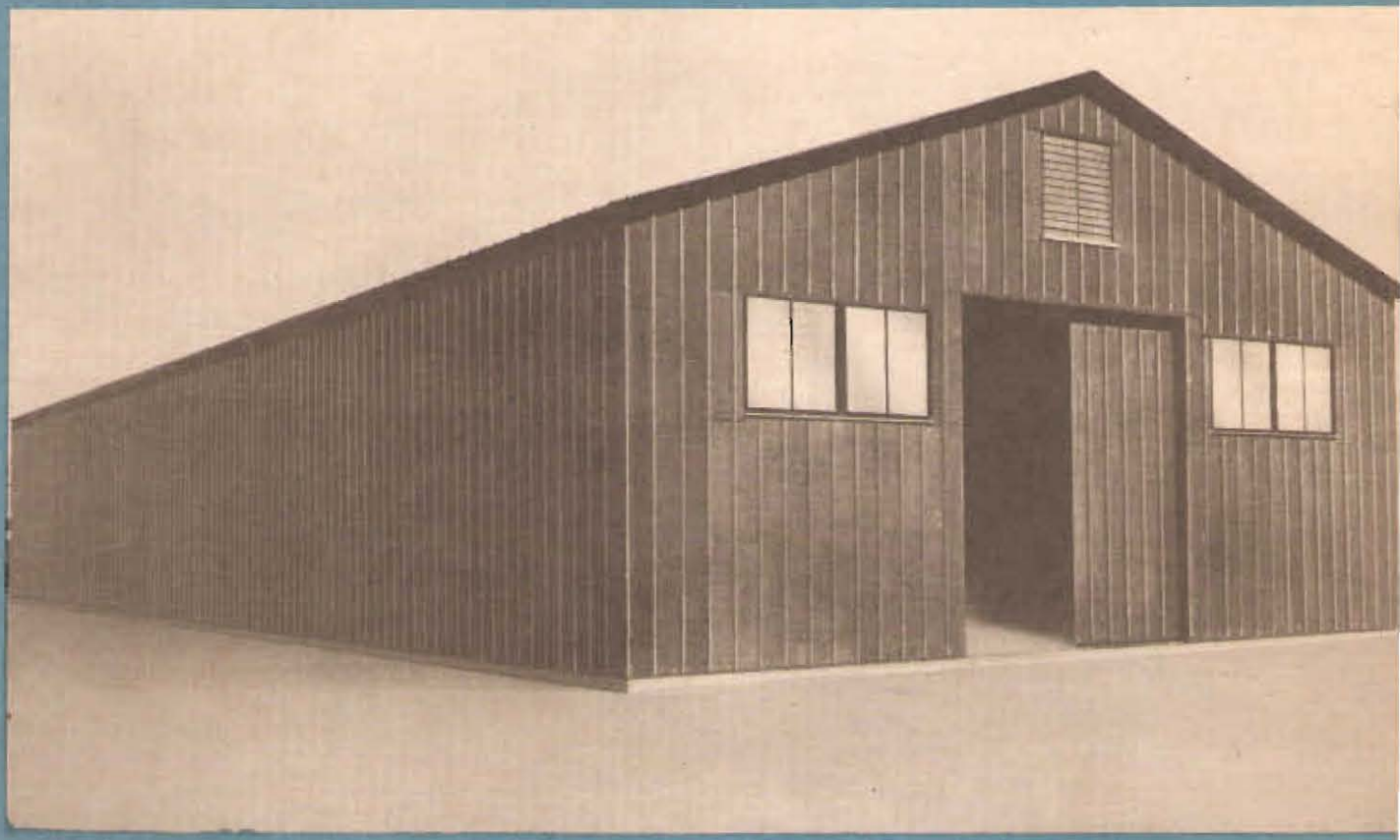
U. S. NAVY

RIGID FRAME UTILITY

WAREHOUSE BUILDING

ERECTION INSTRUCTIONS FOR THE 40'-0" x 100'-0" BUILDING



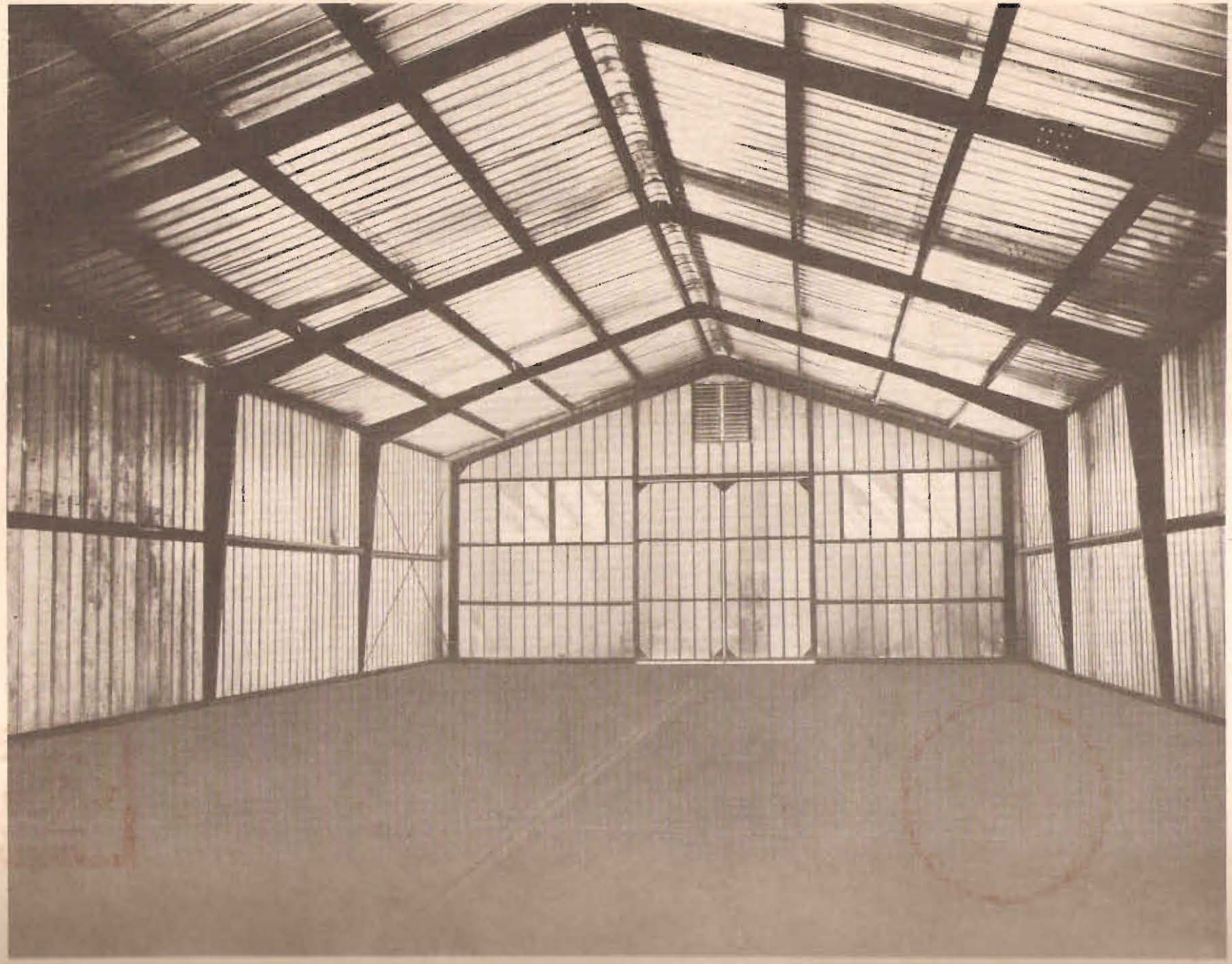
MANUFACTURED FOR

NAVY DEPARTMENT
BUREAU OF YARDS AND DOCKS

BY

BUTLER MFG. CO.

GALESBURG KANSAS CITY MINNEAPOLIS



U. S. NAVY

RIGID FRAME UTILITY WAREHOUSE BUILDING

★

ERECTION INSTRUCTIONS

FOR THE

40′-0″ x 100′-0″ BUILDING

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U. S. A.

ERECTION SEQUENCE
BASIS UNIT

Erection Drawings Applying to Navy Utility Building

(See Pocket in Back Cover)

BASIC UNIT
THE FOUNDATION

Drawing No. 7-BF-2623-1

Place forms for concrete, pour the concrete being sure to keep foundation square and level. If steel reinforcement and floor expansion joints are required due to local conditions place as desired by person in charge of foundation construction.

1. Place the ½″ round by 8″ long anchor bolts (for columns) and ½″ round by 4″ long anchor bolts (for base angle) accurately (per foundation drawing No. 7-BF-2623-1). Do this by measuring along form and using these points on the forms as center line of the anchor bolts. Chalk line has been furnished to line up bolts along wall.

2. The Floor: Slab is the same level as the foundation and can be poured in four longitudinal strips approximately 10′ wide or it may be poured one bay at a time making five 20′ slabs.

NOTE: Refer to section describing jig set-up and field welding as this work can be done while the foundation is being prepared.

3. Lay the corner base shoes marked BP-2 and intermediate base shoes marked BP-1 which are punched to fit over the bolts at each column. Then lay the bottom angles which are punched to fit over the bolts between columns placing the angles marked BA-3 on end walls, BA-2 and BA-2R in the end bay along sidewall and angles marked BA-1 in all intermediate bays along sidewalls. Leave these angles loose until sheeting has been placed to allow for necessary adjustment.

BASIC UNIT
THE FRAME (GENERAL)

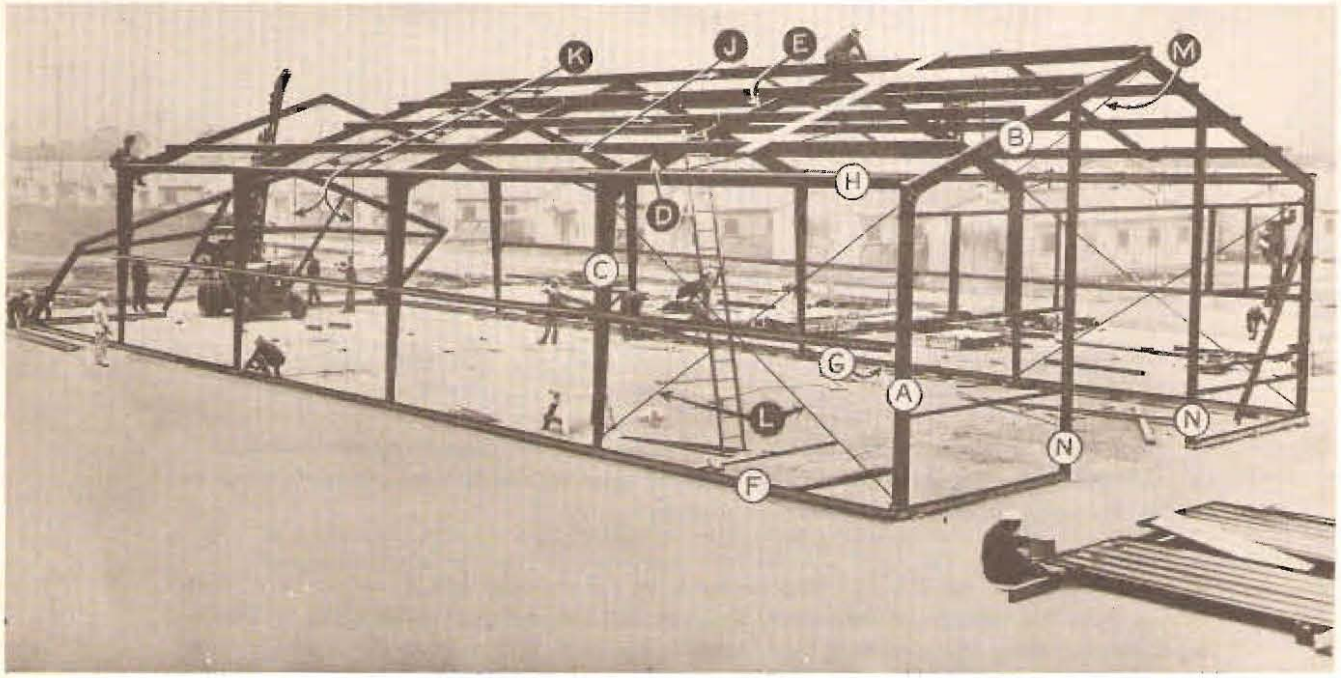


Figure 1 Showing the Following:

A—End Column

B—End Roof Beam

C—Rigid Frame Column

D—Rigid Frame Haunch

E—Rigid Frame Roof Beam

F—Bottom Angle

G—Wall Girt

H—Eave Strut

J—Purlins (four on each side)

K—Sag Rods (double row)

L—Wall Diagonal Rods

M—Roof Diagonal Rods

N—Door Posts

The building frame consists of two end and four intermediate rigid frames for a 100′ long building. The end rigid frames are assembled from four sections and the intermediate rigid frames are assembled from six sections. It was decided to field weld the connection between the haunch and the column of the intermediate rigid frame due to the shipping and handling problems of the joined sections. As described later the end rigid frame is assembled and used as a welding jig. These frames are spaced on 20′ centers and are bolted to base plate shoes at the bottom. These frames are connected by two wall girts, two eave struts and eight roof purlins.

The end bays only receive a series of diagonal rod bracing in each sidewall and in the plane of the roof. These rods are installed after the first end frame and the first intermediate rigid frame are in place and are used to square and plumb the building. It will be necessary to obtain from the crating, timbers to use as gin poles for the erection of the first end truss. After this truss is erected all remaining trusses will be erected by attaching the two erection pulleys to the last raised truss using pulleys to pull truss into vertical position.

Two sizes of bolts only are furnished for the erection of the frame. The $\frac{5}{8}''$ x $1\frac{1}{2}''$ machine bolts are used only at the base and splice connections of the rigid frame. The $\frac{1}{2}''$ x $1''$ machine bolts are used on all other connections.

BASIC UNIT
JIG SET-UP AND FIELD WELDING

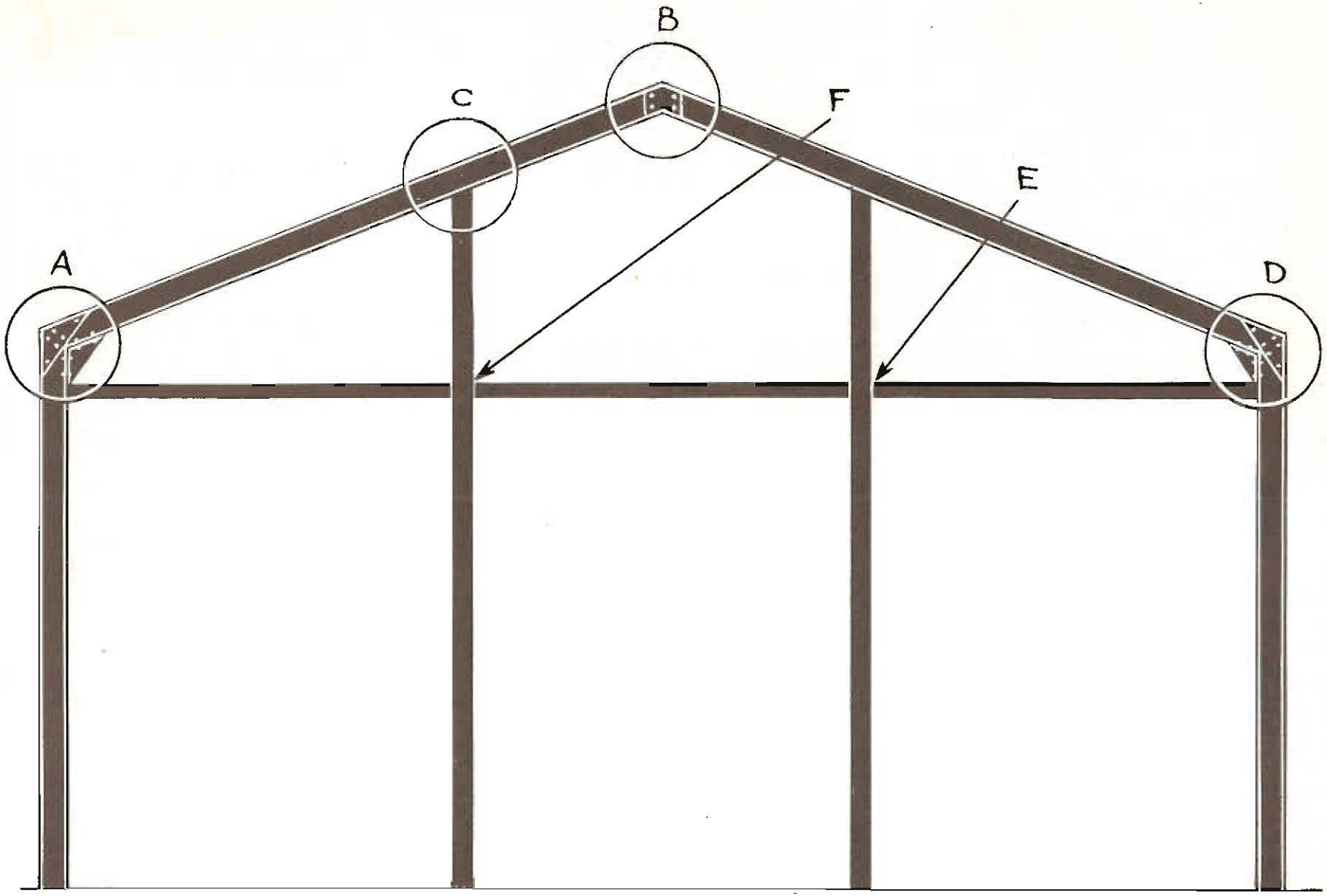
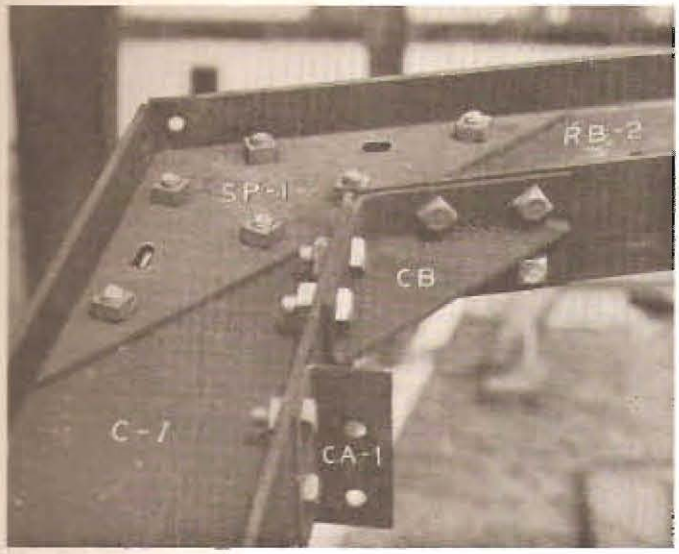
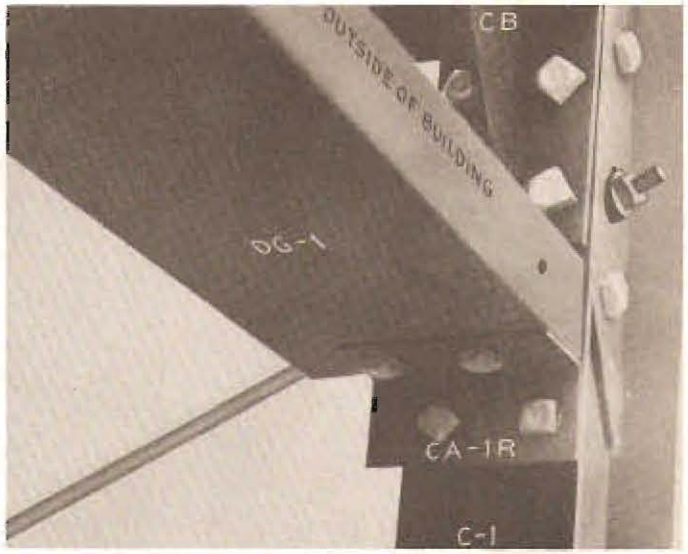


Figure 2

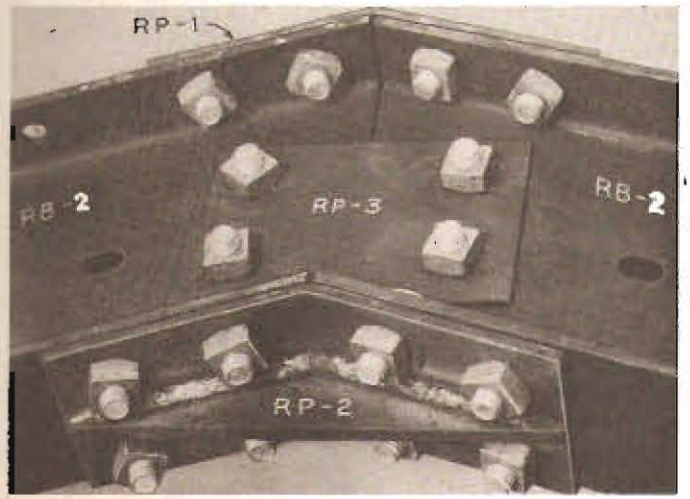
Assemble one of the end trusses as detailed above. Before using jig, check distance across the bottom against distance across eaves, thus making sure columns are parallel. This will properly space the base of the columns so that all rigid frames will fit foundation after being welded.



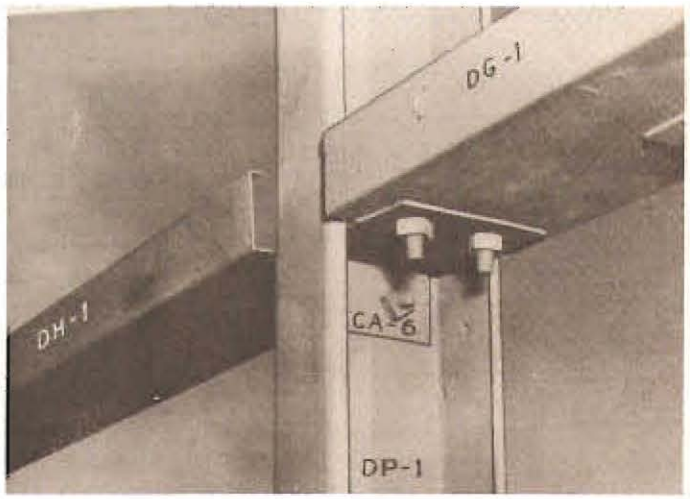
Detail A: At the eave point the end column marked C-1 bolts to the end roof beam marked RB-2 with two splice plates marked SP-1 (one on each side of the web) and with one corner bracket marked CB bolted to the inside flange.



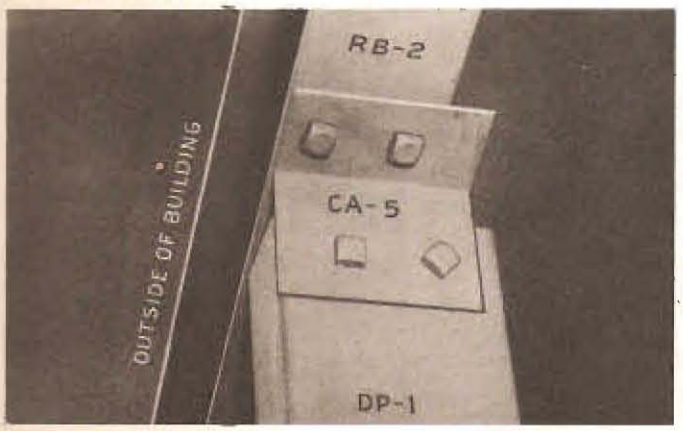
Detail D: Bolt girts marked DG-1 and DG-1R (with open channel toward ridge) in place using clips marked CA-1 and CA-1R for connection to column.



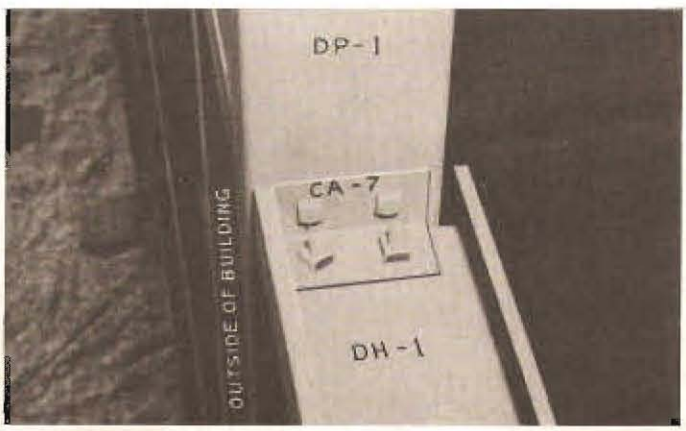
Detail B: At the ridge of the building the two end roof beams marked RB-2 bolt together using two plates marked RP-3 (one on each side of the web), one bent plate marked RP-1 on the top flange and one bracket marked RP-2 on the bottom flange.



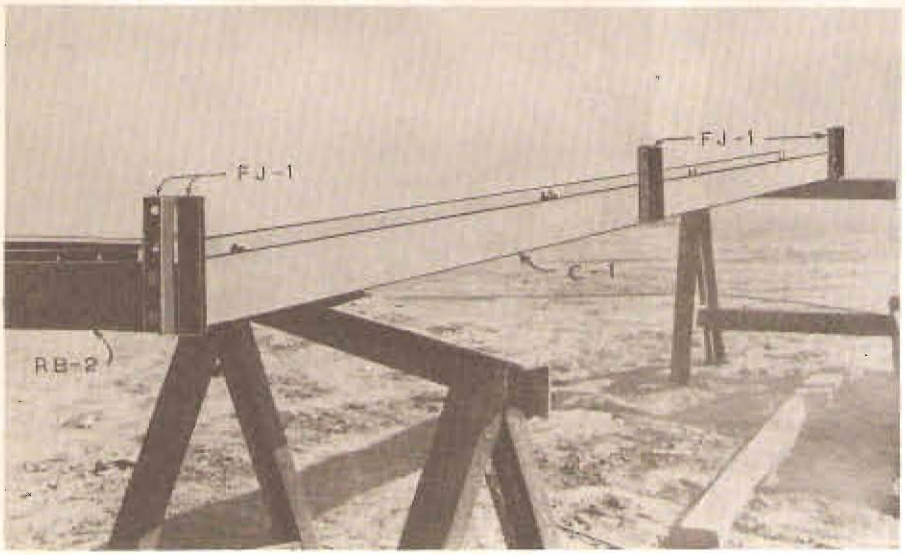
Detail E: Use clips marked CA-6 for connection of girts to door posts.



Detail C: Next bolt door posts marked DP-1 and DP-1R in place, using clips marked CA-5 and CA-5R for connection to roof beam.



Detail F: Assemble door header marked DH-1 between door posts using clip marked CA-7.



Attach ten jig clips marked FJ-1 to truss allowing clips to extend above truss thus completing the jig.

Figure 3

Bolt rigid frame column marked RF-1 and rigid frame haunch marked RF-2 to the jig clips having the diagonal cuts of the two members butted together.

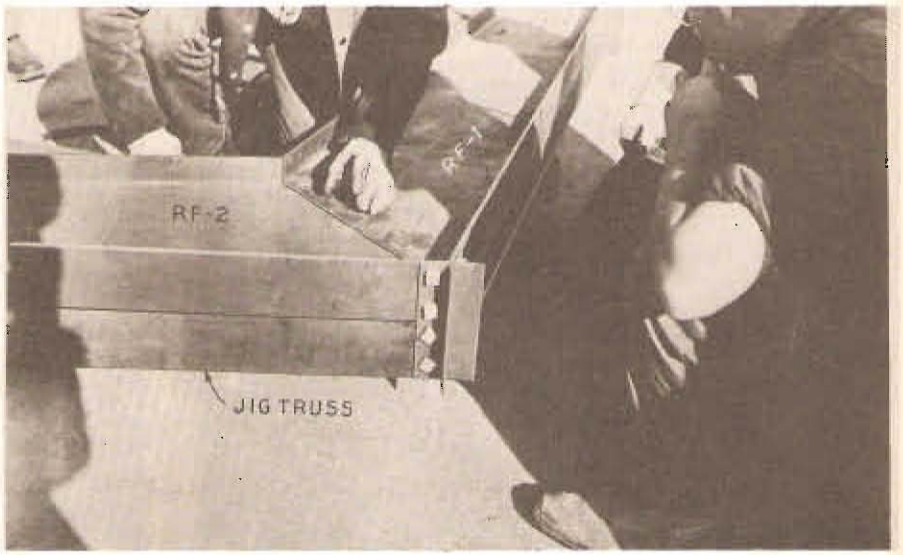
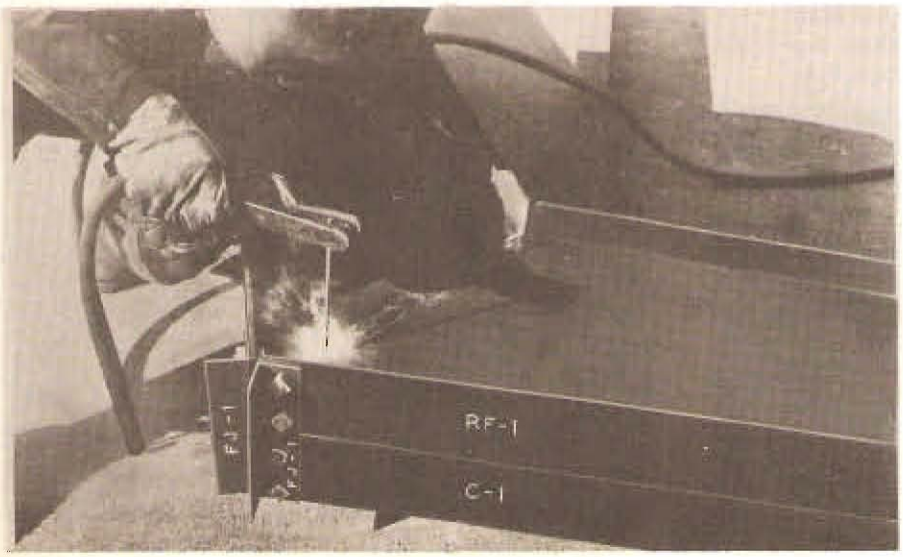


Figure 4



Tack weld together in three or four places and then continuously weld web and lower flange and inside of top flange.

Figure 5

Weld one angle reinforcement marked SPA-1 over this joint before removing from jig. Note this reinforcement angle is notched at one end to closely fit the lower flange and this should be continuously welded.

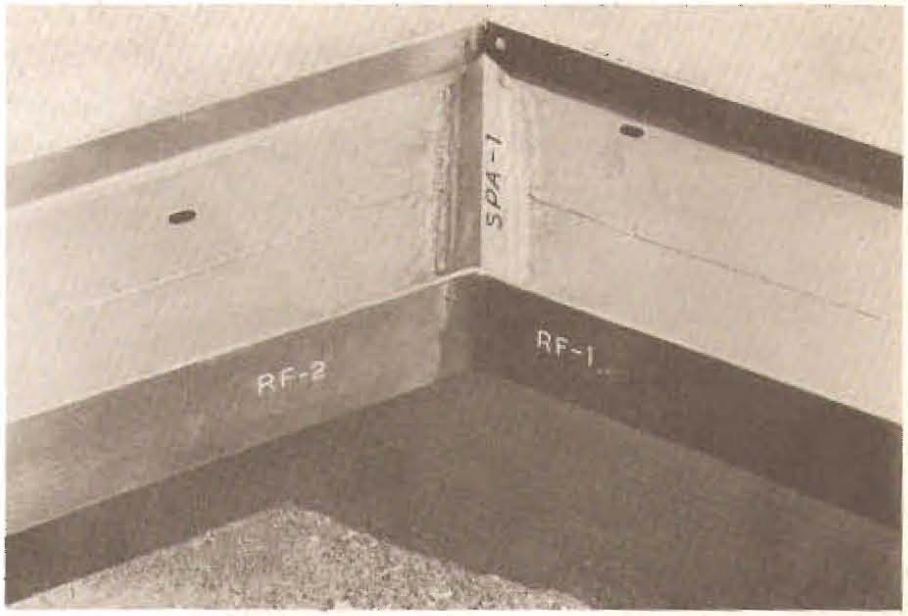


Figure 6

Remove this assembly from the jig, turn over and while laying flat on the ground weld the other side of the flanges so the flanges are welded continuously. It is not necessary to weld opposite side of the web. Place another reinforcement angle marked SPA-1 over this joint again making sure the lower end of the reinforcement angle is welded continuously to the lower flange.

Suggestion: This same procedure can be followed using the other side of the jig, allowing two welders to work simultaneously. Proceed likewise for remaining haunches.

Welding rod has been furnished for each building and it has been estimated an average of eleven rods shall be used for each haunch welded. It is assumed DC welding machines are available in the field. The rod is for this type machine.

Touch-up paint and brush has been furnished with each building for painting this welded connection to complete it.

While the welding is progressing, another crew can proceed with the erection of the building by assembling the other end truss and using welded haunch members as they become available.

BASIC UNIT
ASSEMBLY AND ERECTION

Drawing Nos. 7-BE-2623-1, 2, and 4

Assemble the other end Rigid Frame and the intermediate Rigid Frames at their proper locations in the building. Raise into position and install girts, purlins and eave struts.

Figure 7

To assemble end rigid frame, place base of the end column marked C-1 in its base shoe marked BP-2 and proceed assembling as for the jig truss.

Use one of the structural wrenches for a pivot in raising the trusses.

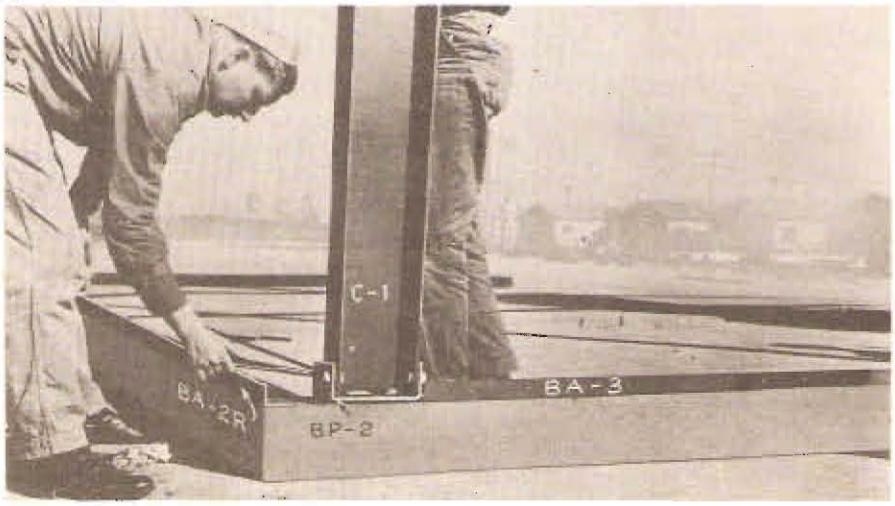


Figure 8

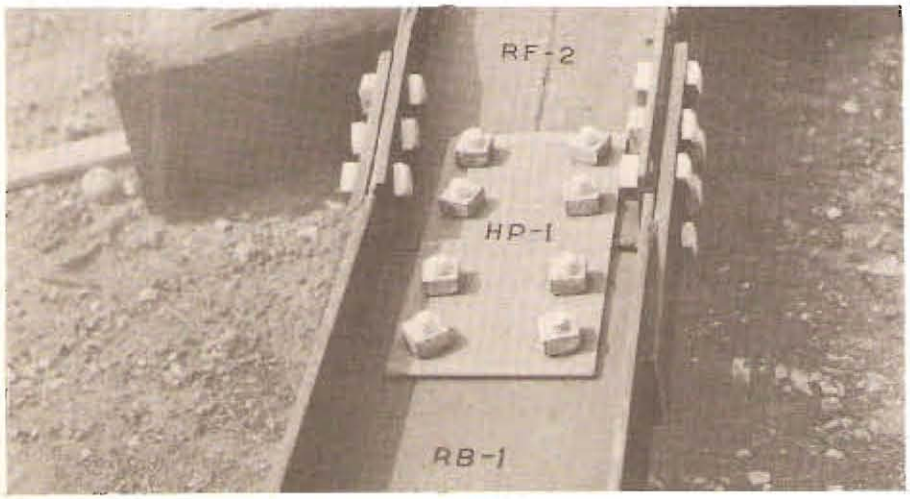


Figure 9

To assemble intermediate rigid frames, place the base of the column marked RF-1 in its base shoe marked BP-1. While lying flat on the foundation, assemble this column section to the roof beam marked RB-1 using two splice plates marked HP-1 (one on each side of web). The other splice plates for this connection are welded to the top and bottom flanges of the roof beam and are to be bolted to the haunch section. Do not assemble the two roof beams at the ridge until the above connection is made. This ridge connection is identical on all frames and, after it is made, the frames are ready for raising.

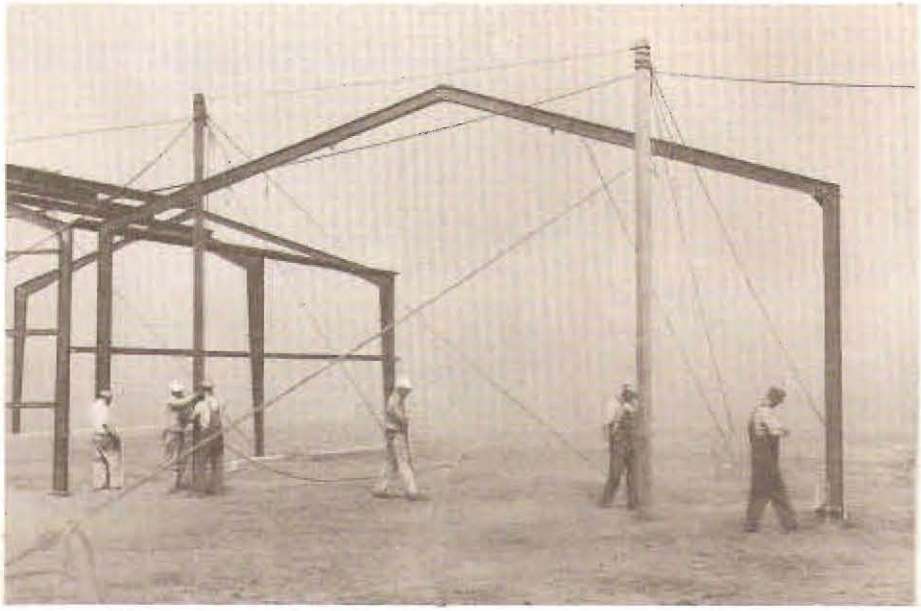


Figure 10

To manually raise the end rigid frame obtain from crate No. 111 four 2″ x 6″ boards and nail two of these together making two 4″ x 6″ timbers about 20′ long to use as erection poles. Attach erection pulleys to top of poles. Also attach guy lines to top of poles. Raise poles and locate each about 12′ in from each side of the foundation. Attach rope running through the erection pulley to the roof beom. Pull end frame into vertical position. Guy this frame with four ropes, two each way, leaving these in place until all of the rigid frames are erected.

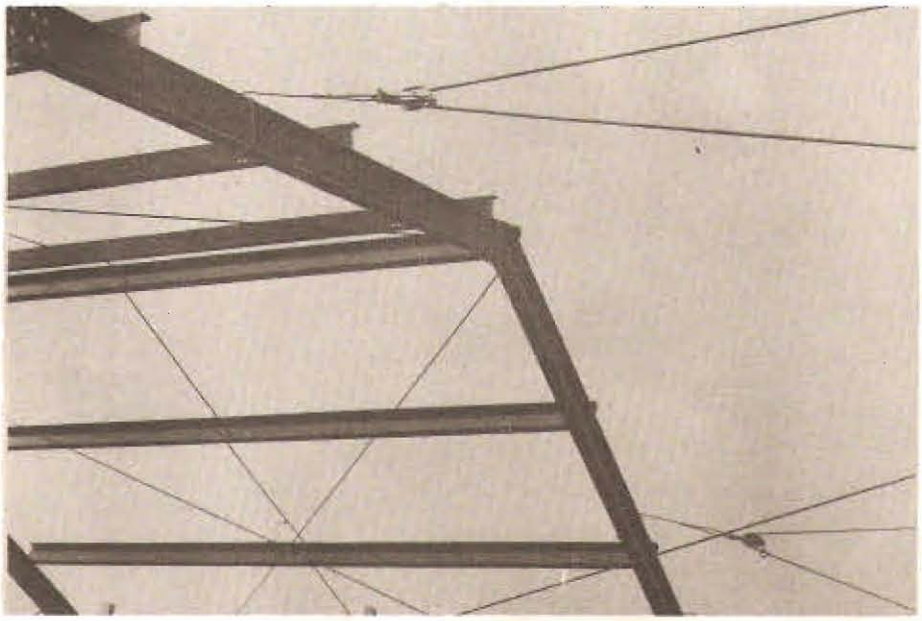


Figure 11

Attach two erection pulleys to the end roof beam at points half way between the ridge and eave for manual erection of next rigid frame.

Figure 12

Pull ropes running through erection pulleys are tied to the rigid frame ready for erection. Assign six men to each pull rope. With other men using timber shores, push truss up until the men on the pull ropes can pull truss into its vertical position. Be sure to have two guy lines on truss to keep same from falling on over.

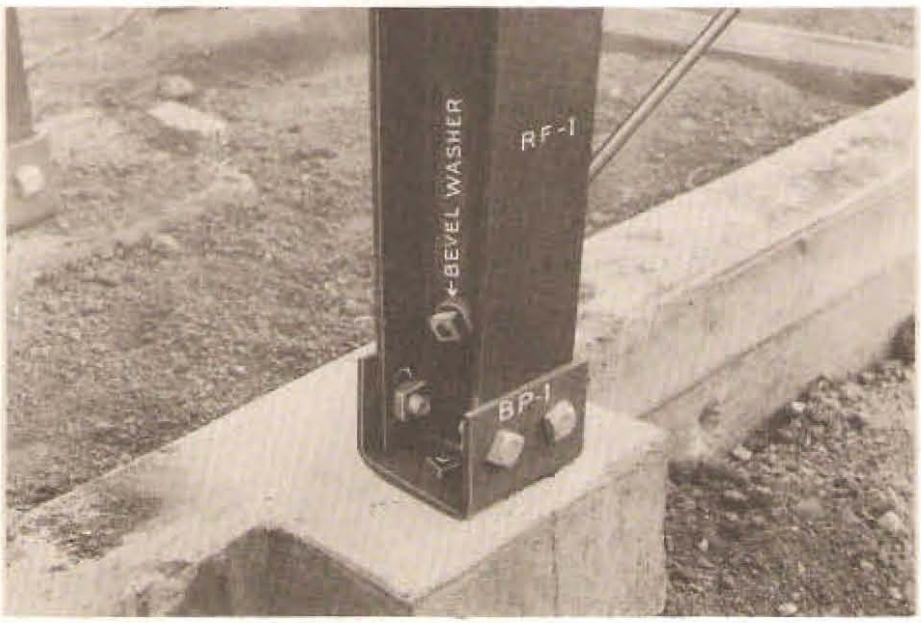


Figure 13

After rigid frame is in vertical position, secure columns to base shoes. Follow this procedure for the remaining rigid frames.

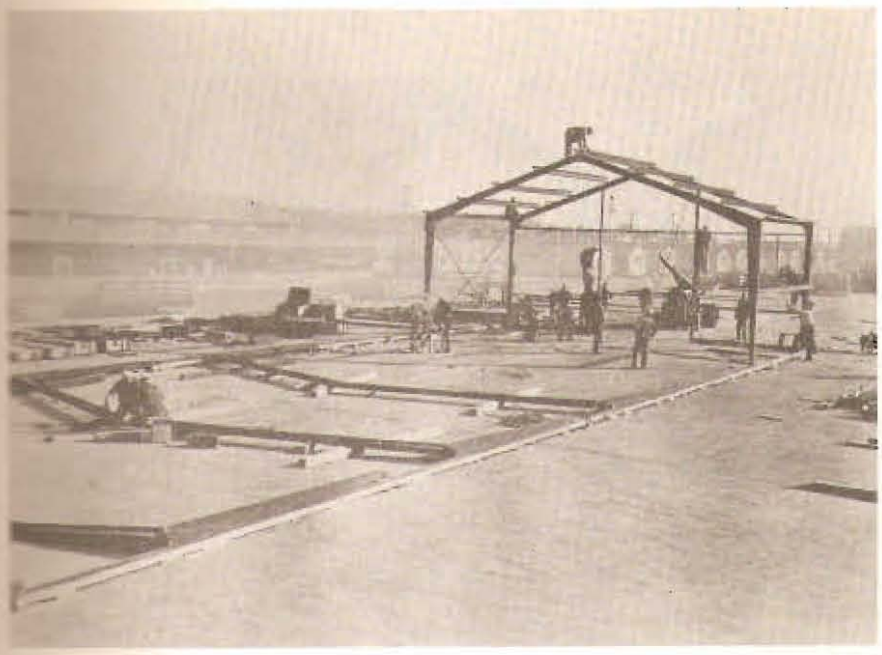
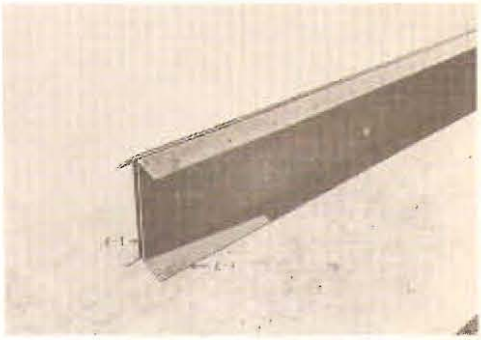
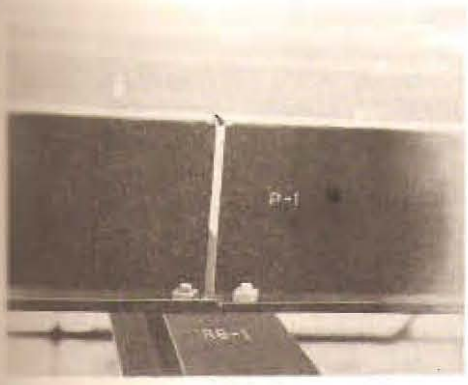


Figure 14



Detail A—Figure 14



Detail A—Figure 15

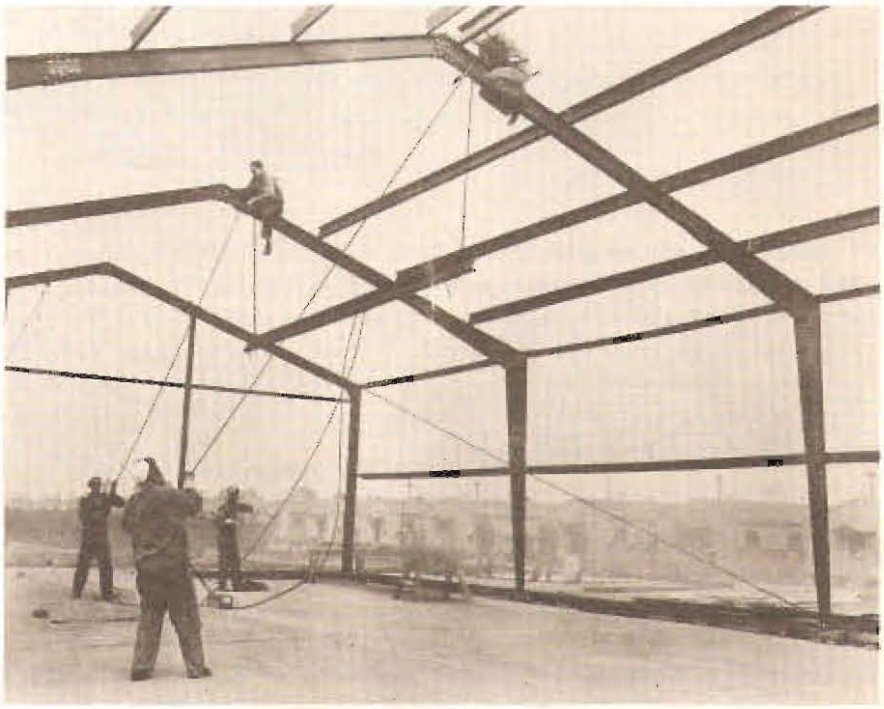
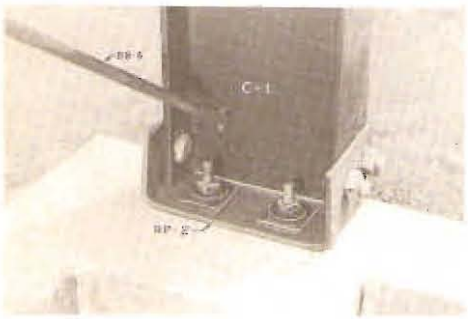


Figure 15

After the end and the first intermediate rigid frames have been erected attach the eight purlins marked P-1 (Detail A), the two eave struts (each being made up from two members marked E-1 bolted back to back [Detail B]) and the two girts marked G-1. Notice that wall girt is made of thicker steel than roof purlins. They are the same size otherwise and although they are plainly shop marked it is possible to use one in place of the other. The design specifications require that the heavier one (marked G-1) be used in the wall.



Detail A—Figure 16

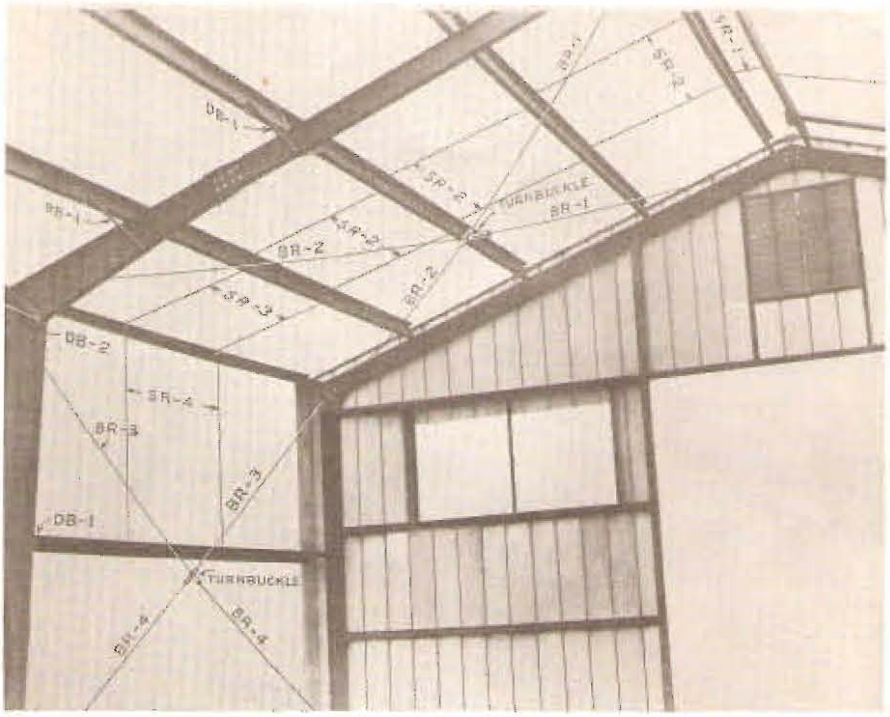


Figure 16

Install diagonal rods marked BR-1, BR-2, BR-3, and BR-4. Each diagonal bracing in roof plane is made up of one BR-1 and one BR-2 joined together with a $\frac{1}{2}''$ x 6″ turnbuckle. The diagonal bracing in the sidewalls is made up of one BR-3 and one BR-4 joined together with a $\frac{1}{2}''$ x 6″ turnbuckle. These rods connect through slots in rigid frame (Detail A) with bevel washer under nut. The purpose of these rods is to square and plumb the building. When installing these rods measurements should be taken along each rod, adjustments being made so this bay is absolutely square. This diagonal bracing is necessary in the end bays only and since all other bays are attached to this one, time will be saved if these bays are properly squared.

Attaching the two lines of sag rods marked SR-1, SR-2, SR-3 and SR-4 through purlins starting with the short rods marked SR-1 connecting the two top purlins. Draw these purlins parallel to each other with these rods, using two nuts on each end of the rods (one on each side of the purlins) so the purlin is rigidly fixed. Use sag rods marked SR-2 between purlins in each of the next three spaces on each side of the top purlins and on these rods use one nut only on each end. Next install sag rods marked SR-3 in the space between the eave strut and purlin using a double nut arrangement at the eave end of this rod. Use the sag rod marked SR-4 between the eave strut and the girt with one nut on each end. Do not tighten the rods marked SR-3 and SR-4 until after sheets are in place allowing movement of eave strut. The purpose of these rods is to take any sag out of the members.

CAUTION: These should not be tightened to the point that they pull the members out of line

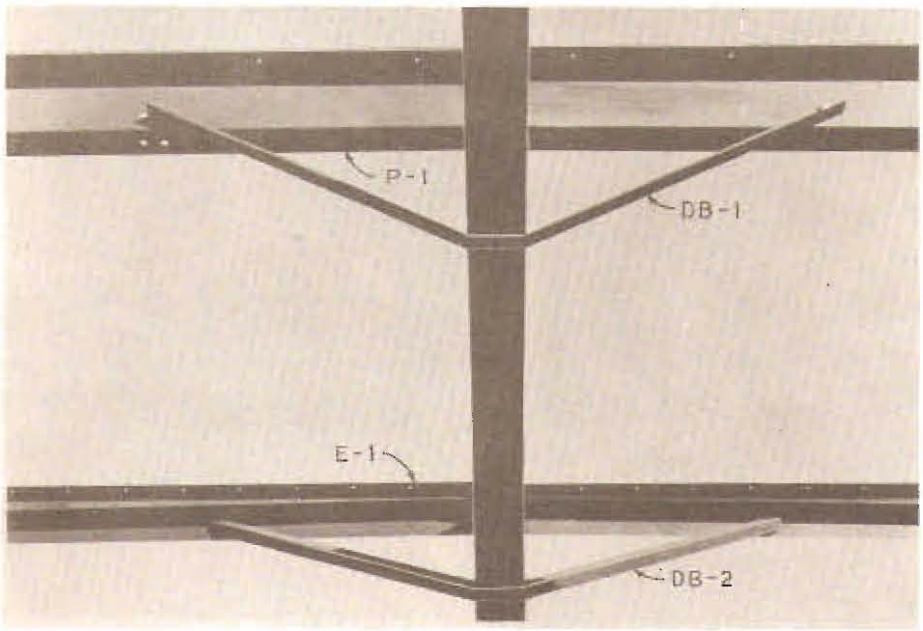


Figure 17

At any time after two or more bays of the structural framework are erected, install the diagonal braces marked DB-1 and DB-2. The DB-1 members are used on the first two rows of purlins above the eave and on the girts. The DB-2 members connect to the eave struts having a notched end to allow it to be balted between the strut. These braces are notched to fit around the inside flange of the rigid frame beams and to install lay this notched portion flat against the frame flange and bend the brace to bolt in place. Because of the column taper and for interchangeability two holes are provided in the purlins and girts, use the holes which will make this member taut

NOTE: No brace is to be used in the upper four rows of purlins

BASIC UNIT
THE END FRAMING

Drawing No. 7-BE-2623-1

Attach the end framing, including girts and louvre angles to the end rigid frame using angle clips. This is assuming the door posts marked DP-1 and DP-1R, the girts marked DG-1 and DG-1R, also door header marked DH-1, were bolted in place as described in the "basic unit" under the section "Jig Set-Up and Field Welding," before the end truss was raised.

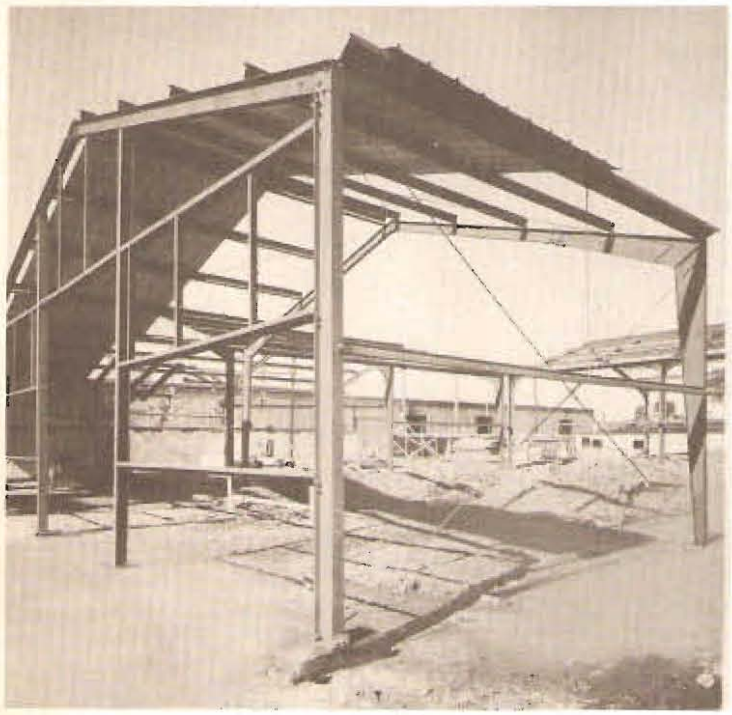


Figure 18

Bolt louvre angles marked LA-1 and LA-1R to door header and roof beam. Bolt louvre to angles temporarily with two $\frac{1}{4}'' \times \frac{3}{4}''$ bolts, one on each side, to hold it in place until gable sheeting is installed.

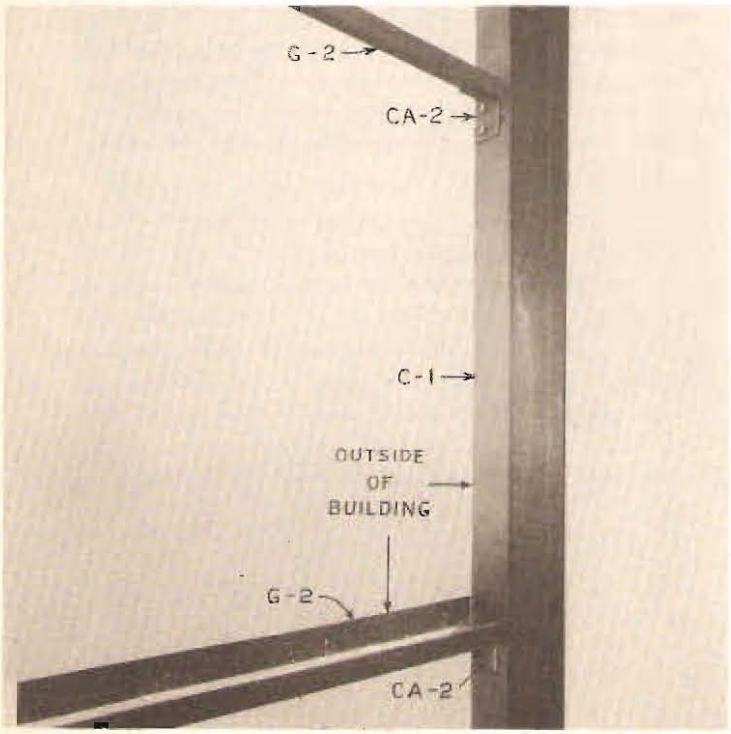


Figure 19

Attach girts marked G-2 and G-2R (outside leg of Z turned up) to columns with clips marked CA-2 and CA-2R respectively. Attach these girts to door posts with clips marked CA-8.

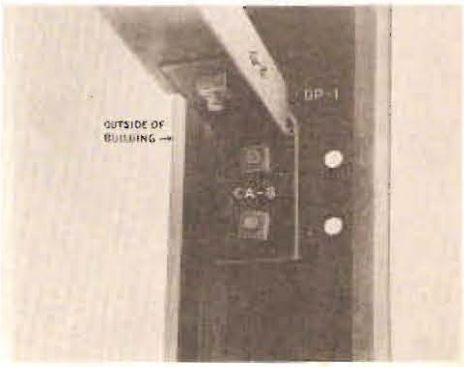


Figure 20

Figure 21

The window angles marked S-1 and S-1R connect to the girts with clips marked CA-3. The window angles marked CW-1 and CW-1R bolt back to back and connect to girts with four clips (two on each end) marked CA-4.

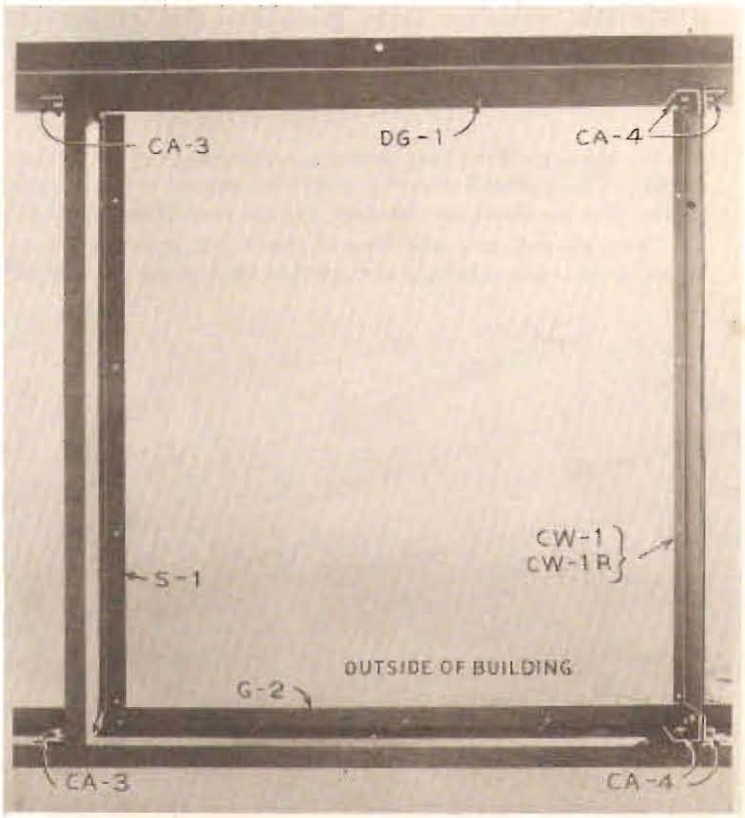


Figure 22

BASIC UNIT
THE END COVERING
INSTALLING DOORS AND WINDOWS

Drawing No. 7-BE-2623-1

Apply sheeting, assemble the doors and install. Assemble windows and install.

Figure 23

This building is covered with BUTLER corrugated sheets having a deep drawn corrugation 12″ on center.

These corrugations are factory punched approximately 2′ on centers, also factory punched for end connections.

It is only necessary to field punch the holes in the flat of the sheets to secure sheets to girts and purlins. Holes in girts and purlins are factory punched and by using the $\frac{3}{8}$″ x 9″ x $\frac{1}{8}$″ punch that is furnished the holes may be easily punched in the sheets to match the holes in these members. On the end wall these holes are to be punched after the end sheeting is completely installed.

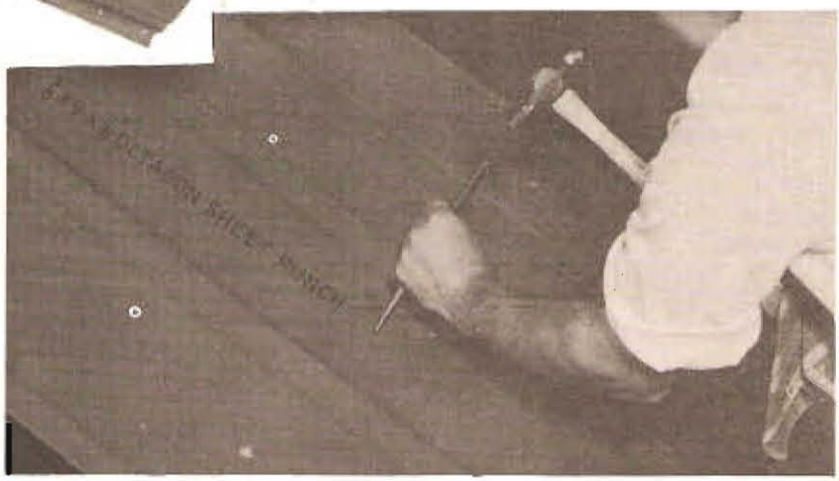


Figure 24

The top sheet should lap over the bottom sheet at all times to obtain a weathertight connection in all sheeting and roofing. The end wall sheeting should be started at some permanent point such as corner or door posts or building center line, so sheets can be kept straight and plumb throughout the entire end wall.

Since all end and side laps of sheets are pre-punched, a certain amount of adjacent sheeting can be bolted together as a sub-assembly and erected as a group on the end wall.

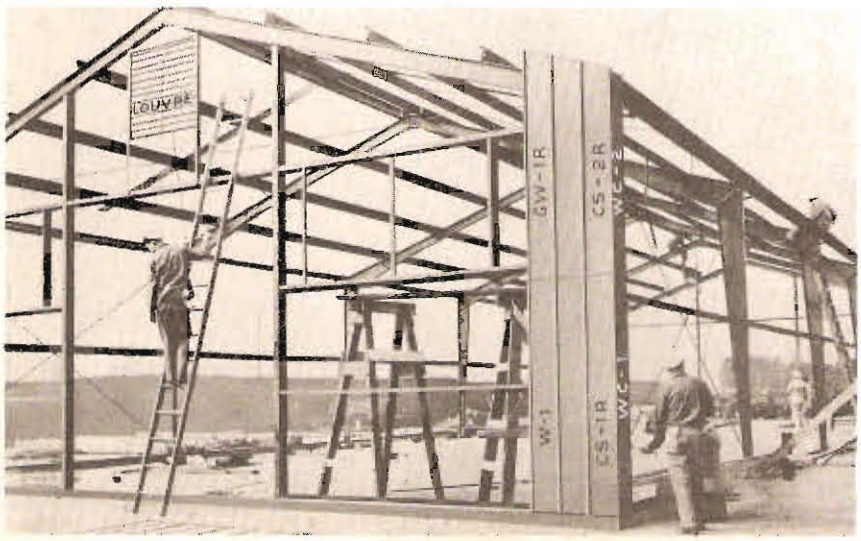


Figure 25

Sub-assemble the corner sheet group using the following sheets: CS-1R, CS-2R, W-1, GW-1R, WC-1, and WC-2. These six sheets when assembled will form the corner sheet group for the right hand end corner. Use sheets marked similar but with the exception of the "R" for the left hand end corner group. Attach these groups of sheets to their respective corners bolting them to the bottom angle first and then eave strut.

Sub-assemble and install as a group the three sheets marked VS-1 below louvre. Sub-assemble GW-10 with GW-9 and GW-9R and install as a group above. the louvre. Be sure to get the center sheet exactly centered in louvre.

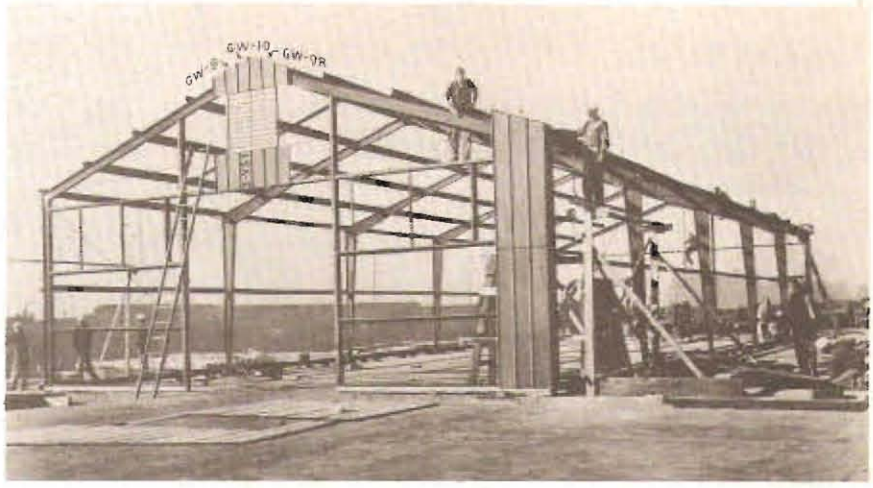


Figure 26

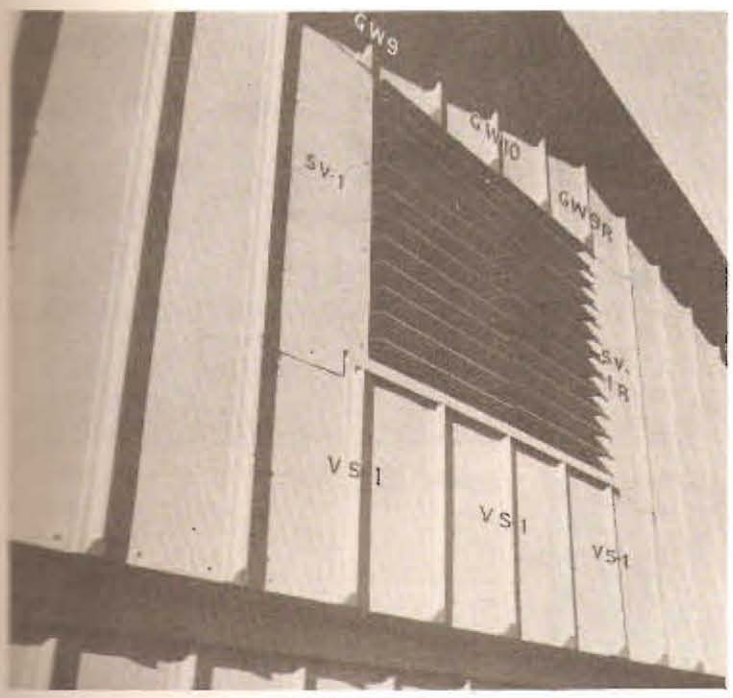


Figure 27

Sheets lap over the louvre at both sides, top and sill and at the sill a two piece flashing furnished with the louvre bolts to sill of louvre extending out and down over the corrugations of the sheet.

Install gable sheets marked GW-8 and GW-8R.

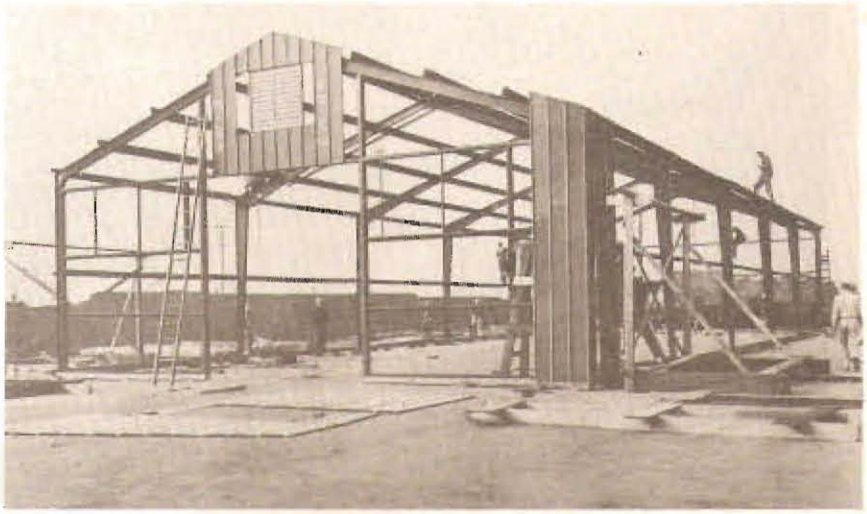


Figure 28

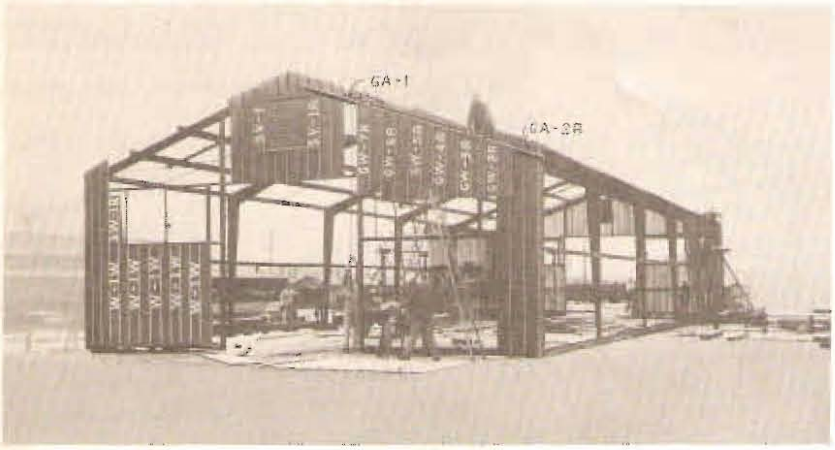


Figure 29

Bolt side louvre sheets marked SV-1 and SV-1R in place. Also sub-assemble the six gable sheets marked GW-2R, GW-3R, GW-4R, GW-5R, GW-6R and GW-7R, attaching gable angles marked GA-1 and GA-2R to the top of these sheets having the top leg of the angle turned out, as the roof sheets bolt to this leg. Raise into place as a unit. Sheets on the left side of gable are marked similar except without the "R."

While this work is progressing the five sheets marked W-1W can be assembled as a unit and installed under windows.

Bolt sheets marked SW-1 and SW-2R in place at each side of the window openings being sure to slip the top of this sheet under the gable sheets. Also bolt the side door sheets marked SD-1R and SD-2R in place.

NOTE: These sheets may be installed before the gable sheets if desired.

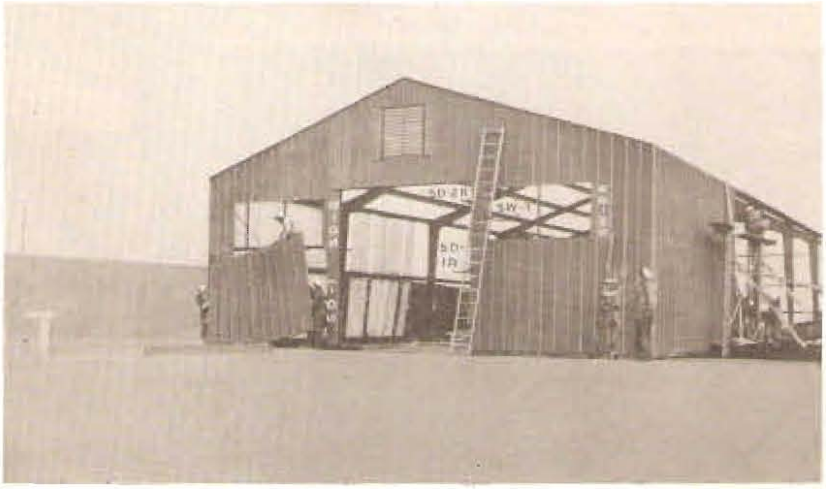


Figure 30

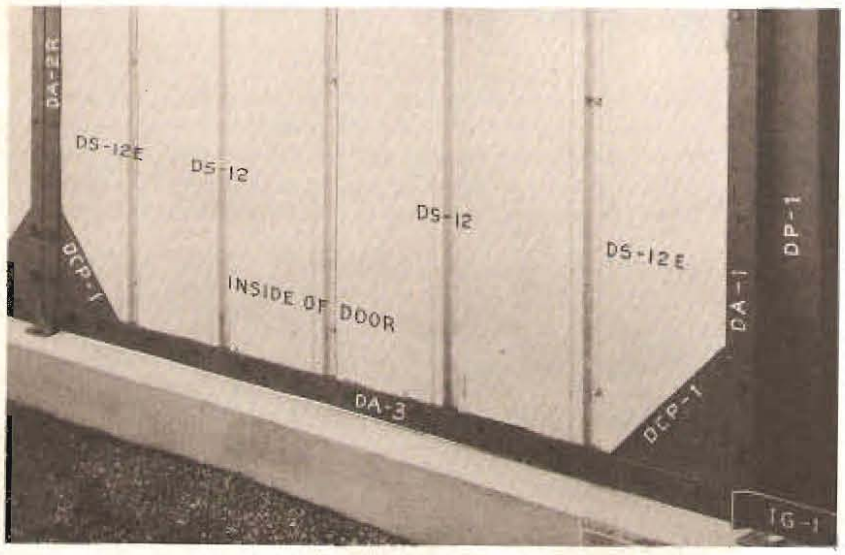


Figure 31

Door Assembly: To reduce cubage the door sheets and the door frame have been shipped knocked down. For assembling the left hand door, lay out the side angles marked DA-1 and DA-2R, also the top and bottom angles marked DA-3. These angles should be placed with the outside leg turned up so door sheets will lay inside. Lay the corner brace plates DCP-1 in place but do not bolt. Attach the side door sheets marked DS-12E to their respective door angles, then attach door sheets marked DS-12 to fill the doors. All door sheets and angles are factory punched to make this much of the assembly. All bolts should be left loose until the door has been checked to make sure it is square. After this check is made bolts should be tightened.

Field punch holes through the sheets for the ½" x 1" bolts to hold the corner plates and the girts marked DA-4 in place. This will keep the sheets from bulging over the bolt head.

The girts marked DA-4 bolt to the inside of door. When in place punch holes in sheets in the flat between corrugations to match girt punching and bolt with stove bolts. Attach the bow type handle to the DA-2R by punching holes through the sheet. Attach the door rollers to top frame angle of door.

Door Erection: These doors are inside slide type. Place two track brackets on one piece of track and bolt these to the door header so this track is centered in opening. Bolt the other two pieces of track in place using a bracket at the splice and two other brackets on each piece. Do not bolt the two end brackets in place until after doors have been hung.

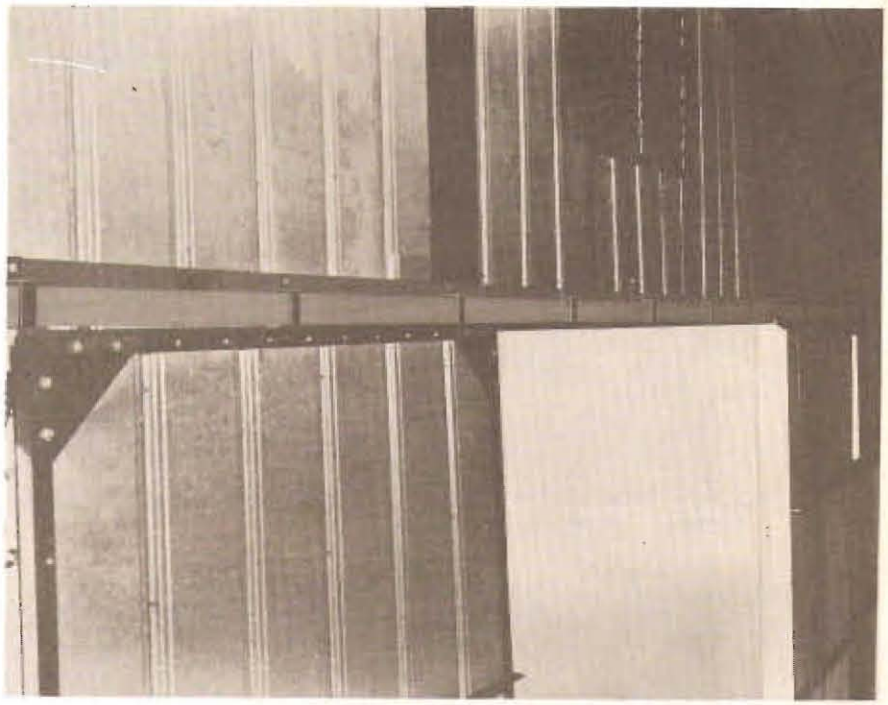


Figure 32

Hang doors and bolt the two end track brackets in place. Adjust doors for level by the top rollers. Close the doors and locate the center door stops. Star drill holes and secure to the concrete with $\frac{3}{8}''$ expansion shields ond screws. With doors in closed position locate the door guide shoe at each jamb so the doors will be held firmly ogainst jambs. Star drill holes and secure guides to concrete with $\frac{3}{8}''$ expansion shields.

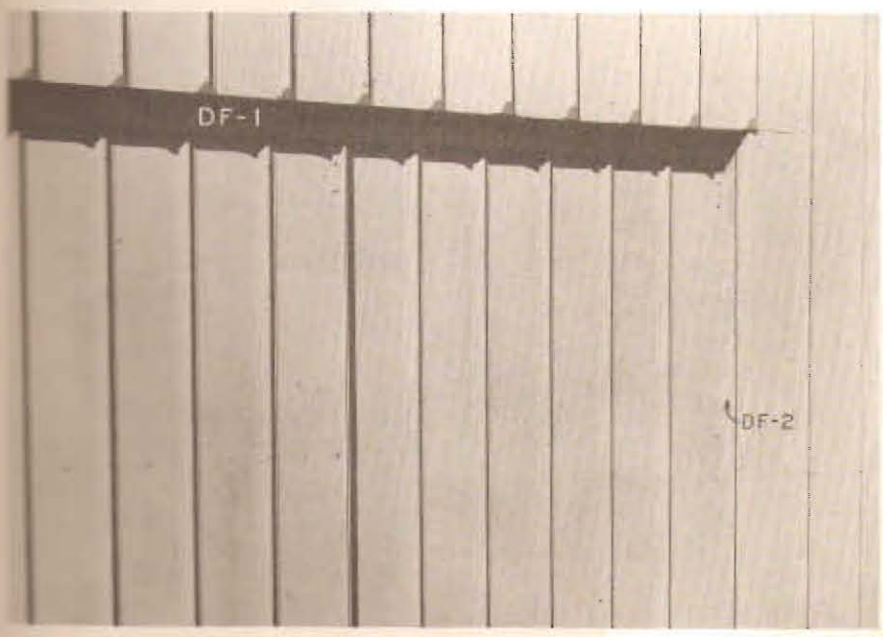


Figure 33

Bolt door header flashing marked DF-1 to slotted holes in door header and bolt the side door flashing marked DF-2 to slotted holes in door posts. Use $\frac{1}{4}'' \times \frac{3}{4}''$ stove bolts

ASSEMBLY OF WINDOWS

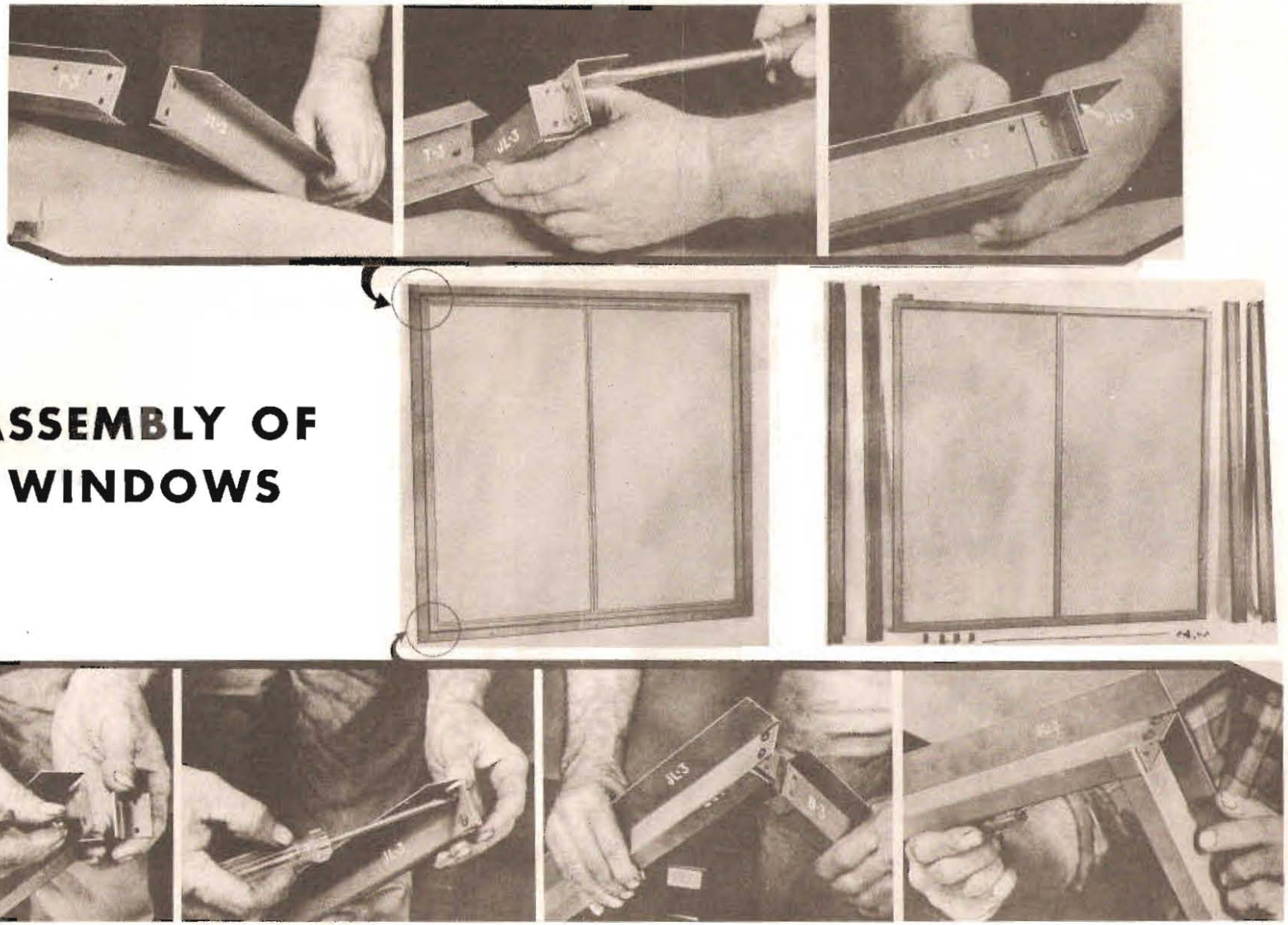


Figure 34

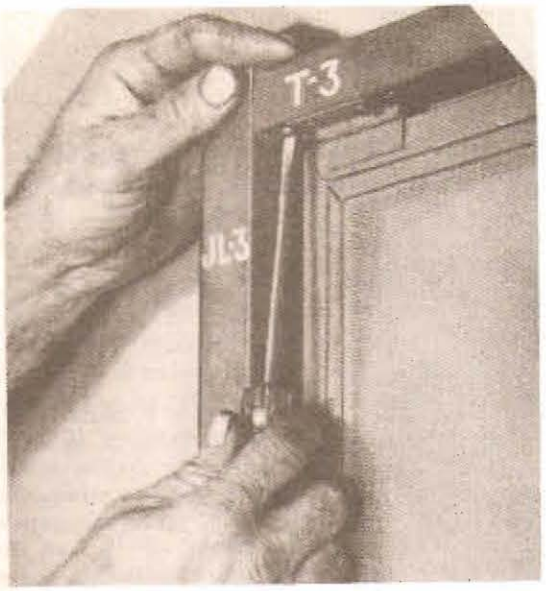


Figure 35

After outside frame is assembled, window is inserted and hinges attached with self tapping screws as indicated.

Stay bar is attached, on inside of window unit, to clip near bottom of vertical center bar with machine screws as illustrated.

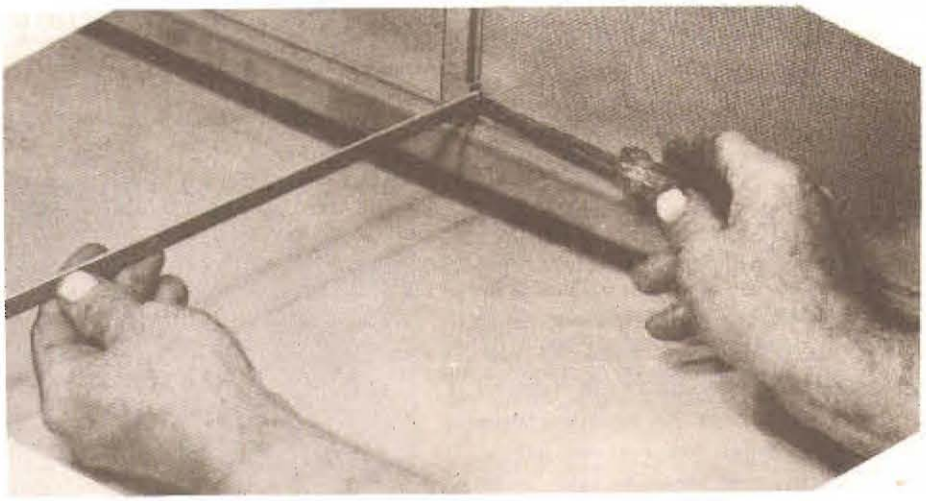


Figure 36

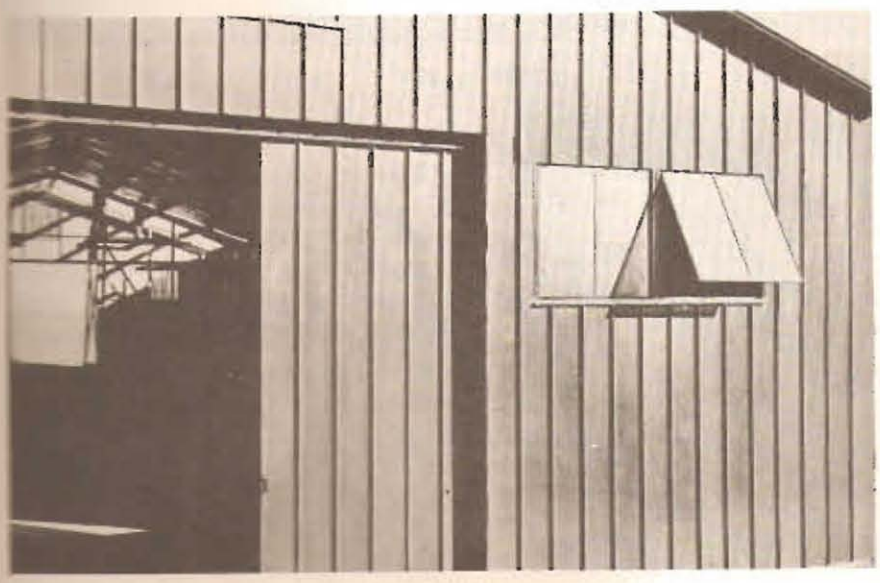


Figure 37

INSTALLATION OF WINDOWS:

Place the window sash in opening having top of window behind wall sheets above window, and outside of side window sheets. Place the 2 type flashing under sill of window so it will extend out and down over the top of corrugations. Place sheet marked SW-3 between windows at time of window installation.

BASIC UNIT
THE SIDEWALL AND ROOF COVERING

Drawing No. 7-BE-2623-2

The sides and roof are covered with BUTLER corrugated sheets having corrugations on 12" centers as described in preceding section "End Covering." All bolts for the sheet installations are $\frac{1}{4}$" x $\frac{3}{4}$" oven head stove bolts. The roof may be applied before the sides or visa versa.

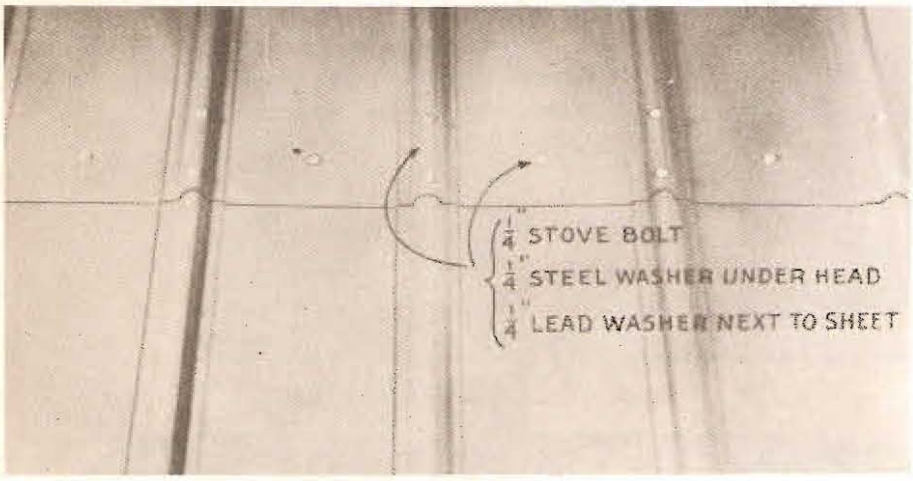


Figure 38

On the roof sheets only use one steel washer and one lead washer under the head of each bolt being sure the lead washer is next to the sheet.

There is a tendency for all types of sheet covering to "grow" as it is being installed. To prevent this the sheets are factory punched where they bolt to the base angle and the eave strut. All holes for sheet end laps are factory punched thus establishing a predetermined lap. If the sheet holes do not match the framing holes at any time during installatian a careful check shauld be made as to squareness of the building, since when you start punching these holes you will have to continue punching on the rest of the building.

Side Sheeting: The height of this wall requires the use of two sheets, the lawer sheet marked W-1 and the upper sheet marked W-22. It is suggested twa lower sheets and two upper sheets be sub-assembled and installed on the sidewall as a group to speed the erection. Make sure the top sheets lap over the bottam sheets. Fasten wall sheets to base angle and work eave strut to attach in factory hales.

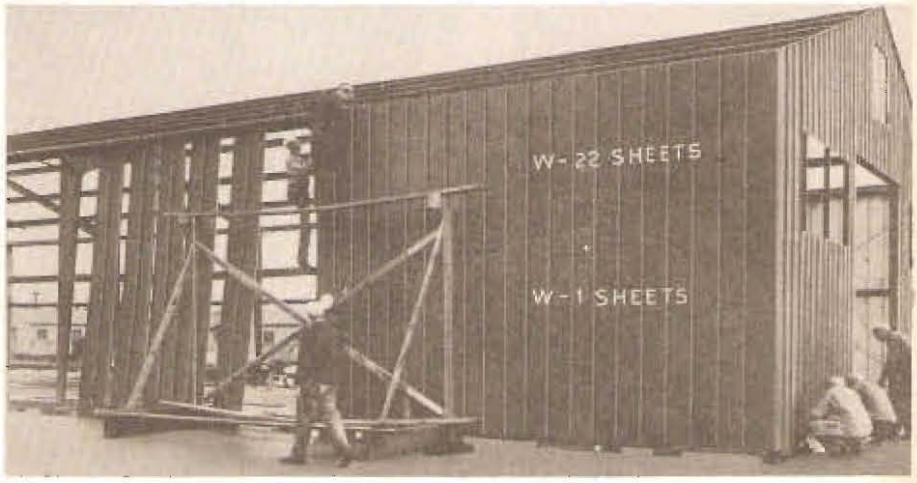


Figure 39

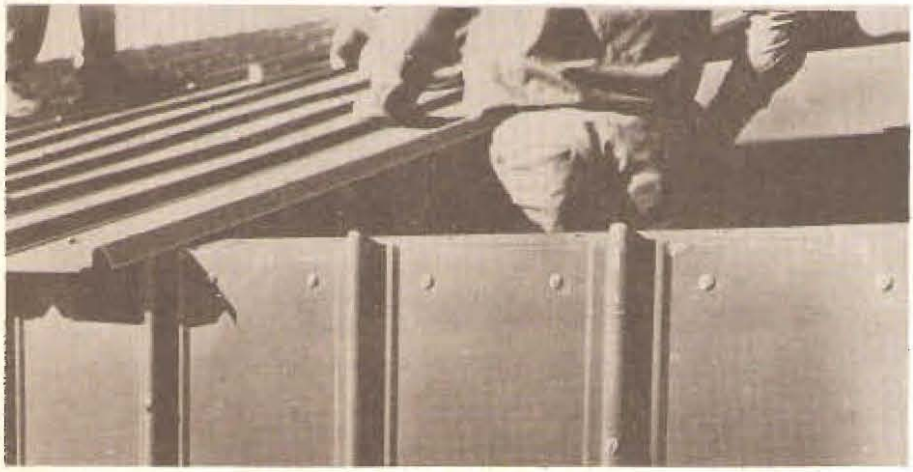


Figure 40

Holes are punched in the sidewall girts and after all wall sheets are installed holes are to be punched in the wall sheets matching these girt hales, with the punch provided.

The top of the corrugations on the top sheets are specially formed to praject into the roof sheet corrugatians to weathertight the eave.

Roof Sheeting: Use lead and steel washers on all bolts in the roof. Be sure to lap the top sheet over the bottom sheet. Asphaltum mastic with gun is furnished to seal horizontal end laps of roof sheets. Under normal weather conditions this mastic need not be used elsewhere. Apply the mastic to lower roof sheet (R-22) being sure to keep bead of mastic below factory punched holes in flat of sheet between corrugations.

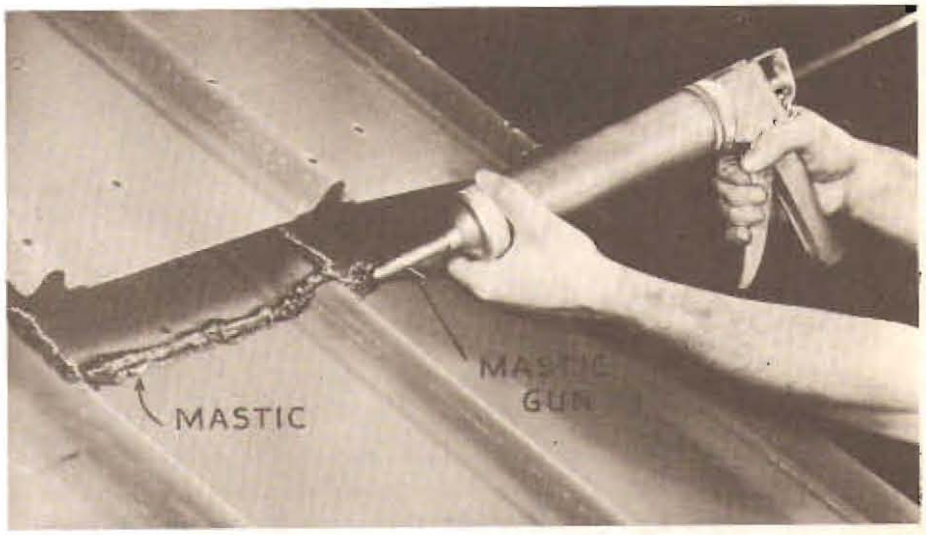


Figure 41

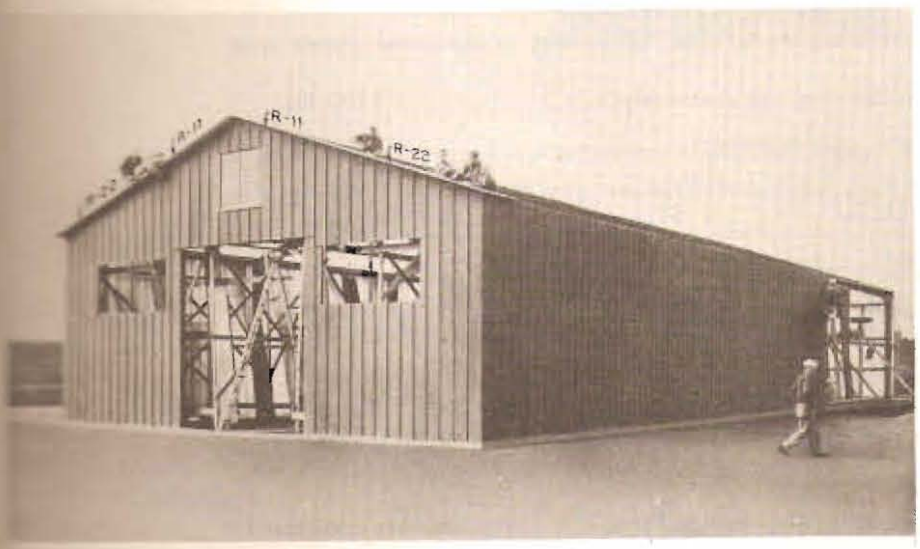


Figure 42

The top sheets marked R-11 have one end curved and to form the ridge of the building the curved ends of the ridge sheets are bolted together. The lower or eave sheets marked R-22 have one end punched for the splice connection to the ridge sheet and the other end is punched between corrugations to bolt to the eave strut. This completes one run of sheets over the building. Bolt this one run of sheets to the eave strut centering it over the end truss and field punch holes in these roof sheets to attach them to the gable angle. Be sure to keep the gable angle parallel with the line of corrugations.

NOTE: Be sure first row of sheets is started square with the building.

The roof sheets may also be subassembled into groups of two or more and assembled as a group on the roof. When applying roof sheets, in order to prevent the above explained tendency to "grow" it is suggested that as each complete run of roof sheets is installed that they be bolted to purlins making sure the holes which are punched in the sheets, to match the factory punched purlin, is exactly in the center of the roof sheet between corrugations. Proceed the length of the building keeping sheets straight.

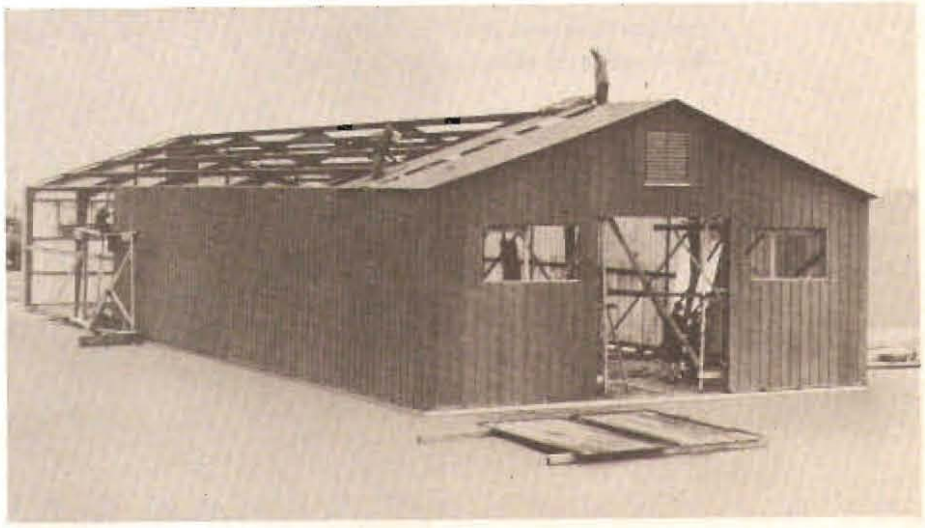


Figure 43

BASIC UNIT
SUGGESTIONS TO ERECTOR

This erection procedure as a whole is based on field conditions where all erection must be handled by manual labor. If mobile equipment is available the erection can be followed along the same general pracedure but would be speeded considerably. A mobile crane with a baom about 20′ lang would speedily erect the rigid frames.

For your help approximate weights of the following component parts are:

One end frame less the wall framing, approximately	1100 lbs.
One intermediate rigid frame, approximately	1200 lbs.
One purlin, approximately	65 lbs.
One girt, approximately	130 lbs.
One assembled eave strut, approximately	130 lbs.
One wall sheet, approximately	25 lbs.

The ease of erection and alignment of this building is based on getting the end truss correctly assembled since this is used as a jig for welding the intermediate rigid frames.

Organization: While one crew is welding the rigid frames together, another crew can be laying out the foundation. If the foundation has been previously made this crew can be assembling the other end truss and proceeding with the erection of the building. As soon as the first end bay is erected and properly squared with the diagonal rod bracing, another crew can assemble and erect the complete end wall. Much sub-assembly can be carried on while the erection of certain parts is being done.

A sheeting crew consists of two men, one man equipped with a Yankee screwdriver and a lining-up punch. This man will work on the outside of the building. The second man will work on the inside of the building opposite his partner. The bolts and nuts shall be separated giving the nuts to the man on the inside of the building and the bolts to his partner. To speed up this work a third man can keep two sheeting crews busy by obtaining and laying out sheets for each crew.

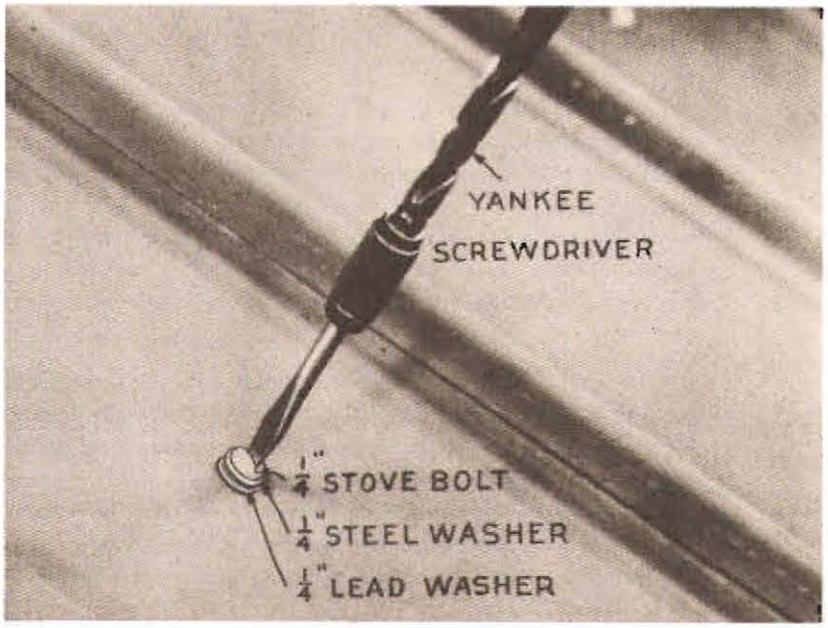


Figure 44

Care should be token not to tear or repunch any factory punched sheet holes. If these do not line up with factory punched framing holes a check should be made on the alignment of the building.

There is o knack in breaking the metal band on crates that if used will save time and tempers. Insert a screwdriver under band and turn blade so that sharp side of blade will contact band and then pull screwdriver up quickly. This will break band easily.

Tools: A list of the tools furnished is in the material list. Three complete sets are furnished for every five buildings and if a group of buildings are to be erected ot one location these tools can be pooled for more convenience.

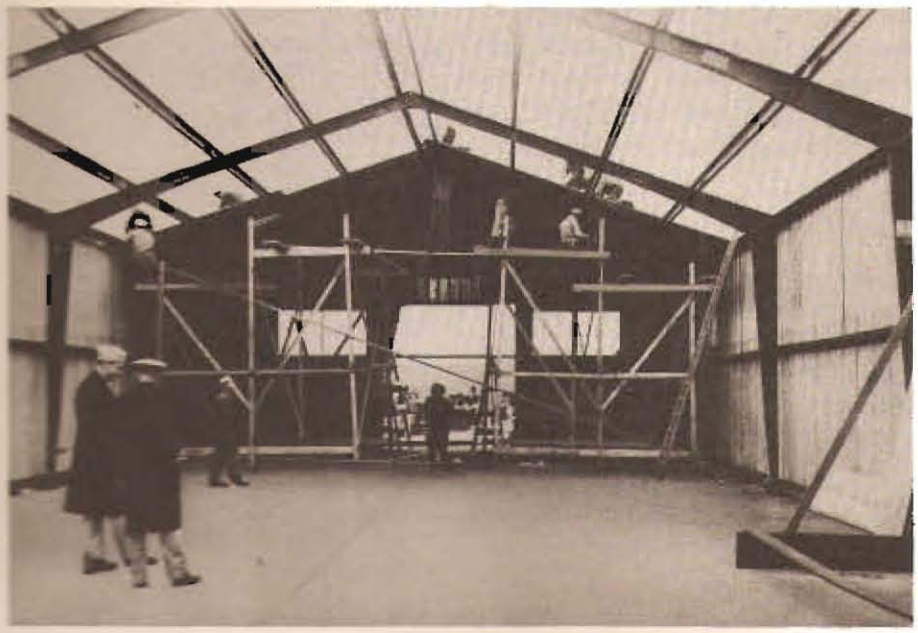


Figure 45

SCAFFOLDING:

This shows one type of scaffolding used to apply roof. This is simple and may be constructed from the crating lumber.

BASIC UNIT
ADAPTIONS

Buildings set side by side: If desired to obtain more working area under one roof, these Butler rigid frame buildings can be set side by side. The adjacent sidewall sheets and girts need not be used giving a clear opening between buildings. It is recommended, in order to obtain necessary gutter area joining the roofs of these buildings, the buildings be spaced apart 2′ 1″ back to back of adjocent columns. Core should be taken to keep this meosurement exact and for faundation plan for buildings when they are so set refer to drawing No. 7-BF-2623. This drawing will give you information for the foundation for any number of buildings set side by side.

It will be necessary to make the gutter between these buildings in the field. For this we recommend the use of the sidewall sheets marked W-1. Flatten the two outside corrugations of these sheets and bend as shown on the upper left hand corner of drawing No. 7-BE-2623-1. When installing use the same bolts as those that join the eave sheet to the eave strut. This gutter should slope approximately $\frac{5}{8}$″ every eight feet from the center of the building out toward each end wall. Lap ends of gutter at least 6″ using lead and steel washers on bolts to hold gutter together. Also use a sufficient quantity of mastic to properly seal gutter.

Ta close in the 2′ 1″ space on the end wall between columns cut and fit wall sheets around gutter thus tying the two buildings tagether and completely weathering the joint.

Buildings set end to end: Although plans are based on the erection of a 100′ long building, these buildings may be erected in lengths of any multiple of 20′. If buildings langer than 100′ are desired it is recommended you use the end rigid frame in its regular pasitian but when so used the end wall framing such as door posts, girts, etc., must remain in place as this end frame is not designed ta carry an intermediate load such as the other rigid frames can carry. If a 40′ clear opening must be had between bays of this longer building it is recommended to use one of the standard intermediate rigid frames.

Buildings on timber foundation: When buildings are intended for temporary use and a concrete foundation is not to be used, this type building may be erected on a timber foundation. In this case it is recommended that a timber which has been trimmed to give ane flat surface be used for the foundation wall.

For the base of all columns we recommend that a timber about 8″ in diameter be set into the ground vertically with the top, level with the foundation wall. This timber should set into the graund at least 4′. Under design load there is approximately 3500 pounds outward thrust at each base of the rigid frame and ta prevent movement at this point we recommend thot heavy stakes be provided in additian to the vertical timber. Lag screws should be used to secure the building columns and the building base angle to this type foundation.

The concrete foundation plan shown in drawing No. 7-BF-2623-1 can be used for general over-all dimensions of this type faundation.

Partitions: The standard end wall as shown on drawing Na. 7-BE-2623-1 can be readily used, with slight alteration, as partitions. This partition can be located at any desired position between rigid frames. It will be necessary to install the standard gable angles directly beneath the purlins. It will also be necessary to notch the end wall sheeting around the purlins ond girts All other ports of the end wall can be erected as described heretofore.

The inherent strength of the Butler Rigid Frame construction makes it possible to hang a concentrated load at any desired point an an intermediate rigid frame. Where normal wind and live loads may be expected a concentrated load of not over 4000 pounds can be suspended from rigid frame.

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