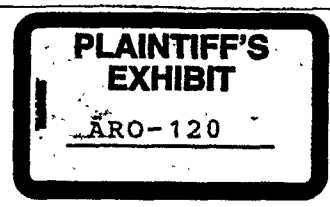
F. W. FANNING 5-1-69



FINAL REPORT

PROJECT NO. 7143

SOAKING PIT FACILITIES

ARMCO STEEL CORPORATION

MIDDLETOWN WORKS

KAISER ENGINEERS, INC.

Middletown, Ohio
April 30, 1969

1.0 Introduction

On May 21, 1964, a general agreement was entered into between Armco and Kaiser Engineers for engineering, construction and other services related to the Armco expansion program known as Project "600". The Soaking Pits facility is a part of this expansion program.

After study and review of many schemes and variations of plans, a Letter of Intent was issued (on March 9, 1966) to the vendor selected to furnish and install the Soaking Pits. This was undertaken prior to the formal approval of the Engineering Report in order to effect a substantial savings in cost of refractories.

Formal approval of the 3-Volume Engineering Report No. 7143-1 (issued May 2, 1966) took place July 1, 1966.

The Soaking Pits facility is designed to heat steel ingots to the proper rolling temperature. The ingots vary in size from 23" x 30" x 82" to 78" x 40" x 96" with a maximum weight of 70,000 pounds.

The facility as designed meets Phase I requirements, that is to heat 235,000 ingot tons per month. It consists of twenty-four Soaking Pits arranged in six batteries of four pits each. Each pit is 12'-6" wide, 26'-0" long and 17'-0" deep, and is rated at 200 tons. The pits are serviced by two soaking pit cranes and are installed in a structure 112' wide x 760' long. Included is a 40' wide covered service area for handling coke breeze and cinders.

The pits are scheduled for twenty-one (21) turn heating operation, and this factor coupled with the use of the new ingot family will insure the Phase I production requirements.

Additional area has been reserved to the east of the Soaking Pit structure so orderly expansion can proceed as required to satisfy future production demands.

2.0 Organization and Key Personnel

2.1 In overall charge of the work for Kaiser Engineers:

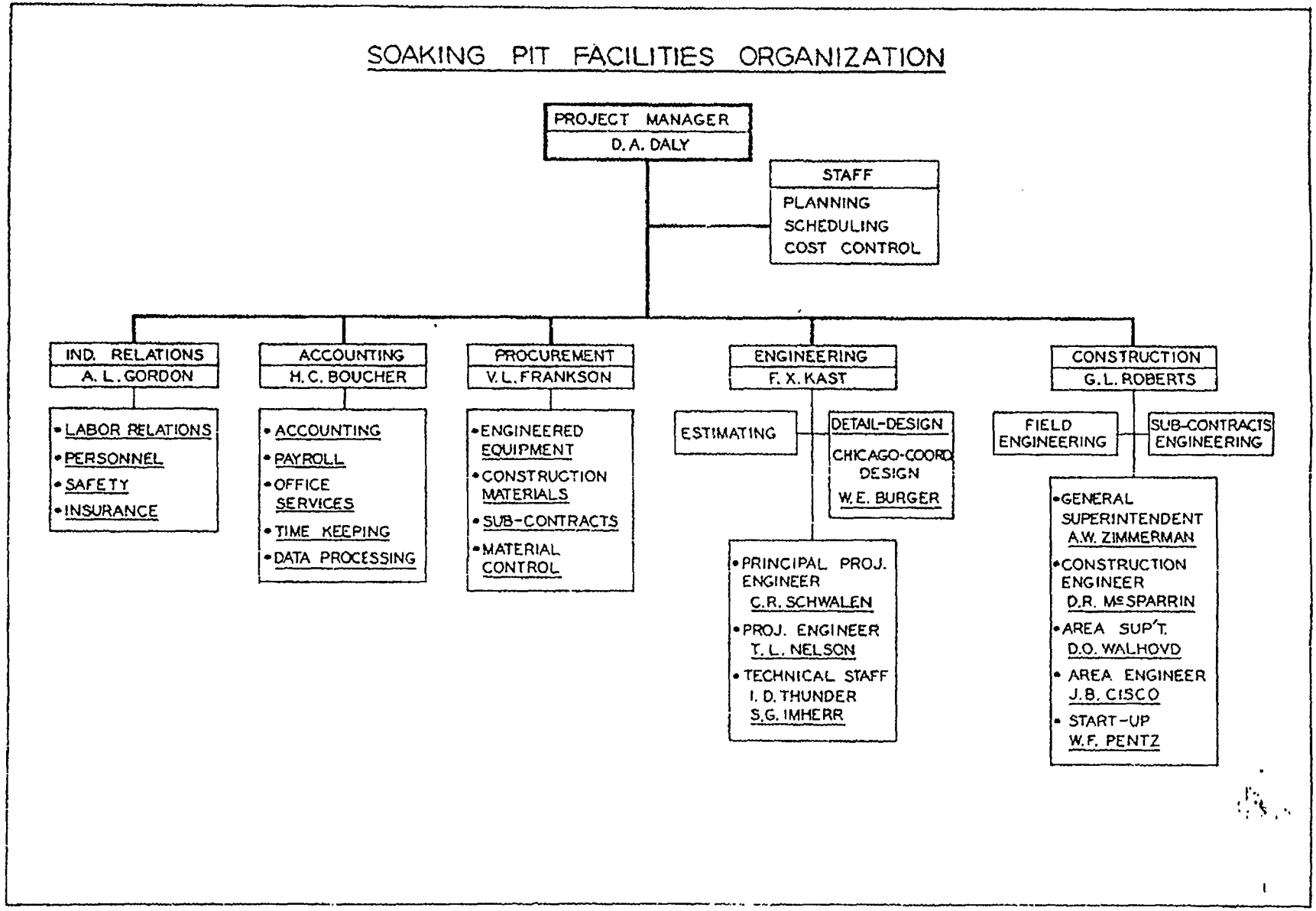
L. H. Oppenheim	- Vice President & General Manager
J. E. Hughes	- Vice President & Assistant General Manager
R. J. Wolf	- Vice President Projects
W. F. Bort	- Vice President, Industrial Construction
D. A. Daly	- Project Manager
C. R. Schwalen	- Principal Project Engineer
T. L. Nelson	- Project Engineer

For Armco:

W. B. Browning	- Director of Engineering to June 1, 1967
C. G. Kramer	- Director of Engineering after June 1, 1967
F. W. Barnes	- Project Manager
F. U. Fanning	- Project Engineer

As shown on the following organization chart, a complete project organization was established in Middletown, staffed with departments for Engineering, Construction, Procurement, Industrial Relations, and Accounting. Cost Control and Planning and Scheduling were staff functions operating directly under the project manager's direction.

SOAKING PIT FACILITIES ORGANIZATION



3.0 General Description

3.1 Facility

The Soaking Pits faciltiy is located in the South Area as shown on Drawing 625126, South Area, Middletown Works. Ingots are supplied to this facility by Open Hearth Shops No. 1 and No. 2. A major source of ingots in the future will be the new Basic Oxygen Shop due to begin production in May, 1969.

The ingots are received on railroad buggies after being stripped from their molds at the ingot stripper and are either charged into the pits directly by the pit cranes or stored in the building for future charging.

After proper heating or soaking the ingots are withdrawn from the pits by crane, deposited on an ingot buggy and transferred to the Slab Mill for rolling into slabs.

The Soaking Pits facility contains approximately 115,000 square feet of floor area under roof which includes the ingot buggy drive houses and the coke breeze and cinder handling area.

The Soaking Pits structure is composed of a single main aisle, 760 feet long, 112 feet wide. A lean-to structure, 30 feet wide, frames into the north side of the main aisle over its entire length. The twenty-four pits grouped in six batteries of four pits each are located on the north side of the structure.

The portion of the enclosure beneath the Soaking Pits has extensive subsurface structures including the basement area, furnace and stack foundations, the cinder tunnel and coke breeze hopper foundations. Other major substructures include the ingot buggy bumper foundations and the drive house bases.

Gravity Ridge ventilators exhaust the heat generated by the Soaking Pits and make-up fresh air is provided by the open wall area on the south side of the structure and louvered intakes on the north side.

Two ingot charging tracks run through the building in an east-west direction. These tracks are composed of heavy crane rail sections, structural steel cross ties, a concrete base and are completely encased in concrete for protection against falling ingots. The switch points on the track are provided with gravity type clean outs.

The Soaking Pits are serviced by two 35/35 ton pit cranes. These cranes are equipped with cover controls to give the crane operator complete access to the pits. The 35 ton auxiliary hook provides maintenance and cover transportation capability. Two (2) twenty ton maintenance cranes (one on each end of the building) are located in a raised area in the trusses to serve the pit cranes.

The 24 Soaking Pits are one way, top fired units capable of operating on natural gas, coke oven gas, or fuel oil and are equipped with recuperators for preheating the burner air.

Each pit is 12'-6" wide, by 26'-0" long, by 17'-0" deep to the brick hearth and is rated at 200 tons. The exhaust gas on the four pits in each battery are ducted into a single stack which discharges these gases to the atmosphere 130 feet above ground. The Soaking Pit covers can also be operated from a console located above the pits on the mezzanine floor, as well as from the pit cranes.

The combustion control house for controlling the firing of the Soaking Pits is located on the mezzanine floor between Batteries No. 3 and No. 4. Various temperatures, fuel rates, and burning ratios are monitored here.

A cover repair area, 50 feet by 100 feet, is located at the west end of the facility. Cover refractories are removed and relined in this area, which is serviced by a 40-ton semi-gantry crane. Waste material is chuted to the basement for common disposal with the cinders.

Coke breeze used for lining of pit hearths is delivered in gondola cars to the coke and cinder handling facility located north of the pits, unfrozen in cold weather by oil, underfired thawing heaters, discharged into a holding bin and fed by conveyor to coke charging buckets inside the building. Pit cranes carry these buckets to the pits and deposit the coke uniformly over the bottom.

A cinder hopper is located under a bell opening in the bottom of each pit. When the useful life of the coke has ended, the residue

is scraped through this opening to the hopper below. A battery driven platform truck is utilized to transport the cinders to a skip hoist for discharge into gondolas.

In addition to the natural gas, coke oven gas, and fuel oil piping systems in the Soaking Pits, there are oxygen, low pressure natural gas, grease, steam, plant air (also used as instrument air), well water, furnace cooling water, storm and sanitary piping systems.

Electrical power for the pits is fed from the Slab Mill motor room, through the south electrical tunnel to the conduit raceway in the lean-to roof, to the various distribution panels and motor control centers. Soaking Pit cranes and ingot buggy drives are also powered from the Slab Mill motor room. Control and positioning of the ingot buggy is, however, achieved through the ingot buggy pulpit.

All of the pits are located west of the ingot receiving table in the Slab Mill, and future expansion east of the Slab Mill is both feasible and practical and should follow the same general arrangement as those pits west of the Slab Mill.

3.2 Facility Requirements and Designed Capability

The Soaking Pits will be required to meet the following forecasted production requirements:

Phase I - 235,000 tons of ingots per month.

Production capability has been evaluated on the basis of the new 40-inch big-end-down ingot family which has been established to meet future Middletown Works production requirements. The new ingot size and related representative mix is as follows:

Ingot Size	Ingot Weight	Percent of Total Mix
23" x 42" x 96"	21,300	4.0
37½" x 40" x 96"	34,000	10.7
37½" x 44" x 96"	37,600	8.8
40" x 49" x 96"	45,000	14.8
40" x 55" x 96"	50,800	23.1
40" x 63" x 96"	58,200	19.8
40" x 71" x 96"	65,800	8.3
40" x 78" x 96"	70,000	10.5

Presently, ingots are being furnished to the new facilities both from the new ingot family and the following present 23" ingot family:

Ingot Size Inches	Ingot Weight Pounds
30 x 23 x 82	13,400
36 x 23 x 82	15,200
42 x 23 x 82	18,000
50 x 23 x 82	21,200
57 x 23 x 82	24,400
63 x 23 x 75	25,300

All equipment will accommodate both ingot families although it is planned in Phase I to eliminate the present 23" ingot family from the production requirements as soon as practical.

The following requirements have been established in order to achieve the Phase I heating requirements of 235,000 ingot tons per month.

- o Ingots charged after 4 hours track time - 145,700 tons/mo.
- o Ingots charged after 7 hours track time - 72,850 tons/mo.
- o Ingots charged cold - - - - - - - - - - - - 16,450 tons/mo.
- o Excess holding time for ingots at rolling temperature in the pits is one (1) hour maximum for seven (7) hours and two (2) hours maximum for cold charged ingots.
- o No excess holding time allotted to 4-hour ingots.
- o Ninety (90) percent of pits available for heating at all times. No more than ten (10) percent down for repairs.
- o Drawing, standing empty, charging, routine maintenance and rolling mill down time must not exceed 31% of the pit availability time.

The present ingot sizes vary somewhat from those proposed when the Soaking Pit heating studies were made. These modifications are minor, however, and the above criteria for meeting heating requirements are still entirely adequate.

4.0 Engineering

4.1 Project Engineering

Project management, project engineers, technical staff, estimating, planning and scheduling people were all located in a central office in Middletown. This arrangement permitted the close coordination with Armco's engineers and operators and with Kaiser construction personnel.

At an initial engineering meeting held on November 25, 1964, the basic concepts for the soaking pits were discussed and tentatively established. In the next few months many layouts and processes were developed by the project and technical staff and reviewed along with participating Armco engineering and operating groups.

An initial Engineering Report which was combined with the Slab Mill and Stripper was completed in October, 1965. Projected cost estimates indicated these facilities to be more expensive than first envisioned. It was, therefore, decided to reduce the overall scope of the project and to publish a separate Engineering Report for the Soaking Pits. This report was issued May 4, 1966. As detail design progressed, project technical staff efforts were utilized to implement the project engineer's efforts relating to detail design direction, dissemination of criteria or information, study efforts, drawing review, and design conformity to scope or accepted scope deviations.

The technical staff maintained a close liaison with the field during the construction period and provided most of the normal field engineering services such as field revisions, as-builts, and implemented changes in scope.

The following drawings and specifications were prepared by the Middletown Technical staff for the Soaking Pits project:

Drawings

Scoping	14
Civil	2
Structural	8
Piping	8
Mechanical	31
Sketches and Layouts	162

Specifications

Construction/Material Subcontract	15
Equipment	10

In addition a Sequence of Operations was written by the project engineering group in which operations for both the Slab Mill and Soaking Pits were described. This document clearly defined the operation of the pits, the types of combustion fuels available and pit control systems for each, the computerized ingot identification system, as well as detailing the operating and support systems for the entire facility. This manual was issued to the start-up personnel and the operating people as a guide for operations management.

During the last months of construction, preceding the Soaking Pit light-off, Project Engineers moved their offices to the job site to work directly with the field supervision toward completion of the facility and to assist in, and coordinate, the start-up and testing efforts of the Armco, Loftus, Foothill and Kaiser groups.

4.2 Detail Design

The detail design drawings for the Soaking Pit facilities were prepared in the KE Chicago Office, with the exception of the Soaking Pit furnaces and related appurtenances which were prepared by the Loftus Engineering Company.

Soaking Pit - Structure

Design of the Soaking Pit Facility was begun in the KE Chicago Office late in December, 1965, and was essentially completed by July 1, 1967. The following summarizes this overall design effort:

	DRAWINGS		MANHOURS		
	Budget	Actual	Budget	Actual	Hrs./ Dwg.
Struct.	110	114	14,604	13,861	121
Arch.	24	28	3,304	2,870	103
Civil	3	3	178	177	59
Piping	23	31	4,221	3,751	121
Elec.	55	64	7,168	7,650	119
Supv.	---	---	2,704	1,944	---
Subtotal	215	240	32,179	30,253	126
Steno-Clerical, Gen. Ser., Admin.			3,555	3,099	
Total			35,734	33,352	

Soaking Pit - Furnaces

Design of the Soaking Pit Furnaces by Loftus Engineering Corporation was begun in May, 1966, and was essentially completed by October 1, 1967, with field changes, etc., being finished at the close of 1968. The following summarizes this drawing effort:

Drawings Completed	Budget	Actual
Structural	33	45
Mechanical	21	33
Piping	17	18
Instrumentation	7	12
Electrical	100	168
Shop Details	75	86
Totals	253	362

4.3 Design Features & Methods

Several new approaches were taken in the preparation of the detail design for the Soaking Pit facilities.

- The trusses and combined building and crane columns were designed as rigid frames. The crane maintenance walkway was located at the top of the crane girder and designed as a horizontal girder to act as horizontal structural bracing members. The wide spacing (five feet) between the building and crane column reduced the column weights and provided adequate crane clearance on the crane walkway. The crane girders were designed to permit free end rotation and yet transmit longitudinal and lateral crane forces into the building columns.

- Continuously welded crane rails were anchored near the center of the runway, while free-floating crane rail clamps fastened with stud weld bolts allow thermal expansion in each direction from the anchors, solving the problem of rail buckling due to high differential heat over the furnaces.
- Since the configuration of the Soaking Pit furnaces made it impossible to install X bracing along certain column lines, the building and crane columns at the furnaces were designed to resist bending in both directions. This resulted in unique star shaped columns for the Soaking Pits.
- A continuous bathtub type foundation was utilized to support the furnace piers, the combined building and crane column piers in the furnace area, the ingot buggy runway, cinder truck passageway and the flue stacks. This arrangement reduced the differential settlement between adjacent pits, building columns, and reduced the dewatering costs.
- Primary ingot data and pit information is recorded on a computer for later usage at the computer controlled Slab Mill and Hot Strip Mill, slab scheduling department.
- Provision has been made for future expansion of the Soaking Pits in an eastward extension of the present facilities and with a minimum disruption of existing pit operations.

4.4 Engineering Costs

The Engineering Budget for the Soaking Pit Facilities was $768,000 with a contingency allowance of $77,000 for a total of $845,000.

Engineering Costs-at-Completion compared to the budget are tabulated below:

	Budget	At Completion	(Over) Under
Design Engineering			
Middletown	$168,000	$150,100	$17,900
Chicago	278,500	209,200	69,300
Subtotal	$446,500	$359,300	$87,200
Feasibility			
Engineering	20,000	71,200	(51,200)
Reproduction	15,000	6,500	8,500
Permits	5,000	1,200	3,800
Outside Services & Consultants	3,000	1,000	2,000
Chicago Office O.H.	278,500	179,200	99,300
Contingency	77,000	-	77,000
Total Engineering	$845,000	$618,400	$226,600
Percent of Budget (Not Incl. Contingency)	100	81	19
Percent Engineering Complete	100		

4.5 Explanation of Engineering Costs

The feasibility engineering overrun of $51,200 resulted essentially from the following:

- o Project duration 6 months beyond original schedule.
- o Extensive scoping studies, necessitated by the change in capacity and layout of the Soaking Pits, dictated by a reduction in capital costs.

The Chicago Office direct labor underrun of $69,300 amounted to 24.9%. This was a result of close coordination between the Middletown project group and the Chicago Design Coordinator, as well as the use of standards and details already developed for the Hot Strip Mill.

Loftus Engineering costs were included directly in their contract for Design and Installation of the Soaking Pit Furnaces.

General

Overall engineering costs, excluding the Loftus portion, underran $226,600. Total engineering cost for the Soaking Pits (again excluding the Loftus portion) amounted to 3.8% of the direct construction cost.

5.0 Procurement

5.1 General

Procurement activity for the Soaking Pits commenced with preparation of the standard proposal for the Soaking Pit furnaces which resulted in a subcontract award to Loftus Engineering Company on December 20, 1965, for furnishing and installing 24 pits together with all associated equipment. There was a total of 56 purchase orders issued for engineered equipment, 2 subcontracts and 218 field purchase orders covering temporary construction materials, miscellaneous steel, piping valves, and fittings and electric cable and related electrical hardware.

5.2 Engineered Equipment

Specifications and inquiries for Engineered Equipment were prepared by the project group, approved by Armco, and then acted upon by the Procurement Department. Bids were evaluated technically by the project engineer and commercially evaluated by the Purchasing Department. A recommendation for placement was prepared and reviewed by the project engineer, the engineering manager, the project manager, and reviewed and approved by Armco.

The following purchase orders cover the major items of Engineered Equipment:

Armco Purchases

7143-97 RP	Alliance Machine	2 Soaking Pit EOT Cranes	$ 804,597
7143-161 RP	Cleveland Crane	40 T Soaking Pit Gantry Crane	146,250
7143-232 RP	Alliance Machine	3 - 20 T Repair Cranes	145,575
7143-325 P	General Electric	Motor Control Center	7,680
7143-10893 RP	Exide Industrial	6 Storage Batteries	10,636
7143-10895 RP	Portman Equipment	Fork Lift Truck	20,117
7143-10896	Moon Equipment	2 Electric Platform Trucks	29,925
7143-10897	Portman Equipment	Fork Lift Truck	10,070

KE Major Engineered Equipment and Material Purchases

7143-1280	Fabreeka Products	Fabreeka Pads/ Washers	12,544
7143-1279	Burt Mfg. Co.	Cont. Ridge Type Gravity Vent.	50,528
7143-1304	Cleveland Crane	Crane Collector/ Rail Comp.	12,710
7143-1372	Stephens-Adamson	Cinder Skip Hoist	50,073
7143-1369	Stephens-Adamson	Coke Breeze Handling System	37,164
7143-1425	Southern Ohio Fab.	Buckets	14,700
7143-1467	Ric-Wil, Inc.	Prefabricated Conduit	20,154

KE Major Engineered Equipment and Material Purchases (Cont.)

7143-1509	Dresser Mfg.	Couplings	12,302
7143-1527	Bethlehem Steel	Area Turnouts	37,300
7143-1525	Rex Chainbelt	Ingot Buggy Bumpers	43,000
7143-1538	International Steel	Structural & Misc. Steel	25,238
7143-1583	The Airolite Co.	Sidewall Louver	32,200
7143-1655	Dave Steel	Tong Repair Towers	18,900

5.3 Field Purchase Orders

Field requisitions were prepared by KE and Foothill from items assigned for Field Procurement on the minor engineered equipment lists prepared by the KE Design Departments and by direct material take-offs from the construction drawings.

Armco manufactured material was requisitioned on field inquiries and sent directly to Armco for their in-plant procurement.

5.4 Subcontracts

There were two subcontracts written directly for the Soaking Pits as follows:

7143-1204	Loftus Eng./Kidde	Soaking Pit Fac.	$6,599,162
7143-1674	Delta Pipeline	Install Piping	229,970

In addition, other major subcontracts which pertain in part to work performed in the Soaking Pits, along with the Soaking Pit portion of the cost, are as follows:

7100-1034	International Steel	Structural Steel	$1,597,535
7100-1254	Ohio Valley Riggers	Rebar	219,721
7100-1276	Moraine Ready Mix	Concrete	359,921
7100-1087	Stuart Painting Company	Structural Steel Painting	49,133
7100-1628	Schriber Sheetmetal	Built-up Roofing	15,570
7148-1359	Moeschl-Edwards	Rolling Steel Doors	6,746
7148-1485	Owen-Corning	Pipe Insulation	13,833

All subcontracts were administrated by the Subcontract Department located at the jobsite. Weekly status reports were issued for each subcontract, and monthly progress payment requests prepared for approval by Kaiser and Armco Management.

6.0 Construction

6.1 General

Construction of the Soaking Pits was accomplished by a Kaiser Engineers field organization using Kaiser forces for excavation, concrete, piping, architectural and similar items, Foothill Electric Corporation for the electrical work, and various other subcontractors for millwright work, structural steel, and miscellaneous specialty items. McGraw Construction Company, a subcontractor to Loftus Engineering Company, installed the Soaking Pit furnaces and associated equipment.

The Kaiser field organization consisted of the Construction Manager and four principal departments, Construction, Engineering, Subcontracting, and Warehousing. The construction responsibility for the Soaking Pits was assigned to an area superintendent reporting directly to the general superintendent. Support was provided by the area engineer and the various craft superintendents.

6.2 Progress

Construction of the Soaking Pits began in June, 1966, with excavation and dewatering requirements, followed by concrete foundations in September and initial building steel erection on December 13, 1966. During the first year, construction progress consisted mainly of excavation and foundation work. At the close of this year, the job was 13% complete with 14,000 cubic yards of concrete placed and 500 tons of structural steel erected.

In 1967, Soaking Pit construction progressed to 72% complete. In April, foundations and building erection advanced to where pit construction together with roofing and siding was started. The first overhead pit crane, No. 357, was erected in May, followed by crane No. 358 on the first of July. Structural steel erection was completed in August, and roofing and siding in September. Service piping began in November and continued through June, 1968. By the end of this year, Loftus Engineering completed erection of the steel liners for the Soaking Pits together with 80% of the pit and flue refractory work. Concrete foundations were completed, and overhead pit crane No. 357 was placed in operation in December, 1967.

During the first six months of 1968, remaining construction, including equipment start-up, was essentially completed. An important milestone was reached on July 2, 1968, when batteries 4, 5 and 6 were lit-off for dry-out. The Soaking Pit facility provided the ingot re-heat requirements in support of the first ingot processed through the Slab Mill on July 26, 1968. The construction time required to build this facility was twenty-five (25) months. Clean up, punch list and additional work items extended final completion to the end of January, 1969.

6.3 Special Conditions

The usage of the overhead pit cranes for construction purposes was limited because after delivery to the jobsite it became necessary to rework the electrical systems for these cranes

to meet Armco's requirements. The existing conduit and wiring was removed and relocated for safety protection.

The operator's cab was also modified by lowering it 20 inches and installing a larger front window to improve visibility which had been impaired by the tong columns in their retracted position. An additional 12-week period was required to complete these modifications for each crane. However, little lost time can be directly attributed to this problem since mobile truck cranes were used in lieu of overhead cranes.

A shortage of skilled craftsmen, mainly pipefitters and electricians, was experienced throughout 1967. Several hundred craftsmen were recruited in other states and Canada to support general manpower requirements. Manpower in the Hot Strip Mill was given priority over other facilities which resulted in lost progress for the Soaking Pits. The Soaking Pits were ready in time, however, to meet the first rolling schedule of the Slab Mill.

Reinforcing steel was detailed and fabricated by the subcontractor on site permitting close coordination with the construction forces and easy checking of the drawings which resulted in a considerable saving in time.

6.4 Labor

Considering the number of craftsmen on the job, very little lost time can be attributed to labor disputes. A walkout by the ironworkers in May, 1966, affected the structural

steel erection and a dispute with the electricians in August, 1967, affected the start-up of the Soaking Pits.

Peak manpower occurred in December, 1967, when some 375 men were working. A total of 833,728 man-hours were expended on construction.

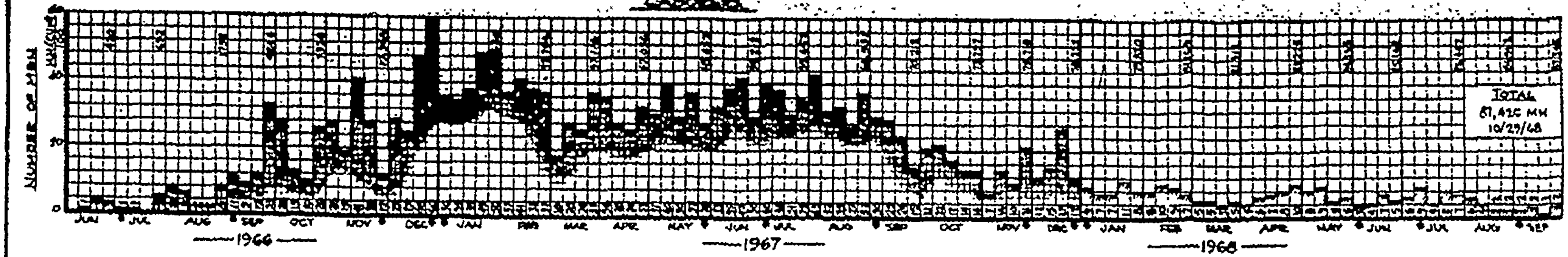
The breakdown by crafts and subcontractors is as follows:

	Man-hours	Peak Manpower	Date Peak Occurred
Laborers	87,425	60	Dec. 1966
Carpenters	97,762	66	Jan. 1967
Cement Masons	5,482	10	Aug. 1967
Teamsters	16,277	8	Aug. 1967
Operating Engrs.	31,270	15	Oct. 1966
Ironworkers	55,718	30	June 1967
Sheetmetal Workers	16,243	29	Aug. 1967
Millwrights	4,084	8	Mar. 1968
Pipefitters	18,644	22	May 1967
Electricians	95,395	78	May 1968
Subcontractors:			
Delta	31,900	36	Jan. 1968
International-Stupp	27,000	25	May 1967
Loftus	298,460	185	Dec. 1967
Ohio Valley	35,000	22	May 1967
Others	13,070	--	- - - -

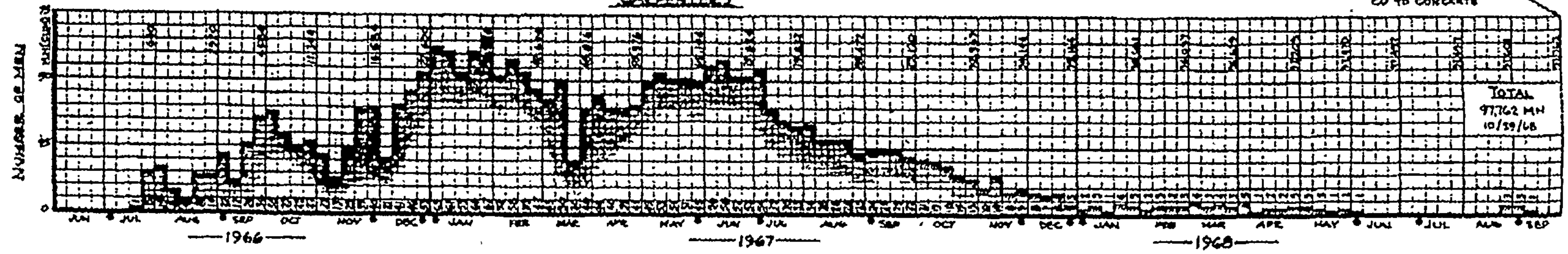
6.5 Significant Quantities

Excavation	74,848 CY
Backfill	115,692 CY
Concrete	29,919 CY
Equipment Grout	1,250 CF
Structural Grout	1,220 CF
Reinforcing Steel	6,555,800 LB
Structural Steel	4,118 TN
Miscellaneous Steel	2,261 TN
Roofing	81,654 SF
Siding	115,762 SF
Built-up Roof	24,940 SF
Ridge Ventilators	770 LF
Piping	34,790 LF
Embedded Conduit	49,577 LB
Exposed Conduit	134,646 LB
Power Wiring (High Voltage)	52,623 LF
Power Wiring (Low Voltage)	2,295 LF
Control Wiring	10,030 LF
Lighting Conduit	72,240 LB
Lighting Wiring	169,410 LF
Fixtures	552 EA
Welding Wiring	22,000 LF
Communication Wiring	11,900 LF
Connected Load	4,900 HP

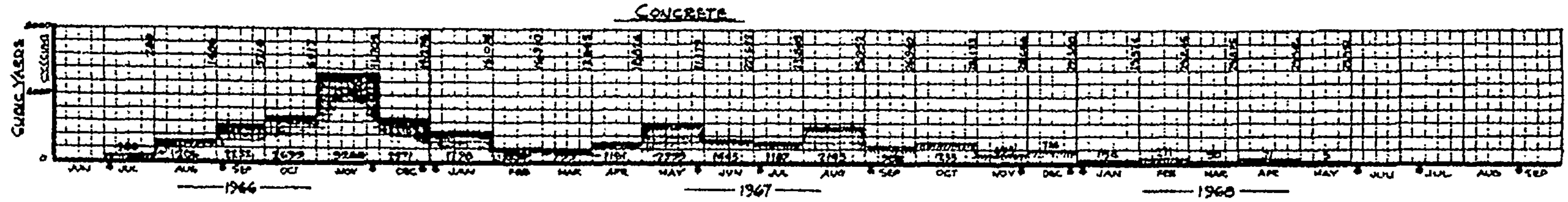
LABORERS



CARPENTERS



CONCRETE



MANHOUR TABULATION

(CRAFTS NOT GRAPHED)

10/29/68

CRAFT	1966 JUN	JUL	AUG	SEP	OCT	NOV	DEC	CUM. M.H.	1967 JAN	FEB	MAR	APR	MAY	JUNE	CUM. M.H.	1967 JUL	AUG	SEP	OCT	NOV	DEC	CUM. M.H.	1968 JAN	FEB	MAR	APR	MAY	CUM. M.H.	1968 JUN	JUL	AUG	SEP	TOTAL
MILLWRIGHTS													192	280	472	397	330	112	245	147	112	1718	10	372	192	547	178	3793	160	127	44	-	4,084
PIPEFITTERS	400	192		800	680	830	1016	3468	876	800	480	1000	2992	1380	[illegible]	[illegible]	2120	924	544	814	176	13,389	368	85	401	441	96	12,673	29	270	535	94	13,644
OPERATORS	432	576	360	237	2960	1992	346	7046	1536	1380	680	960	1200	360	23,402	728	2200	2160	2040	1776	480	[illegible]	1482	1200	997	1228	1657	[illegible]	484	790	440	204	31,570
TEAMSTERS	92	40	360	172	200	728	680	2272	876	440	160	520	736	800	5298	1072	1200	608	800	760	800	[illegible]	1186	1040	657	673	750	16,994	954	526	220	110	16,777
CEMENT MAS.			80	160	200	300	136	176	200	800	120	300	92	920	2360	548	640	648	[illegible]	192	472	6965	60	195	119	82	39	5,596	10	--	44	25	9,882
TOTALS	1024	566	760	1,876	3,640	3,400	2776	13,152	2,968	2,720	1,440	2,680	3,992	4,120	32,312	4,044	6,600	4,296	4,109	2,598	2,220	[illegible]	3,006	3,090	2,387	2,510	2,473	[illegible]	1,299	1,715	1,283	475	75,757

NOTES:

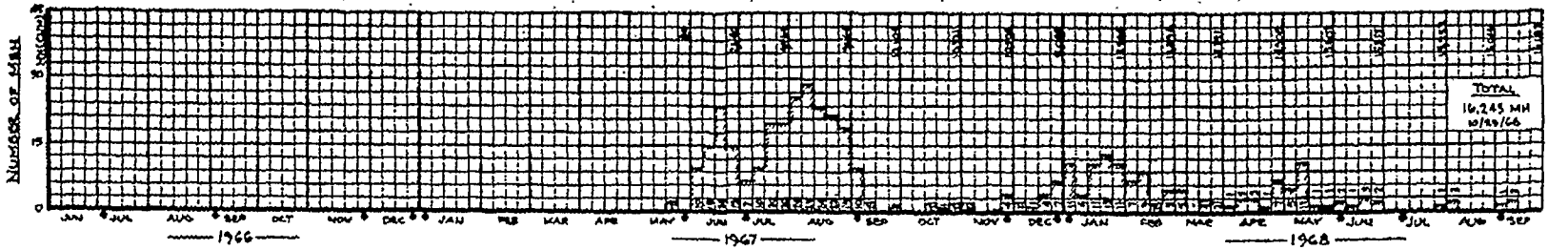
● DENOTES HOLIDAYS

FINAL	10/29/68
UPDATED	7/30/68
UPDATED	5/28/68
UPDATED	4/30/68
REC'D/UPDATED	2/27/68
UPDATED	12/26/67
UPDATED	9/26/67

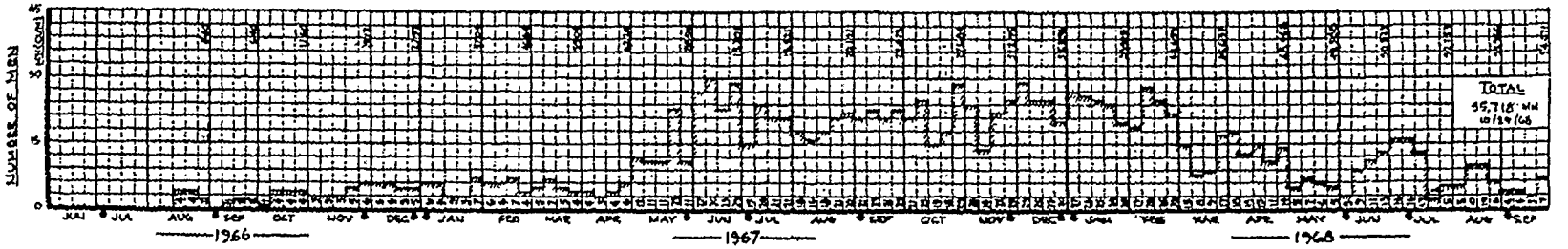
KAISER ENGINEERS - PROJECT 600
- FIELD SCHEDULE -
CRAFT MANPOWER - 7143 SOAKING PITS
SHEET 1 OF 3

DATE SEPT 12, 1967 | BY J.R.C. | APP. D.A.F. | FS-105

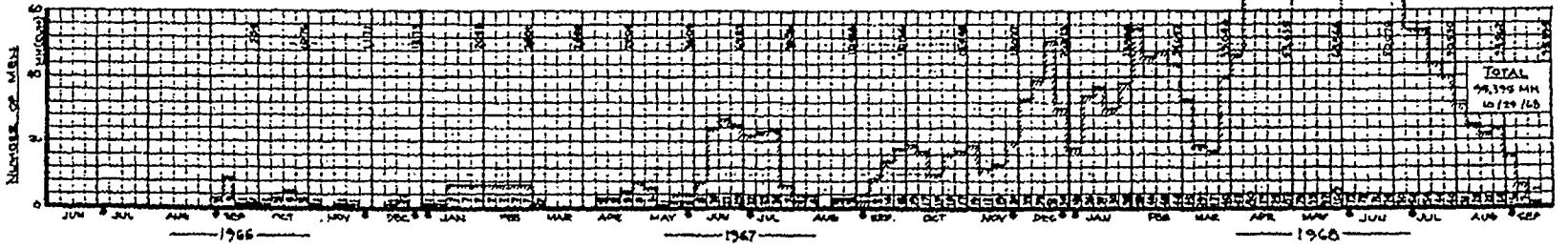
SHEET METAL



IRONWORKERS



ELECTRICIANS



NOTE
* DENOTES HOLIDAYS

1	FINAL 10/29/68
2	UPDATED 7/30/68
3	UPDATED 3/31/68
4	UPDATED 6/30/68

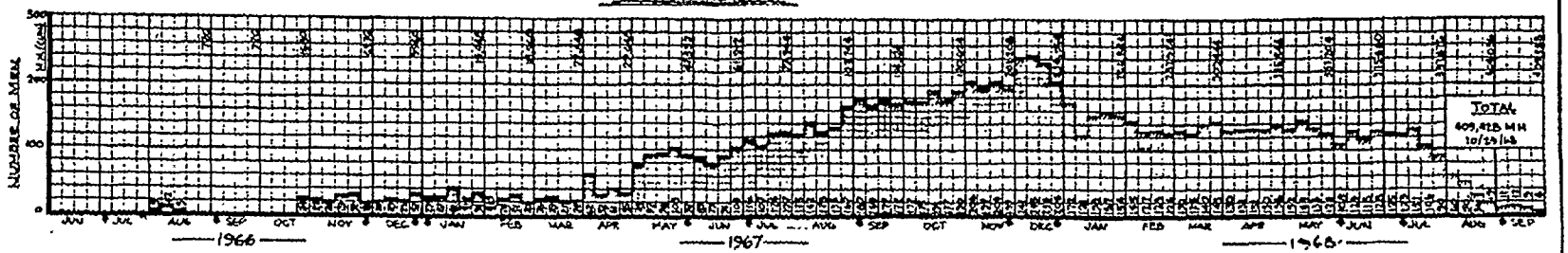
KAISER ENGINEERS - PROJECT 600
- FIELD SCHEDULE -

CRAFT MANPOWER - 7145 SOAKING PITS

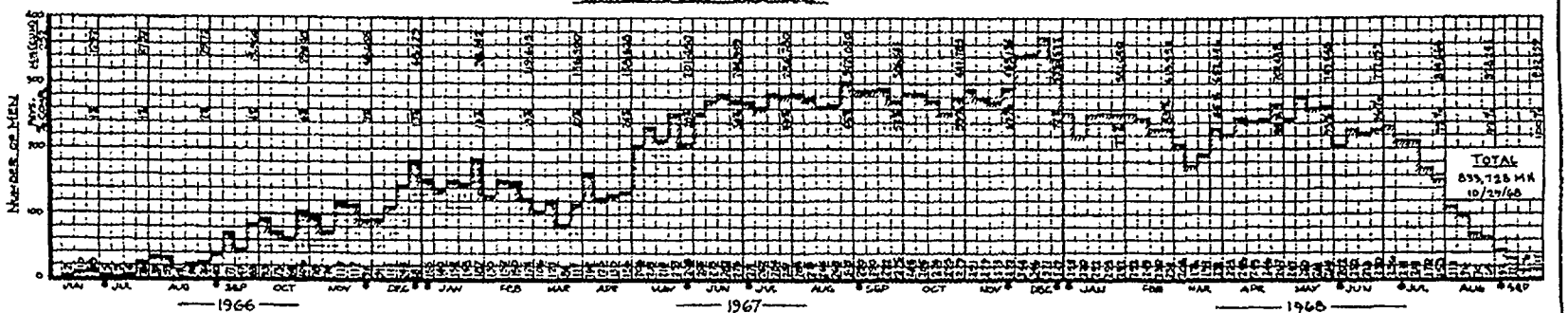
SHEET 2 OF 5

DATE	BY	FS-105 4
FEB 27, 1968	APP.	

SUB-CONTRACTORS



TOTAL CRAFT MANPOWER



NOTE
* DENOTES HOLIDAYS

⚠ FINAL 10/29/68	
⚠ UPDATED 7/29/68	
⚠ UPDATED 6/28/68	
⚠ UPDATED 4/26/68	
⚠ UPDATED 2/27/68	
⚠ UPDATED 11/24/67	

KAISER ENGINEERS - PROJECT 600
- FIELD SCHEDULE -
CRAFT MANPOWER - TIES SOARING PITS
SHEET 3 OF 3

DATE SEP 26, 1967	BY VEC APP. OAF.	FS-105 ⚠

7.0 Progress and Schedules

The initial planning of the Soaking Pits project consisted of establishing the overall time frame for the design and construction effort based upon previously completed projects of like magnitude and scope. These time frames were published through the Master Plan schedule and the Engineering Report for the project and served as a time coordinating factor for the various responsible departments and vendors.

A bar chart was prepared for issuance with the Engineering Report for the purpose of coordinating design effort to the construction effort and to furnish the major equipment vendor such agreed upon information. On this project, Loftus/Kidde was responsible for the design, fabrication, erection and testing of the Soaking Pits which represented about one half of the direct cost of the project.

This schedule, which represented agreed upon basic parameters by various departments, along with the detailed information in the Engineering Report, which included equipment lists and a detailed estimate, became the basis for development of a CPM logic network and subsequent computer output. The resultant data was compiled into a detailed construction schedule bar chart with supporting effort (design, equipment delivery, etc.) delineated in order to show restraints.

Included with the CPM output were manpower loading curves based on data extrapolated from the estimate, experience and current information. These curves dictated the manpower required (incrementally and totally) to accomplish the project completion

date based on current known and extrapolated data and also afforded a criteria against which to monitor, periodically, the actual manpower accruals.

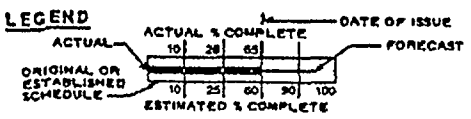
Also furnished by the CPM output was the data required to develop target percentage complete curves of the total job as well as the construction detail increments. These target curves were utilized to apply the actual percent complete figures which gave an excellent picutre of project status at periodic points in time.

In order to make a periodic determination of progress on the project, a mechanized physical progress report was developed. This report was based on the Chart of Accounts used in the budget estimate. Utilizing quantities in the estimate and an extraction of "labor dollars" from direct labor, equipment usage and sub-contract columns, which served as the weighting vehicle, a base was established against which "to-date" quantities were applied on a periodic basis. The resultant calculations gave a percentage of progress on each of the line items within the estimate as well as summating to a percentage of progress for each of the construction detail divisions (i.e., 000 Earthwork, 100 Substructures, etc.) and finally a percentage of progress for the total project. This report served as an extremely valuable and comprehensive tool in the management of the project due to the above capabilities as well as being capable of handling new EAC quantities within the program format. This feature allowed the report to be a dynamic function of the project as alterations occurred.

CPM Summary Reports were issued monthly throughout the duration of the project and conveyed to management the status of major items of interest within the project. A comparison between the original master schedule dates, current planning schedule dates and expected dates was delineated with an arithmetical days ahead or behind between the latter two dates, above, given.

Kaiser Engineers and the vendor coordinated completion of the pits installation and their start-up. No start-up schedule was prepared for the Soaking Pits project due to the fact the vendor furnishing the pits was responsible for his own start-up. Kaiser Engineers afforded support in the construction completion and checkout of the building and supporting facilities.

BIG RED



PROJECT SCHEDULE

SOAKING PIT FACILITIES

ARMCO STEEL CORPORATION, MIDDLETOWN, OHIO

ISSUED: 11-30-65
REVISED: 12-31-66

INCREMENTS	WT	1965 J F M A M J J A S O N D	1966 J F M A M J J A S O N D	1967 J F M A M J J A S O N D	1968 J F M A M J J A S O N D
I. OVERALL PROJECT*		0 0 0 0 0 0 0 1 1 1 1 1	1 1 2 4 6 6 7 9 12 15 19 23	26 28 30 34 38 44 49 54 60 66 71 77	81 86 87 90 94 97 98 99 100
		0 0 0 0 0 0 0 1 1 1 1 1	1 2 2 4 5 6 7 9 11 15 18 22	26 29 33 38 43 48 56 62 69 76 82 89	95 98 99 99 99 100
II. SUMMARY SCHEDULE					
A. ENGINEERING	1	0 0 0 1 1 2 2 3 4 5 6 7	3 7 15 22 31 33 36 41 50 61 67 70	74 76 79 85 90 93 93 96 97 98 98 99	99 99 99 99 99 100
		0 0 0 1 1 2 2 4 4 5 6 7	8 11 15 22 28 33 38 43 47 52 61 70	75 79 84 89 92 95 98 98 99 99 99 99	99 99 99 99 99 100
B. PROCUREMENT	0	1 2 3 4 5 5	15 20 30 45 48 55 60 66 71 74	76 78 90 92 92 93 95 98 99 99 99 100	
		1 2 3 4 5	10 20 30 40 50 55 60 65 70 75	77 80 85 90 92 92 99 100	
C. CONSTRUCTION *	5	1 1 2 4 6 9	13 16 18 20 21 28 34 40 45 52	59 66 72 77 83 85 88 93 96 98	99 100
		1 1 2 4 8 9	12 16 19 23 28 33 39 47 55 63	71 79 87 94 98 100	
					* 72 78 83 89 94 97 99 100

* Revised to conform with the CPM Construction Schedule, January 15, 1968.

PROJECT NO. 7143

KAISER ENGINEERS, INC.

FINAL ISSUE

AKE-004261

LEGEND

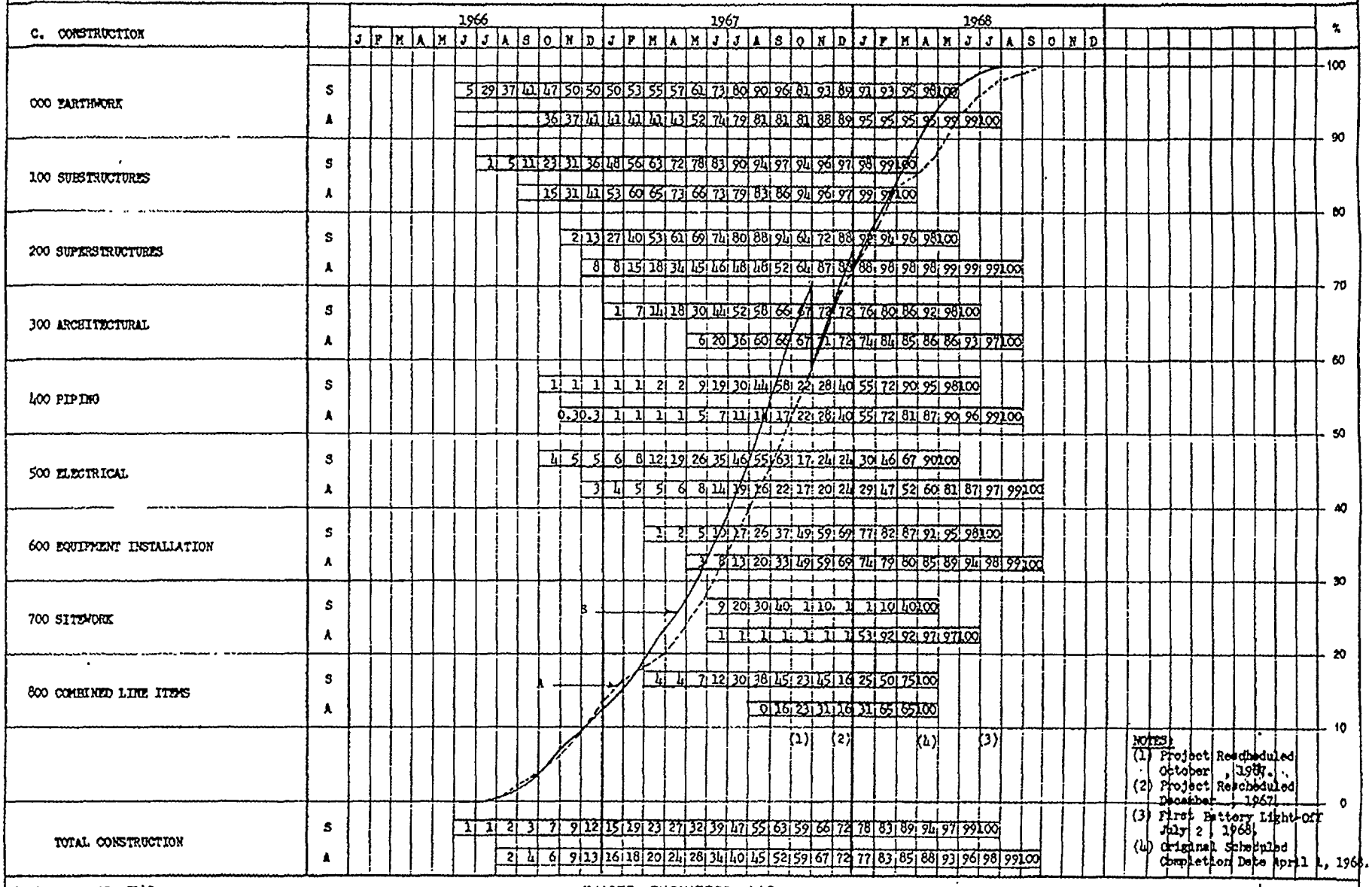
S - INTERMEDIATE START SCHEDULE
A - ACTUAL PROGRESS

PROJECT SCHEDULE

SOAKING PITS COMPLEX

ARMCO STEEL CORPORATION, MIDDLETOWN, OHIO

ISSUED: October 1, 1966



NOTES:
(1) Project Rescheduled October , 1967.
(2) Project Rescheduled December , 1967.
(3) First Battery Light-Off July 2 , 1968.
(4) Original Scheduled Completion Date April 1, 1968.

PROJECT NO. 7143

KAISER ENGINEERS, INC.

8.0 Project Costs

The final appropriation for the Soaking Pits as approved by Armco was $15,996,000, which matches the budget estimate shown in the Engineering Report.

Overall costs for the project totalled $16,359,200, which exceeded the budget by $363,200. This overrun amounted to 2.3 percent of the appropriation.

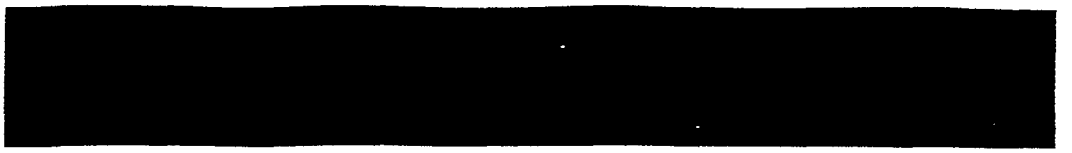
A final Summary Cost and Comparison to Estimate Report is included on the following pages, and significant overruns are reported as follows:

The Soaking Pits Structure, Section 201, exceeded the budget by $481,825, or 23.4 percent. This was primarily due to a low projection on structural steel requirements.

Shop, Service and General Enclosures Lighting, Section 262, exceeded the budget by $46,830. This is offset, however, by a saving of $65,572 in High Bay Lighting, Section 261, a companion account, for an overall saving of $18,742.

Soaking Pit Cranes, Section 301, overran the budget by $52,112, or 5 percent, which is attributable to the large amount of field rewiring necessary to put the cranes in service.

The Soaking Pit Furnace Purchase and Installation, Section 401, overran the budget by $431,369, or 7 percent. This was for premium time payment and settlement of claims for additional compensation by the lower tier erection subcontractor.



FINAL SUMMARY COST & COMPARISON TO ESTIMATE REPORT

Report Date: February 14, 1969

JOB NO. 6471-43 Soaking Pits

Period Ending: January 28, 1969

Project Section	Description	Total Recorded & Committed	Appropriated Budget	ESTIMATE AT COMPLETION			(Over) Under Appropriated Budget	Percent Expended
				Current	Previous	Increase (Decrease)		
201	Soaking Pit Complex Str.	2,540,392	2,065,400	2,547,225	2,545,813	1,412	(481,825)	99
211	Shop Serv. & Gen. Enclosures	17,823	43,200	17,823	17,823	-	25,377	99
231	Offices & Personnel Enclosures	10,598	11,800	10,598	10,598	-	1,202	100
261	High Bay Lighting	160,728	226,300	160,728	160,728	-	65,572	99
262	Shop Serv. & Gen. Encls. Lgtg.	103,030	56,200	103,030	103,030	-	(46,830)	100
263	Walkway Platform & Catwalk Lgtg.	-0-	8,400	-0-	-0-	-	8,400	-
264	Perimeter Lighting	8,636	15,900	8,636	8,636	-	7,264	100
265	Emergency Lighting	916	3,300	916	916	-	2,384	100
281	Shop Serv. & Gen. Encl. Htg. & Vent.	6,456	2,300	6,456	6,505	(49)	(4,156)	100
282	Ofcs. & Persnl. Encl.-Htg. & Vent.	782	1,800	782	782	-	1,018	100
301	Soaking Pit - Cranes #357 & #358	1,109,873	1,059,000	1,111,112	1,111,112	-	(52,112)	99
302	Soaking Pit-Cov. Rpr. Cntry. Crane #366	164,479	243,100	164,479	164,479	-	78,621	100
304	Soaking Pit Crane-Rpr. Crns. #370 & 371	108,850	143,400	108,850	108,850	-	34,550	99
305	Battery Powered Platform Tks.	74,618	115,800	74,618	74,618	-	41,182	99
307	Hoists	8,902	7,100	8,902	8,902	-	(1,802)	100
401	Purchase & Erect Soaking Pits	6,391,824	6,165,000	6,596,369	6,394,700	201,669	(431,369)	97
401	EOT Cranes - Operation	29,675	28,000	29,675	29,675	-	1,675	100
406	Care & Prot. of Elect. Equip.	28	-0-	28	28	-	(28)	100
410	Coke Breeze System	93,040	67,300	93,044	93,044	-	(25,744)	99
411	Cinder Handling System	92,318	108,000	92,318	92,318	-	15,682	100
412	Ingot Buggy Bumpers	43,186	34,300	43,186	43,186	-	(8,886)	100
450	Grease System	24,739	12,700	24,739	24,739	-	(12,039)	100
460	Soaking Pit Facil.-Fdns. & Substr.	2,364,522	1,511,700	2,374,899	2,374,899	-	(863,199)	99
470	Equipment - Painting & Grouting	11,587	27,200	12,864	12,864	-	14,336	87
471	Misc. Steel for Equipment	346,213	360,800	346,800	343,800	3,000	14,000	99
472	Equipment Safety Guards	3,963	2,900	3,963	3,963	-	(1,063)	100
480	Permanent Dewatering System	30,656	87,800	30,656	30,656	-	57,144	100
501	Battery Charging Station	4,852	10,000	5,308	5,308	-	4,692	100
502	Soaking Pit Aux. Equipment	18,190	30,300	18,190	18,190	-	12,110	100
503	Car Thaw Pit & Equipment	13,388	21,000	13,388	13,388	-	7,612	100
694	Vendor's Assistance - Mech.	2,980	5,000	5,000	5,000	-	-0-	59
695	Contractor's Start-Up - Mech.	74,816	184,000	83,000	80,000	3,000	101,000	89
701	Compressed Air	23,858	13,800	23,858	23,858	-	(10,058)	100

FINAL SUMMARY COST & COMPARISON TO ESTIMATE REPORT

Report Date: _____

JOB NO. 6471-43 Soaking Pits

Period Ending: March 25, 1969

Project Section	Description	Total Recorded & Committed	Appropriated Budget	ESTIMATE AT COMPLETION			(Over) Under Appropriated Budget	Percent Expended
				Current	Previous	Increase (Decrease)		
702	Natural Gas	55,964	34,500	55,963	55,726	237	(21,463)	100
703	Oxygen	46,838	36,200	46,838	46,838	-	(10,638)	100
704	Steam	53,307	33,400	53,338	53,338	-	(19,938)	99
705	Well Water	17,026	21,100	18,525	18,525	-	2,575	91
706	Clarified Water	-0-	3,800	-0-	-0-	-	3,800	-0-
707	Treated Water	89,519	62,600	89,519	90,064	(545)	(26,919)	99
708	Fuel Oil	63,934	83,700	63,934	63,965	(31)	19,766	99
709	Coke Oven Gas	31,080	47,800	31,846	31,846	-	15,954	97
713	Sanitary Sewer	10,077	4,400	10,077	10,077	-	(5,677)	99
714	Storm Sewer	-0-	13,500	-0-	-0-	-	13,500	-0-
715	Painting, Color Coding & Tagging	8,284	12,700	8,284	17,300	(9,016)	4,416	100
750	Instrumentation	2,987	21,000	2,987	2,987	-	18,013	100
801	Soaking Pit Raceways	191,072	100,200	169,722	180,048	(5,356)	(72,823)	100
802	Motor Control Centers	10,596	32,700	10,597	10,597	-	22,103	99
803	Power Distribution	186,399	205,500	173,149	173,149	-	32,351	97
804	Soaking Pit Electrics	64,052	19,300	67,508	61,908	5,600	(48,208)	94
805	440 V Welder & Utility Feeder	49,492	28,800	49,493	49,493	-	(20,693)	99
807	Soaking Pits Communication Sys.	31,459	13,700	31,460	31,460	-	(17,760)	99
850	Painting & Grouting	1,949	2,100	1,949	2,200	(251)	151	99
880	Elect. Subctr's Ovrhd. & Fee	91,333	74,200	101,033	108,033	(7,000)	(26,833)	90
894	Vendor's Assistance - Electr.	-0-	2,000	2,000	2,000	-	-0-	-0-
895	Contractor's Start-Up-Elect.	13,555	40,000	14,000	14,000	-	26,000	96
	TOTAL DIRECT COST	14,904,838	13,566,000	15,123,662	14,930,962	192,700	(1,557,662)	99
910	Construction Overhead	182,061	153,000	186,638	186,638	-	(33,638)	97
940	Engineering & Staff	618,266	768,000	618,400	618,400	-	149,600	99
970	Contingency		1,054,000				1,054,000	
	TOTAL INDIRECT COSTS	800,327	1,975,000	805,038	805,038		1,169,962	99
	TOTAL DESIGN & CONSTR. BUDGET	15,705,165	15,541,000	15,928,700	15,736,000	192,700	(387,700)	99
	Other Related Costs (Armco)	352,695	455,000	370,000	455,000	(85,000)	85,000	95
	TOTAL APPROPRIATION NO. 7143	16,057,860	15,996,000	16,298,700	16,191,000	107,700	(302,700)	98

FINAL SUMMARY COST & COMPARISON TO ESTIMATE REPORT

Report Date: February 14, 1969

JOB NO. 6471-43 Soaking Pits

Period Ending: January 28, 1969

Project Section	Description	Total Recorded & Committed	Appropriated Budget	ESTIMATE AT COMPLETION			(Over) Under Appropriated Budget	Percent Expended
				Current	Previous	Increase (Decrease)		
	Evaluated Exposure			60,500	253,200	(192,700)	(60,500)	
	TOTAL PROJECT NO. 7143	16,057,860	15,996,000	16,359,200	16,444,200	(85,000)	(363,200)	98

9.0 Photographs

9.1 Progress Photographs

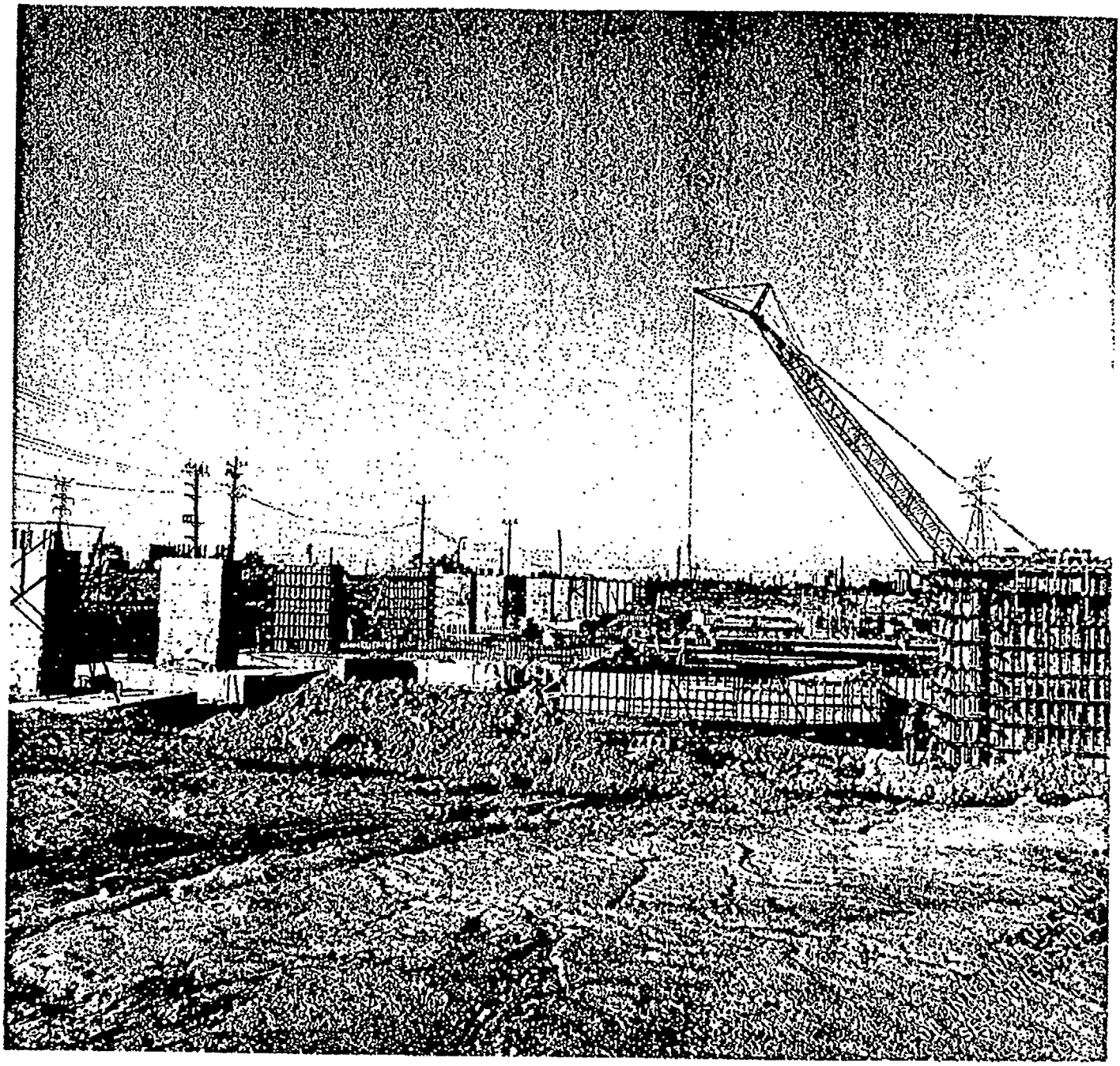


FIGURE 1

Looking west showing piers along W Line and furnace base slabs being readied for pouring (October 1, 1966).

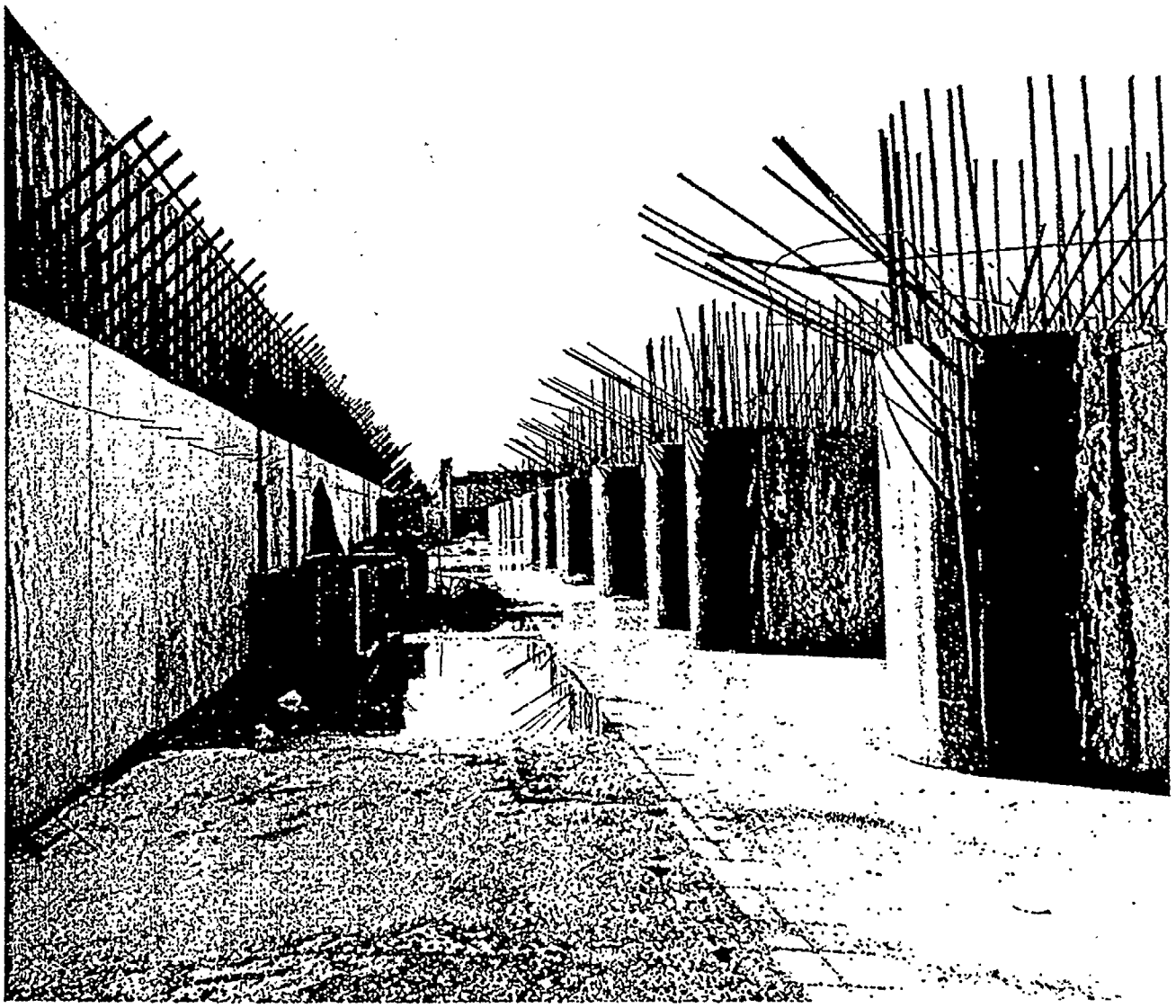


FIGURE 2

View looking down cinder tunnel showing furnace piers with rounded steel bullnoses for traffic protection (March 20, 1967).

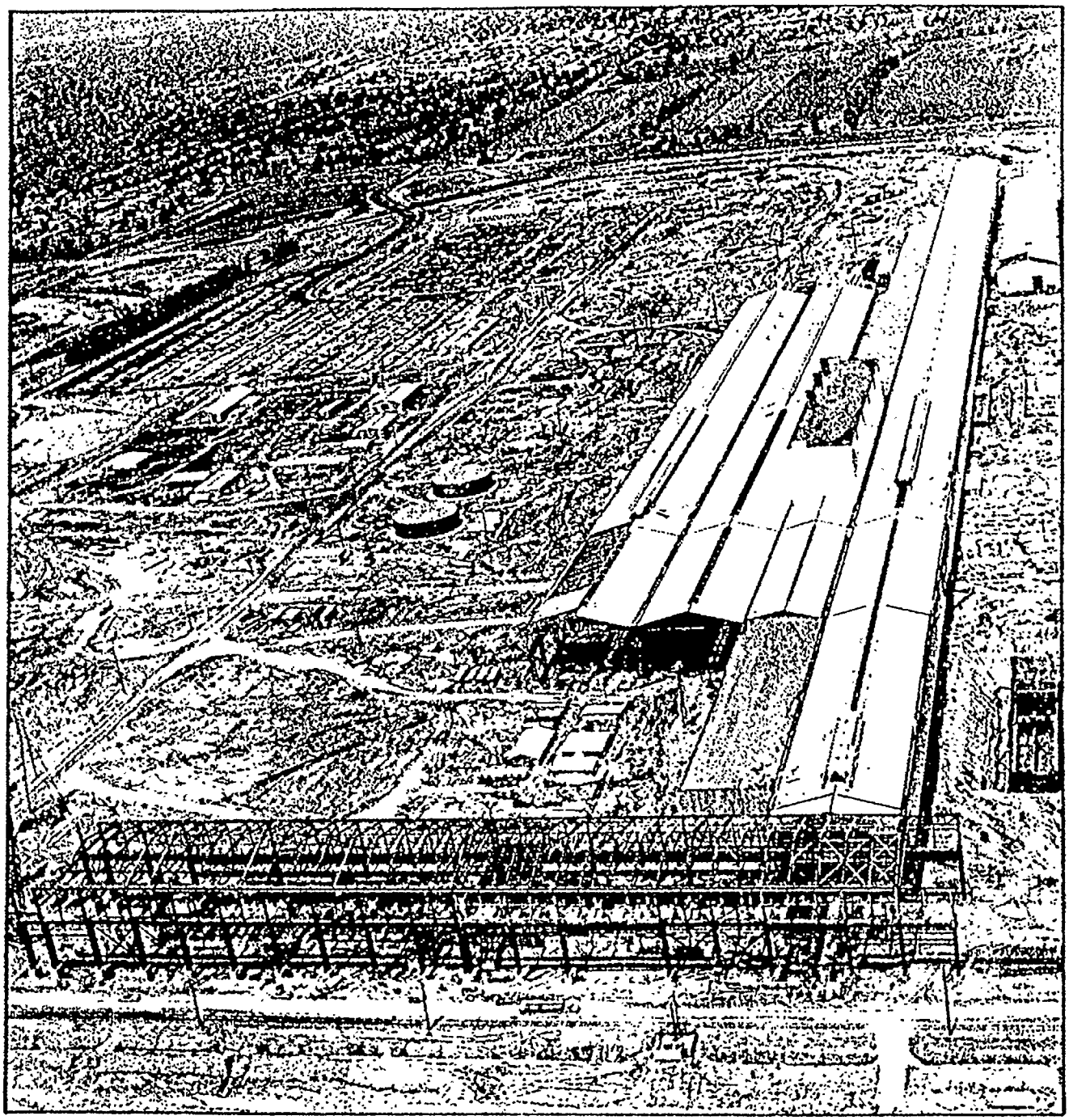


FIGURE 3

Aerial view looking north with soaking pits in foreground with building framing steel approximately 90% complete (April 25, 1967).

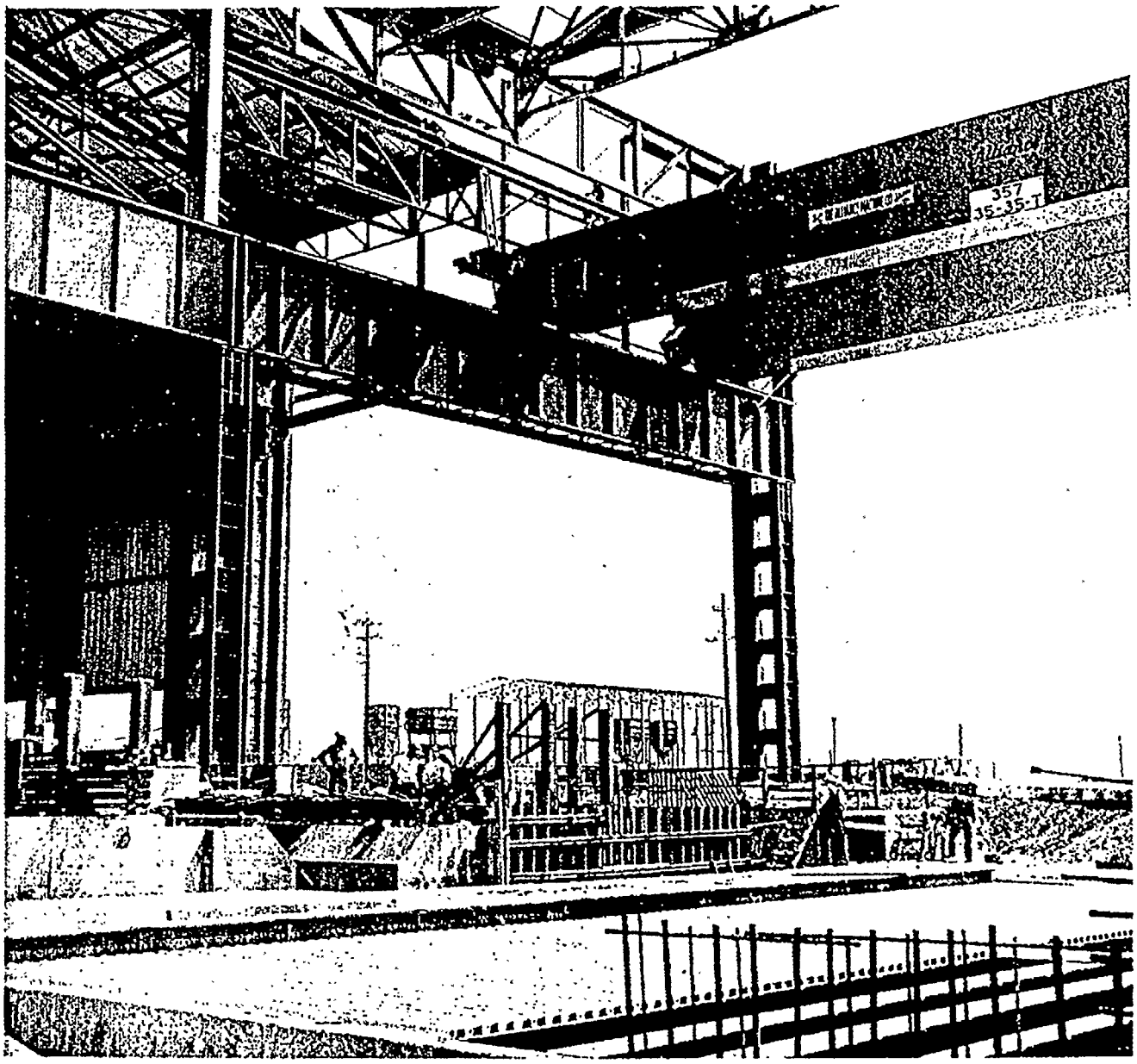


FIGURE 4

Looking northeast at the east end of the building showing soaking pit crane 357 bridge girders and wheel trucks in place (May 25, 1967).

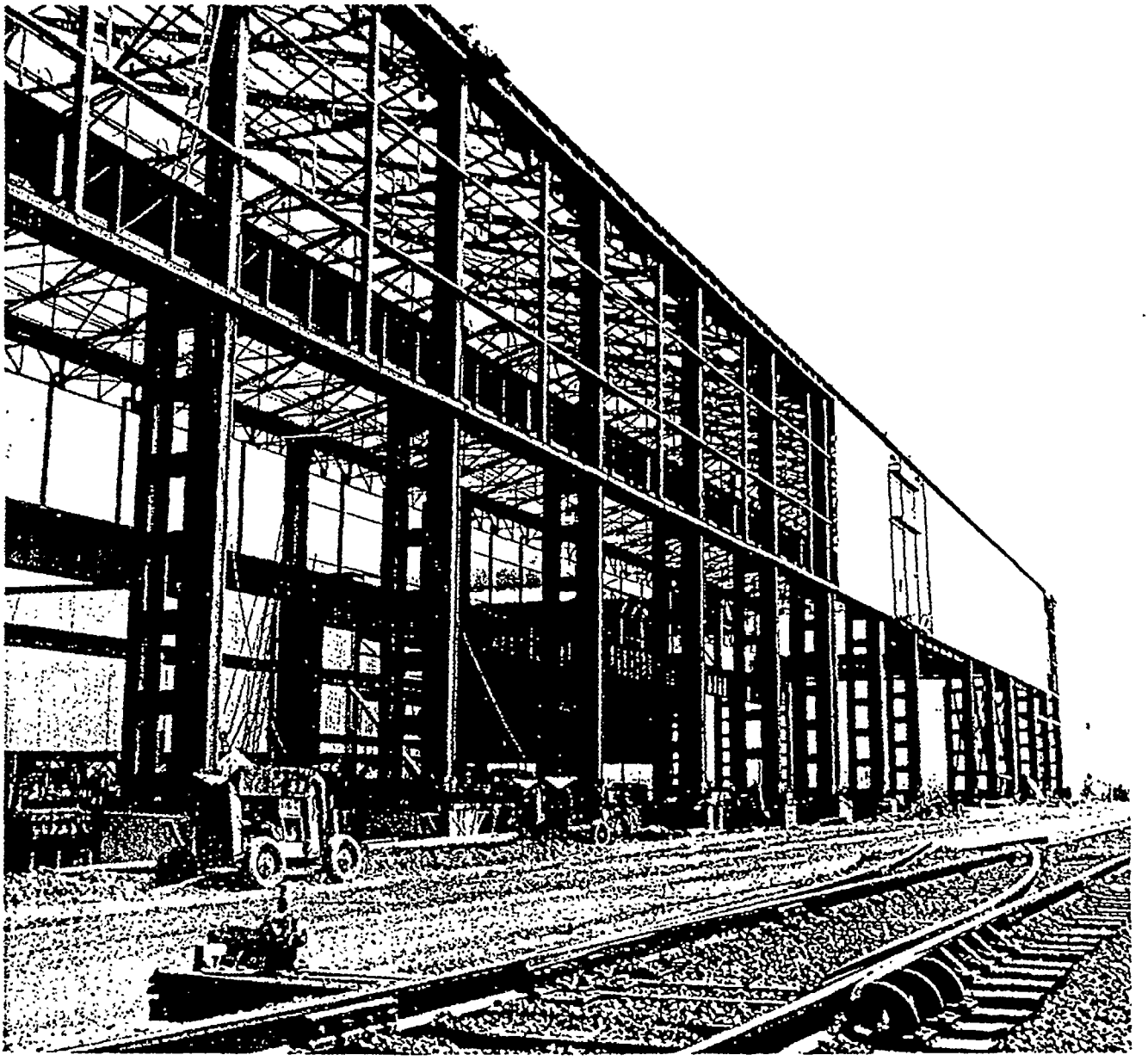


FIGURE 5

Showing the first siding being erected along the W Line along with structural steel bolt-up activity (May 25, 1967).

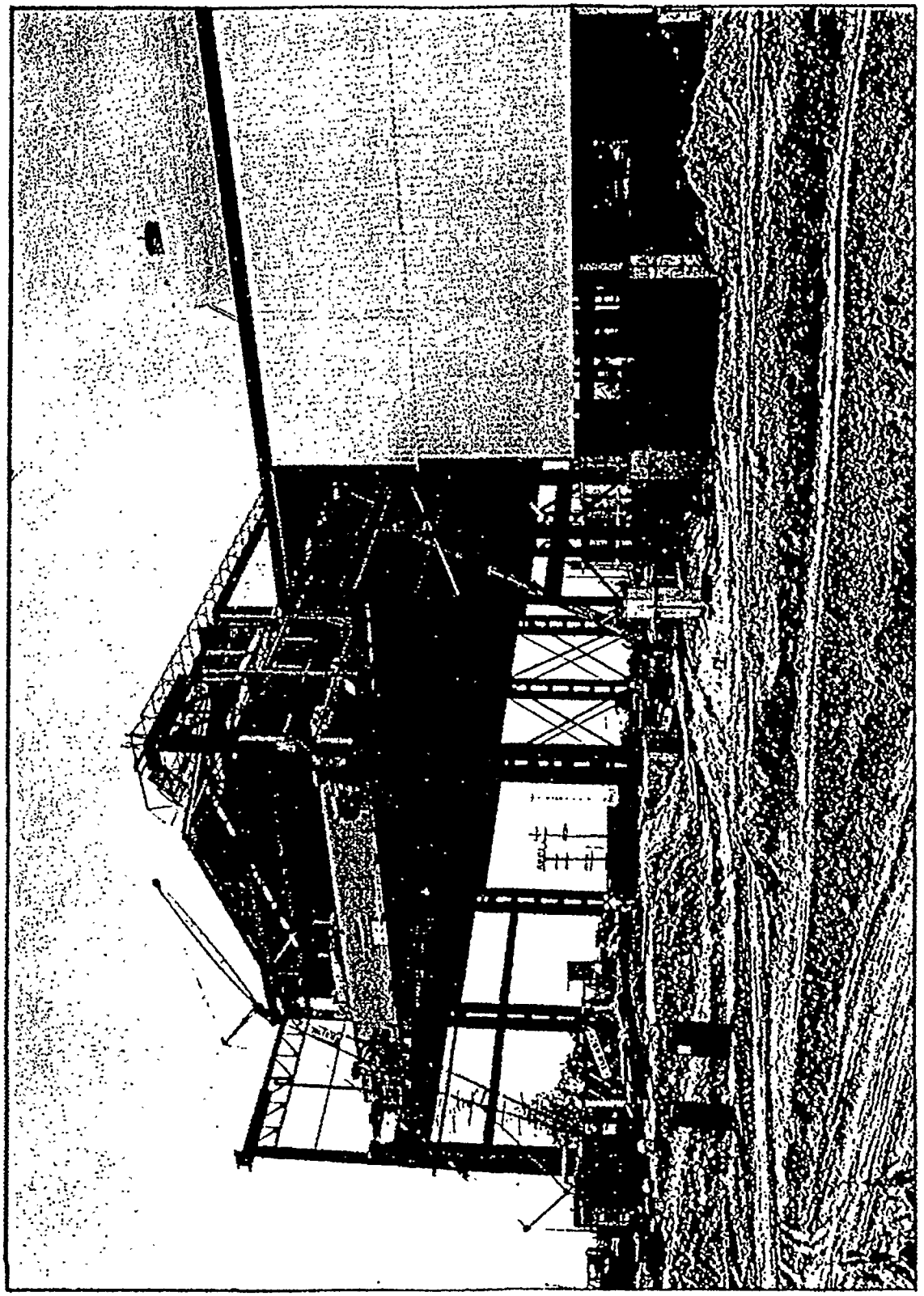


FIGURE 6

Looking west showing the trolley components being erected for soaking pit crane 358 (July 11, 1967).

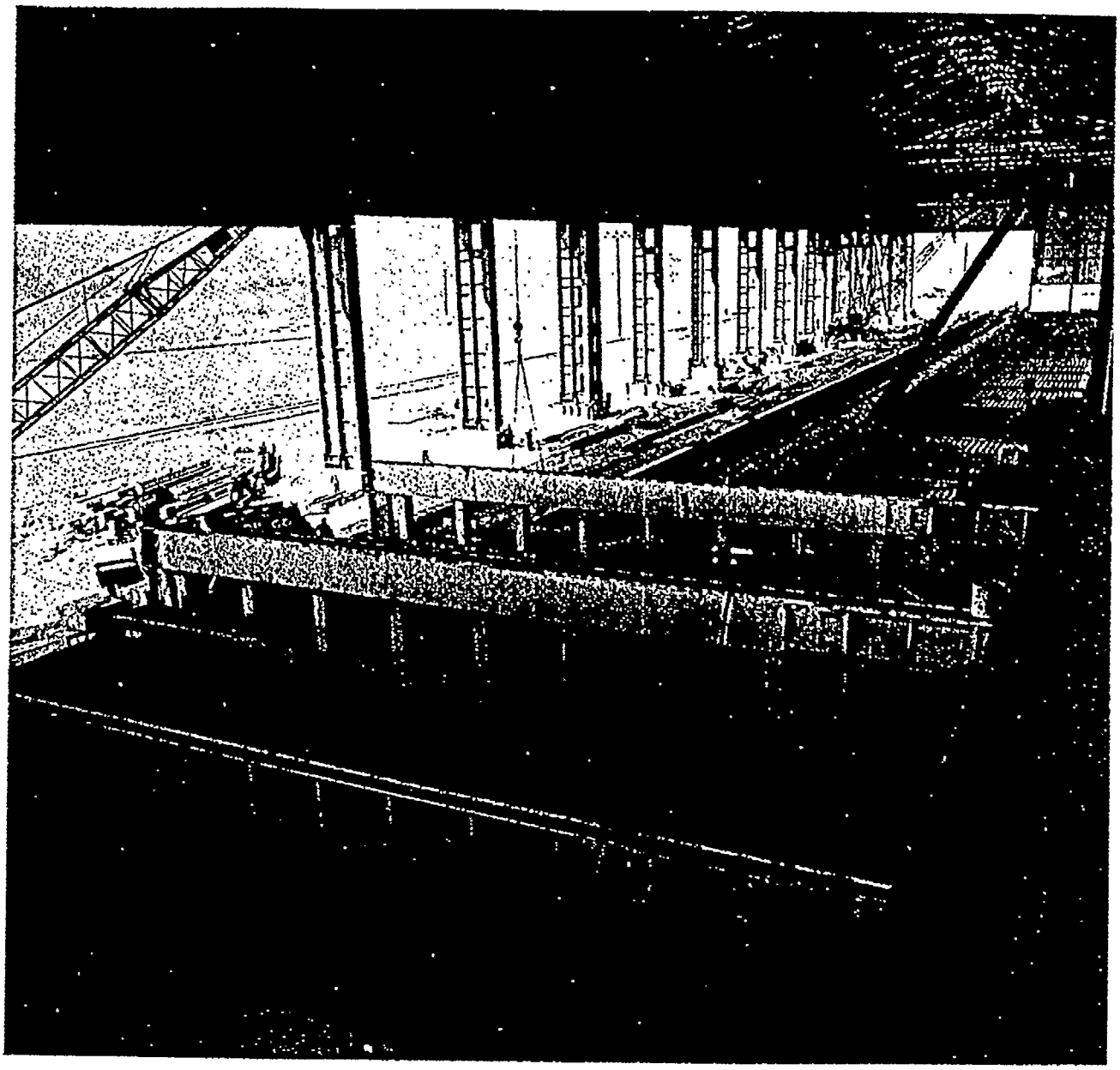


FIGURE 7

Looking west showing the sidewalls and carriage beams erected on Pits 24 and 23 and floor steel in place on subsequent pits (August 25, 1967).

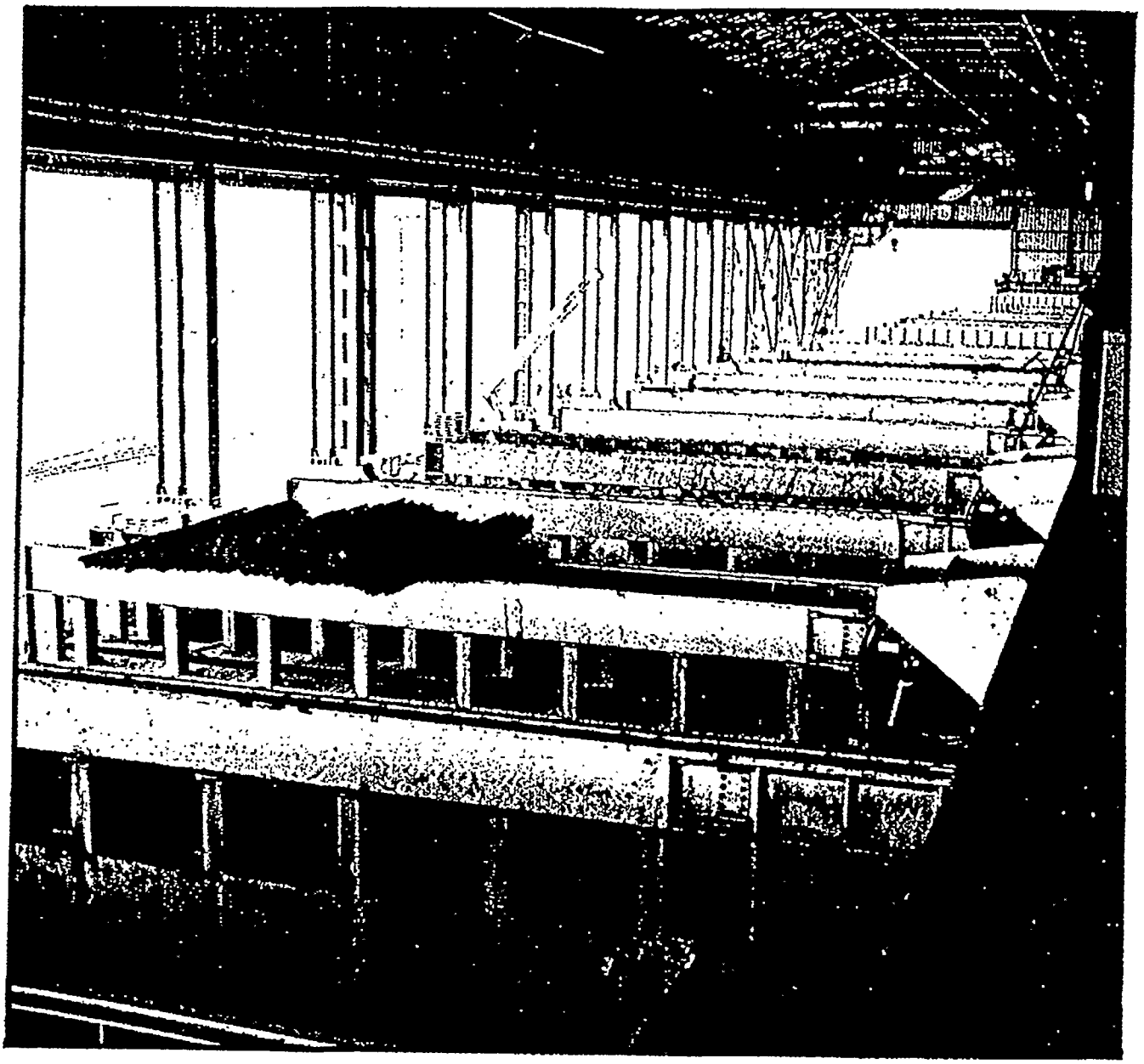


FIGURE 8

View showing completed steel work on the soaking pit structures and refractory brick on operating floor level (October 30, 1967).

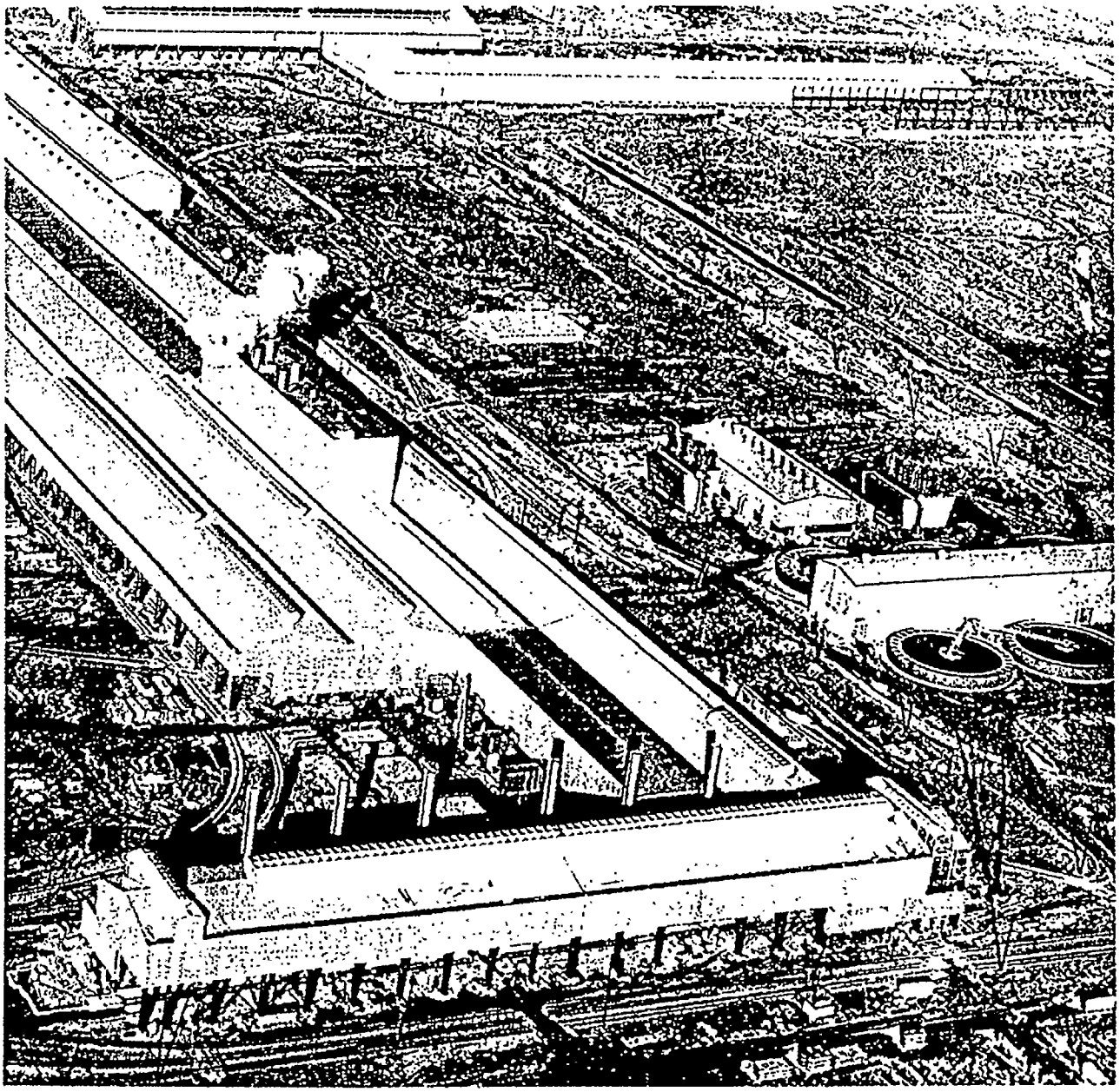


FIGURE 9

Aerial view looking north with soaking pits in foreground and slab mill and strip mill beyond showing general siding and roofing progress (December 26, 1967).

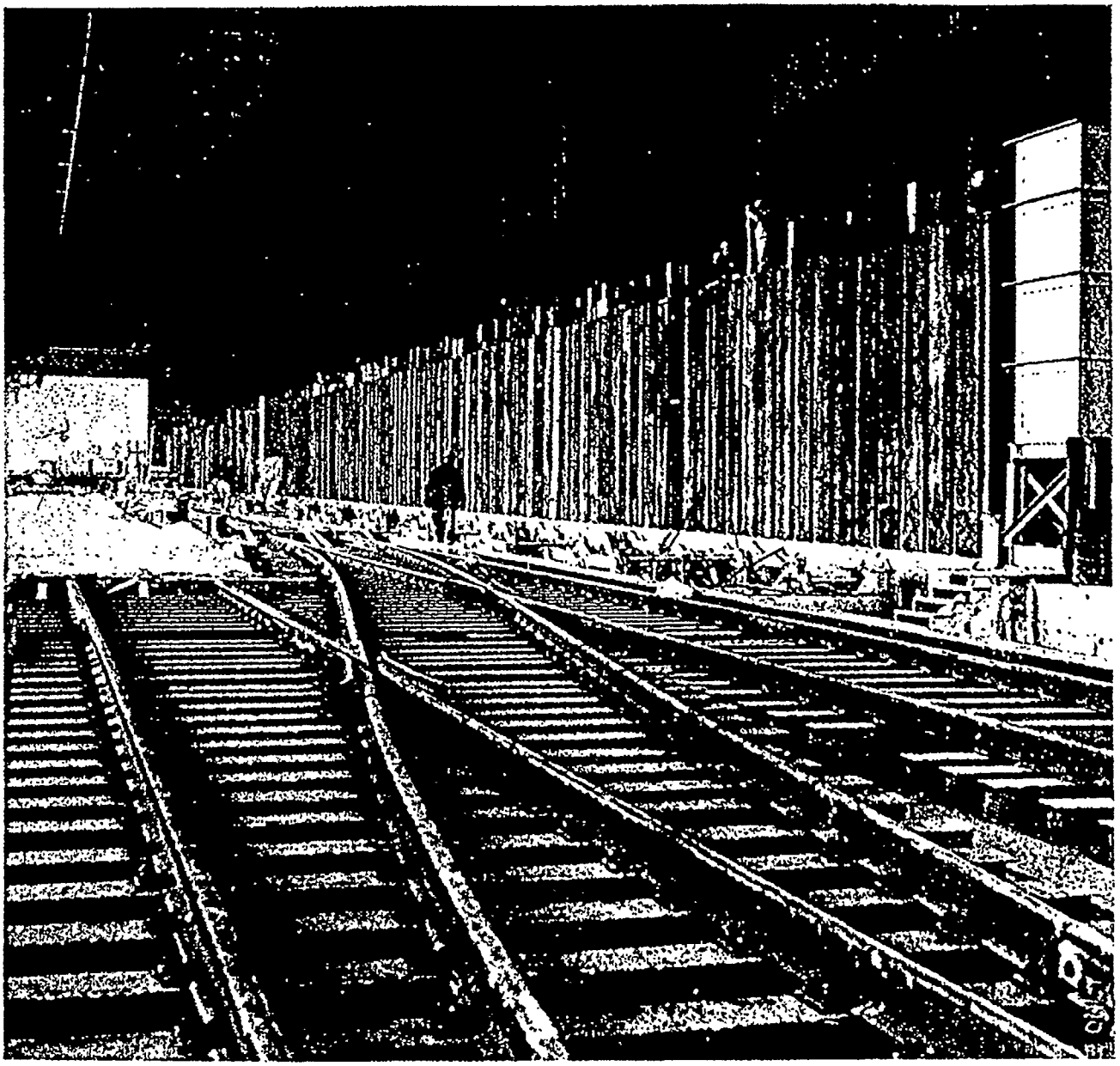


FIGURE 10

Looking west showing ingot buggy trackwork and pit wall armor plating (February 8, 1968).

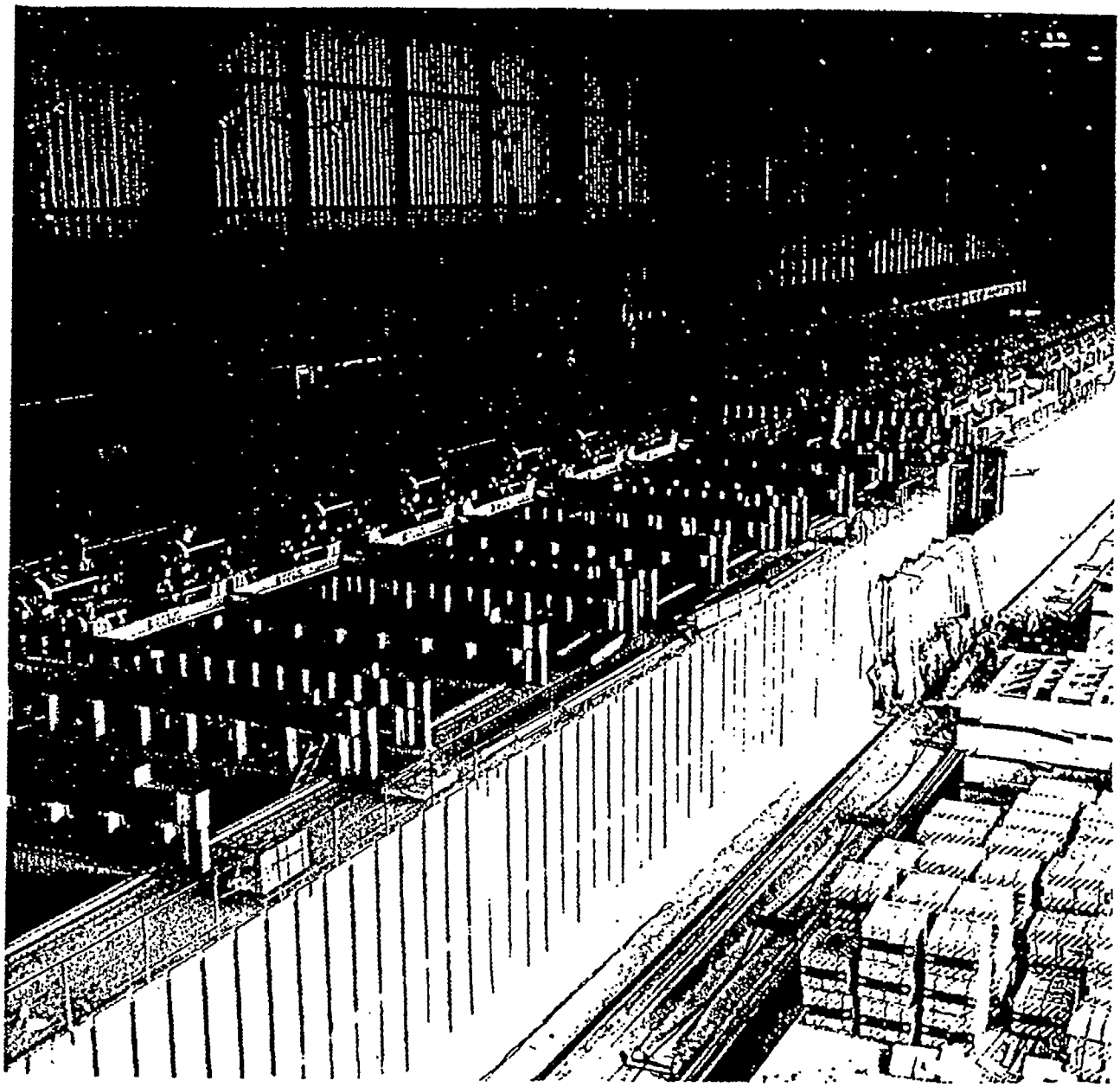


FIGURE 11

View looking northeast showing general completion of refractory lining of pits with cover lining activity shown in front of pits (July 2, 1968).

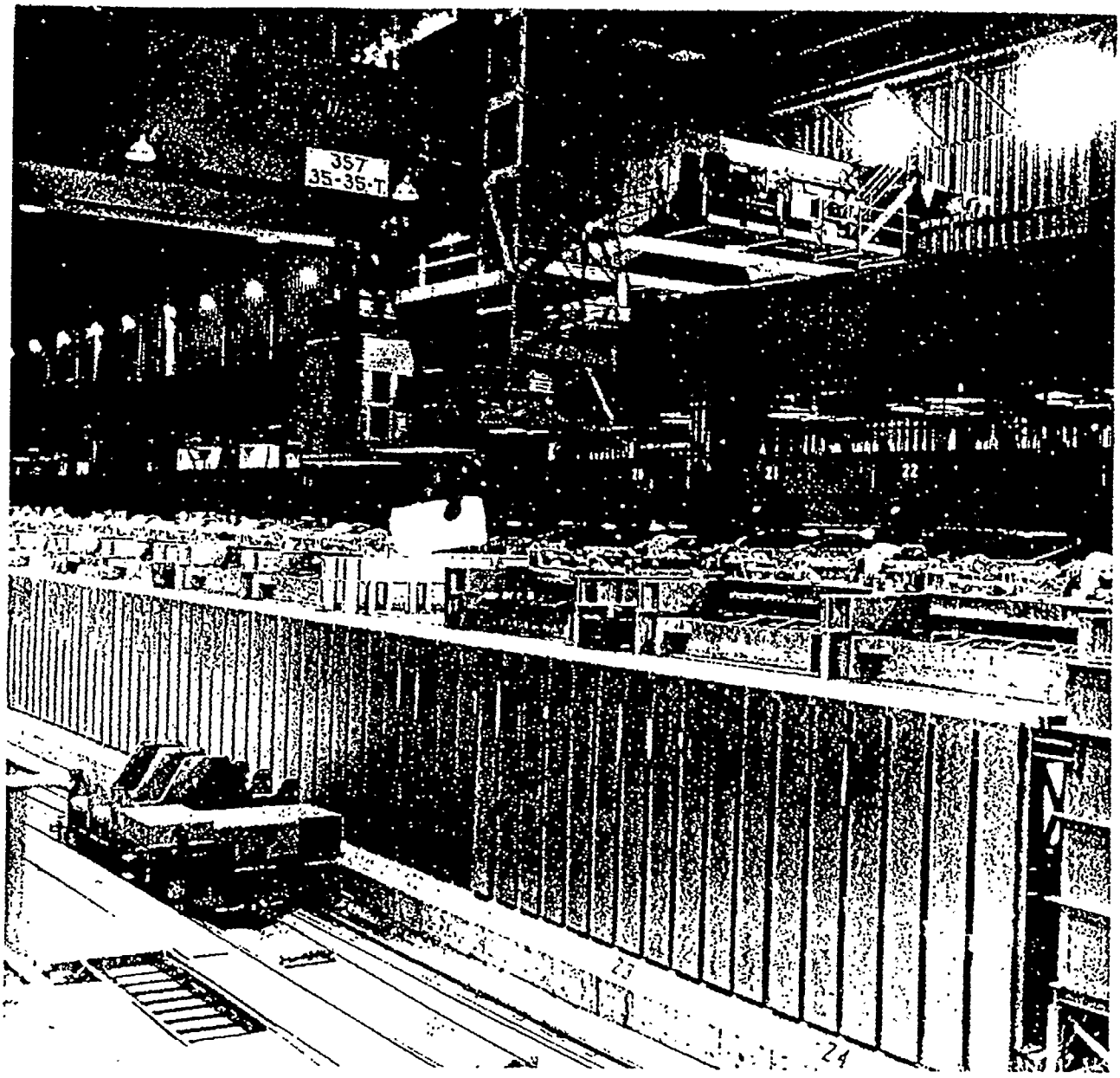
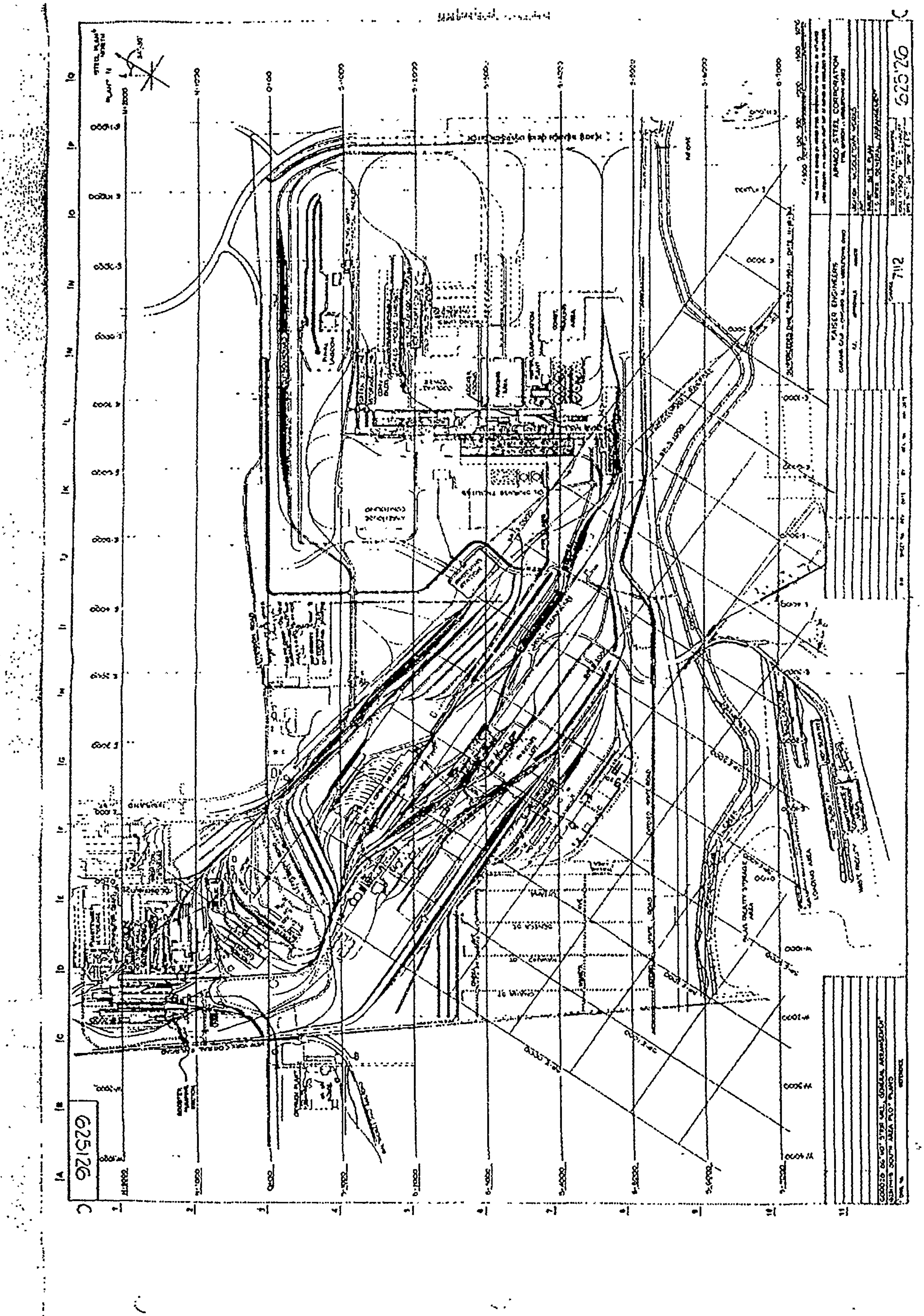


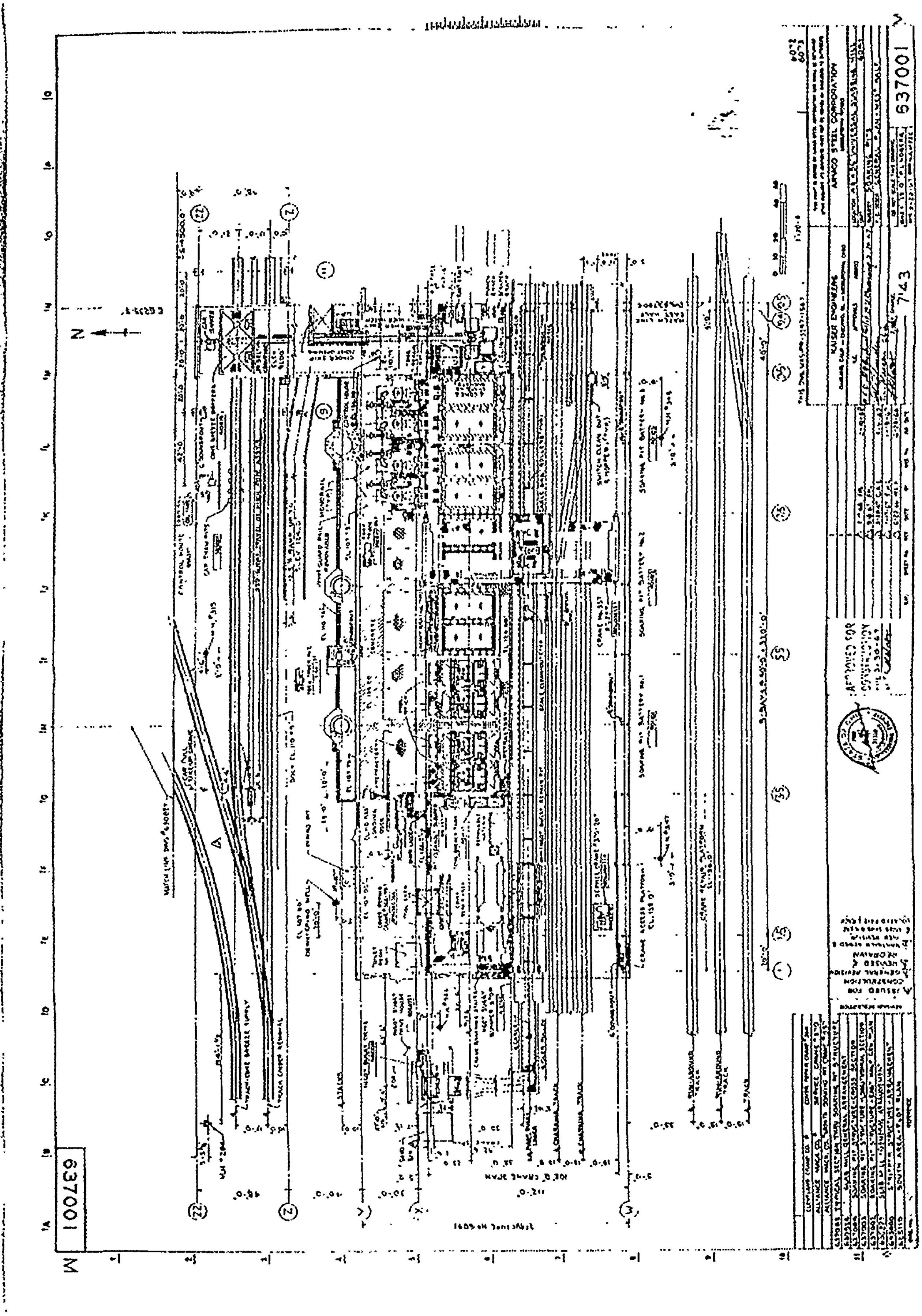
FIGURE 12

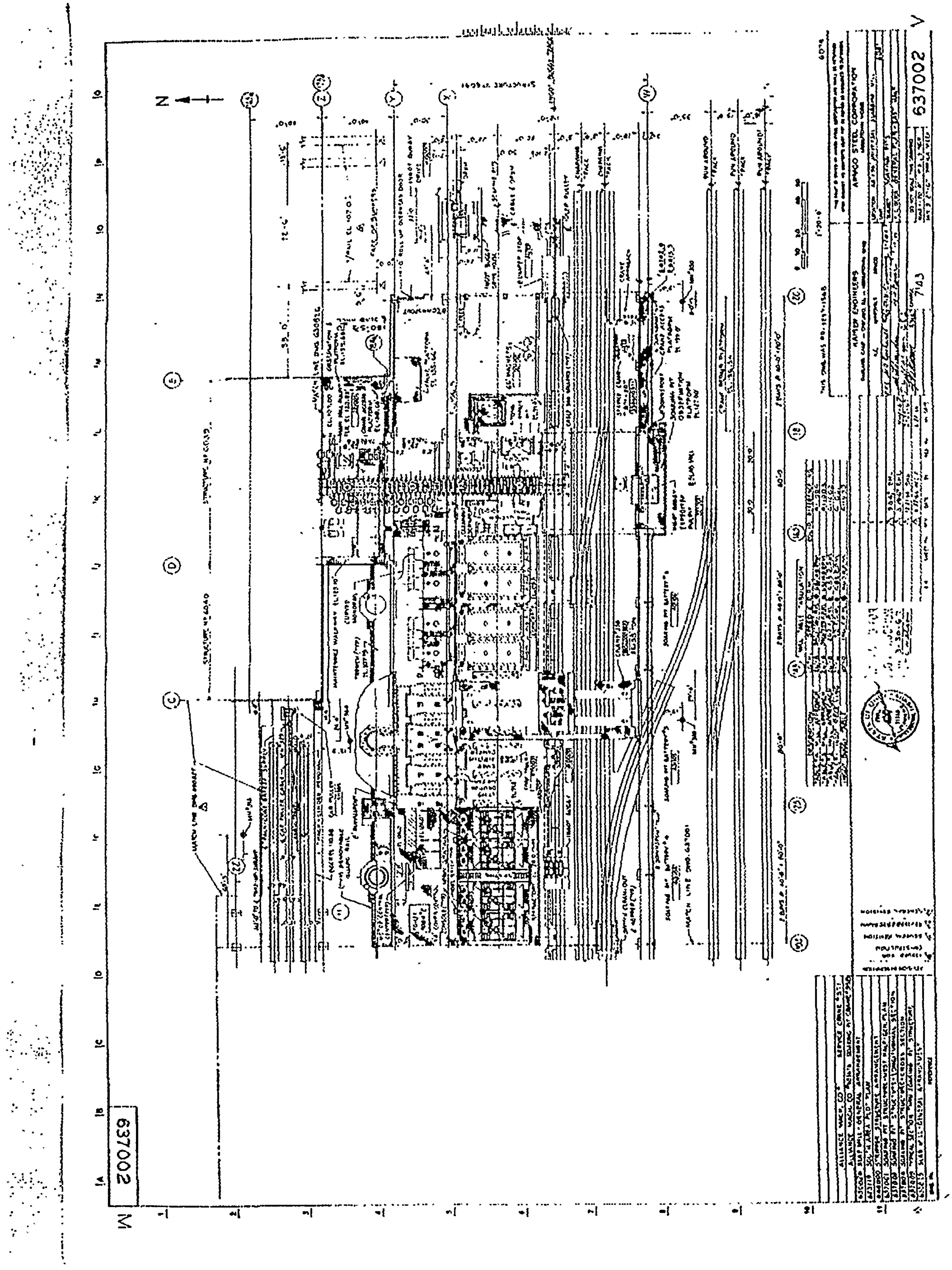
View looking northeast showing ingot buggy in position to receive a hot ingot being withdrawn from pit 21 by soaking pit crane 357 (August 1, 1968).

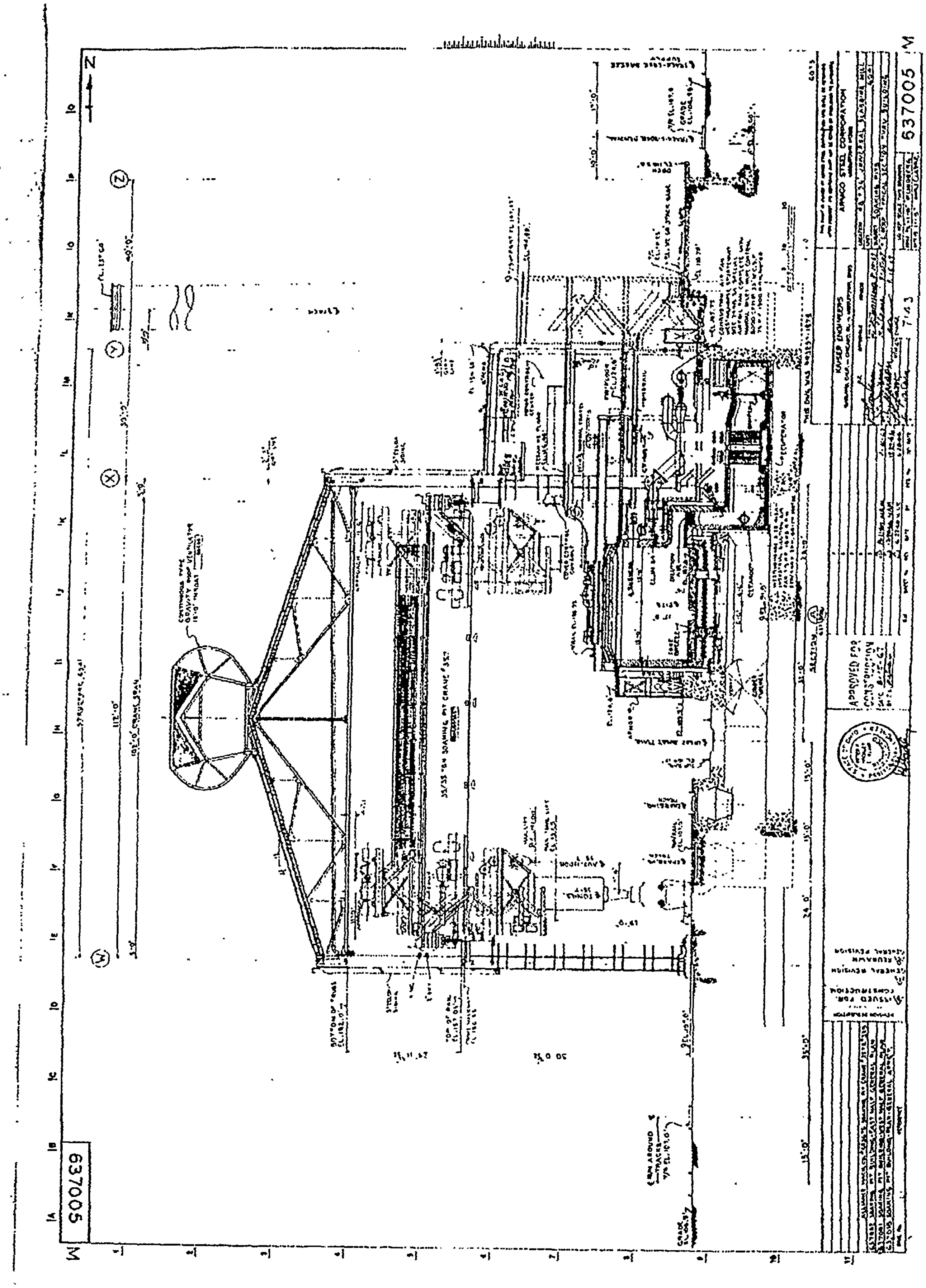
10.0 General Arrangement Drawings

Drawing No.	Description
625126	Site Plan
637001	General Plan - West Half
637002	General Plan - East Half
637005	Cross Section - Typical Soaking Pit
637027	Cross Section - Cover Repair Area and Battery Room
637028	Cross Section - Service Bay

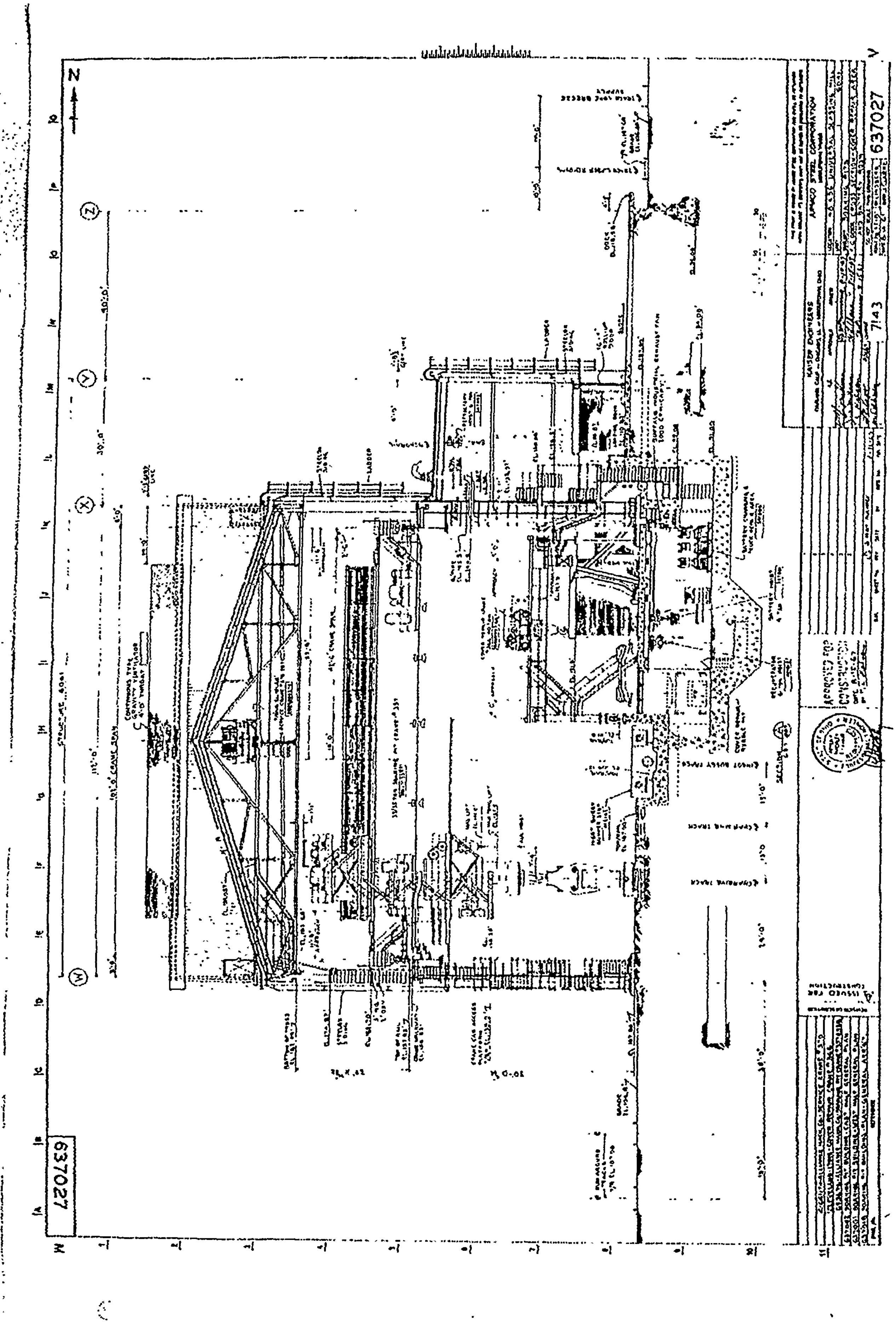

625126
ARMCO STEEL CORPORATION
KAISER ENGINEERS


637001

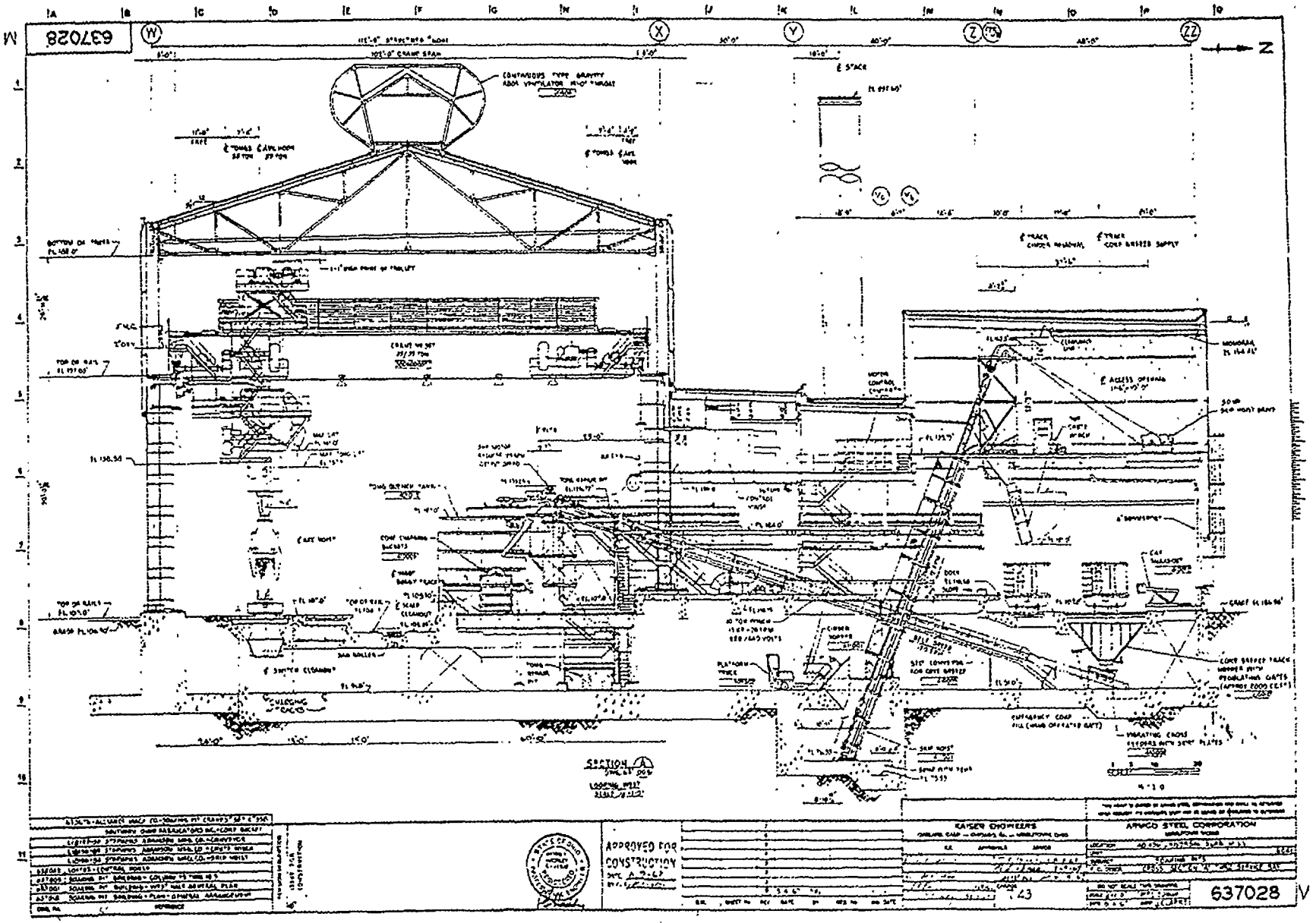

637002



BIG RED


637027
KAISER ENGINEERS
ARMCO STEEL CORPORATION
7143
637027

BIG RED



AKE-004287

Completed
Coping 5/8/98

C-4

(Second)