STRUCTURAL ENGINEERING INVESTIGATION REPORT OF AN EXISTING BUILDING FOR THE SUPPORT OF A PROPOSED 50 TON DOUBLE GIRDER CRANE

FOR

THE US MARINE CORPS
BLOUNT ISLAND COMMAND
JACKSONVILLE, FL

By: _____
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HAI Project No. 2613

March 17, 2006

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HAI Project No. 2613
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I. INTRODUCTION & SCOPE

The US Marine Corps provides maintenance and re-habilitation of military vehicles in a building designed in 1975 for Offshore Power Systems. The building is a multi-bay steel structure which has several different overhead cranes of tonnage capacities ranging from 10 tons to 40 tons as noted on the drawings. The building is more completely described below and in appendices where small prints of existing building drawings have been included.

The scope of this structural engineering investigation was limited to Bay II of the structure which houses a 40 ton crane with a 10 ton auxiliary hoist. The purpose of the investigation is to determine if a 50 ton crane can be installed in the this area. Only the 50 ton crane would occupy a runway span. In other words, no other cranes can be positioned on the same runway span when the 50 ton crane is present.

II. SUMMARY CONCLUSIONS

Based upon the results of the structural investigation of the building as outlined in this report it is concluded that a 50 ton capacity, double girder crane with an end truck wheel base of 4 pairs of wheels spaced at 6'+2'-7"+6'-0" (14'-7" out to out) and a maximum wheel load of 41 kips on each pair can be installed on the existing runway system as originally designed for a 40 ton capacity, double girder crane with a 10 ton auxiliary hoist having 2 pairs of wheels spaced at 14'-7" and a maximum wheel load of 88 kips on each pair. The end truck wheel can be increased, however, a shorter end truck wheel base would require that a review check be made to see if the reduction voids the 50 ton capacity rating.

It is stipulated, however, that only the 50 ton crane should occupy the runway span. No other crane should be operating on the same runway span while the 50 ton crane is in operation. It is further stipulated that this conclusion is predicated on the assumption that all existing connections are properly installed and that the crane rail is properly attached and aligned on the runway and is in good condition. In addition, it is pointed out that the assumption has been made that there are no defects in the existing runway beams and support columns.

III. REFERENCE DRAWINGS

Drawings listed for reference were provided by the USMC. A site visit was made in the facility where the proposed crane would be installed. Field notes confirmed that the existing building drawings could be relied upon to provide the framing information that was to be investigated. The reference drawings were prepared by Florida Steel Corp. for Offshore Power Systems. Several of the drawings bear "Approval Prints" dated October 28, 1975. The drawings specifically used for this investigations included the following:

1. E19 - Runway Plan, North Segment
2. E20 - Runway Plan, Middle Segment
3. E21 - Runway Plan, South Segment
4. E28 - Crane Runway Elevations, Column Line "D"
5. E29 - Crane Runway Elevations, Column Line "E"
6. E43 - Partial Building Section Looking North
   (This drawing also lists the crane loads used in the original design. The loads for the existing 40 ton crane have been used in the comparative study with the loads for the proposed 50 ton crane.)

No drawings were available for the existing 40 ton crane. Small size prints of the Bay II area of the existing building are included in Appendices "B" thru "E".

IV. BUILDING DATA

The building has three main longitudinal segments as defined by drawings E19 thru E22. The north segment includes column lines 1 thru 8. The middle segment includes column lines 9 thru 16. The south segment includes column lines 17 thru 24.

The building width data is also tabulated in **Table 1**.

Table 1 - Building Width Data

Bay No.	Col. Lines	Bay Width	Crane Span	Crane Ratings
I	A - Cm	50'	44'	1-30 T (10 T Aux.) 1-10 T
*II	Cm-Em	113'	102'	1-40 T (10 T Aux.) 1-30 T (10 T Aux.) 1-20 T
* This is the bay evaluated!!!				
III	Em-Gm	118'	102'	1-30 T (5 T Aux.) 1-20 T (5 T Aux.)

IV	Gm-K	79'	68'	1-20 T (Future) 1-20 T 1-10 T (Future)
	Total Width:	360'		

The building longitudinal data is tabulated in **Table 2.**

Table 2-Building Longitudinal Data

Segment No.	Col. Lines	Distance	Center To Center Exp.Jt
North	1 - 8	283'-9"	
Exp.Jt.	8 - 9	2'-6"	285'-0"
Middle	9 - 16	279'-6"	280'-0"
Exp.Jt.	16 - 17	2'-6"	285'-0"
South	17 - 24	283'-9"	
Total Length:		850'-0"	850'-0"

Four (4) drawings have been prepared by Hartley & Associates, Inc. to summarize the building data applicable to Bay II. The drawings are included in Appendix "A" and they include the following:

1. S1 - Partial Runway Plan
2. S2 - Partial Building Cross Section
3. S3 - Elevation, Crane Runways
4. S4 - Crane Runway Loadings

V. DESIGN LOAD INFORMATION

Four (4) reference sources identify the applicable design factors for overhead cranes. These reference documents include:

1. Crane Manufacturers Association of America (CMAA), Specification #70, entitled "Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes". Unless otherwise specified, this specification is the primary document used in the design of crane support systems.

2. ASCE Standard 7-98 entitled "Minimum Design Loads for Buildings and Other

Structures".

3. Florida Building Code, Chapter 16 entitled "Structural Loads".

4. American Institute of Steel Construction, Inc. entitled "Specification for Structural Buildings", Allowable Stress Design and Plastic Design, June 1, 1989.

CMAA requires that supporting runways be designed such that the working stresses do not exceed the allowable as established by appropriate formulas. In addition, the lateral deflection shall not exceed L/400 based on 10% of the maximum wheel load(s) without impact. The maximum vertical deflection shall not exceed L/600 based on the maximum wheel load without impact.

Using the above values, the allowable runway deflections are tabulated in **Table 3**.

Table 3 - Allowable Runway Deflections

Runway Span	Vertical Defl. Limit (L/600)	Lateral Defl. Limit (L/400)
45'-0"	0.90"	1.35"
40'-0"	0.80"	1.20"
38'-9"	0.775"	1.163"

CMAA also stipulates required rail alignment values as defined in Table 1.4.2-1 of the specifications.

ASCE Standard 7-98, The Florida Building Code and AISC specifications all require the following impact factors:

1. Vertical: A vertical impact factor of 10% be applied to the maximum wheel load for a pendent operated crane.
2. Lateral: The lateral force on the crane runway beams with electrically powered trolleys shall be calculated as 20% of the sum of the rated capacity of the crane and the weight of the hoist and trolley. The lateral force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction perpendicular to the beam, and shall be distributed with due regard to the lateral stiffness of the runway beam and supporting structure.
3. Longitudinal: The longitudinal force on crane runway beams, except for bridge cranes

with hand-geared bridges, shall be calculated as 10% of the maximum wheel loads of the crane. The longitudinal force shall be assumed to act horizontally at the traction surface of a runway beam, in either direction parallel to the beam.

The existing crane support system has been evaluated for the above requirements.

It is pointed out, however, that the existing reference drawing E43 tabulates the following load factors as having been applied in the design of the structure:

1. Vertical Impact Factor - 25% of the maximum wheel load
   Note: This value is 15% higher than required by the documents cited above. This should result in a reserve capacity being available in the support system.
2. Lateral Force Factor - 12.5% of the crane capacity plus the trolley weight
   Note: Based on tabulated values, this factor results is a slightly less magnitude for the lateral load when compared to 10% times the maximum wheel load.
3. Longitudinal Force Factor - 12.5% of the maximum wheel load

VI. CRANE END TRUCK AND DESIGN LOAD VALUES

The crane load data used to evaluate the crane support items is listed in **Table 4**.

Table 4 - Crane Load Data

Crane Cap.	No. Pair Wheels	Wheel Base	Wheel Loads Vertical	Lateral
40 Ton	2	14'-7"	88 Kips	8.8 Kips
50 Ton	4	6'+2'-7"+6'	41 Kips	4.1 Kips

Refer to HAI drawing S4 for location of cranes for maximum runway bending and column loads for both the 40 ton and 50 ton cranes. In addition, see Appendix "E" for the original schedule of loads and notes.

VII. INVESTIGATION PROCEDURE UTILIZED

As noted above, Bay II was the area investigated. Maximum bending moments and column reactions were determined for each of the three (3) different runway spans using the 40 ton and 50 ton crane wheel loads. A comparison of the results for the worst case, 45' span, was made to determine if the proposed 50 ton crane would impose excessive stresses on the support members. The results are presented by support component such as runway beam, columns, lateral truss bracing and longitudinal vertical X-bracing. Deflection calculations were also made for comparison purposes.

VIII. RUNWAY COMPARISONS

The comparison of runway maximum bending moments, reactions and deflections are tabulated in **Table 5.**

Table 5 - Runway Comparisons

Crane Size	Max. Moments Vert. Kip-Ft	Lat.	Max..Reactions Vert. Kips	Lat.	Max. Deflection Vert. Inches	Lat.	Max. Defl.Allowed Vert. Inches	Lat.
40 T	1476	139	161	14.71	0.872	0.47	0.90	1.35
50 T	1583	149.4	151	13.71	0.90	0.49	0.90	1.35
Ratios (50t/40t)	1.072	1.075	0.95	0.932	1.032	1.042		

Note the following:

1. The 50 T Moments and Related Stresses are below the allowable.
2. The 50 T Reactions are slightly less than for the 40 T but are not excessive.
3. The 50 T Deflections slightly exceed the 40T values but still meet the allowable.
4. Crane runway end bearing stiffeners should not be affected by the slight increase in beam end reactions.

IX. COLUMN COMPARISONS

The comparisons of column values are tabulated in **Table 6**.

Table 6 - Column Comparisons

Crane Size	Column Size	Max..Reactions Vertical.	Max. Ratios Ra	Rb
40 T	W14x119	161 Kips	0.39	0.21
	W14x127		0.36	0.20
	W14x158		0.272	0.16
50 T	W14x119	151 Kips	0.37	0.20
	W14x127		0.34	0.19
	W14x158		0.27	0.16

Note the following:

1. The W14x119 column has a 2% greater reserve capacity with the 50T crane than with the 40T crane.
2. The W14x127 column has a 2% greater reserve capacity with the 50T crane than with the 40T crane.
3. The W14x158 column has approximately the same reserve capacity with the 50T crane as with the 40T crane.

It is pointed out that the superstructure loads from the roof system have not been included in the evaluation. These loads remain the same regardless of which crane is used. Therefore, only the crane loadings have been compared for effects on the runways and support columns.

It is also noted that the design drawings indicate that each column except at the expansion joint lines was supposedly designed for a 3 ton capacity jib crane with a 30 foot boom. This crane would apply on the column a thrust and tension pull of approximately 28.2 kips. It would also add approximately 7 kips of vertical load to the column. However, there are no jib cranes mounted on the columns. All jib cranes are floor mounted.

In addition, areas along column line "E" have platform framing which, according to other drawings not included, were designed for heavy live loads. These platforms did not appear to have storage loadings applied on them. The platform loadings would contribute additional loads to the columns which support the crane runways. In the absence of these loading, the crane columns would have some reserve capacity that could be replaced by a higher rated crane such as the 50 ton system under consideration.

X. VERTICAL X-BRACING AND RUNWAY LATERAL TRUSS BRACING

A check was made of the capacity of both the vertical X-bracing and the runway lateral truss bracing. Due to the relative comparison of loads applicable to these components by the 40 ton and 50 ton cranes, these members retain their capability to support the 50 ton crane as effectively as the 40 ton crane.

XI. APPENDIX "A"

Refer to Appendix A for reference drawings developed by HAI to supplement and clarify the information used to make this structural investigation study.

XII. APPENDIX "B"

Refer to Appendix B for plan reference drawings of the existing building, Bay II, between column lines "D" and "E".

XIII. APPENDIX "C"

Refer to Appendix C for crane runway elevation reference drawings of the existing building, Bay II, between column lines "D" and "E".

XIV. APPENDIX "D"

Refer to Appendix D for building cross section reference drawings of the existing building, Bay II, between column lines "D" and "E".

XV. APPENDIX "E"

Refer to Appendix E for a schedule of crane loads and applicable notes for the original building design.

APPENDIX "A"

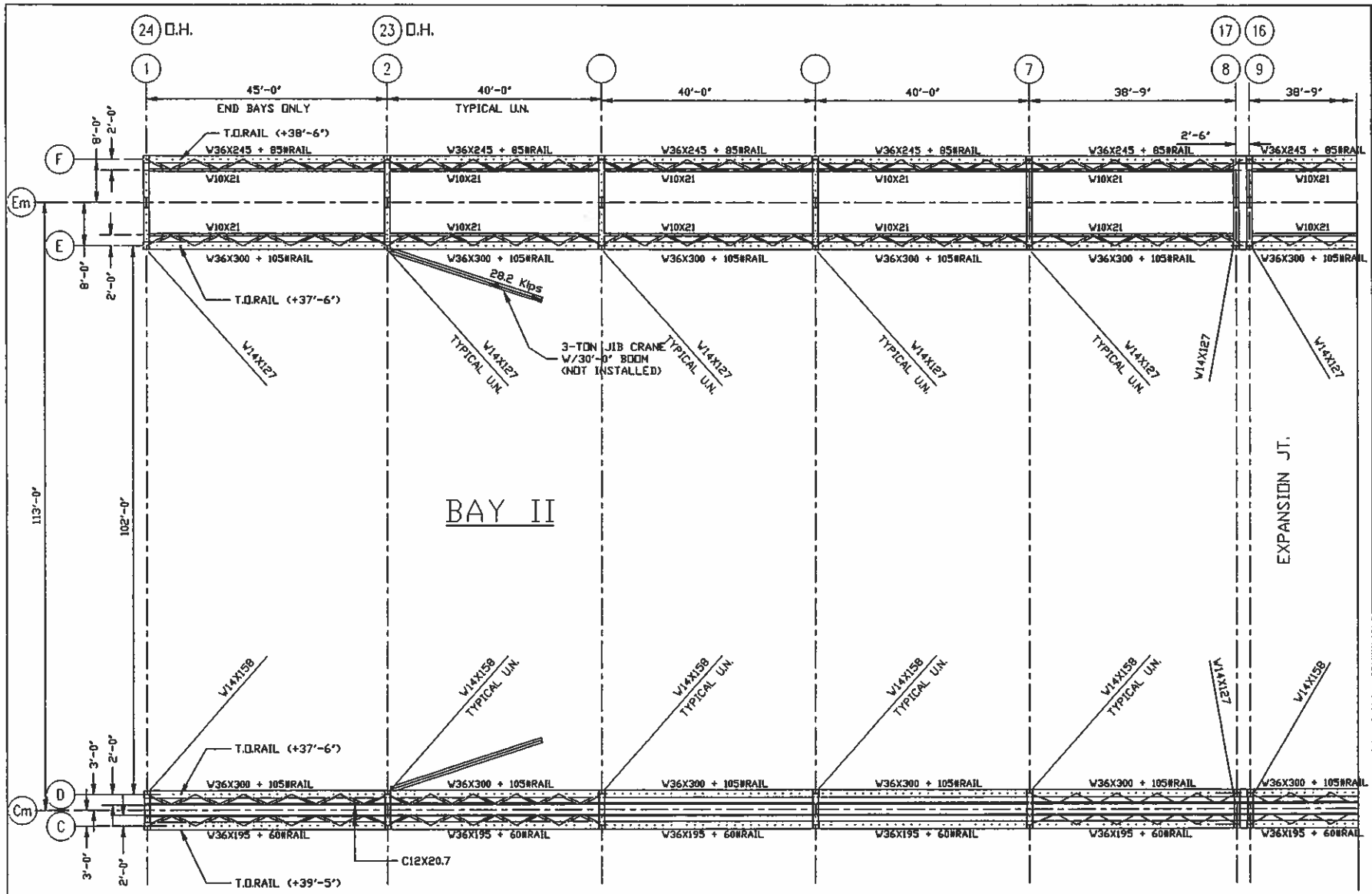
DRAWINGS BY HARTLEY & ASSOCIATES, INC.

S1 - Partial Runway Plan

S2 - Partial Building Section

S3 - Elevation Crane Runway

S4 - Crane Runway Loadings



PARTIAL CRANE RUNWAY PLAN

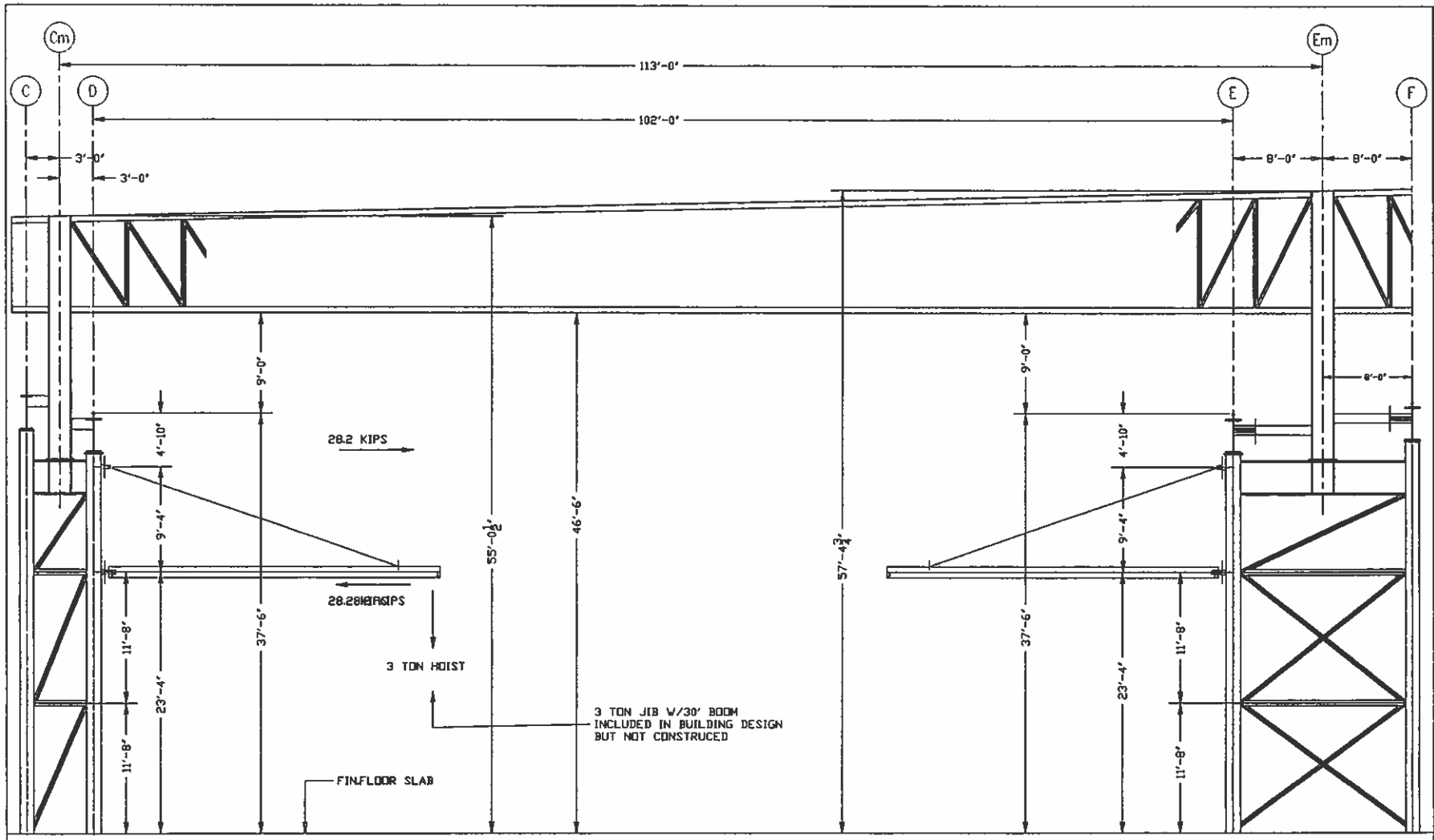
REVISIONS

CRANE PRO SERVICES
JACKSONVILLE, FL
FOR: USMC - JACKSONVILLE, FL
BUILDING EVALUATION FOR 50 TON CRANE

HARTLEY & ASSOCIATES, INC.
CONSULTING ENGINEERS
JACKSONVILLE, FLORIDA

SHEET TITLE:
PARTIAL RUNWAY PLAN

DATE: 03/17/06
JOB NO. 2613
SHEET NO.
S1
OF
DRAWN BY: J.A.H.
CHKD. BY: J.A.H.
SCALE: 1/8"=1'-0"



BAY II - SECTION LOOKING NORTH

PROPOSED 50 TON CRANE

(ORIGINAL BUILDING DESIGNED FOR 40 TON CRANE W/10 TON AUXILLARY HOIST)

REVISIONS

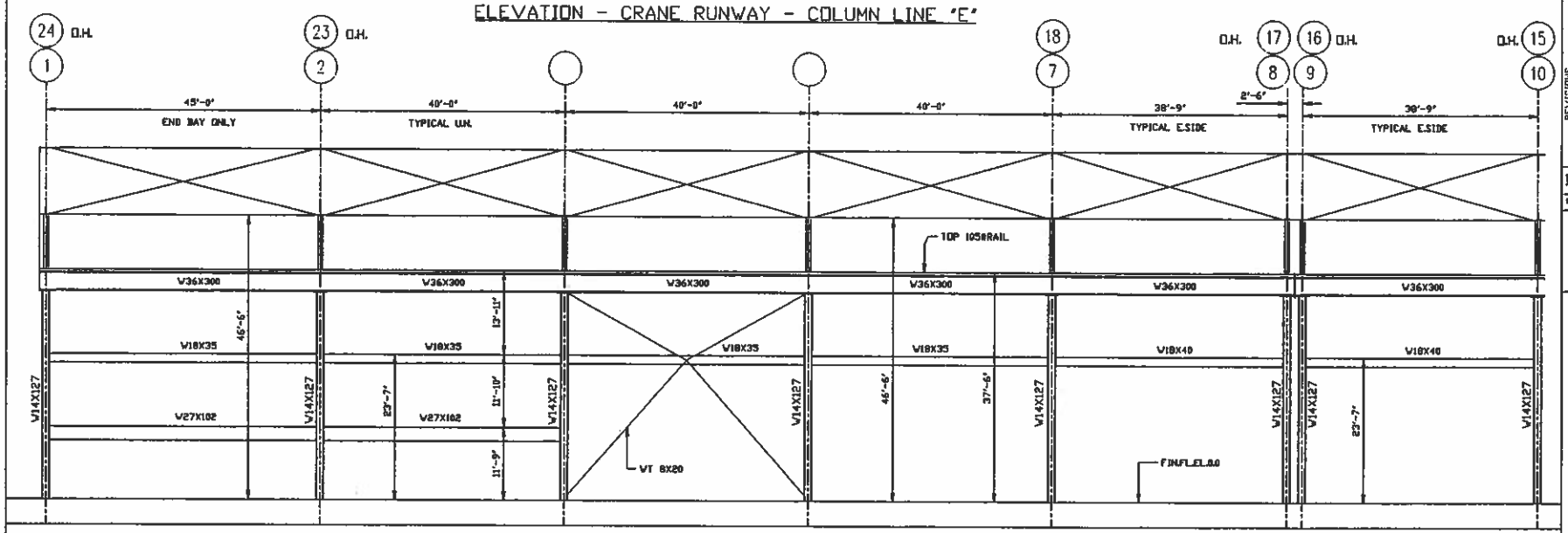
CRANE PRO SERVICES
JACKSONVILLE, FL
FOR USMC - JACKSONVILLE, FL
BUILDING EVALUATION - 50 TON CRANE

HARTLEY & ASSOCIATES, INC.
CONSULTING ENGINEERS
JACKSONVILLE, FLORIDA

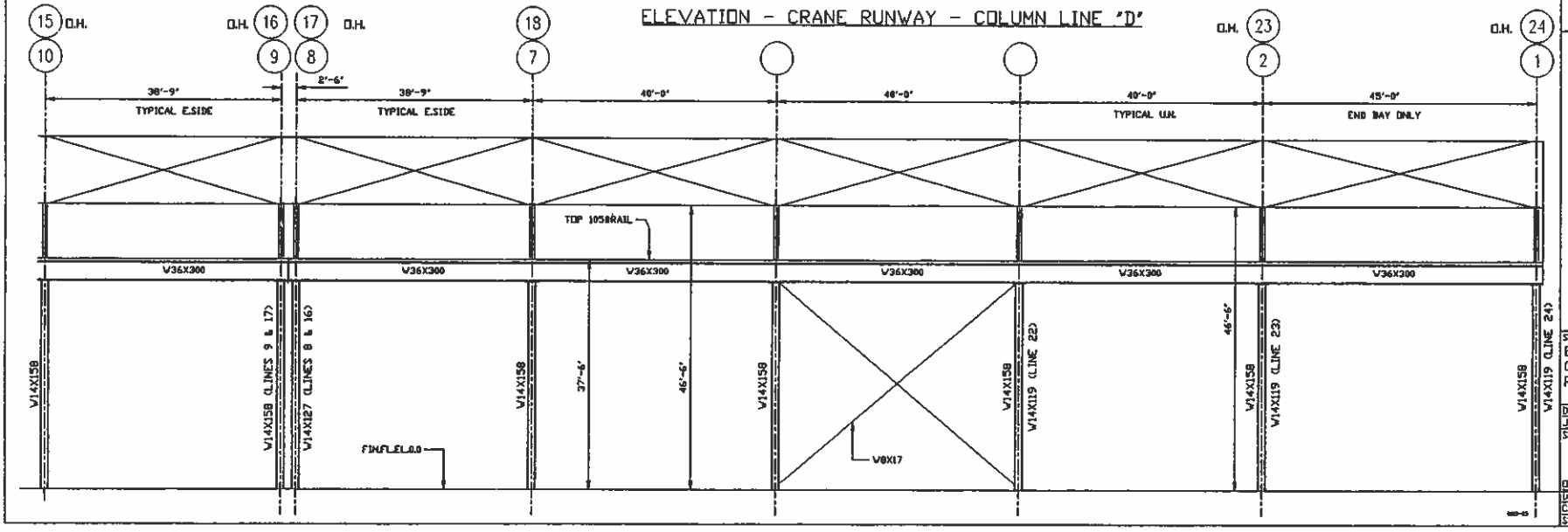
SHEET TITLE:
PARTIAL BUILDING CROSS SECTION

DATE: 3/17/06
JOB NO: 2613
SHEET NO.
S2
OF
DRAWN BY: J.A.H.
CHK'D BY: J.A.H.
SCALE: 1/4"=1'-0"

ELEVATION - CRANE RUNWAY - COLUMN LINE "E"



ELEVATION - CRANE RUNWAY - COLUMN LINE "D"



REVISIONS

CRANE PRO SERVICES
JACKSONVILLE, FL
FOR: USMC - JACKSONVILLE, FL
BUILDING EVALUATION FOR 50 TON CRANE

HARTLEY & ASSOCIATES, INC.
CONSULTING ENGINEERS
JACKSONVILLE, FLORIDA

SHEET TITLE:
ELEVATION
CRANE
RUNWAYS

DATE: 3/17/96
JOB NO. 2613
SHEET NO.
S3
OF
DRAWN BY: J.A.H.
CHKD. BY: J.A.H.
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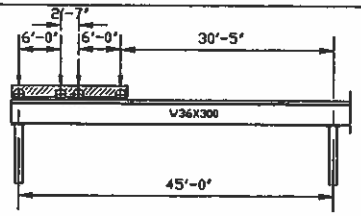
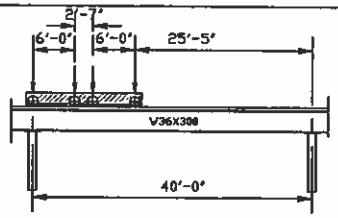
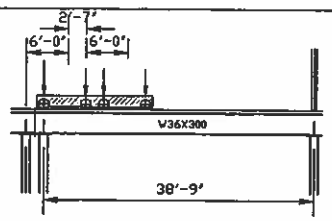
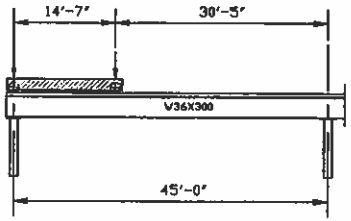
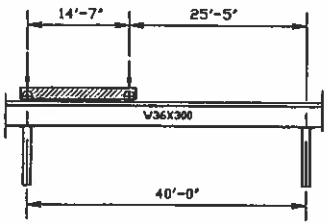


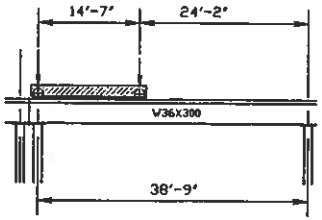




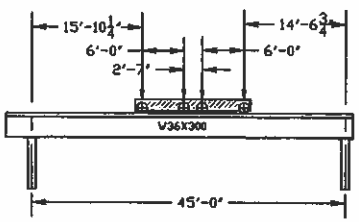
PROPOSED NEW 50 TON CRANE - POSITIONED FOR MAX. COLUMN LOADING

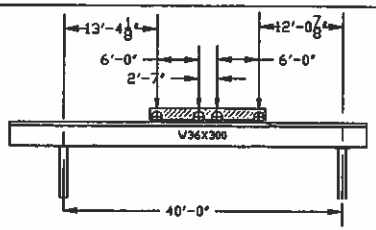


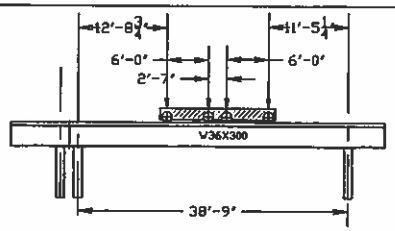




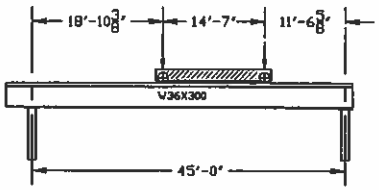
EXISTING 40 TON CRANE - POSITIONED FOR MAX. COLUMN LOADING

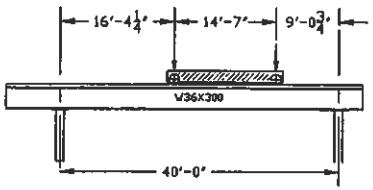


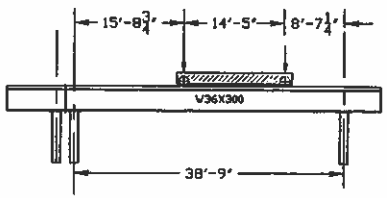




PROPOSED NEW 50 TON CRANE - POSITIONED FOR MAX. RUNWAY LOADING





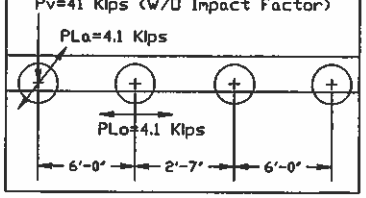


EXISTING 40 TON CRANE - POSITIONED FOR MAX. RUNWAY LOADING

PROPOSED NEW 50 TON CRANE

VERTICAL IMPACT FACTOR: 15%
LATERAL IMPACT FACTOR: 10%
LONGITUDINAL IMPACT FACTOR: 10%
(APPLIED TO MAX. WHEEL LOAD)

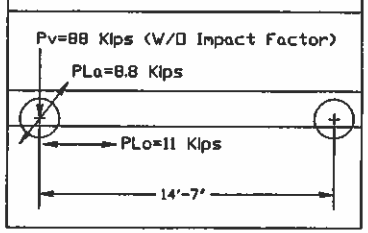
Pv=41 Kips (W/O Impact Factor)



EXISTING 40 TON CRANE + 10 TON AUXILLARY HOIST (DO NOT OPERATE TOGETHER)

VERTICAL IMPACT FACTOR: 25%
LATERAL IMPACT FACTOR: 12.5%XCRANE + TROLLEY WT.
LONGITUDINAL IMPACT FACTOR: 12.5%
(APPLIED TO MAX. WHEEL LOAD)

Pv=88 Kips (W/O Impact Factor)



NO.	DATE	REVISIONS

CRANE PRO SERVICES
JACKSONVILLE, FL
FOR: USMC - JACKSONVILLE, FL
BUILDING EVALUATION - 50 TON CRANE

HARTLEY & ASSOCIATES, INC.
CONSULTING ENGINEERS
JACKSONVILLE, FLORIDA

SHEET TITLE:
CRANE RUNWAY LOADINGS

DATE: 3/17/06
JOB NO. 2613
SHEET NO.
S4
OF
DRAWN BY: J.A.H.
CHK'D BY: J.A.H.
SCALE: NONE

APPENDIX "B"

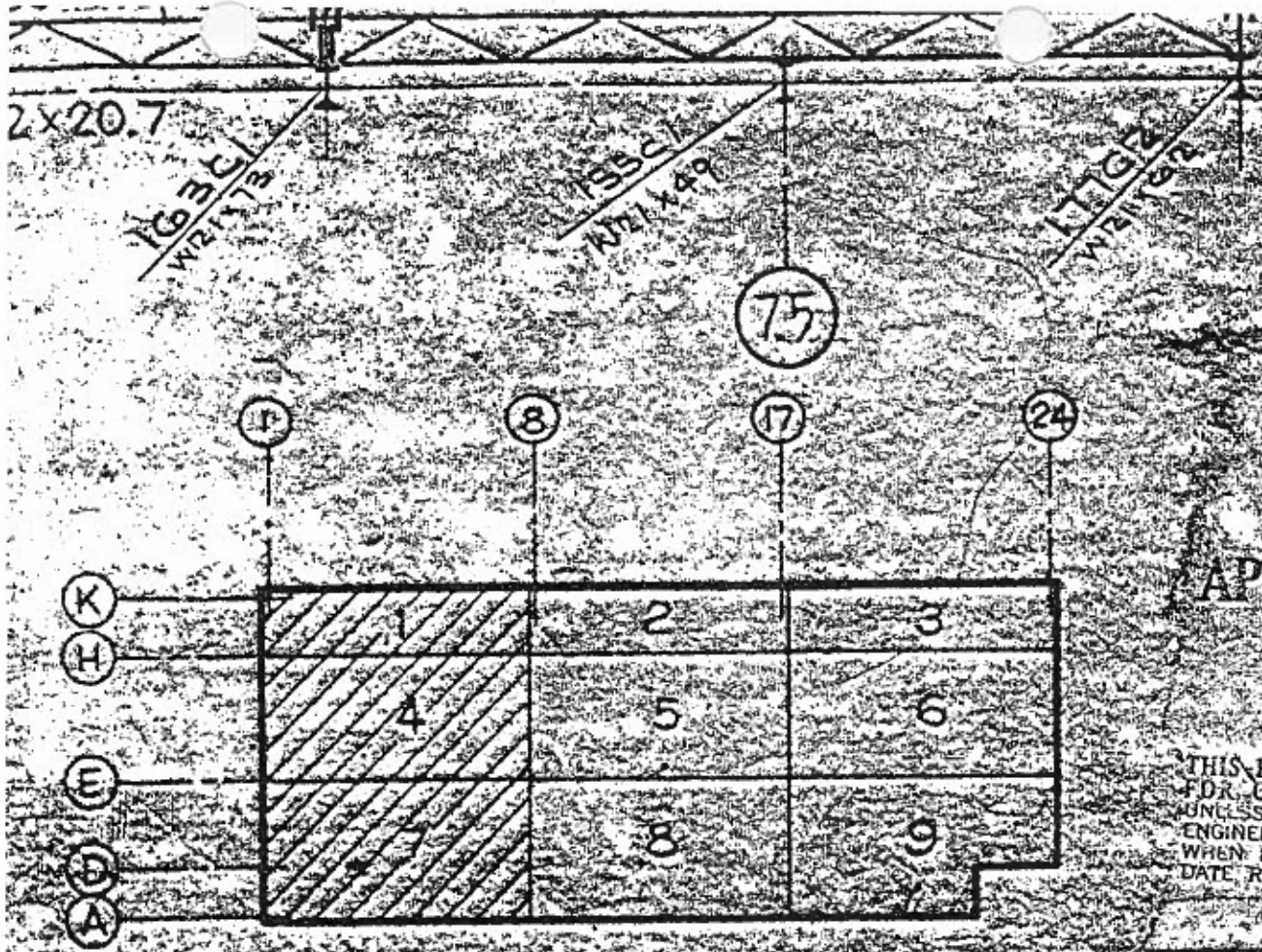
PLAN REFERENCE DRAWINGS

OF THE EXISTING BUILDING,

BAY II, COLUMN LINES "D" & "E"

Notes:

1. Superstructure columns are identified.
2. Crane runway sizes, rails & support columns are identified.
3. Crane runway lateral bracing truss units are not completely identified with member sizes.
4. Main building support beams are not sized.
5. No detailed drawings are available for the building components.



MATCH LINE
FOR CONTINUATION
SEE DWG. 3A-4-3022

RECEIVED
DEC 8 1975
J. A. JONES
CONSTRUCTION CO.

APPROVAL PRINT
DATE MAILED
OCT 28 1975

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS APPROVAL BY ARCHITECT OR ENGINEER AND BUILDING DEPARTMENT WHEN REQUIRED.
DATE RETURNED

RECEIVED
OCT 31 1975
J. A. JONES CONSTRUCTION CO.
JOB 72-107

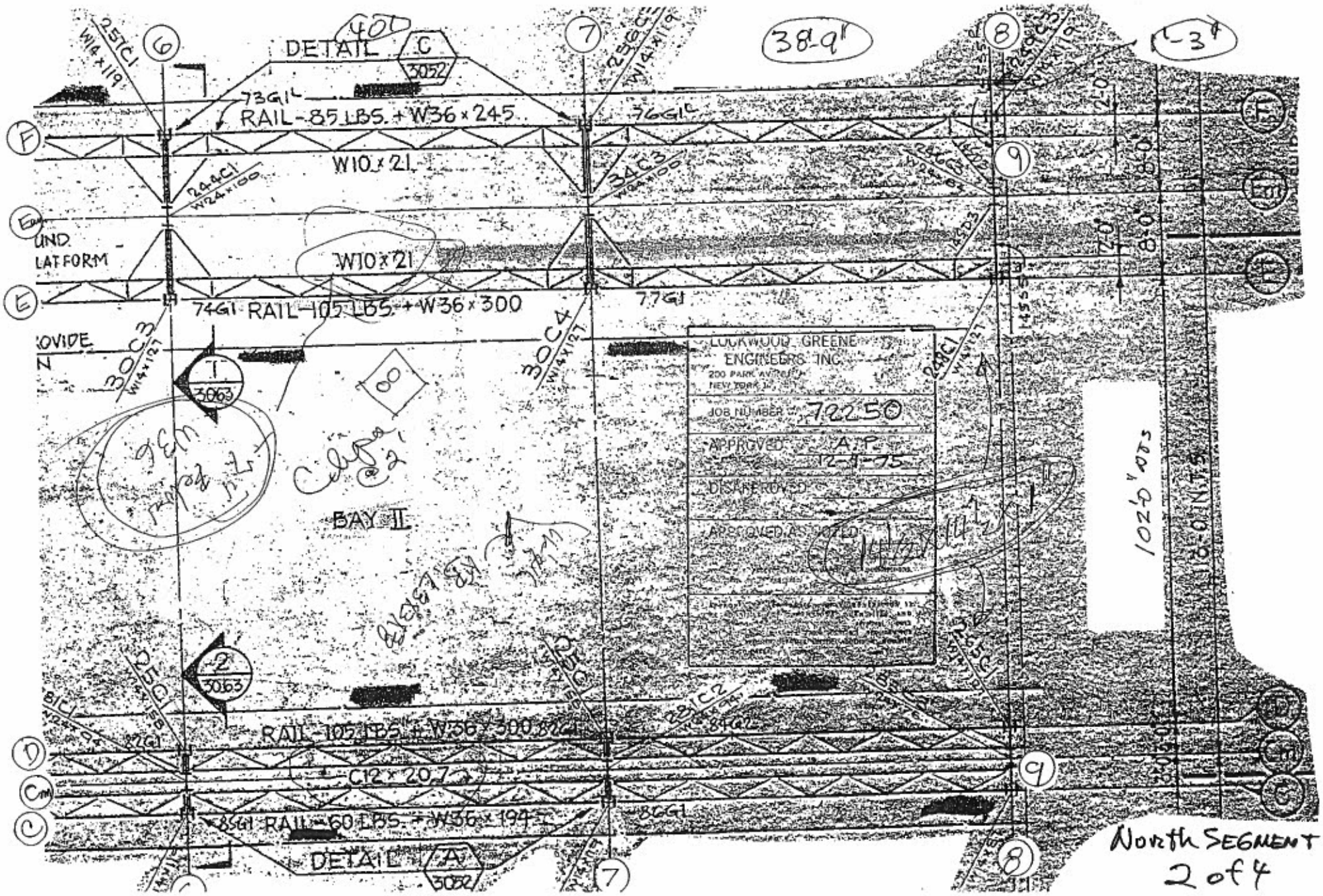
KEY PLAN

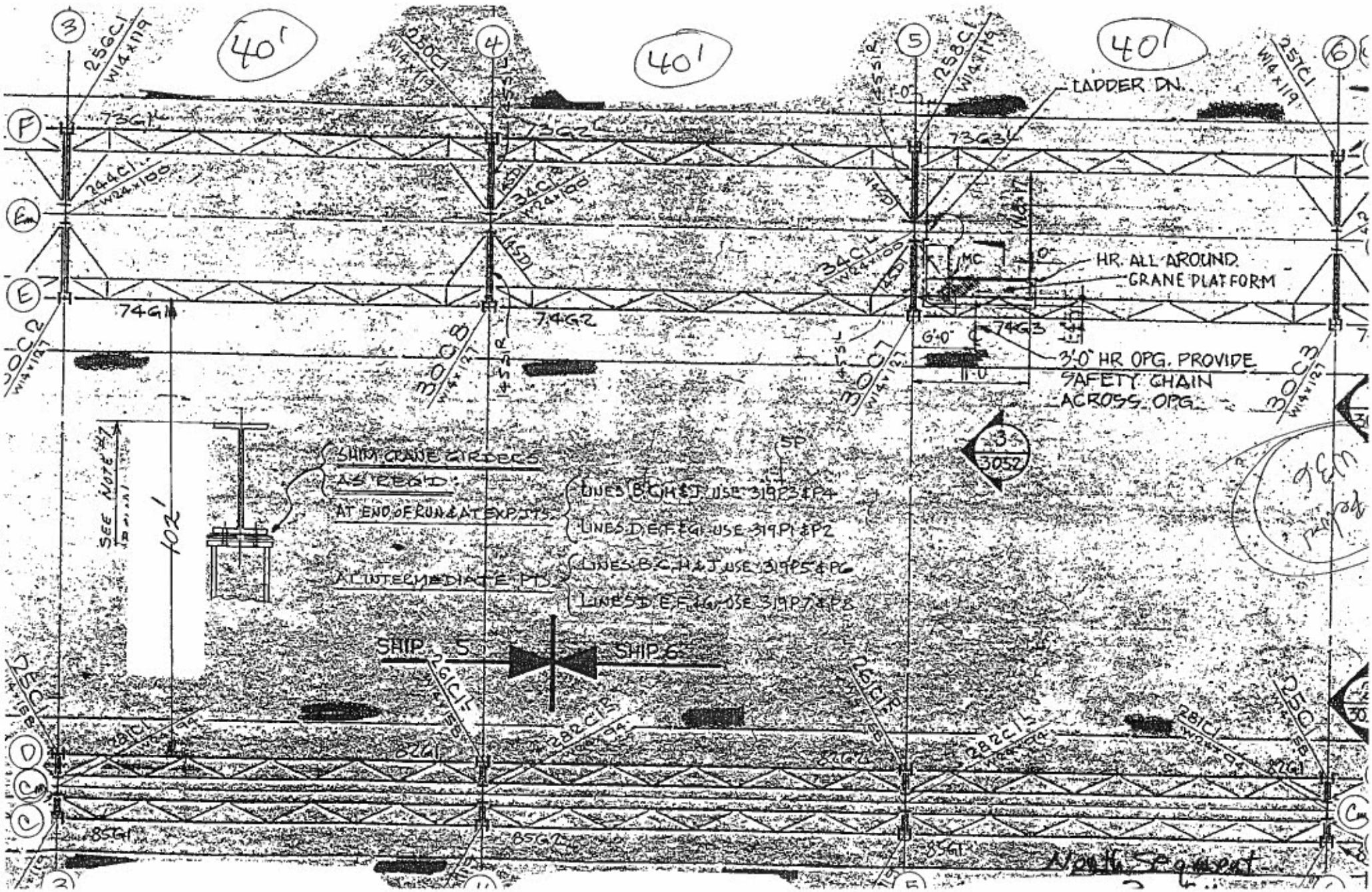
PIPE CUTTING SHOP
AREA 147 - PAPER PLANT
CRANE RUNWAY FRAMING

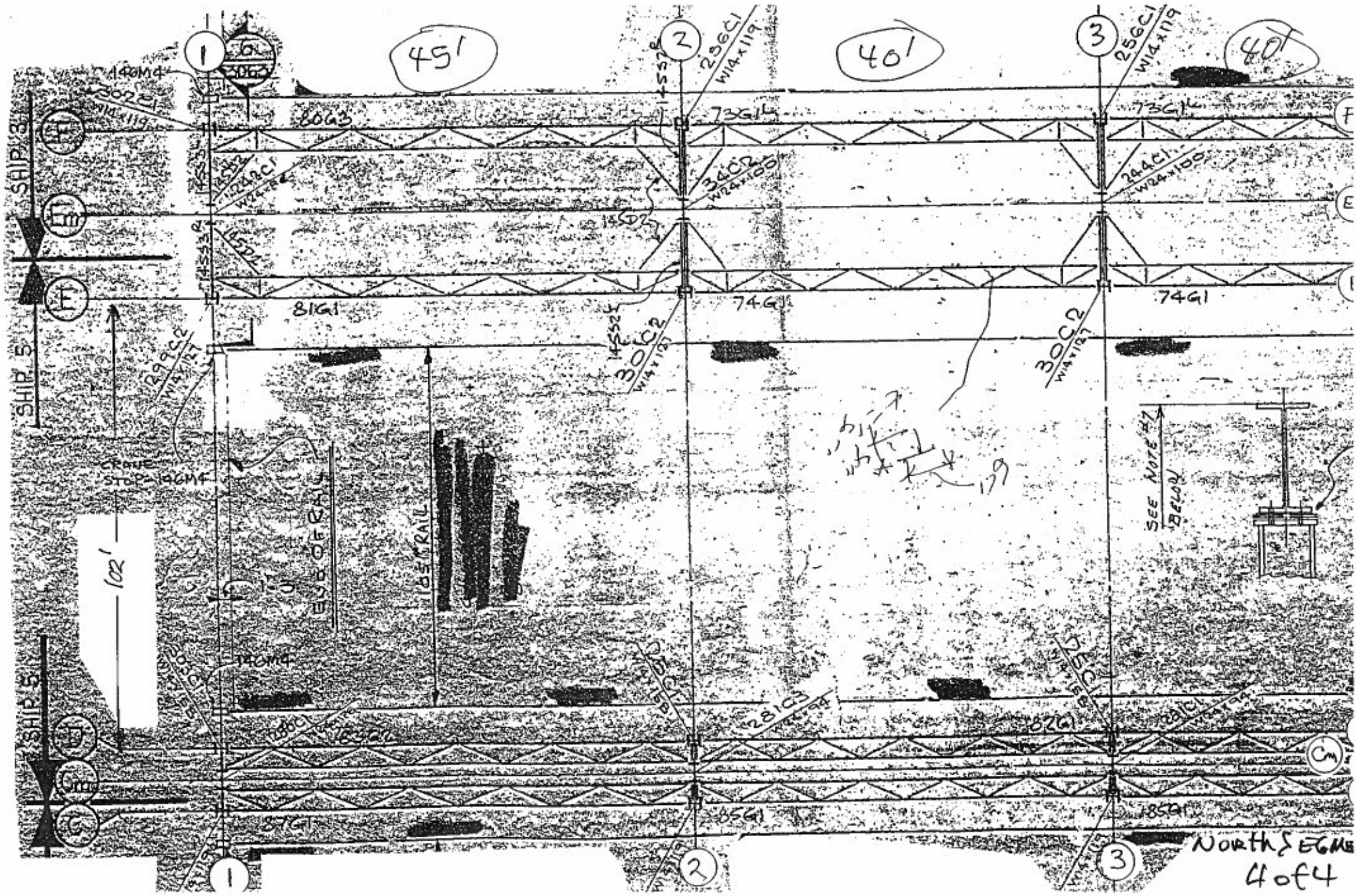
FLORIDA STEEL CORP.
Steel when you want it
JACKSONVILLE MIAMI TAMPA

PROJECT OFFSHORE POWER SYSTEMS
DRAFTING ALLIED CONTRACTS
FABRICATION
CONTRACT NUMBER 0788
DRAWING NUMBER E-10

NORTH SEGMENT
1 of 4


DETAIL C 3052
73G1
RAIL-85 LBS. + W36 x 245
76G1
W10 x 21
W10 x 21
74G1 RAIL-105 LBS. + W36 x 300
77G1
30C3 W14x127
30C4 W14x127
BAY II
LOCKWOOD GREENE ENGINEERS INC.
JOB NUMBER 72250
APPROVED A.P. 12-9-75
DISAPPROVED
APPROVED AS NOTED
102'-0" NTS
RAIL-105 LBS. + W36 x 300
C12 x 20.7
85G1 RAIL-60 LBS. + W36 x 194
DETAIL A 3052
38'-9"
North SEGMENT
2 of 4


40'
40'
40'
LADDER DN.
HR. ALL AROUND
CRANE PLATFORM
3'-0" HR OPG. PROVIDE
SAFETY CHAIN
ACROSS OPG.
SHIM CRANE GIRDERS
AS REQ'D
AT END OF RUN & AT EXP JTS
LINES B, C, H & J USE 319P3 & P4
LINES D, E, F, & G USE 319P1 & P2
AT INTERMEDIATE PTS
LINES B, C, H & J USE 319P5 & P6
LINES D, E, F, & G USE 319P7 & P8
SEE NOTE #7
102'
SHIP 5
SHIP 6
North Sequent



45'
40'
40'
SHIP 3
SHIP 5
SHIP 5
102'
80G3
73G1
81G1
74G1
74G1
146M4
302C1
W14x119
256C1
W14x119
256C1
W14x119
34C2
W24x100
244C1
W24x100
145D2
145D2
299C2
W14x127
301C2
W14x127
30C2
W14x127
CRANE STOP-146M4
END OF RAIL
105' RAIL
SEE NOTE #7 BELOW
146M4
281C3
82G1
87G1
85G1
85G1
North SEGMENT
4 of 4

RAIL 60LBS + W36x194

90G3

C12x20.7

155C1 W21x48

172C1 W21x93

157C3 W12x27

73C2 + 68

3 / 3063

145

155

RECEIVED
OCT 31 1975
L.A. JONES CONSTRUCTION CO.
JOB 72-3787

1 8 17 24

GENERAL NOTES

RUNWAY NOTES

DWG 3A-4-3058

K H E D A

1	2	3
4	5	6
7	8	9

APPROV

DATE

OCT

THIS PRINT IS
FOR CONSTRUC
UNLESS APPROVAL
ENGINEER AND BUI
WITHIN REQUIRED
DATE RETURNED

PRINTS	DATE	DATE	DATE	DATE
APPROVAL				
CUSTOMER				
SHOP				
	FIELD CHECK			
	DATE			

KEY PLAN

SHEET TITLE

PIPE/OUTFITTING SHOP

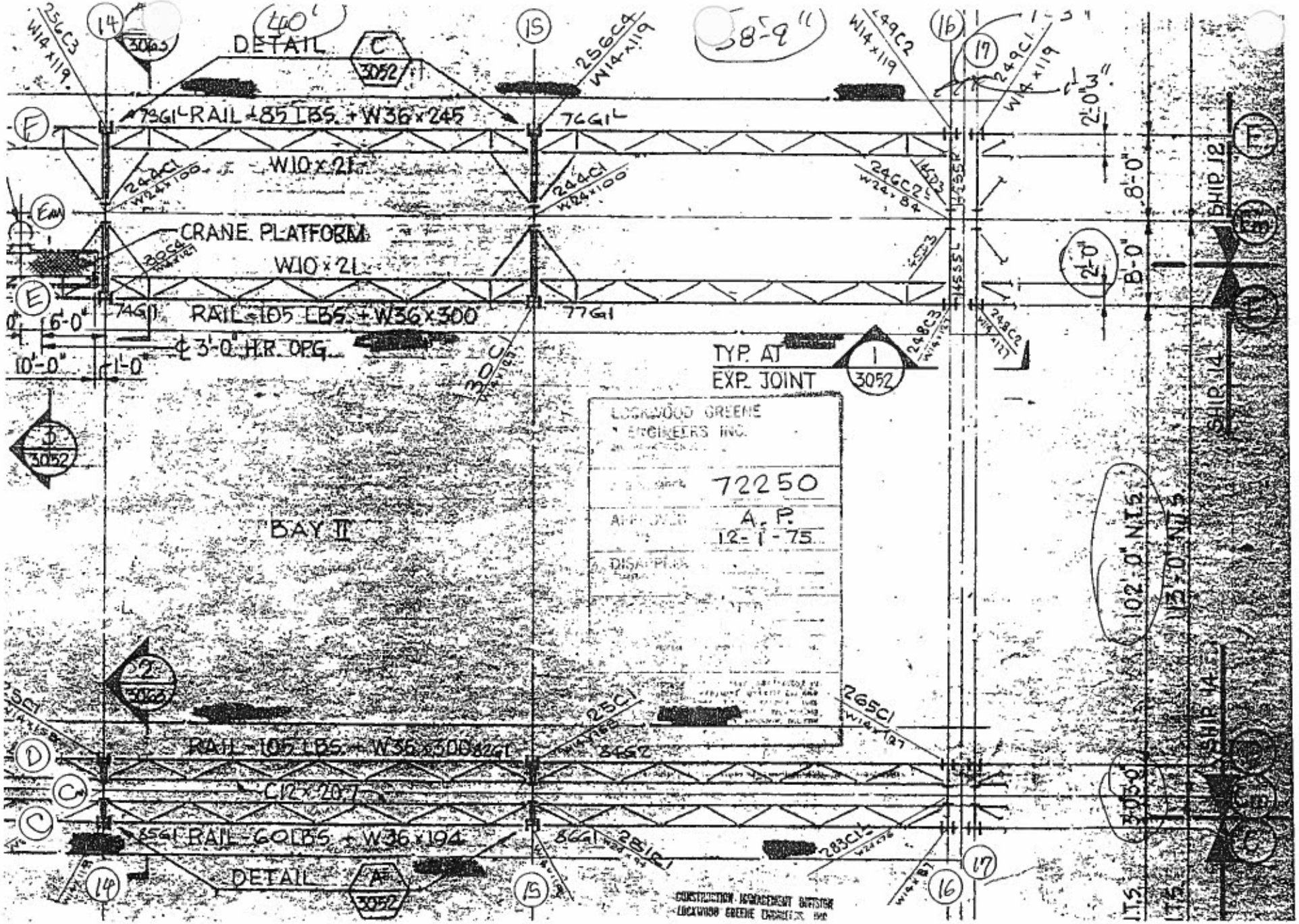
CRANE RUNWAY FRAM

JACK

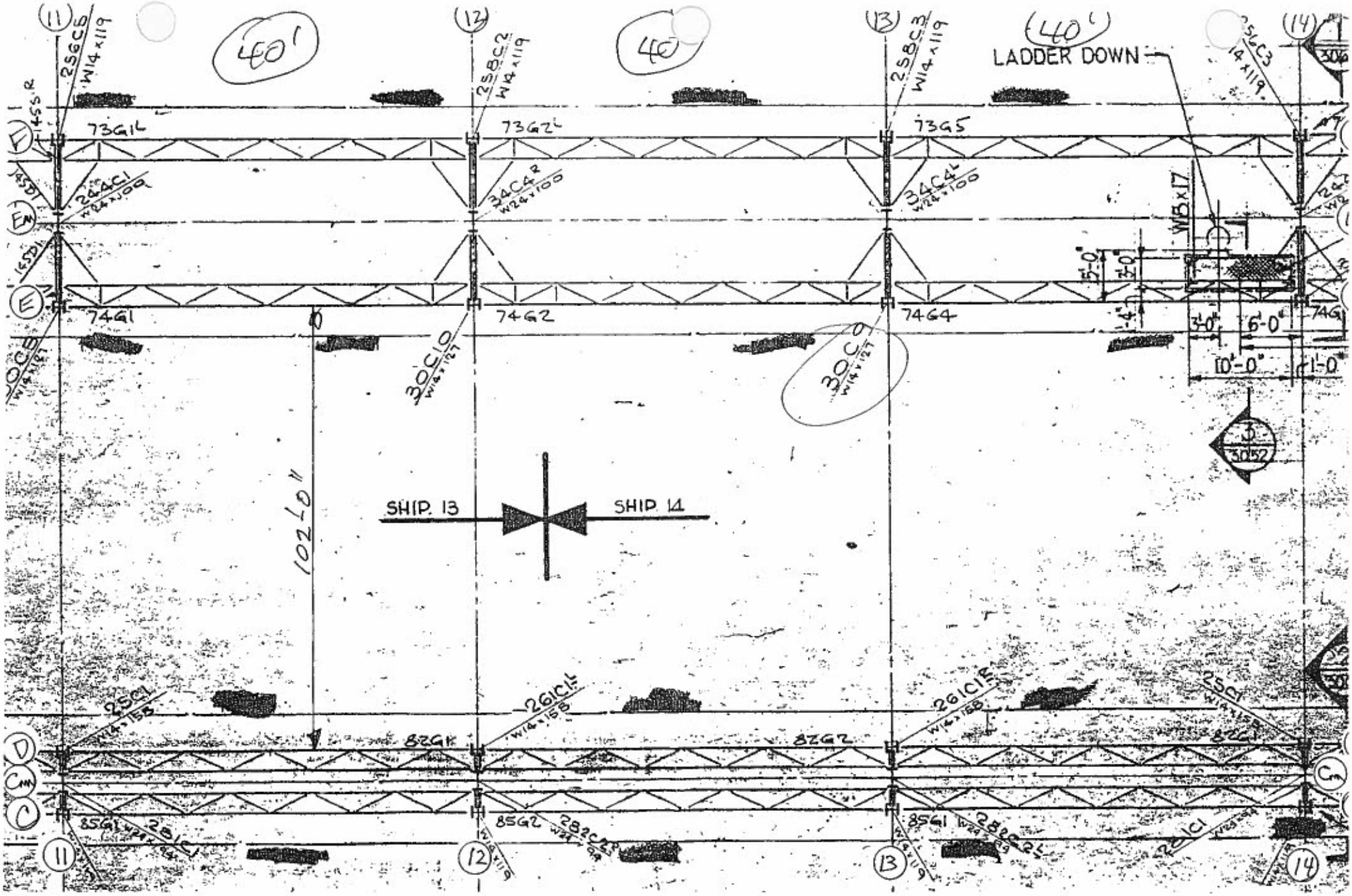
PROJECT OF

MIDDLE SEGMENT

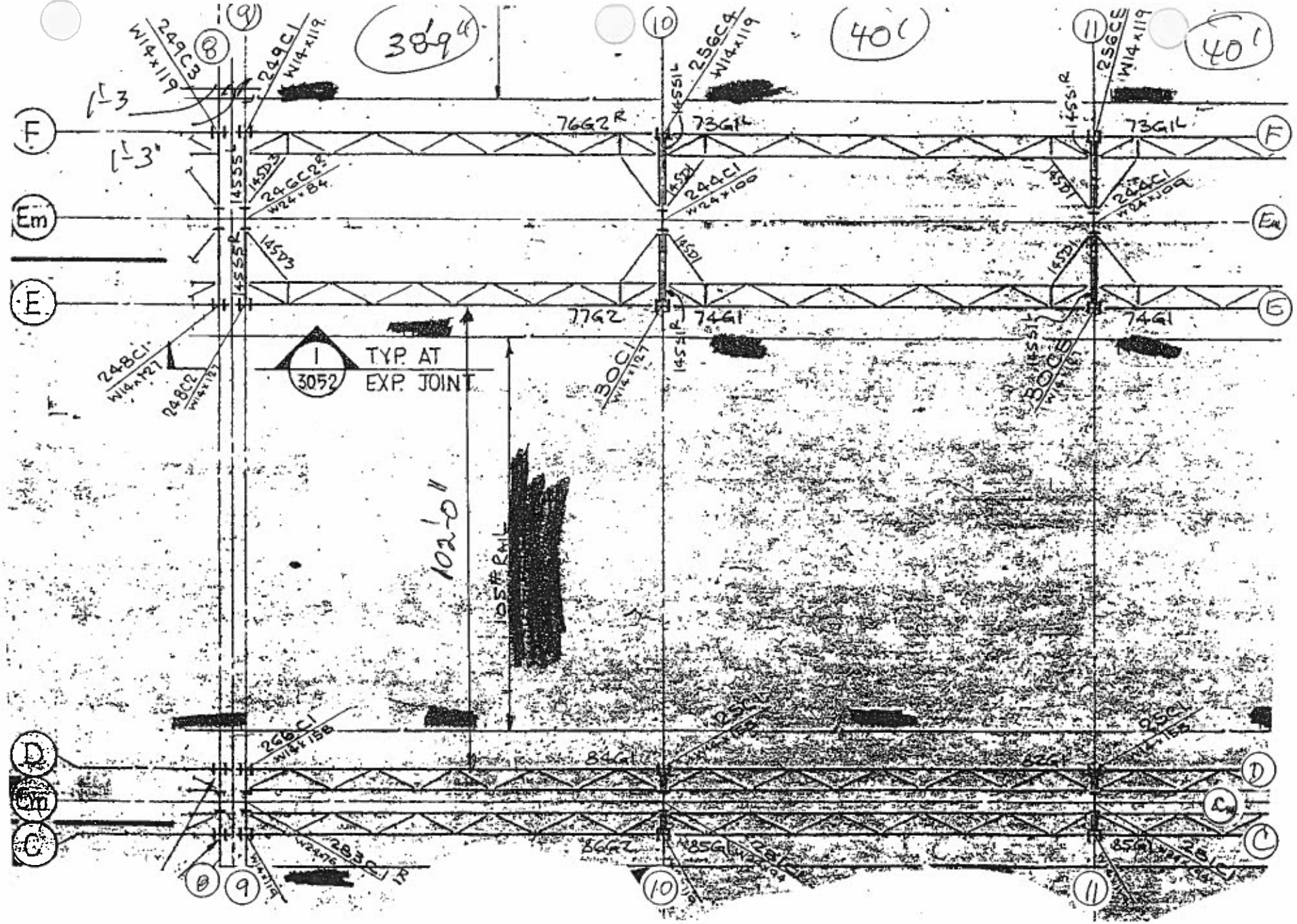
1 of 4



MIDDLE SEGMENT
2 of 4



MIDDLE SEGMEN
3 of 4



MIDDLE SEGMENT

4 of 4

235

9"

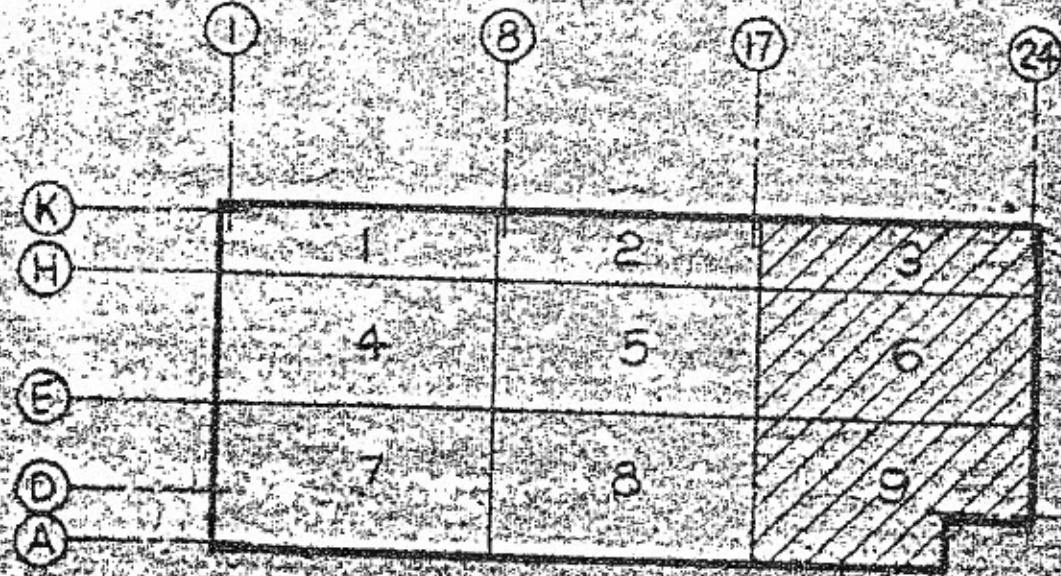
NORTH

CONSTRUCTION MANAGEMENT ... INC.
LOCKWOOD GREENE ENGINEERS, INC.
RECEIVED
NOV 20 1975

RECEIVED
DEC 8 1975
J. A. JONES
CONSTRUCTION CO.

E SECT 2/3052

RECEIVED
OCT 31 1975
J. A. JONES CONSTRUCTION CO.
JOB 72-187

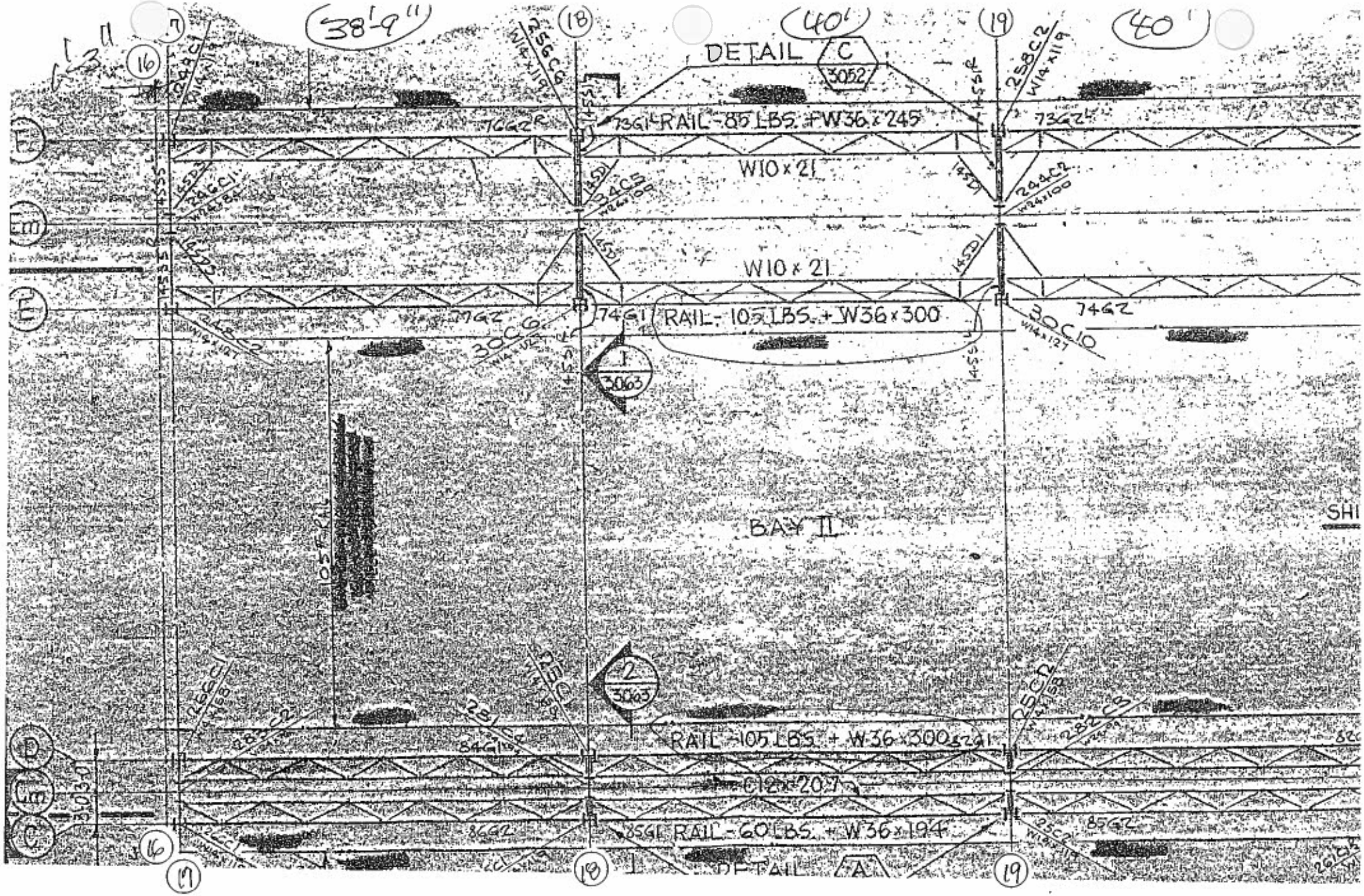


TES

APPROVAL PRINT
DATE ... D
OCT 28 1975
THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION.
UNLESS APPROVAL BY ARCHITECT OR ENGINEER AND BUILDING DEPARTMENT WHEN REQUIRED.
DATE RETURNED

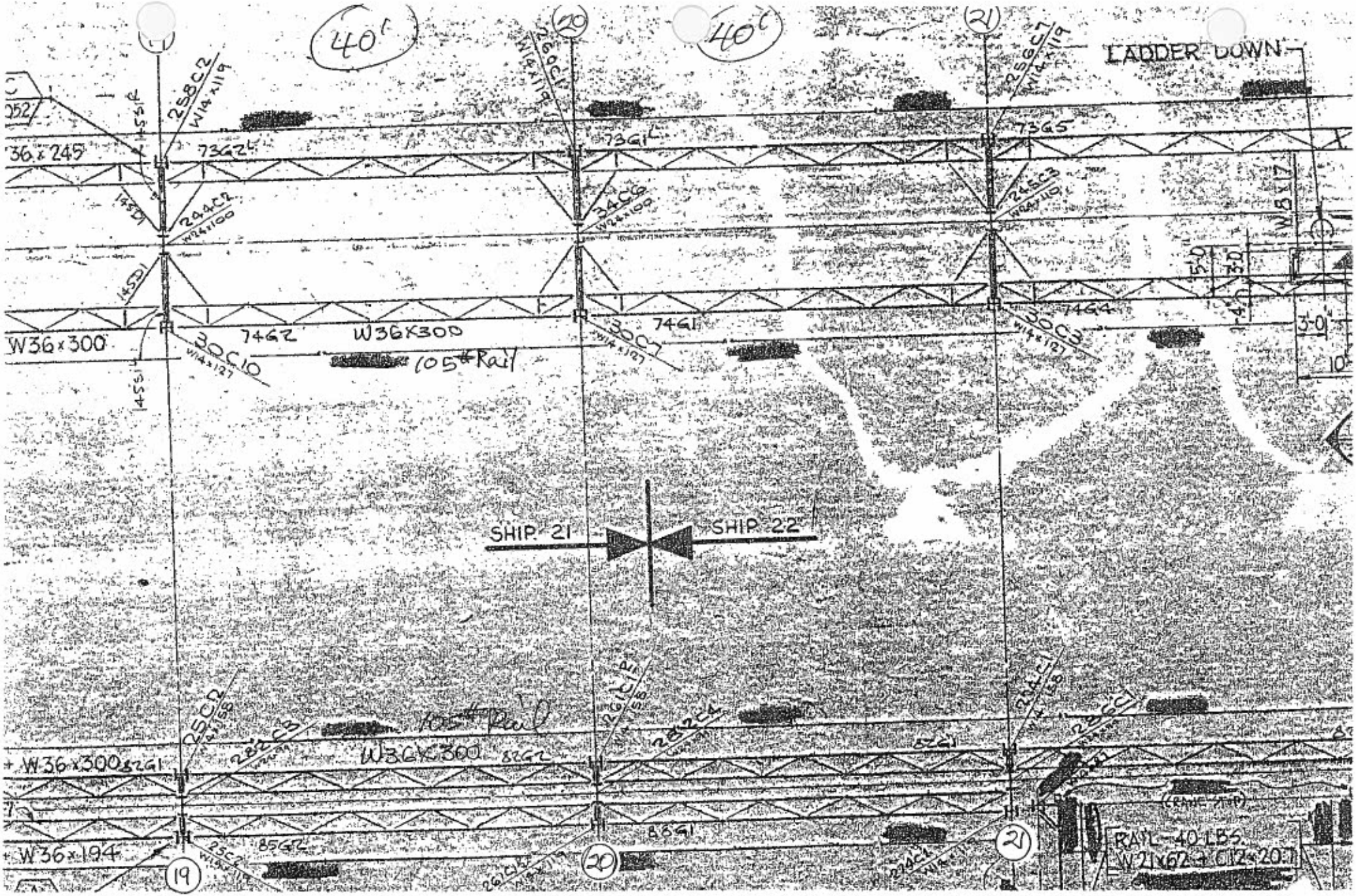
KEY PLAN

SOUTH SEGMENT
1 of 4



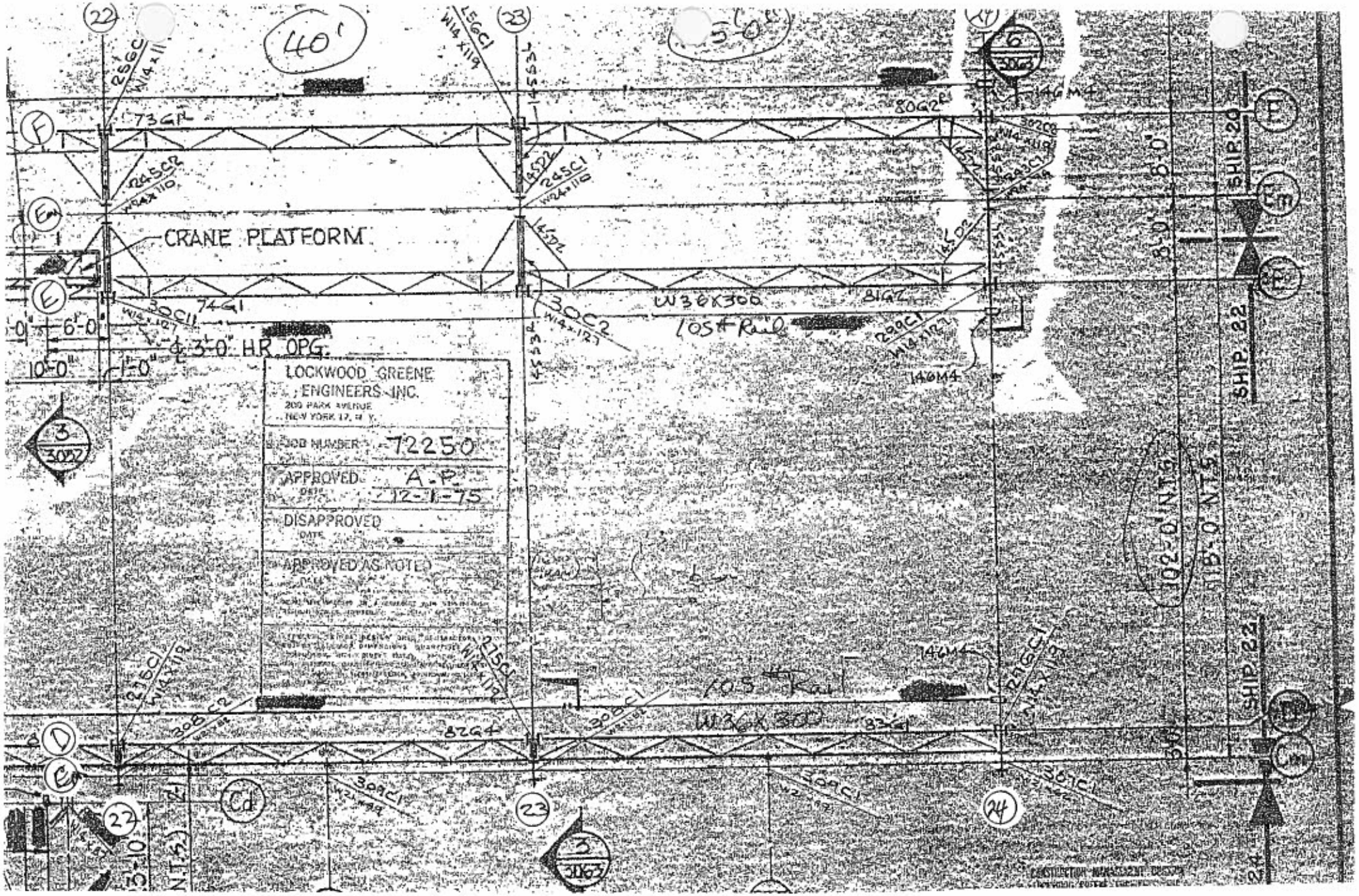
South Segment

2 of 4



South Segment

3 of 4



South Segment
4 of 4

APPENDIX "C"

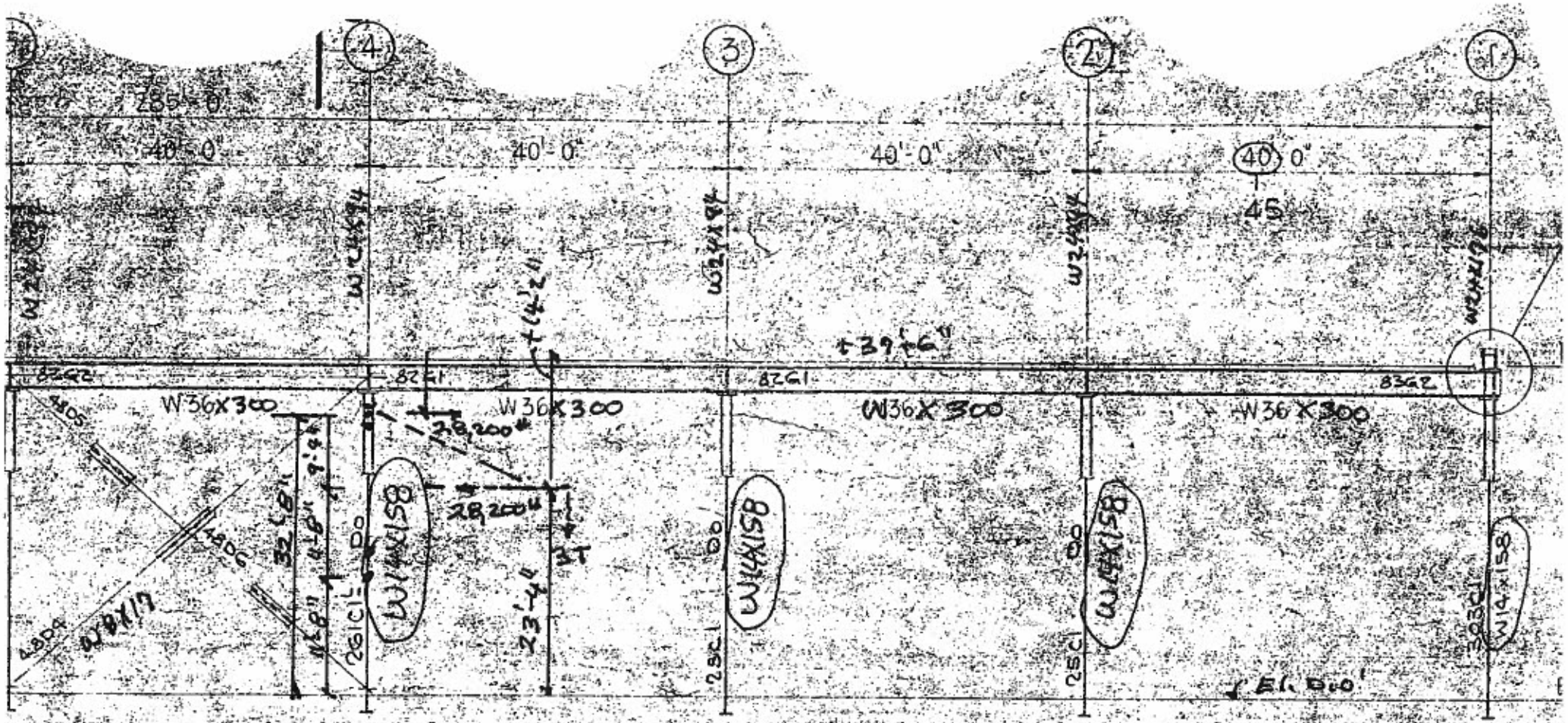
CRANE RUNWAY ELEVATION REFERENCE

DRAWINGS OF THE EXISTING BUILDING,

BAY II, COLUMN LINES "D" & "E"

Notes:

1. No detailed drawings are available for the crane runway and column members.
2. All runway beams are the same size (W36x300) regardless of span.

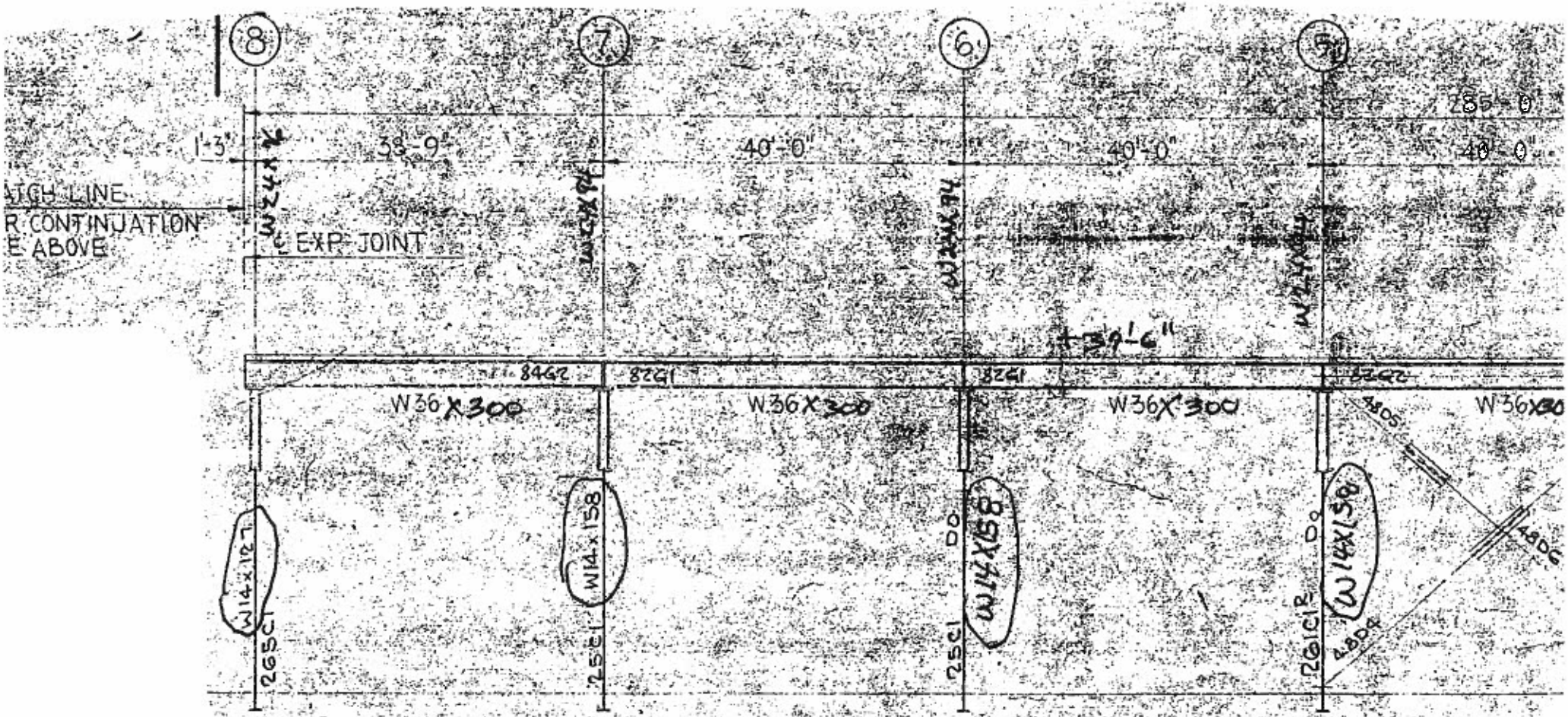


EAST ELEVATION OF COLUMN LINE (D) (PARTIAL CRANE RAIL)

WALL CONNECTIONS - 7/8" Ø A325 BOLTS w/WASHER

105#/Rail · d = 6"

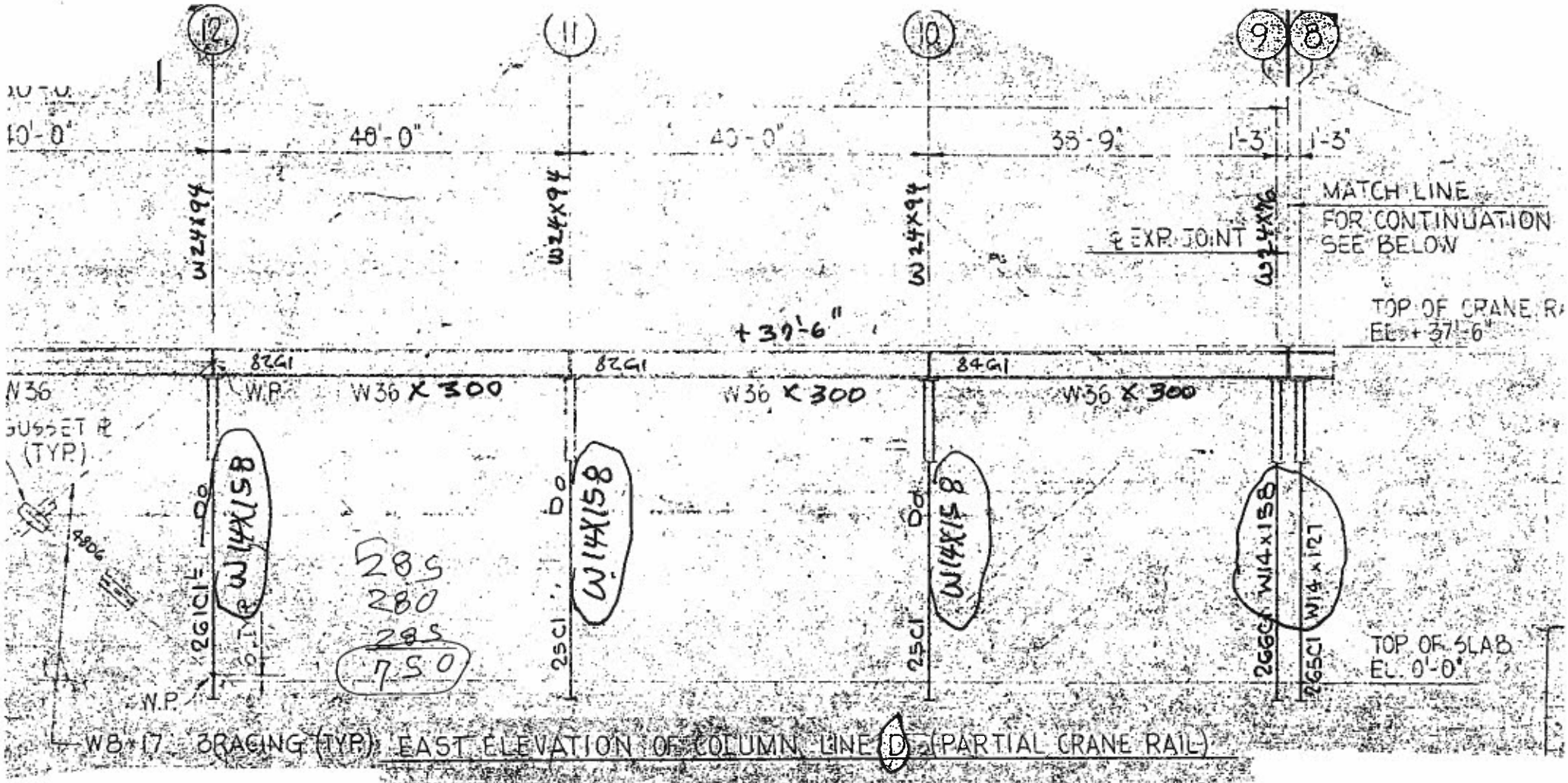
Line "D": 1 of 1



EAST ELEVATION OF COLUMN LINE (D) (PARTIAL CRANE RAIL)

ALL CONNECTIONS - 7/8"ø A325 N w/WASHER

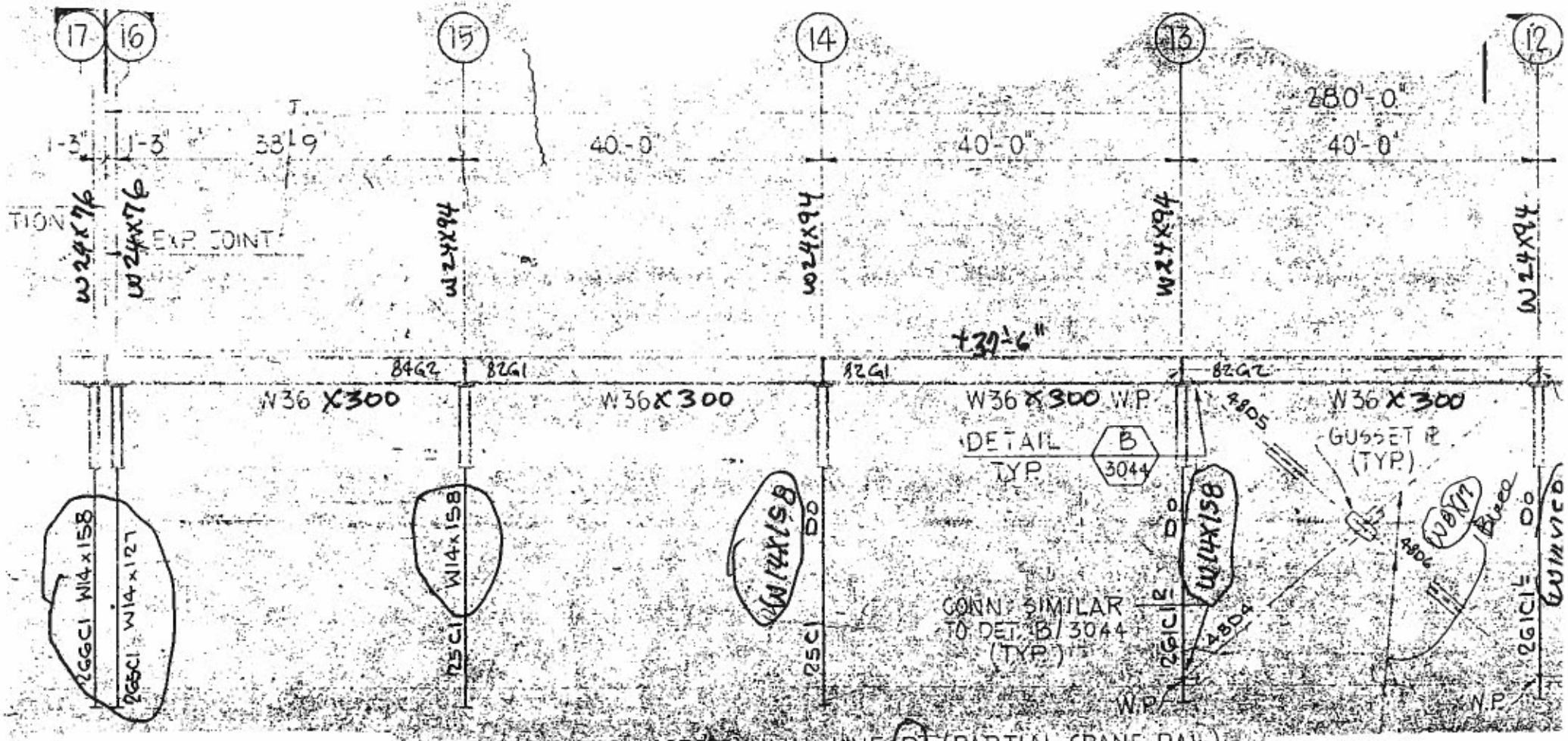
LINE "D": 2 of 6



EAST ELEVATION OF COLUMN LINE D (PARTIAL CRANE RAIL)

ALL CONNECTIONS - 7/8" ø A325 N w/WASHER

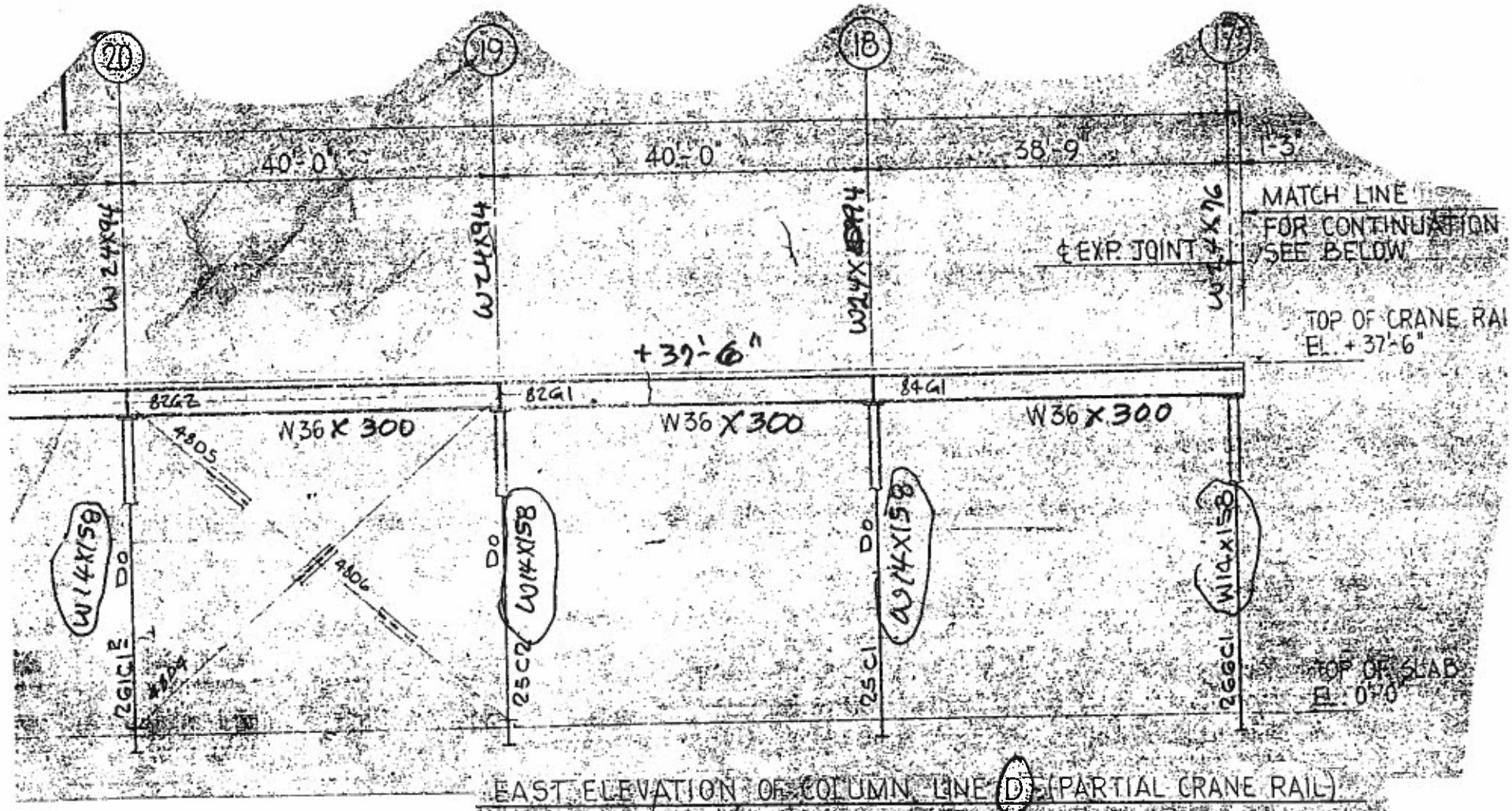
LINE "D": 3 of 6



EAST ELEVATION OF COLUMN LINE (D) (PARTIAL CRANE RAIL)

ALL CONNECTIONS - 7/8" ø A325 N w/WASHER

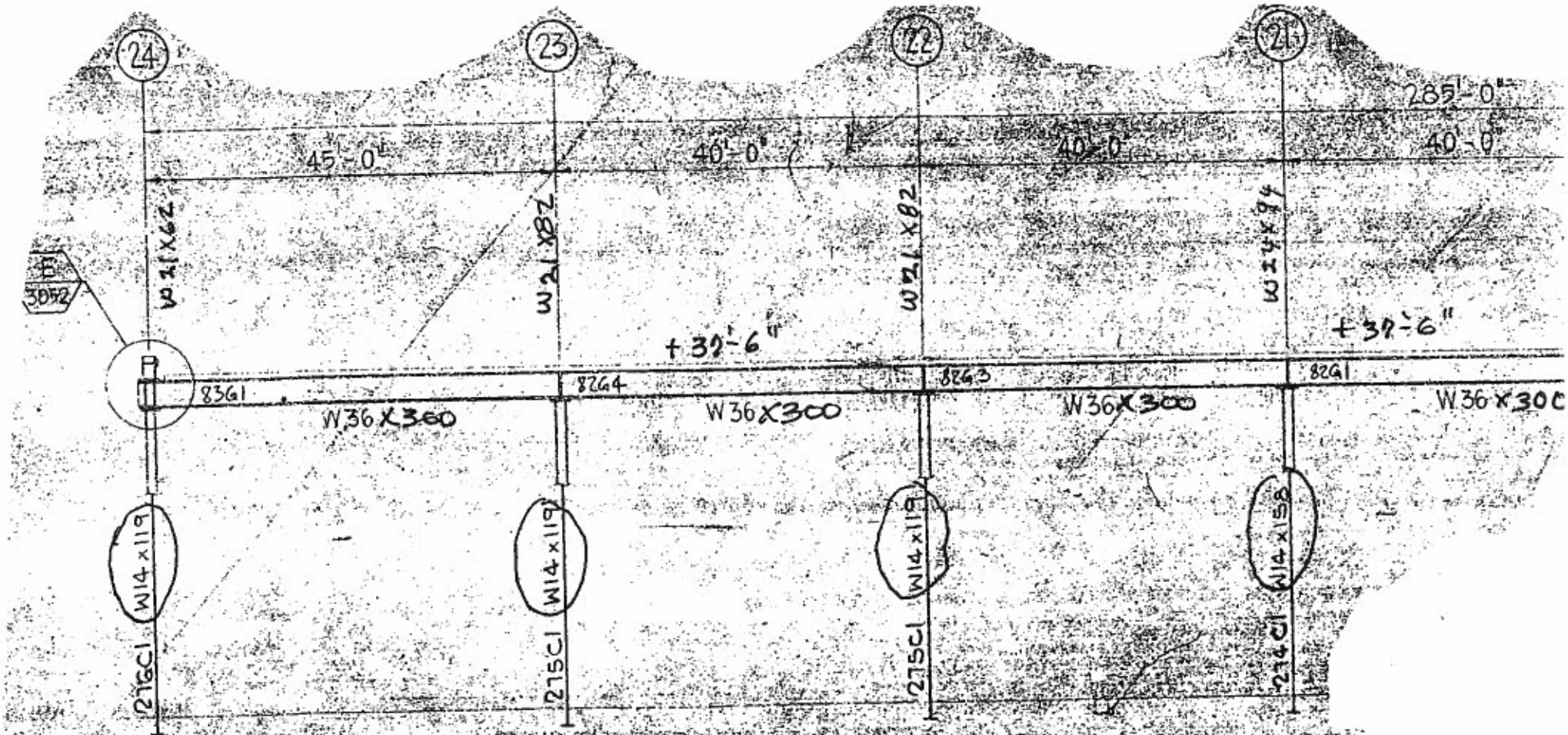
LINE "D": 4 of 6



EAST ELEVATION OF COLUMN LINE (D) (PARTIAL CRANE RAIL)

ALL CONNECTIONS - 7/8" ø A325 N w/WASHER

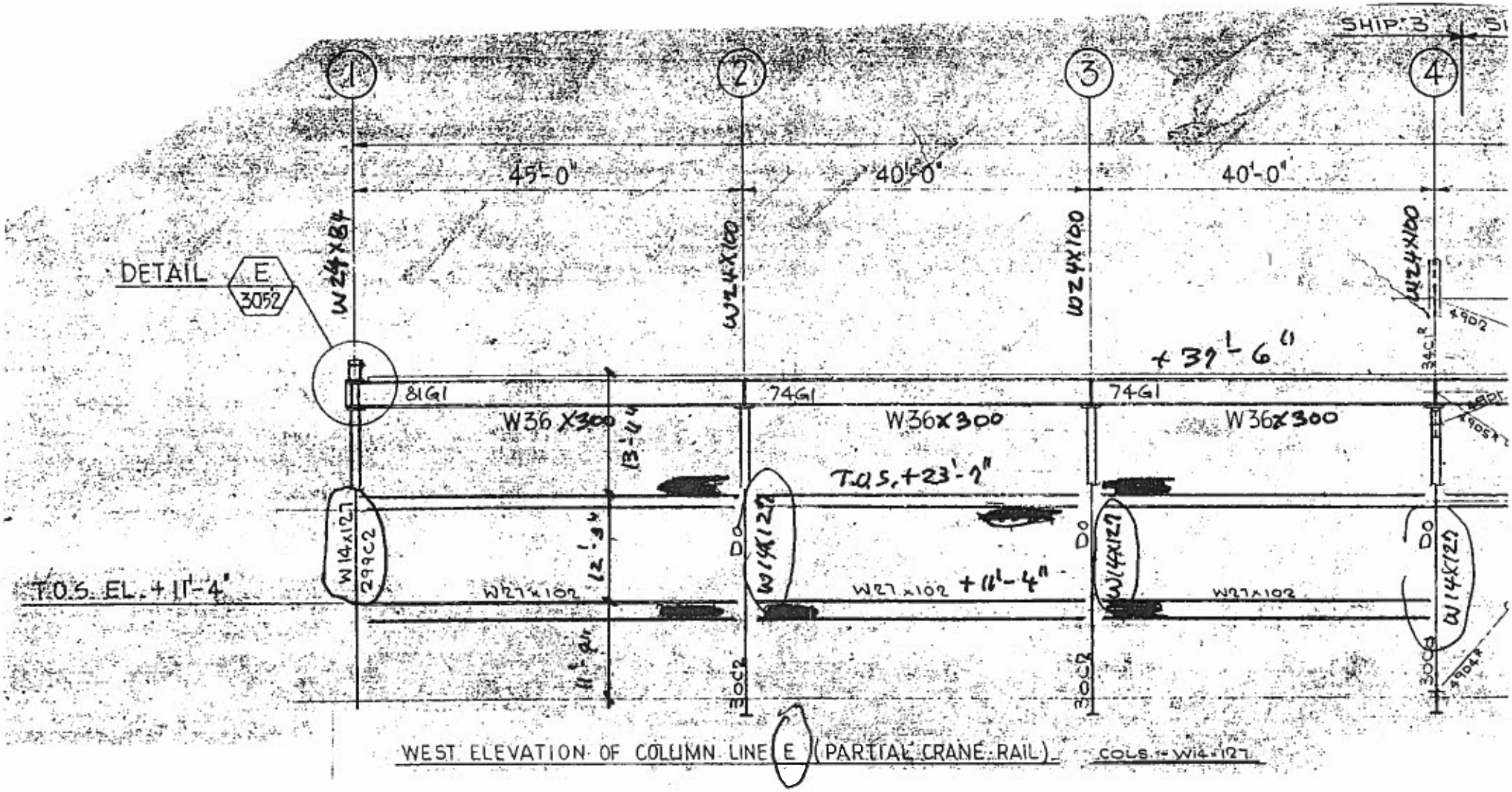
LINE "D" 5 of 6



EAST ELEVATION OF COLUMN LINE (D) (PARTIAL CRANE RAIL)

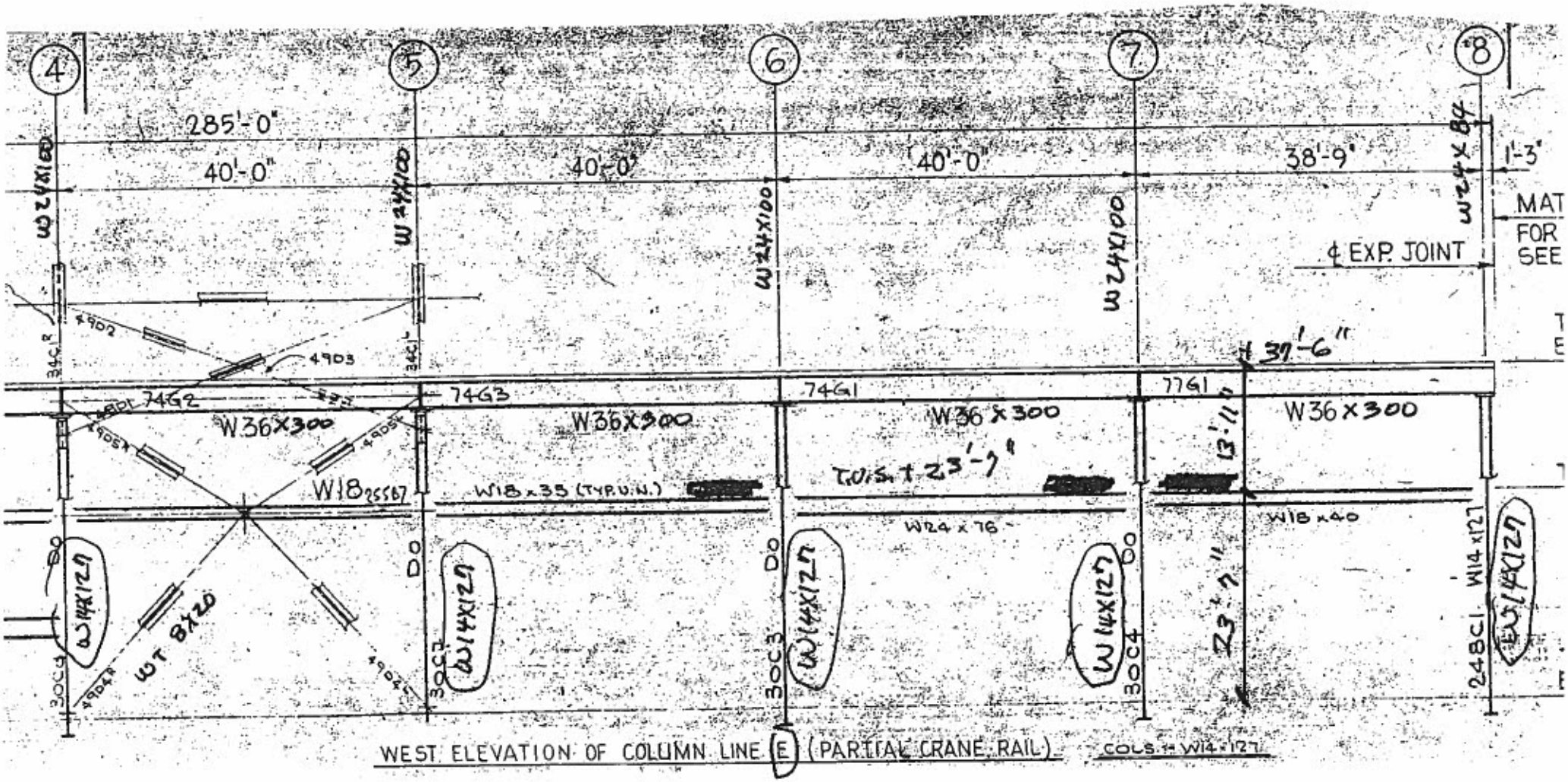
ALL CONNECTIONS - 7/8" ø A325 N w/WASHER

LINE "D": 6 of 6



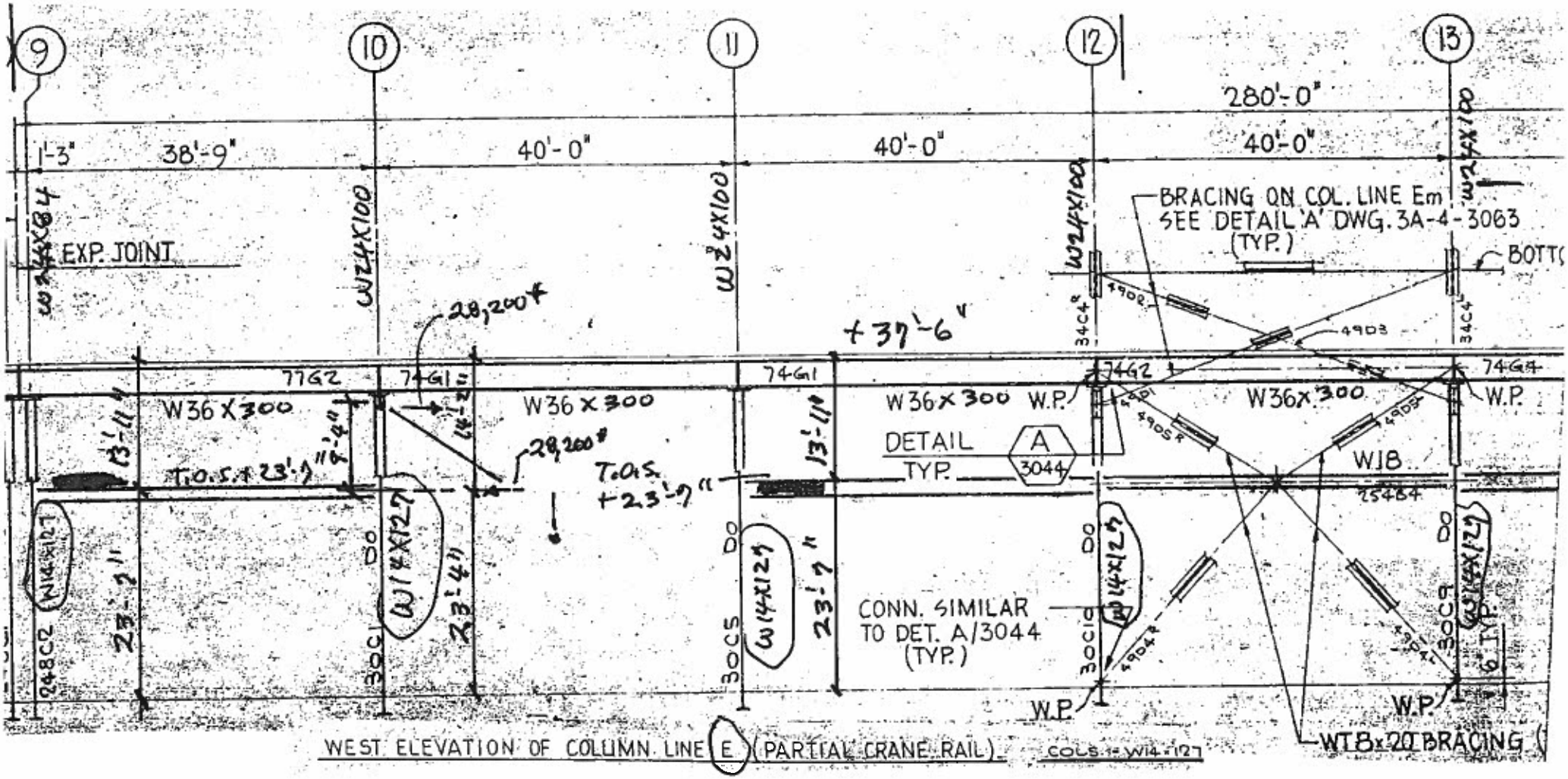
WEST ELEVATION OF COLUMN LINE E (PARTIAL CRANE RAIL) COLS. - W14X127

LINE "E": 1 of 6



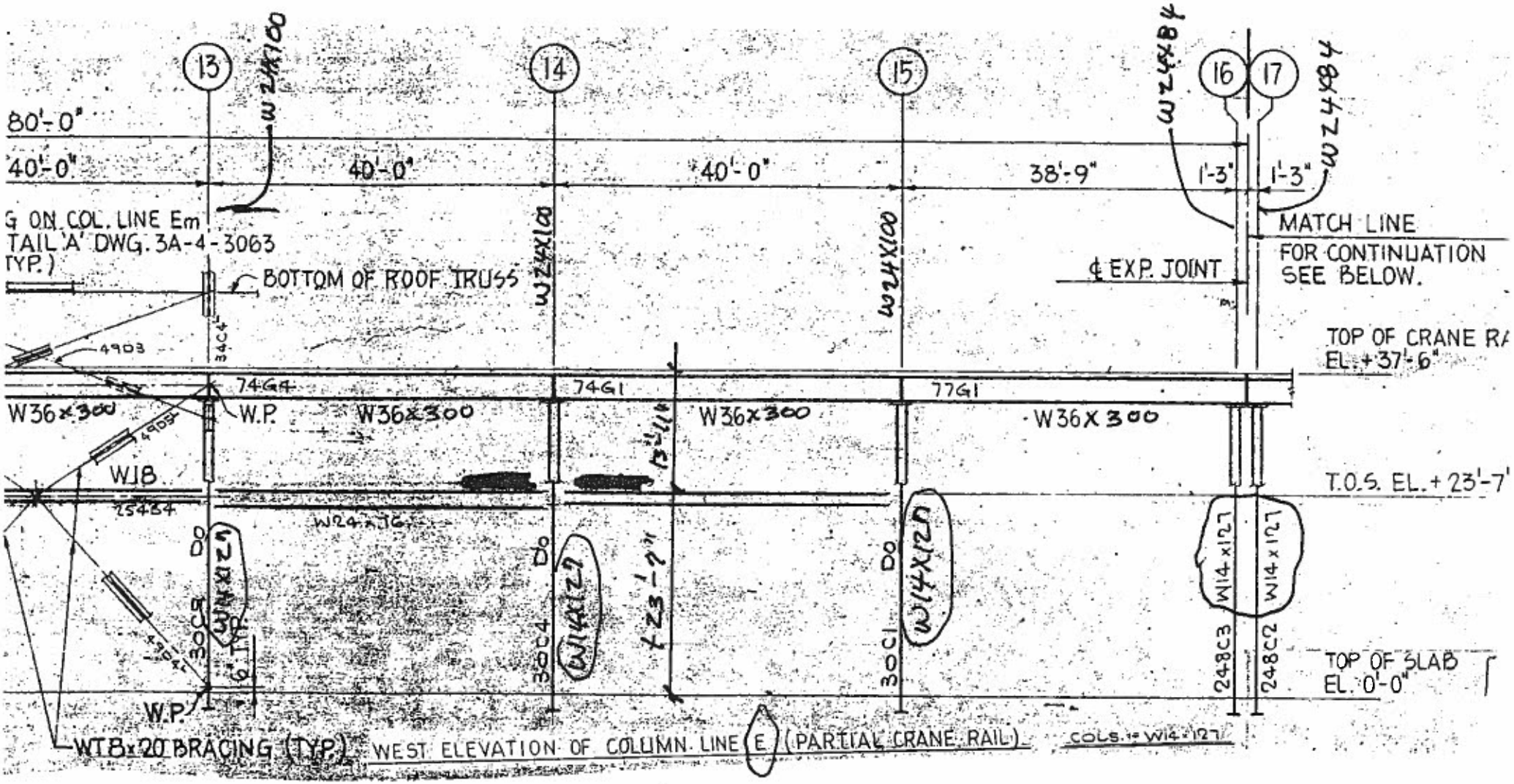
WEST ELEVATION OF COLUMN LINE (E) (PARTIAL CRANE RAIL)

LINE "E" 2 of 6

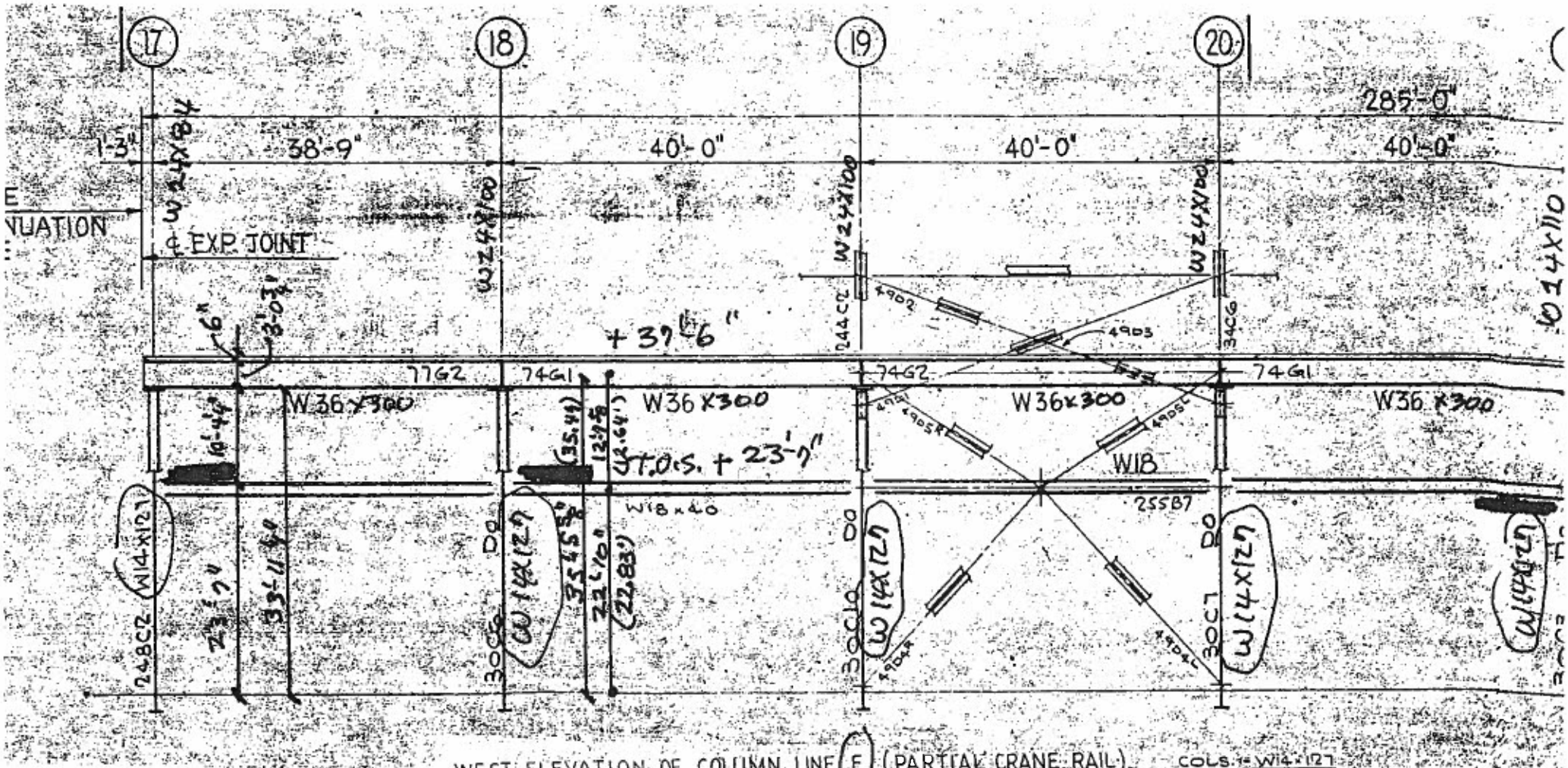


WEST ELEVATION OF COLUMN LINE E (PARTIAL CRANE RAIL) COLS. = W14-127

LINE "E": 3 of 6

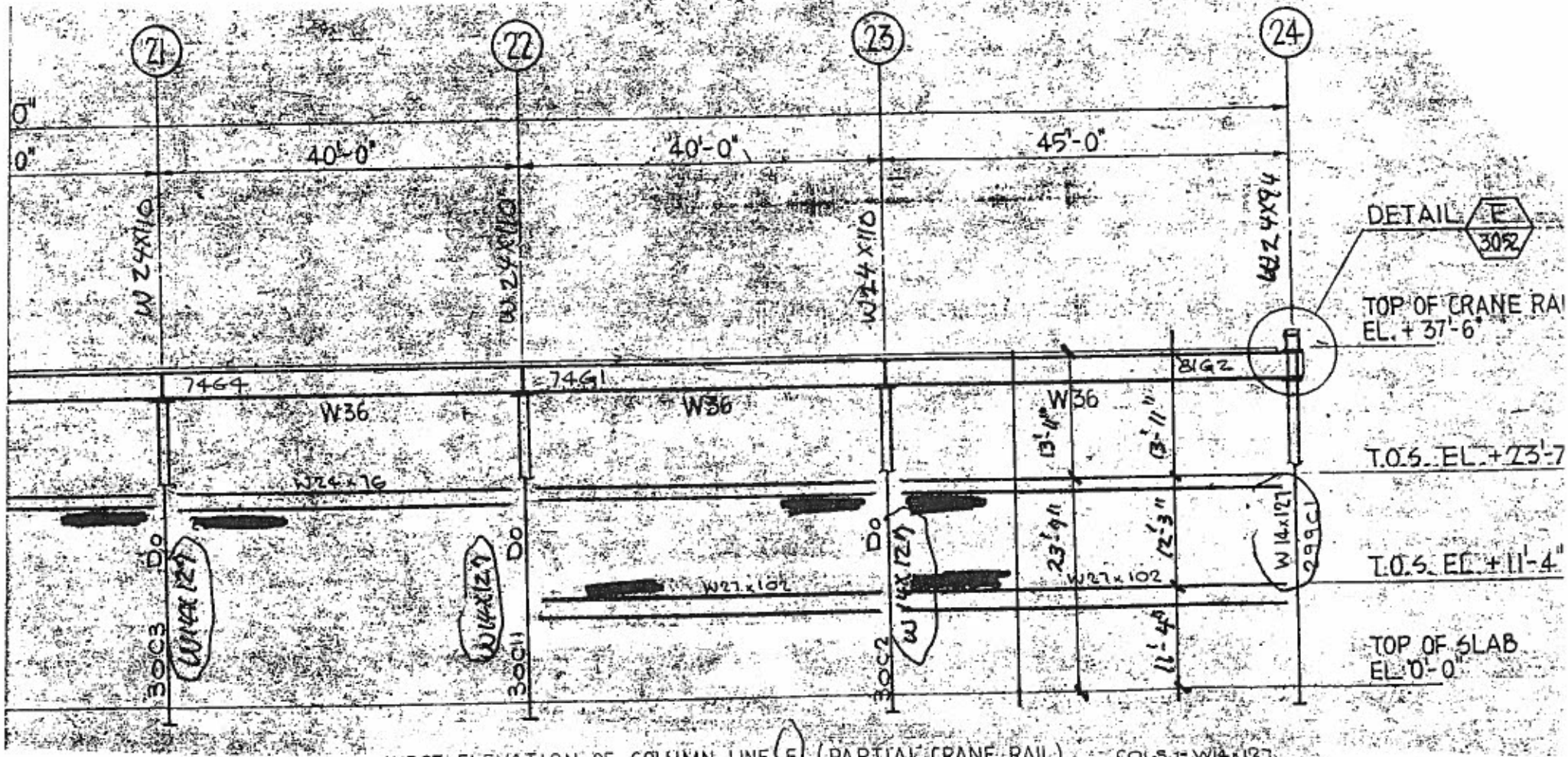

13
14
15
16
17
W24X100
W24X84
80'-0"
40'-0"
40'-0"
40'-0"
38'-9"
1'-3"
1'-3"
G ON COL. LINE Em
TAIL 'A' DWG. 3A-4-3063
TYP.)
BOTTOM OF ROOF TRUSS
MATCH LINE
FOR CONTINUATION
SEE BELOW.
℄ EXP. JOINT
TOP OF CRANE RA
EL. +37'-6"
74G4
74G1
77G1
W36x300
W.P.
W36x300
W36x300
W36X300
W18
T.O.S. EL. +23'-7'
25484
W24x76
W14x127
W14x127
W14x127
W14x127
30C9
30C4
30C1
248C3
248C2
TOP OF SLAB
EL. 0'-0"
W.P.
WT8x20 BRACING (TYP.)
WEST ELEVATION OF COLUMN LINE E (PARTIAL CRANE RAIL)
COLS. = W14x127

LINE "E": 4 of 6



WEST ELEVATION OF COLUMN LINE E (PARTIAL CRANE RAIL) COLS. = W14x127

LINE "E": S of (



WEST ELEVATION OF COLUMN LINE E (PARTIAL CRANE RAIL) COLS. - W14 x 127

LINE "E": 6 of 6

APPENDIX "D"

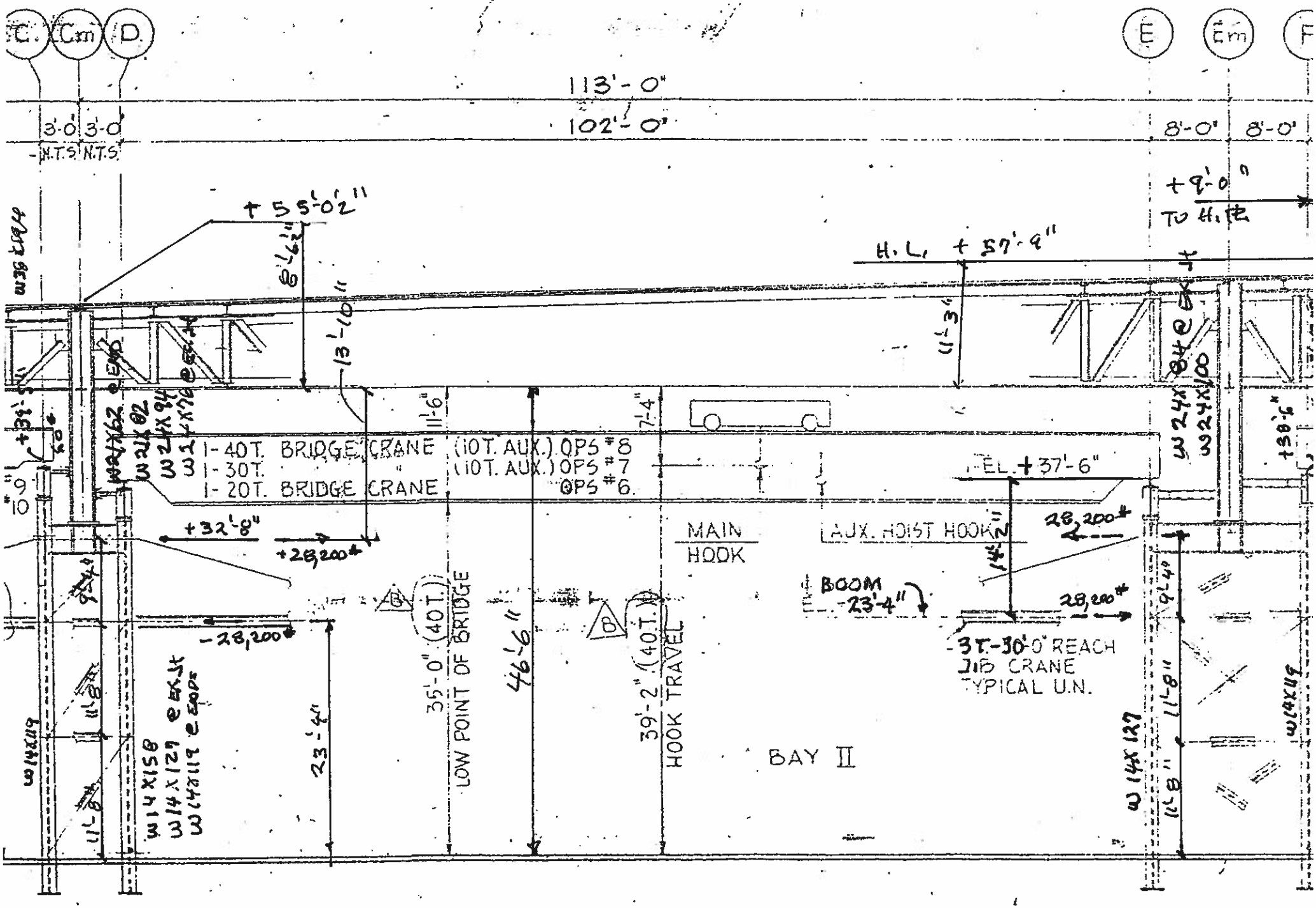
BUILDING CROSS SECTION REFERENCE

DRAWINGS OF THE EXISTING BUILDING,

BAY II, COLUMN LINES "D" & "E"

Notes:

1. Original crane sizes are shown.
2. Jib cranes are noted on the columns. (They were not installed.)
3. Dimensions and elevations are shown.



PARTIAL BUILDING SECTION

APPENDIX "E"

SCHEDULE OF CRANE LOADS AND

APPLICABLE NOTES FOR THE

ORIGINAL BUILDING DESIGN

Notes:

1. Notes indicate that the design values and crane data were taken from a Whiting Crane Handbook which was a widely accepted crane data reference manual.

2. No specific wheel base dimensions were given.

3. No crane speeds including hoist, trolley and bridge were given.

4. Although multiple cranes are shown in different bays of the building there is no information given regarding the restrictions to be imposed on multiple cranes occupying the same runway span. It is assumed that the runways were not designed for multiple cranes to occupy the same runway simultaneously.

CRANE LOADS

RANE ACITY	SPAN	WHEEL LOAD (EACH WHEEL)	VERT IMPACT (EACH WHEEL)	SIDE THRUST EACH RAIL*	LONGIT FORCE EACH WHEEL	BUMPER FORCE PER RAIL
0T. + 10T. AUX.	102'-0"	88K	22	15K	11K	[illegible]
0T. + 10T. AUX.	102'-0"	69K	18K	12K	9K	[illegible]
0T. + 10T. AUX.	44'-0"	55K	14K	12K	7K	[illegible]
0T. + 5T. AUX.	102'-0"	65K	15K	11K	8K	[illegible]
0T. + 5T. AUX.	102'-0"	55K	14K	7K	7K	[illegible]
20T.	102'-0"	52K	13K	7K	7K	[illegible]
10T.	68'-0"	29K	8K	4K	3K	[illegible]
10T.	44'-0"	23K	6K	4K	4K	[illegible]
10T.	30'-0"	21K	6K	4K	4K	[illegible]

* DISTRIBUTED ½ TO EACH WHEEL

NOTES:

WHEEL LOADS DERIVED FROM WHITING CRANE [illegible] MAIN HOOK AND AUX. HOOK LIFTS DO NOT OCCUR AT SAME TIME.

CRANE LOADS ARE BASED ON THE FOLLOWING:

a) LONGITUDINAL FORCE - 12.5% OF MAX. WHEEL LOAD (EA. WHEEL)

b) TOTAL SIDE THRUST EACH RAIL - 12.5% OF CAPACITY + TROLLEY [illegible]

c) IMPACT - 25% OF MAX. WHEEL LOAD

d) BUMPER FORCE PER RAIL = $WV^2/4gS$

WHERE W = UNLOADED WT. OF CRANE

V = 50% OF MAX. CRANE VELOCITY (V = 250 FPM)

S = 0.10 FT. (COMPRESSION TRAVEL OF ENERGY ABSORBING DEVICE)

g = 32.2 FT/SEC²