COMPLETION REPORT

CONSTRUCTION OF

AIRFIELDS, BUILDINGS AND UTILITIES

FOR

SEYMOUR AIR FIELD

DVANCED TWIN ENGINE SCHOOL

JOB A2, A3, A4

ORD 46 & ORD 62

WAR DEPART

CORPS OF

U. S. DISTRICT OFFICE
Louisville, Ky.

CASE, Captain
Engineers
gineer
Indiana

WARREN & VAN PRAAG, Inc.
Architect-Engineer
Decatur, Ill.
Contract No. W559 eng-6015

March, 1943

LIST OF TRANSFERS

NEW CONSTRUCTION

No.	O.C.E. Form No.	Designation of Improvement	Date of Transfer to Post Engineer
1	290A		

INFORMATION FOR THIS SHEET TO BE FURNISHED

BY AREA ENGINEER

See Lt. Bartelson

SECTION 1.

DESCRIPTION OF PROJECT

GENERAL

The Seymour Airfield project is an Advanced Twin Engine School comprising a Base Site and five Auxiliary Fields, constructed for the advanced training of aviation cadets in the flying, operation and maintenance of twin engine planes. The Base Site, consisting of main field and school buildings, is two miles southwest of the City of Seymour, Jackson County, Indiana, and covers a tract of 2,560 acres, two miles square, occupying Sections 25 and 36, T6N, R5E, and Sections 30 and 31, T6N, R6E of the 2nd P.M. The auxiliary fields, described in Section 18 of this report, are located from the base field as follows:

Walesboro Field No. 1 -- 17 air miles, due North
St. Anne Field No. 2 --- 18 air miles, east by northeast
Grammer Field No. 3 ---- 19 air miles, due northeast
Millport Field No. 4 --- 16 air miles, due southwest
Zenas Field No. 5 ------ 26 air miles, east by northeast

For a regional map of the entire project, showing State and County highways, railroads, municipalities, East fork of the White River and small scale key maps of all fields see Exhibit 1-A.

The major construction and improvements at the Base Site comprised clearing and grubbing; earthwork and grading; storm sewers and open ditches; primary and secondary roads; concrete pavements for taxiways, aprons, and runways; parking areas; sanitary sewer system and sewage treatment plant; water supply, including iron removal plant, and water distribution system; railroad connections; primary and secondary electrical power and lighting system; gasoline and oil facilities; 415 buildings and structures; dressing, fertilizing and seeding of the finished surface; and the protective fencing.

Buildings and structures are for housing, messing, recreation, storage, hospitalization, training, ordnance and administration of 380 officers, 520 cadets, 155 WAACs, 31 nurses, 3254 enlisted men, totaling 4350; and messing facilities for civilians employed in the maintenance of post utilities, training and flying equipment.

Major construction and improvements at the five auxiliary fields include clearing and grubbing; drainage; strip grading on auxiliary fields Nos. 3, 4, and 5; over-all grading; stabilized gravel runways and taxiways at field No. 1; concrete runways and aprons at field No. 2; dressing, fertilizing, and seeding of the fields; and protective fencing. The auxiliary fields cover a total area of 4,084 acres;- (see Exhibit 2-A) as follows:

Walesboro Field No. 1 -- 805 acres, approximately one mile by 1¼ miles
St. Anne Field No. 2 --- 809 acres, approximately one mile square
Grammer Field No. 3 ---- 652 acres, approximately one mile square
Millport Field No. 4 ---1160 acres, approximately 1½ x 1 mile
Zenas Field No. 5 ------ 658 acres, approximately one mile square.

The project was developed and designed by the Louisville District Office of the U. S. Engineer Corps, with Warren & Van Praag, Inc., Architect-Engineer, cooperating in the design of the utilities, heating and ventilation, railroad, roadways, and drainage. Field layout work, inspection, engineering and architectural supervision were performed by the Architect-Engineer's staff under direction of the Area Engineer of the project.

Design layout and construction work covered over 1050 original contract drawings, 2700 pages of specifications, over 2000 supplemental detail drawings prepared or checked during construction, and the preparation of 120 approved change orders. Record plans and drawings of the project total 742 and have been officially transferred to the Post Engineer.

Preliminary work was commenced on May 12, 1942, and the entire project essentially completed with minor exceptions on February 28, 1943. The first group of buildings, comprising 7 warehouses, were ready for occupancy on August 23, 1942; other sections of the construction work were completed and utilized at various dates as described in the several sections of this report until the completion date. The entire project was 75% completed when the Post was activated on December 1, 1942.

The total project cost is approximately $15,000,000.00, divided into 35 prime contracts, and undertaken by 28 prime contractors, and over 55 subcontractors, and utilizing approximately 4,000,000 man-hours of work.

In general, each contractor employed adequate equipment, and a sufficient number of workmen for the completion of his contract within the contract completion date. However, in many instances there was an over-run of time required for the completion of construction which included erection of equipment. Time over-runs were also caused by inclement weather conditions during the months of May and June, 1942, and during the late Fall and Winter months, particularly with regard to the construction of concrete runways and aprons. Failure to complete railroad connections, due to lack of rails, was reflected in the construction progress of the concrete work. Considerable delay was also occasioned by high ground water conditions which affected clearing, grubbing and grading; sanitary and storm sewers; and construction of building footings and foundations. There was considerable delay occasioned in the completion of the project as a whole, due to a low priority rating (AA-4) for building materials and fabricated equipment. As a rule, equipment items did not arrive at the site on originally scheduled dates, in spite of concerted efforts to expedite the deliveries.

SECTION 2.

ENGINEERING AND SUPERVISION

District and Area Engineer's Organization

The entire project, comprising the Advanced Twin Engine School, Base Field and Auxiliary Fields, was constructed for the Southeast Army Air Forces Training Center, Maxwell Field, Montgomery, Alabama, under the direction of the U. S. Engineer Corps, Louisville District by authority of Directive A-1391 of the Office of the Chief of Engineers, U. S. Army, War Department.

This work was under the immediate direction of the District Engineer, Henry Hutchings, Jr., Colonel, from May 12, 1942 to November 9, 1942, and Henry F. Hannis, Colonel, from November 9, 1942 to date. Colonel Hutchings designated Jean P. Case, 1st Lt., and Captain since November 18, 1942, as Area Engineer, who has served since the beginning of the project.

As the work progressed through the design and construction periods, the Area Engineer built up an organization of officers, engineers, administrative assistants, auditors, clerks, hired labor, etc., while the Architect-Engineer built up a separate organization which worked in close cooperation with him. The average number of employees from May 12, 1942 to February 28, 1943 (9½ months) in the various departments of the organization was as follows:

Department	Number of Employees
Officers (U.S. Engineers Corps)	5
Administrative Auditors and Accountants	40
Engineers, Draftsmen, inspectors, material checkers	204
Guards	74
Hired Labor	130
Architect-Engineer Organization (Architect, engineers, draftsmen, inspectors stenographers, clerks, accountants)	250

The functional chart of the organization is shown in Exhibit "A".

Architect-Engineer Organization

Warren & Van Praag, Inc., Consulting Engineers of Decatur, Illinois, were the Architect-Engineers for this project. Their contract was negotiated on May 12, 1942, with the Construction Contract Board in Washington, D. C. and is designated as Contract No. W559eng-6015. The services of the Architect-Engineer were performed under the general direction of the U. S. District Engineer Office at Louisville, Kentucky.

The Architect-Engineer contract authorized architectural and engineering services under two sections, namely,

FUNCTIONAL CHART
AREA ENGINEER ORGANIZATION
AT SEYMOUR AIRFIELD

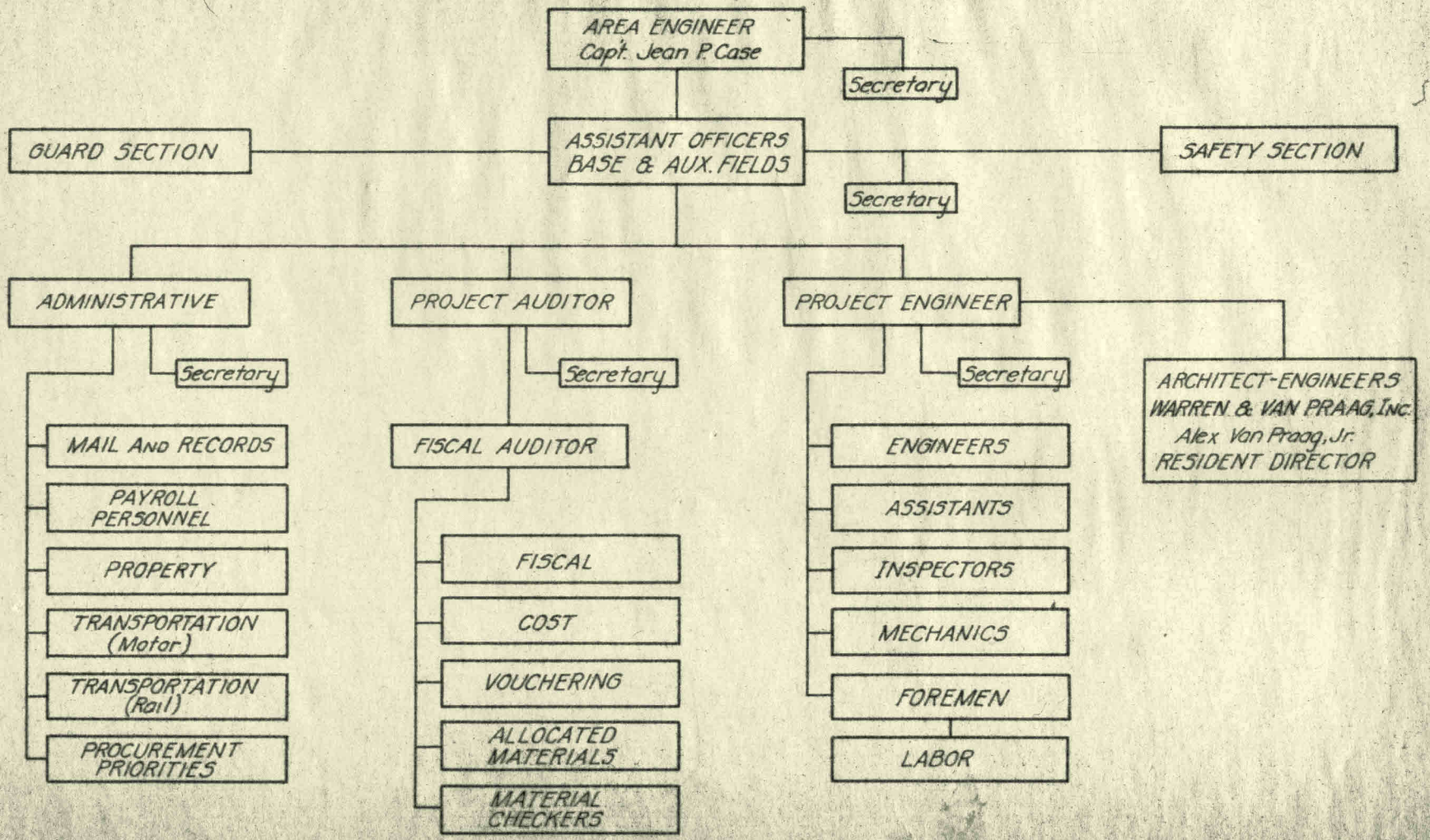

EXHIBIT "A"

Title I, Preparation of the necessary survey, plans and specifications; and

Title II, Engineering supervision and inspection of construction.

The original contract contemplated the construction of the Base Field, Advanced Twin Engine School, and Three Auxiliary Fields. Subsequently, the contract work was extended by increasing the scope of the work to include two additional auxiliary fields; additional buildings and all incidental items of construction; the final boundary surveys; etc. The closing date of the contract was extended to February 28, 1943.

Work under Title I of the Architect-Engineer contract was commenced on May 12, 1942 at Decatur, Illinois. The Architect-Engineer Office was moved on May 24, 1942, to Seymour, Indiana and work was immediately resumed on May 25th in the Shields Memorial Gymnasium. On July 12, 1942, the plans and specifications covering all major utilities, buildings, etc, for the Base Field as outlined in Title I of the contract were completed and delivered to the District Office.

On September 19, 1942, the Architect-Engineer organization was moved from the Shields Gymnasium into a specially built office headquarters at the Base Field, where work was continued for the duration of the project.

Construction and inspection services under Title II were commenced on June 6, 1942, with the demolition of existing structures by purchase and hired labor, and have continued to and including February 28, 1943.

The Architect-Engineer contract work was ordered terminated as of February 28, 1943, and the balance of the work was continued under direction of the engineering department of the Area Engineer. As of February 28th, the work set forth in Titles I and II was essentially completed. There remained only the supervision and inspection work on a few incomplete construction items and the closing of office records, progress reports, and auditing of accounts. The major items of unfinished construction work included the finish grading at the Base Field and five Auxiliary Fields; and the stabilizing of the base for a portion of the runways at Walesboro Auxiliary Field No. 1 together with dressing, fertilizing and seeding of surface areas; and the erection of a portion of protective fencing at both the Base and Auxiliary fields. All utilities and all buildings were completed as of February 28, 1943, as was all other essential heavy construction.

In the prosecution of the work, the Architect-Engineer staff consisting of architects, engineers, draftsmen, construction inspectors, clerical and laboratory staffs, accountants and others maintained an average employment of 250 per day, and reached a maximum of 435 employees during the peak of construction. Exhibit "B" shows the functional chart of the organization.

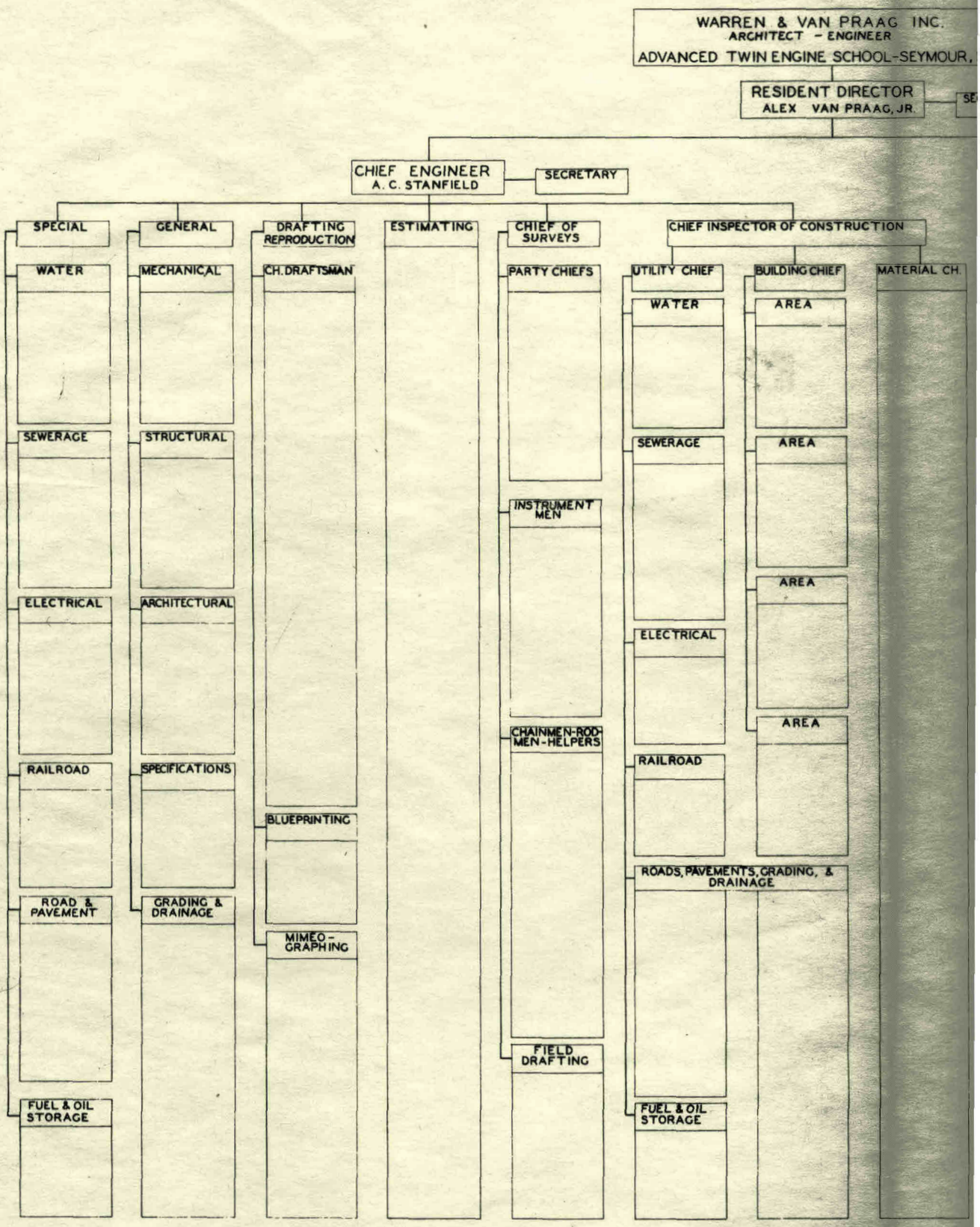
WARREN & VAN PRAAG INC.
ARCHITECT - ENGINEER
ADVANCED TWIN ENGINE SCHOOL-SEYMOUR,
RESIDENT DIRECTOR
ALEX VAN PRAAG, JR.
CHIEF ENGINEER
A. C. STANFIELD
SECRETARY
SPECIAL
WATER
SEWERAGE
ELECTRICAL
RAILROAD
ROAD & PAVEMENT
FUEL & OIL STORAGE
GENERAL
MECHANICAL
STRUCTURAL
ARCHITECTURAL
SPECIFICATIONS
GRADING & DRAINAGE
DRAFTING REPRODUCTION
CH. DRAFTSMAN
BLUEPRINTING
MIMEO-GRAPHING
ESTIMATING
CHIEF OF SURVEYS
PARTY CHIEFS
INSTRUMENT MEN
CHAINMEN-RODMEN-HELPERS
FIELD DRAFTING
CHIEF INSPECTOR OF CONSTRUCTION
UTILITY CHIEF
WATER
SEWERAGE
ELECTRICAL
RAILROAD
ROADS, PAVEMENTS, GRADING, & DRAINAGE
FUEL & OIL STORAGE
BUILDING CHIEF
AREA
AREA
AREA
AREA
MATERIAL CH.

EXHIBIT "B"

AN PRAAG INC.
- ENGINEER
NE SCHOOL-SEYMOUR, IND.

NT DIRECTOR
VAN PRAAG, JR.

SECRETARY

ONSTRUCTION

CHIEF

MATERIAL CH.

CONTROLLER
HARRY MUNDHENKE

PROCEDURE FOR RECORDS & REPORT

FIELD CHECKING & CALCULATION

RECORD FILING

CHARTS & PLATS

REPORTS

PROGRESS REPORTS

MATERIAL REPORTS

OFFICE MANAGEMENT
C.O. HAMILTON

CHIEF CLERK

PURCHASING & PROPERTY

INVENTORY & STOREKEEPER

SUPPLIES

EMPLOYEES IDENTIFICATION

EMPLOYEES RECORD

RECEPTIONIST

MESENGERS

WATCHMEN

JANITOR

MAIL

AUTO REGULATION

AUDITOR

HEAD BOOKEEPER

PAYROLLS

PERSONNEL EMPLOYMENT

STENOGRAPHERS

APPROVED
HENRY HUTCHINGS, JR.
COLONEL CORPS OF ENGINEERS
DISTRICT ENGINEER

WARREN & VAN PRAAG, INC. ARCHITECT - ENGINEER

SCALE

REVISIONS

U.S. ENGINEER OFFICE, LOUISVILLE, KY.
AIR CORPS CONSTRUCTION

SEYMOUR, INDIANA
ADVANCED TWIN ENGINE SCHOOL

ARCHITECT - ENGINEER
ORGANIZATION PLAN

DRWN BY
TRCD BY
CHKD BY

SUBMITTED
ALEX VAN PRAAG, JR.
RESIDENT DIRECTOR

SUBMITTED
CORPS OF ENGRS.
AREA ENGINEER

DATE
MAY 12, 1943.
PLAN NO.

The architectural and engineering services rendered by the Architect-Engineer organization were expeditiously and skillfully performed. The conduct and cooperation of the Architect-Engineer organization with the Area Engineer Office, the Post Commander and other authorized United States Agencies were excellent.

SECTION 3.

LANDS AND RIGHTS-OF-WAY

Land Acquisition

Lands and rights-of-way necessary for the base and auxiliary fields were acquired in advance of surveys and construction work, all of which was accomplished by the Land Acquisition Department, which was in charge of the following project managers:

No. 1. Jos. W. Springer, Land Acquisition Office, Camp Atterbury, Columbus, Indiana. Under his management the initial planning data was commenced. The work was conducted through the Land Acquisition Office in Columbus.

No. 2. Frank H. Wolfe of the Real Estate Section, Ohio River Division, U. S. Engineers Corps, who on June 18, 1942, opened the first land acquisition office in the High School Building, Seymour, Indiana, which was moved to Room 23, Vehslage Building, Seymour, on June 28, 1942. During this time appraisal and optioning programs on the base field and the railroad spur right-of-way were conducted. Tract ownership data was prepared on five auxiliary fields and the appraisal program on these fields was commenced.

No. 3. Lt. Carl Howell, Real Estate Section, Ohio River Division, relieved Mr. Wolfe on September 7, 1942, and continued with the duties of his office until September 14, 1942. During this time appraisal work on the auxiliary fields was conducted and curative work on title certificates was initiated.

No. 4. Robert L. Moss relieved Lt. Howell on September 14, 1942, and continued as project manager until November 16, 1942. During this time, payment and closing procedure was initiated and completed on 18 tracts optioned on the base field and 9 tracts on the railroad spur right-of-way. Appraisal work was completed on the auxiliary fields and the optioning program on them was initiated and completed.

No. 5. Sidney H. Showalter relieved Mr. Moss as project manager on November 16, 1942, and continued in that capacity to the date of this report. During this time, payments and closing procedures on the auxiliary fields were completed. Tract ownership data was prepared and the acquisition of easements for drainage ditches off of the auxiliary fields was initiated. This includes ditches, known as Ditches A, B, and C, Walesboro Field; and a ditch running north from the Grammer Field; the ditches on the west and north of St. Anne Field; and one ditch southeast of Zenas Field. Likewise, tract ownership data was initiated for the Kasting Ditch running south from the Base Field. The drainage ditches include 30 tracts of land totaling approximately 80 acres.

Also, data is being prepared for the acquisition of avigation easements bordering the base field and the five auxiliary fields. Property

ownership maps have been prepared showing the location of obstructions in the glide angles, and these indicate approximately 150 ownerships. Damages for the removal of these obstructions will be substantial on approximately 50% of these properties and in some instances fee purchases may be advisable. Gross appraisal work reflecting the approximate cost of the removal of glide angle obstructions has been completed.

The remaining work to be done by the Land Acquisition Office consists chiefly of completing the acquisition of avigation easements and clearance rights.

Form of Procurements

All procurements of land for the base and auxiliary fields and the right-of-way for the railroad spur includes full ownership of the land, oil and mineral rights. None of this land acquired has ever been undermined. All roads on these sites have been closed by proceedings in Commissioner's Court in their respective counties.

A land survey has been made of each field; maps have been prepared and a perimeter description appears on each of said maps. Transactions for all of the tracts of land hereafter referred to as optioned have been closed and the owners have been paid.

The procurement of the rights-of-way for the drainage ditches outside the boundary of these fields have been in the form of perpetual easements with the right to re-enter upon said rights-of-way for the purpose of repairing, cleaning or enlarging the ditches thereon.

The following essential data for the various fields are tabulated hereafter, as follows:

BASE FIELD
Jackson County, Indiana

Directive: May 4, 1942.
Initial Possession: May 23, 1942.
Initial Possession under: War Powers Act.

Number of Tracts:	25
Acreage:	2,534
Appraised:	$571,643.00
Number of Tracts optioned:	18
Amount:	$353,980.00
Acreage:	1,591
Date:	June 17 to August 12, 1942
Number of Tracts condemned:	7
Amount:	$217,663.00
Acreage:	943
Date of Judgment:	September 3, 1942.

WALESBORO AUXILIARY FIELD No. 1
Bartholomew County, Indiana

Directive: August 26, 1942.
Initial Possession: August 28, 1942.
Initial Possession under: Construction Permit.

Number of Tracts:	25
Acreage:	809
Appraised:	$125,879.00
Number of Tracts Optioned:	25
Amount:	$125,168.00
Acreage:	809
Date:	September 21 to October 16, 1942.

Number of Tracts condemned:
No tracts condemned. Entire field optioned.

ST. ANNE AUXILIARY FIELD No. 2
Jennings County, Indiana

Directive: August 13, 1942.
Initial Possession: August 19, 1942.
Initial Possession under: Construction Permit.

Number of tracts:	16
Acreage:	785
Appraised:	$56,170.00
Number of Tracts optioned:	14
Amount:	$49,382.00
Acreage:	650
Date:	October 7 to October 10, 1942
Number of Tracts condemned:	2
Amount:	$ 6,788.00
Acreage:	135
Date of Judgment	-

GRAMMER AUXILIARY FIELD No. 3
Bartholomew County, Indiana

Directive: August 18, 1942
Initial Possession: August 19, 1942.
Initial Possession under: Construction Permit.

Number of Tracts:	6
Acreage:	640
Appraised:	$77,761.00
Number of Tracts optioned:	6
Amount:	$77,761.00
Acreage:	640
Date:	September 21 to September 24, 1942

No tracts condemned. Entire field optioned.

MILLPORT AUXILIARY FIELD No. 4
Jackson County, Indiana

Directive: August 13, 1942.
Initial Possession: August 19, 1942.
Initial Possession under: Construction Permit.

Number of Tracts:	13
Acreage:	1,141
Appraised:	$136,128.00
Number of Tracts optioned:	7
Amount:	$ 52,654.00
Acreage:	573.
Date:	September 28, 1942 to October 13, 1942.
Number of tracts condemned:	6
Amount:	$ 83,474.00
Acreage:	568
Date of Judgment	-

ZENAS AUXILIARY FIELD No. 5

Jennings County, Indiana

Directive: August 26, 1942.
Initial Possession: August 19, 1942.
Initial Possession under: Construction Permit.

Number of Tracts:	10
Acreage:	640
Appraised:	$48,332.00
Number of Tracts optioned:	10
Amount:	48,082.00
Acreage:	640
Date:	October 2 to October 6, 1942.

Number of Tracts condemned:
No Tracts condemned. Entire field optioned.

RAILROAD SPUR RIGHT-OF-WAY

Jackson County, Indiana

Date of Directive and Initial Possession in Division Files.
Initial Possession under: Construction Permit.

Number of Tracts:	9
Acreage:	7.288
Appraised:	$11,040.00
Number of Tracts optioned:	9
Amount:	$11,040.00
Acreage:	7.288
Date:	August 13 to November 10, 1942.
Number of Tracts condemned:	None

All tracts optioned.

SECTION 4

ORIGINAL TOPOGRAPHY - BASE SITE

GENERAL Exhibit "C" shows the original plat site together with the surface contours of the land, section lines, farm houses, school buildings, fences, wooded areas, roads, lanes, ridges, sloughs, and the existing Seymour Airport, on which the initial preliminary layout of the Base Site has been superimposed. This area was mostly farm land planted in corn, oats, wheat and barley; some pasture land; and several tracts (approximately 126 acres) of virgin timber, mostly oak, beech, gum and sycamore. The trees represented hundreds of thousand board feet of lumber; many trees were five feet through at the butt and stood over 75 feet in height. The area was poorly drained, and had a number of marshy meadows and seeps which remained wet until August. Some of the area had been tiled and drained to facilitate the removal of excess water to carry on farming operations.

A sandy ridge traversed the area irregularly running northwesterly and easterly from the mid-point of the west boundary line to about the north quarter point of the east boundary dividing the site into two main watersheds. Approximately two-fifths of the site is tributary to the East Fork of the White river watershed and drains northerly into Heddy run and thence three miles westerly to the East fork. The southerly three-fifths of the site is in the Muscatatuck river watershed and drains through Kasting and other drainage ditches which extend southwardly for thirteen or more miles before reaching the Muscatatuck river.

The contours of the ground surface shown in Exhibit "C" are given in elevations to the U.S.G.S. datum. The average elevation of the dividing ridge between the above described watershed is from approximately 580 to 600 feet; and the average elevation of the areas to the north and to the south of the dividing ridge is from 568 to 572 feet.

The top soil over the area was a sandy silted loam with some humus, from 4 to 8 inches deep; in a few small spot areas, the soil had peaty characteristics. Subsoils as indicated by trench excavations for sewers were different in the two watersheds. North of the dividing ridge, the top soil is in general underlaid by water bearing sand of varying depth, and immediately thereunder is a dense impervious blue-grey clay which contains a considerable quantity of silt. This so-called silty clay sloughs freely when excavated and becomes soupy when water is present. Another water bearing sandy stratum is generally found immediately below the impervious grey clay. South of the dividing ridge, the top soils are underlaid by a dense highly impervious blue and yellow clay, two to five feet in thickness and underlaid by saturated fine sand and alluvial soils.

Test borings were made and logged throughout the area to ascertain elevations of ground water and types of subsoil. These borings were made at 100 ft. intervals on the center line of all runways and within

the parking apron area, a total of over 300 tests, and presented accurate data on the subsurface conditions.

On the north half of the N-S runway location the ground water elevation averaged one foot below the natural ground surface except at the intersection of N-S and NW-SE runways. At the dividing ridge the ground water elevation was 4½ feet below the natural ground. At the intersection of the N-S and E-W runways location, the ground water elevation was at the ground surface and this area was a veritable marsh. The most unfavorable ground conditions on the entire site were in this area as the subgrade was completely saturated and too light to permit drainage. The west half of the E-W runway was parallel with and approximately 400 feet north of an original farm drainage ditch and the ground water level varied between 1 and 2 feet below the natural ground surface. The east half of the E-W runway traversed a very heavy wooded tract the ground water level practically at the natural ground surface with water pooled in the entire area. The north end of the NE-SW runway was on higher ground and the ground water level was 2 to 3 feet below natural ground surface. The north end of the NW-SE runway was on a sandy ridge and boring up to 9 feet in depth did not reach the ground water level. The borings on the south end of both NE-SW and NW-SE runways showed the ground water level to be 1 to 2 feet below natural ground surface. (See Exhibit "C").

The forces of the Area Engineer set up several test areas to check the perviousness and permiability of the sub-soil by laying drain tile at different depths with different type backfill and then ponding the area, ascertaining that the velocity of flow in the average sub-soil was approximately 1/2 foot in 24 hours.

Preliminary topography work on the base site was done by forces from the Louisville District Office. Final work was done by forces of the Architect-Engineer on the base field and auxiliary fields. There were no U.S.G.S. maps available for the site of either the base field or any of the auxiliary fields.

SECTION 5

CLEARING AND GRUBBING - BASE FIELD

GENERAL

Clearing and grubbing of the Base Field extended over the entire area of some 3550 acres, including 126 acres of virgin timber land divided into 9 tracts of land. Most of these wooded tracts were in the line of the proposed runway, apron and building areas and required immediate removal prior to grading operations. (See Exhibit "C"). The clearing and grubbing work included the felling of trees; removal and blasting of stumps; pulling of roots, burning of all brush; and removal of all logs and salvaged timber. Virgin timber tracts were mostly oak, beech, gum, sycamore and some hickory and locust. Four tracts (No. 1, 2, 3 and 4) containing approximately 100 acres were found growing under very wet conditions. Timbers suitable for fence posts were left piled at the site.

Blasting of the stumps was done in accordance with the rules set up in the Safety Manual, and modified to meet field conditions. All dynamite work was completed free from injuries and casualties. The Safety Department was in full charge of methods for the use of dynamite.

Trees at the sites of the old Saurencamp and Miller residences were left in place inasmuch as these residences are to be utilized by the Air Corps.

CONSTRUCTION DATA

All clearing and grubbing work at the Base Site was awarded as a single contract to Ralph Myers Construction Co. of Salem, Indiana. Pertinent dates in the progress of this work are as follows:

Division No.	B-1
Designation	Clearing and Grubbing
Contract No.	W559eng-6244
Subcontractor	Martindale & Weston Salem, Indiana
Office work started at Louisville	April 16, 1942
Plans & Specs.completed	June 18, 1942
Bids Opened at District Office	June 29, 1942
Letter of Award Issued	July 1, 1942
Receipt of Notice to Proceed	July 2, 1942
Construction started	July 6, 1942
Original Scheduled Completion	Aug.31, 1942
Actual Construction Completed	Oct. 12, 1942

Clearing and Grubbing - Part of Contract W559eng-6244
Ralph Myers Construction Company

Workmanship - Both the prime and subcontractors had skilled and experienced workmen which was reflected in good workmanship.

Construction Progress - Progress was comparatively slow, due to rain and wet ground conditions; and lack of tools and workmen; however, grading operations were not delayed at any time.

An abstract of a chronological description of the construction summarized from the daily construction reports illustrates the important items retarding progress: "The clearing and grubbing work started on July 6, 1942, with 15 men felling timber in Tract No. 3. The contractor was unable to get sufficient tools to employ more than 15 men at the beginning of the job; but on July 10th, a second shift was started and there was a total number of 70 men employed. About this time several days of rain slowed down the operations, and it was impossible to do anything except cut trees and pile brush. The contractor tried to use bulldozers to push out small trees and stumps but he was unable to get traction due to the mud and water in the area. Small tools and sufficient labor continued to be a problem until about the 20th of July at which time the contractor had approximately 120 men clearing, blasting stumps, piling and burning brush. He was using 3 bulldozers and a crane for piling brush."

"By August 1st the ground had dried up sufficiently to allow the contractor to yard his logs and haul them away and by August 4th, Tract No. 2 was completely cleared, ready for grading and tracts No. 1 and 3 were ready for grading by August 15th. Tracts Nos. 4,5,6 and 7 were completed and ready for grading by September 5th. These tracts included all the heavy clearing and grubbing on the area. The other tracts were light; clearing and grubbing consisted, in general, of scattered large trees and brush."

"Tracts Nos. 1, 2 and 3 were set up for completion July 31st. Tract No. 2 was substantially completed August 10th and Tracts Nos. 1 and 3 were substantially completed September 8th and 14th respectively. Tracts 4 to 9 inclusive were set up for completion August 31st. Tracts 4 and 9 were substantially completed September 15th; Tract No. 6 was substantially completed September 22nd; Tracts Nos. 7 and 8 were substantially completed September 24th; Tract No. 5 was substantially completed September 25th."

"Clearing and grubbing in the balance of the contract was completed October 12th with the exception of several stumps along the fence lines of the East, West and South boundary."

No change orders were required under this contract.

Summary of Construction Operation

(a) Organization.....average
(b) Efficiency.....average

(c) Initiative.....average and above
(d) Resourcefulness.....average and above
(e) Execution of contract.....work accomplished efficiently and well
(f) Contractor met all payments to sub-contractor, labor, etc. when due.

SECTION 6.

GRADING - BASE FIELD

GENERAL

Items of work included under the title of "Grading at Base Field" are excavation, stripping, top soil replacement, compacting of the excavation and other similar items. In general, this earthwork comprised 2,311,000 cubic yards of common excavation; 2,000 acres of top soil stripping and replacement covering 1,381,000 cubic yards, making a total of 3,692,000 yards of earthwork handling and compacting.

Established grades at the base field were determined on a maximum gradient of 1½%. The basic design was established by the U. S. District Office at Louisville and developed by the Architect-Engineer. The earthwork covered an area of over 2,000 acres in which maximum excavation cuts below the existing ground level were as large as 12 feet and fills as great as 10 feet above the natural ground surface were required. The specifications allowed a plus or minus of 1/10 foot tolerance in grading. The finished elevations of the subgrade for the area of the runways, aprons, and taxiways was 0.3 feet below the established grades.

In general, tests indicated compaction to or in excess of the optimum requirements. The characteristics of the various types of soil encountered were all conducive to very satisfactory compaction in accordance with the requirements specified. All the fills were placed in 6-inch layers thoroughly rolled and sprinkled for optimum moisture content. The average dry weight of the natural soil was 109 pounds; and the average weight of soil with optimum moisture content was 127 pounds. Specification requirements called for 96% of optimum compaction, and the average results of soil tests for compaction indicated an average of over 110 pounds dry weight per cubic foot. Below this figure, the compaction was considered unsatisfactory and additional compaction was required. (See Section 19 for discussion of Soils Analysis.)

CONSTRUCTION DATA

General - The grading work was arranged in a single contract on a unit price basis per cubic yard and awarded to Ralph Myers Construction Company of Salem, Indiana. Three subcontractors assisted in the earthwork:-

McVaugh-Haynes of Centerline, Mich.	.....doing	18.5%	of the	work
Chernus Construction Co. of St. Louis, Mo.	"	16.2%	" "	"
Triangle Const. Co., Kankakee, Ill.	..... "	4.3%	" "	"

and the balance of 61% was done by the prime contractor.

Pertinent dates from the initial planning to the completion of the grading work are:

Office Work at Seymour started.....May 25, 1942.
Plans & Specs. Completed .....June 18, 1942
Letter of Award Issued .....July 2, 1942
Receipt of Notice to proceed .....July 2, 1942
Construction Started .....July 7, 1942
Original Scheduled Completion .....August 31, 1942
Actual Construction Completed .....February 28, 1943 *
* Final Grading, Seeding, etc. transferred to Job A-5

The above dates of original schedule completion date and actual date of completion include additional earthwork described in Section 7 - Drainage at Base Site. As of February 28, 1943, there remains a small percentage of work to be completed.

Construction Progress - Progress was slow during the first month due to extreme high ground water conditions encountered. The prime contractor broke ground on July 7th at the site of the E-W runway, west of First Street, and spent days in maneuvering his earth loading and handling equipment from bogging down in the mire. Early operations were devoted to fence, crop, and vegetation removals; stripping, stocking, and piling top soil on the E-W runway at the intersection with NW-SE runway.

A brief description of the construction progress is taken from the summary construction report abstracted from the daily inspection reports:-

"After the first stripping was removed in this area using an elevating grader and Euclid wagons, the heavy equipment mired down so that it was almost impossible to make any progress. As many as ten of the thirteen Euclids stuck at one time and the prime contractor using two D-8 Caterpillar Tractors to pull the elevating grader and he kept a couple of D-8's for pushers on the Euclids. After fighting conditions in this area for about a week the contractor was moved to the N-S runway beginning at station 16 and going north. The contractor moved a three yard Northwest dragline in on the sandhill south of Kasting School with 6 Euclids hauling to the dump; and an elevating grader and six Euclids, working on the south end of the sandhill picking up a sandy clay to mix with the almost pure sand coming from the dragline operations. The contractor had 6 twelve-yard LeTourneau scoops stripping top soil from the fill area and stock piling it outside the toe of slope on the west side of runway fill area. There was considerable discussion regarding the foundation under fill area due mostly to the fact that equipment was unable to operate without sticking in the mud after the area had been stripped; this was accounted for by the fact that the ground water level was less than a foot below the normal ground surface. The Louisville District

Office issued a directive that this entire area was unsuitable material and would have to be removed before the fill could be placed so the contractor pulled his equipment off the N-S runway on July 16 and began work, in building area No. 6 using a dragline and Euclids in 9 foot cut near the intersection of the N-S and NW-SE apron building a haul road to the east west apron area where there was a three and one-half foot fill. On July 21st the Louisville District Office sent a soils technician and grading expert on levee work, as technical adviser to the Area Engineer. The specifications required the removal and stripping of top soil 100 feet each side of the center line on the runways and under the taxiways and apron. The Area Engineer directed that all top soil be stripped under the fill area and in the cut areas. A directive from the Louisville office, dated July 22nd, set the subgrade elevations 0.6 feet below finish elevations in the runway and apron areas, and no top soil was placed within these areas. By August 15th grading between the N-S runway and First Street was completely roughed out and the contractor moved into the area east of First Street leaving 6 twelve-yard scrapers on the west side to finish up, that is the entire north-south apron area, the northwest southeast apron area, and the west half of the eastwest apron area was fine graded, also the east west runway area from station 30 to the end Sta. 55+00 and the north south runway area from the south Sta. 55+00 to station 45 was complete and to grade; and building area No. 6 had been graded to blue top stakes west of First St., but the top soil had not been finish graded.

"In the grading area on the east side of First Street it was necessary to require the contractor to do some skipping around in this operation so that the work of other contractors could be started and carried on, particularly for the underdrainage contractor and the general building contractor. Plan changes in the location of the base engineering buildings necessitated an interruption of the normal sequence of operations of the grading contractor so that it was necessary to move him out of his grading operations east of First Street over the building area No. 5 adjacent to First Street and west of the warehouse area in order to expedite other construction work; another interruption to progress in this area was due to an old family graveyard approximately over the north taxi strip parallel to NE-SW runway and about midway of the taxi strip where there was approximately a six foot cut, and it was necessary to leave a large bar of dirt in there to be graded later after the cemetery was moved. However, by September 20th grading was complete on the aprons and runways except for the N-S, and all was complete November 1st. The Myers Construction Company put a part of his equipment in on the N-S runway in addition to McVaugh-Haynes equipment in order to expedite completion.

"When the paving operations were begun September 21st stakes were set to plan grades for the paving. It was found that the grade was consistently a tenth low on the apron area and the grading contractor was required to place approximately 10,000

yards spread out on the apron area. Although the specification allowed a plus or minus 1/10 foot tolerance in grading and compliance with a directive from the district office insisted upon by their grading advisor that the subgrade be held six tenths below finish grade.

"After October 5th Myers and Chernus confined their entire operations to the grading of the all over landing field. Workable plans were never furnished for this area. The original plan was made for under drainage construction and work was laid out and performed in accordance with this plan, however, a later edition changed the entire scheme deleting underdrainage and substituting inlets for the collection of surface drainage. Grading was laid out to this plan, however, a subsequent plan for the drainage deleted several of the original storm drainage lines and changed the location of others after the area grading had been performed. For the most part grading in the all-over landing field was very light, however, it was necessary in most cases to strip and replace top soil after the grading was done. The all-over grading was finished east of the triple box with the exception of some finish dressing in the north and east area and the area grading west of the triple box was about two-thirds finished. No grading has been performed on a strip adjacent to the triple box, and in the area on the west boundary directly west of the E-W runway as of this date."

After December 22, 1942, finished dressing work of the surface could not be carried on expeditiously because of the unfavorable weather conditions.

No change orders were issued on this contract; however, a supplemental agreement, dated August 1, 1942, added earthwork for temporary ditches and permanent drainage ditches which is described in Section 7 - "Drainage - Base Site".

Summary of Construction Operations

(a) Organization . . . . . average
(b) Efficiency . . . . . average
(c) Initiative . . . . . average
(d) Resourcefulness . . . . . average
(e) Execution of contract . . Work accomplished efficiently and well
(f) Contractor made payment to sub-contractors, labor, etc, when due.

Construction Guarantee - Completion of contract is guaranteed by performance bond.

SECTION 7

DRAINAGE - BASE SITE

DESCRIPTION

General. The drainage of the Base Site consists of two major systems of subdrainage, storm water sewers, and open ditches:-namely, (1) The north drainage system serving about 45% of the Base Site area, tributary through a single main ditch to Heddy run and the east fork of White River; and (2) the south drainage system serving about 55% of the Base Site area tributary through Kasting Ditch, 12¼ miles long, to the Muscatatuck River. Exhibit 3-A Part 1 shows the general scheme of the storm sewers and ditches of the north drainage district on the Base Site, and Exhibit 3-A Part 2 shows the general scheme of drainage for the south drainage system.

The drainage improvement comprises 8.94 miles of open ditches involving 425,000 cubic yards of earthwork; 6,450 lineal feet of concrete apron trenches; 5,100 lineal feet of reinforced concrete box-section conduits; 84,500 lineal feet of storm sewers; 60,500 lineal feet of sub-drainage; 382 manholes and inlet structures; 6 reinforced concrete arch bridges; and other appurtenances thereto. In addition 2.33 miles of temporary drainage ditches involving the excavating and backfilling of 179,319 cubic yards of earth were required, preparatory to the grading and underground sewer work.

A set of record plans of the complete drainage systems as described above, covering locations, sizes, sections, elevations, details and other pertinent data has been officially placed on file with the O.C.E. Form 290A, and is designated as Record Drawings No. STES-AE-1DR to 39DR inclusive, dated February 18, 1943.

The north drainage system of the Base Field has been designed by the Architect-Engineer and constructed in general conformity with the preliminary report on "The North Drainage System" dated June 23, 1942 and the construction plans and specifications, dated July 6, 1942.

The south drainage system was designed by the District Engineers Office at Louisville. Plans and specifications were prepared at that office and the system was constructed in general conformity with these plans.

In general, the systems provide reasonable drainage and should remove all of the run-off from the improved areas without appreciable ponding except in the southerly part of the all-over south area.

Basic Data on Design

North Drainage System. The pertinent basic design factors for the north field drainage, including the building area, are as follows:-

(1) Use of rational formula, Q = CIA.
(2) Design storm of 1.4 inches per hour, taken from Miscellaneous Publications, No. 204, U.S. Department of Agriculture, by David L. Yarnell, pages 41, 42, 43.
(3) Frequency of above storm, expectancy of one in 2 years.
(4) Coefficients used in above formula:-
(a) Woods....0.1 (b) Cultivated lands.... 0.2 (c) Lawns and pastures....0.3 (d) Gravel roads .... 0.7 (e) Pavements and roofs....0.9.
(5) Critical time, in terms of velocity in feet per second from the farthest point to intake of inlet:-
(a) Woods.... 0.2(b) Cultivated lands.... 0.5 (c) Pavements and roofs.... 4.0 (d) Gravel roads.... 3.0 (e) Lawns and pastures.... 1.0.
(6) Coefficient of friction ("n") in Manning's formula:-

Open ditches	0.030
Sewer conduits, 6" to 21"	0.013
Sewer conduits,24" to 48"	0.012

South Drainage System. The basic data on design for the south field drainage were developed in the Louisville District Office at the time the construction drawings were prepared.

North Drainage System.

Open Ditches. The existing drainage found in this section was very meager, possibly just sufficient for cultivated and pasture lands. None of the existing ditches were used in the final construction.

The north drainage system is constructed with the main outlet ditch from Heddy run starting just beyond the northwest corner of the military reservation and extends a few hundred feet along the west boundary of the site; thence, it runs easterly and southeasterly to the east side of First Street, which is the main entrance road in the center of the field; thence, it extends south to the north line of E Avenue East, where the 48-inch sewer of the main storm sewer system of the building area discharges; thence, the ditch traverses the building area in an east and northeasterly direction to the northeast corner of the base field, at the Walnut Street entrance. (See Exhibit 3-A, Part 1). The upper half of this ditch provides immediate outlets for all road ditches in the officers area, hospital area, motor pool area, warehouse, etc.

All ditches are flat bottom and of varying widths, with 2:1 sloping banks. They comprise the following lengths and widths starting at the outlet at Heddy run (See Exhibit 3-A, Part 1):-

2840	Lin.	Ft.	with	15	foot	bottom	width
3533	"	"	"	10	"	"	"
1624	"	"	"	8	"	"	"
1548	"	"	"	5	"	"	"
3455	"	"	"	3	"	"	"
900	"	"	"	3	"	"	" (branch ditch)

The gradient of the main ditch is 0.08% except for the upper 2/3 of a

mile which has a gradient of 0.32%.

Sewers. The building area south of E Avenue is drained through the underground conduits and inlets comprising 6 main lines and several connection laterals making a complete system of underground storm drainage of 5.07 miles of sewers, divided as follows:-

1851	Lin. Ft.	- 10"	storm drains	(Vit.	tile)
3128	" "	- 12"	" "	"	"
5856	" "	- 15"	" "	"	"
59	" "	- 16"	" "	"	"
2437	" "	- 18"	" "	"	"
1715	" "	- 21"	" "	"	"
3373	" "	- 24"	" "	"	"
3569	" "	- 27"	" "	(R.C.	pipe)
1389	" "	- 30"	" "	"	"
540	" "	- 33"	" "	"	"
1000	" "	- 36"	" "	"	"
208	" "	- 39"	" "	"	"
933	" "	- 42"	" "	"	"
726	" "	- 48"	" "	"	"

180 - Type A, B & C Inlets

Main lines Nos. 1, 2, 3 and 4 serve the squadron areas of the school area, and main lines Nos. 5 and 6 serve the warehouse area. A number of small drains serving as storm water outlets for a number of buildings are connected to the storm mains.

Temporary Ditches. The main temporary ditch with 8 foot flat bottom, 2:1 slopes, extending for over 4,000 feet, was located to the west and south of the existing Seymour airport, and effectively served to lower the ground water table, and expedited grading and underground work. This ditch has been refilled.

Road Bridges. The six arch-type bridges are located where the main roadways crossed the main ditch as indicated in Exhibit 3-A, Part 1. These bridges were designed according to Bulletin No. ST52 of the Structural Bureau of the Portland Cement Association, but with modifications as to the tensile stress requirements in the bottom slab. This type of bridge presents a pleasing appearance in the area, and requires an unusually small amount of critical material (18.5 lbs. of steel per cubic yard of concrete).

The South Drainage System.

Open Ditches. The drainage area served by open ditches in the south drainage system is divided into two parts, namely, the Marginal Ditches and the main outlet, Kasting Ditch.

The marginal ditches are four-foot flat bottom, with 2:1 sloping banks and have gradients of 0.10% except at the several check dams along these ditches. The total lengths of the east and west marginal ditches are 10,865 feet and 8,850 feet respectively. These marginal ditches serve the all-over landing field area and as outlets for the underdrainage system; and also to divert the run-off around the all-over field area so as to reduce the size of the storm drains within the area.

The north part of Kasting Ditch was enlarged and deepened as an outlet for the concrete triple box conduit and is a 25-foot flat bottom ditch with 2:1 sloping banks, finished to an average gradient of .06%. The improved length of 13,600 feet extends from the south line of the military reservation southwardly for a distance of 2.57 miles. Appurtenant construction items involved in the marginal and Kasting Ditch improvements included three new bridges and the underpinning of one County highway bridge.

Observations of Kasting Ditch during periods of high run-off indicate serious flooding, downstream below the enlarged section of Kasting Ditch and it appears advisable to extend the deepening and widening of this ditch for a distance of five or more miles. This will also involve the underpinning and reconstruction of nine more bridges.

Storm Sewers. The underdrainage system in the south drainage area is divided into two parts; namely, the system serving the runway-taxiway area and the south all-over field.

The runway-taxiway drainage system is made up of ten lines of sewers and the pavement edge drains as follows:

1. Apron trenches, 10 units totaling 6,476 feet
2. Apron trench outlet
3. Concrete box sewers
4. Sewer lines A, B, C, D, E, F and G, totaling 107,616 Lin.Ft.
5. Pavement edge drains

The all-over field system is made up of ten lines of sewers known as lines H, I, J, K, L, M, N, O, P, P-1, and box sewer sub-drain, totaling 13,115 lineal feet.

A breakdown of all underdrainage in the south drainage system is as follows:

Runway-Taxiway Area

225	Lin. Ft.	of $5\frac{1}{2}$' x 6'		Single box sewer conduit
1436	" "	" $5\frac{1}{2}$' x 6'		Double box sewer conduit
3390	" "	" $5\frac{1}{2}$' x 6'		Triple box sewer conduit
698	" "	12" plain concrete	sewer	pipe
1102	" "	15" "	"	"
3026	" "	18" "	"	"
1356	" "	24" "	"	"
197	" "	27" Reinforced concrete		pipe
515	" "	30" "	"	"
1495	" "	36" "	"	"
855	" "	15" "	"	culvert pipe
689	" "	18" "	"	" "
101	" "	21" "	"	" "
832	" "	24" "	"	" "
2454	" "	30" "	"	" "
482	" "	33" "	"	" "
2044	" "	36" "	"	" "
1479	" "	42" "	"	" "
3826	" "	48" "	"	" "

Runway-Taxiway Area (Cont.)

5092	Lin.	Ft.	54"	Reinforced	concrete	culvert	pipe
7088	"	"	60"	"	"	"	"
1729	"	"	66"	"	"	"	"
38995	"	"	6"	Vitrified	sewer	pipe	
14990	"	"	8"	"	"	"	
6177	"	"	10"	"	"	"	
345	"	"	12"	"	"	"	
2998	"	"	12"	Plain	concrete	sewer	pipe

South All-Over Area

2301	Lin.	Ft.	15"	Plain	concrete	sewer	pipe
2728	"	"	18"	"	"	"	"
294	"	"	21"	"	"	"	"
1481	"	"	24"	"	"	"	"
293	"	"	24"	Reinforced	concrete	pipe	
1604	"	"	27"	"	"	"	
1233	"	"	30"	"	"	"	
444	"	"	33"	"	"	"	
1278	"	"	36"	"	"	"	
343	"	"	21"	"	"	culvert	pipe
744	"	"	27"	"	"	"	"
287	"	"	30"	"	"	"	"
296	"	"	33"	"	"	"	"
294	"	"	36"	"	"	"	"
1409	"	"	39"	"	"	"	"
1840	"	"	42"	"	"	"	"
1282	"	"	48"	"	"	"	"

CONSTRUCTION DATA

General. The plans and specifications of the storm sewer drainage systems were arranged in a number of sections to permit awarding of several contracts:

Division AF-1	Contract No. W559eng-6361*
	Contract No. W559eng-6314
	Contract No. W559eng-6744
Division B-8A	Contract No. W559eng-6366
Division B-8B	Contract No. W559eng-6316

*Part of concrete pavement contract.

The above contracts were awarded to four prime contractors:

Contractors	Contract No. and Designation
Drainage Contractors, Inc., Detroit, Michigan Nolan Construction Co., Detroit, Michigan Frank S. Tillman, LaCrosse, Wisconsin (Joint Contractors and Co-adventurers)	W559eng-6361 - The under-drainage for the south drainage system.

Subcontractors:- Birmingham Contracting Co., Birmingham, Michigan Lametti & Lametti, St. Paul, Minnesota R. R. Dawson, Bloomfield, Kentucky	
Ralph Myers Construction Co., Salem, Indiana	W559eng-6314 - Drainage for South Ditch (Kasting Ditch)
R. R. Dawson, Salem, Indiana	W559eng-6744 - Bridge work at Ditches (off reservation)
Birmingham Contracting Co., Birmingham, Michigan (Division B-8A)	W559eng-6366 - Underdrainage lines in North Drainage system
Ralph Myers Construction Co., Salem, Indiana (Division B-8B)	W559eng-6316 - Open ditches in North Drainage System
Subcontractor:- K. M. Winslow, Salem, Indiana	On concrete arch-type bridges

The pertinent dates of the planning and construction period of the above contracts, from the commencement of office design to the final completion and transfer to the Area Engineer, are shown in the attached tabulation.

Underdrainage of South Drainage - Under Contract No. W559eng-6361 - Drainage Contractors, Inc., Nolan Construction Company & Frank S. Tillman, Joint Contractors.

Materials. The major items of material used in the construction of underdrainage of the south drainage system included concrete, reinforcing steel, precast concrete units; vitrified sewer pipe of varying size from 6-inch to 24-inch; plain concrete sewer pipe (B&S) of varying size from 12-inch to 24-inch; reinforced concrete pipe (T&G) of varying sizes from 27-inch to 36-inch; reinforced concrete culvert pipe (T&G) of various sizes from 15-inch to 66-inch; special filtering backfill media around the pipes; electrical ducts; brick, mortar, cast iron frames and covers; precast concrete products; and other similar items.

In general, all materials used complied with general requirements of the specifications with exception of the dimensions of precast concrete products, and availability of suitable filtering backfill. Many of the precast concrete units, especially grating bars for the apron trench, exceeded the limits of tolerance as to dimensions and acceptability.

SOUTH DRAINAGE SYSTEM

Division No. / Designation	AF-1 Underdrainage	Open Ditches	Bridge Work
Contract No. W559eng-	6361	6314	6744
Office work started	Design in District Office		12/15/42
Plans & Spec. completed			1/15/43
Bids opened at District Office	8/3/42	7/18/42	1/23/43 (1)
Letter of award issued	8/3/42	7/21/42	1/23/43
Receipt of notice to proceed	8/3/42	7/23/42	
Construction started	8/17/42	9/1/42	1/29/43
Original scheduled completion	10/1/42	8/15/42	2/28/43
Revised scheduled completion	11/1/42		3/6/43
Construction completed	2/28/43 *	2/19/43	2/28/43 *

(1) At Area Engineer Office, Seymour.

* Balance of minor items transferred to Job A-5

NORTH DRAINAGE SYSTEM

Division Designation	B-8A Underdrainage	B-8B Open Ditches
Contract No. W559eng-	6366	6316
Office work started (Seymour)	6/12/42	6/12/42
Preliminary report filed	6/25/42	6/25/42
Report revised and returned	7/1/42	7/1/42
Plans & Spec. completed	7/12/42	7/12/42
Bids opened at District Office	8/5/42	7/23/42
Letter of Award issued	8/5/42	7/23/42
Receipt of notice to proceed	8/10/42	7/23/42
Construction started	8/14/42	7/28/42
Original scheduled completion	11/8/42	8/22/42
Construction completed	2/28/43 (99%)	12/31/42
Transfer to Area Engineer	2/28/43 *	2/28/43

* Balance of supervision transferred from Architect Engineer to Area Engineer.

Workmanship. In commenting on the workmanship of both the contractors and subcontractors in the execution of this contract, considerations have been given to the local situation as to the limited capacity of raw materials and manufacturing plants of precast concrete pipe; the importance of other construction work, particularly pavements and box sewers, using the output of available crushed stone; and the limited time of the construction schedule. In view of these considerations, the workmanship of all three subcontractors would be classified good, and in many respects better than the prime contractors, whose workmanship as a whole would be classified better than fair.

Construction Progress. The original construction period that this contract covered was a 51 calendar day period, ending October 1st, and was originally extended 31 days to November 1, 1942; the work however, required an additional 4 months (120 calendar days) to reach the final contract completion. The major causes of this over-run in the construction schedule are:

1. There was a loss of 10 days in the initial operations. It required considerable time to organize operating crews, machinery, and delivery of sewer pipe in the 5 days allotted to start construction operations.

2. There was a shortage of labor during August and September 1942. The prime contractor was continuously confronted with the problem of sufficient and experienced labor of all trades. Subcontractors were called in to assist the prime contractor to enable him to maintain a more satisfactory construction schedule.

3. There was an undue amount of breakdown in the excavating machinery prior to October 21, 1942. The daily construction reports indicate that time was lost due to breakdown of machinery, much of which might have been avoided, by proper timing of needs in machinery parts.

4. Construction could not be prosecuted effectively due to the unfavorable weather conditions during the period from November 21, 1942 to February 28, 1943. During the above period there were very few days when any contractor could do outside sewer work with any degree of efficiency or satisfactory progress.

5. During September and October 1942 there was a shortage of sewer pipe to meet the field requirements. The local precast concrete manufacturers did not have sufficient capacity to meet the needs of all contractors working on war defense contracts in this vicinity.

6. Sewer construction was done under unfavorable subsurface conditions. The contractors were delayed in sewer construction due to saturated sand and silt encountered at and below the flow line of many sewers. This one factor alone retarded construction progress. The lack of suitable filter material, or backfilling around the pipe to overcome the difficulties due to fine running sand and silt was present throughout the major part of the construction period.

7. Considerable time and labor were required for the cleaning of inlets and sewers. It was almost impossible to prevent the fine silt and sand from the ground surface to reach the sewers after construction. Many days were consumed in cleaning out the sand and silt which had collected in the system.

Changes. Major changes covered by change orders in the underdrainage of the south drainage system are:

1. The change in pipe specifications from Federal Specifications SS-P-371 types I and II to A.S.T.M. specifications Nos. C13, C14, C75, and C76; the replacing of cast iron inlet covers with precast concrete type; the redesign of the reinforced concrete box sewer; the elimination of some 58 miles of porous type underdrain tile; and reduction in footage of storm sewers of various sizes in the south all-over field area.

2. The redesign for drainage of the south drainage area.

3. The redesign of the triple box sewer to include the run-off of the marginal ditches.

The above changes represented a net deduction of 3.6% from the original contract price.

Contractors's Organization. The contract W559eng-6316 consists of both large-scale sewer construction and concrete paving work, and was awarded to the group of contractors, as a joint contract venture; Drainage Contractors, Inc., and Nolan Construction Company, both of Detroit, Michigan, whose interest was chiefly in the sewer construction under this contract, and Frank S. Tillman of LaCrosse, Wisconsin, whose entire organization was devoted to the pavement work. The Drainage Contractors, Inc., is a corporation with John S. Ventrella, President and Treasurer, Frank Deponi, Vice President, and Edward Miller, Secretary. The Nolan Construction Company is also a corporation, with Thomas Nolan, President, Miss G. Higginbotham, Secretary-Treasurer, both of whom had little to do with the construction. For the purposes of maintaining a smooth operating administrative organization, the bonding company acted as a general manager through the person of H. V. McKenzie, general manager for the joint organization.

Birmingham Contracting Company of Birmingham, Michigan, operated as a subcontractor doing 4.75% of the work. The organization is described under contract W559eng-6366.

Lametti & Lametti of St. Paul, Minnesota, is a partnership and did 9.8% of the contract as a subcontractor.

R. R. Dawson of Bloomfield, Indiana, devoted his organization on the concrete apron trenches, doing 2.8% of the contract as a subcontractor. He normally operates as a partnership with R. Strunk.

Underdrainage of the North Drainage System, Contract No. W559eng-6366 Birmingham Contracting Company, Birmingham, Michigan.

Materials. Materials for the north underdrainage system selected by the contractor were similar to the types described for the south underdrainage system, all of which complied with the specifications.

Workmanship. The contractor had experienced skilled pipe layers and machine operators, which was reflected in a good class of workmanship.

Construction Progress. The original construction period of this contract covered a 93 day period ending November 8, 1942, and has required some additional 120 days to reach a state of final completion and acceptance. The major construction items of the contract were complete within the 93-day period to the extent of over 90% physical completion; however, to date the contractor has been unable to clean all inlets and smaller drains free of silt and sand sufficiently to be acceptable and secure a final release on this contract.

Chief causes of the over-run in the construction period are:

1. Continuous and continual maintenance of the storm sewers due to top soil erosion carrying silt and sand through the inlets to the storm sewers.

2. The relocation of the BEMI building from the original site in the plot plan requiring redesign of additional storm sewers (known as No. 6) in this area. The redesign was made after sewer construction had started.

Changes. Major changes covered by change order in the original contract for the underdrainage system of the north drainage area are:

1. Relocation of the BEMI building described above.

2. Various changes in location of buildings, primary and secondary streets, widening and relocation of parking areas and driveways which required the raising and lowering of inlets to proper grade elevations.

3. The building of headwalls at the end of storm sewer lines in the south drainage system, which were added as a Supplemental Agreement to this contract, dated February 8, 1943, and scheduled for completion on February 19, 1943.

Contractors's Organization. The Birmingham Contracting Company operates as a corporation from the main offices in Birmingham, Michigan, with C. A. Phelps, President, Glenn Phelps, Secretary-Treasurer; R. C. Bishop, Office Manager, Ed Cook, Assistant Superintendent, and Harry Phelps, Resident Agent. No subcontracting firms were employed by this company.

Open Drainage (Kasting Ditch) Contract W559eng-6314
Open Drainage (North Drainage) Contract W559eng-6316
Ralph Myers Construction Company, Salem, Indiana

Workmanship and Progress. The contractor on the above open ditch earthwork had an experienced organization and excellent earth handling equipment for carrying on this work in conjunction with the grading work of the Base Field done under a separate contract. Weather conditions were good, and the work would have been finished within the scheduled periods, except that it could not be started until August 29th due to the immediate need for constructing the temporary ditches. Work in the outlet ditches was postponed until the temporary ditches were completed and the existing airport abandoned.

All open ditch work was done true to line and grade; slopes were fine trimmed in a first-class workmanlike manner. Considerable sloughing of the banks has occurred at several places along these ditches due to the high percentage of silt in the top soils, and the low resistant characteristics of the loose silty soil to erosion.

As part of the open ditch work in the north drainage area, the six reinforced concrete arch-type bridges were constructed by K. M. Winslow of Salem, Indiana, as a subcontractor of Ralph Myers Construction Company. The progress of construction was good although he could not complete all 6 bridges as originally scheduled. The construction of the bridge on G Avenue West could not be started until after September 16, 1942, when the existing airport was abandoned as a temporary flying field. Workmanship on all bridges was excellent. The contractor had excellent skilled workmen, adequate equipment and cooperated at all times.

The temporary ditches described with the grading work was done as part of the above contracts.

Bridge Work (off Reservation) - Contract W559eng-6744
R. R. Dawson, Bloomfield, Kentucky

The work under this contract included the construction of four new bridges and the underpinning of one existing bridge along the enlarged and improved section of Kasting Ditch, south of the Base Field. The work was awarded on February 8th and scheduled for completion February 19, 1943. As of February 28th, this contract was 35% completed.

The underpinning work consists of extending concrete curtain walls below the top of the existing piling supporting the existing abutment walls and piers to a depth of 3 feet below the grade line of the improved ditch. The three new bridges were made of concrete piers, abutment and wing walls with timber beams and wood plank flooring on two bridges and I-beams with wood plank flooring on the other. Timber and I-beams were Government-furnished. In general these bridges have a center span of 24 feet and with two approach spans, making a total length of approximately 48 feet.

Progress has been exceedingly slow due to inclement weather and high water; in fact, a longer period for this work under winter conditions would have been in order, particularly for this contractor, who operates just a small organization with a limited amount of construction equipment available.

Comments and Remarks. A few comments are given herein relative to the more important construction problems and difficulties encountered in the drainage work described in the above contracts, together with some suggestions which may be helpful in the maintenance of the systems and in similar construction work in the future.

It was impossible to secure suitable coarse materials as filter media for backfilling around the pipe to meet the specifications. Either crushed stone or gravel could be used for the filter media as backfill but the only material which could be obtained meeting the above requirement was crushed stone from the local quarries. The available so-called pit-run gravel could be obtained from pits along the East Fork of the White River, but it was little better than sand and not coarse enough to meet the specifications.

When crushed stone was needed as a coarse aggregate for concrete in the pavements, concrete box sewers, apron trenches, and for the base and surface of road construction in the building area, it was not possible to get crushed stone as a filter media for backfilling around pipe, much less to get any material delivered in the field. Hence, it was necessary to delete all special backfill material from the construction after November 30, 1942.

Anticipating the over-all requirements in the matter of sand, gravel and crushed limestone for the project as a whole with respect to available output of local pits and quarries, may have permitted considerable advance stock piling or even advance deliveries to the site. The problem of allocating the material among the contractors, in accordance with their needs and progress, and also finding substitute materials in advance of construction to avoid the demand exceeding the supply without retarding construction progress was difficult.

A most important allied problem arising during the construction of sewers and ditches was that of top soil erosion. The grading of the over-all field and building areas left acres of fine sandy silt surface stripped of vegetation, weeds, hay, etc., with no physical properties available to resist soil erosion. Consequently, inlets and newly constructed small underdrainage lines were partially filled with silt and sand, and no doubt will continue to do so until the ground surface is provided with a mat of vegetation, grass, etc., to prevent surface erosion.

It is recommended that seeding operations be made a part of grading work, even if excavating sewer trenches and other similar work were to destroy some of the seeded areas. Apparently, the only practical solution to prevent soil erosion and silt entering inlets and sewers after construction is to seed all graded areas immediately after grading with a type of grass or growth which will

provide a root mat to hold the newly graded surfaces. It will also prevent the troubles arising due to dust storms, many of which occurred during construction and retarded progress.

Construction difficulties were experienced in the placing of the precast concrete units chiefly the precast grates for the apron trenches, due to the irregularities in the dimensions of the precast products. These bars were cast in wooden forms at the site, under not too favorable conditions, and products true to dimensions and of uniform size, strength and acceptable workmanship were not obtained. Specification requiring the pretreatment process of the wood used for these forms to prevent wear and warping, or the use of metal lined forms should be included in future specifications. A change in the design by avoiding precast concrete grate bars should be considered for future projects.

It is doubtful whether the omission of the crushed stone media around the smaller concrete and vitrified drains can be justified. Time will be needed to see whether these sewers become silted up due to the material reaching the sewers from the openings between the pipe joints. Continuous observations of both the ground surface about the drains and the inside of the underdrainage lines should be made in the south field area.

The extent and drainage requirements of the Kasting Ditch below the enlarged section are matters which will require additional study and observations. It is recommended that several gaging and observation stations be set up along Kasting Ditch to compile data for design of extensions to the open drainage system.

SECTION 8.

RAILROAD - BASE FIELD

DESCRIPTION

General - The railroad system for the Base Field consists of a main track from a connection with the Pennsylvania Railroad at a point about 1.25 miles south of the City of Seymour; and runs southwesterly nearly 3/4 of a mile to the reservation area, and thence continues southwesterly nearly 3/4 of a mile through the Warehouse Area with branch sidings to the coal, oil and gasoline storage areas. (See Exhibit 3-B in Section 22).

There are three spurs from this main railroad connection, viz., No. 1, which further serves the warehouse area; No. 2, which serves the oil and gas storage areas; and No. 3, which serves the coal storage yard. This latter track was extended for the use of Frank S. Tillman, Contractor, in hauling materials for concrete pavements at his own expense.

The railroad extension was designed by the Architect-Engineer and constructed in general conformity with the approved preliminary report on "Railroad Connections for the Advanced Twin Engine School". The general location plan was approved by the Pennsylvania Railroad Company on June 11, 1942.

A set of record plans of the railroad connections showing location, elevations and pertinent details is designated as Record Drawings No. STES-AE-1RR to 7RR, dated 12-14-42, and has been officially filed with the Post Engineer in accordance with the transfer of the improvement in O.C.E. Form 290B.

The railroad connections and sidings were built primarily for hauling freight from the Pennsylvania Railroad to the site and only the engines of this company can operate on it. The lengths of the railroad connection are as follow:

Main Track - - - - - - - - - - - - - -	7,423.0 feet	
Switch No. 1 - - - - - - - - - - - - -	2,618.0 feet	
Switch No. 2 - - - - - - - - - - - - -	1,011.7 feet	
Switch No. 3 - - - - - - - - - - - - -	1,220.0 feet	
Total - - - - - - - - - - - - - -	12,272.7 feet	= 2.324 miles

The track is of standard construction with crushed limestone ballast, ties of native timber, relayer rails, with couplings, bolts, etc., to fit turnouts with No. 8 frogs and tie sets, tie end stops, plank crossings, crossing signs and whistle posts.

All track work on the Pennsylvania Railroad Company right-of-way was constructed by the company. The connection was made to a

siding 17 feet west of the Railroad Company's main track, where a No. 10 turnout was installed 340 feet south of Mile Post I-60, and ran to their west right-of-way line from which point the track was constructed by contract.

From this connection the track takes off at a 10 degree curve to the right and extends southwestwardly to the west line of Walnut Street extended a distance of 3,824 feet. A 50-foot width right-of-way was purchased across private properties (See Exhibit 2A-3) and fenced. The center of the track is 20 feet from the northerly line and 30 feet from the southerly line of said right-of-way. Poles for the electric power feeder line are in the center of the southerly 10 feet of the right-of-way. West from Walnut Street the track continues on the reservation. The maximum curve used is a 10 degree and the maximum grade used is 0.7 per cent. Rails of different weights were used as shown in a table herein according to the construction stations.

The construction work consisted of clearing, draining, grading, road bed, spacing ties thereon, laying lining and spiking rails and switches, spreading ballast, and raising the grade and aligning of track.

The clearing comprised clearing the ground of grass, weeds and cornstalks in advance of the road bed construction. The track was constructed on the subgrade so that the crushed stone ballast could be delivered on cars and dumped on the subgrade. The track was brought to grade in lifts and the ballast spread and compacted thereunder and along the track.

Materials

Ties - The ties were furnished and trucked here by Floyd Stark of Medora, Indiana, from whom 9,000 untreated ties were ordered. Of this number 6,935 were used in the tracks and 976 were piled along the tracks near Walnut Street. The ties were of a very poor grade and did not meet the specifications. They were cut from native timber into sizes 6"x6", 6"x7", 6"x8", 7"x8" and 7"x9". So numerous were the miscellaneous defects that at one time before final delivery the entire lot was rejected. Later their use was permitted because of the difficulty in obtaining a better grade of ties. More than 1,000 were finally rejected, and all rejected ties were purchased by Frank S. Tillman and used in his extension to Track No. 3 leading to his concrete mixing plant. Ties were allocated to this project, and 7,911 were so accepted. Ties used by F. S. Tillman's extension of the track were not accepted. Three sets of sawed switch ties were shipped from a war plant project at Terre Haute, Indiana.

Culverts - Culverts were constructed of creosoted oak timber sawed to dimensions, and these provided 304 lineal feet of 12-in. by 16-in. box culverts.

Rails, Turnouts and Accessories - All rails were second hand or relayer rails. All turnouts used were No. 8, and all couplings, tie plates, etc. had been used prior to delivery to this project. Switches are the same type as those used by the Pennsylvania Railroad and parts therefrom are interchangeable. The rails allocated for the track were 39 gross tons of 100 pound and 280 gross tons of 85 pound weight, but these quantities were not furnished; most of the rails furnished were lighter.

Ballast - All ballast used was clean, coarse crushed stone.

Excess Material - There was used in the Tillman track extension the following list of materials which were allocated for the project, and which were loaned to the contractor, and are to be retained for area maintenance when this contractor's track is removed:-

1,403 lock washers, 902 tie plates, 240 7/8" bolts and nuts, 114 3/4" bolts and nuts, 2,400 lineal feet of 60# rail (80 pcs. 30 feet long), and 82 pairs of couplings for 60# rail.

CONSTRUCTION DATA

Contract No. - W559eng-6238
Contractor - - - - - - - - - - - - - Acme Railroad Construction Company, Cleveland, Ohio

Pertinent Dates	1942
Office Work Started	June 1
Plans and specifications completed	June 15
Bids opened and contract awarded	June 27
Receipt of notice to proceed	July 1
Completion Date, First Priority	August 15
Subgrade began	August 15
First rail arrived, 2000 lin.ft. with bolts, couplings, plates, etc., unloaded by Penn. R.R. Co.	August 17
Construction began	August 25
First rails laid & spiked (250')	September 10
Use of ties, authorized	September 15
Two cars 60 lb. rails & couplings arrived	September 17
Track laying resumed	September 25
Completion Date, Second Priority	September 29
Actual Completion - 47 days late	November 16
Transfer to Area Engineer	November 16

Construction Progress - The chief delay in the construction of the railroad was caused by the delay in receiving allocated materials. The completion date was set under two priorities:- under the first, all work was to be completed in 45 days except that noted under the second priority, namely, the placing of ballast, crossings, signs, and final alignment, which was to be completed in 90 days. The original completion dates were, - First Priority, August 15, 1942, Second

Priority, September 29, 1942.

The final completion date was November 16, 1942, an over-run of 47 calendar days. If the allocated materials were delivered on schedule, the contractor could have easily completed the railroad by the end of the second Priority, or 47 calendar days ahead of the scheduled completion date.

The delay in delivery of the allocated materials for the railroad construction was the most serious of any particular item on the completion of the entire project. By this delay shipment of materials to the site by rail delayed construction progress of the concrete work for runways, aprons and taxiways.

Workmanship - The construction work by this contractor was satisfactory and the track work was in excellent condition at the time of its acceptance. His construction progress was decidedly retarded from the lack of the allocated materials. This was no fault of the contractor for he had a good organization and ample equipment, and during the period materials were available for his work, the progress was good.

Changes - The principal change order was the substitution of 60 pound and 75 pound relayer rails and accessories for that required by the original specifications.

Tabulation of Relayer Rails by Construction Stations-

Main Line	Lin. Ft. 100#	Lin. Ft. 85#	Lin. Ft. 75#	Lin. Ft. 60#
0 + 00 P.C. 10° Curve				
0 + 28 to 9 + 05	877			
0 + 42 to 8 + 87	845			
9 + 05 to 9 + 38		33		
8 + 87 to 9 + 20		33		
9 + 38 to 38 + 66				2,928
9 + 20 to 38 + 71				2,951
38 + 66 to 38 + 74.7			8.7	
38 + 71 to 38 + 74.7			3.7	
38 + 74.7 to 39 + 50 - Turnout				
39 + 50 to 39 + 62			12.0	
39 + 50 to 39 + 74			24.0	
39 + 62 to 45 + 88				626
39 + 74 to 45 + 73				599
45 + 88 to 48 + 63.9			275.9	
45 + 73 to 48 + 63.9			290.9	
48 + 63.9 to 49 + 40 - Turnout				
49 + 40 to 53 + 31			391.0	
49 + 40 to 53 + 31			391.0	
53 + 31 to 54 + 06 - Turnout				
54 + 06 to 54 + 29.3			23.3	
54 + 06 to 54 + 48.5			42.5	
54 + 29.3 to 74 + 23				1,993.7
54 + 48.5 to 74 + 23				1,974.5

For Switch No. 1	Lin. Ft. 100#	Lin. Ft. 85#	Lin. Ft. 75#	Lin. Ft. 60#
0 + 00 Heel of Frog				
0 + 00 to 0 + 16.5			16.5	
0 + 00 to 0 + 27			27	
0 + 16.5 to 25 + 20				2,503.5
0 + 27.0 to 25 + 20				2,493.0
For Switch No. 3				
0 + 00 Heel of frog				
0 + 00 to 2 + 43.4			243.5	
0 + 00 to 2 + 30.5			230.5	
2 + 43.5 to 11 + 41.5				898
2 + 30.5 to 11 + 56.5				926
For Oil Station Track				
End of Frog to P. C.			22.0	
P.C. to P.T.			733.0	
P.T. to End of 75#			19	
End of 75# to end of track				1,094
	1.722	66	2,754.5	18,986.7

The Acme Railroad Construction Company is an organization with qualified men and equipment to handle several contracts at one time, and can furnish ample equipment and do railroad work efficiently.

SECTION 9.

ROADS - BASE FIELD

DESCRIPTION

General - The Base Field is served by a gridiron of improved primary and secondary streets, roadways, service drives, and parking areas including adequate roadway drainage. The system is laid out to comply with the general approved layout plan of the project furnished by the Louisville District Office, with revisions in design to meet changes in and additions to the plot plan, and with modifications in construction to meet the field conditions encountered.

The system comprises 6.15 miles of primary streets; 5.74 miles of secondary streets and roadways; 65,000 square yards of service drives and parking areas; some twenty-four miles of roadway ditches; and 63 road culverts. The completion of this improvement involved 141,530 cubic yards of earthwork for roadway and ditches; placing of 75,650 tons of crushed limestone in 220,000 square yards of surfaced areas; the laying of 2700 lineal feet of culvert pipe 12 in. to 54 in. in size and all other work incidental thereto.

A general location of the roadway system with respect to the buildings and other pertinent data is shown in Exhibit 3-C in Section 22 of this report.

The improved surface of all roadways, drives, and parking areas is a traffic compacted, crushed limestone base course placed on a prepared natural earth subgrade, with special construction methods adapted to meet available materials and unusual subgrade conditions. The detail of locations, lengths, widths, grades, elevations, sections, and design features of the system of roadways is shown on the Record Drawings, identified as drawings Nos. STES-AE-1RPR to 13 RPR inclusive, dated February 15, 16, 17, 1943.

Design - The road surfaces were designed to serve construction traffic and as a base for a bituminous surface when the construction period was over. The exact type and details of design are to be determined when this base has served the construction period and becomes properly consolidated.

The gradients are in general very flat being less than 1% with only a few minor exceptions. The minimum gradient for roadside ditches was planned at two tenths of one percent but some exceptions were necessary.

Special Features - Side ditches have side slopes 4 on 1 or flatter. Flat slopes were desirable because of the sandy nature of the soil. Shoulder slopes are 3/4 in. per foot of width.

The base course for all roadways, drives and parking areas is six inches in thickness except in a few cases where the thickness is 9 inches and 12 inches. The primary roads are twenty-two feet wide with three-inch crown; the secondary roads are eighteen feet wide with two and one-half inch crown, and the service drives ten feet wide with two-inch crowns. French drains of crushed stone were placed at low points in gradients.

Drainage Features - Only the portion of the building area south of E. Avenue is provided with underdrains. Where underdrains were available, inlets to them were provided in road ditches. Where underdrains were not provided, the surface drainage was carried in side ditches to the large open drainage ditches. Culverts were provided where necessary. In the area served by underdrains few culverts were required.

CONSTRUCTION DATA

General - The prime contractor placed the crushed stone base courses and culverts and the subcontractor did all earth excavation and earthwork finishing operations.

The pertinent data and dates covering this section of the work are:

Division No.: - - - - - - - - - - - - B-6
Designation: - - - - - - - - - - - - Construction of Roads
Contract No.:- - - - - - - - - - - - W559eng-6357
Prime Contractor:
Name - - - - - - - - - - Ralph Myers Construction Company
Address - - - - - - - - Salem, Indiana
Sub-contractor:
Name - - - - - - - - - - Triangle Construction Company
Address - - - - - - - - Kankakee, Illinois

Dates

Office work started - - - - - - - - - June 1, 1942
Preliminary report filed - - - - - - June 15, 1942
Report reviewed and returned - - - June 17, 1942
Plans and specifications completed - July 12, 1942
Letter of award issued - - - - - - - August 1, 1942
Receipt of notice to proceed - - - August 1, 1942
Construction started - - - - - - - - August 22, 1942
Original scheduled completion - - - November 14, 1942
Actual construction completed - - - February 22, 1943
Transfer to Area Engineer - - - - - February 26, 1943

Materials - The crushed stone was furnished from the Paul Frank Quarry at North Vernon, Indiana and delivered to the subgrade by truck. It was of good quality, tough and hard and had good binding qualities.

In general three different sizes were used. First layer on the subgrade was 3 inches of stone passing a 2½" screen and retained on a 1¼" screen. Second layer was 3 inches of stone passing a 1½" screen and retained on a ½" screen. Third layer was 1 inch to 2 inches of stone screenings passing a ½" screen and graded to dust. The second and third courses were the same throughout but the gradation for the first course was modified at times to expedite deliveries of stone from the same quarry to the paving contractor.

Culverts - The culverts were built of good quality reinforced concrete culvert pipe manufactured by the United States Concrete Pipe Co., in accordance with the specifications of the American Society of Testing Materials. Serial Designation ASTM-C-76-41.

Workmanship.- The workmanship throughout was very satisfactory. The grading operations by the subcontractor were particularly well done and true to design grade and cross-section. The work by the prime contractor in placing, leveling, compacting, and smoothing the crushed stone courses was likewise well done. Culverts were set true to line and grade and well bedded.

Subgrade - Subgrades were composed generally of sandy soil which contained enough clay binder to compact well. They were accurately shaped, well compacted, dense and hard. There were a few exceptions where soft and unstable material was found. In such cases the unstable material was removed and replaced with suitable natural soil. In several places unsuitable subgrade material was removed and additional thickness of stone used.

The subgrades for the service drives were in general much less satisfactory because such drives were placed during unfavorable winter conditions. In many such cases the subgrades were strengthened and the backfill over culverts was made by the addition of pit run gravel.

Construction Progress - At times the progress was delayed by area grading operations not being completed, by construction operations in progress or not having been completed by contractors for underground utilities; and by the necessity to construct service drives and parking areas after the completion of buildings.

The placing of crushed stone was delayed and progress retarded by allocation of a large portion of the output of the Frank Stone Quarry to the pavement contractor in order to keep pavement construction at maximum production.

By reason of these conditions and the unfavorable weather during the late Fall and Winter months the contract completion time was exceeded by one hundred days making the construction period about double the original contract period.

Change Orders - There were no major change orders. The unit price contract permitted increase or decrease of contract items without change orders and no unusual conditions arose requiring major changes.

Summary of Construction Operations - The prime contractor's organization for this contract was necessarily very small but entirely adequate. General supervision was given by a Superintendent having charge of several contracts on the area, and there was a superintendent who gave his entire time to the management of this contract. Only a small labor force and a small amount of equipment was used by the prime contractor.

The subcontractor had a small but efficient organization. All equipment used by both the prime contractor and the subcontractor was well adapted to the work and was in good condition and was so maintained.

The relations between the prime contractor and subcontractors were entirely cooperative and congenial. Payments by the prime contractor to material producers, subcontractor and laborers were satisfactory and prompt. Laborers of the subcontractor were well treated and promptly paid. All laborers seemed well satisfied with the conditions under which they worked. There were no labor shortages or labor disputes.

In general the work was executed in a satisfactory manner as it progressed so that only minor corrections were necessary later. These were made promptly as requested. The contract was entirely completed in a satisfactory manner in accordance with the plans and specifications.

Guarantees - There are no guarantees of materials or workmanship provided for in this contract.

Comments - It is important that this improvement be well maintained during the next few months. Having been placed adjacent to and over trenches for drainage structures, underdrains, sewers, water mains and other excavations which disturbed the density of the subgrade, unequal settlement of the surface should be expected. Being of traffic bound construction the crushed stone base is not yet fully stabilized. Maintenance should consist of keeping the shoulders and ditches smooth and free from obstructions to drainage, by the addition of crushed stone of proper quality, size and gradation to the surface and by frequently smoothing it.

These maintenance operations should result in a base course of smooth even surface and maximum density to receive the bituminous surface when spring or summer conditions are favorable.

By the satisfactory construction under this contract, the proper maintenance during the next few months and the later placing of a dustless bituminous surface, this road improvement should prove entirely adequate to serve the expected traffic.

SECTION 10

PAVEMENTS - BASE FIELD

GENERAL

The pavement of the flying field at the Base Field consists of a connected system of runways, taxiways and parking aprons so laid out as to enclose the warehouse and building areas on three sides and be readily accessible from them. (See Exhibit 3-C showing Roads & Pavements). The pavements were constructed in accordance with the approved layout plan furnished by the Louisville District Office.

The total pavement area is 828,577 square yards, an area equivalent to approximately 175 acres of concrete slab or enough pavement to build an eighteen-foot concrete highway 80 miles long. The quantity of raw materials required for the construction of this runway-taxiway-parking pavement was 165,000 tons of crushed stone and gravel, 92,000 tons of sand, 211,000 barrels of cement, 196,500 lineal feet of expansion joints, 160,000 pounds of steel, and other incidental materials. The general location and the layout of the improvement are shown by Exhibit 3-C of Section 22 of this report.

The pavement of all runways, taxiways and parking areas is a Portland Cement concrete pavement of a minimum thickness of six inches placed on a prepared natural earth subgrade. It is divided into strips and blocks by expansion joints. The details of the location, lengths, widths, elevations, gradients, joints, etc. are shown on the Record Drawings identified as Plan No. STES-AE-2RPR, dated February 17, 1943 and Plan No. STES-AE-14RPR, dated February 15, 1943. The new work was officially transferred to the Post Engineer with O.C.E. Form No. 290B.

Design - There are four runways each 150 ft. wide and 5,500 ft. long, one in each of the following directions:- North-South (N-S), Northwest-Southeast (NW-SE), East-West (E-W),and Northeast-Southwest (NE-SW), by which each of the runways has been designated. The taxiways are 50 feet in width and have a total length of 11,613 feet. The parking apron has a width of 600 feet with an average length of 5,855 feet, and has 3,288 tie-down anchors spaced throughout its length. A small apron is adjacent to the Base Engineering Maintenance and Inspection Building and has an area of 11,530 square yards.

The maximum gradient for taxiways and runways is 0.68%. Each taxiway and runway slopes from its longitudinal center line to the edges on a one percent grade. The principal apron slopes from each longitudinal edge (both edges) toward covered concrete box drains traversing its entire length and located fifty feet from its outer edge. These drains are connected to the underground drainage system.

The slope of the large apron is one-half of one percent from the inner edge to the box drain and one percent from the outer edge (runway side) to the box drain. The maximum longitudinal gradient of this apron is 0.14%. All runways and taxiways have tile underdrains paralleling both edges throughout their lengths. The adjacent field areas slope away from the pavements toward inlets to an underground drainage system described in Section 7.

CONSTRUCTION DATA

The plans and specifications for the concrete pavements and south underdrainage system including the pavement underdrains were arranged in a single contract No. W559eng-6361 and awarded to a group of contractors, namely;

Frank S. Tillman, LaCrosse, Wisconsin
Drainage Contractors, Inc., Detroit, Michigan
Nolan Construction Co., Detroit, Michigan

as joint contractors and co-adventurers. Frank S. Tillman devoted his organization and equipment to the pavement work, while the other two carried on the construction of the south drainage system.

Subcontractors who worked on concrete pavements under this contract, are:

DeSalvo Construction Co., Cincinnati, Ohio
W. H. Ringwald & Sons Co., Chillicothe, Ohio
Ben K. Stilfield, Rock Island, Illinois
Putnam & Greene, Ft. Wayne, Indiana.

There were five construction plants set up for proportioning and mixing the concrete materials. Four of these plants were in the northeast portion of the area near the north end of the NE-SW runway for which materials were received by both railroad and truck. The fifth plant was near the north end of the N-S portion of the apron to which materials were delivered by truck only. The plant set up by the prime contractor was a central mixing plant from which the mixed concrete was delivered in agitator trucks to the pavement area being placed. The other four plants were proportioning plants from which dry batches of proportioned materials were delivered by truck to traveling concrete mixers operating at the pavement area being placed. At all plants materials were proportioned by weight.

The pertinent dates covering construction period of this work are:-

Division No. - - - - - - - - - - - - - - - - - - AF-2 & AF-3
Designation: AF-2 - - Concrete Pavement for Runways & Taxiways
AF-3 - - Concrete Pavement for Aprons
Plans and Specifications completed - - - - - - At Louisville
Bids opened at District Office - - - - - - - - August 3, 1942

Letter of Award Issued	August 3, 1942
Receipt of notice to proceed	August 3, 1942
Construction started (initial pavement)	September 21, 1942
Original Scheduled Completion	November 15, 1942
Actual Construction Completed	February 28, 1943 *
Transfer to Area Engineer	February 28, 1943

*Except for work added by change order, minor replacements and clean up.

Division of Work - The prime contractor placed the E-W, the NE-SW, and a portion of the NW-SE runways, the major portion of the taxiways and about 18% of the principal parking apron. He produced the concrete at the central mixing plant and hauled the mixed concrete to the subgrade in agitator trucks.

The construction of the N-S and a portion of the NW-SE runways and portions of the taxiways were built by W. H. Ringwald & Sons Company as subcontractor.

The pavement placed by the DeSalvo Co., Ben K. Stilfield and Putnam and Greene was entirely for the parking aprons. The entire area of runways, taxiways and principal apron had been previously graded and consolidated to within one tenth foot of subgrade elevation. The fine grading and consolidation necessary to bring the subgrade to true contour and compaction was done by the pavement contractors just prior to placing the pavement.

The percentages of the pavement placed by the prime and subcontractors are:

Prime Contractor - Frank S. Tillman	43.3%
Subcontractor - DeSalvo Construction Co.	20.6%
Subcontractor - W. H. Ringwald & Sons Co.	16.7%
Subcontractor - Ben K. Stilfield	11.5%
Subcontractor - Putnam and Greene	7.9%

Materials - Raw materials for the concrete work came from the following sources:-

Coarse Aggregates - Gravel from American Aggregates Corp., plants at Richmond and Indianapolis, Indiana, delivered by railroad.

Crushed Stone - from Paul Frank Quarry at North Vernon, Indiana delivered by truck; from Radcliffe & Berry Quarry at Scottsburg, Ind. delivered by truck; and from Louisville Cement Co., quarry at Speed, Ind. delivered by railroad.

Fine Aggregate - Sand from the American Aggregate Corporation from Indianapolis plants, delivered by rail; E. & T. Burnside Co., Inc. from Garden City plant near Columbus, delivered by truck; Thompson from Cortland, Indiana, pit, delivered by truck; and Ahlert & Spray, Seymour, Indiana, pit, delivered by truck.

Cement - Portland cement was furnished in bulk and sacks from the following companies:-

Universal Atlas Cement Co., Buffington, Indiana
Lehigh Portland Cement Co., Mitchell, Indiana
Southwestern Portland Cement Co., Osborn, Ohio
Lone Star Cement Co., Greencastle, Indiana

Natural cement in sacks was received from Louisville Cement Co., Speed, Indiana.

High early-strength-cement in bulk and sacks was furnished by:
Universal Atlas Cement Co., Buffington, Ind.
Lehigh Portland Cement Co., Mitchell, Ind.
Lone Star Cement Co., Greencastle, Indiana

Expansion joint material used was of a non-extruding premoulded type and cut to exact size, furnished by the W. R. Meadows Co. of Elgin, Illinois. Steel for expansion joints and for bar supports was furnished by Laclede Steel Co. of St. Louis, Mo. Tie down anchors were of wrought iron furnished by the American Builders Supply Co. of Louisville, Ky. Curing compound used was Klearcure furnished by National Concrete Curing Materials, Inc. of New York City from its plant at Newark, N. J.

Aggregates furnished by American Aggregates Corp. and part of those furnished by E. & T. Burnsides Co., Inc. were inspected and tested by Pittsburgh Testing Laboratory. Other materials were accepted on certificate of compliance or were inspected and tested by the laboratory staff of the Architect-Engineer. In general all materials were in accordance with specifications or necessary modifications agreed upon during construction. Frequent tests were made throughout the construction period on representative samples of materials and concrete taken during the construction of all pavements. Materials and concrete tests are discussed in Section 19 of this report.

General Construction

Procedure - The placing of pavement slab proceeded in general in the following manner:- One lane of pavement, 20-feet, 22-feet, or 25-feet in width, was placed along the center line of a runway or a taxiway from end to end or for the full length of the principal apron by operating the plant equipment on the adjacent subgrades. When this pavement lane had attained a strength considered sufficient to carry the heavy construction equipment it was used as a roadway for hauling materials for the next lane of pavement abutting thereto to be constructed. Thereafter the edge of the pavement lane already placed served as a form to retain the concrete and as a track to carry the heavy machinery used for preparing the subgrade, and for spreading and finishing the concrete of the adjacent slab to be laid. Thus the placing of pavement proceeded continuously back and forth on alternate

sides of the pavement already placed. By reason of the long lengths of the lanes being laid they were generally well beyond the limits of strengths required before placing any loads thereon. In many cases the results of the beam tests were used as a guide in determining when proper strength had been attained. The minimum time was set at five days.

Batch Plants & Equipment

Tillman Plant - This plant, by far the largest of the paving batch plants, was located on a spur from railroad branch to the field, as were all paving batch plants except Ringwald and Sons Const. Co. The latter was located near the north end of the N-S apron.

At the start of paving operations on September 21, 1942, the field railroad branch was not yet completed. Materials were trucked in to all batch plants, and cement was delivered in bags. Upon completion of the spur, bulk cement was used, and sand and gravel delivered to material bins by conveyor belt.

Aggregate bins, cement bins and cement scales were furnished by Butler Bin Co., Waukesha, Wisconsin. The cement was conveyed to the cement bin by a screw conveyor. The aggregate conveyor was 235 ft. long and 47 ft. high. The conveyor belt, made by the Atlas Conveyor Co. of Clintonville, Wisconsin is of rubber 2 feet wide.

Two 2-C.Y. Ransome mixers were electrically operated. The mixers were supplied by a three-inch water line normally and by two water trucks in cold weather. The mixers produced a maximum capacity of 1280 cu. yds. per day over a 2-day period.

Equipment on the grade - One 25 ft. "R-B" Power Fine-grader; miscellaneous bull dozers, motor patrols, forms, etc; ten Ford and Chevrolet trucks equipped with Rex and Jaeger Agitation mixers, holding four cu. yds. of ready mixed concrete or three cu. yds. of transit mix.

DeSalvo Plant

Equipment at plant - One 125 bbl. Johnson Cement Bin; one Blaw-Knox sand hopper and scales; one Butler Stone bin and scales; one Northwest 5/8 cu. yd. crane; bull dozer; etc.

Equipment on the grade - One Rex 27E Paver and later, one dual-drum 34E Paver; two batch Dodge and Chevrolet trucks; one Adams Motor Patrol; one finishing machine; etc.

Ringwald and Sons Plant

Equipment at the plant - Blaw-Knox Dry Batch Plant with 50 ton stone and 30 ton sand compartments with Blaw-Knox Scales; one 3/4 cubic yard Koehrign bull dozer; one P & H Truck crane on Mack Truck with

1/2 yard bucket; etc.

Equipment on the grade - One 27E Multi-Foote Paver; one 25 foot Jaeger-Lakewood finisher; one 25 foot Cleveland Form Grader; one 25 foot Carr Subgrader; one 25 foot Heltzel Fleroplane; ten Ford and three Chevrolet batch dump trucks.

Stilfield Plant

Equipment at the plant - One 60 ton Erie Aggremeter; one Lorain Crane; bull dozer; etc.

Equipment on the grade - Two 27E Rex mixers; one 20 foot Jaeger Lakewood finishing machine; one Flexplane; one subgrading machine; tank trucks; motor patrol, etc.

Putnam & Greene Equipment

Equipment at the plant - One 300 bbl. Blaw-Knox Cement Plant; one 60 ton, two compartment steel Blaw-Knox bin and scales; one 1½ yard Northwest Crane; one bull dozer; one 3/4 yard Koehring Crane; etc.

Equipment on the grade - One 34E Multi-foote Paver; one 22 foot "R-B" Power Fine grader; one 22 foot Blaw-Knox finishing machine; one Cleft Plane Joint installer; one dual drive 12 foot motor patrol; tank trucks; etc; eight two-batch Ford dump trucks equipped with Hercules cement batch boxes.

Workmanship - The natural soils for subgraders were in general good, being very sandy or sand mixed with clay. Subgrades were well prepared and in good condition for that portion of the pavement placed before freezing weather began about November 1st. Later, after heavy rains and the alternate freezing and thawing weather set in, it was impossible to prepare and keep a satisfactory subgrade composed of natural earth materials. During the remaining construction period all unsatisfactory soft, yielding and frozen subgrade materials were removed and replaced with bank run sand and gravel compacted as thoroughly as possible with heavy caterpillar tread equipment.

Pavement was placed true to lines and grades and well finished up to the time unsatisfactory subgrade materials were encountered after which time a few settlements occurred and the contour of the pavement surface was not as good as that done previously. Likewise, the surface finish was very satisfactory until it became necessary to cover with paper and straw for protection of the concrete against freezing. Considerable marred surface resulted during the period in which paper and straw were used for protection.

Construction progress - There was a delay in getting initial pavement operations started because the railroad spur leading into the area was not completed on schedule. Thereafter the construction progress was controlled largely by the availability of aggregates, the supply of skilled and common laborers and suitable weather conditions.

There were at all times enough laborers to keep paving operations going when other conditions permitted but much of the time during the construction period the progress would have been better if all laborers desired had been available at the time of operations.

The effect of unsuitable weather for pavement construction had the most marked effect on the progress of construction and upon the date of completion. After several factors, principally the lack of railroad facilities to deliver raw materials, had brought pavement operations into the winter months, the alternate wet and freezing weather conditions frequently prevented any progress for days at a time. Temperatures had to rise above 26 to 28° F. and subgrades previously prepared required remaking so that the concrete transporting and placing operation could again be resumed.

The total result of all delays was to prolong the construction period an additional one hundred calendar days. The original construction schedule was set up for seventy days, and with the 100 days over-run, the actual period was 170 days ending February 28, 1943.

Change Orders - The major changes were as follows:

1. A change in material quantities covered by change order due to redesign of pavement, after the award of the contract in which the average thickness of the concrete pavement and length of expansion joints were increased; and the quantity of steel reinforcing bars was reduced.

2. The addition of standard cement and high early strength cement to give higher early strength in the concrete slab to expedite construction in cold weather.

3. The removal of unsatisfactory subgrade material and replacement with pit run sand and gravel.

4. Additional apron and taxiway pavements at hangars and at the BEMI building.

Summary of Construction Operations - The organization of the prime contractor has been described under contract W559eng-6361 in Section 7, "Drainage". The general management of the entire contract of which the pavement construction was a part, was vested in a manager who had general supervision over the distribution of work, the purchase and distribution of the materials and the distribution of the payments. Most of the materials were purchased by the prime contractor and

and distributed to the contractor and subcontractors using them. Cement was an exception being purchased and deliveries managed by each organization independently. In general the supervisory management of all organizations was satisfactory. Each followed the plans and specifications willingly and functioned efficiently and satisfactorily.

The relations between prime contractors, management and subcontractors were congenial and cooperative. Payments to subcontractors material producers and laborers were satisfactory and prompt. Laborers were well treated and promptly paid. Laborers seemed well satisfied with conditions under which they worked. There were no labor disputes.

The pavement work covered by this contract is completed in a satisfactory manner in accordance with the plans and specifications except there remains a small amount of pavement added by change order, minor replacements and clean up.

Guaranty

By the terms of the contract, materials and workmanship are guaranteed for a period of one year after completion and acceptance of the work. This guaranty is covered also by the performance bond which remains in force and effect for the same period of time. Written notice to the contractor as to defective work and materials is required.

Comments

The contractors and subcontractors for this improvement had good up-to-date equipment of proper design, most of which was of the latest and most efficient models. This taken together with efficient management organization places them in an advantageous position to carry on additional work of this nature.

SECTION 11.

WATER SUPPLY, DISTRIBUTION SYSTEM & IRON REMOVAL PLANT

General

The water supply system of the Advanced Twin Engine School comprises tubular wells, deep well pumping equipment, well pump houses, well pump discharge lines, concrete surface storage reservoir, iron removal plant, high service pumping station, chlorination equipment, water distribution mains, fire hydrants, valves, service lines and appurtenances (See Exhibit 3-D).

The water is pumped from the wells by deep well turbine units through low pressure lines directly to the ferro-filter unit for removing the iron content only, and thence flows into the surface storage reservoir. The high service pumping units draw water through independent suction lines into the reservoir and discharge it into the water distribution system at approximately 50 lbs. pressure. Provision for by-passing the ferro-filter and also the storage reservoir have been made so that the raw well water can be discharged directly into the reservoir and into the common suction of the high service pumping units. The water is normally sterilized by chlorine as it leaves the filter before entering the surface reservoir. Water can also be chlorinated when discharging directly into the reservoir and at the main into the suction line of the high service pumps. The electric high service units can be operated either manually or automatically. Water is metered before discharging it into the distribution system.

The water supply system has ample capacity for domestic and fire fighting requirements and for reasonable future expansion. A set of record plans of the entire water supply system as described above, showing locations, sizes, elevations, ties, details and all other pertinent data has been placed on file and is designated as Record Drawings Water Supply and Distribution System, STES-AE-1WR to STES-AE-21WR, dated December 10th, 1942, and Record Drawings STES-AE-22WR to 24WR dated February 20th, 1943, for the iron removal plant.

The water supply and distribution system have been designed and constructed in general conformity with the preliminary report on "Water Supply for Advanced Twin Engine School", Seymour, Indiana, by Warren & Van Praag, Inc., Architect-Engineer, and transmitted to the Area Engineer under date of June 20th, 1942. Due consideration was given during construction to certain recommendations and suggestions

embodied in a letter from the Division Engineer, dated July 31st, 1942.

The iron removal plant is of the ferro-filter type, designed and constructed as a revision to the original iron removal plant design and is based on instructions in a letter from the Division Engineer, dated July 31st, 1942 and is in accordance with instructions from the District Office in a memorandum dated October 21st, 1942.

Preliminary Investigation

a. Sources of Supply

The investigation of possible water resources revealed that there were three possible sources of supply, namely:

1. Water from the Seymour Water Company, which furnished filtered river water to the City of Seymour.
2. Water from the East Fork of the White River.
3. Water from wells in glacial deposits.

The estimated costs of providing a suitable and adequate supply of water from the above sources indicated that a water supply from wells in glacial deposits located within and adjacent to the project to be the most desirable and economical. For detailed information on the investigations of the sources of water supply, see "Preliminary Report on Water Supply for Advanced Twin Engine School, Seymour, Indiana" by Warren & Van Praag, Inc. transmitted to the Area Engineer under date of June 20th, 1942.

b. Electrical Earth Resistivity Survey

An electrical earth resistivity survey was conducted at the project site and on adjacent territory to locate the best sites for test drilling for a ground water supply. For complete details of the area covered and results refer to the report on "Electrical Earth Resistivity Survey at Advanced Twin Engine School, Seymour, Indiana," dated June 24th, 1942.

Summary results of the resistivity survey indicate that the probable water bearing formations lie in the north central portion of the project site and in the area north and west of the project site. Future development of additional supply is possible in the area as indicated by the resistivity survey, and test wells should be drilled to verify the presence of water bearing strata before undertaking construction of additional permanent wells.

c. Quality of water

The sanitary quality of water obtained in the test drilling was good, but contained a total hardness of approximately 300 p.p.m. as calcium carbonate and an iron content of 7 to 12 p.p.m. It was further determined that the iron content of the water could be

economically reduced by proper treatment. Office studies and preliminary plans on the softening of the water (removal of temporary hardness) were prepared, recommendations made, and placed on file with the District Office.

Final Design Data

a. Population served - 6198
(Authorized Resident Personnel of 4132
with 50% increase)
b. Domestic consumption (70 gal. per capita) 480
Daily consumption (301 g.p.m.) - - - - - - - - .434 M.G./24 hrs.
Minimum rate of flow (151 g.p.m.) - - - - - - - .106 M.G.D.
Maximum rate of flow (753 g.p.m.) - - - - - - - 1.08 M.G.D.
c. Fire Flow (rate) - - - - - - - - - - - - - - - - 1000 g.p.m.
(for 2 hours)
d. Source of Supply (wells)
Operating capacity (16 hour day)(2 wells) - 450 g.p.m.
Standby capacity (16 hour day) (1 well) - - 250 g.p.m.
Total capacity 3 wells - - - - - - - - - - - - 700 g.p.m.
e. Storage Capacity - - - - - - - - - - - - - - - - 200,000 gallons
(Based on 12 hours domestic requirements)
f. Pumping Capacity (High Lift Pumps)
Domestic rates (3 units) - - - - - - - - - - 800 g.p.m.
Fire rates (2 units) - - - - - - - - - - - - 1000 g.p.m.
Total - - - - - - - - - 1800 g.p.m.
g. Residual Iron Content
Treated Water (F_e) - - - - - - - - - - - - - - 0.1 g.p.m.
Capacity of iron removal plant - - - - - - - 500 g.p.m.

Source of Supply

a. The water supply for the project is furnished by three tubular wells, each designed for a yield of 250 gallons per minute. Each well is approximately 80 feet deep equipped with 11½-inch outside diameter wound screens, 15 feet long, extending into sand and gravel deposits. Twelve-inch diameter, black steel well casings, weighing 51 pounds per foot, extends from the surface to the top of the screens.

b. Pumping tests show each well to be capable of supplying 300 gallons per minute without excessive drawdown. The observed static water levels in the wells was approximately 9 feet below the ground surface. The drawdowns of the wells when pumping at a rate of 300 gallons per minute continuously for approximately 48 hours was approximately 20 feet giving an average specific capacity of these wells of 15. For reference to detailed logs of these wells, well construction and charts of the official 48 hour pumping tests, see drawings Nos. ATES-AE-62W to 64W inclusive, dated 10-30-42, which have been placed on file.

C. Mineral analyses of the water were made from samples taken during the official pumping tests. Copies of the mineral analysis are given herein:-

Mineral Analysis of Water from Well No. 1 (Post Bldg. No. 387)

	Water as received	Filter Water
Turbidity	120	0
Color	30	4
Iron	9.0 p.p.m.	0.1 p.p.m.
Dissolved CO_2	35.0 p.p.m.	
Reaction	7.1 pH	

ANALYSIS OF WATER AS RECEIVED

Mineral Oxides in Parts per million		Hypothetical Combinations in Grains per Gallon	
Silica	18.0	Silica	1.050
Alumina	4.8	Oxide of Iron & Alumina	1.026
Ferric Oxide	12.8	Calcium Carbonate	12.450
Calcium Oxide	119.6	Magnesium Carbonate	4.648
Magnesium Oxide	38.1	Sodium Carbonate	2.134
Sodium Oxide	22.8	Sodium Sulphate	0.076
Combined CO_2	150.7	Sodium Chloride	0.064
Chlorine, ion	0.7		
Sulphur Trioxide	0.7	Total dissolved solids in grains per gallon	21.448
Half bound CO_2	150.7	Total hardness, calculated to calcium carbonate	17.885

Note that all of the hardness is temporary hardness and this water can be softened to approximately 1 gr. gal. by merely heating the water 200° to 210° F.

Mineral Analysis of Water from Well No. 2 (Post Bldg. No. 300)

Findings in Parts per Million		Hypothetical Combinations in Grains per Gallon	
Sediment			
Silica	2.0	Silica	0.117
Iron	7.0	Ferric Oxide	0.583
Alumina	3.5	Alumina	0.204
Calcium Oxide	3.0	Calcium Carbonate	0.314
Magnesium Oxide	1.0	Magnesium Carbonate	0.122
Carbon Dioxide	3.5	Total Sediment	1.338

CLEAR WATER (Filtered)

Turbidity	0.0	Silica	1.026
Color	0.0	Alumina	0.117
Reaction	7.1 pH	Ferric Oxide	0.023
Iron	0.25	Calcium Carbonate	11.103
Dissolved Oxygen	1.2	Magnesium Carbonate	4.129
Silica	17.6	Sodium Sulphate	0.142
Alumina	2.0		
Calcium Oxide	106.6	Total dissolved solids	16.872
Magnesium Oxide	33.8	Total hardness, calculated to Calcium Carbonate	16.020
Sodium Oxide	4.2		
Combined CO_2	120.8		
Chlorine, ion	3.4		
Sulphur trioxide	1.4	Half bound CO_2	120.8

The Half Bound Carbon Dioxide converts all carbonates into bicarbonates thus holding the insoluable carbonates of calcium and magnesium in solution.

Mineral Analysis of Water from Well No. 3 (Post Bldg. No. 299)

Findings in parts per million		Hypothetical combinations in grains per gallon	
Sediment			
Silica	7.1	Silica	0.426
Iron	12.0	Ferric Oxide	0.980
Alumina	3.7	Alumina	0.215
Calcium Oxide	4.7	Calcium Carbonate	0.489
Magnesium Oxide	1.2	Magnesium Carbonate	0.019
Carbon Dioxide	3.69		
		Total Sediment	2.129

CLEAR WATER (filtered)

Turbidity	0.0	Silica	1.096
Color	0.0	Alumina	0.099
Reaction	6.8 pH	Ferric Oxide	0.051
Iron	0.5	Calcium Carbonate	11.313
Dissolved Oxygen	3.4	Magnesium Carbonate	4.012
Dissolved CO_2	35.0	Sodium Carbonate	2.997
Silica	18.8	Sodium Chloride	1.428
Alumina	1.7	Sodium Sulphate	0.140
Calcium Oxide	108.8		
Magnesium Oxide	32.9	Total dissolved solids	21.126
Sodium Oxide	44.0	Total Hardness, calculated to Calcium Carbonate	16.282
Combined CO_2	142.5		
Chlorine, ion	14.7		
Sulphur Trioxide	1.3	Half bound CO_2	142.5 ppm

The half bound carbon dioxide converts all carbonates into bicarbonates thus holding the insoluble carbonates of Calcium and Magnesium in solution.

Deep Well Pumping Units

Each well is equipped with a deep well turbine type having 60 feet of 6-inch column pipe, in 10-foot lengths with malleable flanges, and 1½" diameter shaft tubing with 1" diameter shafts. Oil lubricated bowls are 4 stage with bronze impellers and drain ports. Ten feet of 6-inch suction pipe was installed below the bowls with a galvanized strainer at the lower end. Sixty-five feet of 1/4" black wrought iron air pipe was installed in each well, the lower end of which is at the elevation of the bottom of the bowls of the pump.

Each turbine pump is driven by a vertical electric motor of 10 h.p. Well pump No. 2 and well pump No. 3 have in addition to the electric motor, 18 h.p. gasoline engine stand-by power units for use when the electric power supply is not available. The gasoline engines drive the pumps through flexible shafts and right angle gear drives

Each well pump is furnished with altitude gauge, solenoid oiler, pressure gauge on discharge, gate valve, check valve, water meter, and is connected to the common cast iron low pressure main. The electric motors on the well pumps can be started and stopped by remote push button controls located in the high service pump house. Each well pump unit is housed in a suitable and substantial frame well building.

Water Treatment

The iron content of the water is reduced by means of a ferro-filter type with mechanical equipment. Water from the well supply is mechanically sprayed on a bed of anthrafilt and the iron thus oxidized as ferric-hydroxide is filtered out in the anthrafilt media. Wash water for the filter is provided by using two of the high service pumps. Forced ventilation of the filter is provided to reduce the carbon dioxide present in the raw well water supply. From the filter unit the water discharges into the storage reservoir. The water is also stabilized by the "Calgon" treatment method of feeding sodium hexametaphosphate to the water as it leaves the high service pump station.

Iron Removal Plant

The ferro-filter installation consists of a wooden tank, 10½ feet in internal diameter by 14 feet in height, in which an under-drain system of cast iron free vents is placed. This system is covered with 12 inches of graded gravel, from 2" to 1/4" in size over which is placed an eight-foot depth of anthracite filtering media. Above the filter bed is the cast iron distributor for spraying of the raw well water. An exhaust blower draws its suction from the bottom of the filter bed, and discharges to atmosphere. Necessary piping, valves and appurtenances are provided to permit proper and flexible operation of the unit. The entire unit rests on wood beams and posts supported from the bottom of the reservoir, and is housed in a frame building.

Water Storage Reservoir

A circular reinforced concrete reservoir of 200,000 gallons capacity was constructed to provide surface storage. This reservoir is covered with a wooden roof and composition roofing.

High Service Pump Units

High pressure water service to the water distribution system is furnished by horizontal, single stage, centrifugal pumping units of the following capacities:

2 units (No. 1 & No. 5)	500 g.p.m. with gasoline engine(41 HP)
1 unit (No. 3)	400 g.p.m. with motor drive (20 HP)
2 units (No. 2 & No. 4)	200 g.p.m. with motor drives (15 HP)

The three electric motor driven pumping units are controlled by an automatic pressure control set to maintain a pressure in the watermain of 50 to 60 pounds per square inch. Manual control is provided in addition on all pumping units. Each pump is independently valved, and can be operated independently or simultaneously with any one or more of the other units.

Chlorinator Equipment

Two automatic chlorinators are installed in the high service pump house. Each chlorinator has a feed capacity of 40 pounds of chlorine per 24 hours. Chlorine can be applied to the raw well water and also the filter plant effluent.

Master Flow Meter

A flow meter of the venturi tube type having a maximum capacity of 2.2 M.G.D. was installed in the high service pump discharge main to indicator record and totalize the amount of water pumped into the distribution system.

Water Distribution System

The water distribution system is of the gridiron pattern and consists of the following major items:

10.4 miles of 10 inch to 4 inch cast iron pipe
3.3 miles of 3 inch to 1 inch wrought iron service pipes
41.3 tons of specials and fittings
85 valves in cast iron water mains
147 valves in wrought iron service connections
107 fire hydrants

All water mains have a minimum cover of 3.5 feet. Fire hydrants have been placed to provide adequate fire protection service throughout the built-up area; valves are located through the system to permit flexibility in operation and making of repairs and additions to the system with the minimum of interruption to the service.

CONSTRUCTION DATA

General - The plans and specifications for the construction of the test wells, the permanent wells, the water supply and distribution system, and the iron removal plant were arranged in four independent contracts as follows:

Test Wells - Contract No. W559eng-6358
Contractor - Diehl Pump & Supply Co., Louisville, Kentucky

Permanent Wells - Contract No. W559eng-6280
Contractor - Layne Northern Co., Mishawaka, Indiana

Water Supply & Distribution System - Contract No. W559eng-6346
Contractor - Birmingham Contracting Co., Birmingham, Mich.

Iron Removal Plant - Contract No. W559eng-6162
Contractor - Birmingham Contracting Co., Birmingham, Mich.

The pertinent dates of the planning and construction period of the above contracts are shown in attached tabulation.

Permanent Wells - Contract No. W559eng-6280 - Layne Northern Company

Materials used for the three permenent wells have been described under the source of supply.

Equipment installed under this contract:

Well No. 1 (Post Bldg. No. 387)

Motor - U. S. Electrical Motors, Inc., Milford, Conn.
H.P. 10 Serial No. 304094
Volts 220/440 Amps. 27/13.5
Type C.F.V. R.P.M. 1800

Pump No. 12179 - Layne-Bowler Inc., Memphis, Tennessee
Marshalltown 6" Combined Pressure and Altitude Gauge
Meter - Sparling Co., Los Angeles, California - 6" Main Line
Meter No. 10492

Well No. 2 (Post Bldg. No. 300)

Motor - U. S. Electrical Motors, Inc., Milford, Conn.
H.P. 10 Serial No. 279225
Volts 220/440 Amps. 27/17.5
Type C.F.U. R.P.M. 1800
Pump No. 12178 - Layne-Bowler, Inc., Memphis, Tennessee
Marshalltown 6" Combination Pressure and Altitude Gauge
Meter - Sparling Co., Los Angeles, California - Main Line
Meter No. 10454
Right Angle Drive No. J6586 - Food Machinery Corp., Massillon, Ohio
Gasoline Engine - Novo Engine Co., Lansing, Michigan
No. C.W. 133710 - 3 1/4" bore 4" stroke
Complete with flexible drive, globe starting battery and tools.

Division No. Designation	Test Wells	Div. B-2 Permanent Wells	Div. B-2A Supply and Distribution System	Div. B-2B Iron Removal Plant
Contract No. W559eng-	6358	6280	6346	6162
Office work started	5/19/42	5/19/42	5/19/42	9/20/42
Preliminary report filed	6/20/42	6/20/42	6/20/42	9/17/42
Report reviewed & returned	6/20/42	7/1/42	7/1/42	9/17/42
Plans & Spec. completed		7/6/42	7/7/42	10/21/42
Bids opened at District Office		7/8/42	7/24/42	11/24/42
Letter of award issued	5/29/42	7/8/42	7/28/42	11/24/42
Receipt of notice to proceed	5/29/42	7/9/42	7/30/42	11/26/42
Construction started	6/2/42	7/14/42	8/8/42	11/27/42
Original scheduled completion	7/1/42	8/23/42	11/12/42	1/28/43
Actual construction completed		10/15/42	12/3/42	*
Transfer to Area Engineer		11/1/42	12/1/42	2/28/43

*Engineering supervision transferred direct to Area Engineers Office on 2/28/43

Well No. 3 (Post Bldg. No. 299)

Motor - U. S. Electrical Motors Inc., Milford, Connecticut
H.P. 10 Serial No. 279213
Volts 220/440 Amps. 27/13.5
Type C.P.V. R.P.M. 1800
Pump No. 12177 - Layne-Bowler, Inc., Memphis, Tennessee
Marshalltown Combined Pressure and Altitude Gauge
Meter - Sparling Co., Los Angeles, California - 6" Main Line No. 10453
Gasoline engine - Novo Engine Co., Lansing, Mich.
No. C.W. 133708 3 1/4" bore 4" stroke
Complete with flexible shaft, Globe starting battery and tools.
Right angle drive No. J7125 - Food Machinery Corp., Massillon, Ohio

Workmanship - Standard accepted methods were used in the construction of the tubular wells. The results of the official well tests are indicative of the high grade of workmanship both in the well construction and setting of the deep well pumping equipment.

Construction Progress - Period of construction covered a 40-day period ending August 28, 1942. The construction actually over-ran 22 days due to failure to receive pumping units as originally scheduled. A detailed construction report for the period from July 14 to date of completion comprising a tabulation of the chronological events during construction and pertinent equipment data has been placed on file.

Principal Changes - A new location for permanent Well No. 3 was necessary and test well was required to determine the characteristics of the glacial deposits before starting construction of Well No. 3.

Construction Operation - The Contractor maintained a No. 2 well drilling rig with adequate and skilled workers for the construction of the three permanent wells which were drilled in order of No. 2, No. 1 and No. 3.

Water Supply and Distribution - Contract W559eng-6346

Birmingham Contracting Company

Materials - The contractor selected cast iron pipe, bell and spigot type class 150 for all water mains, using braided jute and leadite for joints. Water service pipes are of standard wrought iron pipe with screwed fittings. All valves in the distribution system are standard hub-end gate valves of the A.W.W.A. standard; small valves in the service lines are standard brass gate type.

The water supply system included the use of reinforced concrete for reservoir and substructures; superstructure work is of a temporary nature, similar to theatre of operations type construction.

Equipment - Equipment installed in this contract comprises the following:

Pumping Unit No. 1

Gasoline Engine - Continental Motors Corp., Detroit, Mich.
6 cylinder engine - No. F186-5047 with Willard battery
Pump - American Well Works, Aurora, Illinois
Fig. No. 4006 — Size 4 x 4 AE
Head 125 GPM 500 — RPM 1600
Shop No. 66870 — Fisher Air Relief

Pumping Unit No. 2

Motor - U. S. Electrical Motors, Inc., Milford, Connecticut
15 H.P. — Serial No. 307844
220/440 volts — Frame 326-4
40° C Type SC — Amps. 40/20
3 Phase — 60 Amps. 1800
Pump - American Well Works, Aurora, Illinois
Fig. No. 4004 — Size 3 x 3 AD
Head 125 — GPM 200
Shop No. ~~6688~~ 66868 — RPM ~~1690~~ - 1750
Fisher Air Relief

Pumping Unit No. 3

Motor - U. S. Electrical Motors, Inc., Milford, Conn.
20 H.P. — Serial No. 282860
220/440 Volts — Frame 364-4
3 Phase — Amps. 50/25
40°C Type S.C. — 1800 RPM 60
Pump - American Well Works, Aurora, Illinois
Fig. No. 4004 — Size 3 x 3 AD
Head 125 — GPM 400
Shop No. 66872 — RPM 1727
Fisher Air Relief

Pumping Unit No. 4

U. S. Electrical Motors, Inc., Milford, Connecticut
Motor - U. S. Electrical Motors, Inc.
15 HP — Serial No. 308680
220/440 Volts — Frame 326-4
Type S.C. 40° C — Amps. 2/20
1800 RPM 60
Pump - American Well Works
Fig. 4004 — Size 3 x 3 AD
Head 125 — RPM 1690
Shop No. 66869 — GPM 200
Fisher Air Relief

Pumping Unit No. 5

Gasoline Engine - Continental Motors Corp., Detroit, Michigan
6 cylinder No. F186-5046 with Willard battery and charger
Pump - American Well Works, Aurora, Illinois

Fig. No. 4006	Size 4 x 4 AE
Head 125	GPM 500
Shop No. 66871	RPM 1600

Fisher Air Relief

Master Meter - Indicating, recording and totalizing type.

Primary Device	Venturitube 10" x 4.936"
Instrument	No. 10-344-5358
Chart	No. 1194

Chlorinator Equipment

2 Units - Type SA-MASVM	Wallace & Tiernan Co., Newark, N.J.
Platform Scales	Fairbanks - Morse Co.
Gas Mask	Mine Safety Appliance Co.

Control Board

Westinghouse No. A512413 Com. Disk Stock Order C3V77381
400 Amps. 125/250 volts
3 De-ion Circuit Breakers Type A.B. 100 Amps.
Type unit style No. 545023B

High and Low Water Alarm

B&W Controller Corp., Birmingham, Michigan
Relays No. 32387 and No. 32388

Workmanship - Maintaining an alert inspection service was essential to securing acceptable workmanship on the laying of water mains and services. Considerable retesting of water mains to locate leaks for repair was necessary before all mains and services were found acceptable within the limits specified. Workmanship on form work, concrete and superstructures was good.

Progress of Construction - The original construction period for the entire contract was 105 calendar days, ending November 12, 1942; actual completion of the work required 126 days. The over-run in time was due principally to failure to receive the equipment on schedule.

Initial construction of the reinforced concrete reservoir was retarded due to the unusual construction conditions found at the original site of the surface reservoir. Weather conditions were very favorable for progress and no labor disputes were recorded. However, interference with other utilities under simultaneous construction required close cooperation of constructing organizations to prevent loss of time.

Changes - Two major changes covered by change order are:-

1. A reduction in the schedule quantity of unit price items to agree with actual amount constructed and measured.

2. Construction changes in the location of and subgrade for the reinforced concrete reservoir. Excavation to grade at original site showed a soft material with a low bearing value. Yield tests indicated advisability of providing a 3-foot compacted subgrade for the foundation and compacting the earth berms around the reservoir to minimize temperature changes in the concrete walls and water.

Construction Operations - The organizations of the contractors for the permanent wells, water supply and distribution system were good and all work was done in an efficient manner. Initiative and resourcefulness were shown in overcoming delays in construction. Appraisal of the work done shows that the contractors for the various contracts are respectively well qualified to handle construction project of water plants and other similar work.

Iron Removal Plant, Contract W559eng-6162

Birmingham Contracting Company

Material - The description of the iron removal plant has been given in Article 7 of this section and covers the various materials used.

Equipment - The contractor selected the following items of equipment, all of which comply in general to the specifications.

Rotary Aerator - Type R Special, Manufactured by
American Well Works, Aurora, Illinois
Size:- 10'-0" dia. with 4 arms - capacity - 500 g.p.m.

Blower Unit - (Vacuum type) - Capacity 300 C.F.M.
30" water, No. 6-28 Type F Fan,
American Blower Co., Buffalo, N. Y.
Motor 7½ H.P. 220 volts, 60 cycle, 3 phase

Wash Water Meter - Capacity - 1500 g.p.m., Type MS
Simplex valve & Meter Co., Philadelphia, Pennsylvania

Mixing & Feed Equipment - "Calgon"
Chemical - - - Sodium hexametaphosphate
Capacity Range - - 1 to 5.4 gals. per hour
Builders - Providence Co., Providence, R. I.

Workmanship - An alert inspection service was essential to secure acceptable workmanship.

Progress of Construction - The original construction period of the work was 60 calendar days ending 1-28-43; actual completion will be approximately May 1, 1943 on account of slow deliveries in equipment, particularly the blower unit.

Changes - No major changes in design or construction are expected.

Construction Operations - Appraisal of the work done shows that the contractor for the work is well qualified to handle this type of work.

Guarantees - Under the terms of all the contracts, general guarantees are provided in the performance bond against defective materials, workmanship and equipment, for a period of one year from date of final acceptance. In addition, with respect to the performance of the iron removal plant the following guarantee is a part of the contractural documents: "The contractor shall guarantee that the equipment installed will be capable of reducing the iron content of the water flowing from the clear well so as not to exceed 0.1 (one tenth) parts per million effluent iron content."

Government Approval - Final plans for the Permanent Wells, Water Supply & Distribution System, and Iron Removal Plant were submitted to the Indiana State Board of Health and received approval. Recommendations made by the Sanitary Engineering Department of the State Board were incorporated into the work as constructed.

Remarks - The work under the various contracts has been constructed in accordance with good standard engineering practice. Great care was exercised to see that the wells, watermains, pumping equipment, piping connections, and surface reservoir were thoroughly chlorinated before being placed in service. A representative of the Indiana State Board of Health gave valued assistance in testing the various parts of the water distribution system for residual chlorine content.

Complete data on the equipment installed under the various contracts has been compiled and placed in the proper file. A copy of all approved shop drawings has been assembled and transmitted to the Post Engineer.

SECTION 12

SEWAGE & SEWAGE TREATMENT WORKS

GENERAL

The sanitary facilities of all buildings in the military reservation of the Advanced Twin Engine School are directly connected to a separate and independent sanitary collection system, tributary to a central sewage pumping station and sewage treatment plant, located in the northwesterly part of the reservation. (See Exhibit 3-E). The system including treatment works has ample capacity for present requirements with limited provisions for reasonable future expansion likely to be expected. A set of record plans of the entire system covering all sewer and structure locations, sizes, sections, elevations, ties, details and all other pertinent data has been placed on file and is designated as record drawings No. 3TES-AE-1SR to 34SR, dated November 24, 1942.

The system of collection and treatment plant have been designed and constructed in general conformity with the preliminary report on "Sewers and Sewage Treatment Plant", revised to include the corrections and notations made by U. S.Engineer Office, Louisville, Ky., in a letter dated June 11, 1942; and with due consideration given to the recommendations and suggestions offered by the Division Engineer at Cincinnati, Ohio, in a letter dated July 31, 1942.

Sanitary Sewer System

Description - The sanitary sewer system comprises some 42,000 lineal feet of vitrified pipe sewers, ranging in size from 18-inch to 6-inch diameter; 115 manholes; cast iron ditch crossings; special concrete encasements and cradles; and appurtenances, arranged to provide adequate service for present construction and future buildings likely to be constructed within the 500 acre tract between the runways of the airfield, north of the aprons.

Basic Data on Design

The pertinent basic design factors of the system are, as follows:

1. Connected population to be served----------6200
   (Present connected (4132) plus 50% increase)

2. Extent of sewered area----------500 acres

3. Total Length of Sewers & Connections----------42,000 ft.(8.2 Miles)

Breakdown of sewers lengths, by size:-

15"	Sanitary	Sewer	644 ft.
12"	"	"	7872 "
10"	"	"	6510 "
8"	"	"	14028 "
6"	"	" (house connections)	10964 "

4. Flow Quantities

Flow per capita connected-----(normal domestic) 50 gals.per 24 hrs.
" " " " -----(hospital)-----100 gals.per 24 hrs.
Allowance for infiltration (8.2 miles)
Average Gals. per mile per day----------6000 gals.
Total average sewage flow (65 g.p.c.)----------0.5 Mil. Gal.per 24 hours.

5. Sewer Design - Peak Rates for Connected Loads

Tributary Connected Population	Ratio:--Peak Rate to Average Flow	Peak Rates M.G.D.
500	4.0	0.16
1000	3.7	0.24
2000	3.66	0.48
3000	3.62	0.71
5000	3.55	1.15
6000	3.5	1.36
7000	3.45	1.67
8000	3.40	1.77

6. Minumum Grades and Velocities:-

Dia.in inches	Min. Grades in Ft. per 1000 ft. (1)	(2)	Velocity ft/sec * (1)	(2)
6"	6.0	6.3	2.0	
8"	3.6	4.0	1.8	2.2
10"	2.4	2.8	1.8	2.0
12"	1.8	2.2	1.9	2.1
15"	1.3	1.5	2.0	2.0

*Flowing half full
(1) Used for design where necessary.
(2) From Chapter VII of "Engineering Manual" date March 20, 1942.

The reduction in the grades of sanitary sewer below those given in Chapter VII of the Engineering Manual to the extent of approximately 10% was justified inasmuch as self-cleaning velocity can still be maintained in view of the good workmanship obtained on the construction, and inasmuch as it was both economical as well as expeditious not to have exceeded cuts of 18 feet in the unfavorable water bearing subsurface conditions present.

7. Remarks-Future Expansion of System

The sanitary sewer system is designed and constructed to allow for additional submains, lateral sewers and house connections for

sanitary requirements within the built-up area between the runways, north of the aprons. For sanitary service outside of this area, it will be necessary to construct separate main sewers tributary to the main 15-inch sewers. It is essential to the best interests to continue construction of additional sanitary sewers under the same specifications and rigid inspection as that of the original sewers.

Sewage Treatment Works

Description - Complete treatment for the removal of over 88% of the sewage solids and bio-chemical oxygen demand (B.C.D.) from the raw sewage flow is provided by sewage works of the type commonly referred to as "separate sludge digestion, trickling filter and chlorination". The plant comprises a coarse bar screen, comminution of the raw sewage solids, sewage pumping station, primary settling tank, standard trickling filter, final settling tank, chlorination, separate digestion of sewage solids, and open air sludge drying beds.

The raw sewage flow reaches the plant site by gravity through a single 15-inch main sewer, and is immediately passed through a revolving basket, equipped with slots and cutting devices for reducing the size of all solids before flowing into the wet well. The sewage flow is automatically pumped from the wet well through a common force line to a primary settling tank, designed to (a) collect and concentrate all the settleable solids to a central point, ready for removal, and (b) produce a settled sewage containing not over 40 to 45 percent of (suspended) putrescible solids and 60% of the bio-chemical oxygen demand of that contained in the original raw sewage.

The settled sewage (effluent) from the primary tank overflows radially along the peripheral top of the tank, and is collected through a trough and pipe lines to the center of the filter bed, where by means of a revolving distributor the settled sewage is uniformly spread over the surface of the filter bed media (crushed limestone). The limestone primarily acts as a suitable media where the physical characteristic of the sewage solids through biological agencies are changed from a state of colloidal suspension of a non-settleable nature to a state where, if the filter effluent is allowed to remain quiescent, the putrescible solids will actually settle and separate out, leaving a clear stable supernatant liquid, (plant effluent) suitable to be discharged into the natural watercourse. Contrary to the general opinion, a trickling filter does not remove any sewage solids, but rather serves to foster conditions wherein the physical characteristics of the finely divided and colloidal organic matter in the settled sewage, after trickling through the filter media, are changed as described above. Underlying the trickling filter media is a system of open tiles and channels, comprising an underdrain system for collecting the effluent.

The final tank functions similarly to the primary tanks for the removal of the newly formed settleable solids sloughing off the

filter rock. The clear effluent from the final settling tank is finally given a dose of chlorine, acting as a sterilizing agent, and allowed to remain in contact for 15 to 20 minutes to reduce the bacterial count of the plant effluent before discharging it through the outfall sewer in the open ditch and Heddy run, and thence flowing into the East Fork of White River.

The sewage solids collected in the primary and final tanks are pumped to the digestion tank, unheated but equipped for gas collection as a means of controlling the dissemination of odors. The digested sludge is run onto open sludge drying beds of fine sand and gravel, underlaid with a collecting system of open field drains. The dried sludge, a low grade fertilizer, is removed by truck or wheelbarrow and used for fill and top soil for fine grading.

Design Data - The pertinent basic design factors; rated capacity of the various units of the plant; major functions of the plant; and list of special sewage equipment, as taken from the final record plans as built, are as follows:-

(1) Connected Load -

Population (present)	4132
Population Factor	1.5
Total for Design	6200

(2) Sewage Volume (6200 connected) -

Average 24 hour volume:-	(65 g.p.c.)
Domestic (50 g.p.c.)	.310
Hospital (additional)	.020
Infiltration allowance	.050
Misc. Items, Drains, etc.	0.20
	0.40 M.G./24 hrs.

(3) Rates of Flow (6200 connected)-

16 hour rate	0.56 M.G.D.
4 hour rate (Maximum	0.75 M.G.D.
4 hour rate (Minimum)	0.16 M.G.D.
Extreme Peak (3.5 x Av. Volume)	1.40 M.G.D.

(4) Sewage Characteristics (6200 connected) -
Total Suspended Solids (0.27 lb/cap) 1670 lbs/day.
Total Biochemical Oxygen Demand (0.20 lb/cap) 1240 lbs/day
Applied to Filter Bed (0.12 lb/cap) 750 lbs/day

(5) Pumping Capacity -

Unit No. 1 - (5HP)	250 g.p.m.
Unit No. 2 - (5HP)	400 g.p.m.
Unit No. 3 - (7-1/2 HP)	600 g.p.m.
Unit No. 3 (operating with gas engine)	900 g.p.m.
Total 3 units operating together	1250 g.p.m.

(6) Treatment Provided -

(a) Raw Sewage - 90% removal of suspended matter- 88 to 90% bio-chemical oxygen demand (B.O.D.), and 96% bacteria through sterilization.

(b) Disposal of grease and scum - - - - By digestion

(c) Disposal of raw sludge and humus - By digestion

(d) Disposal of supernatant from digester - - By return to primary tank or on sludge drying beds.

(e) Disposal of gas (digestion tank) - By burning as waste for odor control.

(f) Disposal of digested sludge - - - Drying beds - removal by truck and used for fill.

(g) Disposal of plant effluent - After chlorination, through outfall sewer to main ditch and Heddy Run and thence to East Fork of White River.

(7) Screening Facilities -

1- Manually cleaned bar screen,

Clear openings - - - - - - - - - - - - - - - - $1\frac{1}{2}$"

Chanel width - - - - - - - - - - - - - - - - 2'-6"

Depth of flow - - - - - - - - - - - - - - - 15 inches at 1.4 M.G.D.

Angle of bar screen ---------- 30 degrees with horizontal

Comments: The bar screen is to serve as a standby unit for mechanical unit, and to take excess flow over 1.0 M.G.D., if necessary.

1- Comminutor Unit (screening and cutting unit) -

Size - - - - - - 10A (Chicago Pump Company)

Capacity - - - 0.4 M.G.D. at 3" loss
0.7 M.G.D. at 9" loss
1.1 M.G.D. at 15" loss

Control - - - Motor manually controlled through push button station at screen channel.

(8) Primary Sedimentation (Single Unit)-

Type - - - - - - Circular tank, center feed and peripheral overflow.

Dimensions - - - 30 feet diameter by 10 feet side water depth.

Equipment Type - Clarifier Mechanism - (Dorr Co.)

Rating - - - - -

At Rate of flow M.G.D.	Detention Period Hr.	Settling Rate g.p.d./sq.foot
0.40(Ave.daily)	3.18	570
0.56(16 hr.rate)	2.18	820
0.75(4 hr.max.)	1.70	1170
1.40(Peak)	.92	1980

Scum Removal - Automatically skimmed, collected, and discharged.
Sludge Removal - Mechanically collected and concentrated, but manually removed by gravity.
Drainage - - - - By gravity to main sewer.

(9) Trickling Filter Bed (Single Unit)

Size - - - - - - - - - - - - - - - - - - 120 Foot Diameter
Area - - - - - - - - - - - - - - - - - - 0.26 Acres
Depth of Media - - - - - - - - - - - - - 6 feet (average)
Media Size - - - - - - - - - - - - - - 2" to 3" for top 5 ft.
Distribution - - - - - - - - - - - - - - 4 Arm Unit No. 120 (American Well Works Co.)
Underdrains - - - - - - - - - - - - - - Armcre Filter Block
Rates of Application-
Minimum----250 g.p.m. (using Pumping Unit #1)
Average ---400 g.p.m. (using Pumping Unit #2)
Maximum---- 1200 g.p.m.(using Pumping Units #1, #2 & #3)
Application-Intermittently with operation of raw sewage pumps.

Rated Capacity of Unit -

By Volume - M.G.D./Acre
At average flow (0.40 m.g.d.) - - - - - - - - 1.54
At 16 hr. flow (0.56 m.g.d.) - - - - - - - - 2.23
At 4 hr. flow (0.75 m.g.d.) - - - - - - - - 3.08
At Max. Peak Rate - - - - - - - - - - - - - - 5.04

By Organic Loading
At 60% of B.O.D. (0.12 lbs. per capita)
applied to filter - - - - - - - - - - - - - - - 750 pounds
Rate of application, total - - - - - - - - - 480 lbs./acre foot
unit - - - - - - - - - - 0.3 lbs.per.cu.yd. of filter media

By population Loading
For 4132 (present connected) - - - - - - - - 2640 per Acre foot
For 6200 (design) - - - - - - - - - - - - - - 4000 " " "

(10) Final Sedimentation (Single Unit) -

Type - - - - - - circular tank, central feed and peripheral
Dimensions - - - 35 feet diameter by 7 feet wide water depth
Equipment - Type-Clarifier Mechanism (Dorr Co.)
Rating - - -

At Rate of Flow M.G.D.	Detention period - Hr.	Settling Rate g.p.m./sq.ft.
0.40 (Av. Daily)	3.05	420
0.56 (Av. 16 hr.)	2.18	590
0.75 (Max. 4 hr.)	1.62	790
1.40 (Peak)	0.87	1470

Sludge Removal - Mechanically collected and concentrated but manually removed by pumping.
Drainage - - - - By pumping.

(11) Chlorine contact tank (Single Unit) -

Size - - - - - Rectangular, 4'-10" wide x 17'-8" long x 5'-6" side water depth.

Flow direction-Horizontal, around baffles

Rating - - - - Detention Period of 24 minutes at normal plant capacity of 0.4 M.G.D.

(12) Sludge Digestion (Single Unit) -

Size - - - - - 40 foot diameter x 20½ feet side water depth, and 25½ feet total water depth.

Type - - - - - Circular, with hopper shaped bottom

Equipment - - Floating Cover (Pacific Flush Tank Co.)

Capacity - - - Total Volume of 28,000 cu.ft. or 4½ cu.ft. per capita for 6200 connected.

Gas collection-2" line to waste burner for odor control only. No utilization of gas included in plans.

Heating Facilities - None, no coils provided for present or future heating.

(13) Sludge drying beds (4 units) -

Size - - - - - 22 ft. wide x 70 ft. long.

Total Area - - 6200 sq. ft., 1.0 sq. ft. per capita.

Application - Wet sludge by gravity directly onto beds.

Removal - - - By shovel and fork, directly into wheelbarrow or truck run onto beds.

Depth of Filter Media - -12 to 15" of graded sand and gravel.

Underdrains - - 6-inch vitrified clay pipes with open joints.

(14) Connecting channels, sewers, force mains, etc.

Capacity - - - - - 1.75 M.G.D. (max.)

(15) Points for application of Chlorine (sterilization and odor control)

(a) At entrance to wet well.

(b) At outlet of primary tank.

(c) At entrance to contact tank.

(16) Measurement of Sewage Flow

Method - - - - - 90° V-notch Weir at Outlet channel of contact tank with float recording head on Weir.

Size - - - - - - 2'-0" wide by 1'-0" in depth

Max. capacity - 1.6 M.G.D.

Effective Range -0.16 to 1.6 M.G.D.

Records - - - - -By float operation, electrically transmitted to indicator, recorder and totalizing device located in office room.

(17) Bypasses (for plant operation and emergencies)

1. In case of complete power and standby failure for the raw sewage pumping units, use 10-inch valved overflow from wet well to main outfall sewer. Sewage can be chlorinated

as it flows through the wet well.

2. If necessary to by-pass primary tank, final tank can be used as primary, by using 6-inch cast iron by-pass line of the sewage force main.

3. If necessary to by-pass filter bed, use 8-inch valved overflow in 15-inch influent line to distributor at center of filter.

4. If necessary to by-pass final tank, use by-pass gate in final tank inlet box.

5. If necessary to by-pass contact tank, use 18 inch channel along west side of contact tank

6. If necessary to maintain an increase rate of sewage flow through the plant at night, use 8-inch bypass from inlet channel to contact tank through main sewer and wet well.

7. If necessary to by-pass the pumping of raw sludge to the digester, use 6-inch discharge line from pumps to sludge beds.

(18) Drainage facilities

For Wet Well - - - - -	By bulkheading incoming sewer during low flows only.
For Pump Pit - - - - -	Sump pump, discharging into wet well or sewer.
Primary Tank - - - - -	8-inch drain to main sewer.
Final Tank - - - - -	Through 6-inch sludge line to pump, and thence to sludge digester and sludge drying beds.
Contact Tank - - - - -	4-inch valved drain line to wet well.
Channels - - - - -	Drainage provided for all channels when not in use.
Digester - - - - -	To main sewer, and also to beds through sludge pumps.
Plant Grounds - - - -	Surface drainage system to outfall sewer.

(19) Housing Facilities -

Pump Office Control (P-O-C) Building

First Floor for	Laboratory, Chlorine Room, Toilet and office.
Basement for	Sewage Pumping Units, Heating Plant, Raw Sludge Pumping Unit, Electric Controls, Float Switch, Gas Engine Standby, and Coal Storage.
Sludge Control House for	sludge control valves and piping, flame trap (waste gas) and drip trap.

(20) Control Laboratory -

Equipment and chemicals furnished to run following standard tests:

(a) Settleable solids
(b) Suspended solids, total, volatile and fixed
(c) Bio-chemical oxygen demand (B.O.D.)
(d) Dissolved oxygen (D.O.)
(e) Stability (methylene blue)
(f) Hydrogen-ion (PH)
(g) Residual chlorine

(21) Remarks on Provisions for Future Expansion

In view of the tight sewer construction of the sanitary sewer system and the unusual low ground water infiltration secured; and, in view of the feasibility of controlled water supply of a cantonment area as a means of maintaining within the limits of design, both the water supply and sewage flow, it is estimated that the sewer system and sewage treatment plant as designed and constructed may be capable of handling loads in excess of the 6200 connected population design to the extent of 20 to 25%, by making certain small scale additions and changes. Important items for future expansion of this plant which should be given careful consideration before undertaking large scale construction expenditures are:

1. Increasing the sewage pumping capacity by
   (a) Changing impellers of pumping unit No. 1 to the size of No. 2. This will increase the capacity of No. 1 unit from 250 g.p.m. to 400 g.p.m.; and
   (b) Changing impellers and motor capacities of pumping units No.2 and No. 3 to the extent of approximately 33%. No other changes would be necessary in the raw sludge pumping units.

2. The primary settling tank as constructed is capable of handling an increase of 20 to 25% in the design flow with little drop in efficiency as measured by the removal of the settleable solids. The increased loss of head from primary tank through the revolving distributor at peak rate will require raising primary weir two to three inches for efficient operation of the primary tank.

3. The final settling tank as constructed is capable of handling an increase of 20 to 25% in the design flows with little loss in the sedimentation efficiency.

4. An increase of 25% in the design flows will reduce the contact period in the contact tank, but will still remain over the minimum of 15 minutes. Increased contact time can be secured through utilization of the outfall sewer as constructed.

5. Appreciable increases in capacity of the trickling filter bed as designed cannot be made economically; however, the design

of the bed and revolving distributor contemplated expansion of this unit by the addition of a high capacity - low head pumping unit for the purpose of recirculation of the filter effluent at a constant rate through the filter bed. This will be both an economical as well as an efficient method of increasing the rated capacity of the filter. An increase in the total design population and total biochemical oxygen demand loadings of from 30 to 50% of the present filter design may be expected depending on the applied B.O.D. loadings on the filter. The distributor has a maximum rated capacity of 1200 g.p.m. (1.75 M.G.D.)

Small increases in efficiency and/or population loading of the filter unit can be effected by the addition of 2 to 4 inches of crushed granite stone, 1-1/2 inch size, to the top of the bed. Sufficient clearance has been allowed in the design for this additional depth of stone. This granite stone topping is also desirable in the event that the limestone appears to become unduly fractured by the winter weather conditions.

6. The sludge digester as constructed has a capacity of 4-1/2 cubic feet per capita. This appears very ample without the utilization of the sewage gas for maintaining the optimum temperature for maximum rate of digestion of the volatile solids. This unit of digestion capacity may be reduced to 3-1/2 cubic feet per capita or less should heating coils and gas utilization plant be added in the future. The increase in capacity of the unit may then be upward over 30 percent or provide digestion capacity for a connected load of 8,000 people or more.

7. Increase in the capacity of sludge drying beds can be easily made by extending the present beds to the east. Provisions for this expansion has been made in the layout of the connecting lines. One additional bed will increase the capacity of the beds 25% or provide open drying beds for 7,800 population.

8. All force mains, channels and main connecting and outfall sewers are amply designed to handle a maximum flow of 1.75 M.G.D. (1200 g.p.m.).

CONSTRUCTION DATA

General.

The plans and specifications for the construction of the sanitary sewer system and sewage treatment works were arranged in two independent sections in accordance with the nature and type of work as follows:

Division (B-3) - - - - - Sanitary Sewer System
Division (B-3A) - - - - Sewage Treatment Plant

The pertinent data and dates of the construction period of the above divisions of the work from the commencement of office studies to the final completion and transfer to the Post Commander, are as follows:

Division No. Designation	(B-3) Sanitary Sewers	(B-3A) Sewage Treatment Plant
Contract Number	W559eng-6282	W559eng-6345
Prime Contractor	W.L. Hailey Co. Nashville, Tenn.	Buesching Bros. Construction Co. Ft. Wayne, Ind.
Sub-contractor	-	Industrial Piping & Engineering Co. Ft. Wayne, Ind.
Office Work Started	May 19, 1942	May 19, 1942
Preliminary Report Filed	June 6, 1942	June 6,1942
Report Reviewed & Returned	June 14, 1942	June 14, 1942
Plans & Specs. Completed	June 30,1942	July 7, 1942
Bids Opened at District Office	July 9, 1942	July 25,1942
Letter of Award Issued	July 9, 1942	July 25, 1942
Receipt of Notice to Proceed	July 10,1942	July 25, 1942
Construction Started	July 16, 1942	Aug. 3, 1942
Original Scheduled Completion	Sept. 9, 1942	Oct. 16, 1942
Actual Construction Completed	Oct. 16, 1942	Feb. 12, 1943
Transfer to Area Engineer	Oct. 21, 1942	Feb. 8, 1943
Transfer to Post Command	Feb. 12, 1943	Feb. 12, 1943

Sanitary Sewers - Contract W559eng-6282
By W. L. Hailey Company, Contractor -

Material - The major items of material selected within the limits of the specifications included vitrified clay pipe for sewers; cast iron pipe for ditch crossings; hot poured bituminous compound and oakum for sewer joints; brick for manhole walls; precast reinforced frames and covers for manholes; concrete for encasements and cradles; and crushed stone for sewer foundations where required. In general, all materials used were found well within the limits of the specifications, with the exception of the physical requirements for straightness and plumbness of the vitrified clay pipe.

Workmanship - In view of the unusually difficult subsurface conditions encountered, the inexperience of the skilled and unskilled labor available, and the lack of experienced supervising personnel on the part of the contractor, continuous vigilant inspection and engineering construction assistance were maintained to insure good workmanship on the sewers. The workmanship on the construction as measured by the results of the ground water infiltration and physical tests were above average.

A brief statement on the final sewer inspection and ground water infiltration tests of the completed sewer system substantiates the above statement on workmanship:-

1. All sewers were found in substantial compliance with final tests for alignment of sewers made during Oct. 2-20, 1942.
2. All sections of sewers tested for infiltration (final) were found to be well within the limits specified. The final test made on Oct. 20, 1942 by measuring the volume of ground water flow of the entire sewer system in the wet well at the sewage treatment plant, over a 10-hour period indicated an infiltration rate of 6.37 g.p.m., or 1800 gals. per 24 hours per mile of sewer. (Note: Limits specified were 4,000 gals/24 hours/mile for 8-inch sewers, and 8,000 gals/24 hours/mile per 10-inch, 12-inch and 15 inch sewers.)

Construction Progress - The original construction program of the sanitary sewer system (Contract W559eng-6282) covered a sixty day period, ending September 9, 1942, and was exceeded by thirty-seven calendar days; twelve days of this over-run however, were approved to cover the additional sewer work over the original schedule of quantities.

The principal factors requiring additional time to the original construction schedule were

(a) The lack of immediate availability of well point systems. Initial orders and subsequent orders covering some three thousand feet of well points, pumping equipment, etc., required thirty days or more before deliveries were made. Higher priority rating than AA-4 could not improve delivery.

(b) The unusually high ground water levels encountered along the main sewer locations due to the excessive rains of May and June 1942, and lack of surface drainage. Steps to assist this contractor were immediately taken by the construction of both permanent and temporary ditches.

(c) The inadequate timing for deliveries of vitrified pipe complying with requirements. The contractor failed to provide an adequate stock pile of all sizes of pipe, being supplied by a single manufacturer, and consequently at the peak of construction, it was necessary to call on many manufacturers for vitrified pipe, all of whom were filling orders as fast as the pipes were removed from the kilns.

(d) The inadequate planning or anticipating requirements as to special construction equipment, trenching machines, construction supplies, etc. Delays in construction progress were experienced due to failure to have compressor unit, air hammers, diaphragm pumps, suction hose, etc., delivered on the job when first needed. Hours of idle machinery due to repairs were unusually large.

(e) The inexperience in sewer construction on the part of key men of the contractor made it difficult to cope with the subsurface conditions encountered. The District Office arranged for special assistance to the contractor by placing on the job for several weeks an engineer especially experienced in this type of sewer construction and sewer organizations.

Changes - The original contract was arranged on a unit price basis because it was anticipated that (a) changes in location of the sanitary sewers were expected; (b) adjustments in elevations of finished grade and sewer lines would be required to avoid conflicts with water mains and storm sewers; and (c) additional sewers and house connections to service some 24 buildings were contemplated. Such changes were most readily made under the unit price contract.

The principal changes in the original contract were:-

1. The use of cast iron pipe in place of vitrified pipe for the sanitary sewer lines where they crossed new drainage ditches above their flow lines.
2. The increase in the original footage of the sewers and house connections from a total of 37,000 lineal feet to 40,000 lineal feet, an increase of 8⅓%, to provide sanitary drainage to some 30 additional buildings.
3. The increase in the amount of sheeting ordered left in place, gravel for sewer foundations, and concrete for cradle and encasement of sewers.

Construction Operations.- Construction operations were carried on under direction of a single resident superintendent and a representative of the W. L. Hailey Company, who visited the work during the construction period. Skilled workmen and foremen experienced to meet the unfavorable subsurface conditions encountered, were not immediately available; but, with the engineering assistance given and experience gained during the first two months of operation, a well rounded organization with sufficient experienced assistant superintendents, foremen, and pipe layers were present to complete the contract at a very satisfactory rate of progress.

Records indicate that payrolls, invoices for materials, claims for damages and equipment rentals were paid promptly.

Guarantees - Under the terms of the contract general guarantees are provided in the performance bond against defective materials and workmanship in the sewer system for a period of one year after final acceptance, or to October 21, 1943. Written notice to the contractor is required in such event.

Sewage Treatment Plant. Contract W559eng-6345
By Buesching Bros. Construction Company

Materials - The major items of materials selected within the limits of the specifications included vitrified clay pipe for sewers and drains; vitrified clay pipe with slip-seal bituminous joints and encased in concrete for the larger pressure lines; cast iron pipe with lead joints for the small force mains and sludge lines; reinforced concrete for all substructures; wood construction for superstructures, railings, covers, gates, etc.; local limestone for trickling filter media; and precast plain concrete products for steps, walls, etc.

All materials for concrete were within the limits specified, and tests on flexural strength of beams and compressive strengths of cylinders exceeded the minimum requirements. (For summary of tests on aggregates, cement and concrete, see Section 19 - Materials Inspection & Field Laboratory).

Equipment - Sewage equipment items included the following:

No.	Item of Equipment	Manufacturer
1	Comminutor Unit	Chicago Pump Company
3	Sewage Pumping Units	American Well Works
1	Primary Tank Clarifier	The Dorr Company
1	Revolving Distributor	American Well Works
1	Final Tank Clarifier	The Dorr Company
1	Chlorinator Unit	Wallace & Tiernan
1	Set of Laboratory Furniture	W.M.Kimball Co.
	Laboratory Equipment, Apparatus	Kauffman-Lattimer Co.
1	Sewage Flow Meter	The Bailey Meter Co.
1	Sump Pumping Unit	Chicago Pump Company
1	Water Seal Pumping Unit	Chicago Pump Company
1	Plunger Type Sludge Pump	Chicago Pump Company
1	Screw-peller Type Sludge Pump	Chicago Pump Company

All equipment selected by contractor conforms to specifications as to materials, workmanship, functions, and guarantees.

Workmanship - Continuous inspection and engineering assistance were maintained to insure good workmanship for all tanks and substructures. All concrete was batched at the Seymour plant of the Burnside Sand and Gravel Company and transported to the plant site in transit mixers.

The tightness of concrete tank structure as measured by test, and in particular the tightness of pump pit constructed to a depth of 20 feet below the surface and in 16 feet of ground water are examples of excellent workmanship in the mixing and placing of concrete.

The precast concrete work for various walls, steps, walkways, on fills around the plant site have settled. This was unavoidable as it was necessary to expedite the outside work before full settlements of the fills around the tank structures could be assured. This work, being of concrete blocks with mortar or joints may be conveniently repaired during operation; however, it is advisable to delay such repairs until the summer of 1943.

First class workmanship on the fine grading around the plant structures and site was not secured in view of the unfavorable weather conditions. Mulching of the slopes and berms was substituted in place of seeding. It is desirable that additional fine grading of the entire plant site be undertaken in the early spring, preparatory to seeding and landscaping of the site.

Construction Progress -

The original construction schedule of the sewage treatment plant (Contract W559eng-6345) covered an eighty-day period, ending October 16, 1942, and was exceeded by 119 calendar days; 15 days of this over-run were approved to cover the delay in starting due to the relocation of the sewage treatment plant site and other justifiable items.

The rate of construction progress is indicated by the percent of completion based on the partial estimates prepared semi-monthly:

Date of Partial Estimate	Percent Complete	Remarks
August 31, 1942	10.2	
September 15, 1942	20.1	
September 30, 1942	28.8	
October 15, 1942	45.5	
October 31, 1942	66.5	Approximate corrected date of completion
November 15, 1942	86.5	First equipment items in place
December 15, 1942	88.0	
December 31, 1942	90.0	
January 15, 1943	97.0	
February 1,1943	99.5	Except for 3 equipment items awaiting delivery.

Excluding eleven sewage equipment items, all of which were delayed in delivery beyond original shceduled and rescheduled dates, the balance of the contract should have been 80.8% completed on October 31, 1942, or 14.3% behind schedule for the following major reasons:

1. Delay in completing 21 day sodium sulphate tests on local quarries for filter stones to secure satisfactory filter media in compliance with specifications.

2. Delay in delivery of small cast iron pipe, fittings, specials, check valves and valves as originally scheduled.

3. Desire on part of contractor to avoid a period of idleness between completion of major construction items and original delivery dates of equipment; hence, contractor operated with a smaller organization.

4. No work on Sundays; loss of 10 calendar working days. By November 15, 1942, the contractor had all construction items and two equipment items completed, representing 86.5% completion; the remaining 13.5% covered the equipment items, backfilling, fine grading, cleanup, and testing. The period of from November 15,1942 to January 15, 1943 was devoted principally to erection of sewage equipment and other miscellaneous items; and, from January 15, 1943 to February 1, 1943, to adjustments and testing of equipment repairs, backfilling, grading and final check-up. As of February 12, 1943, sludge pump No. 2 and the flow meter have not been delivered.

Changes - The original contract for the sewage plant was arranged on a lump sum price, inasmuch as complete detailed plans could be prepared, and few changes were expected. The principal changes were:

1. The relocation of the site in order to continue operation of the existing Seymour Air Field on which the plant site was originally located.
2. Extension of the outfall sewer due to the plant relocation.
3. Deduction of $1633.00 to cover cost of equipment items deleted from contract.

The above changes and other minor changes represent a reduction of 0.5% of the original contract price.

Guarantees- Under the terms of the contract, general guarantees are provided in the performance bond against defective materials, workmanship; also, mechanical guarantees of all items of equipment incorporated into the plant. The period of guarantee extends over a period of one year after final acceptance, or to February 12, 1944. Individual letters of mechanical guarantee from manufacturers and vendors have been received and properly filed. Written notice to the contractor and manufacturer of equipment is required for replacements in defective mechanical parts, materials and workmanship.

Contractor's Organization - The Buesching Brothers Construction Company of Ft. Wayne, Indiana is a partnership of four brothers, arranged where each of three brothers is placed in direct field charge of a project under construction, and the fourth supervises all office work for the projects from the home office. At Seymour, Werner Buesching was in full charge of the organization, acting also as field engineer and superintendent. The method of operation had advantages in expediting material orders and decisions on construction problems; however, economic interests and the profit motive on the part of the owner-superintendent tended to retard construction progress. Overhead costs were kept at a minimum.

The Industrial Piping and Engineering Company of Ft. Wayne, was subcontractor on the piping, heating and plumbing work, and has an enviable record in this type of work. Sufficient skilled workmen were available as the pipe, valves and equipment items were delivered at the site.

Practically all major construction equipment such as excavating machinery, bulldozers, well point system, trucks, pumps, etc., were secured on a rental basis. Concrete, being ready mixed and delivered to the site, concrete mixing machinery was not necessary.

The volume of labor, both skilled and common was maintained at a minimum, but at an efficient plane.

Buesching Brothers Construction Company is a small, efficient and resourceful organization, well qualified to handle construction

projects of sewage treatment works, water plants, and other similar work.

Governmental Approval -

A written approval under date of July 14, 1942 by the State Health Commissioner of the State of Indiana was secured on the plans and specifications and design data for the sanitary sewer system and for the sewage treatment plant.

SECTION 13

ELECTRIC LIGHT AND POWER FACILITIES

GENERAL

The electric light and power requirements for all buildings are provided by an overhead primary and secondary distribution system, fed through a substation that steps down from 33,000 volts, 3 phase, 60 cycle to 7,200 volts, 3 phase, 60 cycle. Exhibit 3-F indicates the location of the incoming feeder line, the substation, the three distribution feeders, the transformer stations, secondaries, and location of buildings. More detailed information on the distribution systems such as wire sizes, transformer sizes, location of building services, etc., are shown on record drawings STES-AE-1ER to 14ER, dated December 17, 1942. In addition, the construction drawings have been revised to show construction details of work as constructed (Drawings Nos. STES-AE-2E to 14E inclusive and 18E, 20E, and 23E to 36E inclusive). The interior wiring drawings for the various buildings have been revised to show construction details of work as constructed (Drawings Nos. STES-AE-98E to 102E inclusive, 104E to 112E inclusive, 114E to 142E inclusive, 144E to 149E inclusive and 151E to 152E inclusive).

Copies of above record and construction drawings, maps and specifications were delivered to the Post Engineer with the official transfer of construction, Form No. 290A, dated December 10, 1942.

The distribution system and interior wiring has been designed and constructed in general conformity with the preliminary report and drawings, dated June 11, 1942, presented to the U. S. District Office at Louisville, and revised to include corrections and notations from that office and the office of the Division Engineer, Cincinnati, Ohio, wherever possible.

Description and Design Considerations - With the limited information available, power and lighting requirements were estimated and allowances were provided for a 50% increase for future load requirements. The load locations were fixed by a tentative camp layout; and sites and locations of substation and distribution lines were immediately determined. By directive OCE-Circular Letter 1508, Lighting loads were fixed at 0.4 watt per square foot for enlisted men's quarters; 0.8 watt per square foot for officers' quarters, mess halls, administration buildings, post exchanges, post offices, etc.; and 1.0 watt per square foot for recreational rooms with the exception of special buildings, such as theater and chapels where the Government standards were used. Power loads were more difficult to determine at the inception of the design because of the uncertainties in power requirements of the equipment likely to be available at the time of construction. In some cases, especially electric

cooking, receipt of electrical equipment indicated loads to be considerably in excess of those anticipated.

The 33,000 volt feeder was fixed by the power source available and it was decided to distribute at 7,200 volts since that voltage lent itself readily to joint construction with an overhead telephone system and to a delta-connected power system which would allow open delta operation in emergencies and eliminate the need for standby transformers. Load estimates with allowance for 50% increase in the future, called for three 500 KVA transformers in the substation. To provide for still further expansion, if necessary, these transformers are prepared to readily receive and mount forced draft ventilation equipment that would raise the rating of each transformer to 625 KVA.

The substation was located as near the center of load as possible. Three distribution feeder circuits are arranged for radial operation normally, and with loop operation when required in emergencies, where sections may be isolated.

Only one feeder from the source of power was permitted; however, the feeder can be fed from two independent sources of power by the Public Service Company of Indiana - from either Seymour or Scottsburg. At the junction, where this feeder connects with the power company's lines, three-pole top switches were installed and are all closed in normal operation. Two of these switches in the power company's main line can isolate either Seymour or Scottsburg, while the third in the camp feeder can isolate the camp. The camp feeder to the eastern boundary of the reservation was constructed by the Government as part of the 33,000 volt feeder line; the extension beyond the boundary continues along right-of-way of the railroad spur and was erected by the Public Service Company of Indiana.

The substation feeds 75,000 lineal feet of overhead lines and 365 services through 1690 KVA of transformers. The only underground distribution system (4,000 lineal feet) is for the 47 apron service outlets.

In general, the secondary system is 120/240 volt, single phase and 240 volt, three phase. The exceptions are for the five hangars and for the two Base Engineering buildings which are fed with 120 volts, single phase; and 208 volts, three phase, with four wire service from wye connected transformer banks. In all cases, the neutral wire is carried on the poles as the top wire, and where single phase and three phase current are carried from a delta connected transformer bank, the bottom wire is the wild phase. Transformer and line capacities have been figured on actual anticipated loads using diversity factors that vary from 50% to 90% depending upon the nature of the loads with an average diversity factor of 65%. In addition, allowance for 50% future load expansion and for loading transformers 125% to 140% on peaks have been provided. Some of the copper wires, especially for the primary, are larger

than necessary for these figures, because of the mechanical strength requirements.

Floodlighting is provided for the substation, the gasoline storage area, the area in front of the hangars, and for the Base Engineering Maintenance and Inspection Building. Fence lighting is provided around the Ordnance Area and the Bomb Sight Storage Area.

A main series street lighting circuit provides lighting for the main streets that serve as main entrances to the camp area; and for main streets in the hospital, recreation, and headquarters areas. Seven additional multiple lights are spotted at strategic road intersections. Some limited lighting for other secondary streets and parking areas is obtained from the outside lights on buildings adjacent to them.

Utility Company Service Contract - Power is metered at two points - at the main substation, and at the Ordnance Area. A third point will likely be added to serve the Walnut Street entrance. In each case, the meters and metering transformers are the property of the power company. The main power for the camp is being purchased under the Power Company's Rate Code 107 which incorporates the following:

MAXIMUM LOAD CHARGE (monthly)
$1.50 per month per Kilowatt of Billing Max. Load in the month
ENERGY CHARGE (In addition to the Max. Load Charge).
2.25¢ per KWH for the first 3,000 KWH used in any month
1.8¢ per KWH for the next 7,000 KWH used the same month
1.2¢ per KWH for the next 10,000 KWH used the same month
1.0¢ per KWH for the next 80,000 KWH used the same month
0.8¢ per KWH for the next 100,000 KWH used the same month
0.7¢ per KWH for all over 200,000 KWH used the same month

This rated code, in addition, provides that where the customer owns the complete substation structure and equipment, including switches and protective equipment transformers and other apparatus which is necessary to take service from the transmission line voltage, a credit of 10% of the monthly maximum load charge will be made. It also provides adjustment of the maximum load used for billing purposes in accordance with measured power factor and as a load factor credit. 3 mills per kilowatt hour (KWH) will be allowed for all energy used in excess of the product of 360 hours use multiplied by maximum load of the billing.

Remarks on Future Expansion - It is not likely that any future expansion will necessitate any revision in the substation or primary feeder lines and secondary lines. Transformers allow for a 50% growth unless considerable of the growth is concentrated in small areas. Already some building loads are being doubled and trebled which will necessitate an increase in transformer and copper size at those points, if many are grouped on the same transformer.

CONSTRUCTION DATA

General - Electric light and power was handled as three separate activities, i.e. (a) the 33,000 volt feeder line to the project; (b) the 7,200 volt camp distribution system; and (c) the interior wiring for light and power. The plans were drawn simultaneous and built under separate contracts, and divided as follows:

Division (B-4) - 33,000 Volt Feeder Line
Division (B-4a) - 7,200 Volt Distribution System
Division (B-4b) - Interior Electrical Work.

The pertinent data and dates of the construction period are as follows:

Designation	B-4)	(B-4a)	(B-4b)
Contract number	W559eng-6271	W559eng-6294	W559eng-6317
Prime Contractor	Shely Const. Co. Lexington, Ky.	A.Wood Hardin New Albany, Ind.	Pearson Const. Co. Benton Harbor Michigan
Office work started	5/25/42	5/25/42	5/25/42
Preliminary report filed	6/11/42	6/11/42	6/11/42
Report reviewed & returned	6/18/42	6/18/42	6/18/42
Plans & Spec. completed	6/25/42	7/3/42	7/10/42
Bids opened at Dist. Office			
Letter of award issued	7/6/42	7/16/42	7/24/42
Receipt of notice to proceed	7/7/42	7/18/42	7/29/42
Construction started	7/16/42	7/31/42	8/20/42
Original scheduled completion	7/24/42	10/16/42	12/15/42
Actual construction completed	7/29/42	12/10/42	
Transfer to Area Engineer	12/11/42	12/11/42	2/28/43 *

* Engineering supervision taken over by Area Engineers Office

The 33,000 Volt Feeder Line - Contract W559eng-6271

The 7,200 Volt Distribution System - Contract W559eng-6294

Interior Electrical Work - Contract W559eng-6317

Materials - The pole lines were built on full creosoted pine poles, using wood crossarms with metal crossarm braces on the 7,200 volt lines and wood crossarm braces on the 33,000 volt line. Wood braces were specified throughout but were unobtainable and metal ones were substituted. Primary lines are of bare copper and secondary lines are of weatherproof insulated wire. Line hardware is galvanized. The substation is constructed from creosoted poles and lumber.

Under contract W559eng-6317 for the interior electrical work, most of the interior wiring is with loom wire or Romex, utilizing Moncor composition outlets and switches. In some cases, such as the mess halls and engineering shops, black conduit was utilized where necessary to provide more protection to the wire circuits. The majority of the buildings have simple porcelain fuse blocks while some of the more important buildings have circuit breaker panels for circuit protection. With the exception of special service application, simple 12-inch metal shades were used. In all three contracts the specifications for materials have been strictly adhered to with very few exceptions.

Equipment - Electric equipment supplied is as follows:

Item of Equipment	Manufacturer
For Substation	
Transformers	General Electric Co.
34.5 Kv air break switch	Line Material Co.
34.5 Lightning arresters	General Electric Co.
7.2 Kv Lightning arresters	Line Material Co.
34.5 Kv Liquid fuses	Line Material Co.
15 Kv three shot disconnects	Line Material Co.
For Distribution System	
Transformers	General Electric Co.
7.2 Kv Lightning arresters	Line Material Co.
Disconnect cutouts	Line Material Co.
Street Lights	Line Material Co.
Street Light Regulator	General Electric Co.

All equipment selected by contractor conforms to specifications as to materials, workmanship, functions, and guarantees.

Workmanship - Continuous inspection and engineering assistance on all three contracts maintained to insure good workmanship and was as successful as could be expected under present day conditions of time limitation and the labor and materials situation.

Construction Progress - The Shely Construction Company completed their contract on the 33,000 Volt Feeder Line within the allocated time for all practical purposes, and was well ahead of the need for the work involved. The only work left to be done after the expiration of time was the installation of a few guy clips which did not in any way affect the utility of the line. After delivery of the clips, the contractor completed the balance of the contract within a few days.

The contract with A. Wood Hardin for the 7,200 Volt Distribution System extended beyond the allotted period of 90 calendar days for three reasons:

1. Inability to start to work soon enough and with a force of sufficient size because of the priority given to grading operations on the site. Grading had to be done before power poles could be set to proper grade, the first operation in his contract.

2. Delayed shipment of a few items of materials.

3. Time extension necessitated by additional work.

Regardless of an extended completion date, the progress was sufficient to provide service as needed for construction purposes and for Post purposes.

The contract with Pearson Construction Company for the Interior Electrical Work extended beyond the allotted period of 144 calendar days for the following reasons:

1. Lack of available buildings in which to work during the early days of the contract.

2. Slow delivery on some materials due to untimely handling of orders and expediting of materials on the part of the contractor.

3. Slow delivery of equipment, to be supplied by others, for connection under this contract.

4. Additional work by change order.

Changes - The only major change from the original plans and specifications was the addition of a fire alarm circuit; the exterior portion being added to the 7,200 volt distribution system, Contract W559eng-6294 and the interior portion of the wiring to the interior electrical work, Contract W559eng-6317.

Minor changes involved the quantities of electrical items and were due to additional work, and to variations in lighting and power requirements in the various buildings for which unit prices were established, or required to be established. Except for the addition of the fire alarm system, changes did not exceed 2% of the original contract price for the 33,000 volt feeder line and 8% of the contract estimate of the interior electrical work.

Guarantees - The guarantees involved in these contracts are the manufacturer's standard guarantee covering workmanship and materials and the guarantee specified in each of the contracts and signed by the contractors on acceptance of their contract.

CONTRACTOR'S ORGANIZATION

Shely Construction Company - This contract was hardly large enough to set up much of an organization. A line crew was sent here with a foreman and was here only a few days. It was necessary for inspectors to do most of the supervision and expediting of materials.

A. Wood Hardin - This contractor had a good office personnel and did a good job of expediting materials. When the job started the crews lacked adequate supervision, but this situation was later corrected. It seemed that the contractor was unable to get help that could or would do a good day's work. Lacking control over the labor situation, he did the best possible with the labor that was sent to him.

Pearson Construction Company - This contractor did a poor job of ordering and expediting materials. His labor supervision was excellent and only part of his skilled labor was sufficiently experienced to be classified as good.

SECTION 14

GASOLINE AND OIL FACILITIES

General. The gasoline and oil facilities consists of the following systems:

1. An underground gasoline storage system with station and dispensing outlets, located in the Motor Pool Area, near 4th Street and B Avenue, for the purpose of receiving and serving trucks, cars, etc., under the direction of the Post Quartermaster (Q.M. Gas Storage System).

2. An underground lubricating oil storage system with pump house and dispensing outlets located on B Avenue in the northeast part of the Field, for the purpose of receiving tank car shipments of lubricating oil and dispensing to transport trucks for delivery to planes (Air Corps Oil Storage System).

3. An above ground gasoline storage system with pumps and dispensing outlets, located on B Avenue in the northeast part of the Field, for the purpose of receiving tank car shipment of aviation gasoline and dispensing to transport trucks for delivery to planes (Air Corps Gasoline Storage System).

Locations of the above systems are shown in Exhibit 3-G.

Ties, elevations, and dimensions of the various parts making up these systems are shown in the following record drawings, which were officially transmitted to the Post Engineer as part of O.C.E. Form 290A:

1. For the Q.M. Gasoline Storage System - Drawings STES-AE-NO FR1 to FR8, dated 12-1-42.

2. For the Air Corps Oil Storage System - Drawings STES-AE-NO FR9 to FR17, dated 12-15-42.

3. For the Air Corps Gasoline Storage System - Drawings STES-AE-NO FR18 to FR32, dated 2-20-43.

The Q.M. gasoline storage system was designed and constructed in general agreement with standard Army Plans revised to meet local subsurface and topographic conditions. The plans and specifications were prepared by the Architect-Engineer and approved by the District Office at Louisville, July 2, 1942.

General plans and specifications for the Air Corps Gasoline and Lubricating Oil Systems were prepared in the District Office at Louisville as approved by the Chief of Engineers. Detailed working plans were prepared at the site. The systems are in general conformity with Standard Army Plans, revised to meet local conditions.

Q. M. GASOLINE STORAGE SYSTEM

Description. This system has a storage capacity of 12,129 gallons, and operates as follows:- Gasoline is transported via truck from outside sources of supply and delivered into the underground storage tank by gravity andis then pumped by a 100 G.P.M. unit to two dispensing units mounted in the driveways adjacent to the pump house for direct dispensing to trucks and cars. The dispensing units have a continuous maximum output capacity of 60 G.P.M.

Design Features. A 10'-6" diameter Underwriters tank was set on concrete base and saddles and anchored to prevent flotation. Top of tank is set level with pump house floor and mounded over with earth-fill; tank is equipped with combination waterlock and foot valve to prevent water getting into pipe lines. All valves on tank are accessible through valve box on tank and all piping removable by means of double tapped bushings. Other items include automatic variable volume control pump with sufficient capacity for future expansion; air eliminator to eliminate air from gasoline deliveries; positive piston displacement meters in dispensing units to record and total all deliveries; 300 watt mushroom floodlights over pumps for night deliveries; and combination operators station and pump house; motor and all electrical equipment in the pump house are explosion proof, operated by explosion proof remote control switches at dispensing units. Sufficient easily-cleaned strainers of 80 mesh in fill, discharge, and dispensing lines to assure clean gasoline deliveries are also provided.

CONSTRUCTION DATA

Pertinent Dates. The pertinent data and dates of the construction period from the commencement of office studies to final completion and transfer to the Post Commander are as follows:

Contract designation.....W559eng-6297
Contractor, Hipskind Plumbing and Heating Co.,
Fort Wayne, Indiana
Office work started.....May 19, 1942
Preliminary plans and specifications
filed.....June 26, 1942
Reviewed and approved by U.S.E.D.....July 1, 1942
Plans and specifications completed.....July 2, 1942
Bids opened.....July 18, 1942
Letter of award issued.....July 18, 1942
Final contract issued.....August 19, 1942
Construction started.....September 14, 1942
Original completion date.....September 18, 1942
Actual completion made.....November 28, 1942
Transferred to Area Engineer.....December 5, 1942
Transferred to Post Command.....December 18, 1942

Construction Progress. The original program contemplated construction in sixty days which would ordinarily be more than ample; however, after the letter contract was issued, the contractor and contracting officer at Louisville entered into negotiations with reference to the amount to be added for unusual subsurface conditions.

The actual time for completion required an additional 40 days beyond final contract date. This was due to priority delays on critical materials. Since this kind of a job is principally equipment installation, no material progress could be made until the tank arrived. The tank was ordered August 21, 1942, and arrived September 22, 1942. The contractor delayed the excavation as much as possible to time it with the arrival of the tank and also to gain as much as possible from lower ground water conditions, which the drainage system, then under construction near the site, was effecting. We had taken soil tests in June and July indicating ground water at 3 feet beneath the surface. This level had been lowered until in September when excavation started the ground water level was at 10 feet below the surface. This lowered ground water level eliminated part of the sheeting estimated as necessary and a deduction was made from the contract to offset it.

The principal items of equipment used were as follows:

1 - 12,129 gallon Underwriters, Underground Tank, Leader Iron Works, Decatur, Illinois
1 - Pumping Unit with 3 H.P. 3 phase explosion proof motor, Yale & Towne Mfg. Co., Stamford, Connecticut
2 - Meters and Air eliminator, R. N. Brodie Co., Oakland, California
Valves and fittings, Ohio Pattern Works, Cincinnati, Ohio and A. Y. McDonald Co., Dubuque, Iowa

All of the equipment furnished by the contractor conforms to specifications as to materials, workmanship, functions and guarantees.

Workmanship. Continuous inspection and engineering assistance was maintained to insure good installation and operation. All concrete was batched at the Seymour plant of the Burnside Sand and Gravel Company and transported to the site in transit mixers.

The concrete base for the tank was poured monolithic and reinforced with several layers of cleaned old fence wire available on the site, to avoid use of new critical material. The tank saddles were poured after the tank was set in place to give the best setting possible to the tank. They were firmly anchored to the base by reinforcing bars and tank strap anchors in the base.

The rate of construction progress is indicated by the percent of completion shown on the semi-monthly estimates as follows:

Dates	Percent Completed
October 1, 1942	32.0
November 2, 1942	85.0
November 15, 1942	91.5
November 28, 1942	100.0

Guarantees. Under the terms of the contract, general guarantees are provided in the performance bond, against defective materials and workmanship. Equipment is of standard manufacture and carries manufacturer's guarantee. The contractor's period of guarantee extends for one year after acceptance or to November 28, 1943. Written notice to the contractor and manufacturer of equipment is required for replacement of defective mechanical parts.

Summary. The plans and specifications were well prepared for present and future requirements. An additional 12,129 gallon tank of the same size can be added east of the station without interference with underground water and sewer lines and additional dispensing units can be added within the limits of the 100 G.P.M. pump. The installation work by the contractor was excellent and the system should operate efficiently for years with only minor replacements of gaskets and hose required.

AIR CORPS LUBRICATING OIL SYSTEM.

This system consists of four horizontal used tanks placed underground with a total storage capacity of 61,104 gallons divided as follows:

Tank Number	Size - Dia. x Length	Capacity in Gallons	Storage for
1	10'-6" x 29'-5"	19,054	Waste Oil
2	10'-6" x 17'-9"	11,500	Diesel Oil
3	10'-6" x 23'-7"	15,275	#120 Lube
4	10'-6" x 23'-7"	15,275	#98 Lube

The system operates as follows:-oil is unloaded from the bottom of tank cars by gravity directly to the underground storage tanks, and is then pumped from the tanks by three positive displacement variable volume control pumps through three loading arms directly to trucks for delivery to planes. The waste oil tank has provision for receiving waste oil from trucks by gravity and a fourth pump can discharge the oil into the bottom or top of tank cars as desired for shipment to reclaiming plants.

Design Features. Old used aboveground gasoline storage tanks were reconditioned and redesigned for use as the oil storage tanks. Tank installations were designed to meet the existing high ground water conditions; the tanks are set on concrete bases and saddles and anchored to prevent flotation and embanked with earth to provide a 3 foot cover. The system included individual variable piston displacement pumps arranged for operation by remote control from the loading arms.

CONSTRUCTION DATA.

Contract designation.....No.W559eng-6401
Contractor:-Joseph Halpern, Brooklyn, New York

Pertinent Dates.

Plans and specifications completed.....August 10, 1942
Bids opened.....August 20, 1942
Letter of award issued.....August 20, 1942
Contract issued.....August 20, 1942
Construction started
a. Reconditioning of the used tanks.....August 26, 1942
b. Installation.....September 15, 1942
Original completion date.....October 20, 1942
Actual completion date.....December 15, 1942
Transferred to Area Engineer.....December 16, 1942
Transferred to Post Command.....January 8, 1943

Construction Progress. The original program contemplated construction in 60 days, however, indecision in fixing a definite location delayed commencement 20 days. Additional delays were due to time required for reconditioning used tanks, delay in delivery of needed critical materials, and inclement weather conditions.

Change orders were required during the progress of the work to meet local subsurface water conditions, to recondition used tanks, and to provide facilities for handling receipt of waste oil to storage tank.

The rate of construction progress is indicated by percent of completion showing on the semi-monthly estimates as follows:

Dates	Percent Completed
October 1, 1942	6½
October 15, 1942	30
November 2, 1942	63
November 15, 1942	79½
December 1, 1942	98
December 15, 1942	100

Equipment. The principal items of equipment used were as follows:

4 used horizontal riveted and caulked storage tanks with 3/16" shell, 1/4" heads, manufactured about twenty years ago by Graver Tank Company, East Chicago, Indiana, furnished by U.S.E.D., Louisville, Kentucky.

4 new special variable volume control pumps and motors manufactured by Yale & Towne Manufacturing Company, Stamford, Connecticut.

Piping, valves, and fittings manufactured by Buckeye Iron & Brass Company, Dayton, Ohio, and A. Y. McDonald Company, Dubuque, Iowa.

The delivery capacity is dependent on the temperature and viscosity of the oil used; however, the system should be more than ample for all required usages at this field.

All of the equipment furnished by the contractor conforms to specifications as to materials, workmanship, functions and guarantees.

Workmanship. Continuous inspection and engineering assistance was maintained to insure good installation and operation. All concrete was batched at the Seymour plant of the Burnside Sand and Gravel Company and transported to the site in transit mixers.

AIR CORPS GASOLINE SYSTEM.

Description. This system consists of seven used vertical above ground field erected storage tanks with a total capacity of 342,489 gallons divided as follows:

Tanks	Size - Dia. x Height	Capacity in Gallons	Octane and Number of System	
1-A	16' x 20'-2"	30,169	#73	1
1-B	20' x 24'-10"	58,148	#73	1
1-C	16' x 20'-2"	30,169	#73	1
1-D	16' x 20'-2"	30,169	#73	1
1-E	20' x 24'-10"	58,148	#73	1
2	25' x 28'-10"	105,517	#91	2
3	16' x 20'-2"	30,169	#100	3

The system is provided to handle 3 grades of gasoline and operates as follows: Gasoline is unloaded from the bottom of tank cars through fill header line from which positive piston displacing pumps discharge the gas into the storage tanks. It is then pumped directly from the storage tanks by other positive piston displacement pumps directly through loading arms to trucks for delivery to the planes.

Design Features. The design includes exposed fill line headers with facilities for 8 cars; two cross connected positive displacement tank car unloading pumps with total unloading capacity of 500 G.P.M.; and four positive displacement dispensing pumps (cross connected in pairs) with a total output capacity of 1050 G.P.M. All pumps are equipped with strainers, check valves, by-passes and dual set of air chambers. Tanks are individually diked with earth to hold from 1½ to 2 times tank capacities. Each tank is provided with anti-freeze water drain-off valve, fused emergency shut-off valves on inlet and outlet openings, gate valves on inlet and outlet openings, check valve on inlet opening, by-pass relief around gate valves on discharge side, electric water detector locks, outside eye level capacity gauges, wood ladders, top and side manholes and two pressure and vacuum vents on top, one 4-inch for relieving ordinary pressures at 1½ oz. and vacuum at 1 oz. and the other 6-inch for additional emergency relief at 8 oz. in case of excessive pressure due to fire.

Used field erected tanks were rebuilt and reconditioned to save use of critical war material.

There are seven separate dispensing units with wooden operator's platforms to dispense gasoline at 150 G.P.M. each. Lights are provided for night operation. All motors and electrical equipment of any kind are explosion proof. All electrical wires are lead covered and are carried underground in steel conduit and sealed junction boxes. Emergency shut-off switches at dispensing units and transfer pumps shut off the entire system until a master control in A.C. Lube Oil House is manually operated to start operation again.

CONSTRUCTION DATA.

This work was divided into two parts:-one contract for dismantling and re-erection of tanks and one part for installation of piping, pumps, electrical work, etc. Two separate contracts were awarded.

Part One - Erection of Tanks

Contract Designation.....No.W559eng-6578
Contractor: Midwest Construction Company,
1841 West Morris Street,
Indianapolis, Indiana

Pertinent Dates.

No plans prepared
Specifications prepared by U.S.E.D.....October 6, 1942
Contract awarded.....October 6, 1942
Construction started (erection).....October 17, 1942
Original completion date.....December 10, 1942
Actual completion date.....January 15, 1943
Transferred to Area Engineer.....February 15, 1943
Transferred to Post Command.....February 20, 1943

Construction Progress. The original contract was to dismantle four 30,000 gallon tanks at the Standard Oil Company in Indianapolis and to ship and re-erect them at Seymour. While this work was in progress, the District Office at Louisville decided to include in this contract, by Change Order, two 58,000 gallon tanks located at the Pure Oil Company in Logansport, Indiana, and one 105,000 gallon tank located at the Standard Oil Company in Crawfordsville, Indiana.

The rate of construction progress is indicated by the percent of completion shown on the semi-monthly estimates as follows:

Dates	Percent Completed
November 2, 1942	26
November 15, 1942	27½
December 3, 1942	31½
December 15, 1942	68
January 2, 1943	80
January 15, 1943	100

The contractor worked crews simultaneously dismantling at the above locations while other crews were erecting here. The steel for the four 30,000 gallon tanks arrived here and the tanks were completely re-erected November 30th. The steel for the 58,000 gallon tanks arrived here November 23rd and they were completely re-erected December 27, 1942.

The steel for the one 105,000 gallon tank arrived here December 17, 1942, and was completely re-erected by January 15, 1943.

All of the equipment furnished by the contractor conforms to specifications as to materials, workmanship, functions and guarantees.

Workmanship. Continuous inspection and engineering assistance was maintained to insure good welding. The contractor had sufficient crews, equipment, and ability and has done his work well, progressing as rapidly as weather permitted. The Government purchased new steel for tank bottoms in the three large tanks, and top and side manholes for all tanks.

Guarantees. Under the terms of the contract, general guarantees are provided in the performance bond against defective materials and workmanship. Signed statement has been furnished the Post Command, by the contractor, to guarantee the tightness of this work against leaks for three months after acceptance, or until May 15, 1943.

PART TWO - INSTALLATION OF PIPING AND OPERATING EQUIPMENT.

Contract Designation.....No. W559eng-6573
Contractor: Walters Construction Co.,
Woodside, New York

Pertinent Dates.

Plans and specifications prepared by U.S.E.D.	September 28, 1942
Contract awarded	October 9, 1942
Construction started	November 1, 1942
Original completion date	December 10, 1942
Actual completion date	February 20, 1943
Transferred to Area Engineer	February 20, 1943
Transferred to Post Command	February 20, 1943

Construction Progress. Work was started November 1st and continued without interruption except for delays due to winter weather, to delay in erection of tanks, and to deliveries on explosion proof electrical equipment.

During the progress of construction, change orders were made to cover the following equipment: positive piston displacement pumps were used throughout; one additional transfer pump, wood shelters for pump protection, fused emergency shutoff valves, and emergency escapement vents for safety were added. Bonding, insulating, and grounding of tracks was provided for safety. Loading platforms and lights were provided for better operations.

The rate of construction progress is indicated by the percentage of completion shown on the semi-monthly estimates as follows:

Dates	Percent Completed
November 20, 1942	18
December 1, 1942	35½
December 16, 1942	43½
January 2, 1943	60
January 15, 1943	72
February 1, 1943	89
February 20, 1943	100

The principal items of equipment consisted of:

4- 300 G.P.M. pumps with 7½ H.P. motors)	Manufactured by
2- 200 G.P.M. pumps with 7½ H.P. motors)	Viking Pump Co. Cedar Falls, Iowa
7- Loading arms -	Ohio Pattern Works, Cincinnati, Ohio
7- Electric water detector locks.-	Wayne Co., Ft. Wayne, Ind.
14- Vacuum and pressure vents)	Morrison Bros.,
14- Fused emergency shut off valves)	Dubuque, Iowa
Gate valves, check valves and)	Wm. Powell Co.,
strainers)	Cincinnati, Ohio
)	A. Y. McDonald Co.,
)	Dubuque, Iowa

Guarantees. Under the terms of the contract, general guarantees are provided in the performance bond against defective materials and workmanship. Equipment is of standard manufacture and carries the manufacturer's guarantee. The contractor's period of guarantee extends for one year after acceptance, or to February 20, 1944. Written notice to the contractor and manufacturer of equipment is required for replacement of defective mechanical parts.

Organization. The contractor had no equipment of his own and except for supervision, subcontracted all parts of the work as follows:

Name	Address	Nature of Work
Ben Basham	Charleston, Ind.	Earthwork, carpentry and concrete
Greenblatt Electric Co.	Atlanta, Ga.	Electric work
Lockwood Construction Co.	Woodside, N. Y.	Piping and valve work

The contractor's supervision and management of subcontractors was excellent and the work progressed as rapidly as possible after arrival of the tanks and equipment.

Comments and Remarks. All of the plans and specifications were well prepared and only required construction changes due to the use of used tanks of varying sizes and conditions, local subsurface water conditions, and additional safety features.

The following suggestions are made only with the sole thought of helpfulness in preparation of future plans and specifications for similar work:

1. The specifications should designate trade names of equipment, in such a manner as not to eliminate competition, but to set up good standards of requirements, and avoiding uncertainties as to details.

2. The specifications should detail thoroughly the operations of the electrical systems.

3. The functions of valves and mechanical units should be designated.

4. Gasoline should be unloaded from the tops of tank cars.

5. Gate valves should be specified instead of allowing specifications open to either gate or plug valves.

6. Fused automatic emergency shut-off valves should be specified on inlet and outlet openings of aboveground gasoline tanks to stop flow of liquid in case of fire.

7. Sufficient vent escapement capacity should be provided on top of tanks to prevent tanks blowing up in case of fire.

8. Float type water detection should be used as being more positive and durable than electronic tube and probe rod type.

9. Gasoline track should be insulated against stray electrical currents and all rail joints bonded and grounded.

10. All pumps should be housed for protection.

11. Walkways should be provided over dikes to tank operating valves.

12. Lights should be provided for night operation.

13. Platforms should be provided at dispensing stands for loading operations.

14. Specifications should permit use of positive piston displacement pumps with by-passes on all flows over 30 G.P.M.

15. Provisions should be made for insulating and heating the lube oil house to prevent congealing of oil in cold weather.

16. Provision should be made to heat lube oil tank cars for unloading in cold weather.

SECTION 15

BUILDINGS - BASE FIELD

DESCRIPTION

General - The buildings on this Post, comprising 413 structures at the Base Field, have been laid out and designed with the purpose of efficiently housing and servicing the military and civilian personnel. Provisions for civilian personnel have been held to a minimum, although it is contemplated that a relatively large number of civilians will be employed in various capacities when the post is operating at full strength. There are no provisions for housing them on this reservation; messing facilities have, however, been provided.

Attention is directed to Exhibit 4-A, in Section 22, entitled "Alphabetical List of Buildings and Structures". This Exhibit contains, in a concise tabulation, the pertinent information on all buildings and structures.

Capacities - Buildings were originally contemplated for a military personnel of 372 officers, 506 cadets, 3254 enlisted men and 150 WAACs. Based on the allotment of 60 square feet per person for living quarters, the Post, as constructed, has a capacity for 432 officers, 520 cadets, 3434 enlisted men and 155 WAACs and officers. Subsequent directives from the Office of the Chief of Engineers have indicated that increases in personnel at air force stations of this type will be made by an adjustment in the capacities of the existing structures, based on an allotment of 40 square feet per person for living quarters.

Capacities for the various classifications of structures at this station are tabulated herein on the following condensed Schedule of Building Types and Capacities:

CONDENSED SCHEDULE OF BUILDING TYPES AND CAPACITIES

Types of Structures	No. of Bldgs.	Capacity
Barracks and Quarters	161	4641 Men
Hospital Buildings	(8	321 Men
	(6	14460 sq.ft.
Lavatory Buildings	38	4650 Men
Warehouses	19	84405 sq.ft.
Mess Halls	8	3777 Men
Shops, Hangars, Etc.	(18	132,272 sq.ft.
	(1	2 Vehicles
Recreational & Instructional Bldgs.	(4*	1322 Men
	(34	60621 sq.ft.

Types of Structures	No. of Bldgs.	Capacity
Supply Buildings	20	29507 sq.ft.
Ordnance Buildings	7	6820 sq.ft.
Administration Buildings	46	109,488 sq.ft.
Miscellaneous Buildings	17	19,426 sq.ft.

* School, theatre, chapels.

Any discrepancies observed between the Schedule and the capacities listed above is accounted for by the fact that the Schedule lists total capacities of all structures under any one classification; thus, in the case of the Barracks and Quarters; for instance, the capacities of the Guards' and Prisoners' Barracks have been included in the totals in the Schedule, but were not listed in the facilities above.

Record Drawings - Record drawings of all building construction showing plans, elevations, sections, and details of construction as built have been officially filed as directed in O.C.E. Form 290. These record drawings of the buildings and structures, described under this section, have been prepared in accordance with the contract divisions and contract awards, and are grouped and indexed as follows:

Division A-1	3 Drawings
Division A-2	39 Drawings
Division A-3	105 Drawings
Division A-4	84 Drawings
Division A-5	93 Drawings
Division A-6	96 Drawings
Typical Drawings Applying to Divisions A-4, A-5, and A-6	19 Drawings
WAAC Housing	37 Drawings
Skeet and Pistol Ranges	6 Drawings
Total	482 Drawings

The above record drawings include complete detailed records of all plumbing, heating, refrigeration and ventilation systems installed as subcontracts (See Section 16 of this report) and all the electrical work in the hangars, WAAC housing and Civilian Mess.

The basic types of the record drawings fall into five groups, as follows:

A. Drawings prepared by the Architect-Engineer modifying standard Government drawings.

B. Drawings prepared by the Architect-Engineer without reference to Government drawings.
C. Standard Government drawings modified by the Architect-Engineer for use on this project.
D. Standard Government drawings used without modification.
E. Standard Government drawings modified by the U. S. Engineer Office, Louisville, Kentucky, for use on this project.

The record drawings themselves are also appropriately marked so that an inspection of any individual drawing will indicate in which of the above-listed groups it belongs. (See Exhibit 4-B)

Design Data and Layouts. The original layout of buildings and structures for this project was made by the U. S. Engineer Office, Louisville, Kentucky, in conjunction with the approval of the Southeast Army Air Forces Training Command, Maxwell Field, Montgomery, Alabama. Reference is made to Exhibit 4-B in Section 22, which is a tabulation of all buildings and structures on the Base Field, arranged numerically by "Post Building Number" and contains pertinent data on each structure including basic type of building by group. This exhibit will be helpful in analyzing and studying the nature and extent of the buildings and structures.

From the operating standpoint, the buildings are grouped and classified as follows:

1. Officers Area
2. Cadets Area
3. Squadron Areas
   a. School Squadrons (Nine)
   b. Band Squadron
   c. Air Base Group Headquarters and Headquarters Squadron
   d. Air Base Squadron
   e. Material Squadron
   f. Aviation Squadron (Colored)
   g. Quartermaster Squadron
   h. Quartermaster Squadron (Colored)
4. Hospitalization
5. Station
6. Ordnance
7. Range Facilities (See Section 17 of this Report).

Several additional buildings were added to the original general layout of the Base Field, and the several approvals for these buildings have been secured from the Post Command, Louisville District Office, and the S.E.A.A.F.T.C.

A site layout plan of the Advanced Twin Engine School is shown in Exhibit 3-H. The air operations buildings and the A. C. Squadron Hangars are grouped around the periphery of and adjacent to the concrete aprons; the school squadrons are grouped in various sections in areas adjacent to the north; the officers quarters, hospital

area and WAAC housing areas are located at the northerly end, near the center of the reservation; and the Sub-depot and warehouse areas are arranged in the northeastern quadrant, near the railroad spur and main supply road. The ordnance area is in an isolated area, located in the northwestern section of the site, 1,200 feet west of the north end of the N-S runway.

The types of building construction fall into two classifications: Theater of Operations Modified, and Mobilization Modified. Mobilization Modified construction is used for the majority of the buildings in the Hospital Area, the principal buildings in the Sub-Depot and Ordnance Areas, and certain recreational, instructional or operational buildings such as the Theater, Chapels, Photographic Laboratory, and Link Trainer Buildings. With few exceptions, all other buildings are Theater of Operations Modified type.

The construction employed for Theater of Operations Modified and Mobilization Modified types is discussed at greater length hereinafter under "Construction Data."

Future Expansion. The possibilities for expansion of the existing living facilities has been previously described under "Capacities." There is ample room for expansion of the field by the addition of future buildings. The original general layout of the field was apparently conceived with careful thought given to building expansion possibilities. With the building spacing employed on this project, the ratio of building area to site area in the populated portions of the field is 14%; whereas, the average percentage of total building area to total building site area is approximately 6, which is indicative in a general way of the expansion possibilities available.

Special Features of Design. The only special features of design employed in the construction of these buildings is in the types of modification employed, inasmuch as the great majority of structures have been constructed from the standards established by the Office of the Chief of Engineers of the War Department.

The Theater of Operations buildings were modified by the use of wood floors in all living quarters, and concrete floors in all other buildings of this type. This was done in the interest of conservation of critical materials. With the exception of the seven Temporary Warehouses constructed under Division A-1 (Contract W559eng-6220), the exterior facing of all T. O. Buildings is a buff colored Celo-Siding, a product of The Celotex Corporation. This project was one of the first in this section of the country to utilize this exterior wall surfacing material on such a sizeable scale. It is felt that the substitution of this material for the tar paper and wood lath battens (typical for T. O. Construction) originally contemplated, has resulted not only in a better appearing project, but in a more weathertight, useful and serviceable construction as well.

The modification of the Mobilization Type Buildings has been confined principally to the elimination of critical materials such as metal stacks, reinforcing, and other items of metal and other similar materials. Floor construction in all mobilization buildings except hospital buildings was also changed to concrete.

CONSTRUCTION DATA

General. The plans and specifications for the construction of the buildings (except the few buildings included with utility contracts) were divided in eight divisions, as follows: Divisions A-1 to A-6 inclusive, the A. C. Squadron Hangars, and the WAAC Housing. The A. C. Squadron Hangar drawings were classified with Division A-6 for record drawing purposes because all five hangar buildings are located in that area.

Construction of the A. C. Squadron Hangar Buildings and the WAAC Housing was authorized subsequent to the other buildings on the base field. The purpose of subdividing the base field buildings into six original divisions was to expedite construction by allowing certain portions to be started before the drawings and specifications for the whole were completed. This was effective in the case of Division A-1, the Temporary Warehouses; bids were taken and a contract awarded before the most of the drawings for the remaining buildings were completed. The drawings and specifications for the other five divisions were filed at various dates with the District Engineer. Proposals were arranged which offered prospective bidders the choice of bidding on any one or more divisions of the work. The award of Divisions A-2 to A-6 inclusive was made to O'Driscoll & Grove, Inc., and H. L. Fischer, Inc., of New York City as a single contract. This was helpful from the construction standpoint in that it reduced the contract work and reports required, expedited progress, and aided in standardization of construction features.

Pertinent Dates of Construction. The pertinent data and dates of the construction period of all the above mentioned divisions of the work from the commencement of office studies to the final completion and transfer to the Area Engineer are listed on the following sheet entitled, "Pertinent Dates of Construction".

Subcontractors. The subcontractors employed by the various prime building contractors on this work are listed below according to contract number:

Subcontractors Under Contract W559eng-6220

Name and Address	Brief Description of Work
Robert J. Stadtmiller, Shelbyville, Ind.	Plumbing & Heating
Edward Maritz, Shelbyville, Ind.	Window Cleaning
Martin Kelsay, Shelbyville, Ind.	Painting
Pearson Construction Co., Seymour, Ind.	Electrical
Dunlap & Co., Inc., Seymour, Ind.	Millwork
Burnet-Binford Lumber Company, Indianapolis, Indiana	Millwork

Subcontractors Under Contract W559eng-6319

Name and Address	Brief Description of Work
Carlson Building Specialties, Chicago, Illinois	Miscellaneous Iron
Chicago Roofing & Sheet Metal Co., Chicago, Ill.	Roofing & Sheet Metal
Commercial Fuel & Service Co., Bellville, Illinois	Trucking
The Dell Corporation, Morton Grove, Illinois	Warm Air Heating & Vent.
Fox Bros. Mfg. Co., St. Louis, Mo.	Millwork
General Electric Supply Corp., Louisville, Kentucky	Refrigeration Equipment
James E. Smith Plumbing & Heating Co., Louisville, Kentucky	Plumbing & Heating
Stanley Schultze & Co., Louisville, Ky.	Glazing
R. B. Tyler, Louisville, Ky.	Expansion Joint Material
United Cork Co., Cincinnati, Ohio	Refrigeration Insulation
VanCamp Hdw. & Iron Co., Indianapolis, Indiana	Hardware
Mid-States Engineering Co., Champaign, Illinois	Refrigeration Unit
E & T Burnside, Columbus, Ind.	Plant Mixed Concrete
Alphons Custodis Chmney Const. Co., Detroit, Michigan	Radial Brick Stack
Ceco Steel Products Corp., Chicago, Illinois	Steel Reinforcing
Erickson Flooring Co., New York, New York	Floor Laying
Sager Weatherstripping Co., Chicago, Illinois	Weatherstripping
A. F. Koedding, Jr., St. Louis, Missouri	Painting
F. A. Wilhelm, Indianapolis, Ind.	Masonry Work
W. I. Schnurr, Louisville, Ky.	Plastering
The Bartel Co., Toledo, Ohio	Wood Flag Pole

Subcontractors Under Contract W559eng-6481

C. L. Mahoney, Kalamazoo, Mich.	Plumbing & Heating
Platt & Schneider, Edinburg, Ind.	Masonry
Imbus Brothers, Cincinnati, Ohio	Roofing & Sheet Metal
C. (Buss) Kirchdorfer, Louisville, Ky.	Painting
Sager Weatherstrip & Caulking, Corp., Chicago, Ill.	Caulking

Subcontractors Under Contract W559eng-6702

Name and Address	Brief Description of Work
Frey Planing Mill Co., Inc., Louisville, Kentucky	Millwork
James E. Smith Plbg. & Htg. Co., Louisville, Kentucky	Plumbing & Heating
Chicago Roofing & Sheet Metal Co., Chicago, Illinois	Roofing & Sheet Metal
Pearson Construction Co., Benton Harbor, Mich.	Electrical Work
Belknap Hardware and Mfg. Co., Louisville, Kentucky	Hardware

Prime Building Contractors. The construction data included in this report will be analyzed and narrated by reference to the various prime building contractors, in order that the work performed by each prime contractor, even though comprising different types of construction, may be considered with respect to the workmanship and management of the individual contractor's organization. Information regarding the mechanical work on these buildings is not discussed here, but is contained in Section 16 of this report.

1. Shelby Construction Co., Inc., Contract W559eng-6220, Construction of 7 Warehouses

General. The construction of seven Temporary Warehouses was the first building contract awarded on this project. The contract included no mechanical work; the electrical work was handled under another contract, and there were no provisions in these buildings for plumbing or heating of any kind. Certain interior partitions and cannon stoves were subsequently furnished and installed by purchase and hire, entirely without reference to the contract under discussion.

Construction of the Field Quarters Buildings for the Area Engineer and the Architect-Engineer was added to this contract by Supplemental Agreement, which included plumbing, heating and electrical work.

Construction. The exterior wall construction on the Temporary Warehouses consisted of nominal 1" wood sheathing covered by tar paper and painted wood lath battens. These are the only buildings on the project using this exterior treatment.

Difficulties Encountered. Considerable difficulty was encountered with the standard roof construction called for by the Government drawings which were the basis of the Architect-Engineer's drawings

PERTINENT DATES OF CONSTRUCTION
BUILDING CONSTRUCTION CONTRACTS

	Cont. W559 eng-6220 Shelby Constr. Co., Inc., Shelbyville, Ind.	Cont. W559 eng-6319 O'Driscoll & Greve, Inc. and H. L. Fischer, Inc., New York, N.Y.	Cont. W559 eng-6481 Pearson Const. Co., Benton Harbor, Mich.	Cont. W559 eng-6702 G. Kehl Sons Chicago, Ill.
Office Work Started	5-14-42	5-14-42	Work done in District Office	Work done in District Office
Plans and Specs. Completed	6-6-42	7-12-42	7-12-42	7-12-42
Bids Opened at District Office	6-20-42	7-22-42	9-1-42	12-1-42
Letter of Award Issued	6-20-42	7-24-42	9-1-42	12-1-42
Receipt of Notice to Proceed	6-22-42	7-27-42	9-1-42	12-9-42
Original Scheduled Completion	8-21-42	9-15-42(1) 10-15-42(2) 10-10-42(3) 10-25-42(4)	11-15-42	1-15-42
Authorized Extended Completion Date	9-14-42		12-18-42	
Actual Construction Completed	11-10-42	2-28-43		
Transferred to Area Engineer	11-16-42	Transfer began 10-29-42 Transfer completed 2-28-43	2-28-43*	2-28-43*

(1) Div. A-2
(2) Div. A-3
(3) Div. A-4
(4) Div. A-5 & A-6

*Engineering Supervision transferred from Architect-Engineer to Area Engineer

for these buildings. It is felt that the purlin spacing originally called for was inadequate to prevent excessive deflection of the 1" roof sheathing boards on roofs of such a flat slope, and that the specified roofing material (standard for T. O. construction of this type) was inadequate. To overcome these defects, the purlin spacing on five of the seven buildings was reduced from 4'-0" to 2'-0" c.c. This was of material aid from a construction standpoint, but did not alleviate the inadequacy of the 55-lb. mica surfaced roll roofing installed as the roof covering. The contractor repaired the recurring leaks several times before final acceptance of the buildings, but they kept reappearing so it was decided to re-roof the buildings, employing a two-ply mopped built-up roof applied over the original roofing material. This was accomplished by a separate contract entered into by the Area Engineer and the Chicago Roofing and Sheet Metal Company.

Allocated and Government-Furnished Equipment and Materials. Allocated materials under this contract consisted of structural lumber and nails, with the customary provisions that the non-structural lumber and certain starting lumber be furnished by the contractor. There was no Government-furnished equipment for these buildings.

Workmanship. The contractor's workmanship and coordination of the work of subcontractors was very satisfactory, and continuous inspection by the Architect-Engineer staff resulted in a job of uniformly good construction.

Progress. The contractor's progress was good; the scheduled completion date was not strictly complied with, but all buildings were substantially completed and ready for occupancy within a few days of the scheduled date. It is not felt that the contractor was remiss or negligent in the prosecution of his work. Final acceptance was delayed by the arrival of certain minor items, over which the contractor had no direct control.

Changes in the Work. There were no major changes in the work under this contract. The installation of additional purlins has been previously mentioned. On the Field Quarters Building certain minor revisions were made during the course of construction to render the building more adaptable to the operations of the Area Engineer and the Architect-Engineer.

Guarantees. A one-year general guarantee covering repair and/or replacement of defective materials and/or workmanship is one of the contractual obligations.

Contractor's Organization. The Shelby Construction Co., Inc., is a small, compact, adaptable and efficient organization which operates effectively with a minimum of overhead costs.

2. O'Driscoll and Grove, Inc., and H. L. Fischer, Inc.
Contract W559eng-6319
Construction of T. O. Mod. and Mobilization Mod. Buildings.

General. The largest building construction contract on this project was awarded to the above mentioned organization which, for purposes of simplification, will hereinafter be referred to as O'Driscoll and Grove. Their contract comprised all building work in Divisions A-2 to A-6 inclusive, exclusive of electrical work, and constituted all of the originally authorized building construction on the Base Field, except the Temporary Warehouses.

Construction. The principal innovation in the construction of the buildings under this contract consisted in a change in the contemplated exterior wall construction of the T. O. Buildings from 1-inch wood wall sheathing with tar paper and painted lath battens (stud spacing 4'-0" c.c.) to 1/2-inch T&G gypsum sheathing and 7/8-inch granule surfaced fiberboard exterior facing, installed over studs respaced on 2'-8" center to provide additional rigidity.

All construction was based on Government standards so far as principal features of layout, design and structural work were concerned, and modifications at this field were as previously described herein.

Allocated and Government-Furnished Equipment. Structural lumber, nails, cast iron low pressure boilers, medium pressure boilers, steam hot water generators and storage tanks, water heaters and hot water storage tanks, and vacuum and condensate pumps were allocated under this contract. Government-furnished equipment to be installed by the contractor included cannon stoves (U. S. Army #1 Space Heaters), grease interceptors, kitchen equipment, and hospital medical equipment.

The quality of the allocated structural lumber was none too good, particularly in the larger members, and careful inspection had to be exercised to prevent the incorporation of unsatisfactory pieces into trusses, columns, and similar members. For a discussion of the difficulties encountered with allocated medium pressure boilers, storage tanks, etc., see Section 16 of this report.

A considerable delay was experienced in the delivery of the Government-furnished kitchen and hospital medical equipment from central procurement. In fact, some of the equipment called for by the drawings was never furnished, and proper credits were established for the omission of the installation.

Workmanship. The contractor's workmanship was generally good. Coordination of the subcontracotrs was about as good as could be expected, considering the very large number of them. The final results, however, are considered well above average in most instances. On the whole, the types and quality of materials, and the ability and experience of direct and supervisory labor were consistently good.

Progress. The progress of this contract was considerably behind the original schedule, and none of the specified contract completion dates for the various divisions were met. There were several reasons for this: (1) Due to the nature and extent of the heavy grading operations being performed under another contract, not all of the site was available to the contractor for the commencement of building operations at the beginning of his work. (2) A considerable delay was experienced in the delivery of much of the allocated and Government-furnished materials and equipment. Attempts were made by both the contractor and the Area Engineer to expedite delivery of this material, with only moderate success. A considerable delay in final completion of the contract was occasioned by the continuous rescheduling of the delivery dates. (3) The contractor prosecuted his work in an efficient, diligent manner until the contract was approximately 75% complete, at which time he began reducing his organization to the point where the construction progress noticeably declined. It is not felt that this slowing down was justifiable in the light of other pertinent factors, or that it resulted in any appreciable net gain to the contractor since it delayed final completion of the work as a whole. With practically no exceptions, however, all of the buildings were ready for occupancy by the Air Corps when required.

Changes In the Contract. Changes in the work can roughly be classified into four groups: (1) additional buildings or facilities not covered by the original directives; (2) changes in construction and requirements caused by subsequent directives modifying or revising the contract work; (3) miscellaneous structural and mechanical changes and revisions required by changes in allocated and/or Government-furnished equipment; and (4) miscellaneous changes made in the interest of improving the construction as it applied to individual problems of operation and maintenance.

The total cost of change orders under this contract totaled approximately $165,000.00. The contractor's original proposals covering this work were in excess of $210,000.00, but negotiations carried out by the Architect-Engineer prior to preparation of the actual change orders resulted in a saving of the difference in the above figures.

Guarantees. A one-year general guarantee covering repair and/or replacement of defective materials and/or workmanship is one of the contractual obligations.

Contractor's Organization The contractor's organization was well-integrated and performed very efficiently on most items of the work. The purchasing and delivery of contractor-furnished materials was handled very effectively with little or no delays. The contractor was, however, dilatory in the submission of proposals for authorized changes in the work which were ordered executed in advance of price agreements.

3. Pearson Construction Co., Inc., Contract W559eng-6481
Construction of A. C. Squadron Hangars.

General. The construction of the five Air Corps Squadron Hangars was awarded to the Pearson Construction Co., Inc., subsequent to the award of the principal building contract to O'Driscoll and Grove. This contract included all mechanical work. The construction of a Triple Skeet Range (See Section 17 of this report) and the Civilian Mess Building were added by Supplemental Agreements to this contract.

Construction. The construction was carried out in accordance with standard Government drawings, modified and adapted for use at this station.

Allocated and Government-Furnished Equipment and Materials. All lumber except exterior and interior wall sheathing, siding and millwork was allocated; there were no other allocated items. The Government-furnished equipment consisted of copper conductor (wire or cable), electric light bulbs, and forced warm air furnaces.

Considerable difficulty was experienced in obtaining satisfactory delivery of the allocated structural truss lumber, and in obtaining the proper lengths necessary for the construction of the 120 foot trusses and columns. Much of the original allocation list called for "random length" pieces, and until the invoices were received it was impossible to know what was going to be delivered. An excessive amount of short lengths was contained in the random lengths, which required redesign of column and bracing members to use the shorter pieces of truss lumber received.

Progress. The contractor's progress was consistently behind schedule, for several reasons. The allocated lumber was very slow in arriving, and some of it was not on the job until a month after the scheduled completion date. Many of the important sizes of lumber did not arrive until early in December, which delayed fabrication of the trusses. This brought the construction work, all of which was outdoors at that time, into winter weather, and continued precipitation caused complete cessation of the work on numerous occasions and hindered operations on other days.

The contractor's efforts to overcome these obstacles were satisfactory and generally effective. There was no principal delay caused by non-delivery of materials other than the allocated lumber.

Changes In The Work. The changes in this work were relatively few. Re-design of certain columns and bracing members due to improper sizes of allocated material has been referred to previously. The other changes were principally concerned with adaptation of the construction to the site conditions, and conformity with the standards established at this station.

Guarantees. A one-year general guarantee covering repair and/or replacement of defective materials and/or workmanship is one of the contractual obligations.

Contractor's Organization. The performance of the contractor's organization was quite satisfactory. Purchases and deliveries of contractor-furnished items were well coordinated. One or two of the sub-contractors were usually behind the progress of the remaining work, though this did not result in any serious delays. Excellent supervisory employees on the part of the contractor resulted in a job of uniformly high quality.

4. G. Kehl Sons, Contract W559eng-6702, WAAC Housing.

General. The smallest of the building contracts was for the construction of the four buildings comprising the WAAC housing, which were awarded to G. Kehl Sons of Chicago, Illinois. This work was the last building construction work of any magnitude authorized for the Base Field. The mechanical work for these buildings was included in this contract.

Construction. The WAAC buildings are a sort of hybrid combination of T. O. Modified and Mobilization Modified construction. The contractor was given an option in the choice of siding materials, and chose to use 1/2 inch T&G gypsum sheathing and wood siding. The general framing of the buildings is comparable to T. O. construction. The two WAAC Barracks are the only two-story buildings constructed on this project.

Allocated and Government-furnished Equipment. There was no allocated material under this contract. The following items, however, were Government-furnished: cannon stoves, copper wire, electric light bulbs, and kitchen equipment. Largely through the expediting efforts of the Area Engineer and the Architect-Engineer, all of the Government-furnished equipment was delivered in time to be installed by the contractor without delay in the construction schedule of his work.

Workmanship. The workmanship on this contract was unusually good. Many of the stock items of trim, lockers, cabinet work, etc., were fabricated by the millwork subcontractor instead of by hired labor on the job, which resulted in a class of work better than could have been required by the strict interpretation of the specifications. There was a manifest interest in obtaining good workmanship, and the finished product is evidence of this fact.

Progress. The progress of this contract was the nearest to schedule of all the building construction contracts. On the contract completion date the work was 96% complete, and was virtually ready for occupancy. A few undelivered items of hardware, some exterior

painting which was held up by cold weather, and other minor items of final clean-up were all that remained at that time, and the first two of these items were outside the contractor's control. Considering the fact that this was entirely a winter contract, and that the allotted time was no more than sufficient under favorable circumstances, the contractor's performance was unusually good.

Changes. The changes in this work were negligible. The work proceeded smoothly, the drawings and specifications were closely followed; no altering directives were received during the course of construction, and the change orders were held to a minimum.

Guarantees. A one-year general guarantee covering repair and/or replacement of defective materials and/or workmanship is one of the contractual obligations.

Contractor's Organization. The contractor's organization functioned very efficiently on this job, as was evidenced by the progress of the work. It has been the observation of this office that the organization is closely knit and operates very efficiently, with little lost motion.

SECTION 16

PLUMBING, HEATING, REFRIGERATION & VENTILATION

DESCRIPTION

General. The items of work described in this section under the above title are the equipment and installation of all complete plumbing, heating, refrigeration and ventilation systems in the various buildings on the Base Field, constructed by both prime and subcontractors. Divisions of the work given in the following tabulation:

Contract	Title	Division
Prime Contract W559eng-6354	Hospital Heating Plant & Systems	Div. B-10
Subcontract of W559eng-6319	Hospital Area Sprinkling System	In Div. A-3
Subcontract of W559eng-6319	Refrigeration systems	In Divs. A-2 to A-6
Subcontract of W559eng-6319	Heating Systems	In Divs. A-2 and A-6
Subcontract of W559eng-6319	Heating Systems	In Divs. A-2 to A-6
Subcontract of W559eng-6319	Heating Systems	In Divs. A-2 to A-6
Subcontract of W559eng-6702	Heating Systems	In Div. A-3
Subcontract of W559eng-6702	Heating Systems	In Div. A-3
Subcontract of W559eng-6481	Plumbing System	In Div. A-4 and A-6
Subcontract of W559eng-6319	Plumbing System	In Div. A-2 to A-6
Prime Contract W559eng-6481	Refrigeration in Civilian Mess	In Div. A-4

In Contract No.	Heating, Plumbing, Refrigeration and/or Ventilation Work By	Arranged and work done by
W559eng-6354	Hipskind Heating & Plumbing Co.	Prime Contractor
W559eng-6319	James E. Smith Plumbing & Heating Co. J. E. Lindsly Sprinkler Co.	Subcontractor on Plumbing & Heating Work for O'Driscoll & Grove, Inc., & H. L. Fischer, Inc.
W559eng-6319	General Electric Supply Corp.	Subcontract on refrigeration for O'Driscoll & Grove, Inc., & H. L. Fischer, Inc.
W559eng-6481	C. L. Mahoney	Subcontract on heating and plumbing for Pearson Const. Co.
W559eng-6702	James E. Smith Plumbing & Heating Co.	Subcontract on plumbing and heating for G. Kehl Sons

The plumbing work done by subcontract under Contract W559eng-6319 required continuous and continual retesting of the plumbing connections before acceptance as a whole was finally made.

Materials and Workmanship. In general, all materials and equipment furnished by contractors on the plumbing, heating, refrigeration and ventilation systems were in full compliance with the requirements of the several plans and specifications under which the above contracts and subcontracts were constructed and with one exception, namely: The commonly known "Victory" type of cast iron pipe was used in place of the type specified inasmuch as specified pipe was not available.

Workmanship on heating systems under contract W559eng-6354 was excellent. Initial tests on the complete work were indicative of the care taken by skilled labor in assembling the heating equipment, connecting piping, etc.

The plumbing work done by subcontractor under contract W559eng-6319 required continuous and continual retesting of the plumbing connections before acceptance of the work as a whole was finally made.

The workmanship by the subcontractors on plumbing and heating in the Civilian Mess Building, A. C. Squadron Hangars and the WAAC housing was good and all tests were found to be well within the limits of acceptability.