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PREPARING ENGINEERING DRAWINGS  
FOR PUBLICATION

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Transportation and Facilities Research Division  
Agricultural Research Service  
UNITED STATES DEPARTMENT OF AGRICULTURE

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PREPARING ENGINEERING DRAWINGS  
FOR PUBLICATION

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Agricultural Research Service

INTRODUCTION

The final result of much engineering research in the U. S. Department of Agriculture is a drawing--an improved layout, a new building design, or new or modified equipment. The drawings are usually published in bulletins or reports of the standard 7 7/8- by 10 1/4-inch trim size.

In the evolution of a drawing from the first rough sketches to the final published print, the sooner the engineer considers how the drawing will appear in the publication, the better. Drawings are often prepared on large sheets and must be reduced considerably when they appear in publications.

The purpose of this publication is to help engineers and draftsmen to prepare drawings that will be clear and readable when they are reproduced. Careful planning before the drawing is made, and careful checking before it is prepared in final form, will help ensure that:

1. The drawing does fit the standard-sizes of illustrations used in reports.
2. The lettering is clear and readable in reduced form.
3. The drawing is not too detailed to be understandable in reduced form.
4. Labels in the drawing match descriptions in the text.
5. Abbreviations, symbols, and spelling are correct.

METHODS OF PUBLISHING LARGE DRAWINGS

Some drawings are prepared on sheets as large as 3 by 5 feet; it is difficult to prepare a layout of a 20,000-square-foot plant showing the important equipment without making a large drawing. Sometimes the reduction required to fit the drawing into a publication would make the details or lettering unreadable. To prevent excessive reduction of large drawings, consider the following methods of preparing and publishing the drawing:

1. Compact the drawing.--The first consideration in preparing engineering drawings for publication is to prepare and arrange the drawing so that it can fit the standard 7 7/8- by 10 1/4-inch publication and still be clear and readable. Details on many drawings may be compacted, and wasted space eliminated, so that the main part of the drawing is not unnecessarily reduced. For example, the large white area between the body of the drawing and the border could be reduced in figure 1. The legend in figure 2 could be removed from the drawing and put in print on a facing page of the text; thus the layout could be shown at a larger scale. Other details and lettering can be eliminated from the drawing and put into the text in chart or table form. For example, figure 3 shows a room-finishing schedule in chart form that can be placed in the text rather than on the drawing.

2. Separate the drawing into its components.--Drawings can sometimes be split into their various components: For example, the drawing shown in figure 4 might have been made into two or more drawings with the floor plan, elevations, and details shown on separate sheets. Detailed floor plans of large warehouses or plants can also be divided. The overall layout of a plant with the various rooms can be shown in one drawing and details of each room can be shown on separate drawings.

A disadvantage of this method is that it is sometimes difficult to get the overall view or concept of the design if it is divided into several drawings. It makes considerable cross-referencing and turning of pages necessary. The main advantage of this method is that drawings do not have to be reduced as much and can usually fit the standard 7 7/8- by 10 1/4-inch publication.

3. Divide the drawing into two parts and place the parts on facing pages of the text.--This method is similar to method 2, except the drawing is always divided into two parts and the parts are always placed on facing pages of the report. This eliminates some of the cross-referencing required by method 2 and eliminates some of the problems of foldouts--method 4 (fig. 5).

One disadvantage is that special care must be taken and careful instructions given to the printer to make sure that drawings will face each other in the final publication and that borderlines, match lines, etc., do match up. See figures 6-A and 6-B. This method is not practical for large layouts, floor plans, or maps that cannot be divided into two parts. One exception to this is the center spread of the publication, where the drawing can run continuously across two pages without a break.

4. Use a foldout.--Where methods 1, 2, or 3 cannot be used, the foldout may be the solution for large layouts, floor plans, maps, etc. Foldouts require special attention when the publication is put together at the printer's, and thus they greatly increase the cost. If many pages of the report are foldouts, the report is not as neat as others and is often bulky.

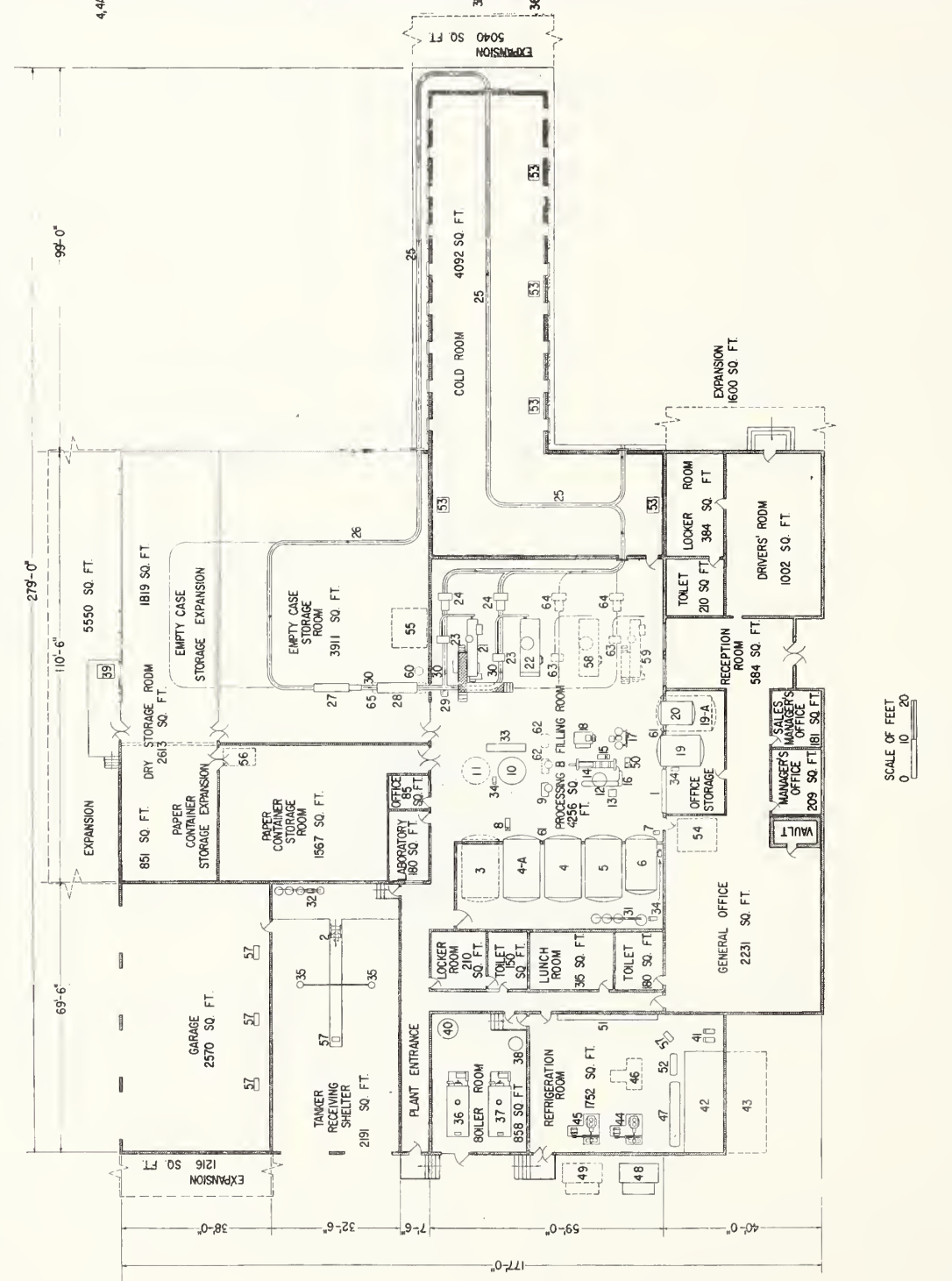
5. Make a larger publication.--Reports made up of extra-large pages are difficult to handle, distribute, and store. But in some special cases, this may be the only practical solution. For example, with a report in which about 20 percent or more of the pages are large drawings, a larger publication might be more practical and cheaper than using bulky foldouts. A report with





**LEGEND**

- 1 CONTROL PANEL 180 GPM
- 2 RECEIVING PUMP
- 3 FUTURE 10000 GAL RAW MILK STORAGE TANK
- 4,4A,5 7000 GAL RAW MILK STORAGE TANKS
- 6 4000 GAL SKIM MILK STORAGE TANK
- 7 TRANSFER PUMP 75 GPM
- 8 POSITIVE DISPLACEMENT PUMP 20 TO 70 GPM
- 9 11000 #/HR COLD MILK SEPARATOR - 40,000 #/HR CLARIFIER
- 10 1000 GAL 1/2 B 1/2 VAT
- 11 FUTURE 1000 GAL VAT
- 12 BALANCE TANK
- 13 VITAMIN FEED CABINET
- 14 3500 GPH PLATE HEAT EXCHANGER
- 15 POSITIVE DISPLACEMENT TIMING PUMP
- 16 HOLDER TUBE
- 17 ULTRA HIGH TEMPERATURE HEATER
- 18 3500 GPH HOMOGENIZER
- 19 3000 GAL PASTEURIZED MILK SURGE TANK
- 19A FUTURE 6000 GAL SURGE TANK
- 20 1000 GAL PASTEURIZED 1/2 B 1/2 SURGE TANK
- 21 QUART & PINT PAPER CARTON FILLER 75 CARTONS/MIN.
- 22 HALF GALLON PAPER CARTON FILLER 72 CARTONS/MIN.
- 23 AUTOMATIC CASER 100 CARTONS/MIN.
- 24 AUTOMATIC CASE STACKER 15 CASES/MIN.
- 25 FLOOR CONVEYOR
- 26 IN-FLOOR CONVEYOR STACK MAGAZINE
- 27 AUTOMATIC CASE UNSTACKER 15 CASES/MIN
- 28 CASE WASHER 15 CASES/MIN
- 29 AUTOMATIC CASE DIVIDER
- 30 ABOVE FLOOR CONVEYOR
- 31 AUTOMATIC CIP UNITS
- 32 COP PORTABLE WASH TANK
- 33 CIP SOLUTION RETURN PUMP 160 GPM
- 34 CIP TRANSPORT TANK WASHER ON HOIST
- 35 75 BHP STEAM BOILERS
- 36,37 BOILER FEED WATER SYSTEM INCINERATOR
- 39 HOT WATER TANK
- 40 SWEET WATER PUMPS
- 41 46,000 # ICE BUILDER
- 42 FUTURE ICE BUILDER
- 44 50 HP AMMONIA COMPRESSOR
- 45 30 HP AMMONIA COMPRESSOR
- 46 FUTURE AMMONIA COMPRESSOR
- 47 20" x 16" AMMONIA RECEIVER
- 48 65 TON EVAPORATIVE CONDENSER
- 49 FUTURE EVAPORATIVE CONDENSER
- 50 HOT WATER SET FOR HT ST SYSTEM
- 51 ELECTRIC DISTRIBUTION PANEL
- 52 20 HP AIR COMPRESSOR
- 53 COOLING UNITS
- 54 10,000 CFM AIR CONDITIONING UNIT ON ROOF
- 55 20,000 CFM AIR CIRCULATING & HEATING UNIT ON ROOF
- 56 5000 CFM AIR CIRCULATING & HEATING UNIT ON ROOF
- 57 UNIT HEATER SUSPENDED FROM CEILING
- 58 FUTURE HALF GALLON PAPER CARTON FILLER
- 59 FUTURE QUART-PINT PAPER CARTON FILLER
- 60 CONVEYOR LUBRICANT SUPPLY TANK
- 61 CIP HOOP UP STATION
- 62 FUTURE CLARIFIERS
- 63 FUTURE AUTOMATIC CASERS
- 64 FUTURE AUTOMATIC STACKERS
- 65 FUTURE CASE WASHER



SCALE OF FEET  
0 10 20

Figure 2.--Legend could be placed on facing page of text, and the image size of drawing could then be larger.

FINISH SCHEDULE																			
FLOOR						BASE				WALL				CEILING				REMARKS	
FINISH NUMBER	Asphalt Tile	Concrete	Terrazzo	Vinyl Asbestos	Wood	Unglazed Facing Tile	Brick	Glazed Facing Tile	Wood	Rubber	Brick	Concrete Block	Glazed Facing Tile	Wood	Plaster	Wood Fiber Deck	Metal Acoustic Pan	Cement Plaster	
1	X					X					X				X				
2		X				X					X				X				
3				X		X					X				X				
4			X				X				X		X				X		
5				X				X			X				X				
6			X			X					X					X			
7			X			X	X			X	X				X				
8			X				X				X		X		X				
9	X					X					X				X	X			
10				X					X		X				X				
11		X				X	X				X	X			X				
12		X					X				X				X				

Figure 3.--This room-finishing chart was removed from a drawing and placed in the text.

dimensions of 10 1/4 by 15 7/8 inches, bound along the 10 1/4-inch side, would be considered standard size for such large reports containing engineering drawings.

One solution to the problem of distributing and storing large reports is to have the publication folded in half at the printer's with the cover shown on the exposed half (fig. 7). This is called a soft-fold publication.

6. Distribute drawings separately from report.--For large, detailed drawings another solution is to distribute full-size or nearly full-size reproductions of the drawings separately from the report. The drawings can be distributed through trade associations, State colleges, private concerns, or the originating division. A report or press release can be distributed describing the engineering drawings and giving instructions about where the drawings can be obtained. For example, the drawing shown in figure 8 (Gainesville Livestock Market) was distributed through a trade association. Plans for farm buildings prepared by the Agricultural Engineering Research Division (AERD) are distributed through State agricultural colleges and other agencies.

The main advantage of this method is that drawings can be kept at or near full-scale. The disadvantages may be the extra problems and cost in distributing the drawings.

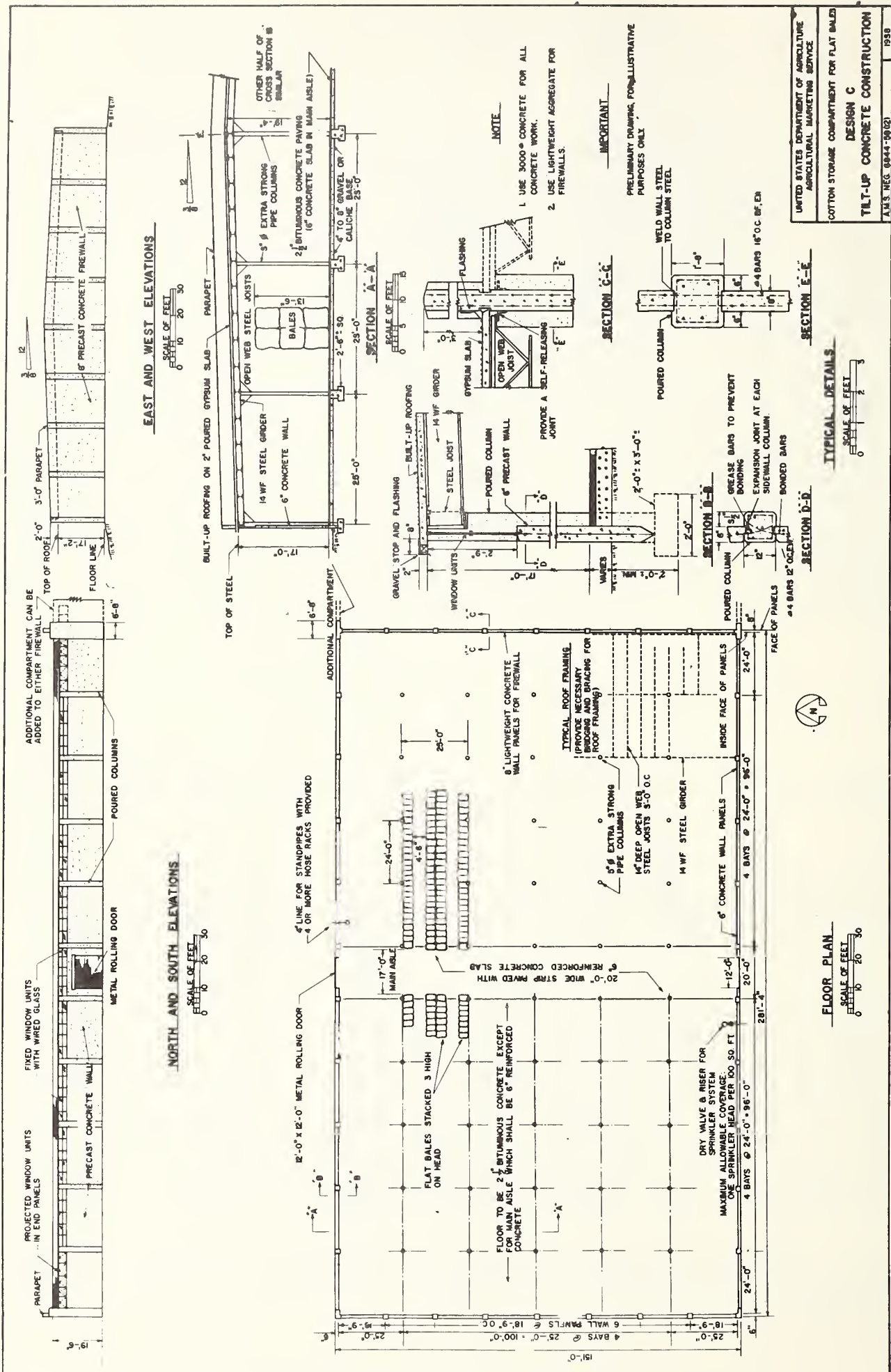


Figure 4.--An example of crowded detail. Sections "A-A" through "E-E", with notes, should have been placed on another drawing.

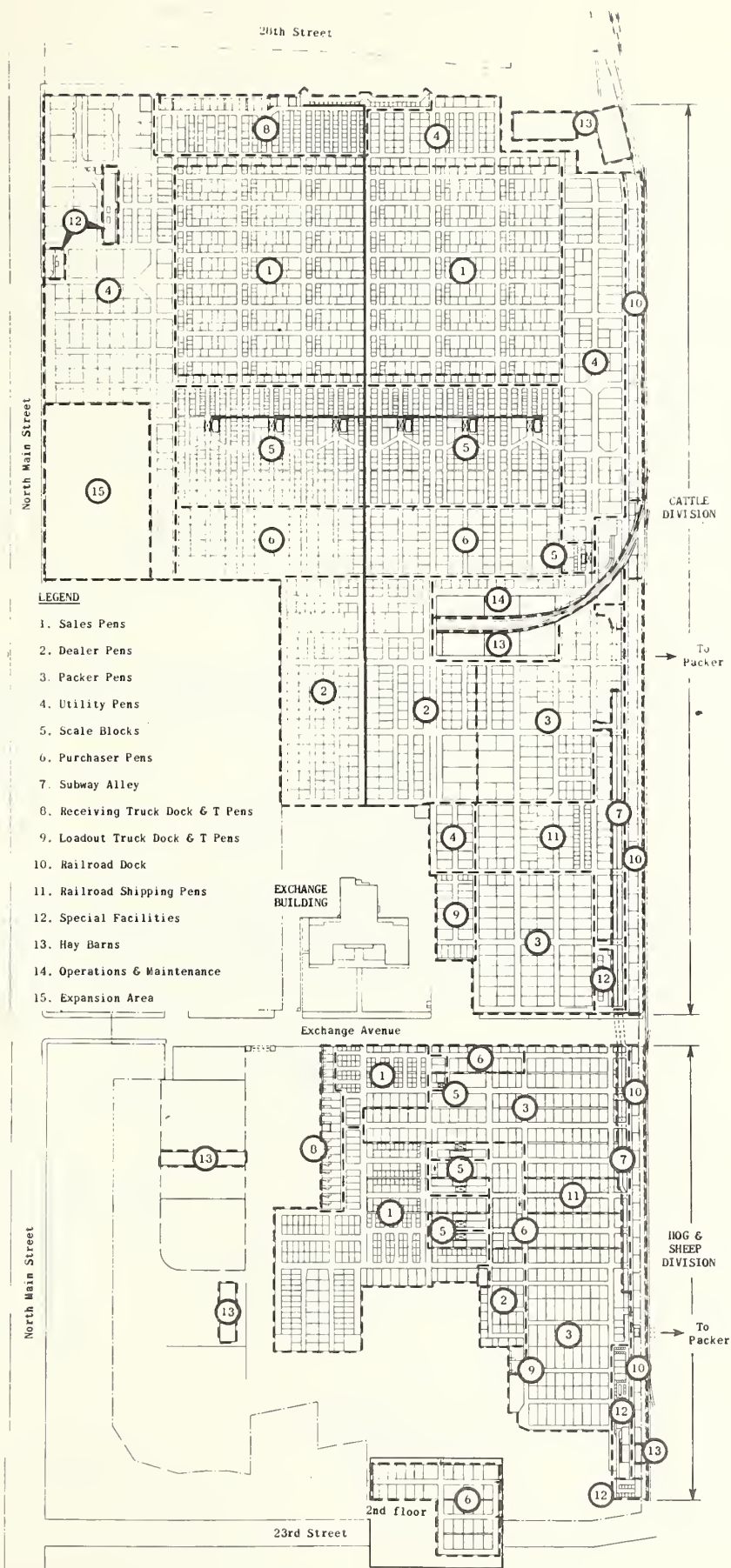
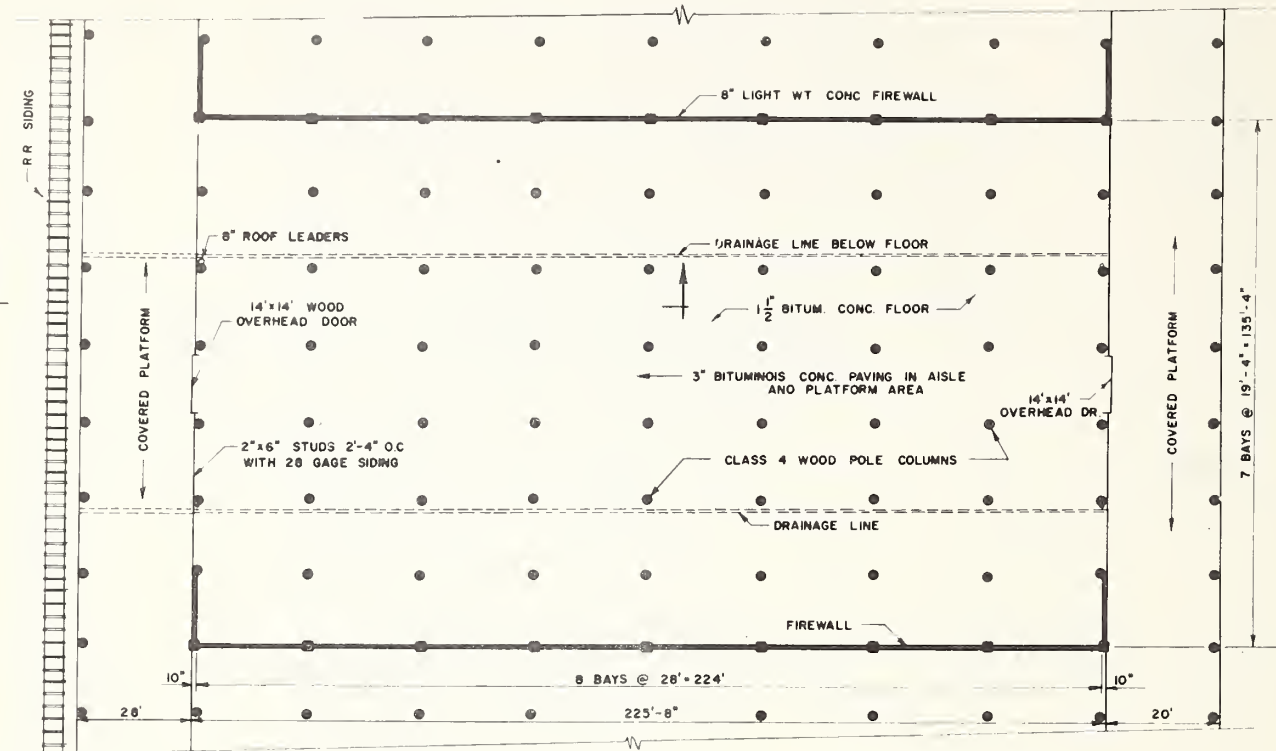
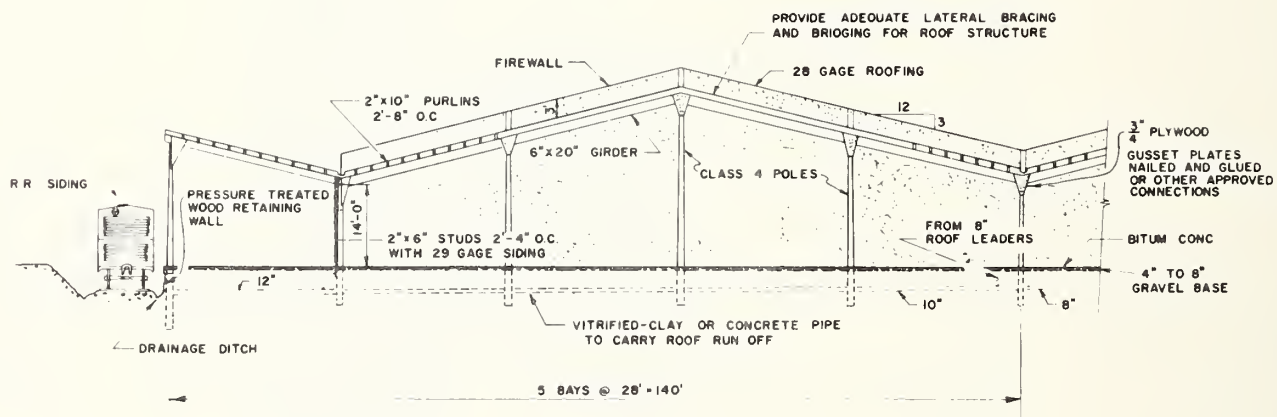


Figure 5.--This long, narrow drawing could be turned sideways and reproduced as a foldout. The lettering would have to be changed to the proper direction for reading across the page.



FLOOR PLAN  
ONE STORAGE COMPARTMENT

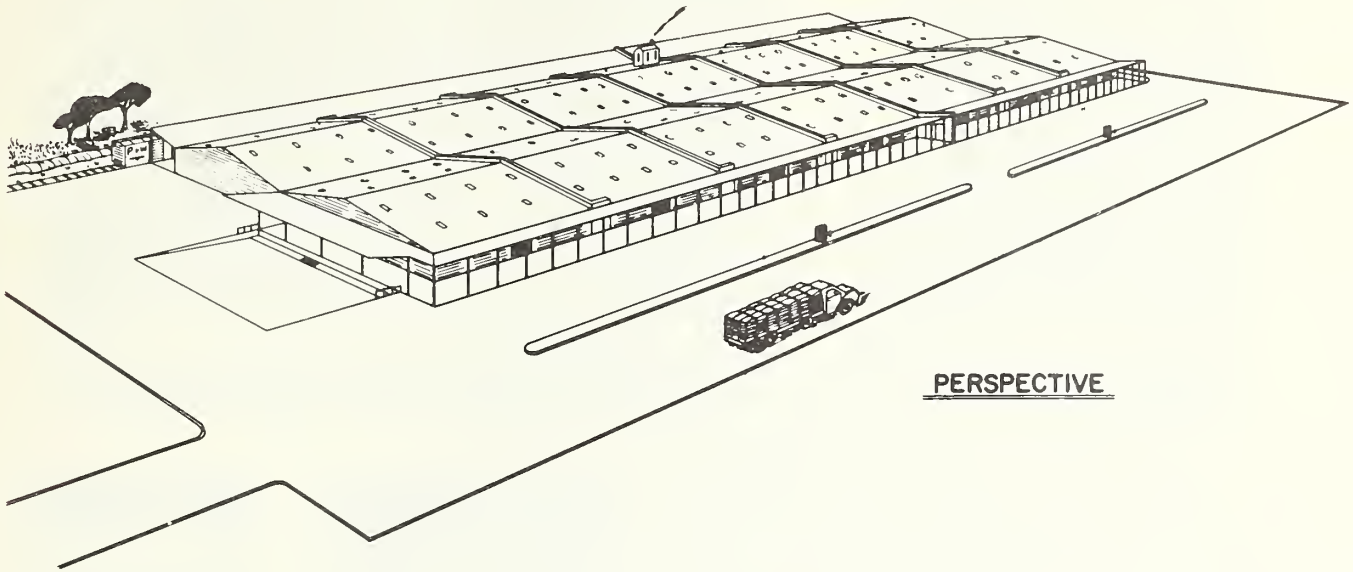
SCALE OF FEET  
0 8 16 32



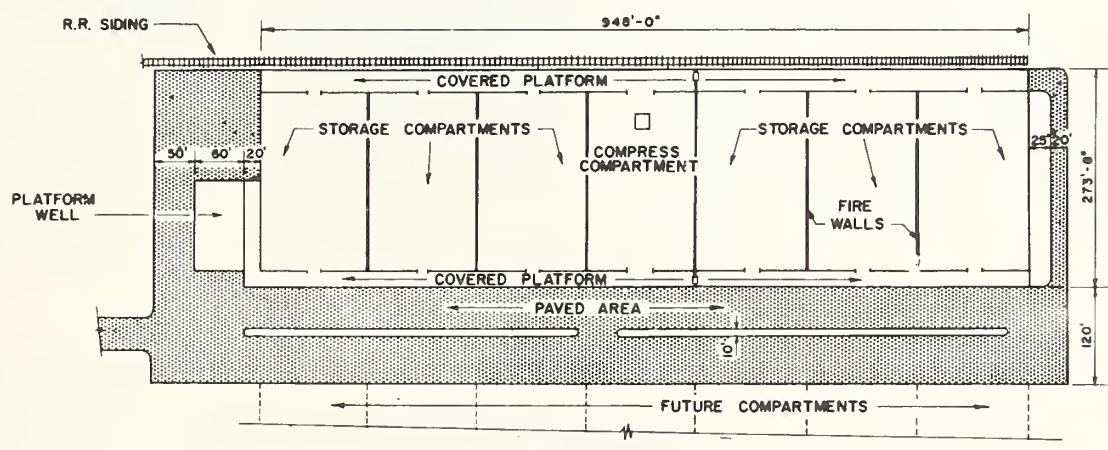
SECTION

SCALE OF FEET  
0 5 10 20

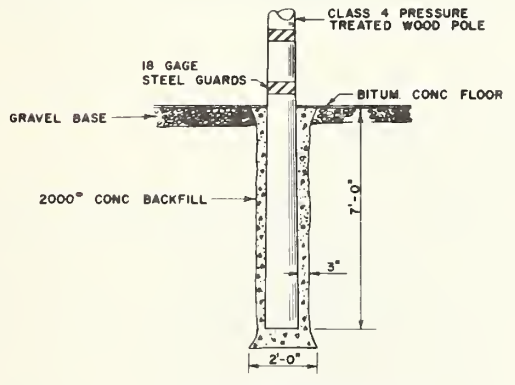
Figure 6-A.--This drawing was divided in half to make a facing-page illustration.



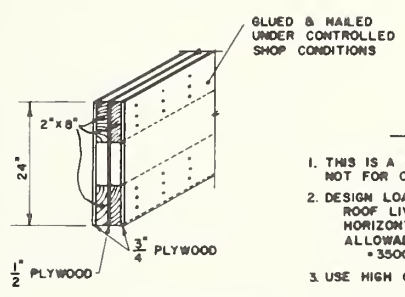
PERSPECTIVE



SITE PLAN  
SCALE OF FEET  
0 50 100 150



POLE FOUNDATION  
SCALE OF FEET  
0 1 2 4



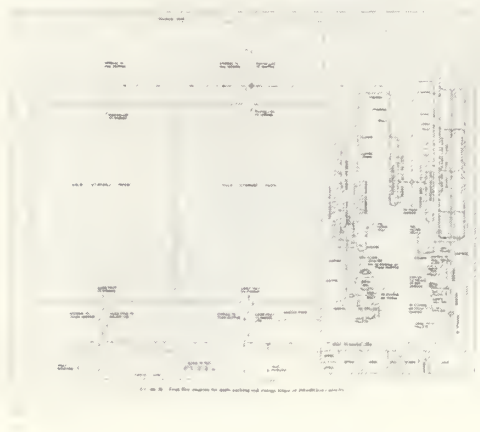
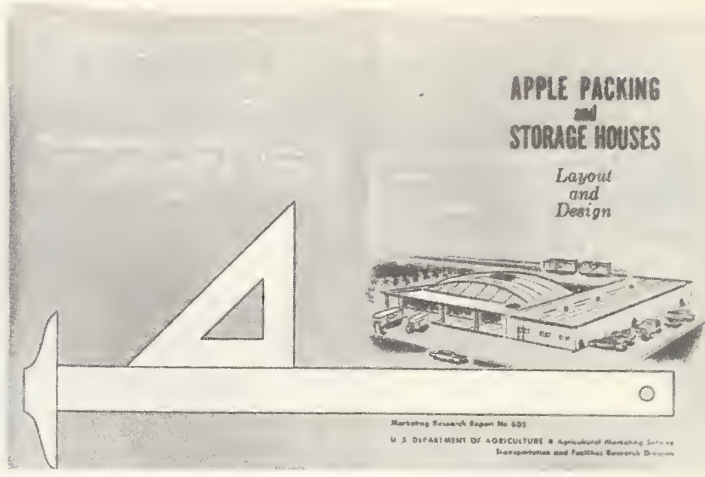
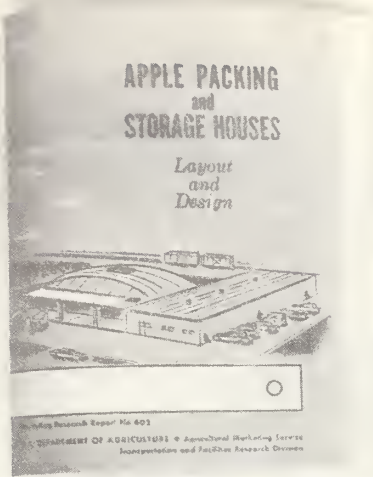
PLYWOOD BOX BEAM  
(SUBSTITUTE FOR 6" x 20" GIRDER)

NOTES

1. THIS IS A PRELIMINARY DRAWING, NOT FOR CONSTRUCTION PURPOSES
2. DESIGN LOADS:  
ROOF LIVE LOAD = 20 PSF  
HORIZONTAL WIND LOAD = 20 PSF  
ALLOWABLE SOIL BEARING CAPACITY = 3500 PSF
3. USE HIGH QUALITY STRESS-GRADE LUMBER

UNITED STATES DEPARTMENT OF AGRICULTURE  
AGRICULTURAL MARKETING SERVICE  
COTTON WAREHOUSE FOR STORING  
COMPRESSED BALES  
POLE TYPE CONSTRUCTION  
AM 5 NEG. 230-82(9) 1962

Figure 6-B



The house, the packing and storage house... (Detailed architectural description text follows, describing the layout and design of the facility.)

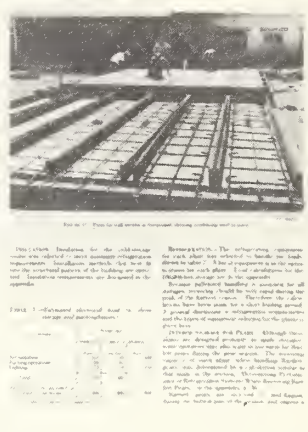


Table 1: Recommended size of drawings and lettering to fit various parts of the standard 6 1/2- by 8 3/4-inch printed matter on a 7 7/8- by 10 1/4-inch page.

Part of Drawing	Recommended Size
Full page illustration	6 1/2" x 8 3/4"
Half page illustration	3 1/4" x 4 1/8"
Quarter page illustration	1 3/4" x 2 1/8"
Lettering (various sizes)	Varies from 1/4" to 1 1/2"

Figure 7.--A folded 15 7/8- by 10 1/4-inch report (MRR No. 602) requires no more space than the standard 7 7/8- by 10 1/4-inch report but allows much larger illustrations. This illustration shows the front cover of the report when it is folded to 7 7/8 by 10 1/4 inches; the front cover with the report unfolded to the full 15 7/8 by 10 1/4 inches; and two facing pages, each 15 7/8 by 10 1/4 inches.

### MAKING DRAWINGS IN THE PROPER PROPORTIONS

The original drawing must, of course, be drawn in the same proportions that the drawing is to appear in the publication. Table 1 shows the recommended size of the original drawing and lettering to fit various parts of the standard 6 1/2- by 8 3/4-inch printed matter on a 7 7/8- by 10 1/4-inch page: 1/4, 1/2, and full page (fig. 9). Note that these sizes are nominal and that the dimensions of drawings that appear in publications are affected by the number of lines in the legend, whether the legend is at the side or bottom of the page, and other considerations.

As shown in table 1 and figure 9, the nominal half page illustration covers a little more than half the page. This is recommended so that standard drawing sheets can be used. To provide good balance between text and illustration some prefer illustrations that take 1/3 or 2/3 of the page rather than half of the page.



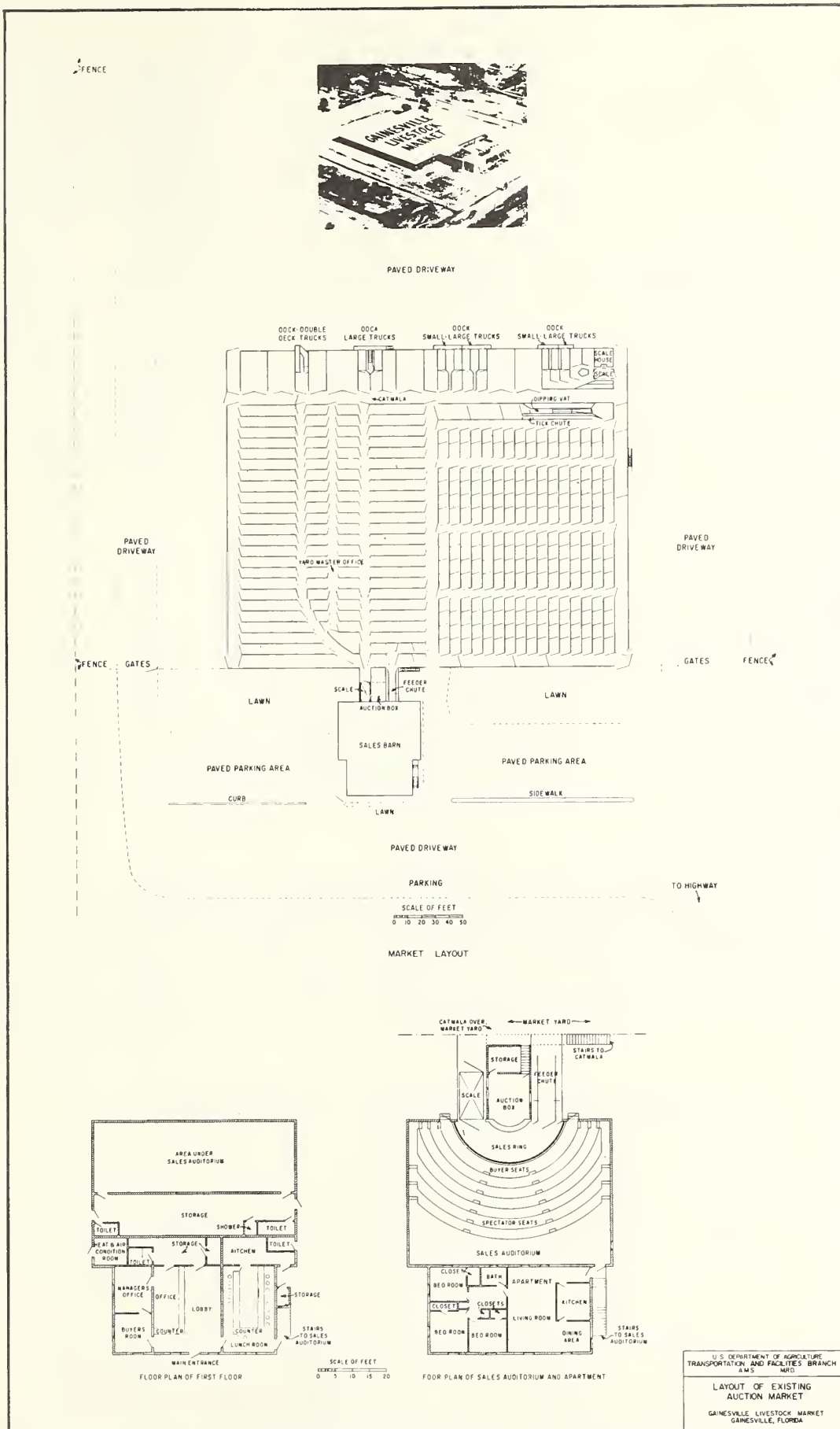


Figure 8.--A long, narrow drawing that was distributed full-size through trade associations. Original size was 16 by 26 inches.

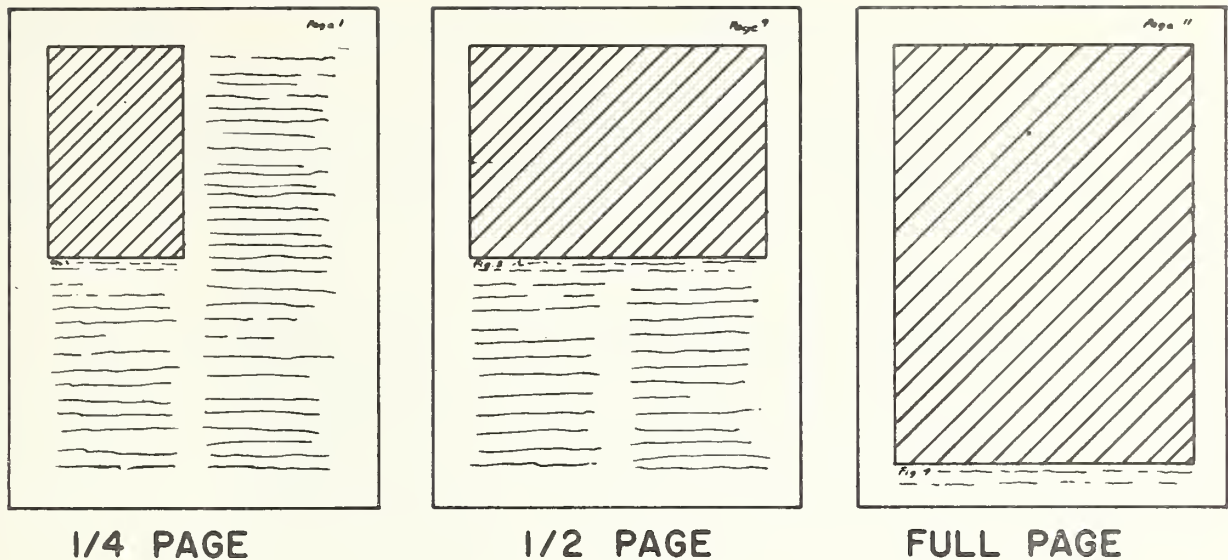
Table 1.--Recommended sizes of original drawings and lettering

Nominal size of Illustration	Actual size of published illustration (border size)	Approximate ratio of length of illustration to width	Recommended size of original drawing		Amount of reduction	Recommended size of lettering on original drawing <sup>1/</sup>
			Inches	Inches		
1/4 page <sup>2/</sup> .....	3 x 4	1 : 1.33	8 1/2 x 11 3/4	8 x 10 1/2	62	175
1/2 page.....	5 x 6 1/2	1 : 1.33	17 x 22	16 1/2 x 21 1/4	67	200
Full page.....	6 1/2 x 8 1/2	1 : 1.33	17 x 22	16 1/2 x 21 1/4	60	175
2-part illustration on facing pages.....	each drawing 6 1/2 x 8 1/2	1 : 1.33	17 x 22	16 1/2 x 21 1/4	60	175
Foldout.....	9 x 14	1 : 1.58	22 x 34	21 x 33	60	175
Full page in large report, 10 1/4 x 15 7/8 inches.....	9 x 14	1 : 1.58	22 x 34	21 x 33	60	175

<sup>1/</sup> Leroy No. 175 is 3/16 inch high and No. 200, 1/4 inch high. Use the sizes recommended above for lettering at least 1/16 inch high after reduction. Use larger type for headings, titles, and so forth. See footnote 2 on page 16 about trade names.

<sup>2/</sup> See figure 9 for explanation.

<sup>3/</sup> Lettersize sheets (8 1/2" x 10 1/2") can be used in place of 8 1/2" x 11" sheets.



### QUARTER, HALF, AND FULL PAGE ILLUSTRATIONS

Figure 9.--The full-page illustration in this drawing is vertical on the page, and the legend is at the bottom of the page. A full-page illustration that runs broadside of the page must be reduced enough to allow space for the legend along the right-hand margin.

As can be seen from the table, all the various sizes of illustrations can be drawn on drawing sheets of three sizes: 8 1/2- by 11-inches, 17- by 22-inches, and 22- by 34-inches.<sup>1/</sup> It is recommended that these sizes be used so as to standardize the drawing sheets and to simplify storing the drawings. Some drawings, however--of a long conveyor, for example--may have to be made in other proportions.

### IMPROVING THE READABILITY OF LETTERING ON REDUCED DRAWINGS

In lettering an engineering drawing for publication, the draftsman has to keep in mind at all times what the finished product will look like and work back from that. Careful consideration should be given to size and spacing of letters and to line weight.

<sup>1/</sup> The three sizes are recommended by the American Standards Association. The farm building plans prepared by AERD are made on 17- by 22-inch drawing sheets.

## Size and Spacing of Lettering

To be readable, lettering should usually be 1/16-inch high on the reduced copy (table 1). Although smaller lettering can be read, drawings with a lot of detail become confusing, especially to those who are not trained in reading blueprints. Lettering for headings, titles, etc., should be 1/8-inch or higher for emphasis.

The clarity of lettering is affected also by line weight or line thickness. Heavily inked lettering sometimes becomes unreadable when it is reduced. When template lettering such as the Leroy<sup>2/</sup> is used, the pen to use in most cases is the one recommended on the template. However, when drawings are to be reduced, a smaller pen than recommended on the template is often advisable. As can be seen in figures 10 and 11, showing lettering reduced to one-half and one-fourth of original size, sometimes a smaller pen on templates Nos. 175, 200, and 240 is more acceptable than the one recommended. In figure 11, pen size 3 is recommended on template No. 240 for full-scale work, but pen size No. 1 may be better for a reduction to one-fourth original size.

Another factor involving the readability of the words that are reduced is the distance between letters. The area and not the distance between letters should appear about equal. Spacing the letters just a little farther apart than normal can often improve readability when the drawing is reduced. Too much space, however, may make it more difficult to read (fig. 12).

Another point in letter clarity is the spacing between lines. If the letter size in the original is small (Leroy #175 or less), the spacing between lines should be between one-half the height of a letter to full letter height.

## Type of Lettering

Lettering should be uppercase Gothic letters, except in special cases. For example, if the report is typewritten for offset printing, lettering for drawings can be matching typewritten letters in both upper and lower case.

## Methods of Lettering

Freehand pencil lettering is usually the most economical method of lettering. Good freehand pencil lettering will reproduce satisfactorily for reports and is often more pleasing to the eye than lettering produced with mechanical aids. (See section on pencil tracings.)

Lettering done in ink with mechanical lettering devices, such as the Leroy lettering instrument or the Wrico lettering guides, is usually slow and costly, but produces consistent, readable letters. Instant lettering transfer paper, such as Letraset, may also be used in some drawings.

---

<sup>2/</sup> Trade names are used in this publication solely for the purpose of providing specific information. Mention of commercially manufactured products does not imply endorsement by the Department of Agriculture over similar products not mentioned.

GUIDE NO. & PEN SIZE	REG. SCRIBER	EXTENSION SCRIBER		
		3	6	10
⊕ 100-00	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
100-0	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
120-00	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
⊕ 120-0	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
140-00	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
140-0	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
⊕ 140-1	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde	ABCDP & abcde
175-0	ABCDP & abcde	ABCP & abce	ABCP & abce	ABCP & abcde
175-1	ABCDP & abcde	ABCP & abce	ABCP & abce	ABCDP & abcde
⊕ 175-2	ABCDP & abcde	ABCP & abce	ABCP & abce	ABCDP & abcde
200-1	ABCDP & abcde	ABCP & abce	ABCP & abce	ABCP & abcde
200-2	ABCDP & abcde	ABCP & abe	ABCP & abe	ABCP & abcde
⊕ 200-3	ABCDP & abcde	ABCP & abe	ABCP & abe	ABCP & abcde
240-1	ABCDP & abcde	ABP & abe	ABP & abe	ABP & abcde
240-2	ABCDP & abcde	ABP & abe	ABP & abe	ABP & abcde
⊕ 240-3	ABCDP & abcde	ABP & abe	ABP & abe	ABP & abcde
240-4	ABCDP & abcde	ABP & abe	ABP & abe	ABP & abcde
240-5	ABCDP & abce	ABP & ae	ABP & ae	ABP & abce
290-2	ABCDP & abce	ABP & ae	ABP & ae	ABP & abce
290-3	ABCDP & abce	ABP & ae	ABP & ae	ABP & abce
⊕ 290-4	ABCDE & abe	ABP & ae	ABP & ae	ABP & abe
290-5	ABCDE & a e	ABP & ae	ABP & ae	ABP & abe
290-6	ABCP & abe	ABP & ae	ABP & e	ABP & abe

⊕ PEN SIZE RECOMMENDED FOR A GUIDE NUMBER WHEN DRAWINGS ARE SHOWN FULL SCALE

Figure 10.--Fifty percent reduction of Leroy lettering.

Regular typewritten lettering or labels can sometimes be put directly on the drawing, as in figure 13. Good results cannot be obtained if dirty type is used or if typing is done on glossy paper or cloth. Typewritten lettering smudges easily, so the drawing should be handled with care. If larger lettering is needed, the varityper can be used, as in figure 14.

GUIDE NO. & PEN SIZE	REG. SCRIBER	EXTENSION SCRIBER		
		3	6	10
100-00	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
100-1	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
120-00	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
120-0	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
140-00	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
140-0	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
140-1	ABCDF & abcde	ABCDP & abcde	ABCDP & abcde	ABCDEP & abcde
175-0	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
175-1	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
175-2	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
200-1	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
200-2	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
200-3	ABCDF & abcde	ABCP & abcde	ABCP & abcde	ABCP & abcde
240-1	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
240-2	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
240-3	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
240-4	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
240-5	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
290-2	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
290-3	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde
290-4	ABCDE & abcde	ABP & abcde	ABP & abcde	ABP & abcde
290-5	ABCDE & abcde	ABP & abcde	ABP & abcde	ABP & abcde
290-6	ABCDF & abcde	ABP & abcde	ABP & abcde	ABP & abcde

• PEN SIZE RECOMMENDED FOR A GUIDE NUMBER WHEN DRAWINGS ARE SHOWN FULL SCALE

Figure 11.--Leroy lettering reduced to one-fourth the original size (75 percent reduction). Note that some pen sizes are much harder to read than others, even when the letter size is constant.

Where possible, lettering should appear right side up when holding the report in its normal position. The lettering in figure 15 appears upside down when the report is held in its normal position. When lettering a drawing, the draftsman should place it on the board in the same direction as it will appear in the report. All lettering in a drawing should run in the same direction, whenever possible.

### Use of Leaders

If drawings are crowded with lettering and details, labels on sections and blowups of fine detail may be placed outside the view and leaders with arrows used to label each part. The labels themselves should be spaced so they will not interfere with each other or tend to run together. Names of equipment or equipment parts in floor plans may sometimes be placed within the outline of the equipment. Special care should be taken when the drawing is to be greatly reduced, however, because the space between the lettering and the outline may be so compressed that the lettering runs into the outline (fig. 12). In this case, and when the lettering is too large for the outline, the label should be placed outside the outline and an arrow used.

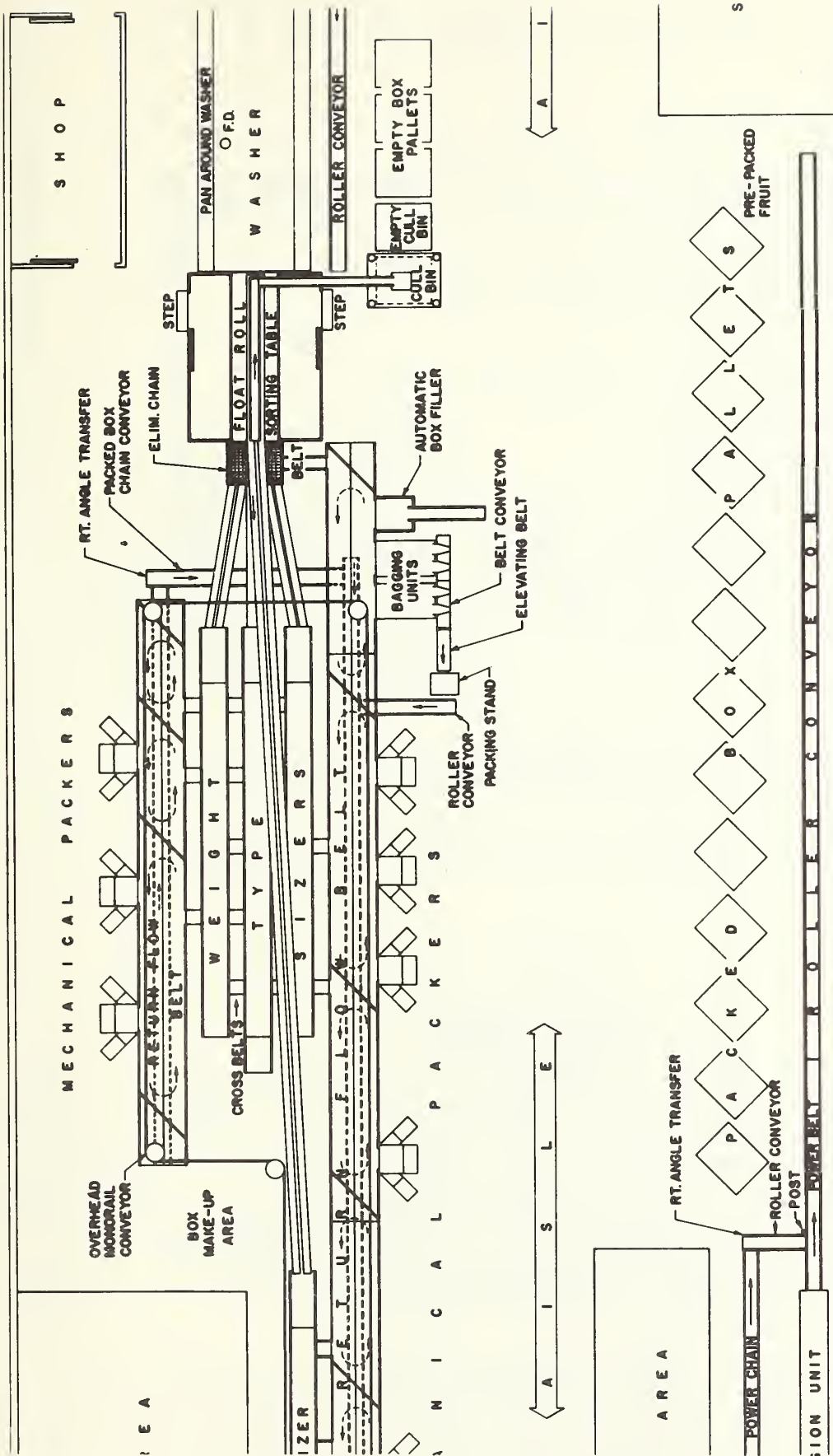


Figure 12.--Most of the lettering in this drawing has too little space between the letters (e.g. "overhead monorail conveyor" at upper left) or too much space (e.g. "cold storage" at lower edge). Spacing of the words "mechanical packers" at upper left is about right for this reduction.

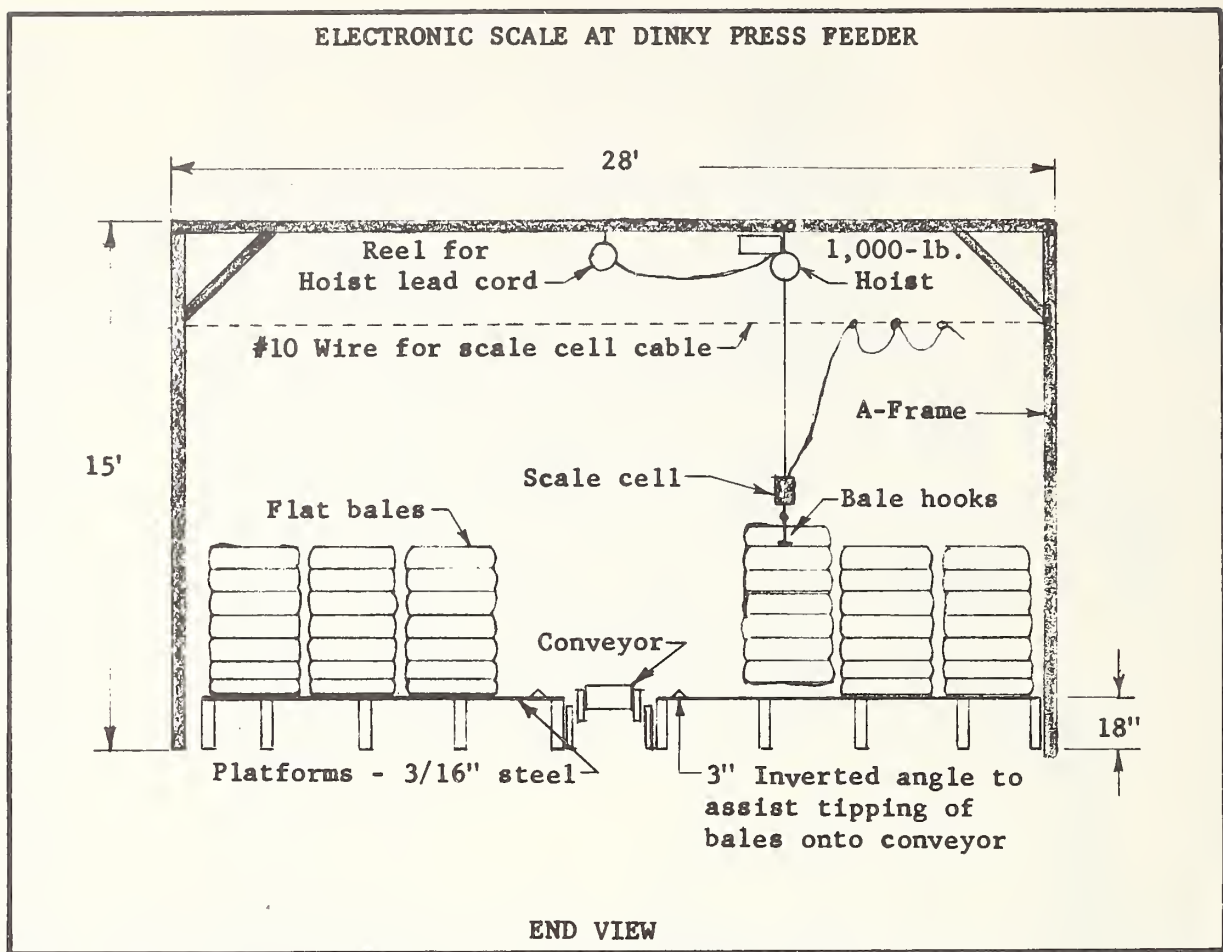


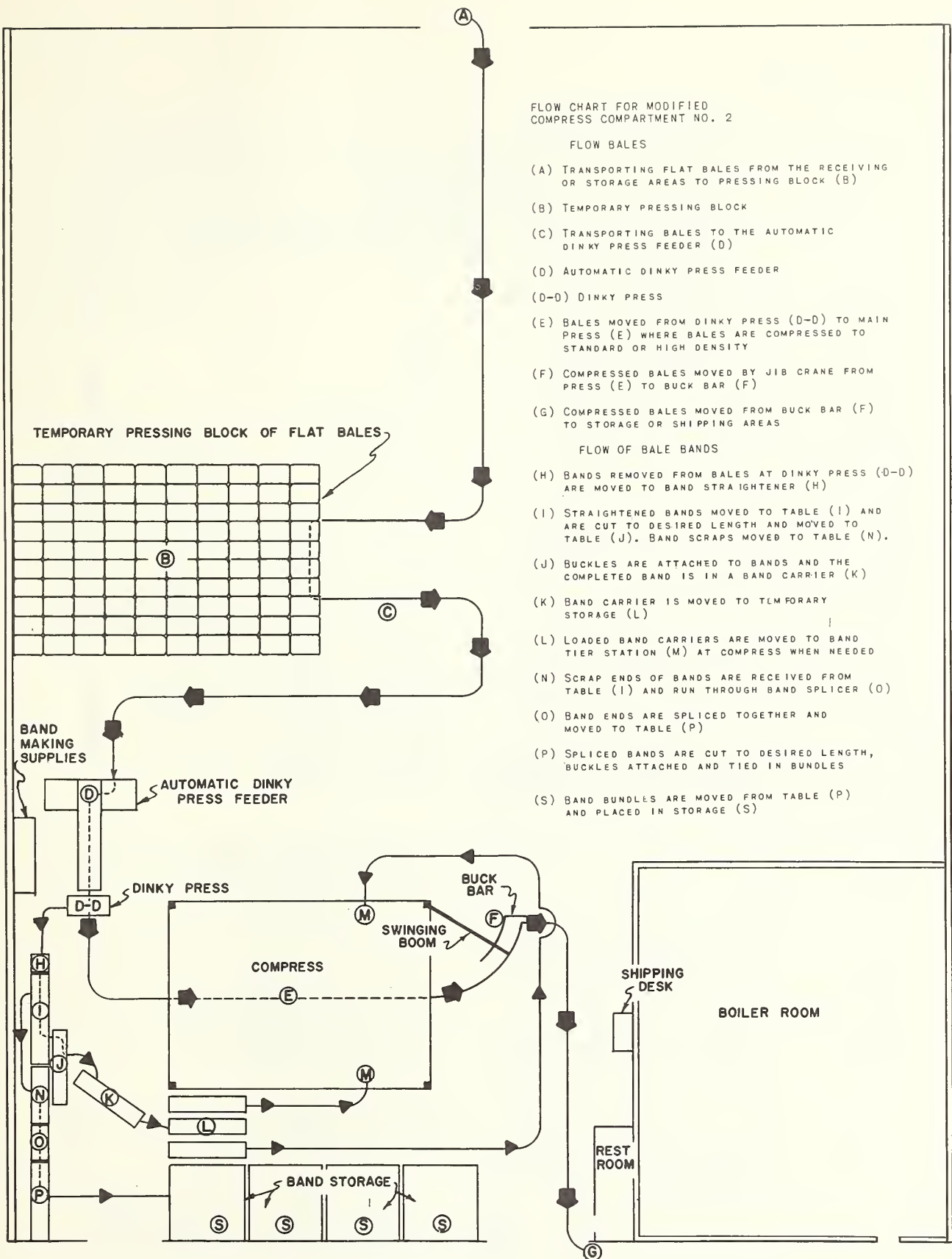
Figure 13.--A small drawing with typed lettering.

#### USE OF PENCIL TRACINGS

Good pencil tracings may be reproduced and used in reports, especially when the drawing is made on mylar and reproduced full size by offset printing. It is also possible to reduce the size. It is naturally more economical to use a pencil drawing than to retrace it in ink. However, particular attention must be paid to line weight, clarity, and evenness of lettering on a pencil drawing. Lines that are too thin may become illegible in a photographic reduction. If care is taken to follow good drafting-room procedure in preparing a drawing (see any good book on drafting for line widths), there is no reason that pencil drawings cannot be photographed (fig. 16).

Use heavy, bold lines of differing widths (or weight) to solve most reproduction problems encountered with pencil drawings. Care must be taken not only when making the drawing, but also when having it reproduced. The negative should be the same size as the illustration will be so that contact prints can be made, thereby eliminating loss in clarity caused by lens resolution (loss of fine detail).





FLOW CHART FOR MODIFIED  
COMPRESS COMPARTMENT NO. 2

FLOW BALES

- (A) TRANSPORTING FLAT BALES FROM THE RECEIVING OR STORAGE AREAS TO PRESSING BLOCK (B)
- (B) TEMPORARY PRESSING BLOCK
- (C) TRANSPORTING BALES TO THE AUTOMATIC DINKY PRESS FEEDER (D)
- (D) AUTOMATIC DINKY PRESS FEEDER
- (D-D) DINKY PRESS
- (E) BALES MOVED FROM DINKY PRESS (D-D) TO MAIN PRESS (E) WHERE BALES ARE COMPRESSED TO STANDARD OR HIGH DENSITY
- (F) COMPRESSED BALES MOVED BY JIB CRANE FROM PRESS (E) TO BUCK BAR (F)
- (G) COMPRESSED BALES MOVED FROM BUCK BAR (F) TO STORAGE OR SHIPPING AREAS

FLOW OF BALE BANDS

- (H) BANDS REMOVED FROM BALES AT DINKY PRESS (D-D) ARE MOVED TO BAND STRAIGHTENER (H)
- (I) STRAIGHTENED BANDS MOVED TO TABLE (I) AND ARE CUT TO DESIRED LENGTH AND MOVED TO TABLE (J). BAND SCRAPS MOVED TO TABLE (N).
- (J) BUCKLES ARE ATTACHED TO BANDS AND THE COMPLETED BAND IS IN A BAND CARRIER (K)
- (K) BAND CARRIER IS MOVED TO TEMPORARY STORAGE (L)
- (L) LOADED BAND CARRIERS ARE MOVED TO BAND TIER STATION (M) AT COMPRESS WHEN NEEDED
- (N) SCRAP ENDS OF BANDS ARE RECEIVED FROM TABLE (I) AND RUN THROUGH BAND SPLICER (O)
- (O) BAND ENDS ARE SPLICED TOGETHER AND MOVED TO TABLE (P)
- (P) SPLICED BANDS ARE CUT TO DESIRED LENGTH, BUCKLES ATTACHED AND TIED IN BUNDLES
- (S) BAND BUNDLES ARE MOVED FROM TABLE (P) AND PLACED IN STORAGE (S)

Figure 14.--An example of a drawing on which Leroy and varitype lettering is used.

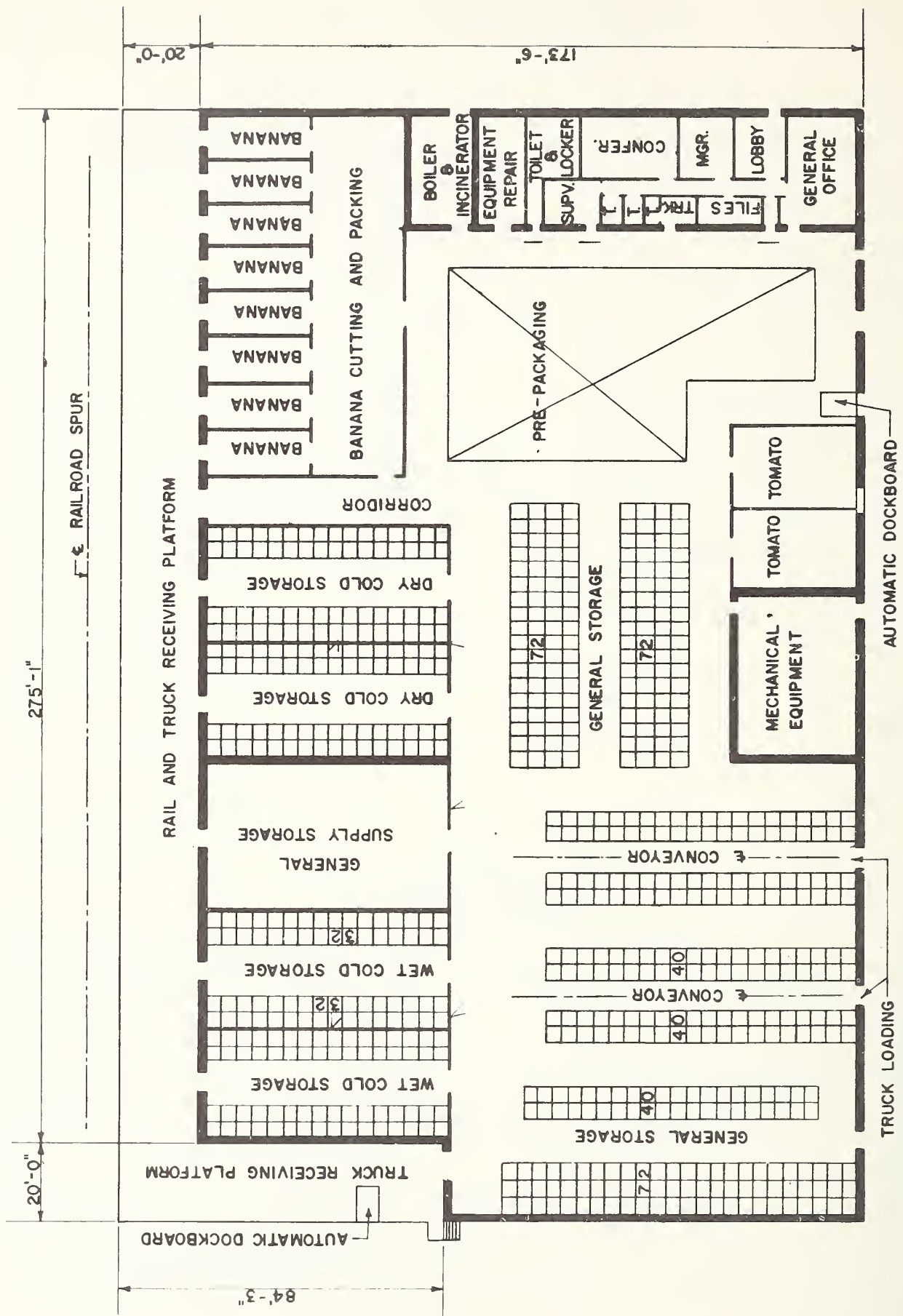
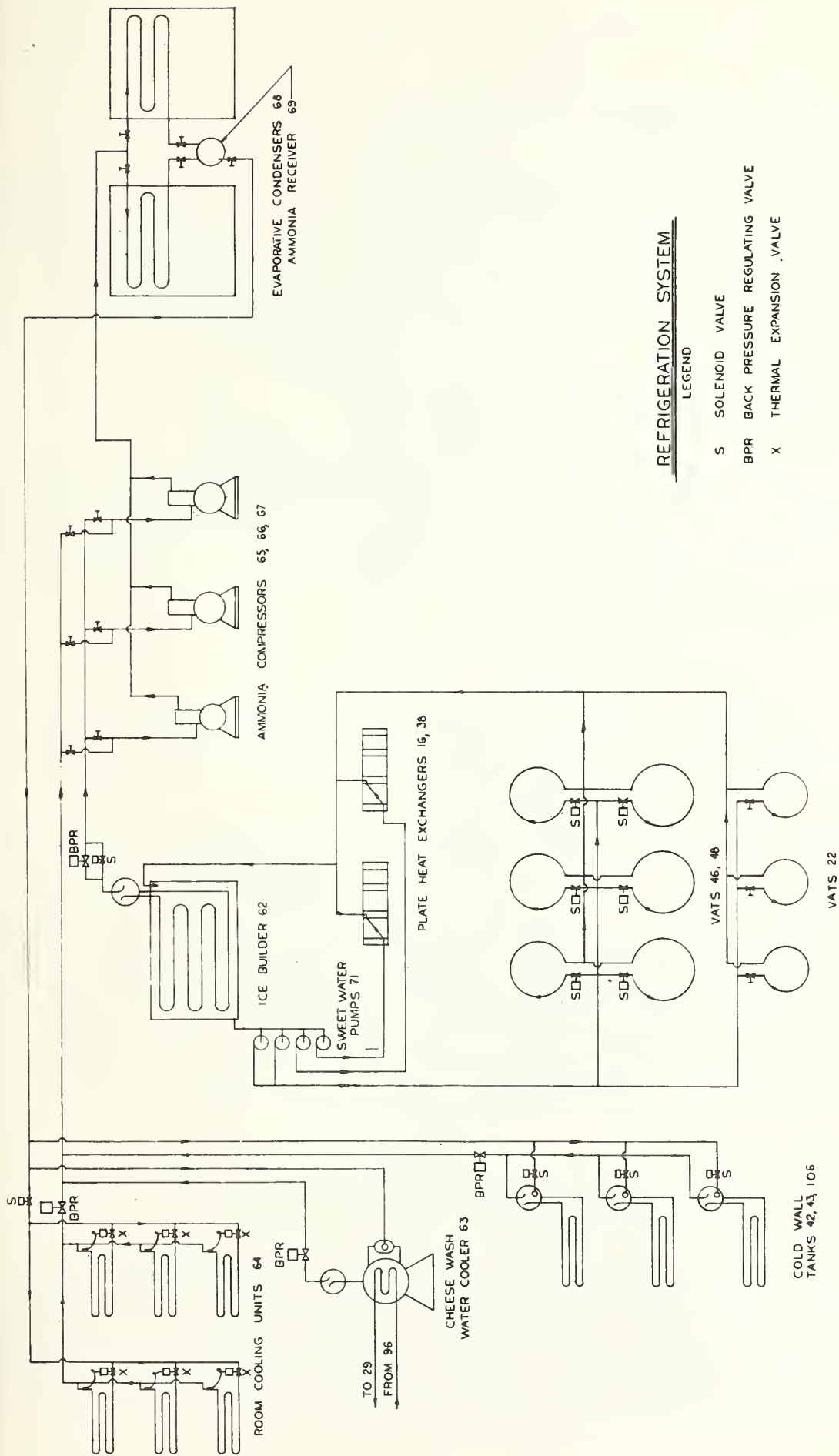


Figure 15.--The lettering should not appear upside down when the report is held in its normal position, as in this illustration.



REFRIGERATION SYSTEM

LEGEND

- S SOLENOID VALVE
- BPR BACK PRESSURE REGULATING VALVE
- X THERMAL EXPANSION VALVE

Figure 16.--A schematic drawing done in pencil.

## MISCELLANEOUS CONSIDERATIONS

### Borders and Title Blocks

When a drawing is made up of several views--plan view, sectional view, elevations, etc.--a borderline around the drawing is useful to tie the drawing together, as in figure 4. A simple title block (fig. 4) with legend also helps give the drawing a certain amount of unity. The title block would especially be needed if the drawings are to be sent out separately from the report. A drawing showing only a layout or single piece of equipment does not need a border (fig. 17).

### Use of Zip-a-Tone

Zip-a-tone patterns--dots, dashes, etc.--tend to run together and appear darker than desired when a drawing is reduced. Lighter than normal patterns should be used on the original drawing, or the Zip-a-tone can be added to the reduced print. It is never good practice to use Zip-a-tone over lettering (fig. 18).

### Scale

Since engineering drawings are usually reproduced in publications at a different scale from which they are drawn, it is important that the scale be indicated in graphic form as shown in figure 17.

Sometimes engineers want their drawings all to be on the same scale in the report. For example, if there are several layouts of different sizes and shapes of the same type of plant or facility, it may be desirable for the layouts all to be on the same scale for comparative purposes. This can be done by making the drawings on the same scale within borders or guidelines that are the same for each drawing. The border around a drawing is used as a guideline when the drawing is reduced photographically and when it is sized for the printer. If borders are not used, the engineer should mark guidelines on the drawing in a blue (nonreproducible) pencil. Reproducing a number of drawings on the same scale, however, may require excessive reduction of one or more of the drawings.

### Flow Diagrams

Flow diagrams are important tools of the engineer in visualizing and presenting the movement of products or personnel in existing or improved layouts of plants or work areas. Flow diagrams, then, should justifiably be presented in a clear, straightforward manner. Both diagrams in figure 19 show the same information, but the diagram at the bottom is easier for the reader to understand and easier for the draftsman to draw. (Also see figure 20.)

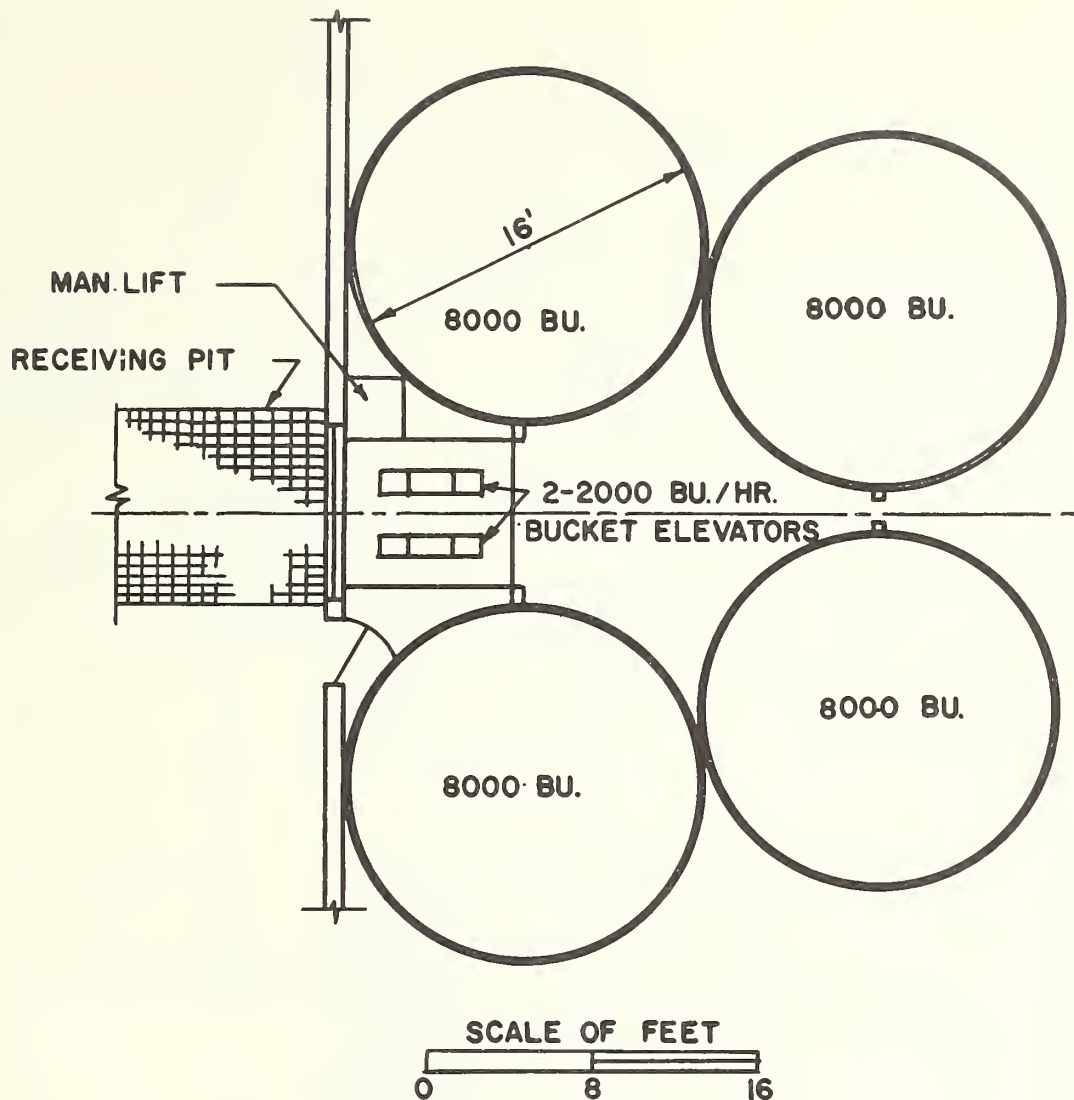


Figure 17.--This simple drawing does not require a borderline.  
Note that the scale of feet is in graphic form.

### Overlays

Another practice that saves time in drafting is the transparent overlay made on clear plastic. Transparent overlays are merely one form of overlay, but this particular one lends itself to many more uses than any other type. It may be easily photographed with no loss in information or it may be used in many dry-type copiers, such as the ozalid. It saves time in that one drawing may be made of a plant layout and the equipment placed on a series of overlays, using a different overlay for each equipment arrangement. Too, a series of overlays or partial overlays in different combinations may be used, saving in each case the cost of repeating an entire drawing. Overlays in this case are intended as a drafting short-cut and not for use in a report.

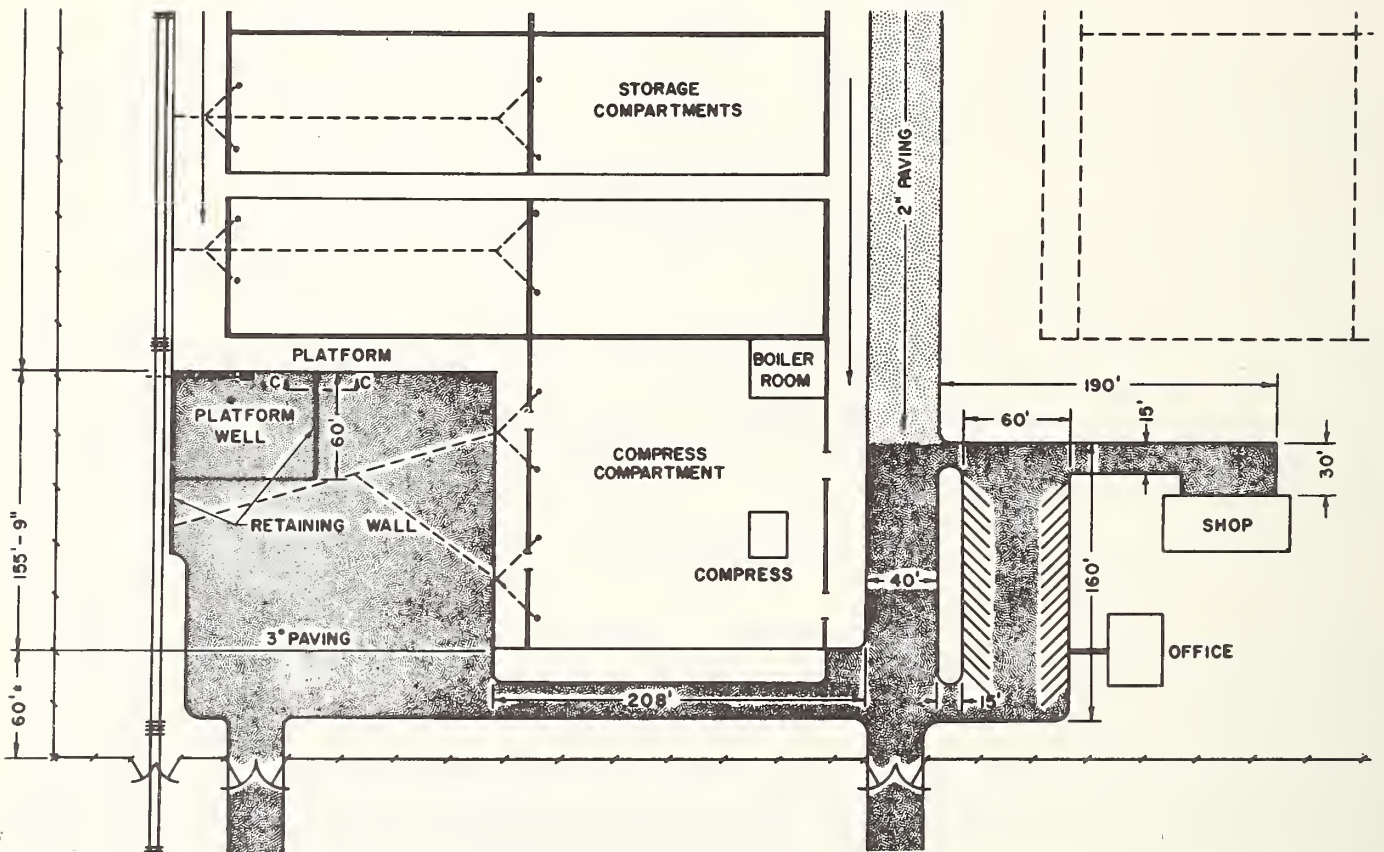
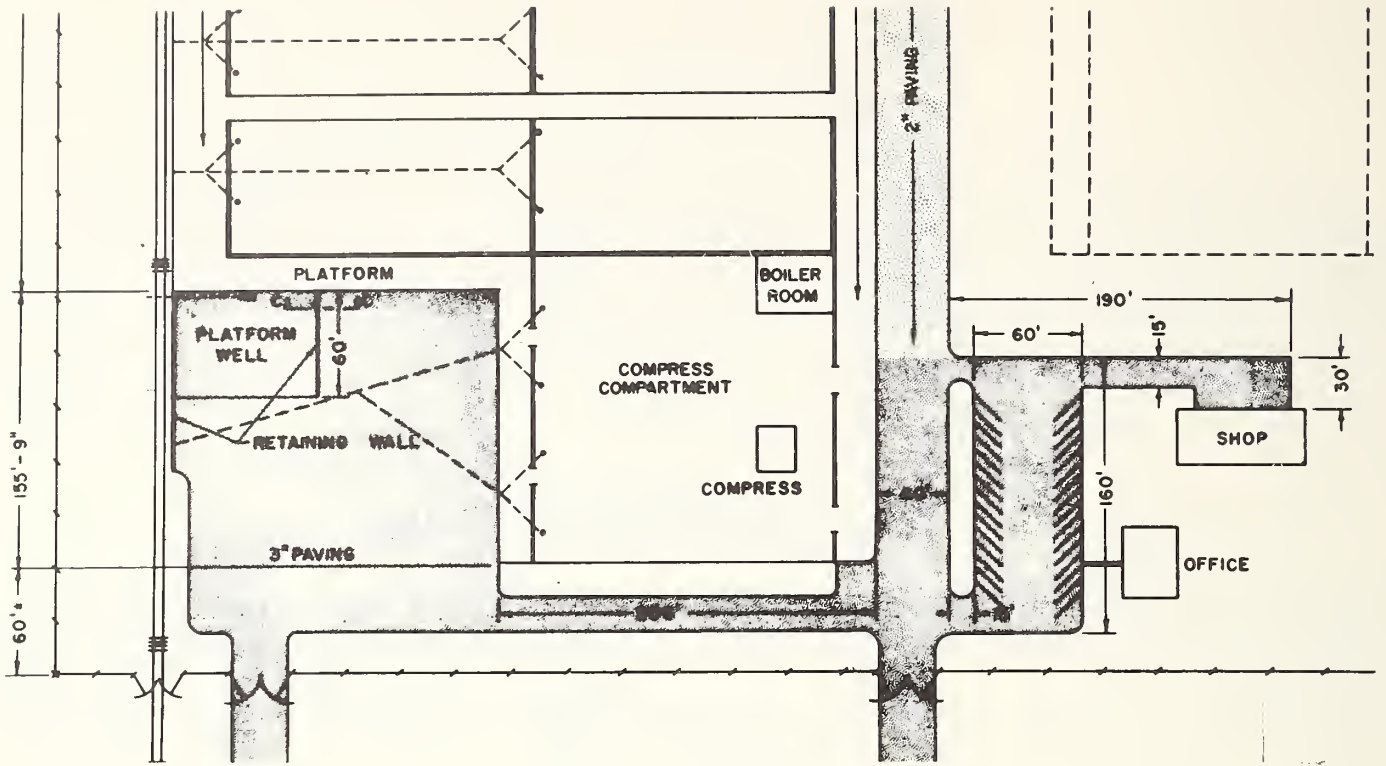


Figure 18.--(Top) Zip-a-tone has been used to indicate paved areas, but the dark tone value caused by reduction has made the lettering under it unreadable. (Bottom) The Zip-a-tone is cut away over the lettering to make the lettering stand out.

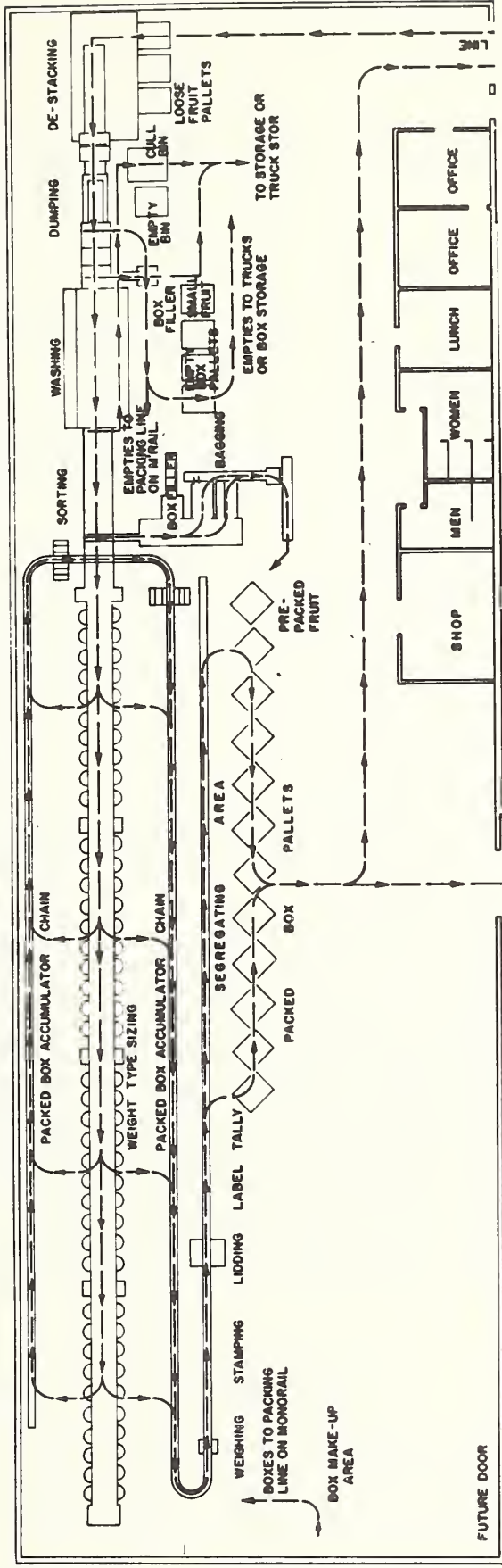
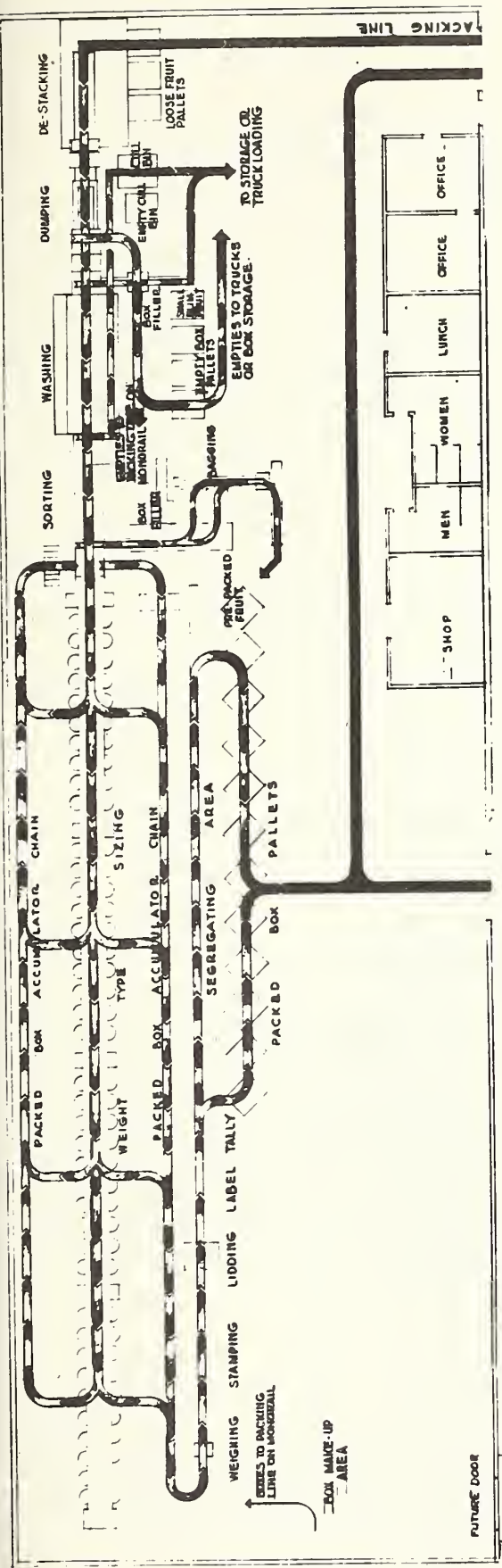


Figure 19.--The arrows in the top flow diagram are very time-consuming and tedious to draw. The simplified flow chart at bottom is easier to read and the arrows much easier to draw.

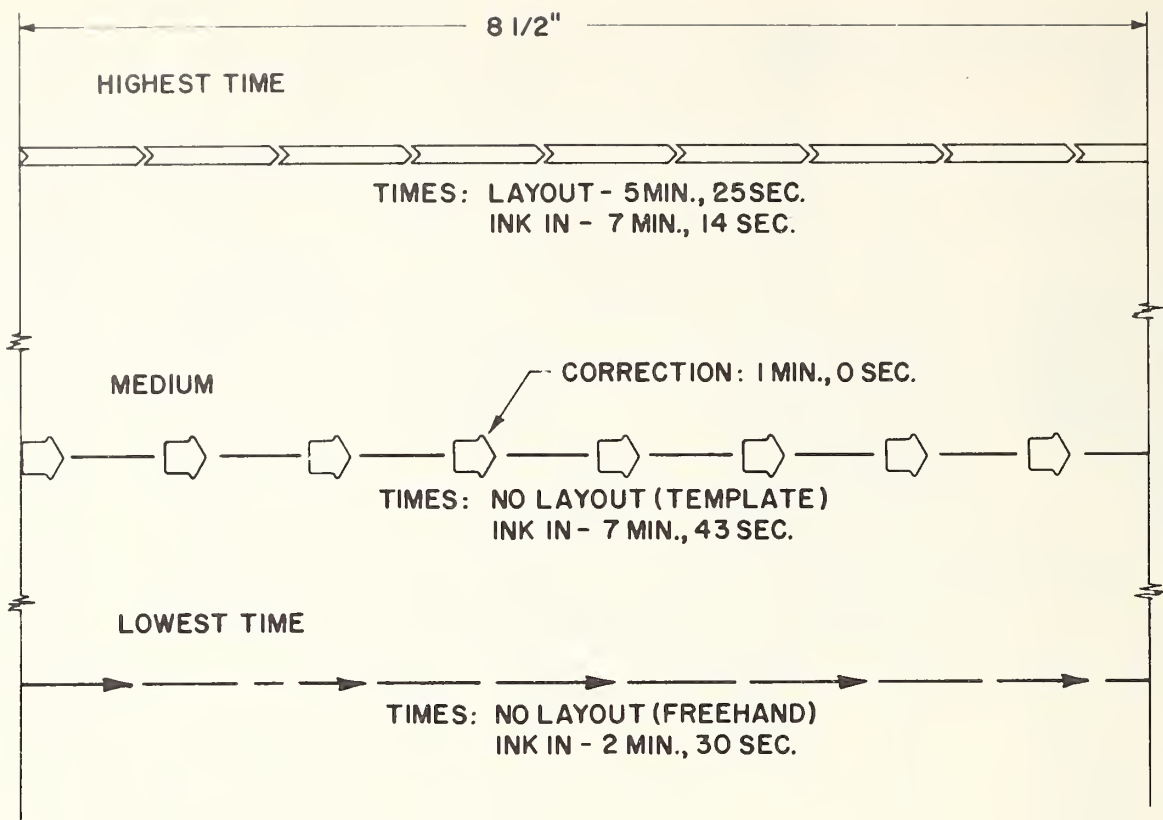


Figure 20.--The time required to draw various types of arrows used in flow diagrams.

### Symbols, Legends, and Abbreviations

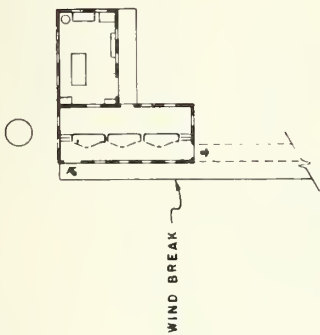
For drawings that are not too detailed, it is usually advisable to avoid the use of symbols and legends and to label each part directly. This eliminates cross-referencing. However, many engineering drawings would be too crowded if all parts were labeled directly and it is necessary to use symbols and legends for such items as wiring and electrical fixtures, piping, building materials, equipment, handling operations, etc. Symbols recommended by the American Standards Association should be used. As mentioned in a previous section of this report, the legend can be put in the text. Abbreviations used in drawings should be in conformance with the GPO Style Manual.

### General Improvement of Drawings

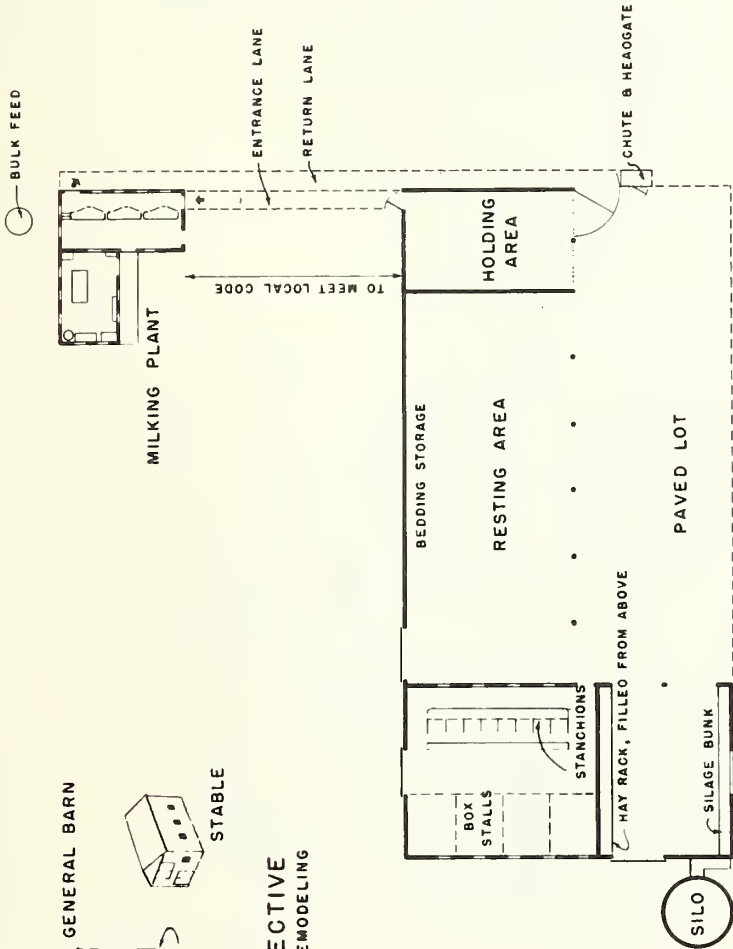
Since published engineering drawings are read by many people and often by people with little technical background, special care should be taken to make these drawings clear and readable. A good engineering drawing should have unity and symmetry.

The use of perspective (fig. 21) or isometric (figs. 22 A and B) drawings usually helps to improve the readability of the drawing. The use of photographs in connection with drawings also is helpful, as in figure 23. Cutaway

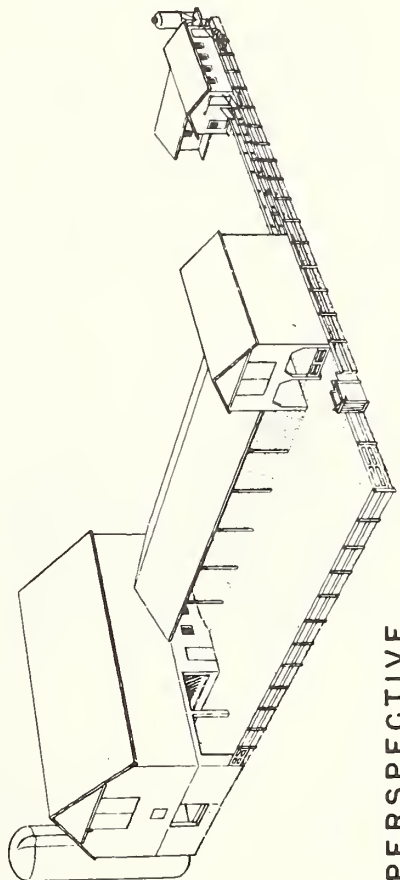




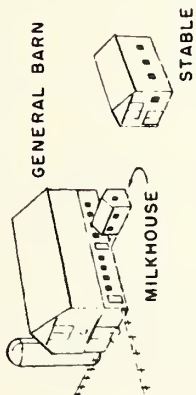
ALTERNATE ARRANGEMENT



PLAN



PERSPECTIVE

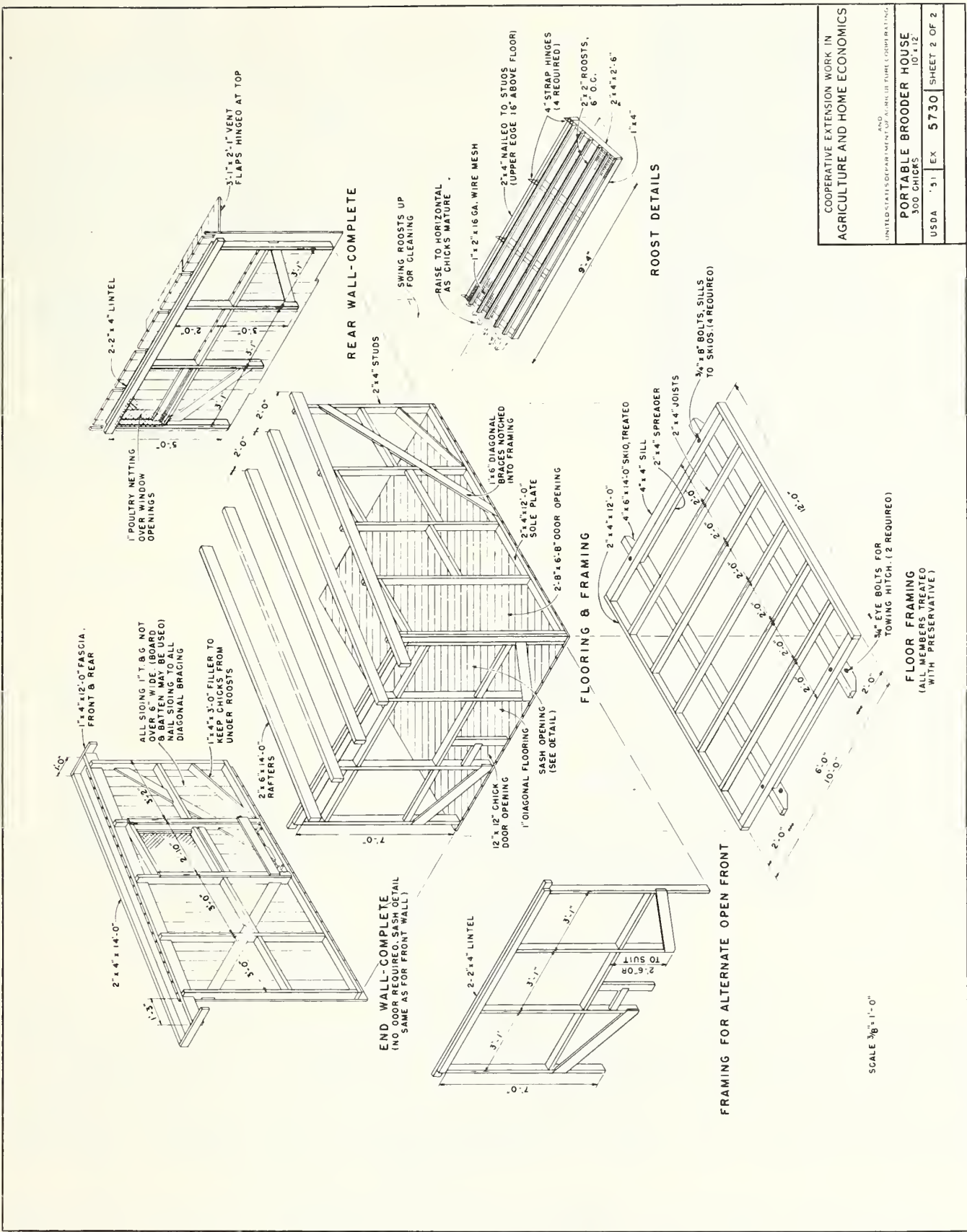


PERSPECTIVE BEFORE REMODELING

COOPERATIVE EXTENSION WORK IN	
AGRICULTURE AND HOME ECONOMICS	
UNITED STATES DEPARTMENT OF AGRICULTURE - OFFICE OF EXTENSION	
AND	
LOOSE HOUSING LAYOUT	
INCORPORATING EXISTING BUILDINGS	
MD.	'60 LX 5883 SHEET 1 OF 1

Figure 21.--Using perspective to show how an existing structure may be improved.





COOPERATIVE EXTENSION WORK IN  
AGRICULTURE AND HOME ECONOMICS

AND  
UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF COOPERATIVE EXTENSION

PORTABLE BROODER HOUSE  
300 CHICKS  
10' x 12'

USDA '31 EX 5730 SHEET 2 OF 2

Figure 22-B.--The second of a set of two drawings. The exploded isometric is used to show construction details of the house in figure 22-A.

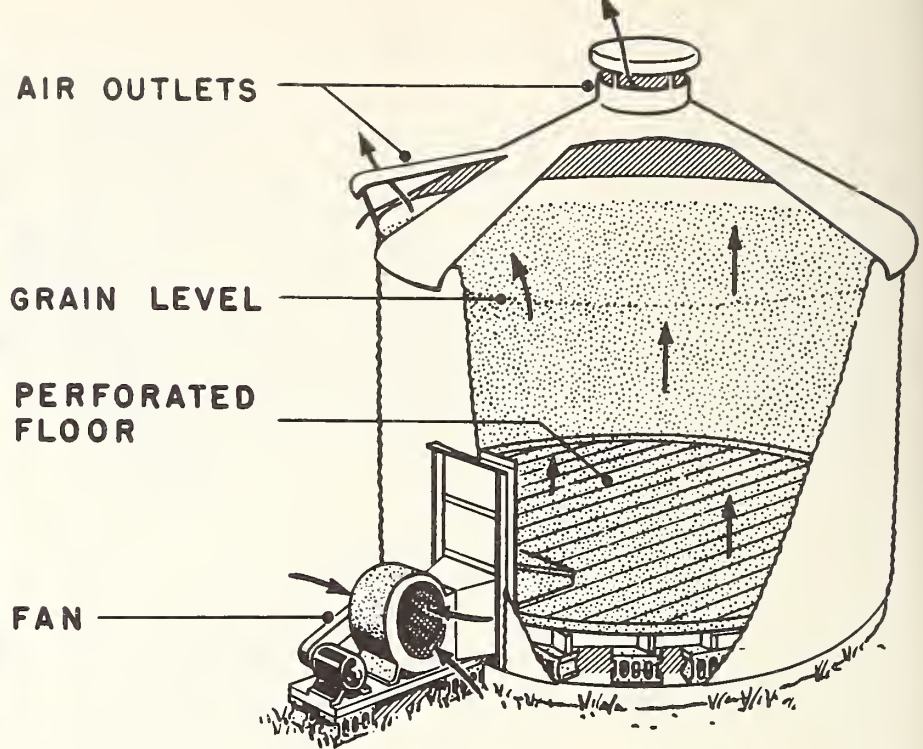


Figure 23.--The use of a drawing and a photograph to present an idea.

drawings can improve understandability, for example, as in figure 24. This type of drawing, however, should not be used indiscriminately, since it is expensive to draw.

Heavy, bold lines for layouts are desirable when possible (fig. 25).

With a little imagination, one can present engineering drawings or concepts in interesting and helpful forms such as are shown in figures 21 through 27.

#### TYPE OF PRINT TO SUBMIT WITH MANUSCRIPT

The most practical way to handle drawings is to make photostatic copies of the pencil drawing for submission with the manuscript. The photostat should be approximately the same size that the drawing is to be in the report. There is usually sufficient time between the date the report is sent to the editors and the time it is ready for the printers for any necessary finishing work, such as inking, to be done and for negatives and prints to be made.

A photostatic copy gives a fairly good idea of how the drawing will look as a finished print. Although the lettering may not be as clear, it should be possible to determine if it is large enough.

If corrections are necessary, a great deal of work, time, money, and irritation may be saved by making them before the final work on a drawing is done. The technical reviewer and editor may suggest changes or corrections.

The editors check the illustrations along with the text of the manuscript. It is not unusual for the editor to find that equipment has a different name in the drawing than in the text, or that changes made in the text have not been followed through in a drawing. Misspelled words are also not rare.

When the drawing is ready to be submitted to the printer, dull photographic prints should be made. The prints should be approximately the same size that the illustrations will be in the report.

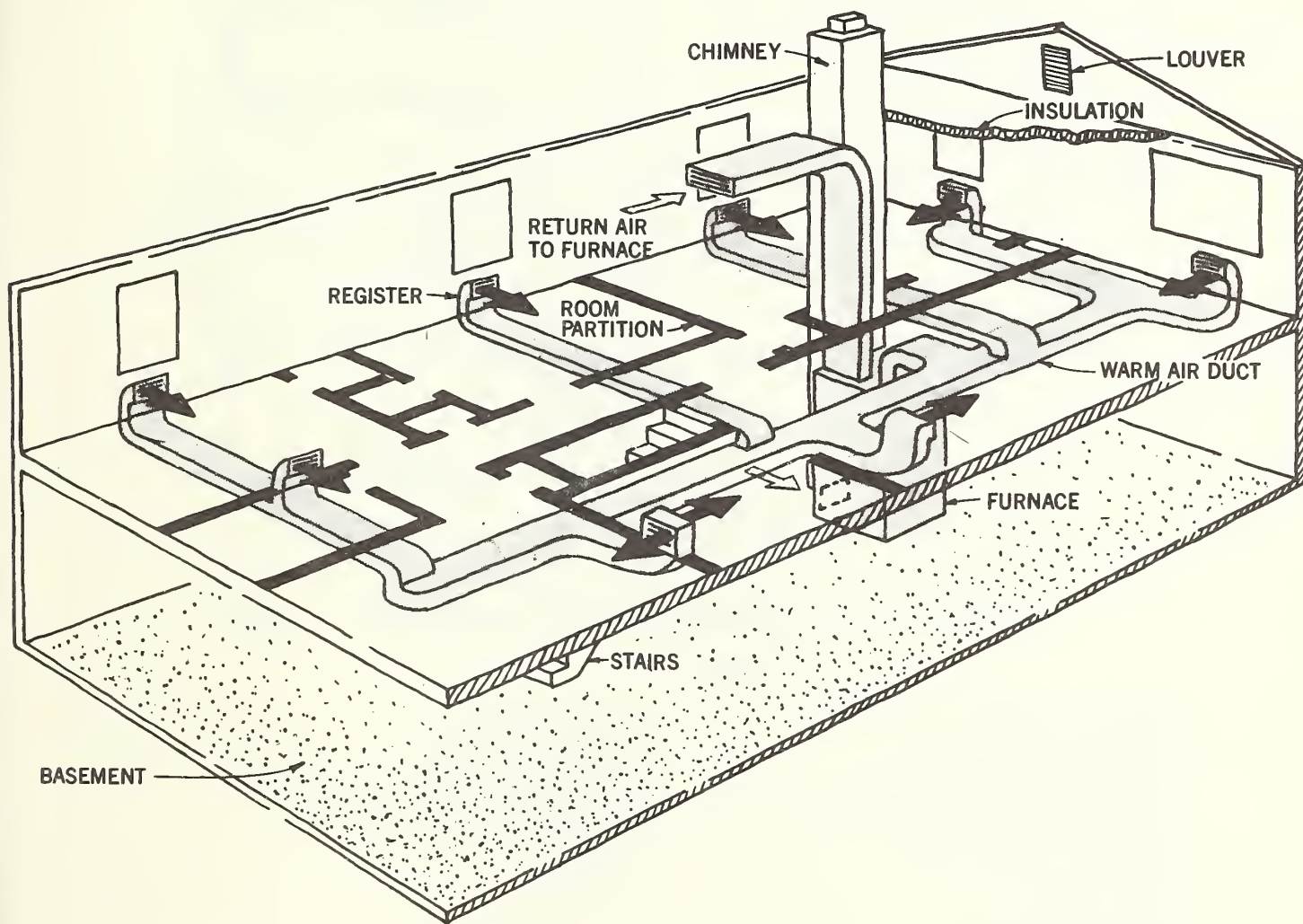


Figure 24.--A phantom view of a heating system in the average 2-story house.

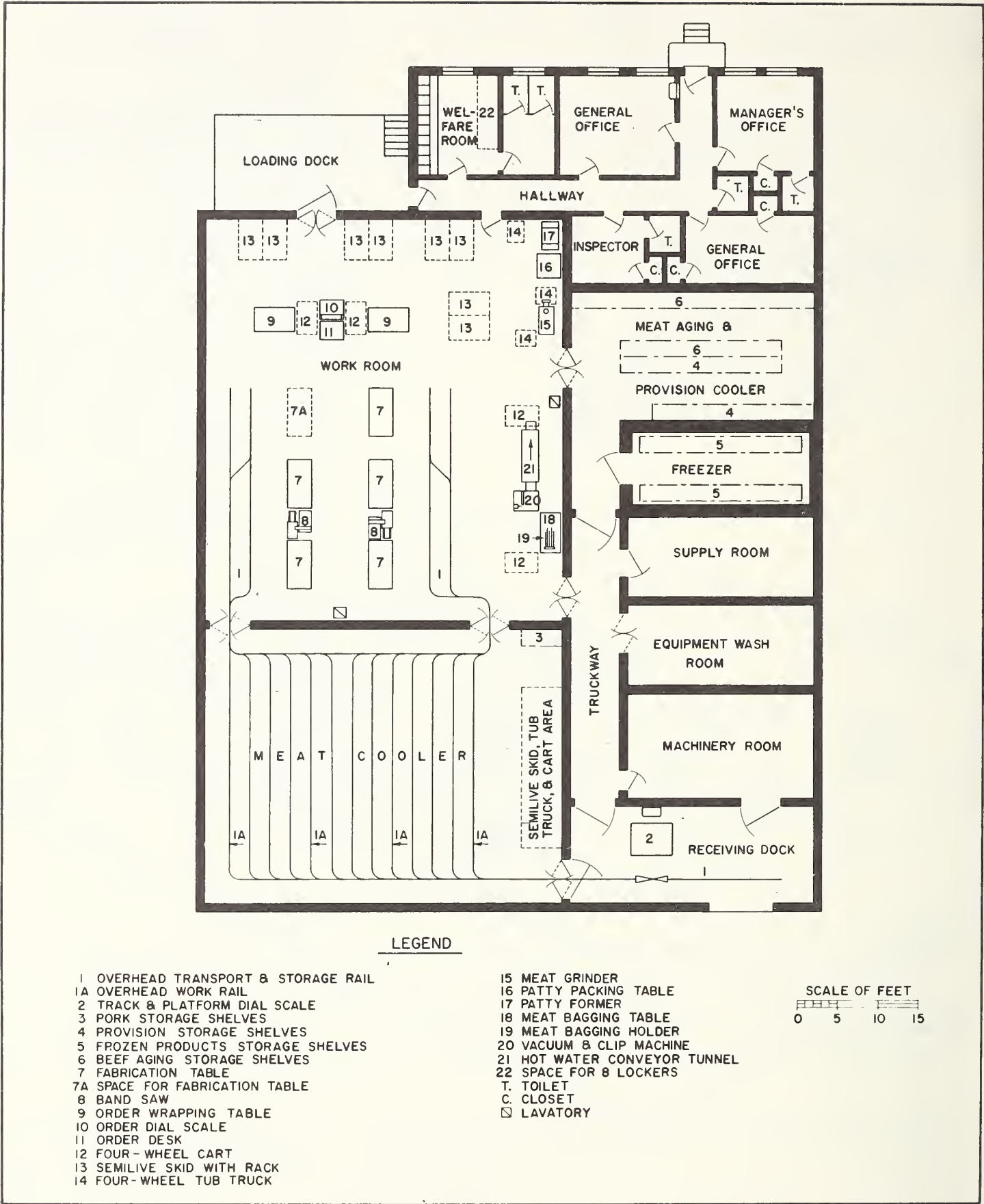
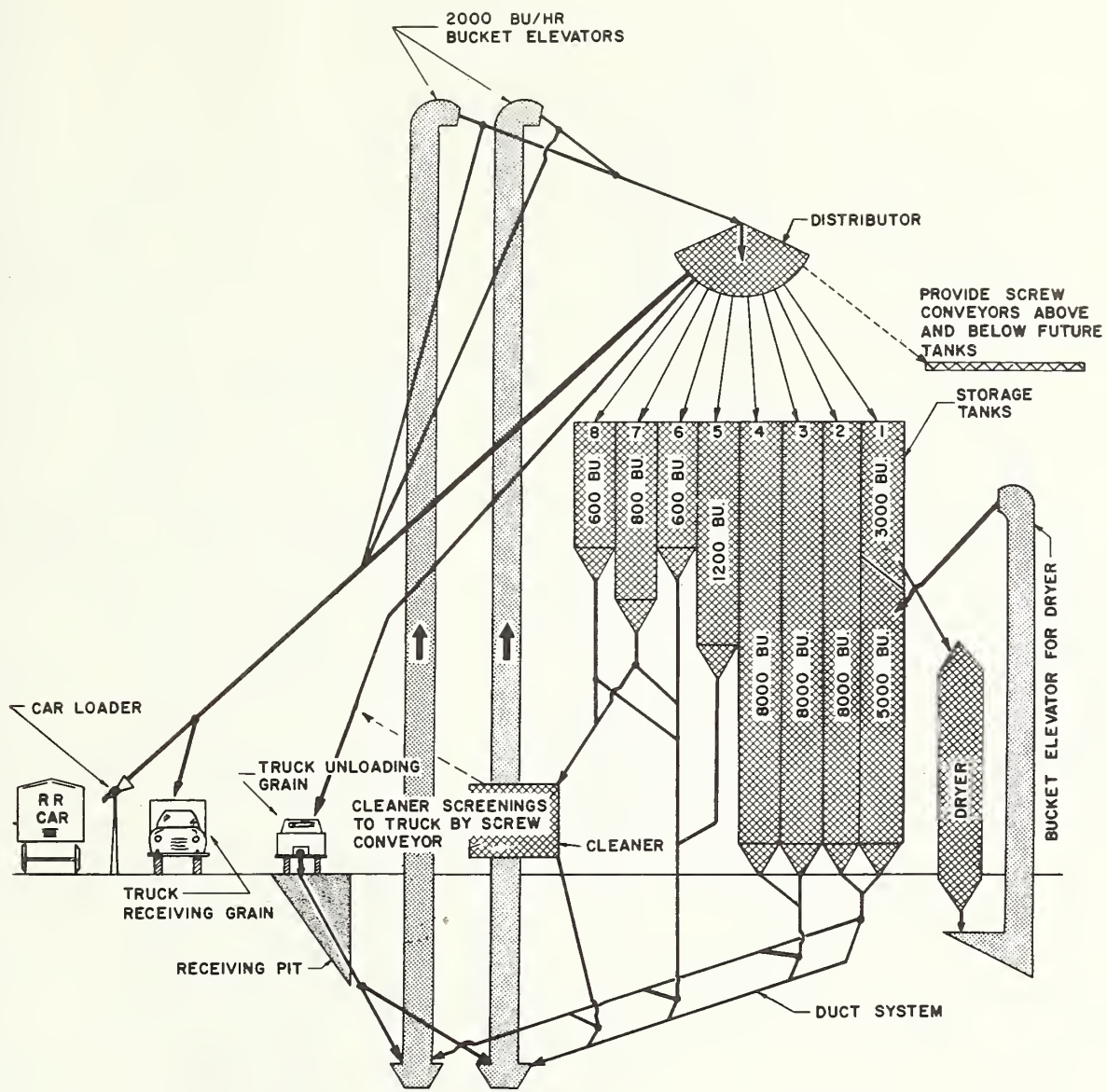


Figure 25.--A meat packing plant. In a layout such as this, if it is necessary to show different arrangements of equipment, the overlay would be useful. (Note that the legend could have been put in the text, and the drawing enlarged.)



**FLOW DIAGRAM**  
NO SCALE

Figure 26.--The flow of grain in a typical elevator.  
Another form of flow diagram.

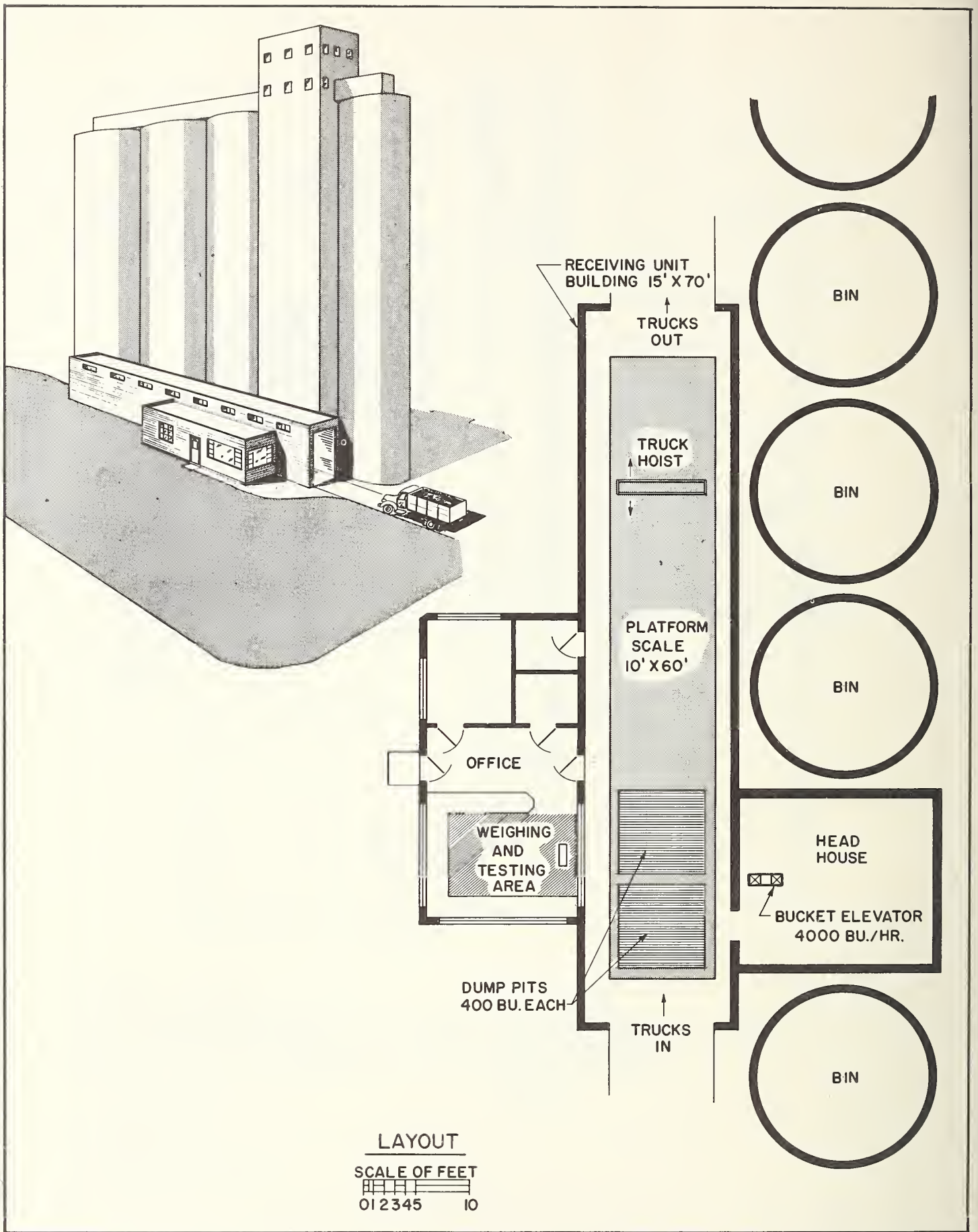


Figure 27.--The use of a perspective coupled with a layout.  
Note the Zip-a-tone shading.





