NATIONAL BUREAU OF STANDARDS REPORT

10505

LIVE LOAD STUDIES OF CONVEYOR SYSTEMS AND POSTAL FACILITIES

Interim Report IV

3-Story Facility
(Omaha, Nebraska)

Sponsored By

Post Office Department

U.S. DEPARTMENT OF COMMERCE

NATIONAL BUREAU OF STANDARDS

NATIONAL BUREAU OF STANDARDS

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LIVE LOAD STUDIES OF CONVEYOR SYSTEMS AND POSTAL FACILITIES

Interim Report IV

3-Story Facility
(Omaha, Nebraska)

by

J. O. Bryson and L. E. Cattaneo

Building Research Division
Institute for Applied Technology, NBS

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Washington, D. C. 20234

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3-STORY FACILITY

(OMAHA, NEBRASKA)

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1. Introduction

This report presents the results from the survey of the occupancy loads in the 3-story mail handling facility of Omaha, Nebraska. The information presented here is the first level reduction and analysis of the loads data recorded for this facility. It is in the same format as the preceding interim reports referred to below. The survey techniques and data evaluation procedures used in the study are described in detail in the first interim report, NBS Report 10141, "Live Load Studies of Conveyor Systems and Postal Facilities." A more definitive description of and interrelationship between building occupancy loads and work floor areas are given in the second interim report, NBS Report 10262, dealing with 1-story facilities. Also, it is recommended that section 2.3 of NBS Report 10262 be read prior to studying the results presented

here. This section presents, very briefly, the more important factors which influenced the survey procedures and evaluative approach for this study. Additional related material which will serve as background can also be obtained from a third interim report, NBS Report 10347, pertaining to 2-story facilities.

In the original planning of the sample, three multi-story mail handling facilities were scheduled for surveying. However, as the work progressed, the conclusion was reached that the data from one of the three multi-story facilities could be classed as redundant. In this regard, one facility in this group was eliminated. More recently a second facility was eliminated for reasons of funding (reference: letter from J. N. Wiernicki, POD to J. R. Wright, BRD, NBS, dated June 2, 1970, REPT: C. C. Arnolts: par 68257). This left the data from only one multi-story facility, Omaha, Nebraska, to be used to determine characteristic loadings for this category of facilities.

2. Description of Facility

The U.S. Post Office, Omaha, Nebraska, as well as all other buildings that were surveyed for occupancy loads in this investigation are classed by POD as "Major Postal Facilities." A major postal facility is one that has a work floor area greater

than 50,000 sq. ft.[1] The space provided in these facilities is divided generally into four major areas:

1. Workroom area
2. Mail handling support services areas
3. Platform or docking areas
4. Administration, personnel, and public services areas.

The workroom is a large open bay floor in which the mail processing activities are centered. The floor area is lined with regularly spaced structural columns which superficially divide the floor space into "grid squares". With the exception of the public services areas, the other areas serve to support, in different ways, the activities on the workroom floor.

The Omaha Post Office is a three-story building located adjacent to the Burlington Northern Railroad Station on Pacific Street between 11th and 13th Streets. The service and lock box lobby is located in a wing at the southeast corner of the facility on a level which coincides with the middle story. The wing contains 3 more floors of offices above the lobby. As is the custom of the facility's occupants, the first story of the remainder

[1] Postal Space Standard and Equipment Layouts Vol. I, POD Publication 37

(and major part) of the structure is referred to as the Ground Floor; the second story is called the 1st Floor; and the third story, the 2nd Floor. Figures 1, 2 and 3 show the general floor plans of these three stories, respectively. A truck platform extends along the West side of the building on the ground floor which opens to grade elevation. A second truck platform extends along the East side of the building on the 1st floor which also opens to grade elevation because of the easterly rising topography. Connection with railroad facilities is by conveyors through the north side of the facility at the ground, and 1st floor levels.

Space for processing mail is distributed throughout all three stories. The gross space enclosed on the ground floor for mail handling is approximately 48,000 square feet, on the 1st floor, 69,000 square feet and on the 2nd floor, 72,000 square feet. All stories contain moderate, or more, amounts of mechanization (see Figures 4, 5, 6). For the most part, mechanization on all stories is ceiling-suspended. Notable exceptions which are floor mounted on the 1st floor are the slide (located under conveyor 6B-2), and the partially floor supported parcel sorting platform which feeds conveyors PSM-1, 2, 3, and 4; on the 2nd floor, two LSM's and the central sack separation unit are floor supported.

3. Results

The data collected at the facility pertain to two general categories of loads: (1) Ceiling loads; and (2) Floor loads.

3.1 Ceiling Loads

Calculations were made to determine values for the total load equally distributed over the horizontal area for each mechanization section. In previously examined facilities, the hanger loads for mechanization suspension rods were calculated for one of two different support arrangements: (1) with suspension rods located at the four corners for small conveyor sections; (2) with suspension rods supporting large sections of mechanization, at every 5 ft. in a rectangular coordinate grid. The four-corner support calculations were not made for any of the mechanization section data at Omaha because none of the selected sections was considered suitably small for 4-point suspension. The 5-ft. rectangular grid support points were chosen since they conform to the POD specification for the arrangement of insert anchor-points for the support of suspended mechanization systems.

The locations of suspended mechanization sections measured for weight estimates at the Omaha facility are indicated on the plans in Figures 4, 5, and 6. A section was chosen on each

story which was visually considered to the most densely occupied by mechanization on that story, and the weight estimate data recorded.

The data collected from these locations were reduced to ceiling loads for the mechanization sections investigated and are presented in Table 1. Values of hanger loads in parentheses are so indicated to note that mechanization was actually partially or totally floor supported. However, the calculated values are submitted to show what ceiling loads might be developed for such loads, excluding consideration of lateral stability problems. Of the 4 sections observed, section (A) on the ground floor is the only one within which there is a notable amount of space unoccupied by mechanization.

As in preceding reports, it is to be noted that values for uniformly distributed loads were computed for dead weights of mechanization sections alone (UDL) and for mechanization with design live load added on to the conveyor belt areas where they would occur (UDL_2). The design live loads (mail) used are those currently specified by POD (30 psf). The computed hanger rod loads for the 5 ft-spaced coordinate grid support points are based on the minimum number of support points in a 5 ft grid system which fall within the plan area of the mechanization.

The section of mechanization (A), Figure 4, chosen for estimation of heavy ceiling loads of the Ground Floor occupies an area measuring 51 ft N-S by 27 ft E-W. Contained in this space are the tail ends of several conveyors and chutes (10P, 10R3, 10N, 10H, 10G and 10R2) which are fed by the sack-distributing monorail MR-1. Load-carrying and return-lengths of the monorail are included in section (A) as well as a length of sack conveyor 15-E and miscellaneous construction such as walkways. All mechanization in this section is ceiling-suspended.

On the First-Floor, section (B), Figure 5, which was chosen for mechanization loads estimation, contains the 4-station parcel sorting unit which feeds PSM-1, 2, 3 and 4. Although part of this load is carried by the floor through 3 -6" x 6" WF columns, it was assumed for this estimate that the entire load was ceiling-suspended. The section, which measures 33 ft N-S by 42 ft E-W contains, in addition to structural platform construction, the following major components: conveyor 1-J, a distributing slide with four kicker rollers, and 4 sorting stations (1-L, 1-N, 1-0 and 1-T) which include sorting conveyors, controls, cross feed conveyors, storage cabinets, chutes and stairways.

Mechanization load estimates were determined for two sections on the Second-Floor, (Figure 6). Section (C) contains the central sack separation unit and occupies an entire grid square (A-12); section (D), a smaller area, measures 11 ft N-S by 20 ft E-W and contains obviously heavy mechanization worth noting. Again, the mechanization in both sections is all or mostly floor-supported but is calculated and tabulated as ceiling loads (Table 1) which might conceivably be developed if so suspended. Sack-central in section (C) contains conveyors 5-A, 4-A, 6-A, 7-A, 8-A, 9-A, and 10-A as well as slide and platform construction; conveyors 18-B and 18A-1, 2, 3 which are actually ceiling suspended are also included.

Section (C) contains the head ends, with drive mechanisms and take-up rollers, of three large (60" x 36") sack-storage conveyors 4C-1, 2, 3; also included is the tail end portion of conveyor 4-D together with miscellaneous structural steel.

3.2 Floor Loads

The workroom floor is divided into designated work areas to accommodate specific mail processing activities. The work areas are of different sizes, depending on amount and type of

activity, and usually cover a number of grid squares. Within the work areas the activities and types of equipment employed for processing the mail toward its destination are the principal factors which affect the characteristics of the occupancy loads. Table 2 presents the area distribution for the total of the three stories of the Omaha facility in terms of amounts of floor space occupied by the various work areas.

The data for the floor loads part of the study was reduced and evaluated with a computer program which was designed to provide information on the loads related to work activity and the geometry of the structure. The computer prints out tables and graphs of principal information and data relationships. From these printouts the maximum values of loadings occurring on floor areas of different size divisions are presented in Table 3. These were chosen to show the upper limits of loadings occurring in the Omaha facility at the time of surveying.

Figure 7 shows the relationship between loaded area and discrete load values for the total workroom area surveyed in the Omaha Post Office. The area supporting discrete loads greater than a specific value is given as a ratio of the total loaded area on the vertical axis and the values of

discrete load are given along the horizontal axis. Therefore, this plot indicates the fraction of the loaded area which supports loads greater than a particular value of discrete load.

Table 4 gives the percentage of space occupied by load items in each work area. In reviewing data from this and preceding surveys, and considering work activities and the associated load items, the conclusion is drawn that occupied space will not exceed 60 percent except in storage areas. This is because the maneuvering space needed for people and mobile equipment to function in activity associated areas is often found to exceed 40 percent and is occasionally found to be 80 percent or more. Storage areas, however, do not require as much free space for maneuvering.

3.3 Analysis of Data

In analyzing the loads data, emphasis was placed on determining characteristic uniformly distributed loads and high load concentrations. However, sight was not lost of the fact that a structure must be designed to safely support all loads that it will be subjected to during its lifetime. In this regard a great deal of attention was devoted to upper limit values of loadings for both ceiling loads and floor loads.

The floor areas on which the loads are applied are divided into two categories: (1) Activity associated areas; (2) Structurally significant areas. The activity associated areas are the work areas. The structurally significant areas are the grid square and grid sector areas.

When there is a change in basic activities on the work floor area of a facility the characteristic loading changes as well. The grid square represents the basic floor and ceiling element that the characteristic loading relates to in terms of first order design loads. Therefore, the loadings within work areas have been evaluated in terms of their effect on grid squares (floor or ceiling structural panels).

Table 1 presents the suspended mechanization loads recorded at Omaha. The UDL_2 values for all three stories range from a low of 20 psf to a high of 100 psf.

Figure 8 is a plot of the uniformly distributed loads (UDL_2) for the mechanization sections versus the plan areas of the sections. This curve was originally constructed using only the data from the 1-story facilities. Later, (in NBS Report 10347) the addition of the data from the 2-story facilities appeared to support the validity of the assumed upper limit load value boundary curve. The addition to

Figure 8 of the data from the Omaha 3-story facility includes one point which is slightly outlying but is not considered to affect the general aspect of the assumed upper limit curve significantly. The pronounced change seen in this boundary curve still occurs near the 100 psf value. The point in question is for a 100 psf load applied over a 220 sq ft area as opposed to a previously suggested limiting area of 50 sq ft. The conservative choice of 50 sq ft was based on the cluster of observed values rather than the curve. The value of uniformly distributed load on the upper limit boundary curve which corresponds to the grid square area of 1023 sq ft for the Omaha facility is 80 psf. The analysis of the floor loads data was carried out in the same way for the 3-story facility as was done for the 1- and 2-story facilities. The floor loads data from the surveys include information that is area associated in terms of activity divisions and structural divisions. The data presented in Table 3 show the maximum floor loadings found on different size areas. This tabulation shows very clearly that as the area gets smaller the loading approaches the maximum discrete load value which by definition is the limit. The maximum loading recorded was 163 psf on a grid sector. However, the grid square stands as the most structurally significant area for studying design loading. Consequently, the data need to be analyzed from the standpoint of a probable

maximum loading on grid squares. The curves giving the cumulative fractions of loaded areas for discrete load values by work areas can be conveniently used for this analysis. These curves are composed of surveyed loads and their respective areas set up to show the variation in discrete loads on the loaded area. Within a work area, there are different types of items used in the mail processing operations. The weights of the items that contain mail vary from some minimum to a maximum value depending on the amount of mail being carried. Therefore, in a work area where there are different sizes and types of items containing different amounts of mail, the discrete loads range over a wide spread in values. The fractions of the loaded area corresponding to discrete load values in a work area are indicative of the relative loading characteristics in terms of magnitudes and distributions.

The cumulative curves of discrete loads for each of the work areas (similar to Figure 7) were used to obtain a load profile to be applied on a grid square area. The load profile used effectively optimizes the loading on the panel for maximum bending moment. This means that the maximum values of actual loadings recorded during the field surveys of the facilities were arranged to impose the most severe bending moment effect on a grid square area. In this way actual loadings

were used to arrive at values for the maximum loadings likely to occur from the various activities being conducted in each of the work areas.

Figure 9 illustrates the procedure used in applying the load values from cumulative curves to grid square areas for maximum loading effect. This example is the same one given for 1-story facilities (NBS Report 10262) where the cumulative curve for work area 1 in the Greensboro facility was used. The total area for work area 1 is 8512 sq. ft. and the loaded area is 1741 sq. ft. or approximately 21 percent of the total area. It is this loaded area (1741 sq. ft.) that is represented by the vertical axis (ordinate) for the curve. The area for the grid square in Greensboro is 1089 sq. ft. which is 62 percent of the loaded area for work area 1. The portion of the cumulative curve from 0 to 0.62 area ratio is equal to the grid square area size. This lower portion of the curve also includes the heaviest discrete loads encountered in the work area. These loads are ordered according to weight along the horizontal axis and according to relative area covered, along the vertical axis. Figure (a) of 9 shows how the areas for the respective discrete loads are arranged on a grid square panel for maximum effect on bending moment. The panel is next considered as a 1-way simply supported slab and the load profile on a

1 ft. wide strip through the center of the panel is constructed as shown in (b) of Figure 9. The maximum moment caused by this loading arrangement is computed, and from it an equivalent uniformly distributed load (EUDL) is determined by use of the following relationship,

$$EUDL = \frac{8M}{\ell^2}$$

where,

M = maximum bending moment

ℓ = span length

The values of EUDL for the each of the work areas surveyed at Omaha are presented in Table 5.

3.4 Comments

The comments which follow are based on the data from the Omaha 3-story facility. As such, they are made in the light of qualifying remarks also expressed in the preceding interim reports to which the reader is again referred but which are repeated here, in part, for ease of reference.

The overall plan for the study of loads on postal mail handling facilities was designed to have the data from each phase of the investigation be applicable to all phases of the study.

This is to say that, although the investigation was generally divided into groups of facilities according to their number of stories, the final results would need to be based on data from all facilities in order to broaden the sample information for any one group sufficiently for design load analysis. The rationale is that characteristics of loadings within work areas (i.e., loadings caused by specific activities) are independent of the number of stories in a facility. Consequently, the results presented here are considered preliminary and will be re-evaluated in a later final report covering all facilities surveyed. Further, as has been previously noted, the information presently available does not reflect conditions during peak periods such as the Christmas season. Particularly, efforts to obtain peak values of bulk mail conveyor loads have not been as productive as desirable, and it is considered advisable to obtain some additional data for this element of the facility loading. At this writing, a request to the sponsor is awaiting consideration for an observer to gain entry, just prior to Christmas, into several of the facilities which were surveyed. In order to avoid disrupting operations by more detailed survey techniques during this rush period, it is being suggested that the investigators be permitted, at least, to make visual and photographic observation of peak load conditions. Such information would

lessen some of the uncertainty (regarding peak periods) in striving for reliable recommendations concerning structual live loads in postal facilities. The extent of occupancy of normally empty floor spaces by rolling stock and by stacked sacks of mail could be more realistically assessed. In addition, an unmanned automatic instrumentation package should be in operation in at least one facility during this same period to record heavy conveyor live loads.

Pertaining to the mechanization loads in Table 1, it has already been noted (in Section 3.3) that one of the plotted values lies beyond the previously assumed (for 1- and 2-story facilities) upper limit boundary curve of Figure 8. However, such an empirical representation of existing field conditions could, in a final analysis, be made to include such values with only slight modification of the curve's region of transition and little change in its definition of location. Again, therefore, it appears that the assumed upper limit boundary curve is still generally applicable to the data from this facility as well as those previously surveyed.

As in preceding reports, it should be noted that the values of floor loadings for grid squares and sectors in Table 3 are maximums, as indicated, which were encountered in the survey but which often are isolated cases and not necessarily

typical. For example, the maximum sector UDL of 163 psf (caused by stored miscellaneous equipment) is in a grid square having a UDL of only 21 psf. A broader view of the floor loadings is given by the loaded area cumulative fraction curves for work areas (not included in this report) and for the total building as seen in Figure 7. Also deserving of comment in Table 3 is the practically totally occupied grid square A12 with a grid UDL of 31 psf. This grid square of floor loading is the same area containing Sack-central in Mechanization Section (C) of Table 1. The higher UDL value in Table 1 (38 psf) arises from a consideration of all mechanization within the grid square (some of which is actually ceiling-suspended) plus the inclusion of conveyor live load on belt areas.

The use of work area cumulative fraction curves mentioned above in computing equivalent uniformly distributed loads for grid squares (EUDL) by the method described in Section 3.3 leads to conservative values. The EUDL values for grid square floor loads presented in Table 5 are maximum values derived from surveyed loadings within work areas. These values are considered very conservative even though computed from surveyed data. Such an evaluative approach has been used, however, in order to obtain comparisons of loading values by using surveyed data samples which are of limited number and sometimes not too resemblant. For example, no allowance is made for maneuvering space which varies in different work areas; and all grid square panels are considered as one-way slabs.

To offset some conservatism an appraisal was also made of the Omaha floor load data by obtaining grid square EUDL's from the work area cumulative fraction curves but on the basis of a 2-way slab support consideration. As a result, the values in Table 5 were lowered by, from 6% to 24% with a mean of 13% depending on the ratio of the 2-way to 1-way calculated bending moment values. However, the 1-way slab values were tabulated for consistency and comparison with preceding reports. Further consideration of all combined data may well employ more such less conservative approaches in their analysis.

With the foregoing comments in mind, the following preliminary values were determined as a summary of the information developed thus far from loads in the one 3-story facility surveyed:

(1) For bulk mail load on storage conveyors - - 30 psf

(2) For suspended mechanization loads - - 100 psf

(3) For live floor loads - - 190 psf

Since the data for bulk mail load on storage conveyors were not satisfactorily augmented during the survey of the 3-story facility, value (1), above, remains at 30 psf as first presented in Interim Report II for the reasons discussed therein. Acquisition of additional data pending, the value of 30 psf is considered satisfactory until further investigation shows otherwise.

As discussed in Sections 3.3 and 3.4, the upper limit curve (Figure 8) developed for suspended mechanization loads and related occupied areas in preceding facilities is still applicable to the data gathered in the 3-story facility and value (2) remains at 100 psf.

Value (3) for this facility is recorded for the present as 190 psf. with the reminder that it stems from a storage area at ground level which is abnormally loaded.

4. Tables and Figures

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Floor	Mechanization Section	Total Material Weight (lb)	Plan Area of Section (sq. ft.)	Gross* UDL, W/O L.L. (PSF)	Gross UDL$_2$ Incl. Conveyor L.L. @30 PSF (PSF)	Hanger Load Assuming 4 - Corner Support		Hanger Load Assuming Support at 5-Ft. Co-ord. Grid Pts.	
						W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)	W/O L.L. (lb/hanger)	with Conveyor L.L. @30 PSF (lb/hanger)
Ground	A	19000	1377	14	20	---	---	290	430
1st	B	44500	1386	32	38	---	---	(710)**	(850)
2nd	C	39300	1023	38	62	---	---	(800)	(1290)
2nd	D	17100	220	78	100	---	---	(1140)	(1470)

*UDL = Uniformly Distributed Load; L.L. = Mail Live Load

** ( ) = Total load assumed to be ceiling supported

Table 1 - Ceiling Loads from Suspended Mechanization Sections - Omaha, Nebraska.

Work Area Code No.	Activity Description	Approximate Area Grid = 33' x 31' = 1023 sq. ft. sq. ft.	 %
1	Culling, facing & cancelling	16499	9.8
2	Letter distribution	28382	16.9
3	Main office carriers	3243	1.9
4	Flats distribution	25507	15.2
5	Pouching	5342	3.2
6	Sawtooth platform area	29152	17.4
7	Outgoing parcel post	25472	15.2
8	Incoming parcel post	11352	6.8
9	Outgoing non-preferential	---	--
10	Tempo storage (outside parcels and equipment)	22803	13.6
Total Workroom Area Surveyed		167752	100.0
Gross Workroom Area		174307	

Table 2 - Distribution of Workroom Floor Space in 3-Story Facility at Omaha, Nebraska.

OMAHA

Floor Level	Work Floor				Work Area				
	Total Load kips	Area Sq. ft.	UDL psf	Occupied Space %	Code	Total Load kips	Area Sq. ft.	Maximum UDL psf	Occupied Space %
Gnd. Floor	481	43817	11.0	27.8	10	211	14665	14.4	28.7
1st Floor	459	58571	7.8	25.7	10	38	2342	16.2	41.2
2nd Floor	736	65364	11.3	31.4	10	92	5796	15.9	38.6
Gnd., 1st & 2nd Floor	1676	167752	10.0	35.5	10	342	22803	15.0	32.5

Floor Level	Grid Square					Grid Sector					
	Code Grid Sq. (Work Area)	Work Area UDL psf	Area Sq. ft.	Maximum Grid UDL psf	Occupied Space %	Code Sector (Gr. sq.) (Work Area)	Work Area UDL psf	Grid Square UDL psf	Area Sq. ft.	Maximum Sector UDL psf	Occupied Space %
Gnd. Floor	D12 (6)	9.3	1023	49.7	68	1-2 (C13) (10)	14.4	21.2	63.9	163	86
1st Floor	C07 (7)	6.6	1023	23.0	62	1-2 (C10) (7)	6.6	15.2	63.9	70	38
2nd Floor	A12 (1)	12.9	1023	31.2	99	1-4 (B13) (10)	15.9	20.9	63.9	84	56
Gnd. 1st & 2nd Floor	D12 (6)	9.3	1023	49.7	68	1-2 (C13) (10)	15.0	21.2	63.9	163	86

Table 3 - Maximum Loadings on Floor Areas of Different Size Divisions at Omaha.

OMAHA

Work Area	Percentage of Occupied Space				Occupied Area (sq. ft.)				Total Surveyed Area, (sq. ft.)			
	Gnd. Flr.	1st Flr.	2nd Flr.	Gnd., & 2nd 1st Flr.	Gnd. Flr.	1st Flr.	2nd Flr.	Gnd., & 2nd 1st Flr.	Gnd. Flr.	1st Flr.	2nd Flr.	Gnd., & 2nd 1st Flr.
1	-	-	38.8	38.8	-	-	6409	6409	-	-	16499	16499
2	-	-	26.3	26.3	-	-	7475	7475	-	-	28382	28382
3	-	23.1	-	23.1	-	748	-	748	-	3243	-	3243
4	-	23.1	29.0	25.3	-	3739	2709	6448	-	16162	9345	25507
5	-	-	31.7	31.7	-	-	1691	1691	-	-	5342	5342
6	27.3	-	-	27.3	7957	-	-	7957	29152	-	-	29152
7	-	24.6	-	24.6	-	6276	-	6276	-	25472	-	25472
8	-	29.5	-	29.5	-	3347	-	3347	-	11352	-	11352
9	-	-	-	-	-	-	-	-	-	-	-	-
10	28.7	41.2	38.6	32.5	4203	964	2234	7401	14665	2342	5796	22803
Total	27.8	25.7	31.4	28.5	12160	15074	20518	47752	43817	58571	65364	167752

Table 4 - Percent of Work Area Space Occupied by Load Items.

Equivalent Uniformly Distributed Load (EUDL)

psf

OMAHA

Work Area Code	Cnd. Floor	1st Floor	2nd Floor	Gnd., 1st & 2nd Floor	Comments
1	---	---	74	---	
2	---	---	107	---	
3	---	48	---	---	
4	---	80	62	83	1st & 2nd Flr.
5	---	---	45	---	
6	98	---	---	---	
7	---	67	---	---	
8	---	48	---	---	
9	---	---	---	---	
10	172	71	118	190	Gnd., 1st & 2nd Flr.

Table 5 - Equivalent Uniformly Distributed Loads (EUDL) Derived from Optimized Loadings on a Grid Square.

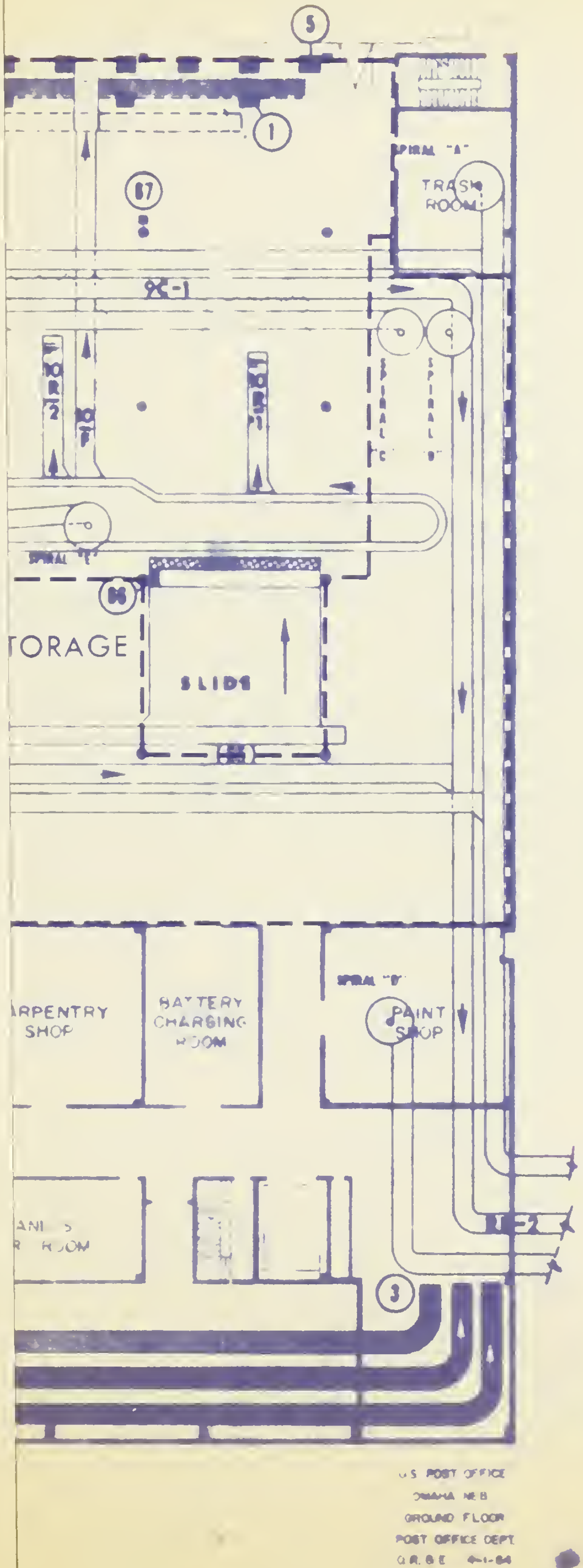

FIG 1 OMAHA POST OFFICE GROUND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

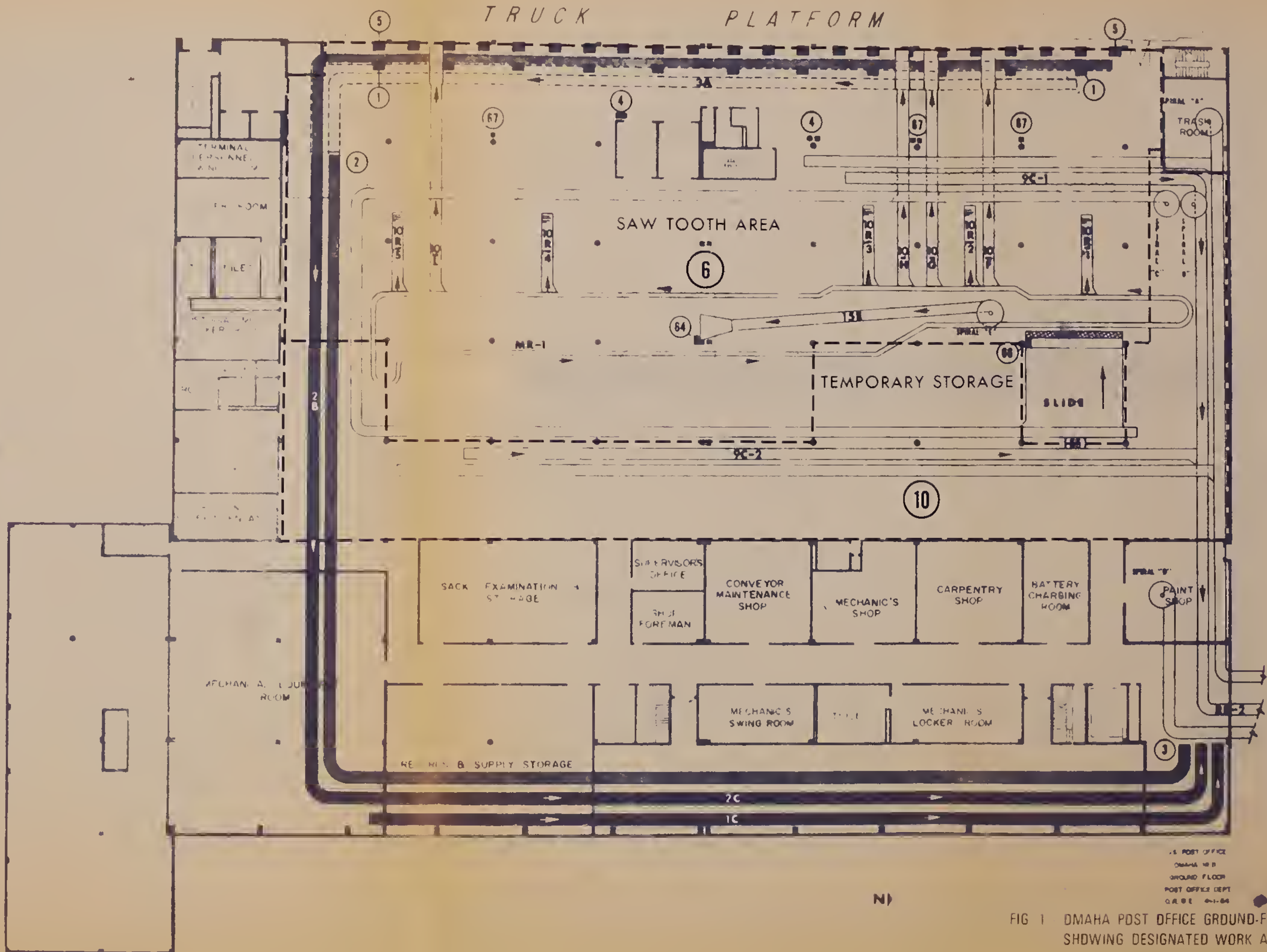

FIG 1 OMAHA POST OFFICE GROUND-FLOOR PLAN SHOWING DESIGNATED WORK AREAS

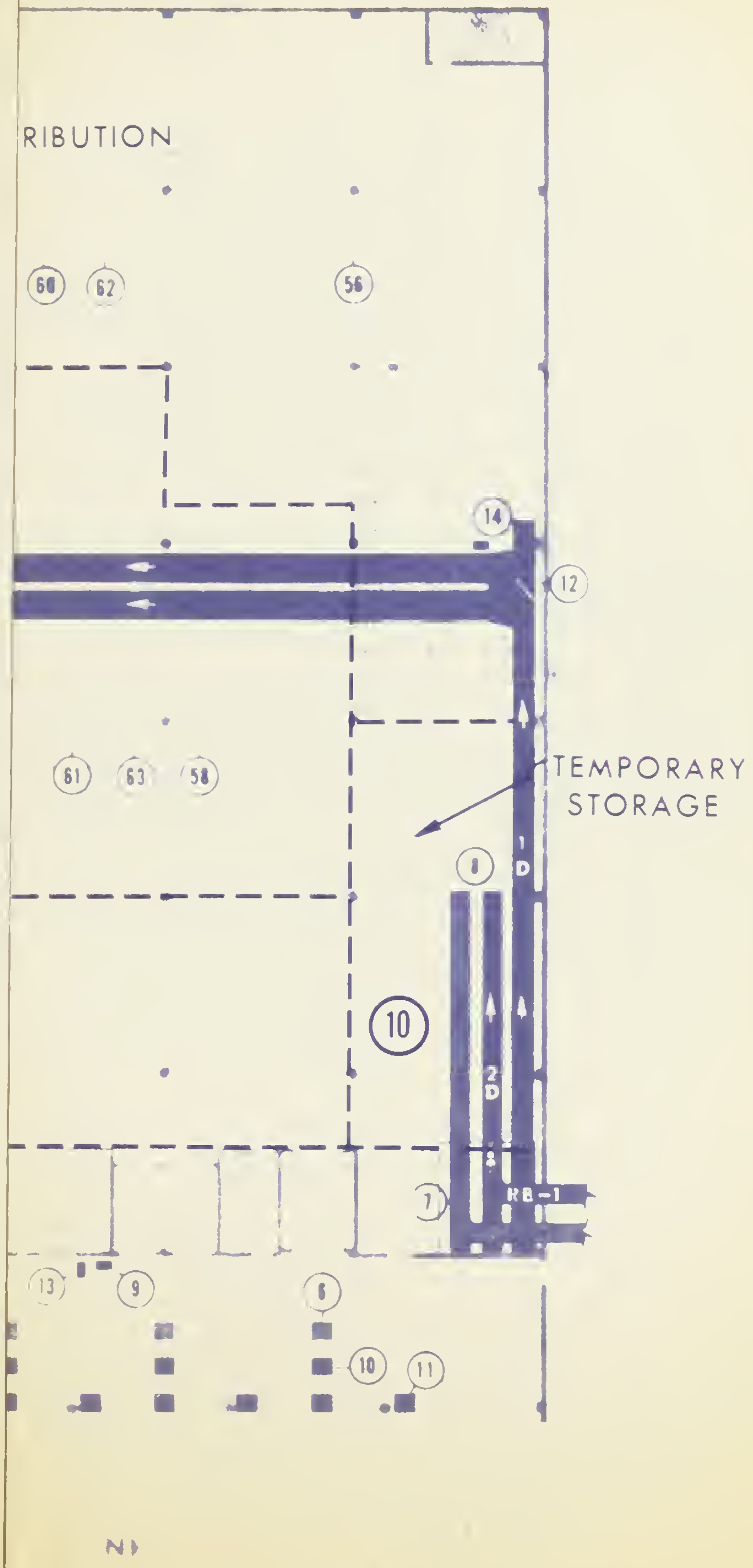

FIG 2 OMAHA POST OFFICE FIRST-FLOOR PLAN
SHOWING DESIGNATED WORK AREAS

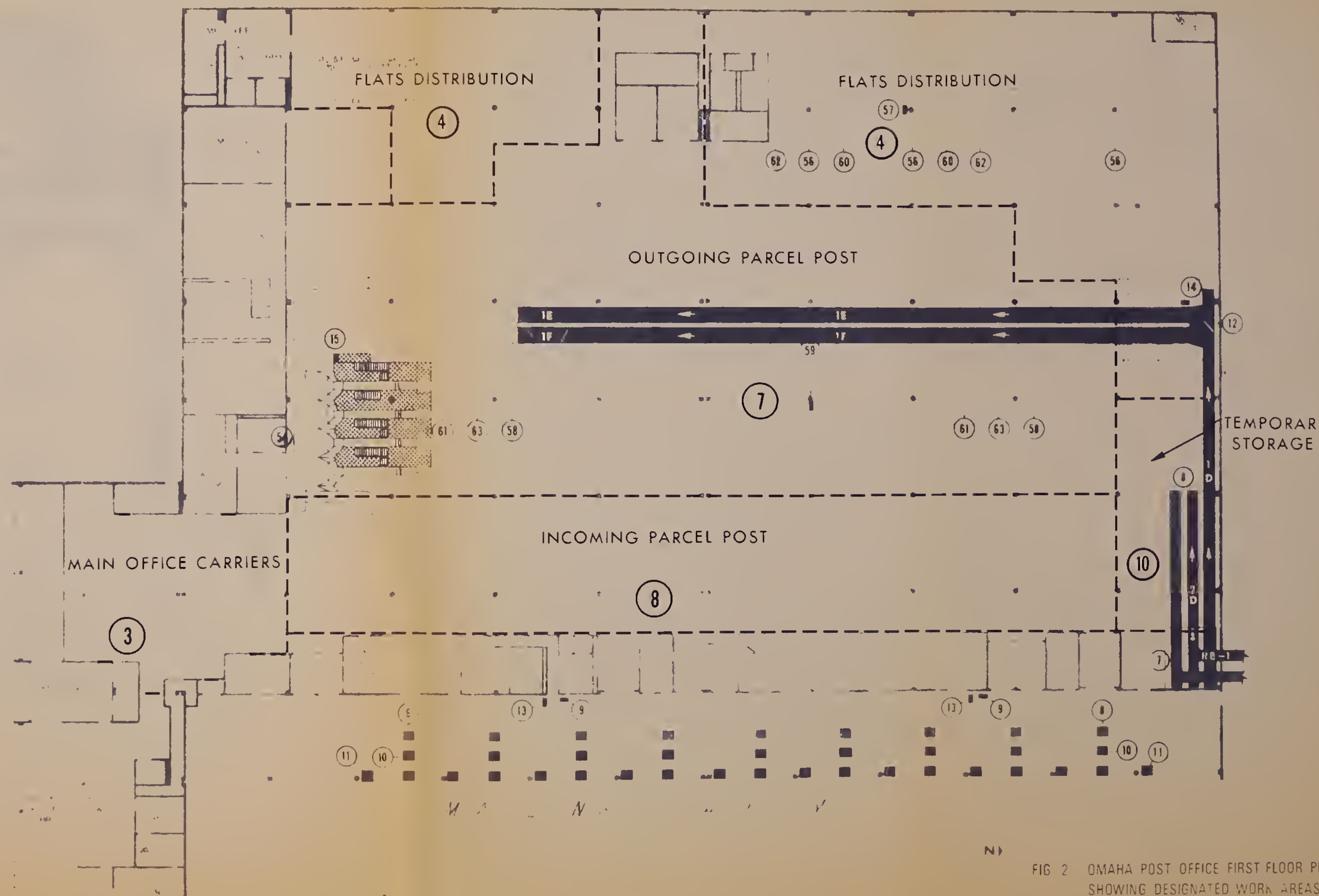

FIG 2 OMAHA POST OFFICE FIRST FLOOR PLAN
SHOWING DESIGNATED WORK AREAS

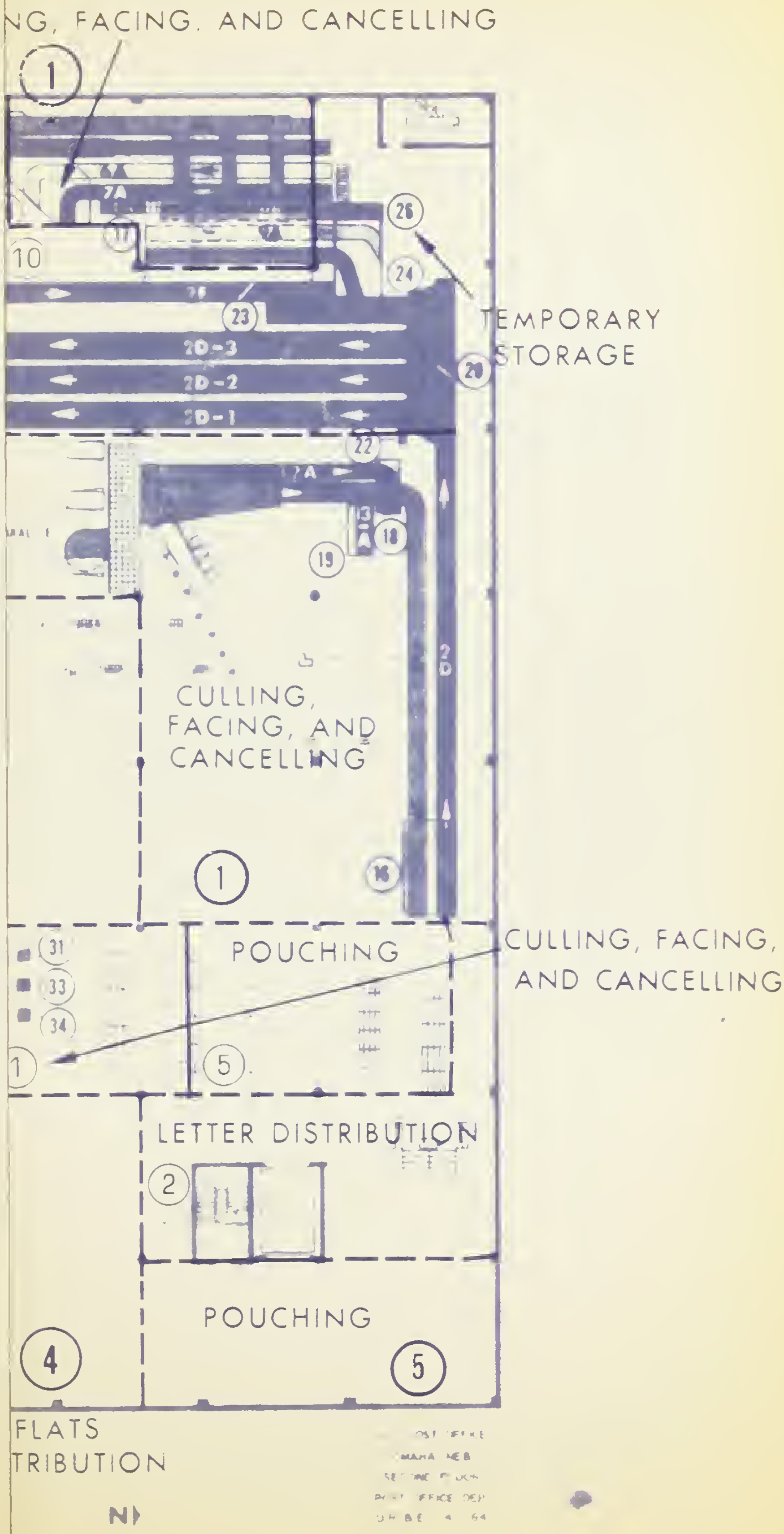

FIG 3 OMAHA POST OFFICE SECOND-FLOOR PLAN
SHOWING DESIGNATED WORK AREAS

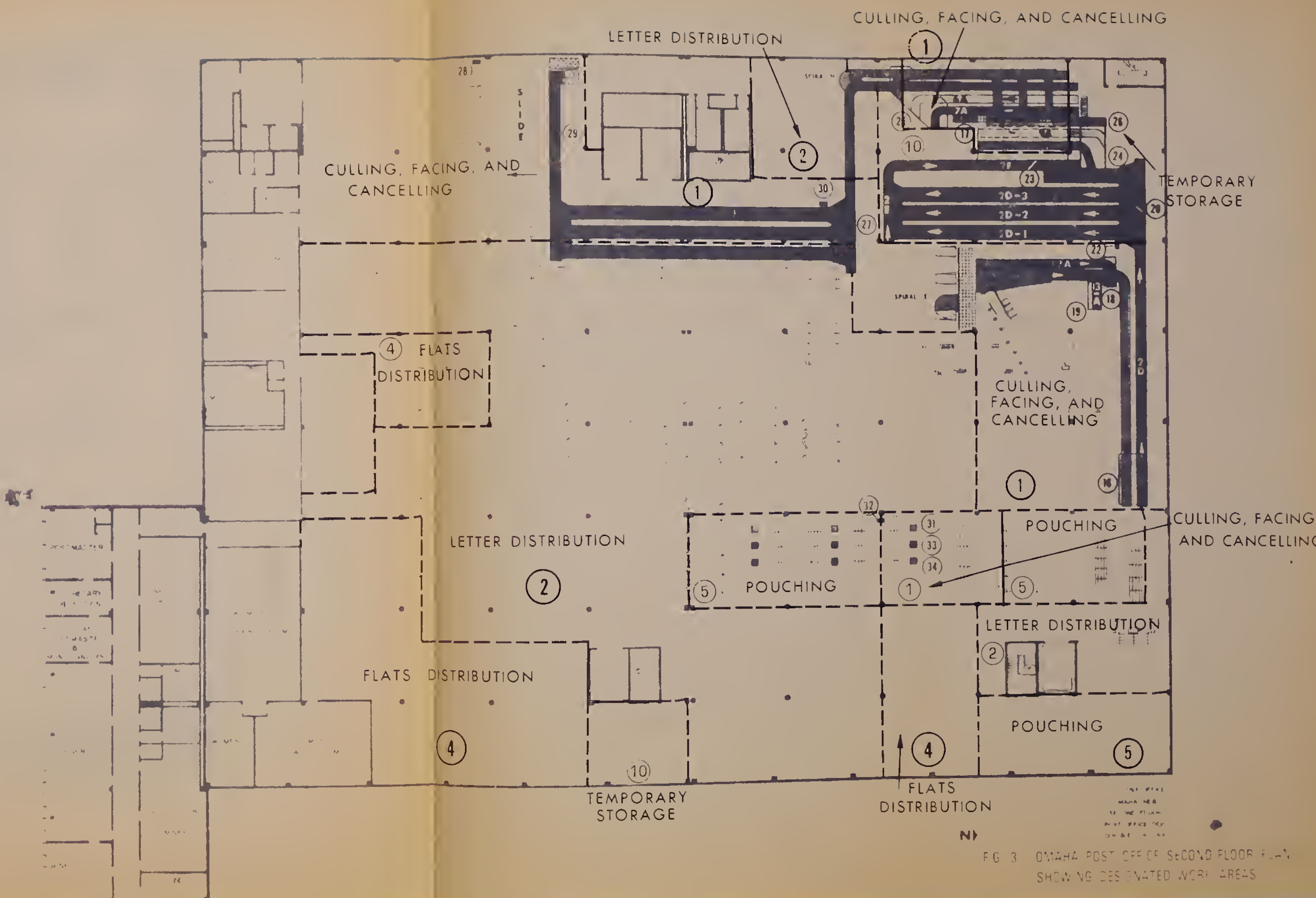

FIG. 3 OMAHA POST OFFICE SECOND FLOOR PLAN SHOWING DESIGNATED WORK AREAS

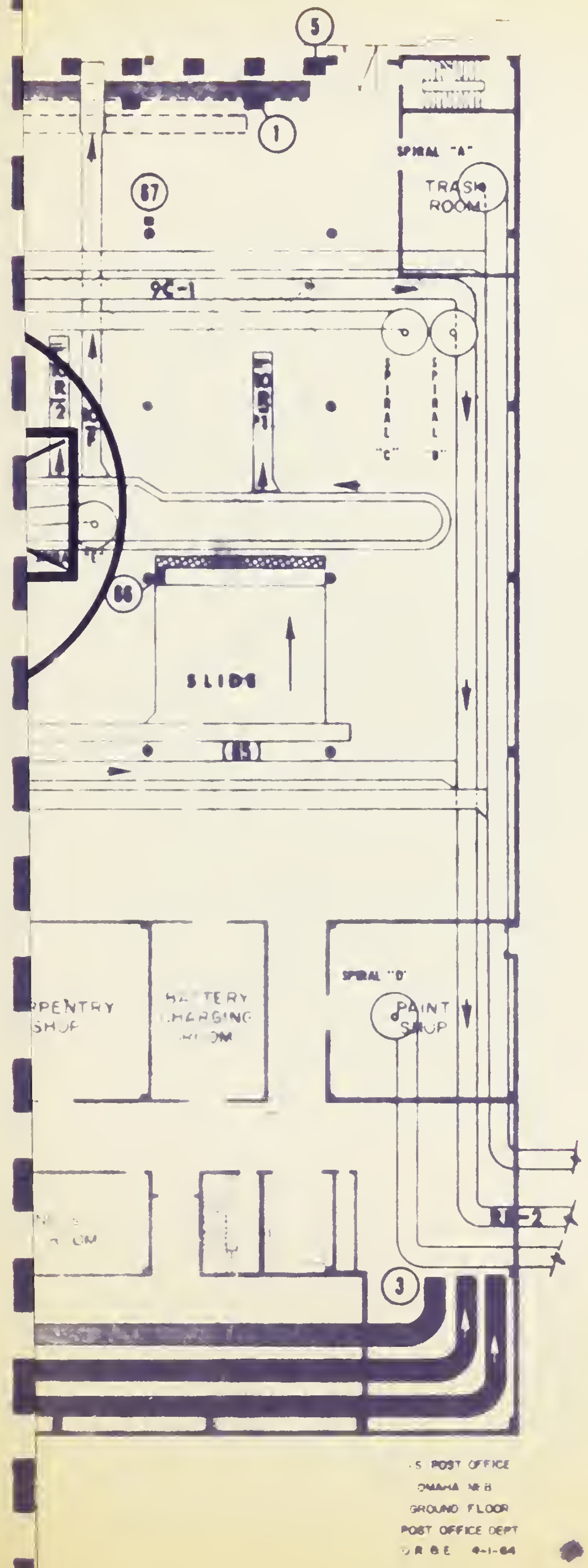

FIG 4 MECHANIZATION SECTION AT OMAHA GROUND-FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

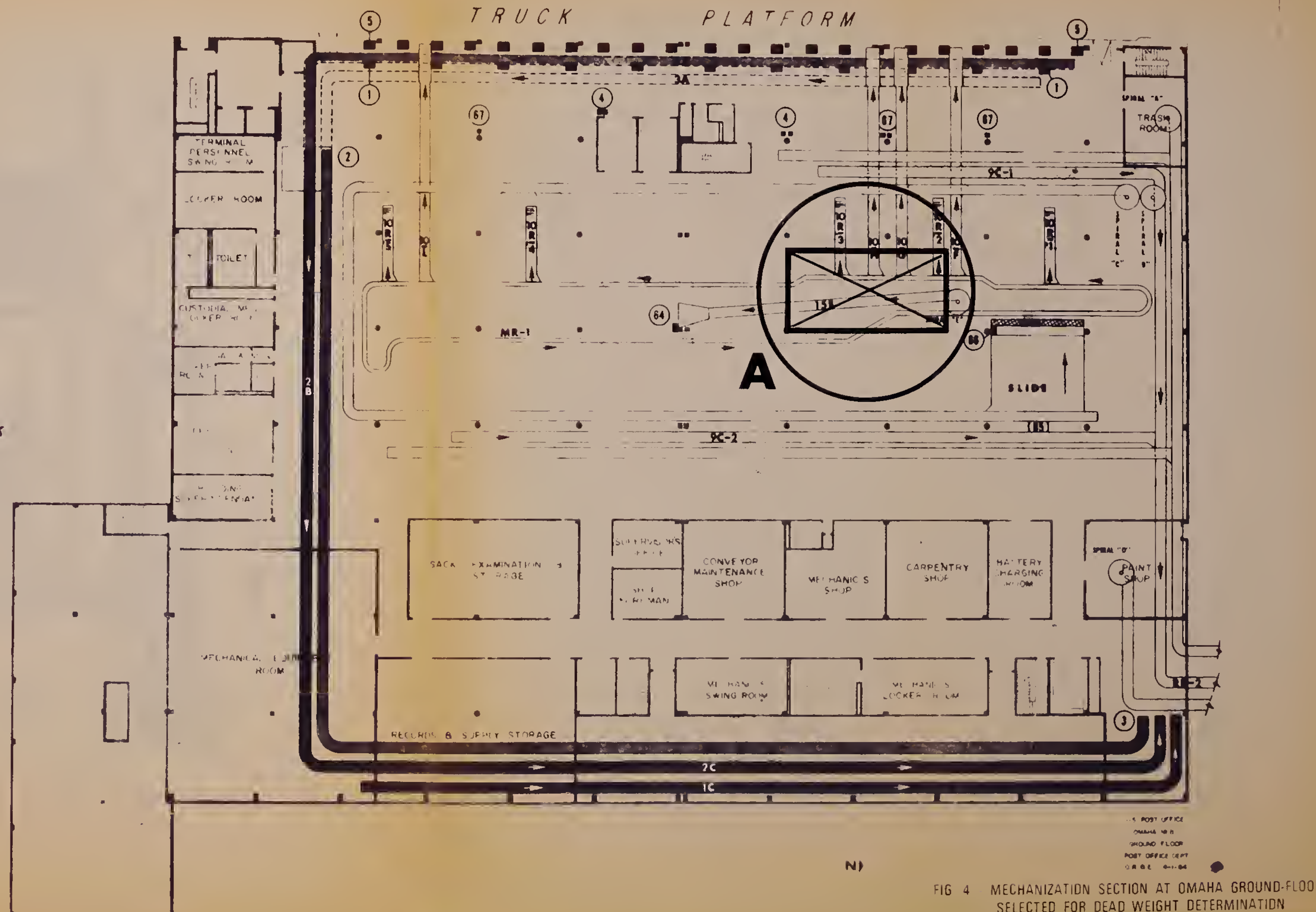

FIG 4 MECHANIZATION SECTION AT OMAHA GROUND-FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

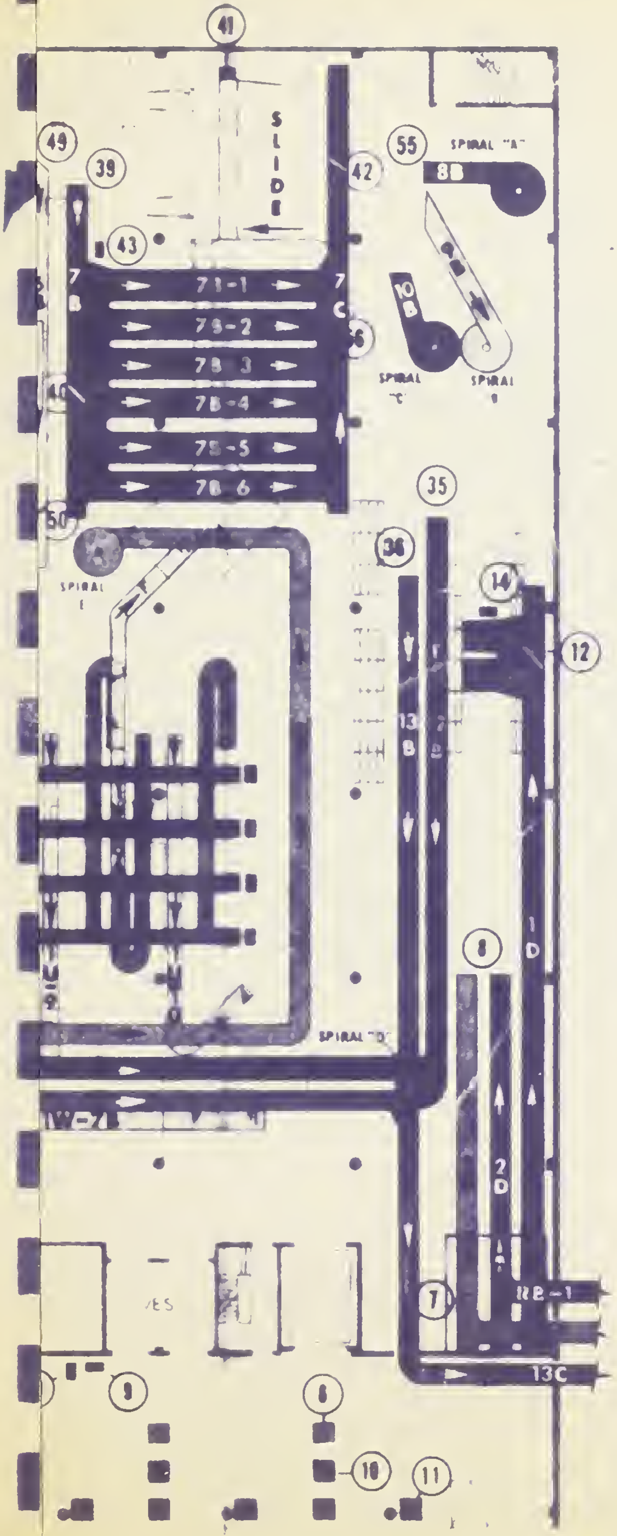

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FIG 5 MECHANIZATION SECTION AT OMAHA FIRST FLOOR
SELECTED FOR DEAD WEIGHT DETERMINATION

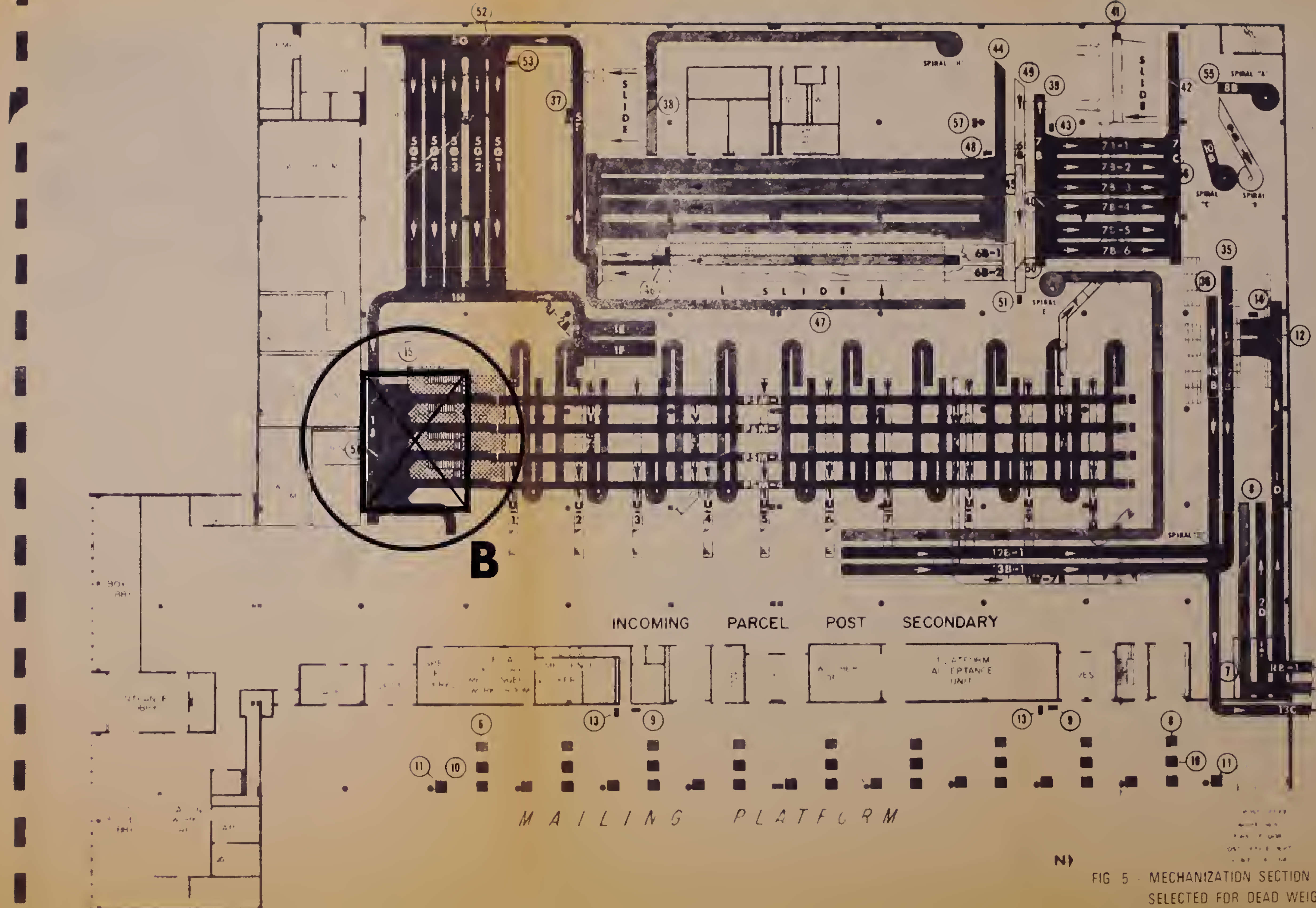

FIG 5 · MECHANIZATION SECTION AT OMAHA FIRST FLOOR
SELECTED FOR DEAD WEIGHT DETERMINATION

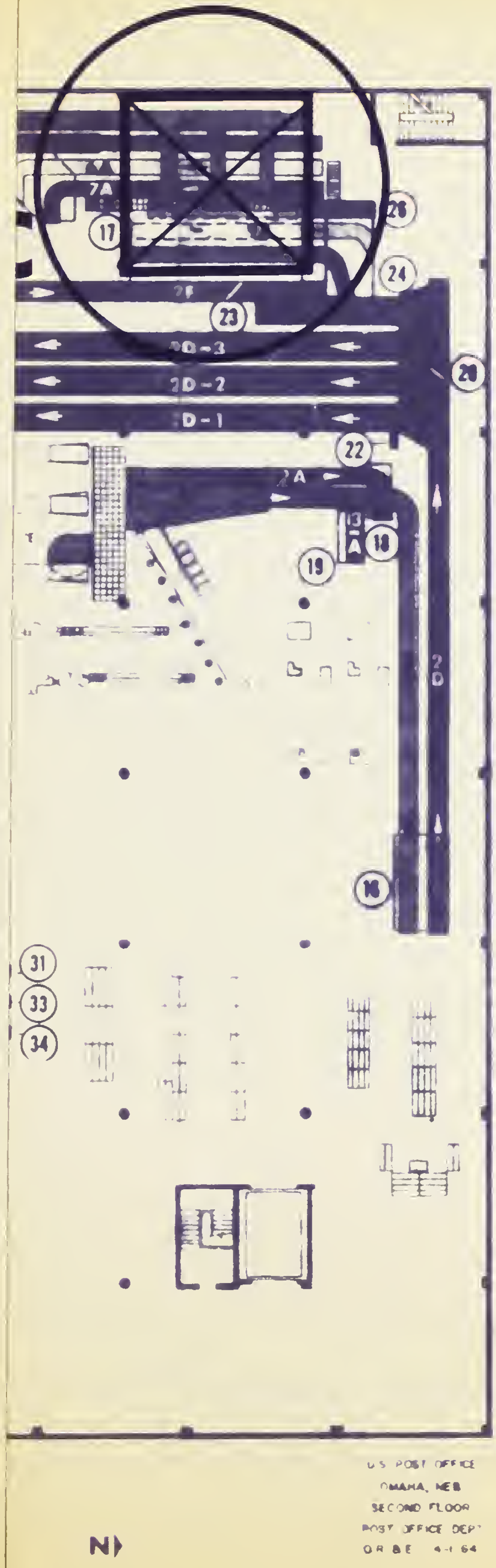

FIG 6 MECHANIZATION SECTIONS AT OMAHA SECOND FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

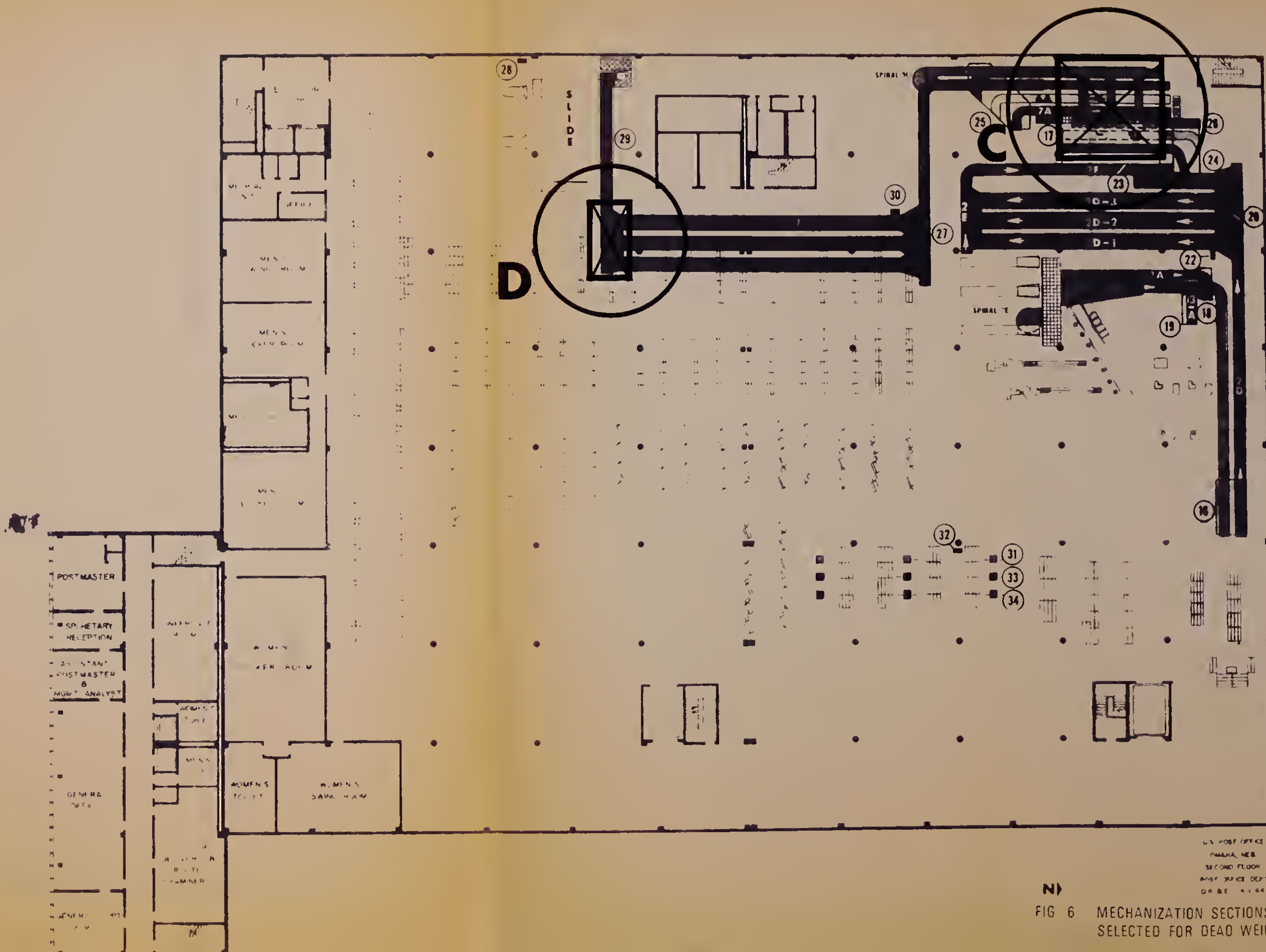

FIG 6 MECHANIZATION SECTIONS AT OMAHA SECOND FLOOR SELECTED FOR DEAD WEIGHT DETERMINATION

CUMULATIVE FRACTIONS OF LOADED AREA CARRYING LOADS GREATER THAN A DISCRETE VALUE, WORK AREA, BDG.T.
TOTAL AREA= 167,752.0 SQ.FT.
LOADED AREA= 47752.4 SQ.FT. - 28.5 % OF TOTAL AREA
ZERO LOAD= 119,999.6 SQ.FT. - 71.5 % OF TOTAL AREA
U.D.L.= 10.0 FOR TOTAL AREA

OMAHA

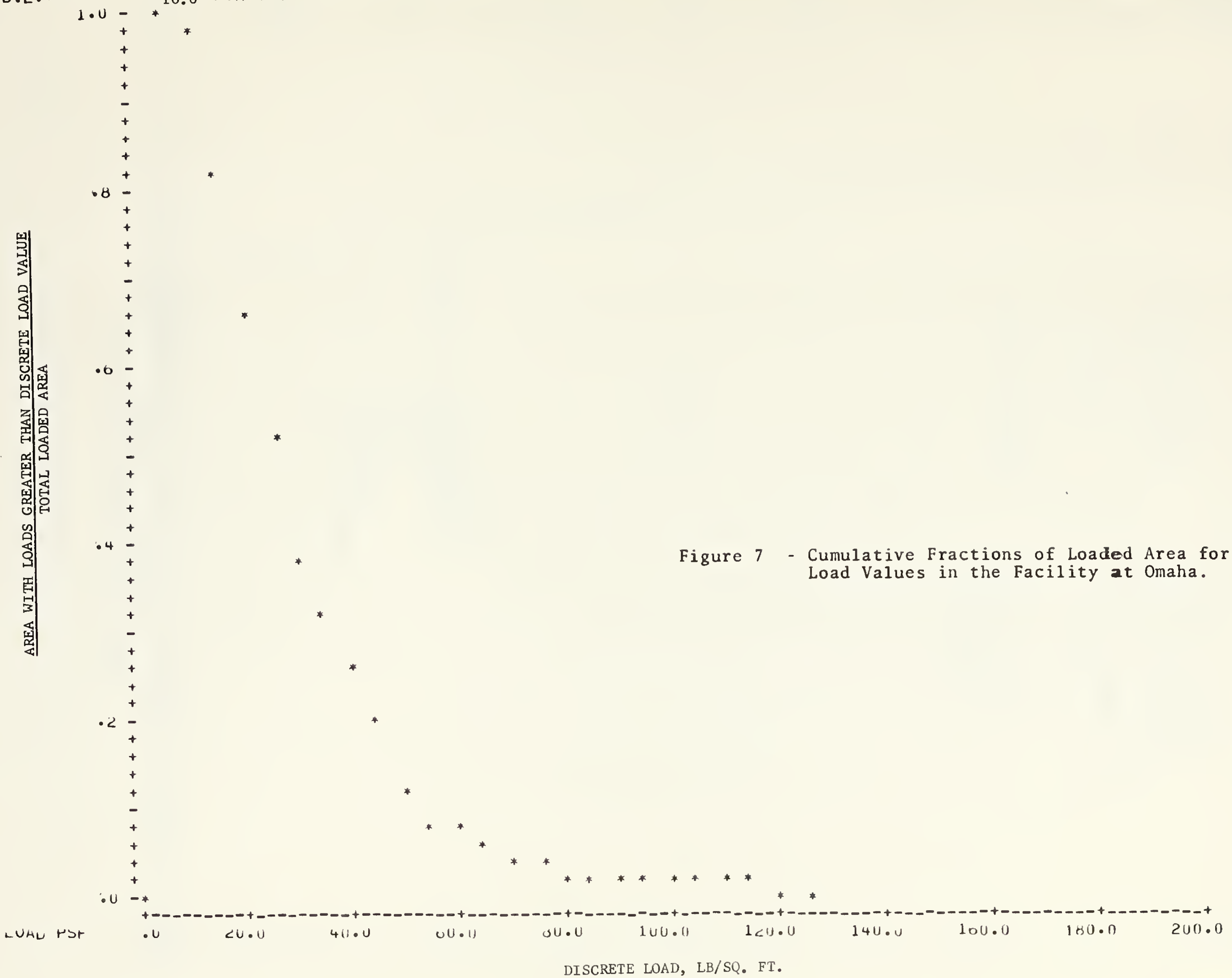

Figure 7 - Cumulative Fractions of Loaded Area for Discrete Load Values in the Facility at Omaha.

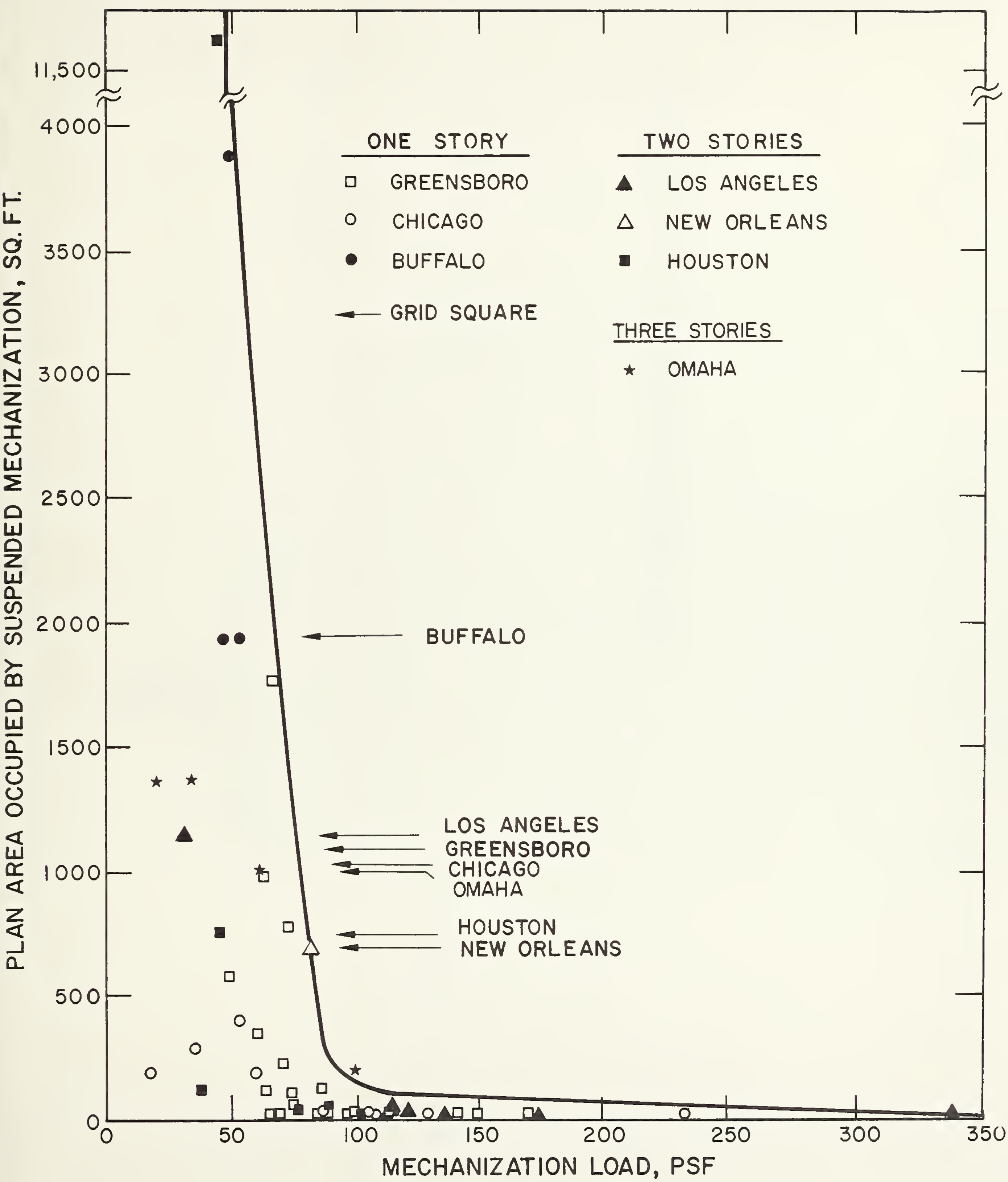

Figure 8 - Plot of Suspended Mechanization Loads vs. Plan Area of Sections.

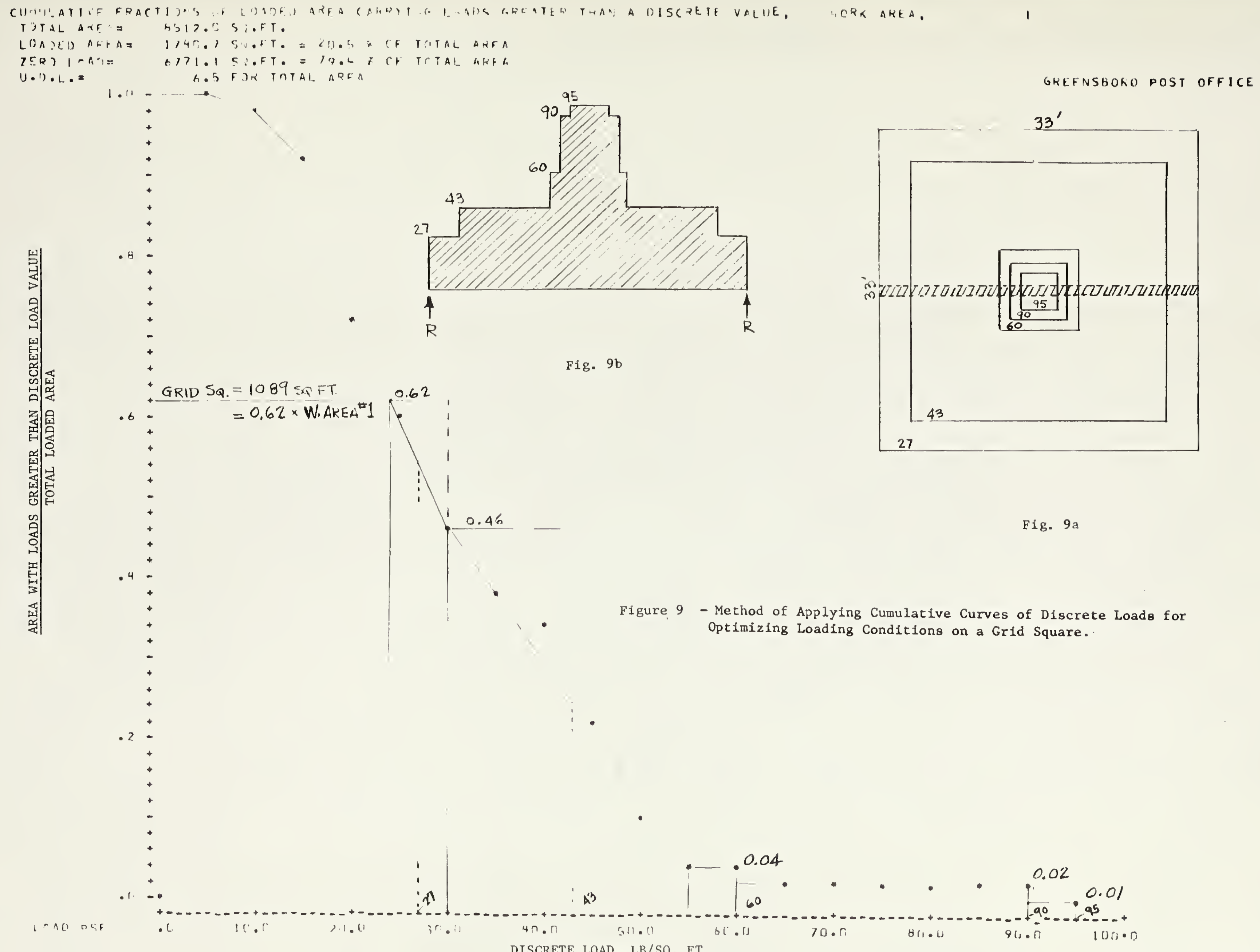

Fig. 9b

Fig. 9a

Figure 9 - Method of Applying Cumulative Curves of Discrete Loads for Optimizing Loading Conditions on a Grid Square.

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