COMPLETION REPORT
1941

CAMP JOSEPH T. ROBINSON
LITTLE ROCK, ARKANSAS

NARRATIVE REPORT

of

THE CONSTRUCTING QUARTERMASTER'S OFFICE

To be included in the completion report

of

CAMP JOSEPH T. ROBINSON, ARKANSAS

DESCRIPTION

Camp Joseph T. Robinson, tent-barracks regimented cantonment designed for twenty-five thousand soldiers including the classifications of a fully equipped Division, with headquarters and administration buildings, hospital, railroads and warehouses, communications, roads and all utilities, was constructed between September 9, 1940, and March 31, 1941, at an over all cost of eleven and one-half million dollars. Sixteen thousand troops of the 35th Division and the 153rd Infantry Regiment were received between January 2nd and January 7, 1941, the original date scheduled for arrival of troops.

Under the direct supervision of the Constructing Quartermaster, the Camp was built under a cost-plus-a-fixed-fee contract by MacDonald Construction Company and G. L. Tarlton Contractor, Inc., St. Louis, Missouri. Black and Veatch, Kansas City, Missouri were supervising engineers.

Situated at the site occupied by Camp Pike during the World War, in the low rolling foothills of the Ozark Mountains in the center of Arkansas six miles north of Little Rock, Camp Robinson embraces an area of forty-four thousand acres including artillery ranges and maneuver areas. The United States Government owned six thousand acres of this land and the rest was acquired by the U. S. Engineers through lease and condemnation proceedings while the Camp was being built. Elevation of this locality is from four to six hundred feet above sea level; average

temperature sixty-two degrees; average yearly rainfall forty-seven inches; average yearly snowfall, five inches; average wind velocity seven and one-half miles per hour, and average sunshine sixty-three percent of possible. The ground is generally rocky and thickly overgrown with post oak, sweet gum and black gum.

CONSTRUCTION

Captain (now Major) Frank H. Reed, Jr., QMC Reserve, Constructing Quartermaster, arrived September 17th, and on the same day Major J. Harris, Finance Officer, Seventh Corps Area, was at the Camp site to arrange for accomodations for the Post Finance Officer and staff. Captain Reed spent his first day in securing quarters and temporarily assigning them for use of the Constructing Quartermaster, the Auditors and the Contractors. The Engineers were already stationed in two offices in the existing National Guard theatre building.

Messrs. J. J. Gilmore and R. E. MacDonald, Contractors' representatives, arrived September 18th and took quarters in one end of the existing Administration Building.

The first of the Constructing Quartermaster's Staff Officers to arrive were 2nd Lieutenant (now 1st Lieutenant) Walter P. Blum, Ord-Res., who assumed his duties as Property Officer on the morning of September 19th, and Captain Lynn C. Barnes, QM-Res., who reported on the afternoon of the same day. Mr. Austin C. Hoolihan, Engineer, civilian employee assigned to the Constructing Quartermaster as Chief Materials Inspector, Auditing Branch, reported for duty of September 20th.

The first joint conference of Constructing Quartermaster, Contractors and Engineers concerning office hours, fire prevention, hospitalization, and general matters of policy was held on September 21st.

Freight, materials and supplies began arriving September 19th; approximately two hundred employees were already on the Contractors' payrolls, and bus service to Camp was instituted September 23rd. Construction was beginning in earnest and the task of making provision for the audit of labor, the receiving and auditing of materials, the establishing of procedure and setting up of forms fell to the Constructing Quartermaster and his four aides already arrived.

On September 24th the Constructing Quartermaster held a conference on plans for housing construction with Colonel George D. Wahl, Lieutenant-Colonel Max A. Elser, and Major Charles S. Miller of Seventh Corps Area Headquarters.

On September 25th the completion date was fixed by the Quartermaster General at January 2, 1941, and the Constructing Quartermaster was authorized to contract with the Missouri Pacific Railroad for trackage in Camp, and to procure office furniture and equipment in the open market.

Mr. H. M.,Hurlburt, Chief Fiscal Auditor for the Constructing Quartermaster, reported for duty on September 27th, and the Field Auditor, Mr. Charles F. Bridewell, on September 30th. Mr. Bridewell had served as Field Auditor in the construction of Camp Pike during the World War.

Captain Sydney F. Abrahms, Assistant to the Constructing Quartermaster, reported on October 1st; Mr. George M. Davis, Administrative Assistant to the Field Auditor, on October 3rd; Mr. George Eckelkamp, Field Auditor's Chief Time Inspector, on October 7th; and Captain William C. Campbell, QMC, on October 9th; Lieutenant M. B. Easterling on October 28th,

Visitors at about this time included General Truman, General Bishop, Colonel Wahl, Major R. L. Groves, Governor Bailey and Senator Miller of Arkansas, Mr. J. Z. Burgee, Architect-Representative of the National Defense Committee, and several War Department inspectors.

On October 9th. the Constructing Quartermaster went to Seventh Corps Area Headquarters at Omaha for final conference on approval of the Camp layout.

By October 12th the Project was reported as eight percent complete, and the Contractors showed expenditures of one million, three hundred thousand dollars. The Field Auditor had been handicapped in obtaining personnel by Civil Service regulations and the lack of available registers, and although the regulations were waived early in October, his force was not adequate to audit labor, material and equipment until late in the month. The first labor payroll to be successfully preaudited was that of October 30th.

The peak of construction activity was reached by mid-December. The Contractors had approximately ten thousand employees and the Constructing Quartermaster and Field Auditor about two hundred. Most of the important alterations of design had been approved, including the

installation of storm sewers and natural gas facilities for the tents. Work on the warehouses and utilities lines was continued twenty-four hours per day with the aid of flood-lights.

Labor was procured through the cooperation of the State Employment Service. Ninety-eight percent of the labor was local. The structural steel workers were imported, as were many of the plumbers and steamfitters. Workers were subjected to physical examination prior to employment.

There was no labor trouble. No condition or incident ever ripened into anything more than the normal expectancy for a construction project with ten thousand employees. There were evidences from time to time of trouble brewing among the plumbers and steam-fitters but in each instance they were quieted by the Constructing Quartermaster before any difficulty developed.

Two methods of checking labor were employed by the Constructing Quartermaster's Field Auditor. For the stationary crews (buildings and tent-frames) he required workers to report in and out by number at fixed stations; his auditors received carbon copies of the check-in lists taken by the Contractors' time-keepers and verified the presence of each man on the job at least twice during the working period. For the roving crews (utilities and road crews, plumbers, electricians, brush and fire prevention crews) he required the workers to report in and out at the foreman's tool-box, which was constantly being moved, and employed roving crews of auditors to comb the utilities lines and other areas of work making lists of men on the job, which lists were then applied to the records of those reporting in and out. The workers never knew when to expect an auditor,

and in practice the syetem was entirely satisfactory both as a stimulus to labor and as a check of the labor payrolls. Contractors' labor payrolls, prior to payment, were audited against employment and classification lists approved by the Constructing Quartermaster, and against the records accumulated by the Auditor's men in the field.

The labor cost on this Project was approximately four and one-half million dollars, of which one-half million dollars was for overtime work. Although it was impossible to maintain ideal labor efficiency throughout the entire construction period because of inclement weather, the pressure of overtime requirements, changes in design, and temporary shortages of material, such savings as might have been effected in labor costs would have been counterbalanced by loss of time.

Materials costing approximately six million dollars went into the Project. The lumber, approximately twenty-five million board feet, was obtained from the local market. After the Chief Materials Inspector had cleared the initial confusion occasioned by the arrival of materials before his procedure, forms and organization could be set up, he was able to establish an ideal system of materials audit which was maintained from November, 1940 to the close of construction. Materials were checked in the field when received and listed on receiving reports signed by the Auditor's representative as to quantity and by the Engineers' representative as to compliance with specifications. These receiving reports were then verified in the office against the requisitions and purchase orders approved by the Constructing Quartermaster. When invoices for materials were later received by the Contractors they were routed to the Chief Materials Inspector's office where they were verified against the

receiving reports prior to approval for payment. All cash discounts were then taken by the Field Auditor's fiscal section and it is to be noted that only eighteen dollars in discounts offered was lost for the entire project.

Expendable materials and supplies were checked from receiving reports through storage and into use by the Constructing Quartermaster's Property Officer.

Rented equipment for use both in construction and in the offices, was checked by the Constructing Quartermaster through the Tools and Equipment section of the Field Auditor's office. All equipment (typewriters, desks, cranes, bulldozers, jackhammers, etc.) was inspected into Camp for arrival date and usability. It was constantly inspected for time used during the period of rental, and maintained in proper repair. Rental invoices cleared through the Field Auditor's office where they were audited against the field reports prior to approval for payment. Time of use and payrolls for trucks employed on an hourly basis were verified in the same manner by the Field Auditor's force.

Under the general supervision of the Property Officer, the control of rented equipment during the entire construction program was ideal. Rental contracts included purchase option clauses under which rents paid could be applied to the purchase price, and great savings for the War Department have been effected by the Property Officer in procuring from the supply of equipment rented on this Project, office furniture and fixtures and construction machinery, for use by the incoming troops and the Constructing Quartermaster for the lump sum additions to this Camp,

as well as for transfer to War Department construction projects elsewhere.

The Contractors' and Engineers' organizations were thorough and adequate. Several men of unusually broad previous experiences were employed to superintend the various phases of construction, particularly the sewer system, and it is an apparent tribute to the capabilities of these men that despite all time pressure, haste, additions to design, bad weather, and the beginning of construction prior to organization, the Camp received and accomodated its troops on the date originally scheduled. In only two instances was it deemed advisable for the Constructing Quartermaster to exert direct supervision, these being in the laying of the water supply line beneath the Arkansas River and in the construction of the gas distribution system. These were highly specialized undertakings and properly trained supervision was more readily available to the War Office through the cooperation of the U. S. Engineers.

Utilities for the completed Project include a full communication system through the facilities of the Southwestern Bell Telephone Company, Western Union and Postal Telegraph Companies, and Camp radio system; a plentiful supply of excellent water from the pumping stations and reservoirs of the Little Rock Municipal Water Works to a three million gallon storage tank feeding a thirty-seven thousand foot distribution system within the Camp; a ninety-one mile gas line system connecting to an inexhaustible supply of natural gas from the Arkansas-Louisiana Gas Company's high pressure line adjacent to the Reservation; an ample arrangement of centrally located warehouses and gasoline storage tanks

serviced by fourteen spurs totalling thirty thousand feel of rail connected to a trunk line of the Missouri-Pacific Railroad, and a full system of storm sewers and sewer lines, with sewage disposal plant.

Roads include twenty miles of asphalt and ten miles of asphaltic concrete; and two hundred thousand dollars was expended for the development of motor storage and parking areas.

GENERAL

A fire prevention and brush cleanup crew was organized at the beginning of construction and maintained until the arrival of Army fire-fighting equipment. This crew stationed water barrels at strategic points, kept the grounds clear of rubbish, and guarded against fire. There were no fires on this Project.

A regular water-service crew was established which kept the various construction units supplied with fresh water, a water-barrel being assigned to each unit. Individual drinking cups were required.

Safety measures and supervision were in effect throughout the entire program. Only one fatality was experienced, that being the case of a worker who when attempting to board a moving truck, fell and was crushed beneath the wheels. A building roof collapsed during December; however, no one was seriously injured.

The Constructing Quartermaster purchased directly all gasoline and oils for the Project in order to avoid local and State taxes, which exceeded the cost of product. Approximately four hundred thousand gallons of gasoline, fifty thousand gallons of fuel oils, fourteen thousand

gallons of lubricating oils and twenty-eight thousand pounds of grease were thus purchased.

During construction there was only one main highway leading to Camp, and in order to avoid congestion, different starting and quitting times were established for various classifications of work. The State of Arkansas with the aid of Federal funds is now improving the highway system into Camp.

As troops came in during the progress of construction it was necessary on several occasions to move the offices of the Constructing Quartermaster, Field Auditor, Contractors and Engineers. While this was inconvenient, it was the best practical solution of the problem as presented. Diverted effort and expense would have been required to construct special buildings for these offices and Army occupation would have been hindered through longer retention of the buildings which were used.

In summary it may be observed that the completed state of this Camp attests the fact that no problems during construction were permitted to become serious. Practical field impediments were to be expected; they arose in various quarters and were dealt with successfully by the means at hand.

RECOMMENDATIONS

As will be seen from the foregoing report, recommendations must be limited to the suggestions that, time permitting, organization be

established before the start of construction, and that all specifications be incorporated in the original plans if at all possible. While it is recognized that additions to the program (storm sewers and gas for the tents, approved in December and requiring the lifting of tent-frames already set and the redesigning of the gas system already laid for a lighter load) could hardly have been forseen, nevertheless these alterations caused difficulty and lowered efficiency for the Project.

Bad weather, labor difficulties, and materials shortages are simply unpredictable casualties and a general field problem.

CONCLUSION

As a result of transfers to other projects there have been four Constructing Quartermasters assigned to the building of this Camp, each of whom came in near the beginning of construction for service in the Office of the Constructing Quartermaster. They are;

Major Frank Reed, September 17, 1940 to January 25, 1941;

Captain Lynn C. Barnes, January 25, 1941 to April 12, 1941;

Captain William C. Campbell, April 12, 1941 to May 4, 1941; and

1st Lieutenant Walter P. Blum, May 4, 1941 to date.

WALTER P. BLUM
1st. Lieutenant, Quartermaster Corps
Constructing Quartermaster

ORGANIZATION AND PROCEDURE OF PROPERTY SECTION
CONSTRUCTING QUARTERMASTER, CAMP ROBINSON (FIXED FEE)

The Property Office was organized under the direction of Lieutenant Walter P. Blum, with the following personnel: (1) Clerk and (1) Senior Stenographer. Property records were set up on the basis of fourth copies of the invoices for which the Contractor was reimbursed on Form 1034A. Non-Expendable materials were determined by the Clerk, in accordance with Army Regulations, and immediately issued to the Contractor on Memorandum Receipts. The items that were determined to be non-expendable were picked up on Stock Record Form 424, and upon receipt of a signed copy of a Memorandum Receipt were posted to Form 488, "Account of Property on Memorandum Receipt". The expendable items on the above mentioned invoices were dropped by the use of the following certificates:

(1) I certify that the expendable supplies listed hereon are procured for immediate use in current service, and will not be taken up on the stock record account. That the unused residue thereof, if any, will be taken up and accounted for as prescribed in P. 3, AR 35-6520.

(2) I certify that the articles marked (X) listed hereon have been purchased for repairs or replacement of rental equipment as provided for in Articles I (1) d. Contract W 6110 qm 1 & 2 O. I. No. 1 & 2-41, and have not been picked up on stock record account.

Property Officer

(3) I certify that the expendable articles on this voucher, designated by Mark (X) have been, or will be expended in construction of buildings, for Camp Joseph T. Robinson, at Little Rock, Arkansas, and have not been taken up on the Property Account.

_____

Property Officer

Then as property was received by direct government purchase this property was also picked up on Stock Record, and issued to the Contractor on Memorandum Receipt, procedure outlined above.

Upon completion of each regimental area, or as soon as practicable thereafter, an inventory was made of each building, and a Shipping Ticket was made up to the Camp Quartermaster, on Form 434, for permanent release from accountability and responsibility. As the work progressed, it became necessary to add additional personnel to the office, and in the final analysis of the section the requirements were as follows: (1) Chief Property Clerk, (1) Warehouse Clerk, whose duties consisted of the receipt and issue of warehouse property, (2) Clerks, for posting to Stock Records and Memorandum Receipt Books, (1) Stenographer, (1) File Clerk, for maintenance of voucher files, (1) Field Clerk (full time) for delivery of Government-purchased equipment and field inventories, and (1) Field Clerk (part time) with same duties. In January, an auditor from Seventh Corps Area Headquarters audited property records and pronounced them complete and accurate with no discrepancies.

After construction was completed, the Property Office shipped to other stations several carloads of tools and equipment. The Property Office handled the recapture of rental furniture and equipment as deemed necessary and authorized by the Zone Constructing Quartermaster, also doing necessary work for proper accounting for and disposition of same. This section was also in charge of turning over unused residue of materials to the Camp Quartermaster and Inspection and Inventory Report on all unserviceable tools and equipment worn out through fair wear and tear. Upon complete disposition of all property which can be located and properly disposed of, a report of survey will be instituted covering all property lost, stolen or damaged, not due to fair wear and tear. Upon completion of this report of survey, the property account of the Constructing Quartermaster, on Fixed Fee Construction will be closed.

NARRATIVE REPORT

of

THE FIELD AUDITOR'S OFFICE

To be included in the completion report

of

CAMP JOSEPH T. ROBINSON, ARKANSAS

On September 16, 1940, a Cost-Plus-A-Fixed-Fee Contract was entered into between the War Department of the United States Government and MacDonald Construction Company and G. L. Tarlton Contractor, Inc., of St. Louis, Missouri, to be known as the General Contractors for the construction of buildings, utilities and appurtenances at Camp Joseph T. Robinson, Arkansas.

Black & Veatch, Consulting Engineers, of Kansas City, Missouri, were employed by the Government as Architect-Engineers and arrived a few days prior to the General Contractors and the initial plans and set-up were in readiness for an immediate start.

As of September 18, the General Contractors were at the camp site and had employed some of their key personnel both in the field and office and were actively carrying out the plans and specifications of the contract.

I do not know the date of the arrival of the Constructing Quartermaster and his immediate assistants but it was approximately that of the General Contractors.

For the Field Auditor's organization the Chief Materials Inspector was the first to arrive, September 20th, and then followed by the Fiscal Auditor as of September 28th. By this time approximately two hundred (200) men had been placed on the payroll; materials were arriving in

considerable quantities both by truck and train and the General Contractors were getting a little concerned as to the establishing of the proper procedure and office systems that were expected and that would be acceptable by the Government. Arriving at the project as Chief Fiscal Auditor, on the morning of September 28th, the first steps taken was a meeting between the representatives of the General Contractors and myself. We first went over their payroll set-up and in a short time agreed upon a procedure to follow. We then went over some of their other problems and with little difficulty were able to come to a mutual understanding on office procedure and requirements. Within the next two or three days the first payroll was completed and all employees were paid. On the morning of September 29th we had the printers at our offices and asked for bids on about one-half of the forms called for in the Field Auditor's Manual. As of October 1st the Field Auditor arrived and we then finished ordering forms as required by the Field Auditor's Manual and made arrangements for a representative from the Civil Service Commission to come to Camp Robinson and discuss with us our anticipated personnel requirements. He advised us we would have to use the Civil Service register, and in trying to create an office force requiring a considerable number of classifications of experienced office employees, we were greatly retarded in getting started. However, in the course of a few days we were fortunate in that an official from Washington came through and discussed our problems with us and after he understood the handicap which we were experiencing,

went over the matter with the Civil Service Representative and a mutual understanding was reached which permitted us to hire certain classifications through the local Employment Bureau. This enabled us to complete our organization without further delay and we were then in a position to go ahead and attempt to catch up the large volume of work that had accumulated. The key men of our organization were somewhat delayed, especially our Chief Traffic Inspector and our Chief Tool & Equipment Inspector. Our Chief Time Inspector was also delayed and thus prevented our getting a pre-audit as early in the program as we would have liked. However, we met all difficulties to the best of our ability and built our organization as rapidly as possible to handle the work and problems that made up our responsibilities. Under date of November 12th the original Field Auditor was transferred to another project and I assumed the responsibilities of the position of Field Auditor. Because of the fact that I had been carrying out the responsibilities of Chief Fiscal Auditor and had been working closely with my predecessor I found no reason for making any major changes as we, together, had formulated our procedure and agreed upon the policies to pursue.

At no particular time during the construction of Camp Robinson were the General Contractors in any particular financial difficulty because of negligence on the part of the Field Auditor's Office. It is true that when the project was at its peak, employing practically 10,000

persons and the payroll running at approximately $400,000 per week, the General Contractors needed money. On one occasion during this peak there was a change in Finance Officers at St. Louis which necessitated about a three-day stoppage of reimbursements while the retiring Finance Officer was closing out his accounts and the incoming Finance Officer was taking over. Two other occasions similar in nature were the weeks in which fell Chirstmas and New Year. Both of these holidays fell on Wednesday and the Finance Office was closed on Tuesday of each week; thus, creating and extending the holiday period during which no reimbursements were made. As previously mentioned, the payroll during the peak was nearly $400,000 per week which together with the reimbursement for heavy purchases being made at the same period, it took very little delay out of the Finance Office to place the contractor in a position where their working capital was depleted. I understand the General Contractors had about $900,000 working capital to finance this project with the exception of one or two of the pinches just mentioned and it is my understanding that for a few days they had about $1,100,000 working capital. In my opinion this amount of working capital was inadequate but because of the extreme cooperation and friendly attitude exercised by the Contractor's organization, the Constructing Quartermaster's Office, the Finance Officer in St. Louis, and the Field Auditor's Organization the above amount proved ample for practically all requirements.

The greatest number of persons employed in the Field Auditor's organization, both in the office and the field at any one time, totaled

one hundred and eighty one (181). As previously stated a good many of these people were employed through the local Employment Bureau which proved of real value and assistance in helping us to build our organization. Their cooperation has been and should be highly appreciated.

Regarding the various Departments I want to make only a brief comment relating some of the happenings, responsibilities and accomplishments of each.

FISCAL DEPARTMENT

When this Department was originally set up it became my responsibility, as Chief Fiscal Auditor, to organize it. At that time the only information available was such as was outlined in the Field Auditor's Manual and because of the fact that there was no procedure outlined or comments made referring to appropriations, allotments or other details regarding Governmental procedure, in the matter of handling and caring for funds, it was difficult to know what was expected. However, we established such records as seemed practical, and went ahead. As previously stated the writer was made Field Auditor on November 12, 1940, and the Fiscal Department was taken over by an assistant. At subsequent dates our Fiscal Auditors were transferred to other projects so that in this particular Department, which is certainly vital, there has now been five individuals caring for its responsibilities. Due to the fact that a number of essen tial reports are required from this department it has been a difficult proposition to control and yet keep accurate information going forward.

The Fiscal Department has received from the General Contractors,

and distributed to the appropriate auditing sections for pre-audit, all invoices for materials and services, keeping records of such invoices received and approved for payment or decline, and making adjustments in billings where necessary. It has also received for final audit all vouchers from the General Contractors claiming reimbursement from the War Department for expenditures, including labor, materials, rentals, and services, under the contract. Approximately 1400 such vouchers have passed through this Department. They have been examined for compliance with the contract, checked against the Fiscal Department's records of invoices approved for payment on pre-audit, and tested for accuracy in the extensions, in addition to being placed in the form and supported by various documents requested by the Finance Officer for payment. Appropriate records have been maintained with reference to the several alloted funds and payments to the General Contractors charge against these funds. All Auditing Department financial reports relating to fund allotments and expenditures have been prepared by the Fiscal Department from its records.

MATERIALS DEPARTMENT

The Chief Materials Inspector was the first of our organization to arrive at the project and immediately made arrangements with the contractor to keep a record of all incoming materials even though the proper forms were not yet printed and ready to be put into effect. After we were authorized to start building our personnel and our forms were prepared, then it was a problem of putting into effect the office procedure outlined

in the Field Auditor's Manual. There was no particular difficulty experienced in doing this but we did have difficulty in catching up accumulated work. Because of the lack of previous experience in Government operations and the large volume of work that went through this office in comparatively a few weeks, we did at one time have a considerable amount of unpaid invoices in our files. However, after the project has come to a close and all settlements have been cared for we have actually lost in cash discounts $18.10 on total purchases of approximately $5,050,000. The reason for this particular loss was caused by an apparant shortage of twenty five (25) rolls of roofing paper which was not satisfactorily explained until long after the discount period had lapsed and the vendors would not then agree to the waiving of this item. The main difficulty experienced in checking our invoices with Materials Received Reports was that a good many of our large vendors who shipped materials direct from the factories did not place our purchas order number or any other information on the materials to indicate with whom the purchase order had actually been placed. In other words, shipments were made by firms with whom we had no contract and had never heard of. Our Material and Receiving Reports were made as having received materials from these unknown firms but our invoices were rendered by the people with whom we placed Purchase Orders. There was no information ever given us telling that a certain shipment was made direct from a factory or jobber to fill a purchase order placed by us with other firms. Trying to correlate the

receiving reports and invoices caused us an endless amount of trouble and was therefore the direct cause of an accumulation of a large number of invoices in our files for a few weeks. However, as above stated, we actually lost discounts to the extent of $18.10 in the handling of approximately 12,900 invoices. All materials were checked into the project by actual count or measure and receiving reports were prepared by our field force. All invoices were checked as to prices, terms, and extensions; every item was also checked with Receiving Reports and Purchase orders thus making a complete detailed check by our office force.

LABOR DEPARTMENT

The Chief Time Inspector arrived at Camp Robinson on the morning of October 7, 1940, and at this time several hundred men were at work for the contractor. Our office and field force was only in the making and we were unprepared to make a pre-audit of labor payrolls at that time. However, employees were put in the field as quickly as possible and four checks were made daily. A Post-Audit was carefully made of payrolls up to early November and beginning November 6, 1940, a pre-audit basis was reached and maintained to the end of the project. At the peak of construction nearly 10,000 men were being paid off in a period of three-hours time on Saturday, as at the close of the previous Wednesday. This placed every employee's check in his hands in two and one-half days time after the close of the work week. The General Contractor's payroll force worked three eight-hour shifts, utilizing equipment which prepared the checks, Old Age Security card and five copies of the payroll at one operation. A check signature

machine was used in signing checks and a check protectograph was used to perforate checks. Approximately 150,000 checks were issued and distributed to the employees on this job and all employees claims were given just consideration and if after careful investigation it was believed an employee was entitled to an adjustment he received same.

TOOL AND EQUIPMENT DEPARTMENT

The actual organization of this department was deferred until the arrival of the Chief Tool and Equipment Inspector October 23, 1940. Upon his arrival the initial step was to immediately place an equipment number on every piece of rental property as a future reference or identification number. There were approximately 2,100 pieces of equipment on a monthly rental basis in addition to approximately 600 trucks which were on an hourly basis. A large number of these trucks worked night and day which necessitated field checkers being on the job a full twenty-four hours per day to make periodic checks and make sure that all equipment was actually rendering value received for the full time which was being turned in to the credit of that particular piece of equipment. It was equally important to determine that this equipment was actually being utilized as well as it was to determine that it was on the reservation. Contracts had to be drawn and approved, methods had to be arranged to determine the cost of repairs and constant attention had to be exercised to determine that property of all types, especially that of small units were not being carried away from the project. This department audited all rental rolls prepared by the General Contractors and was able to approve

or disapprove the amounts submitted from data accumulated by this department.

TRAFFIC DEPARTMENT

As of October 18, 1940, the Chief Traffic Inspector arrived at our office to assume the responsibilities of this department. His first problem was to get into the proper records the arrival and departure of all car shipments for the purpose of determining any possible demurrage that may have accrued. It was also necessary to check all freight bills whether railroad, express or truck, with Bills of Lading and advise the General Contractor of incoming materials.

A most efficient record was established for this department in that there were 5,941 freight cars hauled into the yards and not a single dollar of demurrage was allowed to accrue. In addition to the materials received via railroad there were thousands of loads received by truck.

PERSONNEL

Authority to employ the Administrative Assistant was granted October 11, 1940, and at that time an appointment was made. The new appointee assumed his duties on that date and immediately started negotiations with the Civil Service Commission to furnish, from their eligible register, personnel for the Field Auditor's Office. He was advised that no eligibles were available and was authorized under Sec. 4, Civil Service Rule VIII, to appoint any suitable qualified persons to fill the positions needed.

Applications for appointment were received on Civil Service Form 375 and each applicant was personally interviewed before determining their qualifications and fitness. The original estimate of personnel requirements was ninety seven (97). From October 15, 1940, seventy appointments were made to fill needed personnel in the different departments. A total of one hundred eighty one (181) employees were working in the Field Auditor's Office for the period, December 16 through December 31. To date the personnel has been gradually reduced and there are now nineteen (19) persons employed.

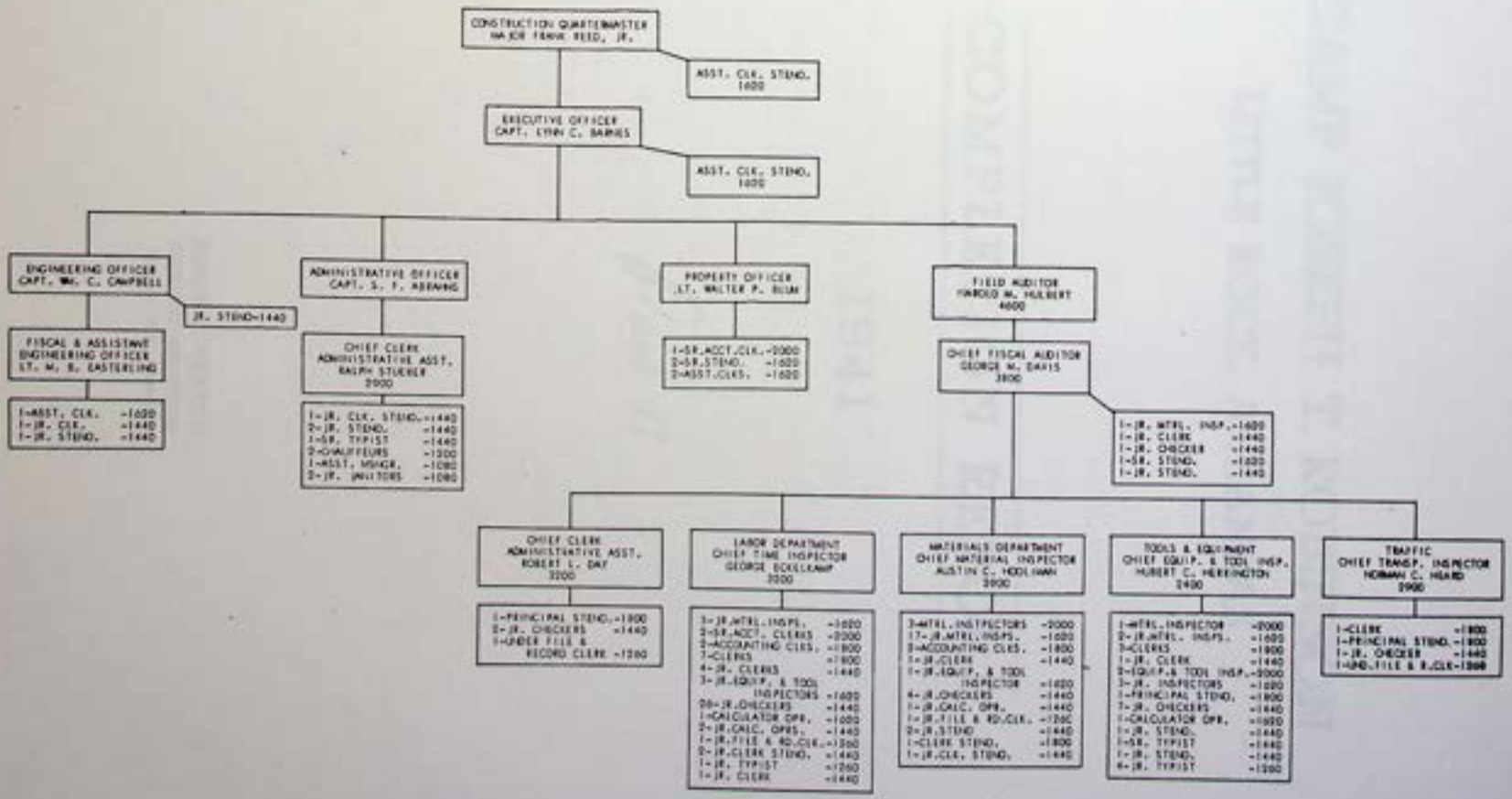
Requisitions for office supplies, equipment, and forms which were made to the General Contractor and to the War Department were issued when needed and the cost of such was kept at a minimum.

In closing may I say that through the bonds of human understanding may we weld together a national unity of friendship and loyalty that will bear the fruits of peace or victory. This is the goal for which we are all striving and are putting forth so much effort, together with the unknown sacrifices that may be made by our male citizens who make up an Army of Defense.

In leaving Camp Robinson I wish to take this opportunity to thank all of those who have so graciously assisted me, to express my appreciation for the many friendships gained and the cooperation given me by the personnel of the Constructing Quartermaster's Office, the General Contractors and the Architect-Engineers. I leave with malice toward none.

ORGANIZATION CHART

CONSTRUCTING QUARTERMASTER OFFICE
CAMP JOSEPH T. ROBINSON
LITTLE ROCK, ARKANSAS



CAMP JOSEPH T. ROBINSON

LITTLE ROCK, ARKANSAS

COMPLETION REPORT

1941

Part II

BLACK & VEATCH
ARCHITECT-ENGINEERS
Kansas City, Missouri

E. B. BLACK
H. T. VEATCH, JR.

A. P. LEARNED
J. F. BROWN
C. I. DODD
F. H. VEATCH
H. F. LUTZ

BLACK & VEATCH
CONSULTING ENGINEERS
4706 BROADWAY
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E. L. FILBY
W. S. FOWLER
W. O. THOMPSON
S. C. BREWSTER
R. E. LAWRENCE

CAMP JOSEPH T. ROBINSON, ARKANSAS

March 15, 1941

FROM: Architect-Engineers,
Camp Joseph T. Robinson, Arkansas

TO: Constructing Quartermaster,
Camp Joseph T. Robinson, Arkansas

SUBJECT: Completion Report of
Camp Joseph T. Robinson, Arkansas

We are submitting herewith our Completion Report on the construction of Camp Joseph T. Robinson.

This report gives the methods and details of construction, together with the lists of materials used and the cost of same.

Drawings covering the various phases of the work are also attached.

Very truly yours,

BLACK & VEATCH
Architect-Engineers

By A. V. Ferry
A. V. Ferry
Architect-Engineer Representative

CAMP JOSEPH T. ROBINSON
LITTLE ROCK, ARKANSAS

COMPLETION REPORT

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CAMP JOSEPH T. ROBINSON
LITTLE ROCK, ARKANSAS

COMPLETION REPORT

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COMPLETION REPORT

OF ARCHITECT-ENGINEER ON THE

CONSTRUCTION OF CAMP JOSEPH T. ROBINSON, ARKANSAS

INTRODUCTION

The Engineering Contract covering architect-engineer services for Camp Joseph T. Robinson was executed on September 9, 1940. The architect-engineers were instructed verbally at the time of executing the contract to proceed immediately with the preliminary engineering work at Camp Robinson.

Acting on this authorization, the architect-engineers sent key men from their home office in Kansas City, Missouri, some of these men arriving at Camp Robinson on the same date that the contract was signed.

Official notification to begin work was issued on September 13, 1940, as follows:

"B63 51 2 EXTRA GOVT DL - FT LEAVENWORTH KANS 13 1150A
BLACK AND VEATCH - 1940 SEP 13 PM 1 12
4706 BROADWAY -

RE ENGINEERING CONTRACT NUMBER W SIX ONE TEN QM DASH ONE CAMP ROBINSON DATED SEPT NINE NINETEEN HUNDRED FORTY PROCEED WITH WORK IN ACCORDANCE WITH TERMS CONTAINED THEREIN STOP ACKNOWLEDGE RECEIPT OF THIS AUTHORIZATION BY LETTER TO BE SENT DIRECT TO THE CONSTRUCTING QM CAMPROBINSON LITTLEROCK ARK C 43 NM -
GREGORY QMG WASHINGTON DC 1201P"

The above communication was answered on September 13, 1940, as follows:

September 13, 1940

The Constructing Quartermaster,
United States Army,
Camp Robinson,
Little Rock, Arkansas.

Dear Sir:

In accordance with the instructions contained in the following quoted day letter we are acknowledging receipt of the authorization to proceed in accordance with our contract for work at Camp Robinson.

"B63 51 2 EXTRA GOVT DL - FT LEAVENWORTH KANS 13 1150A
BLACK AND VEATCH - 1940 SEP 13 PM 1 12
4706 BROADWAY -

RE ENGINEERING CONTRACT NUMBER W SIX ONE TEN QM DASH ONE CAMPROBINSON DATED SEPT NINE NINETEEN HUNDRED FORTY PROCEED WITH WORK IN ACCORDANCE WITH TERMS CONTAINED THEREIN STOP ACKNOWLEDGE RECEIPT OF THIS AUTHORIZATION BY LETTER TO BE SENT DIRECT TO THE CONSTRUCTING QM CAMPROBINSON LITTLEROCK ARK C 43 NM -
GREGORY QMC WASHINGTON DC 1201P"

Our organization is already located at Camp Robinson and has the necessary engineering work underway.

Yours very truly,

BLACK & VEATCH

BY: E. B. Black (Signed)
(E. B. Black)

EBB:P

CC - Mr. A. V. Ferry

SCOPE OF WORK

4.1 GENERAL: The engineering work consisted of the layout, design, and supervision of all construction necessary for the proper housing of the 35th Division, consisting of four regiments of infantry, one regiment of heavy field artillery, two regiments of light field artillery, one regiment of engineers, division of special troops, 35th Division Headquarters, one quartermaster regiment, one medical regiment, the 153rd Infantry Regiment, and a 1,000-bed hospital on a 1,500-bed plan was also included in the original layout for Camp Robinson.

The work in connection with this housing also included proper warehousing for this unit, together with all utilities including roads, railroads, water supply, water distribution, electric distribution, gas distribution, sewers, sewage disposal plant, and the proper camp layout for all of these units.

After this original layout was completed, additional units were added to the camp, including housing for a regiment of combat engineers, a 500-man Reception Center, one signal company (Photo), and a detachment designated as Station Overhead Troops. Also, included in the work was the rehabilitation of the old National Guard area in the east end of the camp, for the purpose of housing the Corps Area Service Command troops.

LOCATION AND GENERAL WEATHER CONDITIONS

5.1 LOCATION: The site of Camp Joseph T. Robinson is on a rolling plateau in the foothills of the Ozark Mountains, approximately six miles by road north of Little Rock, Arkansas. It is built on the location originally used by Camp Pike during the World War.

5.2 TEMPERATURE: Over a 61-year period the highest temperature recorded was 110° on August 10, 1936. The lowest was -12° on February 12, 1899. The average yearly maximum was 71.3°; the average yearly minimum was 53.2°.

For 1940 the highest temperature recorded was 96° on September 9, the lowest was 0 on January 19. The average maximum for the year was 69.3°; the average minimum was 51.3°.

5.3 PRECIPITATION IN INCHES:

	Over 61-Year Period	For 1940
Average Yearly Total	47.51	34.66
Greatest Intensity on Record:		
5 Minute Duration	0.60	0.48
10 " "	1.01	0.65
15 " "	1.35	0.73
30 " "	1.92	0.83
1 Hour "	2.42	0.84
2 " "	3.23	1.28
24 " "	9.58	1.86

5.4 SNOWFALL: Average yearly snowfall for 56-year record was 4.9 inches. Greatest snowfall in 24 hours, 13 inches January 17-18, 1893. Total snowfall for 1940, 8.8 inches.

5.5 WIND DIRECTION AND VELOCITIES: Average hourly velocity for 61-year record, 7.4 miles per hour, prevailing direction south. Average hourly velocity for 1940, 8 miles per hour, prevailing direction south.

Highest velocity for 61-year record, 49 miles per hour in June 1915, from northwest. Highest velocity for 1940, 34 miles per hour January 14, from west.

5.6 HOURS OF SUNSHINE: Total hours of sunshine per year for 47-year record, 2,834; percent of possible, 63. Total hours of sunshine for 1940, 2,814.4; percent of possible, 62.

5.7 DENSE FOG: Average number of days per year for 48-year record of prevailing dense fog, 8. Total days of prevailing dense fog for 1940, 13.

TOPOGRAPHY AND LOCAL SOIL CONDITIONS

6.1 GENERAL: The plateau on which Camp Robinson is constructed varies in elevation from four hundred eighty five feet to six hundred feet above sea level. Extending along the southerly and westerly boundary of this site is a steep slope varying from one hundred fifty feet to two hundred feet in height, with sharp ravines penetrating it at frequent intervals. The stream beds are usually dry except during times of heavy rainfall. The sides of the ravines are deeply indented and weathered. The drainage of this slope is in a southerly direction and toward the Arkansas River.

On the north side of the plateau the ground slopes down gradually to Five Mile Creek, which has its origin near the northwest corner of the camp site and winds in a meandering course to the eastern boundary. From Five Mile Creek the ground rises gradually in a northerly direction.

The entire area occupied by the camp is rolling, varying from gentle conformations to sharp ravines. Throughout the camp there are few level areas and outcroppings of rock are frequent. The area was covered with a dense growth of post oak, black oak, jack oak, sweet gum, and many varieties of hickory.

The top soil is composed of loam having a thickness of only a few inches. Below this loam is a red clay overlaying shale or rock. The total depth of clay and top soil varies from a few inches to three feet over most of the camp site, two feet being about the average depth from the surface of the ground to shale or rock. However, in some cases there may be a depth of as much as six feet to the top of the shale strata.

The bearing capacity of the soil has been used as approximately two tons per square foot for foundations for buildings or structures. This is a very conservative figure and in most locations, if a high bearing capacity were required, it would only be necessary to excavate to the top of the shale or rock for a structure requiring a high bearing capacity.

During periods of extended rainfall the water penetrates the top soil and clay into the shale formations and will follow this formation on down into the rock formations below, so that the ground water level varies with the seasons of the year and the amount of rainfall.

Due to the contour of the ground, rainfall run-off is comparatively high. The clay overlaying the shale or rock is relatively impervious and prevents any great amount of percolation.

Drawing No. 6110-403 attached to this report shows the general camp layout and contours.

ENGINEERING ORGANIZATION

7.1 GENERAL: The engineering contract covering Architect-Engineer services for Camp Robinson was executed September 9, 1940. A number of the engineering personnel arrived at Camp Robinson on this same day.

An organization was set up, having the architect-engineer representative in charge, with principal assistant engineers in charge of each division of the work in the field, and a chief designer in the office in charge of all design work.

7.2 FIELD ORGANIZATION: The divisions of the work in the field consisted of staking, roads, railroads, water supply line, water distribution, electric distribution, gas distribution, sewers, sewage disposal, and buildings. Each principal assistant engineer in charge of these various phases of the work had the necessary field parties and inspectors under his jurisdiction to properly supervise and inspect all construction work. Additional inspectors and field parties were added from time to time as the work progressed and their services became necessary.

The principal assistant engineer in charge of staking had charge of all staking crews on general surveys and the staking of buildings and tents throughout the camp. It was his duty to keep these field crews organized and dispatched each day to the locations where their services were required in order to keep the necessary stakes for buildings and tents ahead of the contractor's forces.

As a rule, each principal assistant engineer in charge of utilities directed his own staking crews while the work under his jurisdiction was being started, and during the progress of construction.

7.3 DESIGN ORGANIZATION: The designing portion of the work was under the direct supervision of the chief designer who had under his jurisdiction engineer-designers in charge of each phase of the work, the divisions of which were much the same as those in the field.

The design for the camp layout, buildings, estimates and utilities, presented a problem of an unusual nature. The average construction project allows sufficient planning time to efficiently man and organize the planning and estimating work with a small personnel, some of whom move from one phase of planning to another, with estimates following design work as a final step. Due to the time element in which results were expected in days instead of weeks, and in many cases, in hours instead of days, an entirely different and highly specialized organization was required.

The original office design personnel with which the work was started was small, some eight men. However, this personnel formed the nucleus and the individuals were for the most part the key men in squad organization as the work expanded to meet demands.

The first division of the design organization to crystallize and go into action was the layout and estimate section. This work was handled by two designers and upon these men, aided by advice from principal assistant engineers and those in charge, fell the problem of settling upon a camp layout, handling preliminary estimates and authorizations, and formulating a working map of the area. Due to the continuous process of change and enlargement which followed throughout the time of construction, this first squad continued to function through the entire period of construction.

The next group which went into action following the formation of a tentative map of the camp, was the utility squads. These were divided into mechanical, electrical, building, gas, water, sewers, sewage disposal and water supply. One man was placed in charge of each of the above divisions of design and drafting aid was assigned to help and when possible, the key designers were given a permanent squad to continue throughout the job. Outside of key men, it was found difficult to obtain men with sufficient experience in any one line of utility work to claim specialization, and it was necessary to train men whose experience and aptitude fitted them for the work required by a particular utility design.

During the period of camp layout planning, the utility layouts were necessarily held up for several days. Advantage was taken of the time allowed by proceeding immediately with the design of the water supply line from the City of Little Rock to Camp Robinson. Key men originally engaged in this work later separated to other individual assignments, except one man who became responsible for plans and estimates in this connection.

The electrical distribution system design was laid out in a preliminary way by design men on the ground. Following the layout, an electrical engineer of considerable experience from the Architect-Engineer's home office was brought in to check and advise. The latter check was carried on over a period of weeks and included the preparation of a preliminary estimate of cost. During the final drawings of plans, the office organization included a principal assistant engineer in charge of field and office work, an electrical designer who had the responsibility for the detail design and drafting of plans, and assisting draftsmen to expedite detailing and tracing of plans.

Mechanical design proceeded from the outset of camp work with the layout, estimates, and design required in connection with the hospital system and boiler house, and mechanical equipment for heating and for kitchens. This squad was organized with a mechanical designer in charge, who undertook the design in connection with the hospital boiler plant, a designer assigned to building equipment, a designer for building heating, and assisting draftsmen for detail plans and tracing. The mechanical designer in charge also undertook design work in connection with the gas distribution system subsequent to the original layout work.

The building work was handled by an architectural designer. Plans for standard cantonment buildings were to be furnished by the Quartermaster General's office, but it was soon evident that a great deal of building planning of a special nature was required. Drafting assistance was provided with another

architectural designer who also helped with the heating and estimating for building work.

Sewage disposal was handled by a designer with the original functional layout and preliminary design under the advice of a principal assistant engineer from the home office. Subsequent structural and hydraulic design was done by the designer in charge, with the assistance of detail men.

Sewers were handled under the direction of a principal assistant engineer who also was in charge of field construction. The detailed design and drafting for sewers was done chiefly by one designer, with drafting assistance.

Roads were handled chiefly by the field. Staking and planning was done in the field. Preliminary profiles and grades were run on all roads and plotted in the office. Plans were drawn for the highway tie-in on the old Rifle Range road, including several bridges and one designer was detailed to handle this work.

The water distribution system was laid out under the direction of an engineer from the home office. Work was then carried on by one designer who made all detailed layouts, with drafting assistance.

The gas distribution system had the same origin and design as the water distribution, but was later handled by a mechanical engineer with a designer in charge of detailed layouts, with drafting assistance.

Landscaping was originally laid out by Mr. L. V. Sheridan, Consulting Landscape Architect, engaged for this purpose, whose detailed report is a part of this Completion Report. Detailed layouts were worked out by Mr. Sheridan during the early part of the work. The inked tracings were made in the drafting room, as well as numerous revisions as the work progressed. This work was handled by a designer draftsman who was responsible for the drafting of the plans.

Storm sewers were originally designed in the office, checked and built in the field, and the plans completed and revised by a designer draftsman under the direction of and with the notes from the field.

A filing, printing and supply department was found necessary as a tremendous volume of plans, standard and special was required. One man was assigned to this work and carried it through to the completion of the project. To give a measure of the amount of work involved, over seventy-five thousand blue prints were provided.

The design work, including plans, estimates, reports, specifications and recommendations of letting of contracts, was carried on under the direction of the chief designer. The organization engaged in design duties varied in number, but averaged about twenty-five men. It was the object, in organizing this work, to delegate detailed responsibility to one man in charge of each division of work, leaving coordination, contacts with the contractors and the Constructing Quartermaster's office, correspondence of general nature and policy, in the

hands of the chief designer. The organization worked very smoothly considering the press of time and unusual requirements made of the number of men involved. A chart showing the Architect-Engineer organization is attached to this report.

7.4 SCOPE OF WORK BY OFFICE ORGANIZATION: The work carried on under office engineering was sub-divided as follows:

(1) Design and drafting of plans.
(2) Writing of specifications.
(3) Preparation of estimates of costs.
(4) Recommendations for letting of contracts for equipment and materials.
(5) Reports.
(6) Preparation of equipment lists for kitchen, hospital, plumbing, fire, etc.
(7) Checking and approval of shop drawings.
(8) Correspondence, expediting, and correlation with the Constructing Quartermaster, General Contractor, Camp Quartermaster, and Engineering field forces.
(9) Printing and handling of plans.

Each of the above divisions will be discussed briefly.

(1) Under "Design" was included the detailed design of the camp layout, and the design of utilities, including sewage disposal, water supply, hospital heating plant, gas distribution, electric distribution, water distribution and roads. It also included the design of special buildings and alterations to standard buildings. Approximately two hundred and fifty standard size plan drawings were made for the job. These sheets were incorporated in the plans, although many other studies were made on the standard plans which were never incorporated in special drawings.

(2) Specifications were required for the purchase of all materials. As far as possible, standard specification references were used, but a large part of the specifications for utility materials and special equipment was written by this office. Specifications furnished by the War Department consisted of Standard Housing Specifications, Civil Engineering Specifications, Temporary Housing Specification 1700-E, Standard Power Engineering Specifications, and binders of Federal Specifications for materials. The Temporary Housing Specification 1700-E was used as much as possible as were also the Civil Engineering and Power Specifications. It was important that specifications be made as simple as possible to aid in ready purchase in a rapid fire era of purchasing and that specifications be consistent with the plan for a five-year life of housing. An engineering organization is likely to be guided by standard Government specifications and good practice from civil life. The result, if not carefully watched, will be gilt edged but very expensive job, and a correspondingly slowly put-together piece of construction. On the other hand, it was necessary to maintain good construction consistent with policy.

(3) Estimates of costs were required from the outset of the work. Washington asked for an early estimate of cost on the project and followed with a

steady series of requests, particularly in regard to the cost of utilities. Estimates were prepared of cost indicated for the construction of these utilities. As the work advanced and methods of work were demonstrated, in which time was the prime factor and cost was apparently considered of secondary importance, estimates were increased to allow for the speed with which the work was to be done and allowing for the attendant increase in cost to be expected. It was found, however, that the ultimate cost of the work greatly exceeded the contemplated cost. The estimate of cost of December 15, 1940 of $7,873,000.00 was based on a detailed study of costs on each utility and the building work. However, when the cost reached Eleven and One-fourth Million Dollars at the close of the work it was obvious that normal methods of estimating fell far short of the true cost of the work. The type of contract involved and the lack of cost accounting records on the part of the contractor made it difficult to determine actual costs prior to the job completion. The overrun of the estimates was an indictment of the fixed-fee method of doing work, since the contractor's responsibility became one of completion within specified time, and not of control of cost.

Numerous phases of estimating were required. Besides estimates of cost and for design, it was necessary to estimate costs of all manner of revisions of buildings and utilities to measure the value of recommendations from all sources.

Estimates of time required, schedules of construction for each phase of the work, and weekly detailed estimates of progress, were all included in the estimating problem. In the final analysis, it was decided to attempt to furnish, with a field check from all reliable sources, an estimate reflecting the actual cost distribution of the job. This estimate took into account actual total labor payroll, material purchased, equipment rentals and other costs as paid. With the advent of Government accounting control methods, a group was set up to handle this final report estimate. This estimate proved to be a difficult task since the Engineer's office was dependent upon the Auditor's and Contractor's office, both of which were very busy agencies, for the detailed records. Difficulty was encountered in getting proper payroll separation, particularly for the early portion of the work, since cost control methods were not satisfactorily established for some time after construction was under way. An estimate, representing a great deal of study, was finally completed. This estimate, which is a part of this report, is probably as near a true study of the jobs costs as will ever be available.

(4) Under "Recommendations for letting of contracts for equipment and materials" the burden of proper selection fell upon the engineering office as it should.

At the outset of the work, equipment and materials were being purchased at the discretion of the contractor, under specifications by this office. Under this method of operation it was possible for the contractor to misinterpret the specifications. Under the press of a program requiring the utmost in speed, decisions were made hastily and without sufficient technical insight and knowledge of design details. It was requested then, that no equipment be purchased without approval from the engineering office, and all abstracts of bids were forwarded for examination and recommendations. This one phase of the work

proved to be a sizable undertaking. As many as fifteen recommendations for award were made per day at the peak of the work and several engineers were kept entirely engaged on this work. As a result, however, the materials and equipment selection were under close supervision and the Government was insured of materials complying most nearly to specification requirements. In selection of bids for award of contract, the primary consideration was substantial compliance with specifications. The second consideration was cost, and the third was time of delivery. As the work neared completion the latter item became of prime importance.

(5) The office of the Constructing Quartermaster made use of the Engineering office as an advisory agency on technical questions and in studies requiring detailed reports to furnish information for which to justify or determine certain actions. There were also a tremendous number of requests by Washington for every imaginable form of data regarding the work. A great deal of repetition of effort was caused by the latter requirements, since often substantially the same information would be asked for by two distinct sources, but in sufficiently different detail to require completely new setups, on the same work. Apparently due to the rush of the Defense Program, a lack of correlation on such information existed in Washington.

Another source of trouble was the fact that Procurement would handle certain items of purchasing at times after the items were already purchased and on the ground, and again when the particular items were not required for the Camp Robinson work at all. It was very difficult to get detailed information on items purchased in Washington as to supplier, with cost, specifications on items, and roughing in dimensions.

(6) The preparation of equipment lists for camp buildings, including the hospital, was essential. The contractor had little information on equipment and specifications, and plans were indefinite in a great many cases, as to items to be furnished. The lists itemizing each item of equipment and specification reference were furnished for kitchen equipment, heating equipment, plumbing fixtures, and fire fighting equipment. The preparation of these lists, the correspondence, and supervision of these items constituted a full time occupation for an engineer specialized in this type of work, and often several were required to handle adequately the demands for information on these subjects.

(7) Shop drawings were required on such items as mechanical and other equipment for the hospital heating plant, the sewage disposal plant, the cold storage plant, bakery, magazines, ordnance shop and many other structures and items of equipment.

(8) Correspondence, the expediting of purchasing, delivery and installation of materials and equipment, and the business relations and correspondence with the contractor's purchasing forces, the Constructing Quartermaster's office, and the Camp Quartermaster's office, all fell within the scope of the office design organization.

The correlation of the different engineering units functioning, including a proper understanding of methods and time required, was an important phase of the work. On such projects where speed of action is essential and where an

organization of thousands of men are at work , the telephone, personal contact, and correspondence work of the office engineering force is a very important factor in proper results and understanding among the work forces. The office acted as a clearing house on all manner of requests, complaints, suggestions, and applications.

(9) Building plans were furnished by the Quartermaster General's office for the standard camp buildings. These were furnished in the form of Van Dyke negative prints of drawings which were blue printed locally to supply the demand for construction drawings. These drawings numbered several hundred which,in addition to the drawings produced by the engineering office, and the revisions which poured in from the Quartermaster General's office, reached a filing total of nearly a thousand drawings. Prints were furnished to the contractor, the initial order being twenty sets, eight sets to the Constructing Quartermaster's office and five sets for the local engineering use. At the outset, this demand for prints was a serious burden to the local printing facilities. Printing machines ran long hours seven days a week to supply the thousands of prints required. After the initial orders, it was found in a great many types of buildings where the number of buildings was considerable, that more than fifty sets of plans were required to supply sufficient copies to the many crews engaged on the same type of work. As the work progressed, a great many revisions to the standard drawings were received from Washington. In the early stages of the work, an effort was made to incorporate these revised drawings in the plans in circulation. In many instances this required that a single revision consisting of a notation change in the drawing, required over one thousand prints to make the substitution in the plans in circulation. About this time it was decided that the changes required by a revised drawing would require substantial changes before a substitution would be made. It then became the duty of this office to check the many revised standards constantly coming through from Washington to decide if changes should be incorporated. The same study was required for specification changes and the same policy incorporated. If work was advanced to the stage where new construction would have to be revised to allow the change, the changes were not made unless imperative. Recommendations were written to the Constructing Quartermaster in such case of the status of such drawings and specifications.

Due to the nature of engineering quarters, in temporary wood buildings, and lacking adequate fire protection, a policy was adopted whereby negatives of drawings, though only partially complete, were made and filed in a fire-proof vault in Little Rock. In case of fire, due to this policy, the job record would have been substantially up to date and reproductions of drawings would have been possible.

7.5 ESTIMATES: Estimates were required from the outset of the work. The Office of the Quartermaster General furnished an initial estimate approving certain work. The interpretation of this approved work and the subsequent layout of such items naturally fell within the efforts of a group whose members became familiar with this phase of the work. Subsequent supplements to the original estimate were soon issued and the compilation of numerous estimates setting out particular phases became a constant requirement.

Keeping adequate records of authorization and appropriation of necessary funds for construction became more and more difficult as time went on. Estimates

The cost chargeable to contractor's overhead was obtained from the Field Auditor, Engineering costs were obtained from the Architect-Engineer's records.

The fact that the Engineer's estimates, notably the one of December 15, 1940 of $7,873,604.00, were exceeded, as was indicated by the final estimated cost of $11,276,691.65, was due to several causes.

Items added constitute a total of approximately one million dollars. The balance of the overrun, about $2,400,000.00, must be charged to methods of doing work under the fixed-fee contract such as existed on the Camp Robinson work. There are some contributing factors such as excessive overtime hours worked by plumbers, relative inefficiency of labor during peak rush, and disorganization resulting from changes in schedules of buildings to be completed, which are extenuating circumstances.

However, the above points are not all allowable as a logical reason for such an overrun. The great part of such an overrun is unexplainable and must be charged to the method of working. The contractor kept little or no record of running costs of doing the work. The Engineer's office was aware of conditions but was not given authority to control the cost situation. The mounting estimate, as time went on, was the evidence of the lack of control, the extent of which was not evident until the close of the work.

A complete system of cost accounting should be set up by the contractor at the start of any project, under the supervision of the Constructing Quartermaster and the Architect-Engineer. Cost accounting is the only method by which cost control can be kept, and to have economy in construction it is an absolute necessity that the cost of the work be known at all times, on a fixed-fee contract.

7.6 ARCHITECTURAL AND STRUCTURAL: As stated elsewhere, standard plans were furnished for most of the camp buildings. Some of the structures which were designed by this office are:

Finance Building
Third Echelon Motor Repair Shop
Quartermaster Administration Building
Unloading Docks
Laboratory Building for Sewage Disposal Plant

Other architectural design requirements consisted, for the most part of revisions to standard or existing layouts. A few of the buildings requiring such design revisions were:

Camp Administration Building
Building Addition for the Constructing Quartermaster
Remodeling of Building to serve as Camp Headquarters
Infirmary for Corps Area Service Command
Quarters for Engineering Office
Remodeling of old Magazine Building for Signal School use
Warehouse Revisions for shelving
Recreation Building revisions to include toilet rooms

Ordnance Warehouses - Office space and other space requirements.
Revisions to A-10 Administration to include Post Exchange.
Termite Shield Requirements.
Reception Center Receiving Warehouse

Design requirements also included investigation and provision for structural requirements as well as architectural.

In such buildings as the Cold Storage, Lavatories and the SP-2 Motor Repair Shops, it was necessary to provide framed concrete floor systems, where subsoil conditions would not allow floors on grade without support. Structures were designed for the Sewage Disposal Plant. The hospital heating plant building also offered a number of structural design problems, such as the support of smoke breeching, surge tank and feed water heater. A retaining wall was designed for the parking area at the bakery, along the railroad.

A steady stream of requests for changes in building of an architectural nature poured through the office from the first week of construction in October until well into February 1941. These requests varied from minor revisions such as provision for closets, tables, partitions, shelves, and garbage can racks, to entirely new building layouts. A great many such changes were eventually approved and incorporated in the work. Estimates of cost were made with each revision and a letter of transmittal or recommendation relayed it to the Constructing Quartermaster for approval. Under no circumstances was new work incorporated in the camp construction without the prior approval of the Constructing Quartermaster's office. In some cases, requests were received which were not felt to be sound economically or structurally. In such cases recommendations were made, giving technical opinion for such action as the Constructing Quartermaster's office should see fit.

Early in the progress of the work it was noted that the high columns supporting the buildings due to the hilly terrain, coupled with the skirting carried to the ground line, presented a very great hazard from the standpoint of wind loading. It was impractical to attempt to remedy this situation during the early rush to house troops prior to January 1941. However, early in January, after the initial rush was over and troops were in, a thorough survey of the camp was made to determine the requirements for eliminating the hazard due to the high building piers when subjected to a wind storm.

A steel tie rod and turnbuckle cross bracing scheme was developed which provided satisfactory trussing of the columned supporting bays at a nominal cost. This bracing was installed at an estimated cost of about twenty thousand dollars. About fifty buildings were provided with wind bracing, an average height above grade of four feet being taken as a criterion for minimum installation requirements.

Specification references were furnished and, if need be, written for detailed architectural work, as required. In general, the 1700-E specifications for Temporary Housing governed, but there were considerable items requiring the writing of specifications to suit.

7.7 MECHANICAL WORK: The mechanical work on the project divided naturally into several distinct phases. One was in the work entailed in the design of the hospital boiler plant and the heating system, which included drawings, specifications, and recommendations for equipment contract awards. The second was the design required for building heating, including plans, specifications, recommendations for equipment contract awards, and material records for heating equipment. The third division of the work was set up to care for equipment records and specifications for other building equipment, including kitchen equipment, hospital equipment, and plumbing fixtures. A fourth requirement of the mechanical group was the design, including sizing of mains, calculations of pressure losses, and specifications, for the gas distribution system. The actual detailing and drafting of plans of the gas distribution system was carried on by another group. A fifth division was the design, check, specifications, and supervisory work required for the Cold Storage Plant and Bakery.

Under the design of the hospital boiler plant and heating system, it was necessary to design all controls of auxiliary equipment and piping for the boiler house. It was also found advisable from the topography of the hospital site to redesign the heating distribution system layout which was provided as a standard plan by the office of the Quartermaster General. The boilers for the heating plant were purchased in Washington. Two 400 Horse Power and one 300 Horse Power units were provided, totaling 1100 Horse Power, and were to be coal fired boilers. The first step by this office was to recommend that gas burners be purchased for these boilers, which was done by the Quartermaster General's Office.

Due to the short time intervening between the arrival of the engineering organization and the start of construction, there was considerable haste in the purchase of mechanical equipment and materials for such items as the steam heating system. Specifications were written, material estimates were made, and contracts let in a period of a few days, in order that the work would not be delayed by delivery of equipment.

Heating equipment for buildings was specified by the engineers and purchased through the general contractor with the exception of the forced air furnaces which were installed in the Administration, Exchange, Infirmaries and Recreation buildings, as well as other special installations. Unvented gas fired cabinet type heaters were specified by the engineers and purchased through the contractor for mess halls. Gas fired unit heaters were used for lavatories and shop buildings.

The forced air furnaces were purchased by Washington and sent to the job knocked down and not designated as to location. Camp Robinson is located in the south portion of the zero degree zone as set up by the Office of the Quartermaster General. For hospital heating, Washington had designed a system based on the zero degree zone. However, it was later found that for camp cantonment buildings it was the intention, when the purchase of furnaces was made, to design the building heating on a basis of the plus twenty degree zone. This matter was straightened out prior to the installation of furnaces and these were installed as fast as they arrived at Camp Robinson. There was a shortage in delivery of this equipment, and in order to provide for the troop arrival the first of the year, it was necessary to install furnaces in buildings where heat was essential, even though proper size heater units were not available.

Later, when the proper furnaces arrived, the original installations were removed and the proper size installed.

For special building design, by the Architect-Engineer, heating requirements were calculated and submitted for approval.

One of the most laborious and difficult tasks under the mechanical department's work was the listing, specifying, and allocating of plumbing fixtures and other building equipment. There was very little data available by the Quartermaster General's office for kitchen equipment and hospital equipment at the time the camp work was commenced. It was necessary that lists be prepared in the office showing locations of fixtures and equipment to allow the contractor to rough in for the equipment and for the equipment to be purchased. In regard to plumbing, the contractor purchased, among his first orders for materials, a large order of plumbing fixtures. This item was purchased from a list given to the contractor, which showed no allocation. Plans and specifications were indefinite in many cases as to what was to be furnished for certain buildings. A great deal of study and time went into the plumbing lists of fixtures. Kitchen equipment lists were prepared from specifications and plans, and in many cases there was no information as to source of the material and whether it would be furnished by the Government or whether the contractor should purchase. The same is true for the hospital equipment. It became the duty of this office to allocate items of equipment and to attempt to straighten out items for which no source definition was available.

A description of the problem of design for the gas distribution system will be described under that heading.

The cold storage building and bakery required special attention because of the special nature of the mechanical equipment. The installation of the insulating material, refrigerating equipment, doors, tracks, and other items made a great deal of detailed work necessary on the cold storage buildings. Location of air ducts, wiring requirements, and equipment foundations were also items to be designed.

7.8 OBSERVATION ON CONDUCT OF WORK FOR ENGINEERING ORGANIZATION: At the outset of the project, certain policies, which later were proved desirable, were as yet not established. In the first weeks of operation the exact relation of the various agencies on the ground had not been defined. The initial problem was not one of policies and methods, but on account of the short time allowed, was one of getting the work under way. Certain policies in relation to plans, specifications and letting of contracts, were established as the work progressed. In similar work certain points should be brought out as suggestions. Points will be enumerated below.

First, all utility material quantity estimates would be made up in the Engineer's office and a tabulation kept in summary form of all such orders by types of utilities. An effort should be made, as was in the work just past, to include in each order as complete a list of quantities as possible to minimize the number of orders. Each utility order would be marked in the letter

of transmittal, with a code number as to destination, whether gas, water, electric or other utility in building group.

As materials are delivered to the project, the Architect-Engineer should have sufficient inspectors to check all items as to specification compliance and quantities. These quantities received would then be furnished to the office for a running check on materials received as compared to orders. In this manner there would be a continuous check as to status of orders.

Second, a step which was not provided in this past program would be incorporated; that is, a division or working section would be set up to check the requisitions as copies were received from the contractor. This would enable the engineers to check the material orders for specification errors, omissions, reliability of service, and cost. Requisitions would be coded by the contractor's office to clearly indicate for what part of the job the order was intended. On the past work no effort was made by the contractor to keep track of the material as to job destination and immeasurable confusion resulted from the lack of such direction. The cost of such indirection was considerable. It was not unusual for a search of several days duration to be made for some particular items, such as valves or fittings. These might finally be found in some entirely foreign pipe yard from the utility for which they ware intended. Or, if not found, duplicate orders were entered and delays occasioned in the installation of the needed items. Little effort was made to correct this condition. Coding of orders would have saved a great amount of lost motion.

Third, the abstract of all bids for construction materials would be subject to a check by the engineering office for recommendation. This was only partially done on this project.

Fourth, the contractor's office would be asked to provide better coordination between his office and the field. Too many times in this period of work the engineer's office was informed that the contractor's field forces were not supplied with plans or communications from their own office. A gap seemed to exist in the contractor's communication system. The engineering office made an effort to expedite the placing of plans, specifications and notice of changes on rulings in the contractor's hands at the earliest possible moment, twenty copies being sent to the contractor for initial distribution. However, many times it was found later that these documents would arrive and lie in the contractor's office indefinitely because there was no directing agency to get these to the men requiring the instruction for proper direction of their work.

The engineer's office was also weak on this point, although an effort was made to coordinate work between the field and office. A notice of approval of a building, or a change in location, did not always reach the utility principal assistant engineers and it would be some time before they were aware of work of which they should have been notified. A remedy for this lack of current information would be an open file or bulletin board for all letters of approval or change which would be of interest to such heads. Said file to be kept up day to day and the responsibility for reading be called for a checking stamp carrying the name of parties to be notified.

Fifth, an earlier start and a more thorough running record of cost should be required than was attained in the past work, if adequate cost records are to be maintained.

Sixth, progress charts of the construction work should be started at the outset of the work and a close check kept on these for expediting the work.

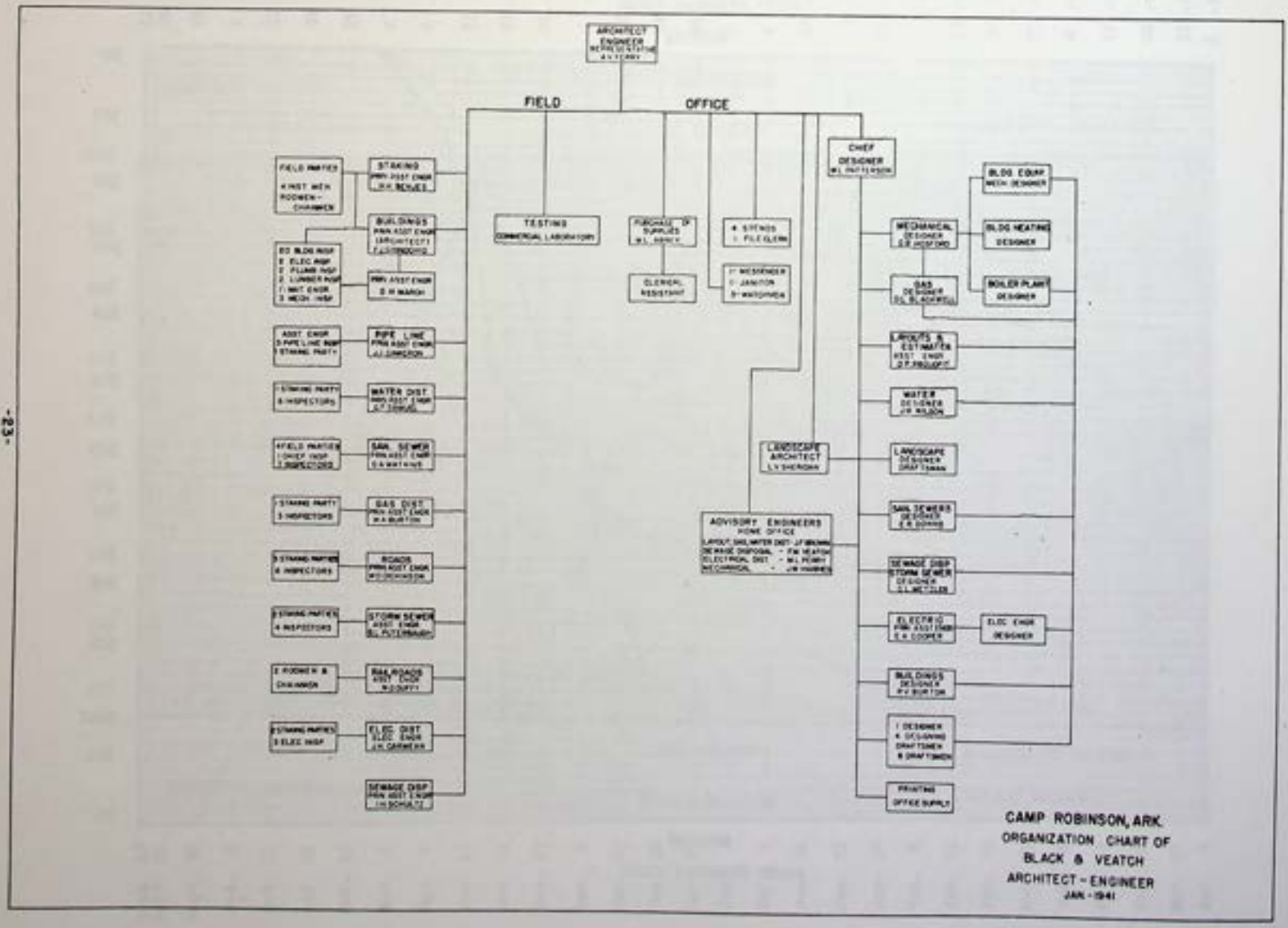
All of the above points would require additional personnel in the engineering offices. This requirement is not always possible of fulfillment, and would add somewhat to the cost of the work. However, a better ironing out of some of the lacking points in the past work might be so attained.

A further recommendation would be made in respect to correlation of office and field inspectors. Inspectors should be provided with a set of plans and specifications. Standard plans could be reduced in size and produced in letter size editions economically. Specifications could be mimeographed and the inspector provided with both plans and specifications on the part of the work for which he was interested. Such plans and specifications could be provided at a cost of less than five cents per sheet. Standard size plan sheets cost, in blue print, approximately twenty-five cents each.

Additional inspectors, particularly for mechanical work, should be provided. Points on mechanical work which was in need of alteration were often brought in by office personnel when such information was directly the province of the inspector.

7.9 ENGINEERING COSTS: A breakdown of the engineering costs is as follows:

Surveys and Staking (Labor and Expenses)	$ 18,172.94
Layout, Design, Drafting and Estimate (Labor and Expenses)	40,498.95
Field Supervision (Labor and Expenses)	65,203.65
Office Overhead (Labor and Expenses)	9,009.75
Testing of Materials	19,540.13
Blue Prints	20,000.00
Office Supplies	4,542.57
Field Supplies	1,636.84
Insurance - Est.	1,500.00
Social Security - 2% of Labor	2,464.89
Unemployment Insurance - 3% of Labor	3,697.35
Field Equipment Rental	1,249.66
Office Equipment Rental	3,098.32
Fixed Fee Initial	33,430.00
Fixed Fee (Estimated additional)	7,500.00
Total Engineering Costs	$ 231,545.05



CAMP ROBINSON, ARK.
ORGANIZATION CHART OF
BLACK & VEATCH
ARCHITECT - ENGINEER
JAN. 1941

DAILY PROGRESS CURVE

SHOWING

STATUS OF ROADS

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ——— —

ACTUAL PROGRESS ——— —

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Sept. 18
Sept. 20
Sept. 27
Oct. 4
Oct. 11
Oct. 18
Oct. 25
Nov. 1
Nov. 8
Nov. 15
Nov. 22
Nov. 29
Dec. 6
Dec. 13
Dec. 20
Dec. 27
Jan. 2
Jan. 9
Jan. 16
Jan. 23
Jan. 30
Feb. 6
Feb. 13
Feb. 20
Feb. 27
Mar. 6
Mar. 13
Mar. 20
Mar. 27
Apr. 1

DAILY PROGRESS CURVE

SHOWING

STATUS OF RAILROAD

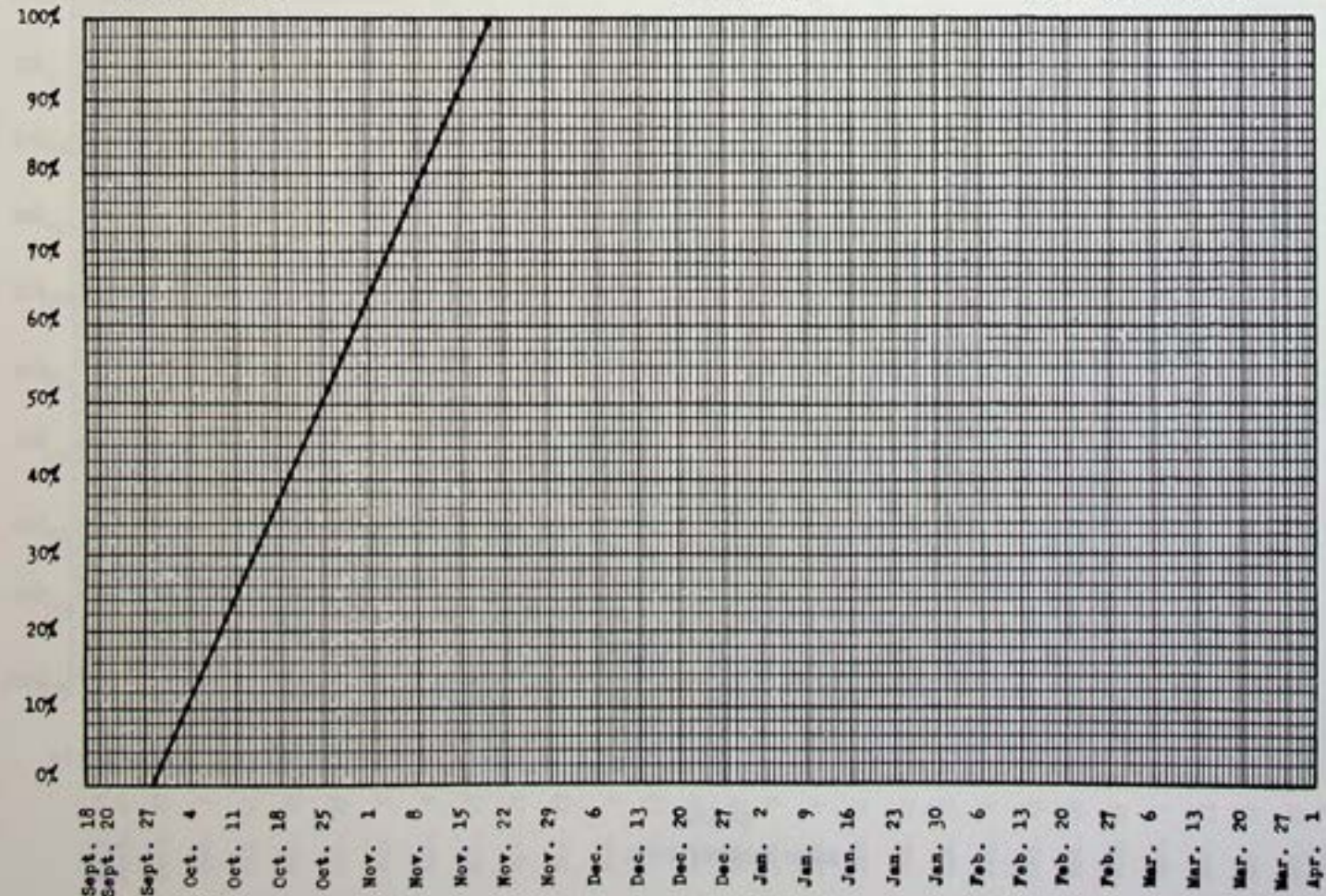
CAMP ROBINSON

SCHEDULED PROGRESS

ACTUAL PROGRESS ——————

BLACK & VEATCH

SUPERVISING ENGINEERS



DAILY PROGRESS CURVE

SHOWING

STATUS OF WATER SUPPLY PIPE LINE

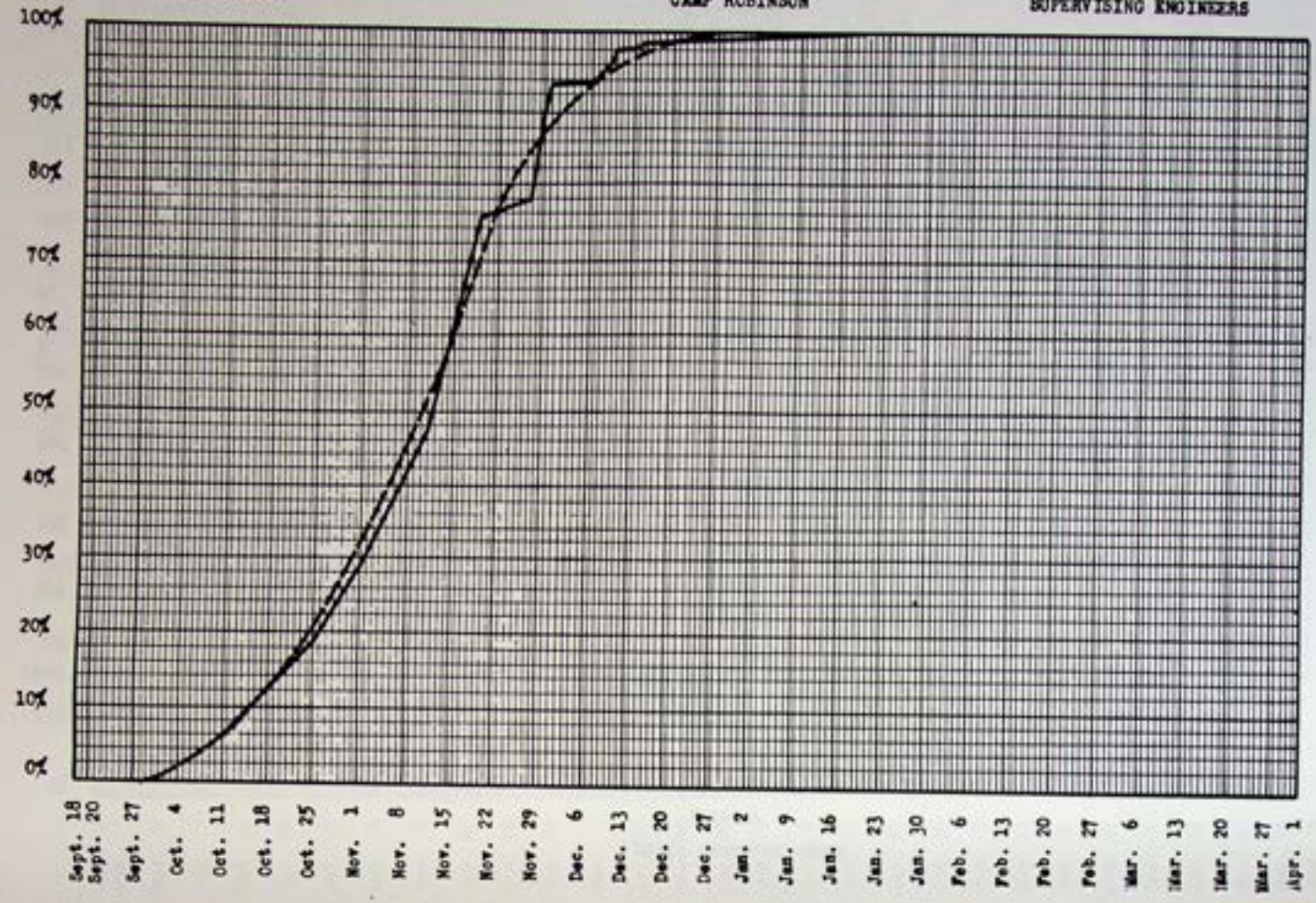
CAMP ROBINSON

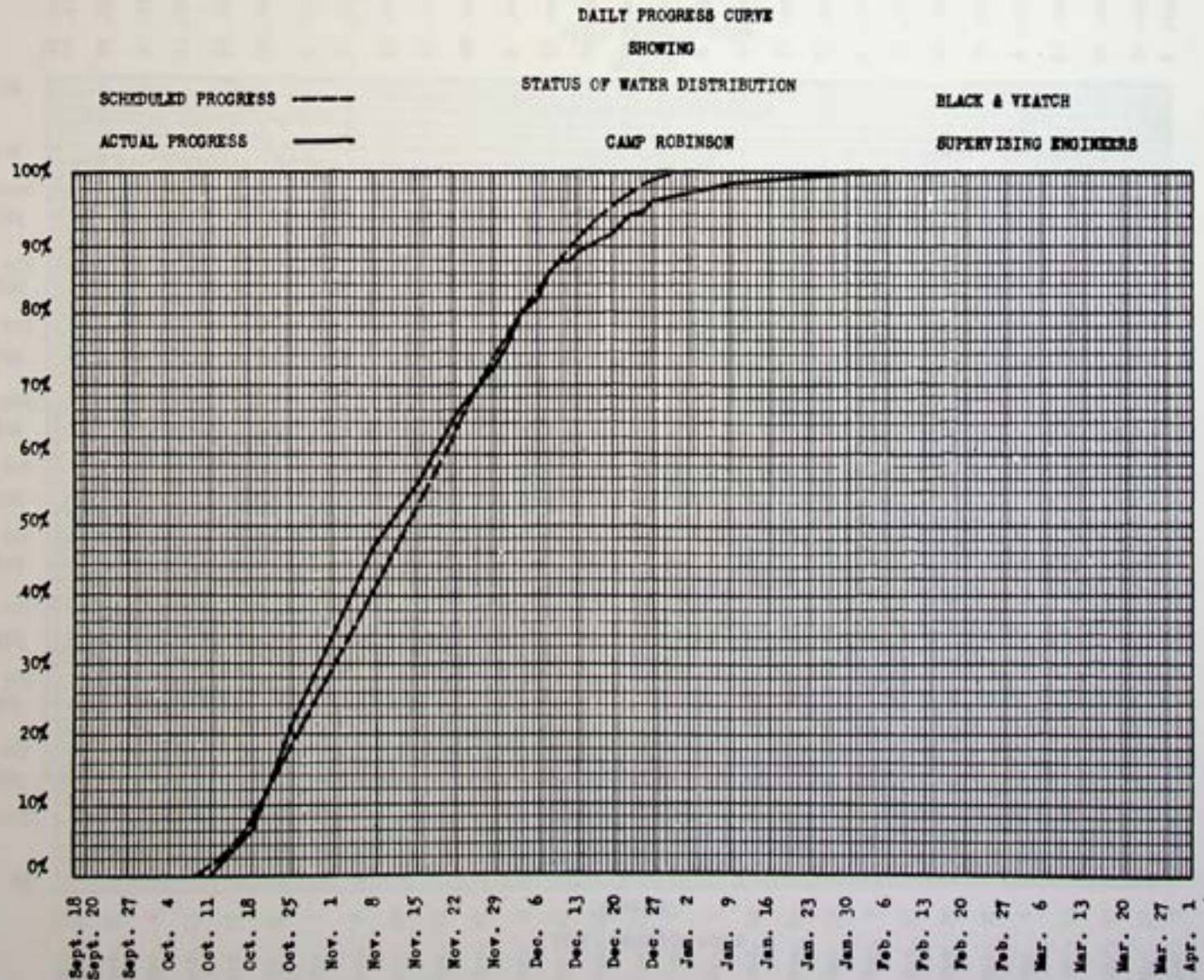
BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ----

ACTUAL PROGRESS ——




DAILY PROGRESS CURVE
SHOWING
STATUS OF WATER DISTRIBUTION
CAMP ROBINSON
SCHEDULED PROGRESS
ACTUAL PROGRESS
BLACK & VEATCH
SUPERVISING ENGINEERS
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Sept. 18
Sept. 20
Sept. 27
Oct. 4
Oct. 11
Oct. 18
Oct. 25
Nov. 1
Nov. 8
Nov. 15
Nov. 22
Nov. 29
Dec. 6
Dec. 13
Dec. 20
Dec. 27
Jan. 2
Jan. 9
Jan. 16
Jan. 23
Jan. 30
Feb. 6
Feb. 13
Feb. 20
Feb. 27
Mar. 6
Mar. 13
Mar. 20
Mar. 27
Apr. 1

DAILY PROGRESS CURVE

SHOWING

STATUS OF POWER LINES

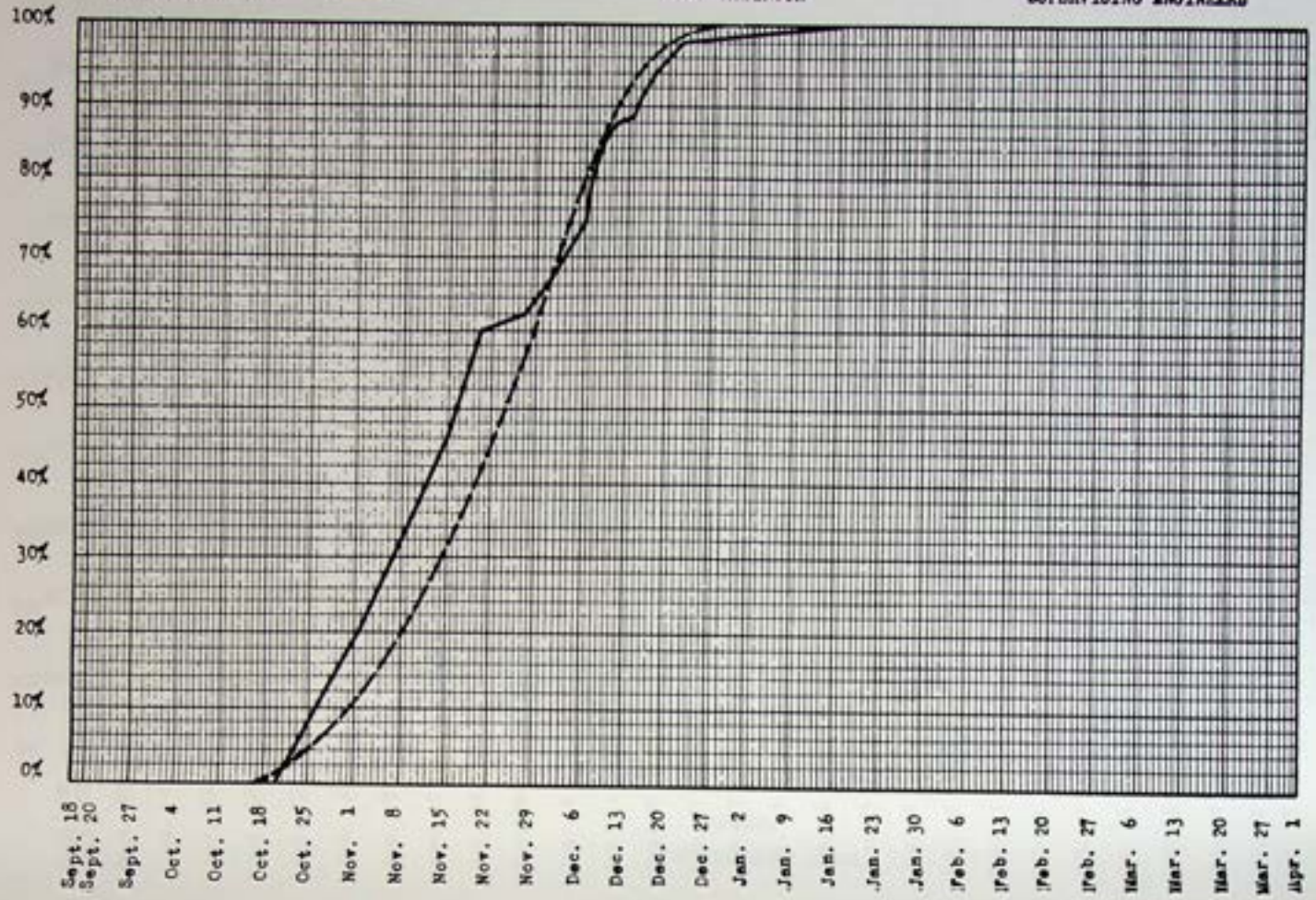
CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ---

ACTUAL PROGRESS ———



DAILY PROGRESS CURVE

SHOWING

STATUS OF GAS DISTRIBUTION

CAMP ROBINSON

SCHEDULED PROGRESS ———

ACTUAL PROGRESS ——

BLACK & VEATCH

SUPERVISING ENGINEERS

DAILY PROGRESS CURVE

SHOWING

SCHEDULED PROGRESS ———

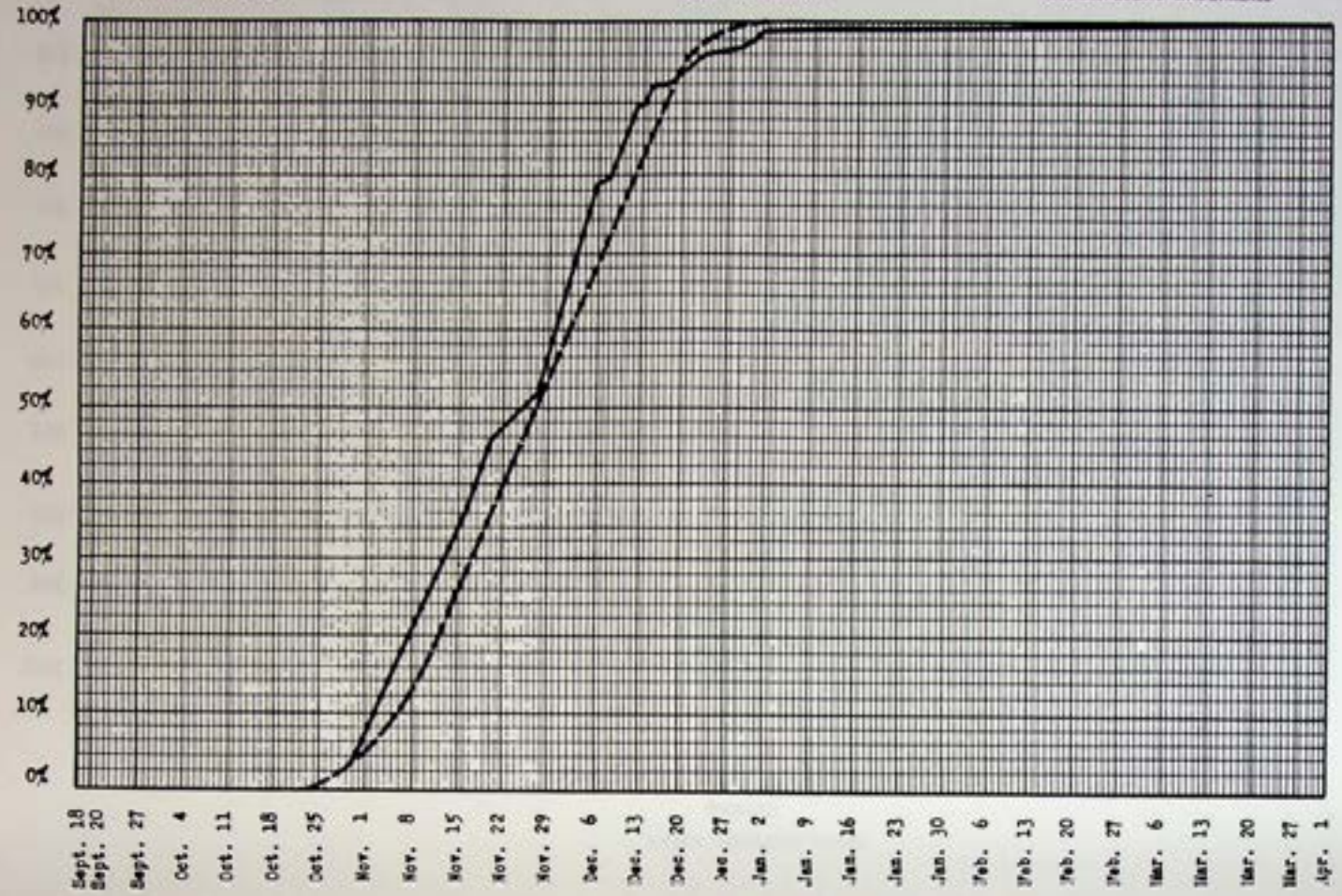
ACTUAL PROGRESS ———

STATUS OF SEWERS

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS



DAILY PROGRESS CURVE

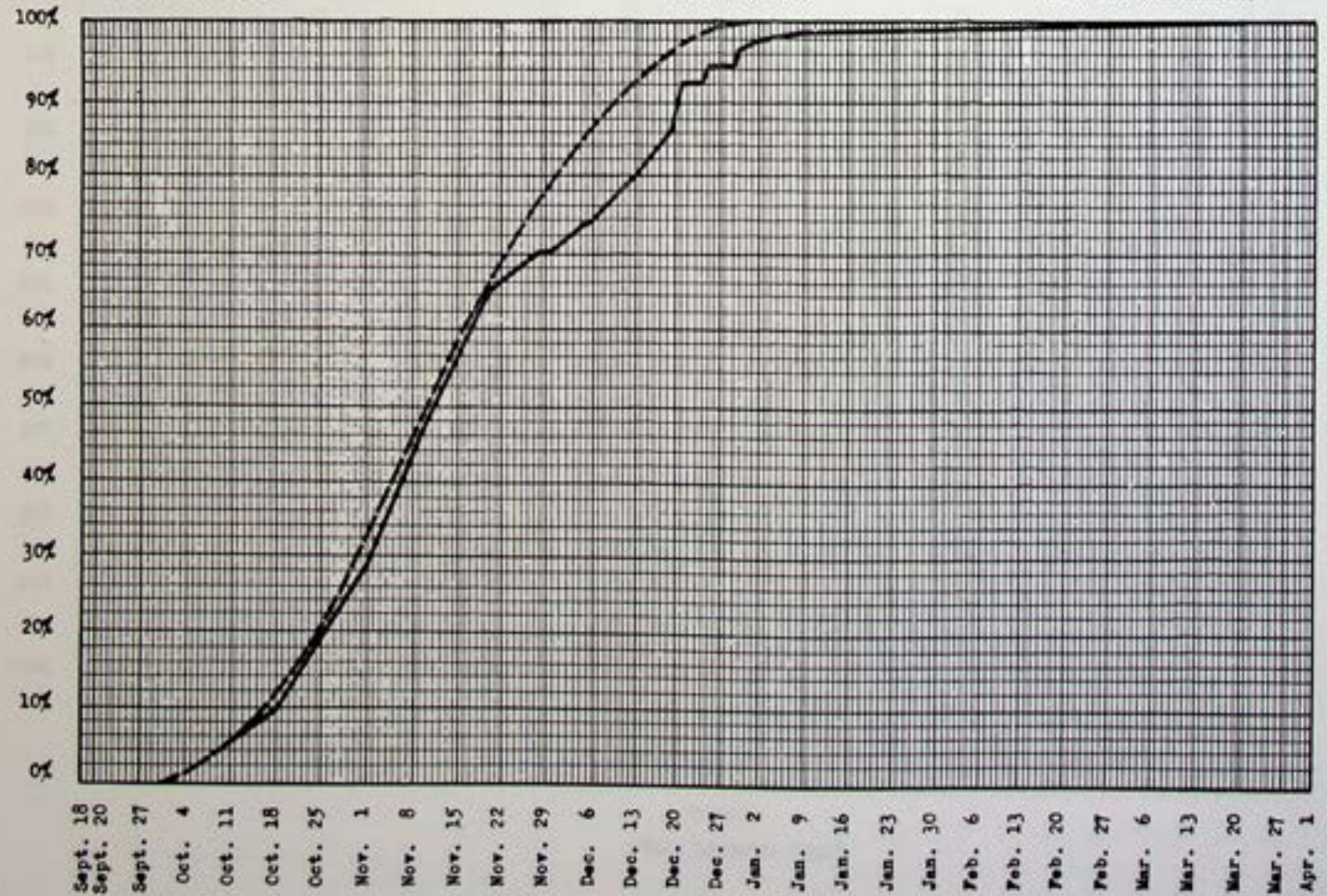
SHOWING

STATUS OF SEWAGE DISPOSAL PLANT

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS



DAILY PROGRESS CURVE

SHOWING

STATUS OF HOSPITAL BUILDINGS

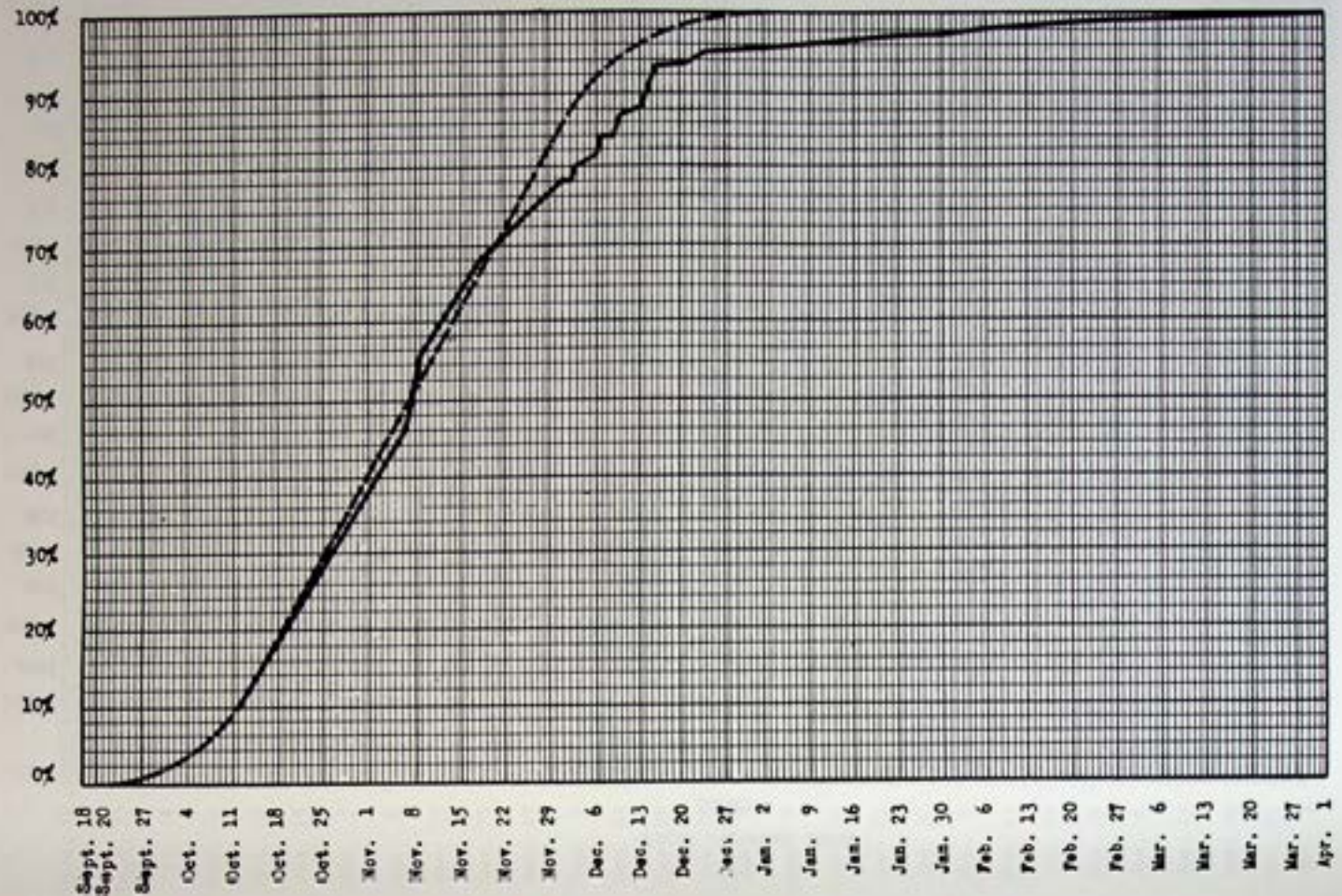
CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ———

ACTUAL PROGRESS ———



DAILY PROGRESS CURVE

SHOWING

STATUS OF GARRISON BUILDINGS

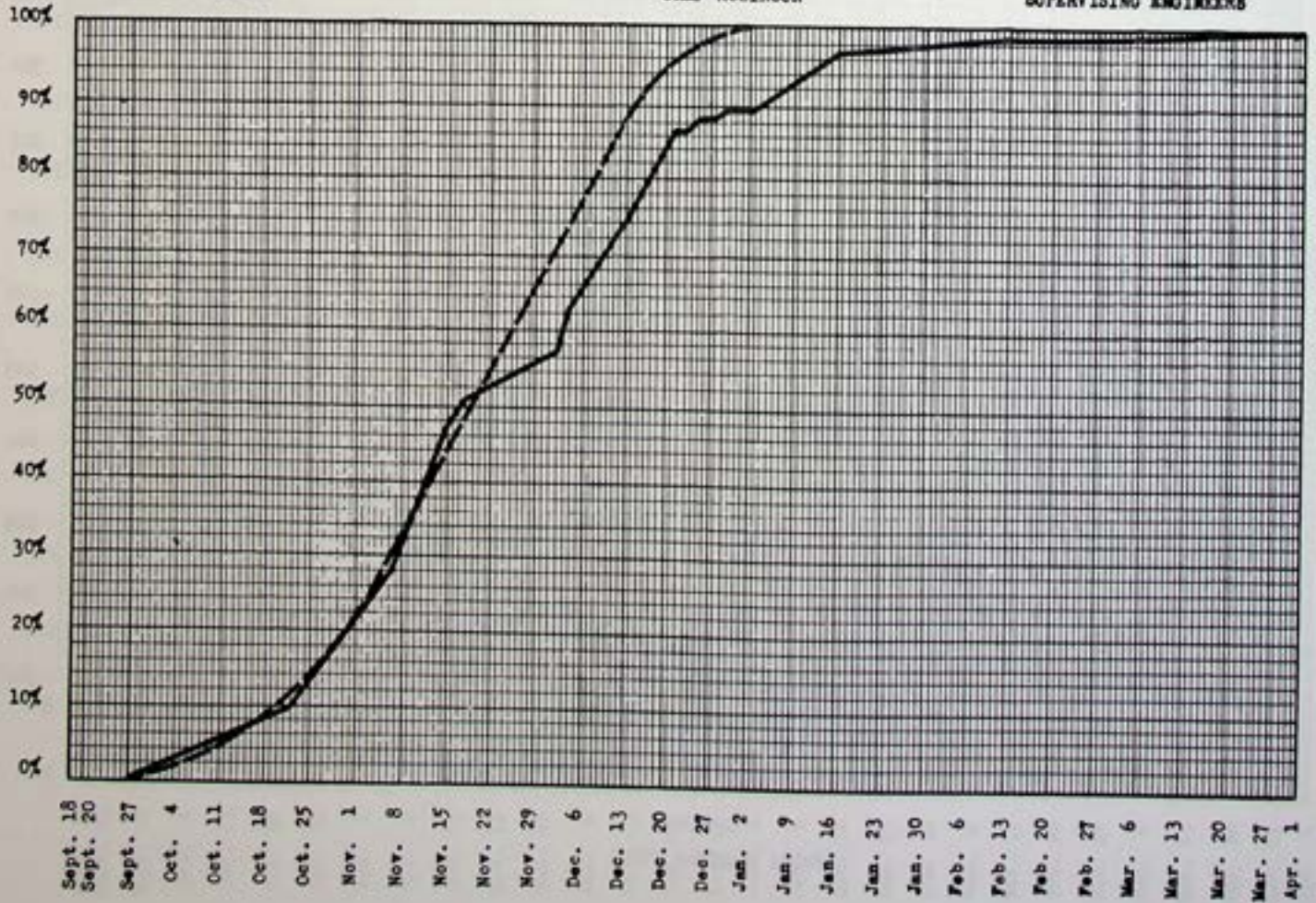
CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ———

ACTUAL PROGRESS ———



DAILY PROGRESS CURVE

SHOWING

SCHEDULED PROGRESS ———

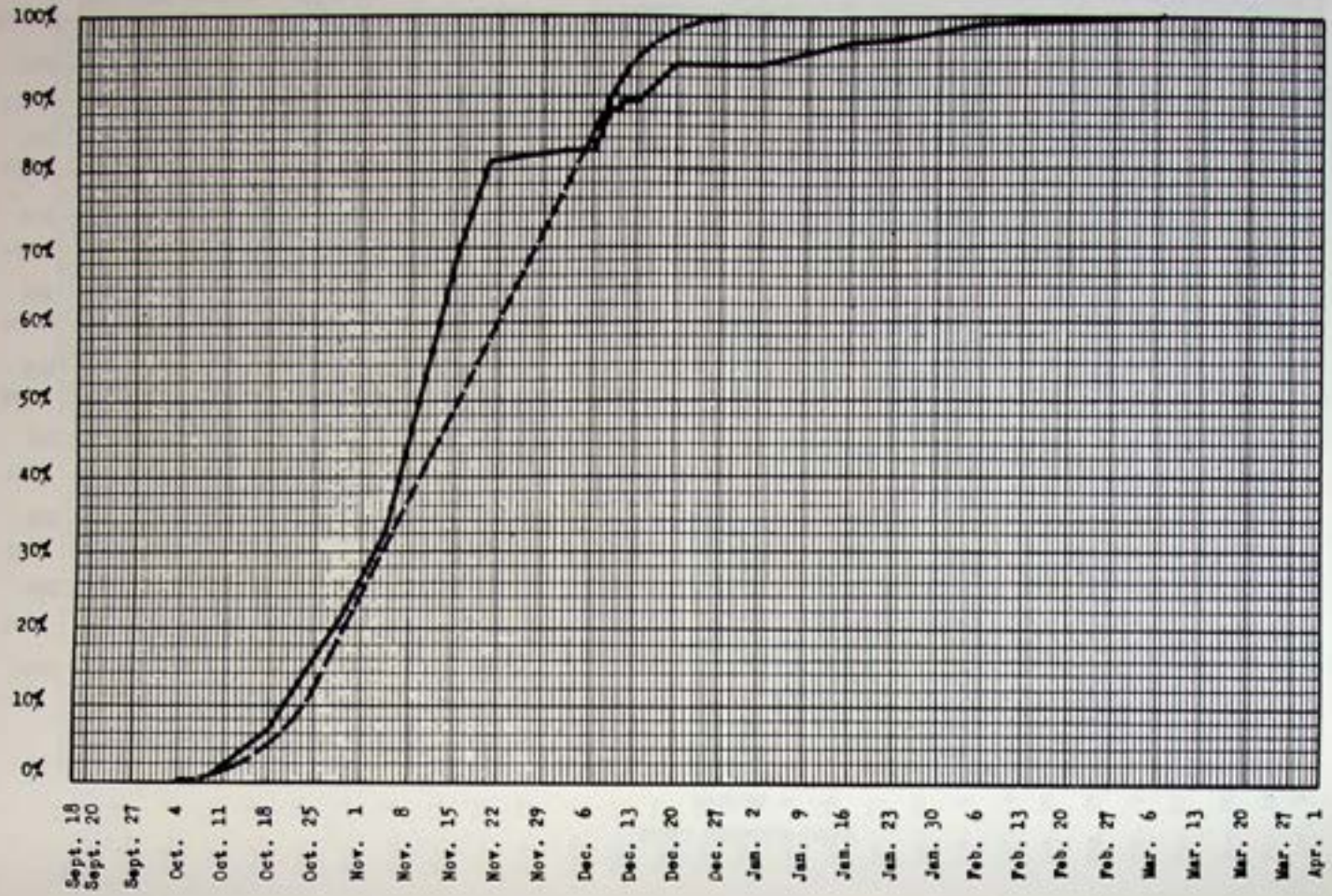
ACTUAL PROGRESS ———

STATUS OF TENTS

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS



DAILY PROGRESS CURVE

SHOWING

STATUS OF TOTAL PROJECT

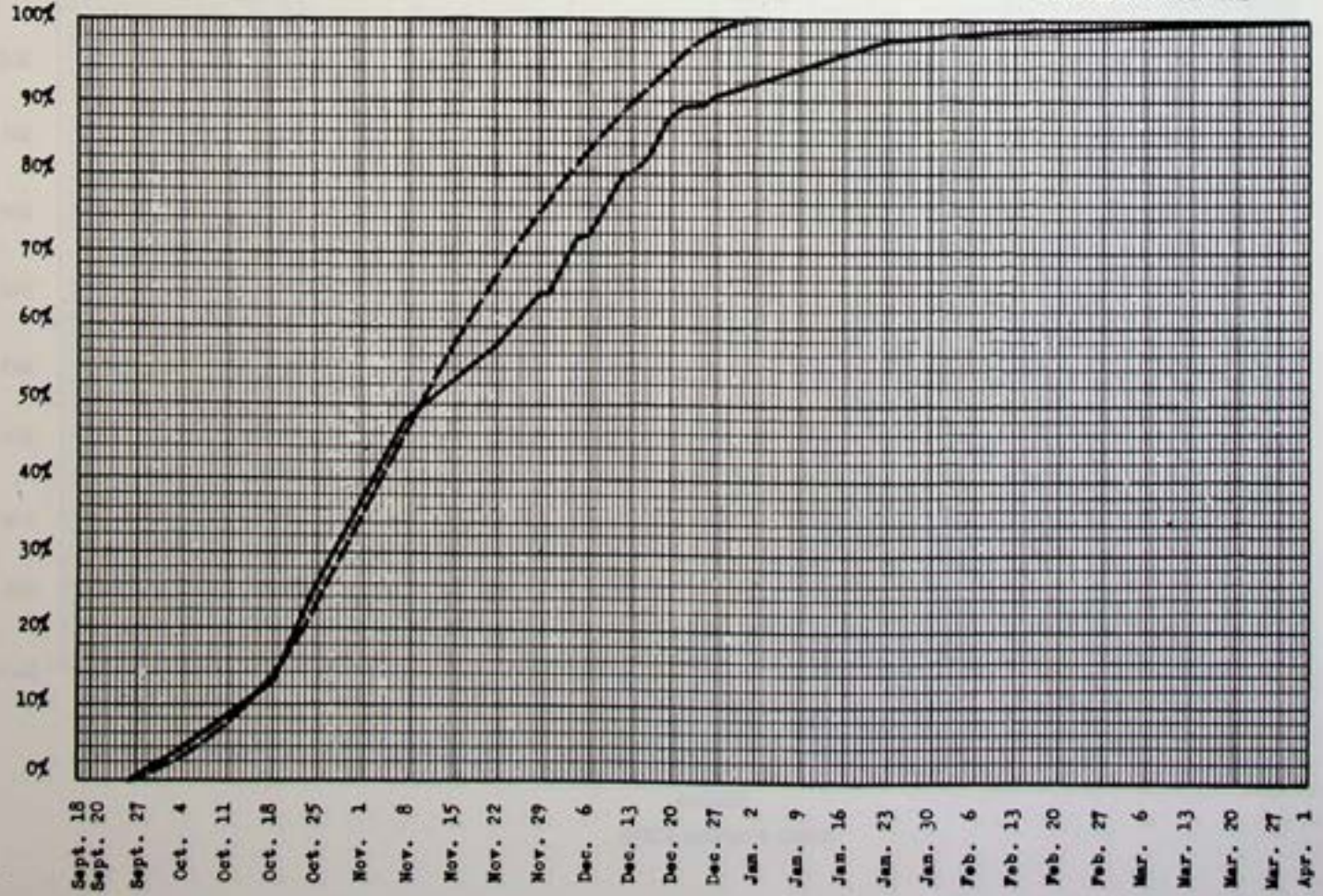
SCHEDULED PROGRESS ———

ACTUAL PROGRESS ———

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS



DAILY PROGRESS CURVE

SHOWING

STATUS OF GRADING AND CLEARING

CAMP ROBINSON

BLACK & VEATCH

SUPERVISING ENGINEERS

SCHEDULED PROGRESS ——— ———

ACTUAL PROGRESS ———

OFFICE ACCOMMODATIONS

8.1 GENERAL: At the time of beginning the engineering work, office space was provided in the existing Theater Building in the National Guard area at Camp Robinson for the engineering personnel. This consisted of two offices, one on either side of the main foyer on the first floor, each being approximately twenty-two feet by fifty feet in size.

The quarters were used until troops began arriving and it was then necessary that some other space be provided, since it was the intention to use this theater for entertainment, and also as a school for the instruction of soldiers. This office space was used until November 10, 1940 when the engineering organization was moved to new office space in the Post Exchange building of the 153rd Infantry. This new space could be used only until such time as the troops of the 153rd Infantry were admitted to camp.

It was then necessary to again move the office location from this building to the old hospital building in the National Guard area so that troops would be able to use the Post Exchange building on their arrival in camp January 2, 1941. The move from this building was made December 29, 1940. The offices in the old hospital building were used until the completion of the engineering work.

In order to disrupt designing personnel to a minimum, it would be advisable to provide proper and ample office space for the Architect-Engineers so that they could use the same office space for the entire duration of the construction program.

The policy of using existing buildings on this project was adopted for the purpose of holding costs to a minimum, since existing buildings were available. However, each move disrupted the designing work to a certain extent. It was also necessary that a portion of various engineering personnel spend considerable time in arranging and providing proper facilities in the buildings to which moves were made.

LAYOUT

9.1 GENERAL: After an examination of the site had been made on the previous day, work was started on the design layout at Camp Robinson September 11, 1940.

The camp layout was influenced by the remains of the original Camp Pike, as built in 1917-1918. Some of the original roads remained in fair condition and the original foundation of buildings was evidence of the original layouts.

A number of trial layouts for distribution of the division units were tried. The units to be provided for originally were the 35th Division, the 153rd Infantry Regiment, and the 1,000-bed Base Hospital. The troop units were arranged in a fan shape around what is now the loop formed by Iowa Avenue, 23rd Street and Kansas Avenue. The units face toward the center of the camp and the area bounded by the above streets was maintained free of troop units. Several difficulties were encountered in the arrangement.

The regiments were laid out as for a "Square Division" organization. Clearance between buildings was held to a specified limit of forty feet minimum clearance. Clearance between buildings and centerline of roads was held at fifty feet for main roads, thirty-five feet for secondary roads, and thirty-three feet for Battalion streets. Tent layouts were based on the standard original layout drawing furnished by the Office of the Quartermaster General.

A regimental layout was made to conform to the typical layout as nearly as terrain and local conditions would permit. Regulations required that a two hundred and fifty foot fire gap distance be provided between buildings of adjacent regiments. It was found in a number of cases that the topography of the ground allotted to a certain regiment would be such as to require alteration to the space requirements on account of drainage courses, slopes and local features.

The location of the Base Hospital was not settled for some time. Several sites were considered; one north of the camp proper, near the old site of the Officers training center of the previous war construction, another site northwest of the camp proper, and a third site in the southwest corner of the camp. The latter site was finally chosen as most suitable for this use. The ground was open, slightly rolling, and somewhat higher in elevation than the eastern part of the camp. Drainage was adequate and connections to existing sewer system could be made without great expense.

SURVEYS AND STAKING

10.1 GENERAL: To stake a project of this magnitude and to run the necessary surveys in connection therewith, in the relatively short time that was available, a maximum of speed and industry was required of all the persons connected with the staking.

10.2 ORGANIZATION: All surveying and staking was done under the supervision of a principal assistant engineer, whose duty it was to coordinate the work between the engineering office, the field parties, and the contractor. It was his duty to see that units were staked to conform with the layout as approved, as nearly as possible, and to have units staked before the contractor was ready to start work on them.

Staking parties consisted of one instrument man, who was the chief of the party, two rodmen-chainmen, a stakeman and the necessary axmen to keep the line cleared ahead of the parties. Level parties were composed of a levelman, one rodman, and in some cases, an axman to cut brush ahead of the party.

Survey crews were added from time to time as the work progressed, in order to keep the staking well ahead of the contractor's construction crews. In only a few minor instances was there any delay in getting staking work ready prior to construction requirements.

The contractor started construction in the Base Hospital area and later expanded to each regimental area with construction crews. It was, therefore, necessary that staking be provided in practically all areas of the camp simultaneously. Staking crews were added as the work progressed until twenty crews were in the field on the staking work, including both transit and level parties. During the "rush period", when the regimental units were being staked, the field parties worked nine hours a day in the field. The instrument men received their instructions in the evening so every available daylight hour was used for field work. Most of the personnel of the survey parties was hired locally. The quality of their work and their industry and cooperation with the engineering organization resulted in speed and accuracy above the average.

10.3 BASE LINE: The running of two base line surveys, to which all later surveys and staking were referenced, was the first survey made upon the arrival of the engineering organization on the job. These surveys were started on September 11, 1940.

Two survey parties, consisting of an instrument man and two rodmen, made the base line survey with both parties starting at the same initial point at the main entrance to the camp. From this point one party ran their line

west along South Dakota Avenue. This line was known as the South Base Line Survey. The other party ran their line north along Military Road to Missouri Avenue, turning west and following Missouri Avenue to approximately 28th Place. This line was known as the North Base Line Survey. The party running the South Base Line turned north at approximately the point where South Dakota Avenue would intersect 28th Street, if both streets were extended to an intersection. From this point the South base line was run north to close with the North Base Line at approximately the intersection of 28th Street and Missouri Avenue.

Nails with red flagging, known as "redheads", were driven to mark one hundred foot stations on the base line where the base line fell within the limits of an existing road. Stakes were driven in the shoulder of the road opposite the stations, with the station number marked on them. Where the base line ran through open country, center line stakes only were used. All angle points were referenced to nearby objects to make possible easy relocation when lost.

10.4 BENCH MARKS: Bench levels were run along the lines of the old sewers remaining from Camp Pike construction. Elevations were taken on the top of the cast iron ring on the manholes, and also at the invert elevation. Since the layout of Camp Robinson followed very closely the layout of old Camp Pike, this old sewer system covered the major portion of the area of Camp Robinson and the elevations established on the tops of the manhole rings were used as permanent bench marks during construction.

Since the levels on all of these sewer lines were carried on sea level datum, it was possible for instrument men to use these bench marks throughout the camp area very conveniently without the necessity of running any great distance for controls in levels. A map was made up, showing these elevations and distributed to the men in the field for their convenience.

10.5 ROADS: Roads serving the regimental areas were located to conform as nearly as possible with typical regimental layouts as made up by the Architect-Engineers. Changes were made wherever it was necessary to fit ground conditions or to fit existing roads. The location of roads, as staked in the field, was furnished the office as soon as it was available, so that the necessary layouts for buildings, tents and utilities could be made.

Right-of-way widths for roads were increased from those shown on the typical layouts as it was felt that additional width should be provided to take care of road ditches and utilities. Minimum clearance between buildings of one hundred feet on the main roads, seventy feet on regimental roads, and sixty-six feet on battalion roads, was used throughout the camp.

Existing roads were used wherever their use would not require too much deviation from the typical layouts. Roads were laid out perpendicular from

the base lines wherever possible, and stationing was numbered consecutively from the base line. This procedure resulted in an accurate location of all roads and aided plotting in the office.

A standard procedure in staking was followed by all parties. Road numbers and letters were arbitrarily assigned to each road by the principal assistant engineer in charge of roads. This method of referencing was necessary as names had not been assigned to the roads at the time the surveys were made. Center line stakes were driven on one hundred foot stations with the station number marked on one side and the road designation on the other. In addition, twenty-five foot offset stakes were driven on each side of the center line, opposite every other station, to reference the road center line. This method of referencing the center line is of great value but can be improved on by offsetting the stakes a greater distance. Twenty-five foot offset stakes are usually destroyed in grading or when utilities are placed.

In addition to the offset stakes, block corners were set at every road intersection. These block corners consisted of two inch by two inch hubs set twenty-five feet from each road center line at the intersection. The value of a block corner could be increased a great deal by placing it at the point where the building lines intersect, as then it could be used direct as a point for laying out buildings and tents.

Profiles were run as soon as the roads were staked. Tentative grades were plotted on the profiles but were not used for actual construction as slope stakes were not set and grading was done as a cut and fill proposition to conform closely to natural ground.

10.6 BUILDINGS AND TENTS: Buildings and tents were staked out to conform with the regimental layouts as furnished by the Architect-Engineers, but were modified to fit the conditions in the field. In some cases structures were not located as shown on the layouts as steep slopes, drainage, or large trees would have made such a location undesirable.

Three corners of each building and one corner of each tent were staked in every case. For uniformity in staking, the two corners facing regimental headquarters and the third corner to the right were established for each building. The corner facing regimental headquarters and to the right was established for each tent. The staking of three corners, instead of four corners, for each building, cut the number of instrument set-ups necessary to stake a building by one-third, and consequently, saved a great deal of time. From the three corner stakes it was very easy for the contractor's layout men to establish the fourth corner.

Due to the speed necessary to keep ahead of the contractor's forces, several parties worked in the same regimental area at the same time. To coordinate the work and to keep a record of the number of structures and their locations

as staked, each party chief was required to note on a staking layout every night, the structures he had staked and the dimensions necessary to tie in their location. In addition to these records, each party chief was required to keep a record in a standard field notebook of the location and size of each structure that he staked. This procedure when faithfully carried out by all the parties concerned, results in a complete and accurate set of staking records.

When staking buildings and tents, particular care was exercised to preserve all large trees and structure locations were adjusted to meet this condition.

Certain portions of the staking, principally those on buildings, were completed very rapidly and the men who had been used on the staking parties, if qualified, were then transferred over to construction, being used as inspectors and supervising engineers on the construction work.

10.7 UTILITIES: Utilities were staked out under the direction of each principal assistant engineer in charge of the various utilities.

10.8 CONCLUSIONS: An accurate system of bench levels, based on mean sea level datum, should be established before any levels are run for other purposes. This system of bench levels should be run by a competent levelman and should be consistent with good practice for second order control levels. Frequent bench marks should be set and a complete description made of their location.

A standard system of note keeping should be established and followed throughout the duration of the project. This system of note keeping should be consistent with good practice and written specifications on the method of keeping notes should be furnished each party chief. Duplicating field note books could be used, which would allow one copy for use in the office and a carbon copy for use in the field, preventing notes on one subject being scattered through several field books.

Block corners, as described previously, should be located at building line intersections so they will be of better use in staking out structures. Offset stakes from road center lines should be set at least thirty-five feet, and a greater distance if possible, from the road center line, in order to be well out of the way of grading operations.

ROADS

11.1 GENERAL: The layout of Camp Robinson follows very closely the original 1917 layout of old Camp Pike. In the original camp layout certain roads were constructed with an asphalt surfacing on water bound or penetration macadam. These roads which were so constructed are the ones which are designated on the Camp Robinson layout as South Dakota Avenue from the camp entrance west to 22nd Street, Missouri Avenue from Military Road to 19th Street, Military Road from the camp entrance to Missouri Avenue, 6th Street from South Dakota Avenue north to North Dakota Avenue, and some other short streets in the Arkansas National Guard area. There was a total of 4.9 miles of this old pavement.

It was found practicable to make use of eleven miles of old road location. The old paved surfaces consisted of crushed stone, gravel and macadam roads, as described above. Subsequent paving and repair work, since the time of original construction, had left the surface irregular and so uneven that a new surface was necessary.

These roads were also widened to conform to the new sections adopted. Some of the other original roads remained, although in general they were found to be narrow and in poor condition, and so located that with certain exceptions they were not considered in the layout plans for the new camp.

Except for the eleven miles of old road mentioned, the entire road system was graded through virgin territory. Right of way was cleared and stumps removed for a width of fifty feet. Large or ornamental trees near the border line were allowed to remain. A map of the entire camp layout, which shows the road system together with types of surfacing, is included in this report as shown on Drawing No. 6110-415.

Certain roads were designated as high type or heavy duty roads and these roads were constructed of a higher type surfacing in order to take the heavy truck traffic. This high type or heavy duty road is carried between the service areas and the tented troop areas of each regiment so that truck traffic following these roads will be near to their service areas. One entire loop around the camp of this type of road makes up the heavy duty road for truck traffic and follows a route from the entrance to camp along South Dakota Avenue to 22nd Street. This portion is over an old existing macadam road. This high type road then turns to the left on 22nd Street, running to Minnesota Avenue, thence to the right on Minnesota Avenue to 26th Street, thence north on 26th Street to Missouri Avenue, east on Missouri Avenue to 23rd Street, north on 23rd Street to North Dakota Avenue, east on North Dakota Avenue to Military Road, thence south on Military Road to the camp entrance.

These roads which were originally hard surfaced were primed and a hot mix asphaltic concrete applied to the surface. In most cases this reconstruction was accomplished by approximately one hundred fifty to two hundred pounds of binder course and fifty pounds of seal coat per square yard. In some cases this old asphalt surface was in very good condition and in those cases it was primed and a seal coat only applied.

1.2 miles of old asphalt pavement in the National Guard area was found to be in good condition and the only treatment given was to seal the surface with liquid asphalt RC-2 and apply thirty pounds of stone chips per square yard. The pavement or wearing surface used on roads considered of lesser importance and proposed to carry lighter traffic was constructed of a double surface treatment.

11.2 GRADING: The first work in connection with the road construction was the grading and ditching. This work was started on October 18, 1940.

In the design of the road system, two widths of shoulders were adopted. On roads carrying through traffic and heavy loading, the road was graded to a crown width of thirty-six feet. Short service roads in the various military units, estimated to carry lighter traffic, were graded to a crown width of twenty-six feet. Side slopes varied from the typical section, depending on height of fill and depth of cut. Where possible, back slopes were further flattened so as to allow traffic to drive on or off the road. The shoulder slopes were graded to four to one. Drawing No. 6110-422 in this report shows the details of the road sections.

The equipment used for grading was secured from a contractor who had specialized in road grading entirely for a number of years. In addition to the equipment, this contractor brought onto the job a thoroughly experienced and efficient operating organization. Profiles showing finished grades on all roads were furnished the contractor prior to grading. No special effort, however, was made to conform precisely to the grades shown. They were taken as suggestions only and as indicating the proposed method of drainage. However, special care was taken to see that the finished grade presented a pleasing appearance. All the work done by this grading organization was entirely satisfactory.

Equipment furnished was in perfect condition and was so maintained throughout the grading operations. The superintendents and equipment operators were, without exception, thoroughly experienced and familiar with this type of work and seemed to take pride in the quality, workmanship and speed with which this construction was accomplished. The equipment used on the grading work consisted of the following:

7 Caterpillar Diesel-powered Tractors
5 LeTourneau (12 cubic yard capacity) graders
1 Heavy Rooter
2 Bulldozers
2 Blade Road Graders
1 Diesel Motor-driven Road Maintainer
1 15 KW 110 volt Light Plant

This equipment worked ninety days and graded 28.6 miles of road. The estimated amount of material moved was four hundred fifty thousand cubic yards. The grading work was completed on January 25, 1941.

11.3 CULVERTS: Road drainage was provided by the construction of side ditches and culverts were installed wherever necessary. In order to obtain speed in construction it was decided to use pipe for the drainage structures except for the larger drainage areas. The size of pipe used for drainage varied from fifteen inches to forty-eight inches in diameter.

When taking bids on this material, in most cases optional bids were taken on reinforced concrete pipe and corrugated metal arch pipe culverts, asphalt dipped. It developed that the concrete pipe would be the cheaper pipe to use, considering first cost and installation. This pipe was reinforced concrete culvert pipe of road strength.

The lengths of the pipe culverts were equal to the total width of embankment at the toe of the slope. Using this method of construction, concrete head walls were unnecessary. In openings requiring larger areas than forty-eight inch concrete pipe, reinforced concrete culverts were poured in place. Where still larger openings were required, creosoted timber bridges were constructed.

Excavation and pipe laying was, in general, done by common labor. However, where deep excavation or rock was encountered, any available excavating machinery was used.

There were installed in the entire road system one hundred eighty reinforced concrete pipe culverts totalling 9394 lineal feet, in sizes ranging from fifteen to forty-eight inches; nine reinforced concrete box culverts, five creosoted timber bridges. Details of the creosoted timber bridges are shown on Drawings No. 6110-418 and No. 6110-419. The details of reinforced concrete box culverts are shown on Drawing No. 6110-421.

11.4 GRAVEL BASE: The base course of all roads in camp other than the original existing macadam base was composed of a compacted clay-bound gravel having a final compacted thickness of approximately seven inches. On the high type or heavy duty roads the same type of surface was applied to this gravel base as was used in the resurfacing of the existing macadam pavements. This gravel meets the following designated specifications:

The gravel shall be bank run and consist of hard durable particles mixed with sand or clay or other similar binding material, and when tested by laboratory methods, shall meet the following requirements:

Passing	2½" Screen	100%
Retained on	1½" Screen	0 - 15%
Retained on	3/4" Screen	15% - 30%
Retained on	No. 4 Sieve	50% - 70%
Retained on	No. 8 Sieve	60% - 80%
Passing	No. 200 Sieve	5% - 25%

This gravel was shipped by rail from Benton, Arkansas into Camp Robinson. From the cars it was hauled by truck and distributed to the road. Compaction on the road was secured by blading, rolling with pneumatic tired rollers and regular traffic.

It was planned to use the clay bound gravel throughout the camp area for the full depth of the base course. This type of material gives a very tight and fairly waterproof base even without any surfacing material being added, and with a surface treatment of most any type it gives a very satisfactory road.

The work was started under very favorable weather conditions and continued so until during the month of December when several days of rain occurred. The roadway subgrade became very bad in some locations in camp. To eliminate this condition it was necessary that stone be used for stabilizing the subgrade so that the gravel course could be applied and properly rolled in order to make the roads available for troop occupation of the camp on January 2, 1941. For this stone base, a crusher run stone having a maximum size of four inches was used. This gave a very satisfactory material in that there was enough shale and other cementing material to properly bind the stone together under rolling and traffic. The thickness of this stone application varied from approximately four inches to whatever depth might be necessary in order to properly tighten up the subgrade, depending upon the local conditions.

After this application of crushed stone was completed, the clay bound gravel was then applied, usually in thicknesses of about four inches in order to level up the stone sub-base and give a satisfactory base course for application of the surfacing. In many cases, after the application of the gravel and previous to the time of obtaining proper compaction by rolling or by traffic, rains would occur and the uncompacted gravel course would become cut up by traffic. This condition was alleviated somewhat by laying the gravel base course in thinner layers to get compaction more readily, and adding enough layers until the total required thickness was obtained. By utilizing this method of construction in using the stone base, it was possible to continue with the road construction during almost any type of weather insofar as the rock base course was concerned.

The equipment used in laying the gravel base course consisted of the following:

3 Clamshell Cranes for unloading gravel from the cars.
4 Pneumatic Tired Wobble-wheel Rollers (loaded to about 10 tons)
2 Road Graders
3 Rollers
Sufficient dump trucks to handle 30 to 60 cars of material per day.

The above equipment worked ninety days and handled 73,240 tons of crushed stone and 130,000 tons of clay bound gravel. The total road length of gravel base was 28.6 miles.

When the base had solidified and set up under proper rolling and traffic, the surface was primed with a medium cutback asphalt (MC-1) applied at the rate of one-fourth gallon per square yard. This material was required to meet the following specifications:

Cutback asphalt primer MC-1 shall conform to Federal Specification SS A-671 (Medium curing cutback)

A total of 59,611 gallons of this priming material was used.

11.5 ASPHALT CONCRETE SURFACING: The pavement surfacing laid on the heavy duty traffic roads consisted of a plant mixed hot asphaltic concrete laid in two courses. The first, or binder course, was distributed on the prepared base by means of a mechanical asphalt spreader in such thickness that when compacted it would be approximately one and one-half inches in depth. The second course consisted of a seal coat composed of asphalt, fine stone, dust and sand applied hot to a thickness of approximately one-half inch. This was thoroughly rolled into the binder course, dusted with Portland cement, and the pavement turned over to traffic. The asphalt for this surfacing met the following specifications:

COARSE ASPHALTIC CONCRETE WITH SEAL COAT

Shall consist of a binder course of 1½" to 2" in thickness or as directed; with a seal coat approximately ½" thick, placed over all binder course. The finished paving mixture shall conform to the following requirements as directed by the Engineer:

	Binder	Seal Coat
Passing 1 - ¾ inch	25 - 60%	
" ¾ inch	15 - 30%	
" No. 4	5 - 15%	0 - 5%
" 10 M	4 - 11%	10 - 35%
" 40 M	7 - 15%	22 - 45%
" 80 M	4 - 11%	12 - 35%
" 200 M	0 - 4%	10 - 20%
Bitumen	4.5 - 7%	9 - 11%

The asphalt cement used in binder and seal coat mixture shall conform to Federal Specification SS-A-706, Designation AP 6-25 (50-60 Penetration grade).

The coarse aggregate shall consist of broken stone produced from tough durable rock having a percent of wear of not more than 6; and less than 10 percent loss on 5 cycles sodium sulphate soundness test. Sand shall consist of clean sound particles substantially free from clay lumps or bonded aggregation.

Contractor shall provide plant capacity to produce a minimum of 40 tons per hour, equipped with the necessary bins, scales, drier, etc. as approved by the Engineer for the accurate control of the mix.

All of the material was furnished on a price per ton basis, mixed in accordance with specifications and under the supervision of the Commercial Testing Laboratory.

The equipment used in laying the pavement was as follows:

1 Mechanical Paver
3 Road Rollers
1 Tank Truck
1 Mechanical Sweeper
4 Dump Trucks
1 Portable Heater (for the heating of smoothing irons)

The plant capacity and equipment used was capable, under favorable weather conditions, of laying this type of pavement at the rate of six hundred tons of mixed asphalt, or approximately three thousand lineal feet of finished pavement per day. Under actual working conditions, however, this speed could not be maintained. Weather conditions, the necessity of maintaining traffic, and time required to prepare the gravel base, reduced the maximum rate of laying to approximately half of the above quantities.

Asphaltic concrete was laid over an area of 115,800 square yards, requiring approximately 14,069.5 tons of paving mixture. The total length of this type of paving was 9.7 miles. The specification for the construction of the hot top asphaltic concrete pavement, under which this surfacing was laid, is as follows:

CONSTRUCTION METHODS

The methods employed in performing the work and all equipment, tools, machinery used in handling materials, and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory shall be changed and improved as required by the Engineer. All equipment, tools and machinery used must be maintained in a satisfactory working condition.

PREPARATION OF BASE

Prior to the arrival of the surface course mixture on the work, the prepared base shall be cleaned of all loose and foreign materials.

Contact surfaces of curbings, gutters, manholes and other structures shall be painted with a thin, uniform coating of hot asphaltic cement, or asphaltic cement dissolved in naptha, just before the surface mixture is placed against them.

PRIMING

The base course, after being properly prepared, shall be subjected to a prime coat application before the surface course is placed. Traffic shall not be permitted on the road after the application of the prime coat until the surface course has been completed.

The prime coat shall consist of MC-1 cutback asphalt conforming to Federal Specification SS-A-671 applied at the rate of one-fourth gallon per square yard on gravel base. RC-2 cutback asphalt, conforming to Federal Specification SS-A-671 applied at the rate of 0.2 gallon per square yard on old asphalt pavement base.

DISTRIBUTOR

The distributor used in applying the bituminous material shall be a self-propelled pressure distributor, equipped with suitable manifold. It shall have tires of sufficient width so that pressure produced shall be not greater than 650 pounds per inch width of tire so as to

disturb the stone as little as possible. Sufficient and proper screens shall be installed between the tank and the nozzle and same shall be cleaned frequently, to prevent clogging of nozzles. The distributor shall be so designed as to keep a constant and uniform pressure upon the bituminous material as it passes through the nozzles. It shall be so constructed as to make it possible to readily determine the temperature of the bituminous material and the contractor shall furnish and keep on the work available to the inspector at all times, an accurate thermometer suitable for determining this temperature.

FORMS

On all sections of the work where permanent side supports such as concrete curbs, gutters or headers are not in place, approved side forms shall be installed to insure accurate grade and alignment in placing the paving mixture.

Side forms for this work may be of wood or metal, of depth equivalent to the edge thickness of the work prescribed, and straight and free from warp. The method of connection between sections shall be such that a joint is formed free from play or movement in any direction and the forms shall be of such base area, cross-section and strength, and so secured as to resist, without springing or settlement, the impact and vibration of the finishing machine, and to prevent squeezing out or side shoving under the roller or other lateral displacement.

The minimum length of section of forms used on tangents shall be ten feet, with longer lengths preferred. Wood forms may be used on curves of such radius that less than a ten-foot section is required to produce the circular arc desired.

The alignment and grade of forms shall be checked and approved immediately before placing the paving mixture. Forms which show a variation exceeding the surface test requirements as specified in subsequent paragraphs shall be reset or removed as directed.

Forms shall be cleaned before being set to line and grade, before the paving mixture is placed. They shall remain in place until after the placing and final compaction of the surface course. Care shall be exercised in rolling so as not to displace the line and grade of the forms.

LAYING

The mixtures shall be transported from the paving plant to the work in tight vehicles previously cleaned of all foreign materials, and when directed by the Engineer, each load shall be covered with canvas or other suitable material of sufficient size to protect it from the weather conditions. No loads shall be sent out so late in the day as to interfere with spreading and compacting the mixture during daylight unless artificial light satisfactory to the Engineer is provided.

Upon arrival, the mixture shall be dumped into a mechanical spreader approved by the engineer, and immediately spread thereby and struck off in a uniformly loose layer to the full width required, and of such depth that when the work is completed, including the finish coat, it will have the thickness shown on the plans or as directed by the engineer in the field and will conform to the grade and surface contour required.

Hand spreading will be permitted where the width of pavement changes, on curves or at other points at the discretion of the Engineer. When hand spreading is permitted, the work shall be done in the following manner:

Upon arrival on the work, each load shall be unloaded outside of the area on which it is to be spread, upon suitable dumping platforms, and shall then be immediately distributed into place by means of hot shovels and thoroughly combed with hot rakes into a uniformly loose layer of correct depth. Care shall be exercised that the workmen do not tread the surfacing after placing and before rolling.

The process of uniformly distributing the mixtures with rakes shall be so conducted that the prongs of the rakes shall thoroughly and completely destroy any compaction which may have occurred in transporting and placing the material. During the initial raking, the prongs of the rake shall extend entirely through the mixture.

ROLLING

The rolling of the binder course will proceed immediately after spreading or raking. The rolling must be continuous and one roller must be provided for each 200 square yards of surface mixture laid per hour. At least one roller must give a compression of 300 to 450 pounds per lineal inch width of tire. Additional rollers must weigh at least five tons each. Places inaccessible to the roller shall be thoroughly tamped by hand to the satisfaction of the Engineer.

Rolling shall be started longitudinally at the sides and proceed toward the center of the roadway, overlapping on successive trips by at least one-half of the width of the roller. The surface shall then be subjected to diagonal rolling in two directions, the second diagonal rolling crossing the lines of the first.

After the binder course has been properly rolled, the seal coat approximately 1/2" thick shall be uniformly applied and rolled with a roller weighing not less than five tons.

JOINTS

Should continuous asphalt laying be interrupted for a length of time sufficient for the asphalt to cool, the edge shall be cut square. When the laying of mixture is resumed, the exposed edge of the joint shall

be painted with a thin coat of hot asphaltic cement or asphaltic cement thinned with naptha and the fresh mixture shall be raked against the joint, thoroughly tamped with hot tampers and rolled. Hot smoothing irons may be used for sealing joints, but in such case extreme care shall be exercised to avoid burning the surface.

SURFACE FINISH

After initial rolling of wearing surface, the contractor shall sweep the surface with dry Portland cement at rate of one cubic foot of cement to 200 square yards of pavement surface.

SURFACE TESTS

Before the completion of the rolling, the surface shall be tested for thickness and contour as follows, and corrected as necessary by properly adding or removing material, retesting and re-rolling until the finished surface complies with the test requirements.

The finished surface course shall show no deviation from the general surface in excess of one-sixteenth inch per foot as measured by a ten foot straight edge placed parallel to the center line of pavement, the maximum variation in ten feet shall not exceed one-fourth inch.

Such portions of the completed surface course as are found defective shall be removed and replaced with suitable material.

PROTECTION OF SURFACE COURSE

Sections of newly compacted surface courses shall be protected from traffic for a minimum period of six hours, with such additional time as may be necessary until they have become properly hardened by cooling.

The forms mentioned in the specifications were found not to be necessary under actual construction conditions.

11.6 DOUBLE SURFACE TREATMENT: The type of surfacing used for all roads in camp other than the heavy duty road and roads which originally had a macadam base, was what is known as the double surface treatment and was constructed in accordance with the following specifications:

DESCRIPTION

This item shall consist of a surface course composed of a double application of bituminous material applied hot, and covered with crushed stone, and shall be constructed on the completed and approved base course or surface course in accordance with these specifications.

MATERIALS

Crushed stone for double surface treatment shall consist of broken stone produced from tough durable rock having a percent of wear of

not more than 6; and less than 10 percent loss on 5 cycles sodium sulphate soundness test. It shall be free from an excess of dust or coating and shall conform to the following gradation requirements:

Retained on	3/4"	Sieve	0%
Passing	1/4"	"	90% - 100%
"	No. 4	"	0% - 15%
"	No. 8	"	0% - 3%

Liquid asphalt for double surface treatment shall be rapid curing cut-back asphalt, Type RC-2, and shall conform to Federal Specifications SS-A-671.

CONSTRUCTION METHODS

Before the bituminous material is applied, the surface shall be swept free of dust or dirt to the extent of practicable cleaning, but not loosening or dislodging the top embedded aggregate. Layers or cakes of clay, dust or other foreign matter which do not form an integral part of the road surface to be treated shall be removed. The sweeping and cleaning operations shall be carried only far enough in advance of the application of bituminous material as to insure the surface being properly prepared at the time of application.

(a) First Application of Bitumen: After the surface to be treated has been properly prepared in accordance with the specifications outlined above and after the application of the prime coat prescribed, the bituminous material shall be sprayed uniformly over the surface by means of an approved type mechanical pressure distributor at the rate of five-tenths of a gallon per square yard. The machine used for applying the bituminous material shall be required to operate under and maintain a pressure of not less than twenty nor more than sixty pounds per square inch.

(b) First Application of Cover Material: Immediately following the application of the bituminous material, cover material shall be distributed over the bituminous surface in the amount of seventy pounds per square yard of surface area. The cover coat shall be evenly and accurately distributed to insure that a smooth surface is obtained. The application of bitumen and the spreading of the cover material must be closely coordinated in order that the bituminous material does not become cold before the cover material is spread.

(c) First Rolling. Immediately following the application of the cover material it should be brought to a smooth and even surface by a long-base maintainer. And the entire surface shall be lightly rolled with a self-propelled three-wheeled roller weighing not less than two hundred pounds to the inch width of tread. Sufficient cover material must be applied to all parts of the road surface to prevent any of the bituminous material from adhering to the roller during rolling operations. Any depressions, uneven or irregular areas developing in the surface during rolling operations shall be remedied, and the surface brought to the true grade and cross section.

(d) Second Application of Bitumen: Following the spreading and rolling of the first application of cover material, the bituminous material for the second application shall be sprayed uniformly over the surface by means of an approved type of mechanical pressure distributor at the rate of approximately one fourth of a gallon per square yard. The same construction conditions shall apply as outlined for the first application.

(e) Second Application of Cover Material: Immediately following the second application of the bituminous material, the second application of cover material shall be distributed over the bituminous surface in the amounts of thirty pounds per square yard of surface area, the same construction conditions shall apply as outlined for the first application.

(f) Second Rolling: Immediately following the second application of cover material, the entire surface shall be broom dragged and rolled with a self-propelled roller as previously described. Sufficient cover material must be applied to all parts of the road surface to prevent any of the bituminous material adhering to the roller during the rolling operations. Any depressions, uneven or irregular areas developing in the surface during the rolling operations, shall be remedied, and the surface brought to the true grade and cross section.

This type of surfacing gives a very satisfactory road and one which will give excellent service provided the base is properly compacted when the surfacing is applied. Due to the construction being carried on during the time of year at which it was necessary to build the roads at Camp Robinson, there naturally developed a great many soft spots throughout the road system, due to unstable subgrade. As these soft spots developed the soft material was removed and crushed rock put in to replace the soft base and subgrade, and the surfacing was repaired.

In the specification there was no provision made for the drying of the stone due to the fact that it was thought possible to be able to complete the roads before wet weather might set in. At the beginning of the surfacing of this type of pavement, the stone was hauled and dumped in piles along the shoulder of the road to be surfaced. This material was then shoveled from the stock pile by hand onto the roadway after the bituminous material was applied. This method of construction was satisfactory during dry weather but after the beginning of intermittent rains it was difficult to obtain dry material for this type of surfacing. It was, therefore, necessary to provide drying equipment for drying the crushed stone previous to the time of applying this material to the road surface. After setting up the drying equipment, the material was then loaded from the hopper directly into the trucks and was spread on the road surface by means of opening the tailgate of the dump truck a sufficient amount to allow the proper amount of material to be spread from the truck onto the roadway. The material was then broomed so as to get a uniform thickness of material. The equipment used in laying the double surface treatment was as follows:

1 Drying Plant
1 Pressure Asphalt Distributor
2 Gasoline-propelled Road Rollers
11 Dump Trucks

With the above equipment, this pavement was laid over an area of approximately 215,600 square yards. The material required was approximately 195,778 gallons of cutback asphalt, Type RC-2, and 12,080 tons of crushed stone chips. The total length of the road paved with this type of surfacing was 20.4 miles. Under favorable weather conditions the operation of laying this type of pavement is exceedingly fast. However, the actual speed with which this surfacing was laid at Camp Robinson was reduced somewhat due to the fact that it was necessary to maintain traffic while the work was in progress, as the delivery of materials for the construction of buildings and other utilities was of such importance that traffic could not be entirely diverted. For the same reason the preparation of the gravel base course in advance of the pavement was rather difficult in order to obtain a uniform base. The work had to be done in short stretches, which required frequent moving of the equipment. Under these conditions, the average rate maintained was less than one mile per day.

11.7 CHANGES FROM ORIGINAL PLAN: As heretofore stated, a major portion of the road system was built through virgin territory, requiring, in order, the grading, preparation of subgrade, and the compacting and smoothing of the gravel base.

As a rule the placing of pavement surface was not attempted until the above operations had been satisfactorily completed and the base ready to receive the final surfacing. This made it necessary to shift the paving operations to selected portions of the road where base conditions were best.

As the paving construction approached completion, prevailing weather conditions made it increasingly difficult to properly prepare the base so as to warrant the placing of a high type surface. It was, therefore, considered advisable in the interest of speed and economy to make certain changes in the type of pavement from that originally planned, provided that no sacrifice was made in the usability of the roads. These changes were requested by Washington, and were made as follows:

(a) 8th Street, between Missouri Avenue and North Dakota Avenue, was changed from asphaltic concrete to gravel surface only.

(b) North Dakota Avenue, between 12th and 14th Streets, was changed from asphaltic concrete surface to double surface treatment.

(c) Kansas Avenue, from 3rd Place to a point about one hundred fifty feet west of 6th Place, was changed from asphaltic concrete surface to double surface treatment.

(d) 30th Place, from Avenue "A" to the boiler plant and Avenue "A" were changed from double surface treatment to gravel base and prime only, no surfacing material being applied.

(e) The roads around the Evacuation Hospital and within the Base Hospital units were changed from double surface treatment to gravel base only, no surfacing material being applied.

(f) The Magazine road was changed from double surface treatment to gravel base only, no surfacing material being applied.

(g) 11th Street, between Minnesota Avenue and the Incinerator, was changed from double surface treatment to gravel base only, no surfacing material being applied.

(h) The two dead-end roads in the Combat Engineer area were changed from double surface treatment to gravel base only, no surfacing materials being applied.

(i) Curved approach road to the 70th Infantry Brigade Headquarters was changed from double surface treatment to stone macadam only, no surfacing material being applied.

All other roads in the camp were completed as originally planned.

There was a total of 2.13 miles of road in camp that was constructed of gravel base only, having no surfacing material applied.

11.8 CONTRACTOR'S ORGANIZATION: For the surfacing of the roads, including the base course, the general contractor obtained as a superintendent, the services of a man whose father was furnishing the hot mix asphaltic concrete for the surfacing material on the heavy duty roads. This material was purchased on a price per ton basis. This vendor also furnished some of the equipment used for the construction of the base and surfacing on a monthly rental basis, and some of the key men were furnished from his former organization in a loosely thrown together group.

This sort of an arrangement is not a satisfactory method of procedure since the superintendent, in the engineer's opinion, might become more interested in the selling of hot mix asphalt than getting the entire road system satisfactorily completed.

The contractor, in the engineer's opinion, did not have the proper and efficient organization for the construction of the road system that should have been provided for this type of work.

An indifferent attitude was shown at times toward orders issued by the engineers. In some instances the instructions issued by the engineers were ignored.

A great amount of the work done by this organization was not executed in an efficient manner. This was partially due to ignoring of accepted engineering methods on the part of the superintendents and a disregard for instructions. However, on December 19, 1940, when the roads got in such a bad condition due to the rains and lack of proper maintenance, a change was finally made on the insistence of the engineers. A new superintendent for the road construction was obtained, who was disinterested insofar as the furnishing of materials was concerned.

With the re-organization of the road construction personnel, improvement was witnessed in the way of maintaining roads in a passable condition regardless of weather conditions, and the progress of construction in the base course and also on the surfacing of both the hot top and double surface treatment progressed more rapidly than in the past. It is recommended that in no case should a superintendent be placed in charge of construction of any utility, especially road construction, where he is in any way connected with any concern who might be furnishing any material for the construction of the road system. A man with no such connections can work more efficiently and with a more unbiased opinion, and can accomplish a great deal more in the way of construction on a satisfactorily completed system.

11.9 ENGINEERING PERSONNEL: The engineering personnel on the road construction consisted of a principal assistant engineer with the necessary survey crews and inspectors to properly handle the construction work. The inspectors consisted of the necessary men on culvert construction so that inspectors were available for each culvert laying crew, an inspector was also in charge of the graveling, one with each double surface treatment crew when in operation, and also one with each crew during the laying of hot top asphalt.

During most of the construction period, this engineering personnel on roads consisted of three staking parties and six inspectors, in addition to the principal assistant engineer.

11.10 ACCESS ROADS: The road program within the camp area included the construction of an approach road from the camp road system south toward U. S. Highway No. 65. This road, designated as 7th Place from South Dakota Avenue, runs in a southerly direction 3,581 feet to the south side of the camp boundary where it connects with the County road which was graded and graveled by the City of North Little Rock, Arkansas. The road within

the camp boundary was surfaced with double surface treatment. This road will provide a convenient access road from the camp to Highway No. 65. See Drawings No. 6110-416 and No. 6110-417 for the plan and profile of this road location in camp.

The other main approach road into the camp enters at the east end of the camp and was constructed and maintained by the State Highway Department of Arkansas. The road system, as constructed in camp, should give a very satisfactory service with a reasonable amount of maintenance.

11.11 MAINTENANCE: A maintenance crew should be organized by the Camp Quartermaster to properly maintain all roads in camp since in order to maintain a satisfactory surfacing, regardless of the type of construction, it is necessary that proper maintenance be provided at all times.

Drainage should be properly taken care of in the road ditches by having available at all times a patrol grader to keep all drainage ditches open, and whatever laborers are necessary in order to know that all drainage structures are open so that there is free inlet and outlet for storm water.

Road surfacing should also be properly maintained and any soft spots or places where repair is needed should be taken care of as soon as they appear, and not allowed to develop into an impassable spot in the road which would be difficult to repair.

It is recommended that material for the repairing of the hot mix asphalt surfacing be obtained from plants which might be located in Little Rock and can produce this material more economically than it could be produced by any plant which might be set up in the camp area by the War Department. The amount of material needed for repairs for this type of surfacing should not run into any large quantities.

The secondary roads, or those on which the double surface treatment was used, will "bleed" and become soft on the surface during warm weather. In order to properly maintain these roads and provide a permanent surface free from soft asphalt which might be picked up by motor vehicle tires, the surface should be covered with fine crushed rock having a maximum size of one-half inch. This surface may also be very satisfactorily and economically stabilized by adding the dry sandy soil from the shoulder of the road, so as to absorb the excess asphalt softened by high temperatures.

The maintenance crew should consist of a foreman familiar with road work, a road patrol grader, a blade operator, a truck, and the necessary laborers.

11.12 COST: The detailed cost of the road construction was as follows:

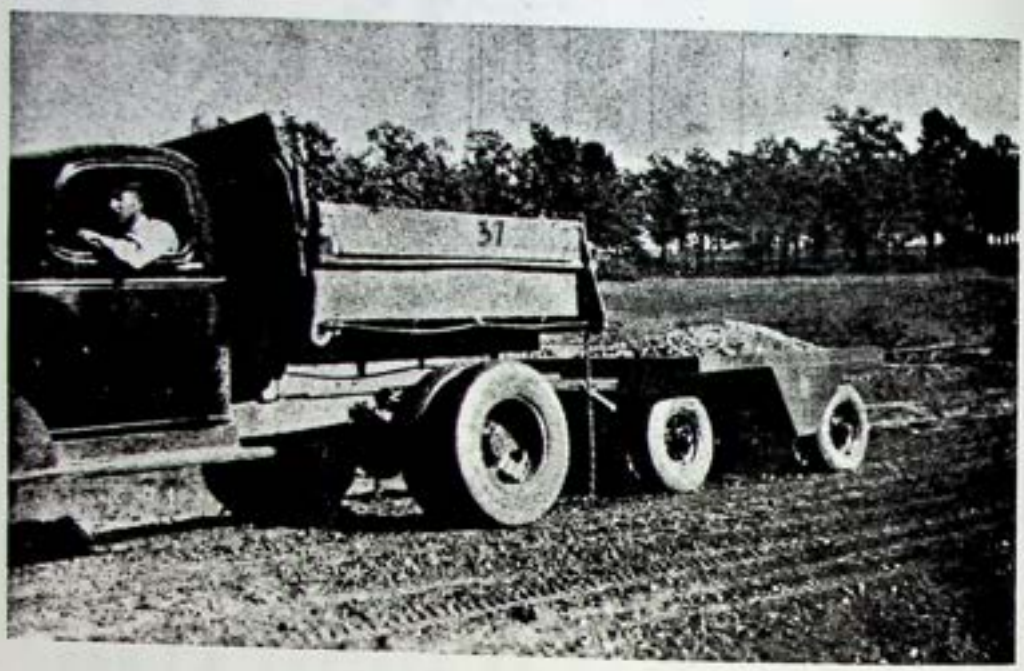
FINAL ESTIMATE

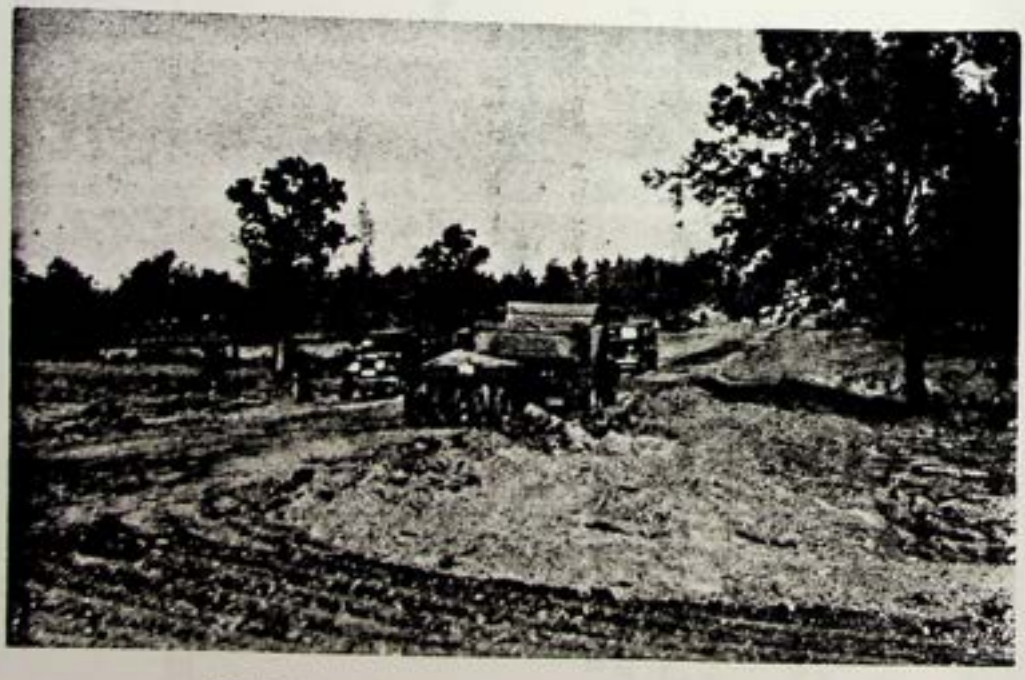
ROADS

QUANTITY		ITEM	UNIT LABOR COST	UNIT MATERIAL COST	UNIT CONSTRUCTION EQUIPMENT COST	TOTAL UNIT COST	TOTAL COST
28.6	Miles	Road Grading	375.45		1,273.25	1,648.70	47,152.82
		(15" Reinforced Concrete Pipe Culvert	.45	.85		1.30)	
		(18" " " " "	.60	1.05		1.65)	
		(24" " " " "	.85	2.10		2.95)	
9,394	Lin.Ft.	(30" " " " "	1.15	2.90		4.05)	23,391.06
		(36" " " " "	2.20	3.90		6.10)	
		(42" " " " "	2.50	4.90		7.40)	
		(48" " " " "	2.75	5.90		8.65)	
9	Units	Reinforced Concrete Box Culverts	160.60	366.10	19.50	546.20	4,915.80
5	Units	Creosote Timber Bridges	1,981.50	1,065.30	28.55	3,075.35	15,376.75
2.2	Miles	)Gravel Base	1,055.94	6,124.48	2,956.64	10,137.06)	22,301.53
23,232	Sq.Yds.	)Course only	.10	.58	.28	.96)	
1.2	Miles	)Prime Coat with Stone Chips on	370.80	1,520.80	202.80	2,094.40)	2,513.28
12,700	Sq.Yds.	)Existing Macadam Base	.032	.15	.016	.198)	
20.4	Miles	)Asphaltic Double Surface Treatment on	1,686.04	8,702.12	3,227.77	13,615.93)	277,764.97
215,600	Sq.Yds.	)Gravel Base Course	.165	.82	.305	1.29)	
6.0	Miles	)Binder Course and Seal Course on	4,202.84	17,142.80	4,198.79	25,544.43)	153,266.58
63,360	Sq.Yds.	)Gravel Base Course	.40	1.62	.40	2.42)	
2.4	Miles	)Binder Course and Seal Course on	3,146.90	11,018.33	1,242.15	15,407.38)	36,977.71
36,140	Sq.Yds.	)Existing Macadam Base	.21	.73	.08	1.02)	

Final Estimate - Roads

QUANTITY		ITEM	UNIT LABOR COST	UNIT MATERIAL COST	UNIT CONSTRUCTION EQUIPMENT COST	TOTAL UNIT COST	TOTAL COST
1.3	Miles	)Seal Coat on Existing	1,115.40	3,905.40	440.00	5,460.80)	$ 7,099.04
16,300	Sq.Yds.	)Macadam Base	.09	.31	.04	.44)	
		Net Construction Cost					590,759.54
		Plus 21.745% for Contractor's Overhead					128,460.66
		Total Construction Cost					719,220.20
		Plus 4.487½% for Engineering, C.Q.M. and Reserve					32,274.29
		GRAND TOTAL					$ 751,494.49





COMPACTING CLAY BOUND GRAVEL ROAD BASE
WITH PNEUMATIC TIRED ROLLERS

PLACING HOT ASPHALTIC CONCRETE

ROLLING HOT ASPHALTIC CONCRETE
BINDER COURSE