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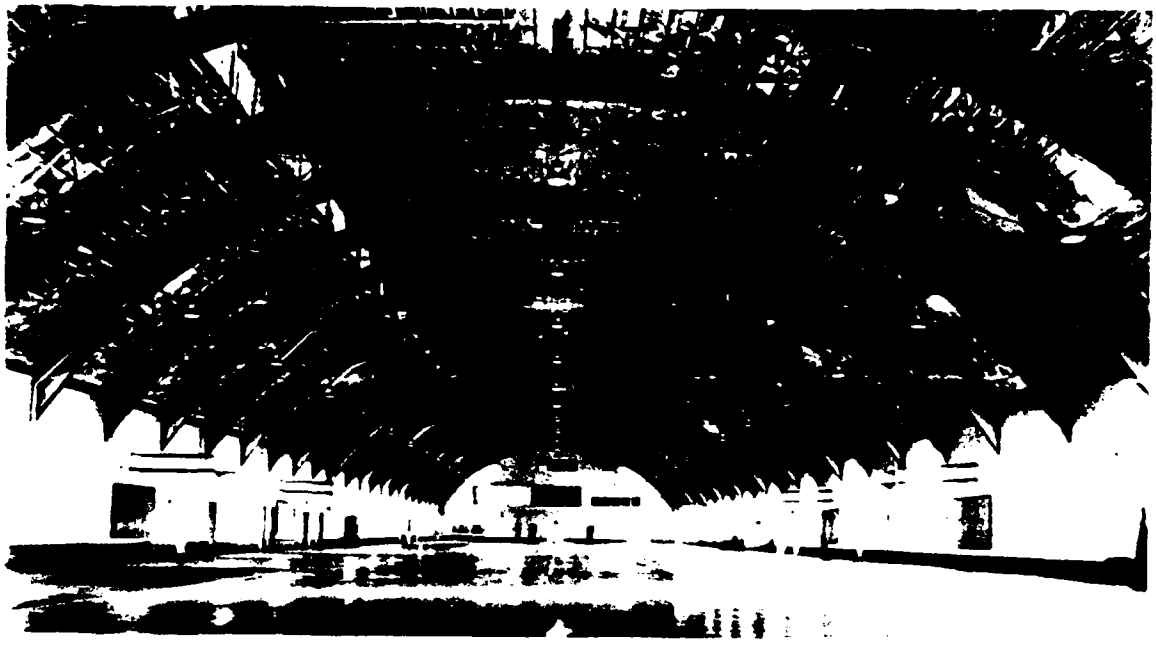
March 1993

World War II Te··· ·rary Military Buildings

A Brief History of the Arc··· ··· and Planning of Cantonments and Trair··· ···ions in the United States

by
John S. Garner



The *Military Construction Authorization Bill of 1983* requires the demolition of World War II-era temporary buildings on Department of Defense (DOD) installations. Before demolition can proceed, however, the historical significance of all affected buildings must be documented and assessed, as required by Section 106 of the *National Historic Preservation Act*. In 1986, DOD entered into a Memorandum of Agreement with the National Advisory Council on Historic Preservation and the National Con··· ··· ment the temporary buildings erected on U.S. military installations during mobilization for World War II. In its role as the Tri-Services Cultural Resources Research Center, the U.S. Army Construction Engineering Research Laboratories (USACERL) coordinated a study of surviving DOD temporary structures, in partial fulfillment of the requirements of the *National Historic Preservation Act*, Section 106.

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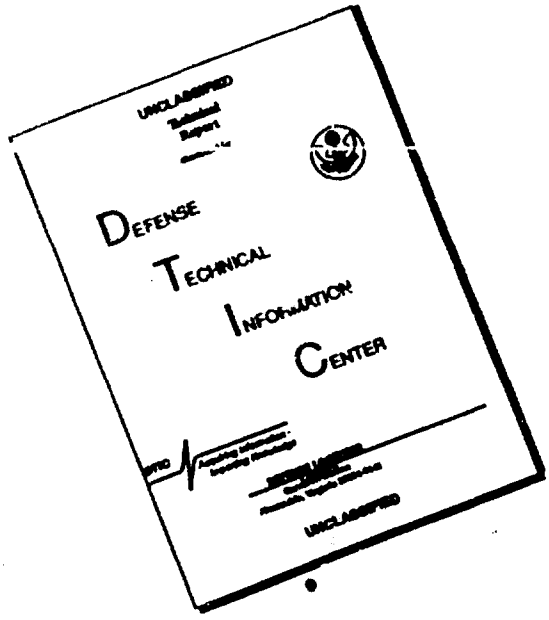

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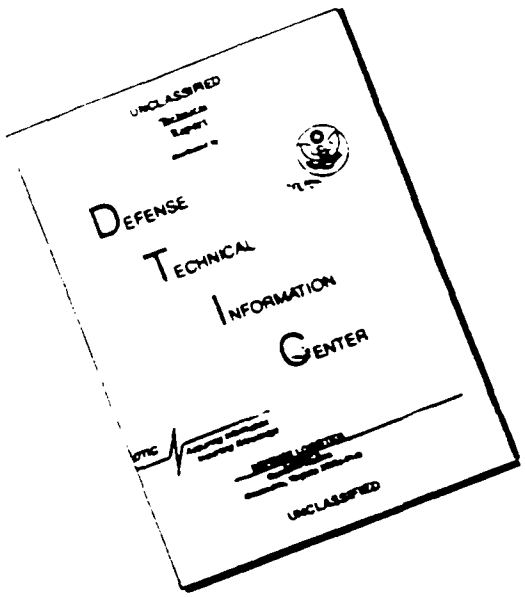

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The *Military Construction Authorization Bill of 1983* requires the demolition of World War II-era temporary buildings on Department of Defense (DOD) installations. Before demolition can proceed, however, the historical significance of all affected buildings must be documented and assessed, as required by Section 106 of the *National Historic Preservation Act*. In 1986, DOD entered into a Memorandum of Agreement with the National Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers to document the temporary buildings erected on U.S. military installations during mobilization of World War II. In its role as the Tri-Services Cultural Resources Center, the U.S. Army Construction Engineering Research Laboratories (USACERL) coordinated a study of surviving DOD temporary structures, in partial fulfillment of the requirements of the *National Historic Preservation Act*, Section 106.

This study describes the principal types of temporary structures built during mobilization for World War II (1939 through 1946), documents their approximate numbers and locations, and provides a historical context to support DOD's future assessment of this architecture's historical significance.

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Foreword

This research was conducted for the U.S. Army Engineering and Housing Support Center (USAEHSC) under MIPR E87910480, dated 26 September 1991. The USAEHSC technical monitor was Dr. Constance Ramirez, CEHSC-FN.

The study was performed on contract for the Environmental Compliance Modeling and Simulation Division (EC) of the Environmental Sustainment Laboratory (EL), U.S. Army Construction Engineering Research Laboratories (USACERL). The author was Dr. John S. Garner, Professor, School of Architecture, University of Illinois at Urbana-Champaign. The USACERL principal investigator was Keith Landreth. Mr. William D. Goran is Acting Chief, EC. Dr. Edward W. Novak is Acting Chief, EL. The USACERL technical editor was Gordon L. Cohen, Information Management Office.

Because of the limited time in which this outline history was compiled, from May to July 1990, the author is indebted to those individuals who have shared information with him and who continue to document the temporary military buildings of World War II. Special thanks go to Dr. Diane K. Mann and Keith Landreth, USACERL Compliance Protocols and Cultural Resources Team, and Richard Hayes, for the information they gathered. Robbert McKay and Ring-Ru Lin, whose work was supervised by Mr. Hayes, provided the line drawings for this study. Dr. Constance Ramirez, Historic Preservation Officer, Department of the Army, Fort Belvoir, Virginia, read the first draft and offered valuable assistance. Dr. Robert Kapsch, Chief of the Historic American Buildings Survey and Engineering Record, Washington, and John Burns, Deputy Chief, encouraged this project and provided information on several field reports conducted by their agency. For Navy-related information, Dr. Vincent A. Transano, Command Historian, and Raymond Benny, in charge of the Master Base Plan File, Naval Facilities Engineering Command, Port Hueneme, California, provided much needed information. Trig Watson, Superintendent of Base Facilities, Great Lakes Naval Station, Great Lakes, Illinois, also offered assistance, as did Michael Hilgren, Historical Architect, U.S. Army Corps of Engineers, Southwest Regional Office, Fort Worth, Texas, for drawings of the Corpus Christi Naval Air Station. Dr. Walter L. Creese, Emeritus Professor of Architecture at the University of Illinois, directed the author to a number of publications that otherwise would have been overlooked.

COL Daniel Waldo, Jr., is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

Tri-Services Cultural Resources Research Center

The Tri-Services Cultural Resources Research Center is a research and technical support center that assists the U.S. military services in the stewardship of cultural resources located within Department of Defense (DOD) installations or facilities. The Center, located at USACERL, helps installations manage their cultural resources and comply with Federal, State, and DOD preservation mandates.

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Background

The *Military Construction Authorization Bill of 1983* requires the demolition of World War II-era temporary buildings on Department of Defense (DOD) installations.[1.1] Before demolition can proceed, however, the historical significance of all affected buildings must be documented and assessed, as required by Section 106 of the *National Historic Preservation Act*.[1.2] In 1986, DOD entered into a Memorandum of Agreement with the National Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers to document the temporary buildings erected on U.S. military installations during mobilization for World War II.

In its role as the Tri-Services Cultural Resources Research Center, the U.S. Army Construction Engineering Research Laboratories (USACERL) coordinated a study of surviving DOD temporary structures, in partial fulfillment of the requirements of the National Historic Preservation Act, Section 106.

Objective

The objective of this study was to describe the principal types of temporary structures built during mobilization for World War II (1939 through 1946), document the approximate numbers and locations of such structures surviving on DOD installations, and provide a historical context to support assessment of this architecture's historical significance by DOD.

Approach

USACERL compiled a record of World War II temporary buildings known to still exist on DOD installations (Figure 1.1 and Appendix A). Documentation was prepared according to the criteria and specifications of the National Park Service Historic American Buildings Survey. Data were gathered through a literature search, examination of related historical documents (Appendix B), and visits to the sites of various World War II temporary structures. The author provides an architectural description of the principal building types, describes the manner in which they were deployed in unit plan and base development, and comments on their overall significance.[1.3]

The convention used for describing lumber dimensions is assumed to be expressed in inches (e.g., 2 x 4 means 2 in.* by 4 in.) unless otherwise noted.

Scope

This report discusses structures built before 1939 to help provide a historical context for the origins, design, and layout characteristics of World War II temporary buildings.

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* U.S. standard units of measure are used in this report. A table of metric conversion factors can be found on page 83.

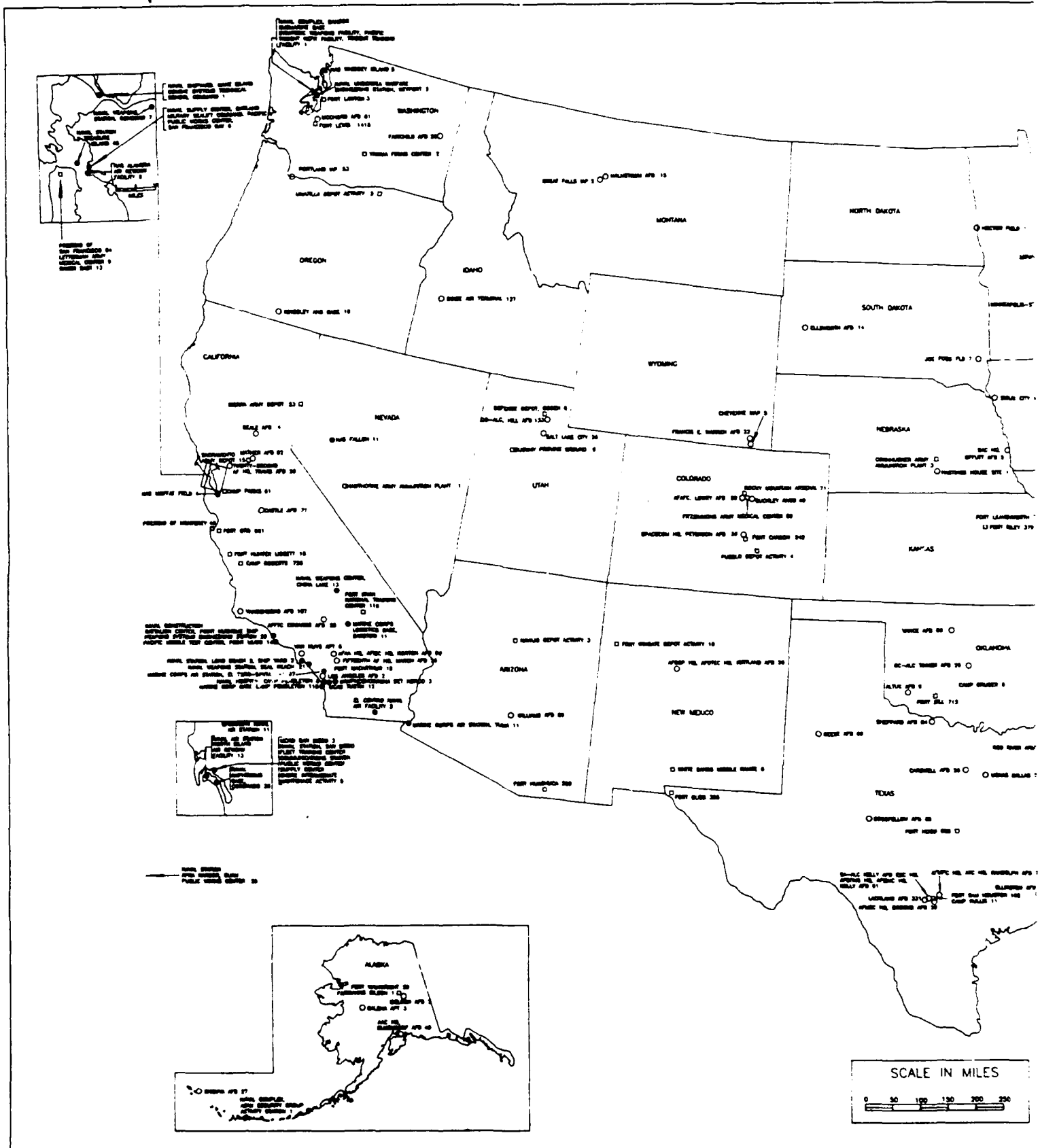

Figure 1.1. Location of Existing World War II Buildings of Temporary Construction, 1990.

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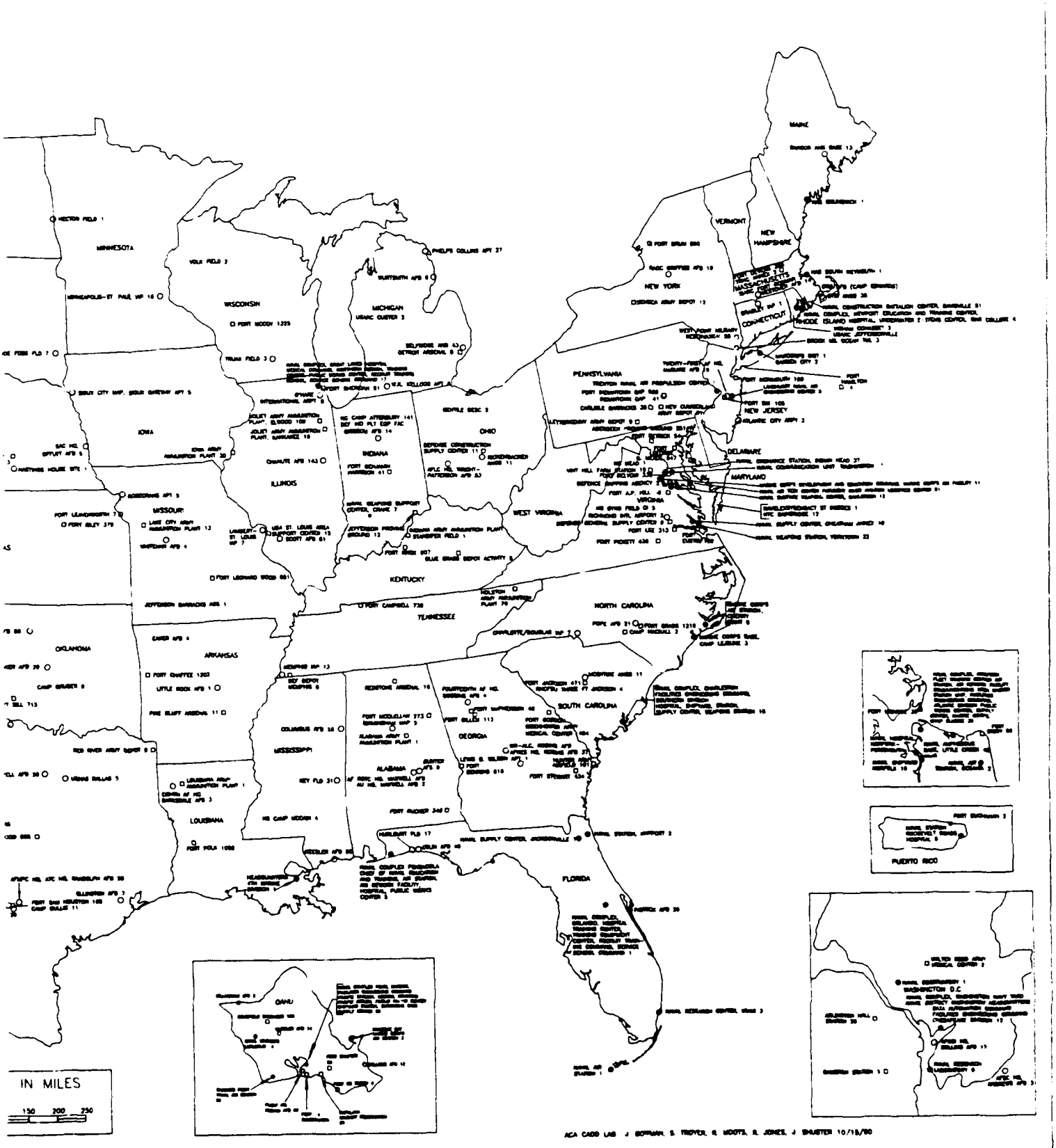

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2 Mobilization

To support any call to action in defense of national security, the U.S. military services—the Army, Navy, Air Force, and Marine Corps—have each developed plans for mobilization. The two world wars dramatized the need to prepare for multiple theaters of operation, as opposed to single fronts. The call of hundreds of thousands of soldiers and sailors into service, and the necessity to train and provision them, created unprecedented challenges. To launch and supervise programs of procurement, production of war materiel, and construction of military bases required the combined efforts of special units such as the Army Corps of Engineers, Army Quartermaster Corps, and the Navy Bureau of Yards and Docks and its Corps of Civil Engineers. It is estimated that, between 1939 and 1946, $20.2 billion was spent for construction of military facilities in the continental United States as a result of the general mobilization. The legacy of this massive investment remains very much in evidence despite the passage of time. The fact that many of the facilities built were intended to be temporary indicates the utility and resourcefulness of the services in maintaining these properties and finding new uses for buildings once considered expendable. Historic preservation takes on a new dimension when applied to military structures.[2.1]

Preparations before and during World War I provided a rehearsal for the operations of World War II. The guidance and historical insight gained from that experience would be invaluable. Even earlier, during the Civil War, and then again during the Spanish-American War, there had been mobilizations on a smaller scale. Calls for volunteers and the institution of a wartime draft (the first in 1863) produced unprecedented numbers of people in uniform, not to mention increases in arms and equipment. The Army Quartermaster Corps and Navy Bureau of Provisions and of Yards and Docks were the branches of service designated to feed, clothe, arm, and shelter the soldiers and sailors. A few exceptional officers stand out through history, such as Montgomery Meigs of the Civil War era, who supervised construction of such large projects as the Washington Aqueduct and the Capitol Building before taking over as Quartermaster General (QMG) of the Union Army, and who was a master of navigating the bureaucracy to get supplies when and where they were needed. Nevertheless, the quartermaster and provisioning corps—Army and Navy—were frequently investigated and criticized because of their organizational shortcomings. A lack of planning for large-scale military operations justified criticism during the Spanish-American War, when supply lines rarely brought troops and equipment together at the needed time and place. Consequently, in an effort to avoid the problems of the past, some advance planning by the Army and Navy (however insufficient) preceded America's involvement in World War I. And many of the junior officers who experienced that conflict, not to mention elected statesmen, were placed in charge of operations before World War II.[2.2]

One aspect of mobilization was the founding of military bases. In the Army, this critical task fell to the Construction and Repair Division of the Quartermaster Corps. Between 1917 and 1918, this division was renamed the Cantonment Division of the Office of the Quartermaster General, and was charged with constructing 32 installations: 16 new Army training centers and 16 additional National Guard camps (Figure 2.1). The division's few senior officers had no experience to prepare them for such an overwhelming assignment. But President Woodrow Wilson and Secretary of War Newton D. Baker had enlisted the services of professional architects, engineers, planners, and management experts from industry to assist the military. Through advisory boards like the National Emergency Fleet Corporation, the General Munitions Board, and the National Defense Advisory Commission, both the Army and the Navy received expert advice. The Committee on Emergency Construction, assembled by Secretary Baker, assisted the Quartermaster Corps' Cantonment Division with advice on planning and construction.[2.3] The chairman of that committee, William A. Starrett, a New York City architect and partner in the firm of Starrett and Van Vleck, summed up the task of the Cantonment Division in a letter in May 1917:

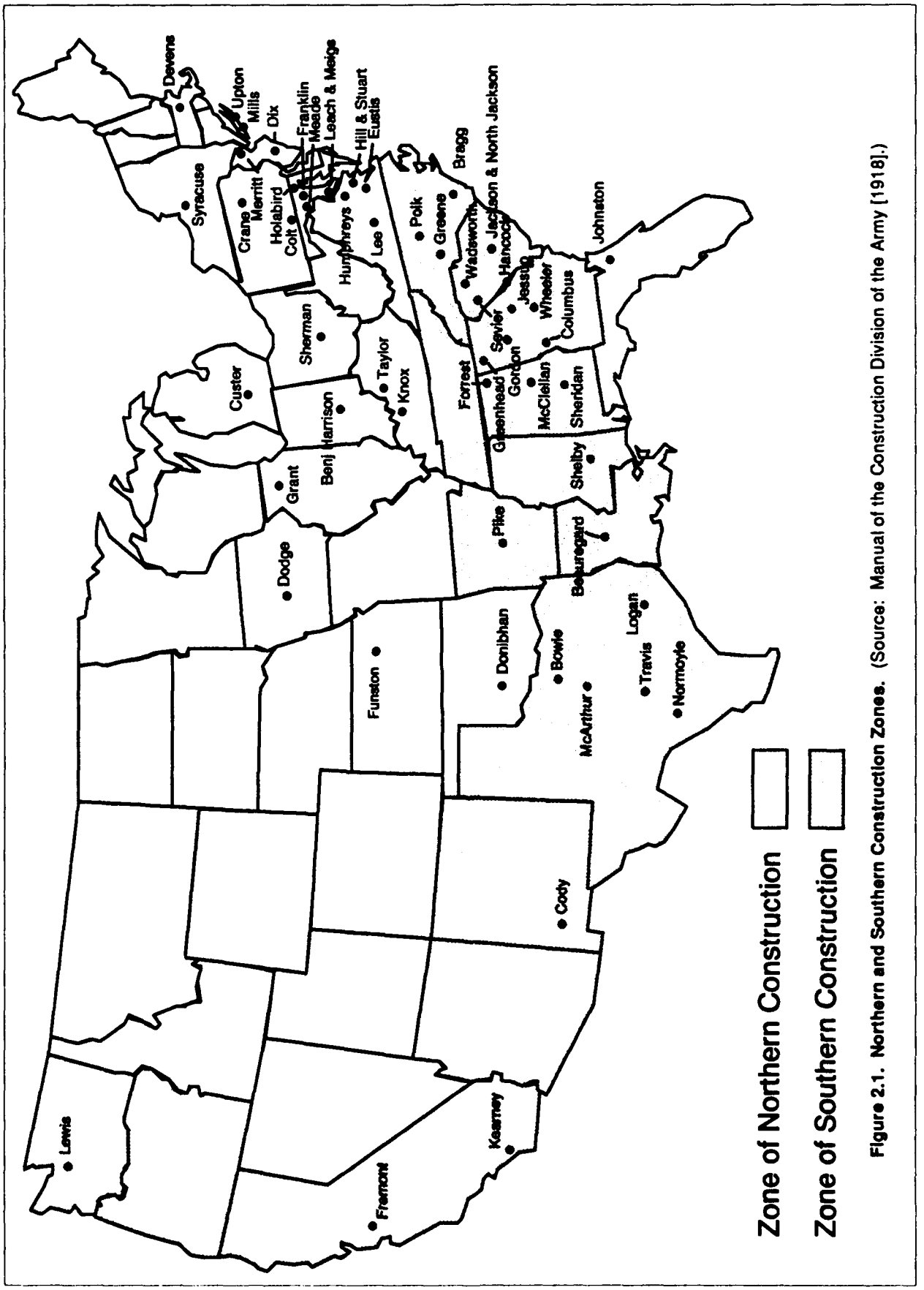


Figure 2.1. Northern and Southern Construction Zones. (Source: Manual of the Construction Division of the Army [1918].)

> Subject: Difficulty of building cantonments within necessary time limit...
>
> In 16 weeks you are expected to have suitable quarters ready for the training of 1,100,000 men. This is equal to providing in each of 32 places for the housing of the inhabitants of Zanesville, Ohio, or Nashua, N.H., or Bangor, Me....
>
> The planning alone for construction work of each of the camps would normally take as many weeks as is given you for the completion of both the engineering and the building. In the present situation the planning, engineering, and the building must go together. There is no time for any other method of procedure.[2.4]

In spite of its daunting task, the Cantonment Division of World War I largely met its goals, meeting deadlines thought to be unrealistic. In so doing, it established procedures for both contracting and construction that would be used in preparations for World War II.

The Navy confronted a similar challenge in World War I. Its four training stations, two of which were built in the 19th century and two others completed just before the war, were far from adequate to handle the influx of new trainees. Prior to 1883, sailors acquired training aboard receiving ships instead of ashore. The Spanish-American War, and the expanded U.S. sphere of influence in Latin America and the Philippines, created a much larger fleet, with more extensive facilities needed to man and maintain it. The Bureau of Yards and Docks was charged with providing all shore installations for the Navy and Marines. In the spring of 1917, the Bureau accepted responsibility for designing and building 20 cantonments along the Atlantic, Gulf, and Pacific coasts, and one on the Great Lakes. From a capacity to train 6,000 seamen before the war to more than 200,000 by the signing of the armistice, the Navy, through emergency measures and temporary construction, succeeded in its training mission.[2.5]

By the onset of World War II, the United States was the most advanced industrialized nation in the world. Despite the withering effects of the Great Depression and America's interwar isolationist policies, the industrial capabilities of the United States seemed unlimited. A network of nearly 200,000 miles of railroad track had been laid; a federal interstate highway program of paved two-lane roads connected cities from coast to coast and border to border. The transportation industry—automobile and airplane manufacturers in particular—had long since employed assembly-line techniques for mass production. The Port of New York rivaled those of Amsterdam and Bremen in annual tonnage, and when combined with the ports of New Orleans, Houston, and Los Angeles, accounted for more tonnage shipped and received than any other country. Utilities, such as electrical transmission, telegraph, and telephone service, had become regionalized, as small municipal power stations and exchanges merged to form larger systems. National radio programming, perhaps more than anything else, diminished regional and ethnic isolation by its popular appeal and marketing through national advertising. Television made its public debut at the New York World's Fair of 1939. The entertainment industry, as represented by the motion picture studios, replaced the live, individual performances of Vaudeville troupes with mass-distributed color films released simultaneously in cities large and small. Fashions changed overnight. The latest trends in popular culture were promoted or sponsored through the mass media. Although family farms would remain small and self-sustaining until after the war, mechanized tilling and harvesting had begun to reduce labor-intensive practices, and grocers and dairymen established regional marketing chains such as IGA (Independent Grocer's Association) to sell farm produce. Clothes—especially uniforms—were entirely machine-made and produced in standard sizes. These advances in technology, organization, and communications would have a great impact on the military services and their various munitions boards. On the eve

of World War II, the only industry that had failed to advance—the only industry to remain localized and provincial—was the construction industry.[2.6]

The Problem With Prefabrication

Prefabrication would have seemed a logical response to large-scale construction programs, especially in for temporary buildings needed during national emergencies such as a general defense mobilization. To be sure, attempts had been made to expedite construction through volume contracting. The Gordon-Van Tine and Frederick T. Ley companies offered a variety of prefabricated frame buildings, and the latter had contracted to build the Savanna Proving Grounds in Savanna, Illinois, during World War I. The Gordon-Van Tine Company, founded in the aftermath of the Chicago Fire of 1871, maintained large assembly yards in Davenport, Iowa, and St. Louis. Industrialists such as textile manufacturers, who built mill villages first in New England and then later in the South, occasionally purchased worker's cottages from these companies. Shortly after the turn of the century, mail-order companies such as Sears and Montgomery Ward offered prefabricated houses in several sizes and styles. Some prefabricated units were purchased by defense contractors for industrial housing during World War I, and then again in World War II. Advance bases (those outside the U.S.) depended on prefabricated construction as represented by Theater of Operations buildings. But these were anomalies in an otherwise conservative, hidebound construction industry, which generally relied on local trades to build or assemble. To the extent that prefabrication was used in the construction of U.S. military bases, it was in the use of prepared materials such as ready-cut lumber delivered to site, and in the assembly-line manner in which buildings were erected.[2.7]

Timber frame construction had undergone a revolution in the previous century. The balloon frame, invented in Chicago in 1833 and attributed to a builder named Augustine Taylor, simplified the tasks of erecting light-timber buildings such as houses, tenements, schools, and chapels. Mill-sawn dimensioned lumber of 2 x 4 and 2 x 6 in. boards (used for sills, joists, studs, plates, and rafters), fastened with wire nails, then covered with 1 in. board sheathing and decking, permitted buildings to be erected in a fraction of the time required for traditional heavy-timber buildings with wood-pegged mortise-and-tenon joints. Builders guides, such as *Woodward's Country Homes* (1865), illustrated the new techniques and claimed that a man and boy could build a balloon-frame house in a week. This claim also assumed that the man and boy could lay a foundation, saw straight, hammer nails straight, and build on the level, because a certain amount of skill was still required. Most who sought to build hired contractors with experienced carpenters. Prefabricated buildings, on the other hand, provided precut materials and partially assembled components. In theory, the skilled work would be completed at a factory or assembly yard. However, foundation preparation, one of the more arduous tasks of building, had to be performed on site. Prefabricated components then had to be assembled. Invariably, the illustrations provided by prefabricators for field assembly were more detailed than the simple balloon frame illustrations in *Woodward's Country Homes* and other builders' guides. And therein lay a problem that has yet to be resolved: prefabricated buildings went together better when prefabricators furnished company-trained crews to assemble them. Moreover, there was tremendous resistance among general contractors and the building trades as a whole to the concept of prefabrication. William Starrett, who had advised the Cantonment Division of the Army Quartermaster Corps on the design of its World War I temporary buildings, dismissed suggestions of prefabrication. Balloon framing, later modified as platform framing, was the one technique that the majority of carpenters and builders understood, and building campaigns requiring hundreds of thousands of laborers and millions of dollars worth of construction materials demanded a system of building that was known and proven, however dated or labor-intensive.[2.8]

During both World Wars, experiments were conducted using prefabricated building components. The Quartermaster Corps, for example, tested ready-cut assemblies of sectional wood types, sectional steel, and concrete on wire-mesh lath with conventional construction at Fort Myer, Virginia, prior to World War I. "Records kept of the cost and time required for construction of these buildings showed that the ordinary type of wooden building, constructed by cutting, framing, and erecting material on the site, was cheaper and could be completed in slightly less time than the other types." But had there been industrialists in the housing field on the scale of the automotive giants, there might have been a greater willingness by those in Washington to extend large contracts for prefabricated buildings. However, there was little reason to believe that private companies, or for that matter, the building industry as a whole, could deliver the completed product to such large projects on such short notice. In construction volume alone between 1926 and 1941, only one year—1930—had experienced national expenditures in excess $500 million. By comparison, a defense-inflated $2.841 billion was expended in just the first 6 months of 1941. The greatest concern about using prefabricated buildings, however, was the uncertainty whether private contractors could secure sufficient raw materials. Delivery within a few months of 40 million feet of lumber—the estimated average needed to build a single World War I cantonment—required the political might of Washington and the oversight of the War Industries Board. Therefore, using conventional materials, the task was simply too large to risk procurement to private companies and contractors. And to appease the critics of timber construction, the War Department authorized experiments at Fort Grant during World War II on the substitution of metal, masonry, and other materials, about which more will be said later.[2.9]

The only standards that had been established in the construction industry were those associated with the dimensions and grades of materials. On the other hand, municipal officials established codes for life-safety, based on minimum standards according to building use. Such codes varied between cities, and enforcement rarely extended to single-family residential construction. It was left to the military services to establish their own minimum standards. The least expensive material for framing and cladding, and hence the most widely used material for temporary construction, was dimensioned lumber. Its use had been made possible by the advent of the rotary steam-power saw, which could cut lumber to precise dimensions, and the lumber yard, which acquired construction materials wholesale and became a fixture of every U.S. town with railroad service. Grades of lumber were specified by the lumber industries and their associations. The better the grade, the fewer the knots and checks, and hence the greater its strength. Iron structural shapes and galvanized sheeting had also been introduced to the building market during the 19th century for industrial, commercial, and residential use, but was used less extensively than lumber. Plywood, hardboard, and asbestos cement, introduced in the early 20th century, were still considered experimental as late as World War II, although the military services would employ large quantities of each. Thus, the materials and techniques used during periods of war were hardly revolutionary and, for the most part, had enjoyed a long history of peacetime development and application.

Contracting

More radical than wartime construction techniques were contracting measures. Mobilization for war called for special contingencies. Contractual agreements were prepared by the Army's Quartermaster Corps and the Navy's Bureau of Yards and Docks. During peacetime, the services budgeted construction from within their annual congressional appropriations. Bids for proposed projects were required to ensure competition among contractors as well as competitive pricing. For political reasons, however, contractors were usually sought from within the states where projects were built. Quartermasters were obligated to receive approval at each level of the division and corps. Prices for construction materials were sometimes specified and listed in the various quartermaster manuals. Tables indicating bills

of material for lumber and hardware were established for various cantonment buildings. Bills of lading or vouchers for delivered goods received by "constructing quartermasters" in charge of projects had to be checked in the field and then sent to Washington to be checked again before approval, together with weekly status reports of ongoing construction.

During World War I and again in World War II, contract negotiation for large construction projects such as cantonments and training stations was changed from a system of competitive bids based on lump sum and percent-of-cost to contracts based on cost plus a fixed fee. Time and money were the critical factors, because there was not enough of either commodity. Average cost of a cantonment was initially estimated to be $5 million in World War I and $8 million in World War II. But actual costs were considerably higher—two to three times as high. Understandably, contractors who were accustomed to bidding on single buildings were uneasy about bidding on multimillion dollar camp sites for which surveys and other site information were frequently incomplete. Although drawings for buildings called for standard modules and details, changes in their number and arrangement were often made in the field. To reduce contractors' risks and to avoid inflated estimates, direct cost plus a fixed fee was accepted as the best approach to ensure and to expedite work under emergency conditions. Although work on Fort Dix, New Jersey, one of the first World War II cantonments, was awarded through competitive bidding in August 1940, it was an exception to what would later become standard practice. Indeed, just before work began on Fort Dix, Congress and the Secretary of War authorized purchases "without advertising," which would enable many small contractors to obtain wartime work on cantonments.[2.10]

Nazi Aggression

The Nazi occupation of the Rhineland in 1936, Austria in 1938, and invasion of Poland in 1939 provided a forewarning of all-out war in Europe that would likely lead to U.S. involvement. Recalling the experiences of World War I, when emergency planning, although ultimately effective, came late in the war effort, the Army Quartermaster General began in 1939 to prepare plans for the expansion of existing military bases and the construction of new camps. Col. Charles D. Hartman, head of the Construction Division and a veteran of the World War I Cantonment Division, undertook the expansion of existing training forts in anticipation of the Selective Service Act of 1940. From an Army of 227,000 soldiers in 1939 to one of 1.2 million by June 1940 required the immediate construction of a half-dozen new cantonments in addition to those installations already available. By December 7, 1941, most of the 20 new cantonments had been completed and enlistment strength stood at 1.64 million. By the end of the war, 5.9 million men and women would be in uniform, and some 10.42 million would have served.[2.11]

The Chief of the Bureau of Yards and Docks, Capt. Ben Moreell, received authority similar to Col. Hartman's. In 1939 Naval enlistments amounted to approximately 110,000 and Marines numbered about 18,000. The four Naval training stations founded before World War I continued to prepare recruits, although could handle no more than 6,000 sailors a year. The temporary cantonments of 1917 and 1918, attached to existing yards and stations, had been converted to other uses. Other camp sites leased by the Navy had been returned to private ownership and the buildings removed. Hence, the receiving stations at Newport, Rhode Island, Norfolk, Virginia, Great Lakes, Illinois, and San Diego, California, were overrun with enlistees after passage of the Two Ocean Navy Bill in 1940 and authorization by the president of the first of a succession of calls for increases in personnel strength. By the end of 1945, naval enlistments would reach 3.01 million, and training facilities had been expanded commensurately. In addition to increasing the capacity of the four existing stations, three new ones were founded: Farragut Training Station at Lake Pend Oreille, Idaho; Bainbridge Training Station at Port Deposit, Maryland; and Sampson Training Station at Lake Seneca,

New York. The existing stations were upgraded to handle between 30,000 and 45,000 sailors, and the new stations between 20,000 and 30,000.[2.12]

Capt. Moreell, eventually promoted to Rear Admiral, superintended all Navy construction programs throughout the war. Having received his appointment in December 1937, he would continue to oversee the Bureau until December 1945. Explaining his mission as director of public works, he listed the types of structures provided: "In the field of buildings alone, these range from officers' quarters, barracks, dispensaries, and other personnel structures to specialized construction such as hangars, shops, power plants, warehouses, parachute lofts, and magazines." Among the largest structures were the Navy's drydocks, some of which represented remarkable feats of engineering. Within the Bureau, the Department of Planning and Design prepared the basic drawings of all onshore projects, including the training stations. The officers of that department and others within the Bureau were drawn from the Civil Engineers Corps. Its members formed a close-knit and loyal group that numbered about 150 at the beginning of the war, but expanded to more than 10,000 by 1945. A distinction should be made between the Civil Engineer Corps (CEC) and the Construction Corps, an equally elite group of naval architects and engineers who designed ships but not buildings or docks. Much of the Navy's success in launching projects during the early years of the war stemmed from the continuity in command that existed within the Bureau and its departments. However, throughout the war, the majority of the staff in the Department of Planning and Design were civilian architects, engineers, and planners, who worked under the direction of Capt. Thomas Trexel, Chief Architect. This contingent of civilian employees would account for differences between projects in the two branches of service. A unique development, sponsored and overseen by the Bureau of Yards and Docks, was the founding of construction battalions, the Seabees, in 1942. These battalions provided the enlisted personnel to work under the newly authorized command officers of the CEC. The Seabees would distinguish themselves during operations in the Pacific Theater, moving in behind the Marines to build bases, harbors, roads, and airstrips. Their work, however, was restricted to bases overseas. Stateside training facilities and air stations were completed with civilian labor. Private contractors directed their own work crews, although they operated under the overall direction of a managing Officer in Charge of Construction, the equivalent of the Army's Constructing Quartermaster.[2.13]

Col. Hartman's superior was Maj. Gen. Henry Gibbins, the Quartermaster General, in the period before the war. Gibbins, like his predecessors, viewed the Construction Division warily. Ambitious chiefs of the Division had in the past circumvented the authority of the QMG. During World War I, the Chief of Construction, with assistance from the Committee on Emergency Construction, was made quasi-independent and answerable solely to the Assistant Secretary of War. History would repeat itself in that a veteran chief would be replaced by a younger, more ambitious man, at the beginning of World War II, just as it had happened during World War I. Col. Hartman would be succeeded in December 1940 by Lt. Col. Brehon B. Somervell, a person with connections in the Roosevelt administration, who had a reputation for getting things done. Col. Somervell had the unenviable task of taking over the cantonment program in midstream. Although he streamlined the Construction Division and tightened accountability, he could not escape the criticism inherent in the system. Constructing Quartermasters were junior officers for the most part, recently inducted from private engineering firms. Wizened contractors working on a cost-plus-a-fixed-fee basis did not take kindly to the meddling of these "johnnys on the spot." Furthermore, labor unions were better organized and more powerful than in the past, and would also have a say in the way a project was run. Commanding officers of the new cantonments, who were senior in rank to the quartermasters, used their authority to advantage and often overturned field decisions by the Constructing Quartermasters. Field inspections by Col. Leslie R. Groves, a transfer from the Corps of Engineers and the QMG's watchdog for construction (who would later oversee the Manhattan Project) criticized those cantonments found to be compromised. The Construction Division was being attacked both externally and

internally. Nevertheless, Col. Somervell could express satisfaction over his accomplishments, when, on the eve of war late in 1941, he gave an account of the Division's performance:

> More than a million soldiers have been housed by the Construction Division. They are better housed, better fed, and in cleaner, more sanitary, more comfortable training camps than those of any other army in the world, or of any army in history, for that matter. Some 332 troop housing projects costing about $880,000,000 have been completed, plus nine large general hospitals costing about $21,000,000 additional.... That's making time! Even the World War building record, which for the past 20 years has justly been pointed to as an example of 'doing the impossible' was overshadowed. During the World War, the Quartermaster Corps furnished 240,000,000 square feet of space within 18 months. During last year's building campaign, the Quartermaster Corps provided, in nine months, 80 per cent of the total square feet of space erected... in 1917-18.... The problem of meeting these enormous demands has been met, I believe, as well as possible in view of obstacles which in many instances seemed almost insuperable.[2.14]

Despite Col. Somervell's efforts to overcome obstacles, deadlines were not met and construction costs far and away exceeded estimates. What is more, he could not compete on Capitol Hill with the politically powerful Corps of Engineers which, as early as September 1940, had taken over the Air Corps projects—one-third of all construction. The Corps of Engineers, which supervised civil works such as waterways, and land and water conservation projects between the wars, had well established field offices with resident experts for large-scale construction projects. The engineers were contemptuous of the quartermasters, and had long coveted the latter's domestic role in building. With mounting pressure on Army Chief of Staff Marshall to complete the cantonments and prepare for building overseas, the decision was made to transfer responsibilities. The new Chief of Engineers, Maj. Gen. Eugene Reybold, assumed control of military construction. In December 1941, President Franklin D. Roosevelt assigned to the Corps of Engineers all construction in the continental United States and abroad.[2.15]

3 Building Types and Construction

Since the bitter winter at Valley Forge encampment in 1777-1778, the U.S. military services have had to provide buildings for administration, supply, and lodging of their officers and enlisted men. For the most part, those built during periods of war were emergency structures, hastily assembled, and poorly provisioned. The Army Corps of Engineers, whose origins date back to the Revolutionary War, was given the task of designing fortifications, which occasionally extended to the construction of entire garrisons. In later years, the Corps of Engineers was assigned responsibility for building roads and bridges and improving waterways. The quartering of troops, and the contracting and provisioning of military installations, however, fell to the Army Quartermaster Corps. Such a division of responsibilities provided a system of oversight that worked reasonably well during peacetime. However, during wartime it created unforeseen complications and conflicts. And the problem would not be resolved until after the beginning of World War II, when construction finally was placed within the mission of the Corps of Engineers. As a result, design and procurement were often separated from one another, and occasionally worked at cross-purposes.

Before describing in detail the construction of World War II temporary buildings, beginning with the Army Series 700 structures designed from 1937 through 1940 and continuing to the Series 800 structures of 1941 and 1942, followed by descriptions of the Navy B Series buildings and Quonsets, a brief history and description should be made of the earliest temporary military buildings, some of which provided prototypes for those later constructed.

The design of military buildings, especially those constructed during periods of mobilization (such as World War II temporary buildings), was determined by operations of line units for training and field use. The smallest administrative line unit of the Army and Marine Corps is the company. For the Navy it is the ship's company, and for the Army and Navy Air Corps, it was the squadron. Each company required a complement of buildings, most prominently a command post, supply room, day room, mess hall, and from one to four barracks, depending on the size of the structure and strength of the company. These companies of buildings arranged in regimental units formed the nucleus of a camp in both operation and planning. Beyond these several basic types were specialized structures such as regimental theaters or assembly halls, dispensaries, depots, dumps or arsenals, warehouses, post exchanges or commissaries, service clubs, bakeries, laundries, etc. Between the two world wars, the programs of requirement had begun to change. The Series 700 buildings, the number assigned in 1928 by the Construction Division of the Army Quartermaster Corps for mobilization-type construction, not only differed from earlier building series in construction, but also in use or program of design requirement. The services had changed—training had become more specialized. Tactical units were enlarged in recognition of this complexity and because of the global nature of world war. Moreover, the experiences of the past—of inadequate and unhealthy camp sites and structures—demanded better facilities. When President Roosevelt promised the mothers of servicemen that their sons would be adequately sheltered and provided with modern facilities, he was determined to make good on his word. In spite of the temporary nature of mobilization construction and camp layout, which began in earnest in 1940, the new facilities would offer substantial improvements over what had been built before.

Early Military Buildings

As early as 1794, the United States had begun to prepare defenses against naval attack in those ports deemed most vulnerable. In addition to forts inherited from the British, French, and Spanish, new defenses were constructed near Baltimore, Philadelphia, New York, Newport, Charleston, and Norfolk, the so called "first system" of permanent construction.

Some of America's best architects and engineers were employed in this work, including Charles Pierre L'Enfant, who had planned the nation's capital, and Benjamin Henry Latrobe, an architect of the Capitol Building who had earlier engineered the Philadelphia Waterworks. Although Washington was sacked during the War of 1812, most of the coastal defenses withstood the threat of British attack, but not without raising congressional concerns about their vulnerability and future effectiveness.[3.1]

Between the War of 1812 and the Civil War, Congress appropriated funding for America's best-known naval defenses, including Forts Hamilton, Delaware, Washington, Sumter, Pulaski, Gaines, Jackson, and Fort Point along the East Coast, Gulf Coast. and Pacific Coast at San Francisco Bay. Although the Corps of Engineers superintended construction and assisted in matters of design, French military engineers, led by Simon Bernard, trained in the tradition of Sebastian Vauban and H.-J. Baptiste Bousmard, provided the architectural designs, plans, and expertise. These permanent installations exhibited elaborate geometries in plan for the emplacement and protection of artillery. Ramparts built of stone salients and casemates enclosed the fortifications with a parade at the center. Within were barracks and stores, sometimes designed as integral parts of the perimeter walls. Fort Monroe, Virginia, begun in 1819 and completed in 1847, survives as a showpiece of the great age of American fortification. The Civil War brought to a close this age of elaborate, French-inspired defensive works. The shelling by rifled cannon of Forts Sumter, Pulaski, Jackson, and other Southern strongholds from 1861 through 1865 reduced even the most sophisticated fortifications to rubble. Moreover, it became apparent during the Civil War that battles were won through offensive—not defensive—strategies. The victors were those who traveled light, moved quickly, and struck with surprise.[3.2]

The Civil War was also America's first experience with general mobilization. Despite the resourcefulness of both sides, a lack of preparedness in readying and supplying troops became all too apparent. Apart from the military academies there were no training facilities for officers—and none whatsoever for noncommissioned officers and draftees. Casualty rates were exceedingly high as recruits were pressed into service with little or no preparation for the hardships they would encounter. Union and Confederate soldiers spent their time in the field in tent camps or bivouacs. Although portable, such tent structures were often discarded or torn beyond repair during forced marches and in the heat of battle. The Union Army did provide standard wooden frames for larger tents, or paulins, such as those used for hospitals, which could be knocked down and transported where needed. Both sides avoided quartering at the expense of civilians, the bane of European occupations, thus upholding the Bill of Rights. But it was also true that soldiers suffered terribly from exposure. Temporary buildings constructed during the war were primarily intended for munitions and supply, such as the Rock Island Arsenal in Illinois, built in 1862. In 1864, however, the first temporary wooden barracks became standardized with fixed dimensions.[3.3]

During the Indian Wars that followed, buildings constructed on the western frontier could be viewed as temporary forerunners of the type of expedient construction used in later campaigns. Western camps were strategically located to protect white settlers and to control militant Indians. Garrisons were small—rarely larger than a battalion in strength—but trained and prepared for rapid deployment. Within months, camps could be abandoned or relocated as conditions warranted. The Army provided no detailed plans or specifications for camp construction. Instead, it was left to the camp commanders and quartermaster officers to determine layout and construction. Many of the senior officers who retained commands following the Civil War were graduates of West Point, and thus had received training in civil engineering. These officers could prepare plans, draft building details, and supervise construction and entrenchment. Because of locations remote from existing cities, the first troops to be garrisoned would provide the labor. What they could not anticipate until their arrival at a wilderness site, however, were the conditions of terrain and availability of materials to be used in building encampments. Construction varied depending on location.

Where lumber was scarce, adobe was used as a substitute or supplement to log or frame construction. The southwestern camps were not unlike those founded by the Spanish on the arid plains and mesas of west Texas, New Mexico, and Arizona. In the Northwest, on the other hand, there was greater abundance of lumber, although not always on the upper Great Plains of Nebraska, Wyoming, and the Dakotas, where Indians hunted and often located their villages. Logging would have to be performed by the soldiers. If a camp were to be fortified, it include a stockade made of thousands of trees, preferably pines. Fort Philip Kearny, Wyoming, for example, founded in 1866, was laid out and designed by Col. Henry B. Carrington. The stockade alone required between 2,500 and 3,000 logs, and Col. Carrington was later criticized for building it. Officer's quarters, enlisted barracks, infirmary, quartermaster supply, and stables were also made of logs. Some fixtures were carried by pack to the site, including doors, sash, glass, oil, and paint. Although steamboats could ferry supplies up the Missouri and Platte rivers, and partway up the Yellowstone River, wagon trains were needed to carry supplies overland. Railroads were not a factor in supplying outposts in the critical decade of post-Civil War encampments and fortifications. Col. Carrington's original drawings for the enlisted barracks indicate a one-story range 24 ft x 124 ft, with a porch along one side. The plan was subdivided into sergeant's quarters, store room, dormitory for privates and corporals, a mess and wash room, and kitchen. The walls were built of dressed logs laid horizontally and chamfered on end to create a tenon set within vertical posts placed about 20 ft apart and routed on each side to hold the ends of the horizontal logs. The posts were set in the ground, "poteau en terre," and the floor was dirt. A tie beam with braced rafters supported a plank roof covered with earth. Despite the crude construction, the barracks's roof "seldom leaked," according to a soldier billeted there. What Col. Carrington did not design, his quartermaster, Capt. George B. Dandy, did. Capt. Dandy completed the fort, the repairs and upgrading of which consumed 600,000 board-feet of lumber and 250 window sashes. In 1868, 2 years after its founding, the fort was abandoned and then burned by the Sioux.[3.4]

The lack of standards in the construction of military buildings prompted a survey conducted by the Surgeon General's Office of Army and Naval installations between 1868 and 1870. The survey was published under the title *Report on Barracks and Hospitals*. Mortality tables on servicemen had been kept since 1840, but in the years immediately following the Civil War, deaths from disease and epidemics increased by 50 percent. Much of the problem was attributed to overcrowded barracks and the practice of double-bunking. British studies on the effects of vitiated air (or carbonic acid) and respiratory disease had begun to influence American medical opinion during the 1860s, resulting in the publication of reports on minimum standards for ventilation. Suggestions called for improving the construction of barracks—namely the placement of windows and ventilators, and the raising of floors off the ground (especially in Southern camps):

> It has been said that we have the best-fed and the worst-housed Army in the world.... The defects in the plan of a barrack[s] are often so far compensated by faulty construction that evil results are not apparent; and the very cracks and crevices in roofs, walls, or floors, which are so often complained of, may explain why destructive lung affections [sic] or fevers have not attended overcrowding to a greater degree than they have done.[3.5]

Notwithstanding the findings of the Surgeon General and the attending reports of medical officers from various stations, little was done to implement the recommendations during the period of military retrenchment after the Indian Wars.

World War I Mobilization Buildings

By the end of the 19th century, and probably as a result of the mobilization for the Spanish-American War, quartermasters were provided with standardized plans for mobilization camps and buildings (Figure 3.1). In 1903, the Construction Division of the Army Quartermaster Corps obtained the appointment of an architect to devise plans and render drawings. Before then, architectural services had been rendered in the field by line officers, contracted separately to civilians, or performed by engineer officers. In 1914 a set of drawings was prepared for mobilization camps by the Advisory Architect of the Construction Division and identified by a job number designation of 600. In large measure, these early 600 drawings remained unchanged throughout the World War I, and even later, they were only modified in part. As late as 1930, the *Handbook for Quartermasters* contained construction documents that had been introduced during the early years of the century. Unpainted single-story gable-roofed frame buildings, with single-sash windows and metal chimneys on tarpaper roofs, did little to advance the art of military architecture. Only when assembled in cantonments—each building occupying a designated location and contributing to the operation of a company, the company to battalion, and battalion to regiment—could the logic and utilitarian strategy of such buildings and their arrangements be appreciated.[3.6]

Log construction gave place to board-and-batten, a method of building that presaged the balloon frame, but persisted in plank frame construction well into the middle decades of the 19th century. Instead of stud walls with horizontal cladding, vertical boards, usually 1 x 12 in., were nailed at top and bottom to heavy plates and sills that were supported by posts at the corners and intermediate door openings in the wall (Figure 3.2). Documents called "plans and bills of materials for temporary buildings for mobilization camps" provided dimensioned drawings and tables for the calculation of field-expedient structures for company-size units. Officer barracks, enlisted barracks, kitchen and bakery buildings, stables, and latrines were among the different types provided.[3.7]

Instead of heavy timbers used for sills, plates, and posts, lightweight dimensioned lumber—largely 2 x 4s and 2 x 6s—were nailed together to form built-up sections for these structural members. Exterior cladding was formed of 1 x 12s, with vertical butted joints covered with 1 x 3 in. battens. These were nailed directly to the plates, sills, and intermediate girts (placed half way up the wall). In other words, a skeletal box frame that required exterior cladding for stiffness and structural stability was all that was specified. Inside walls and partitions were neither insulated nor sheathed, nor was there a ceiling. The roof framing was exposed. The building sat on a raised foundation of 2.5 ft long treated 6 x 6s, placed in the ground vertically to form piers. Girders of doubled 2 x 6s were placed atop the piers, and these in turn carried the floor joists, also doubled 2 x 6s, placed 17 in. on center and covered by a single ply of tongue-and-groove flooring of 3 x 7/8 in. boards. Rafters consisting of 2 x 4s placed 21 in. on center with 1 x 6 ties nailed between every other set supported the roof decked with 1 x 12s and covered with roofing paper. The paper or roofing felt was usually applied in several layers with glued seams, although battens were occasionally used to secure the paper.

The 1914 buildings were modular. The modules were based on a 20 ft span, with overall lengths varying according to need, but divided into bays (or bents) of 7 ft. Each bay contained a six-lite sash window, either hinged at the bottom or pivoted at the sides so the top of the sash opened inward. Enlisted men's barracks, for example, ranged from 20 x 63 ft (for 37 men) to 20 x 70 ft (for 43 men), up to 20 x 147 ft (for 97 men). Therefore, one or two platoons could be housed accordingly. The barracks were heated with a wood- or coal-fired stove placed near the center in one of the intermediate bays. Entry doors to the barracks were located on the sides of the building, at least one to each side, and in the same intermediate bay as the stove. Convective heat was given off by the stove and its flue, and the draft afforded by the entries and windows was considered sufficient to ventilate the barracks. The flue fit into a 7 in. diameter clay tile chimney with a 26-gauge metal smokestack flashed to the exterior of the roof. Latrines and showers were not attached, but constructed separately. It would be

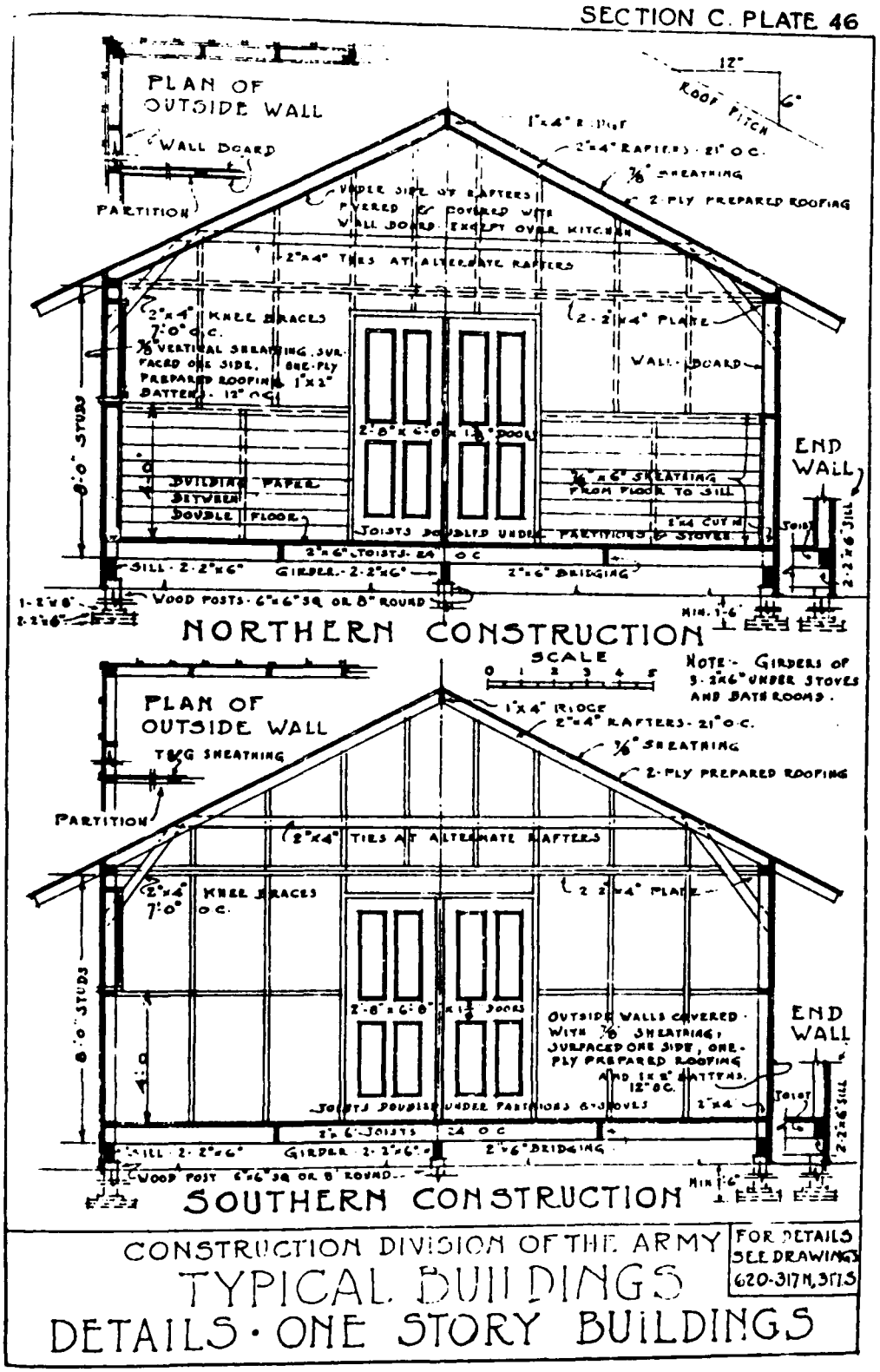
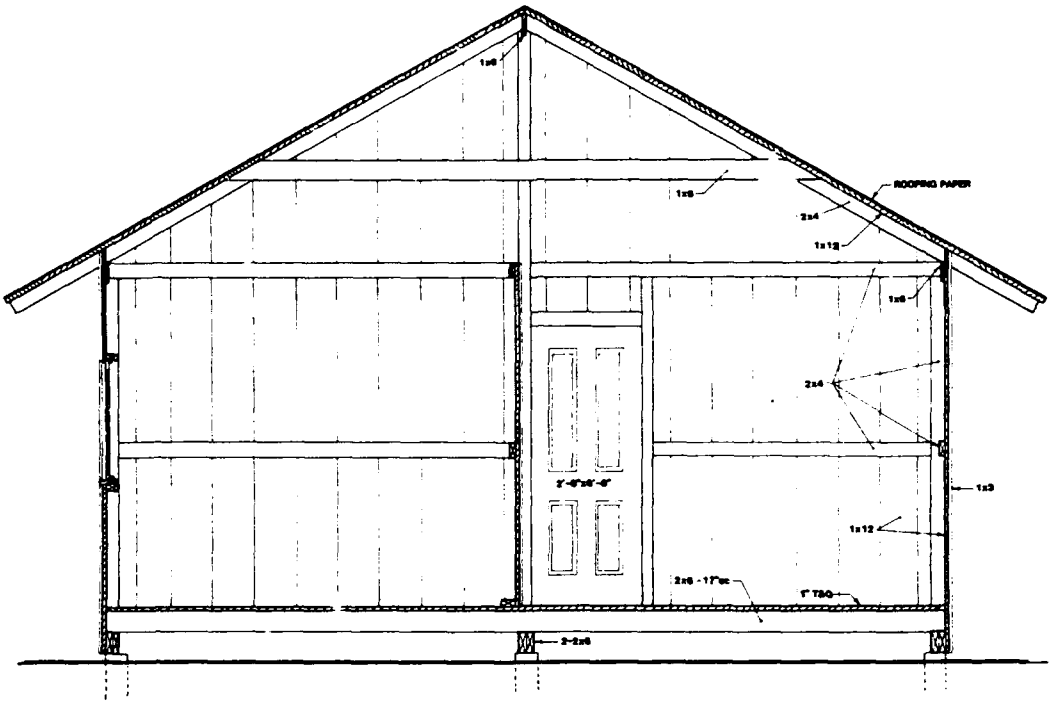
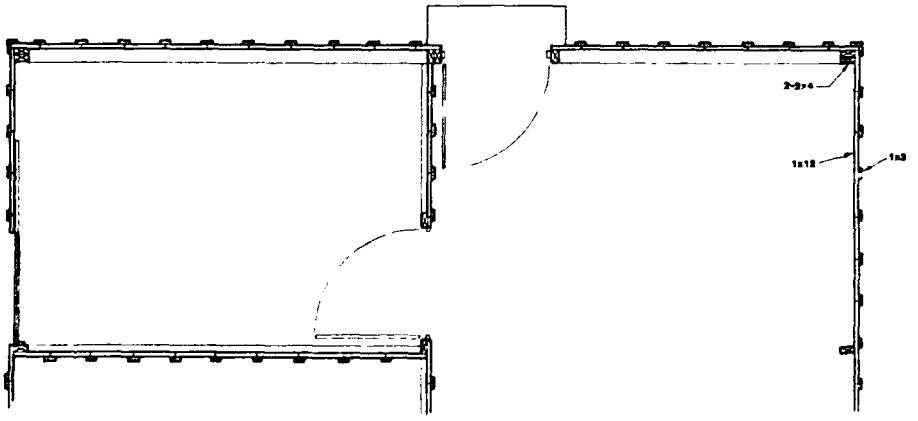


Figure 3.1. Series 600 Northern and Southern Construction: Typical Details, 1918.
(Source: Manual of the Construction Division of the Army [1918].)



SECTION: PLANK FRAME



PARTIAL PLAN: PLANK FRAME

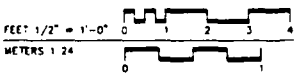


Figure 3.2. Series 600 Mobilization Building, 1914: Section Drawings.

assumed that rural camps or field-expedient developments would not have sewers, so latrine boxes and urinal troughs emptied into vaults. No sewerage was provided for cantonments constructed in Texas during the Mexican Border Uprising of 1916. Also of board-and-batten construction, latrines were roofed, but, for purposes of ventilation, not fully enclosed. No floors were indicated. Bath houses were nearly as primitive, but were built with a raised flooring. Portable pumps would have allowed for water distribution by the onset of World War I.

In plan, single-story enlisted barracks consisted of a nonpartitioned dormitory for the lower grades, with two bays at one end divided by partitions for a 10 x 14 ft office, 7 x 10 ft store room, and 7 x 10 ft quarters for a senior noncommissioned officer (NCO) (Figure 3.3). In 1917, the Cantonment Construction Division devised a new enlisted barracks—one that could contain an entire infantry company of 200 men. Those responsible for designing the new barracks were Col. F. M. Gunby, chief of the engineering department, and Lt. Col. F. B. Wheaton, advisory architect. The barracks was a two-story structure of stud construction (Figure 3.4). Measuring in plan 43 ft by 140 ft, the ground floor would be divided among dormitory, mess hall, and kitchen spaces, while the upper floor was for dormitory space alone (Figure 3.5). Its larger dimensions created a far more imposing structure, and made it the central feature of a camp layout. As in the single-story barracks, entries were located at the sides. However, walls would now define a corridor 20 ft wide (or "company hall") between the entries, with second-story stair and rooms for the senior NCO, and stores opening onto the corridor. The floors were divided by columns and exterior walls into bays 10 ft square. Because of the greater spans and live load conditions, the more substantial stud construction, rather than plank frame construction, was employed. The board-and-batten method described above simply did not lend itself to two-story construction. The weight of an upper floor required the extra stiffness of regularly spaced studs. The idea of combining kitchen and mess within a barracks was not new; many early forts served meals in the same buildings in which the soldiers were billeted. For example, such was true of the barracks designed by Col. Carrington at Fort Philip Kearny. An inherent danger was the risk of fire from food preparation over an open flame within buildings where people were sleeping. Moreover, there was also the nuisance problems of food odor, vermin, and noise. Cooks and cook's helpers would arise before reveille to prepare breakfast. Although the kitchen was given a separate entrance, it could hardly have dampened the cries of cooks and scrambling of KPs (kitchen police) who pulled kitchen duty. Stoves were symmetrically located on the first floor, with flues extending through the second floor to provide heat above. Because of the heat, especially in second story spaces, a monitor to provide ventilation was placed on the roof and extended the length of the ridge. Vent ducts to exhaust fetid air from the first floor dormitory continued through the upper floor to the ridge. Windows were larger than in the single-story barracks, with a double-hung sash of six lites (panes) each above and below. For no apparent reason other than aesthetics, the second to end bays of both stories provided double windows separated by mullions. Another novel feature that would reappear in a modified version in World War II barracks was a pent roof above the ground-story windows and the second-story windows on the ends of the barracks. The construction of these barracks was similar to those of the Series 700 buildings (which are described in detail in later section).[3.8]

Administration, mess, officer, guard, post exchange, and hospital buildings were of similar construction to the single-story 1914 barracks with 20 ft spans and 7 ft bays. Latrines, showers, stables, garages, and store houses each varied in construction, with differing spans and bays, but continued to be of plank frame construction.

The largest of these other types of buildings was the store house, which had a span of 36 ft (Figure 3.6). Because of the weight and bulk of supplies to be stored—largely food, hardware, and dry goods—the foundations and floors of these structures were heavier than those intended for personnel. Footings of either concrete or creosote-treated timber were placed on grade, with two 3 ft long 12 x 12s placed on side and one 2 ft long 12 x 12 placed across these

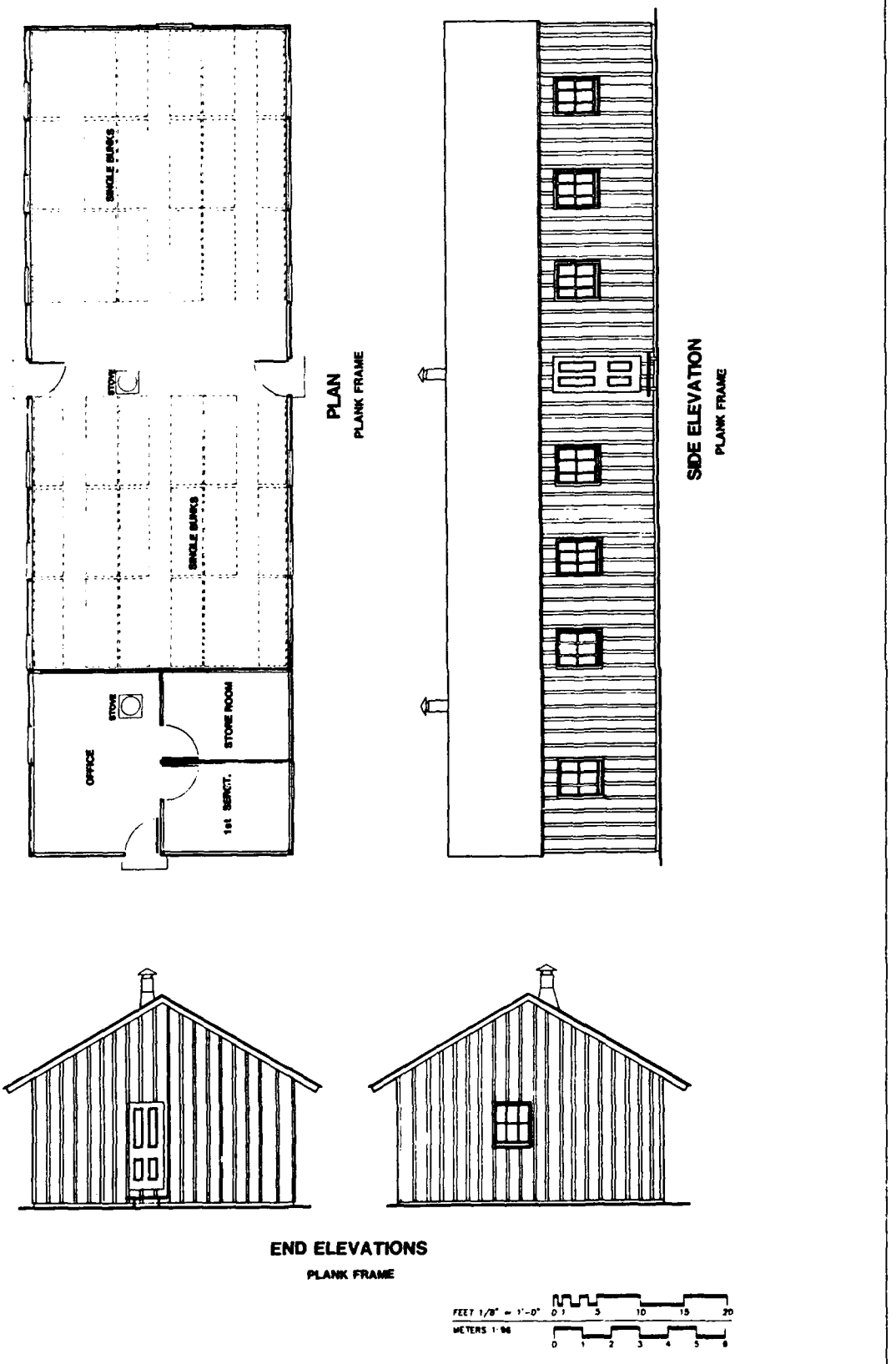
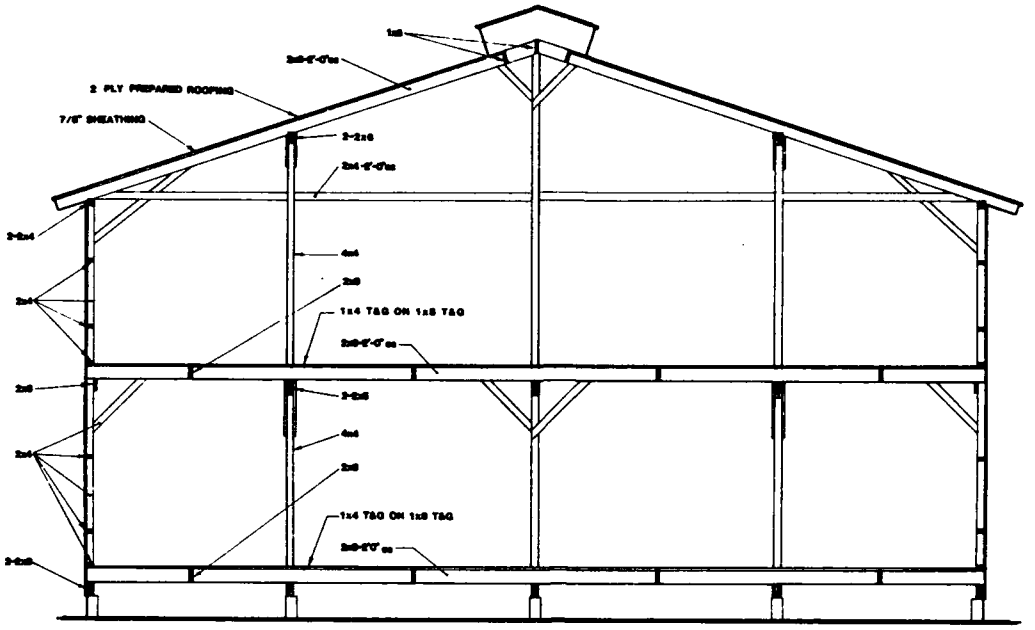
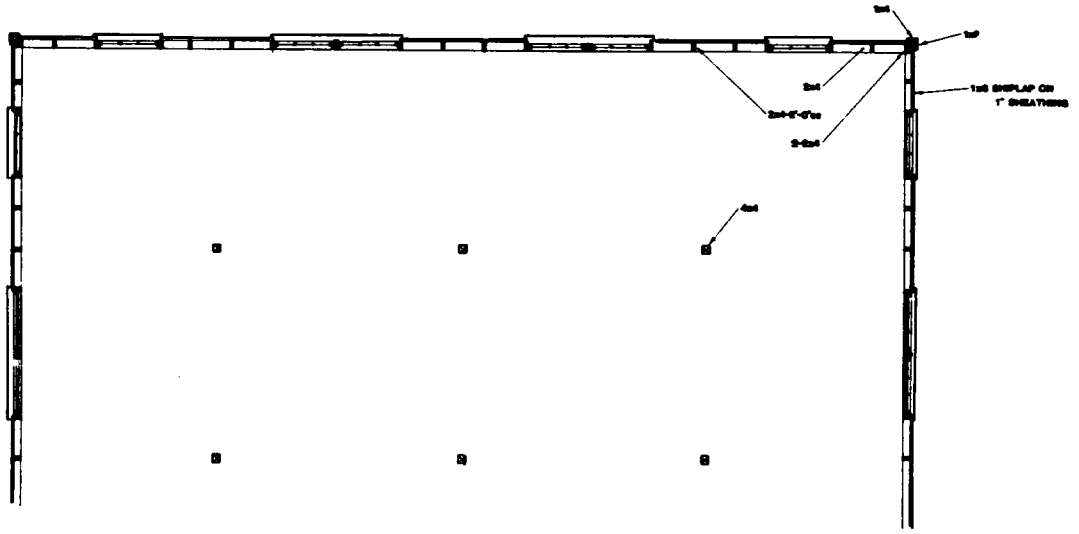


Figure 3.3. Series 600 Mobilization Building, 1914: Single-Story Barracks.



SECTION: 600 SERIES



PARTIAL PLAN: 600 SERIES

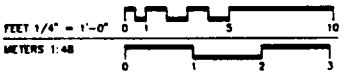
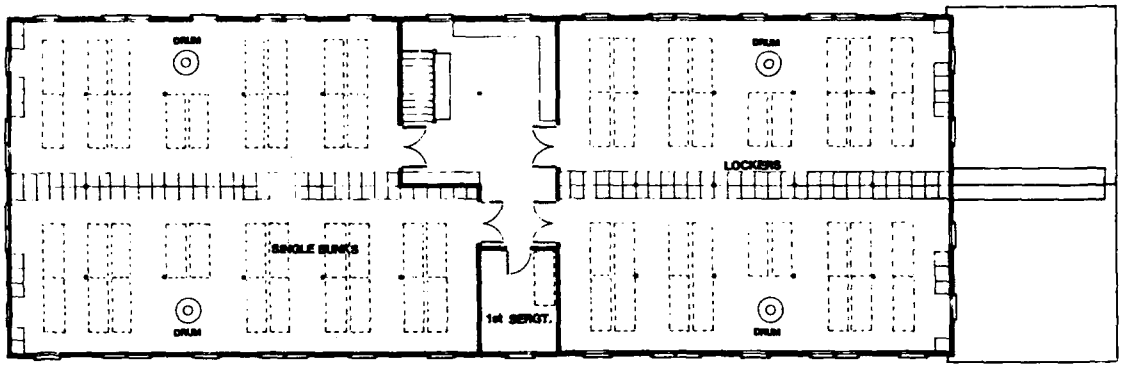
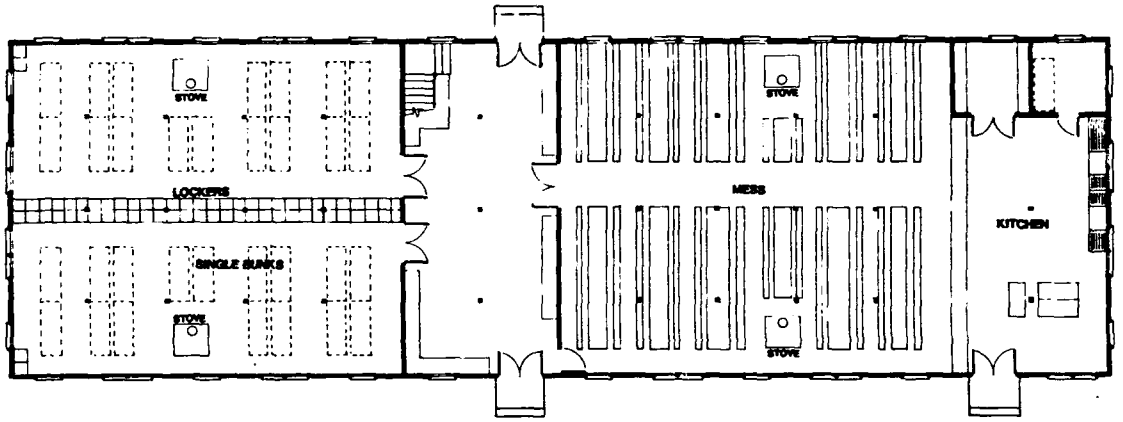


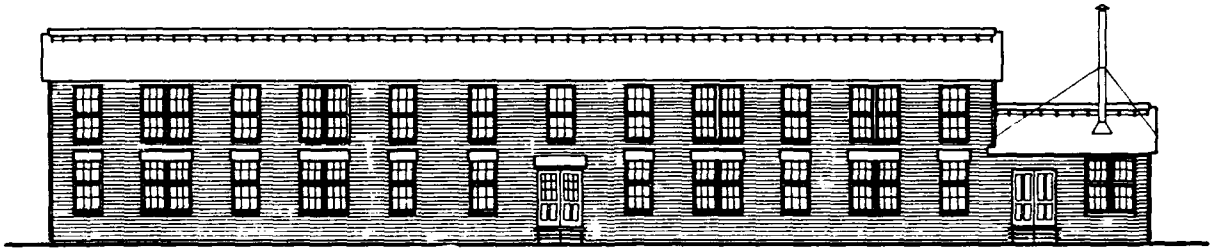
Figure 3.4. Series 600 Mobilization Building, 1917: Section Drawings.



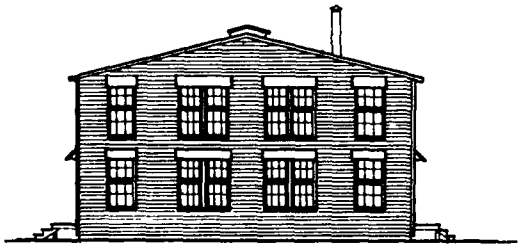
SECOND FLOOR PLAN
600 SERIES

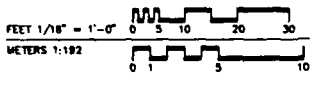


FIRST FLOOR PLAN
600 SERIES



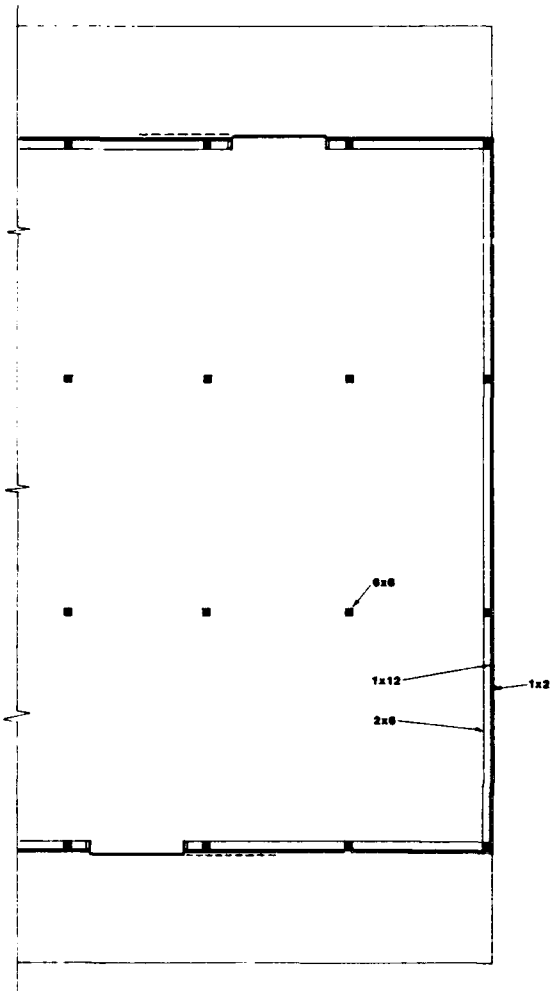
SIDE ELEVATION
600 SERIES



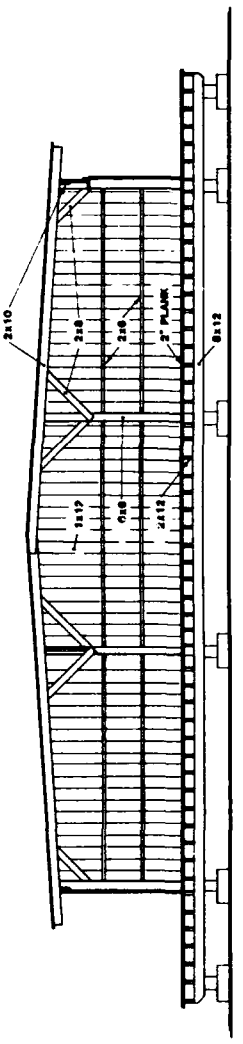


END ELEVATION
600 SERIES

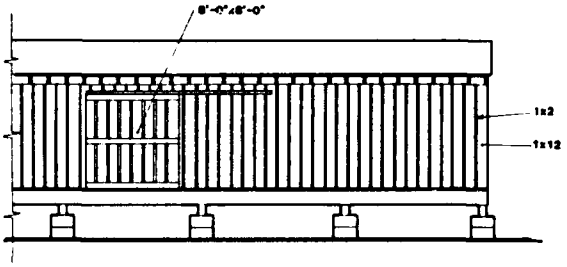
Figure 3.5. Series 600 Mobilization Building, 1917: Two-Story Barracks.



PARTIAL PLAN



SECTION



PARTIAL ELEVATION

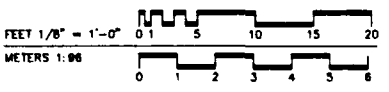
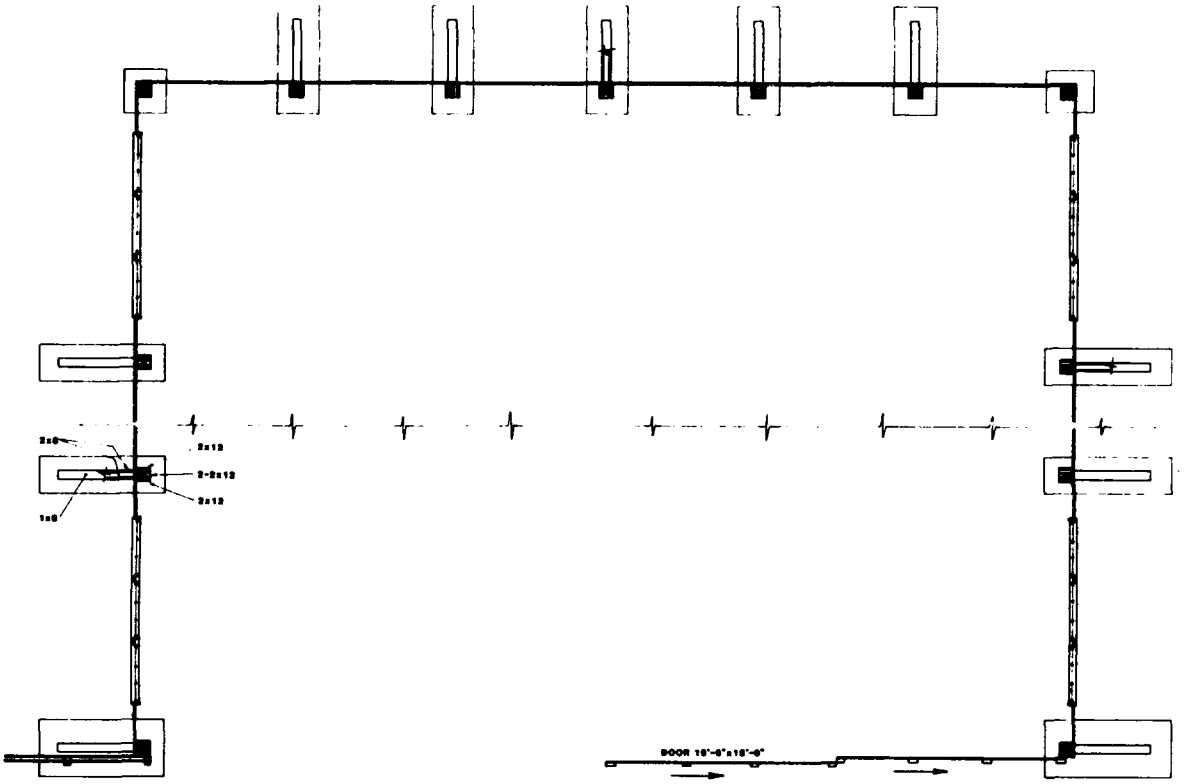


Figure 3.6. Store House, 1914: Section and Elevation Drawings.

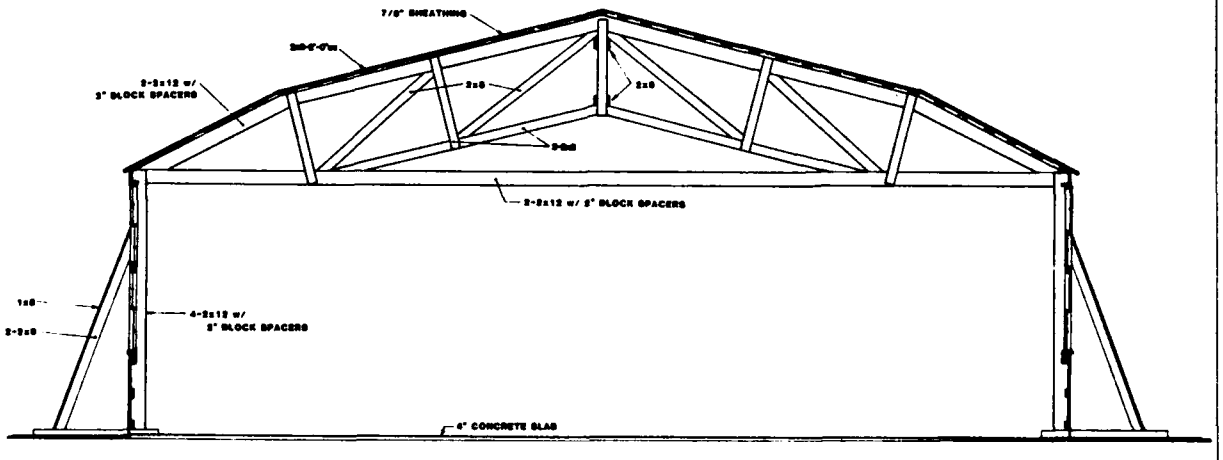
on top. The footings were set 12 ft apart and spaced 10 ft on center over the length of the structure, supporting 8 x 12 girders which in turn carried 2 x 12 joists covered with a 2 x 10 plank flooring. The superstructure was composed of 6 x 6 in. columns placed to form bays of 12 x 20 ft and braced to rafters overhead. Girts 2 x 6 in. were nailed across the columns to support the board and batten cladding. The door was a sliding barn-type door 8 ft wide, hung from a 16 ft track. The columns supported two 2 x 10s laminated to form a plate that carried 2 x 10 rafters spaced 24 in. on center. A deck of 7/8 in. tongue-and-groove boarding covered with paper "Paroid" roofing completed the structure.[3.9]

Hangars for the Army Signal Corps (later separated as the Army Air Corps) posed a new challenge. Although balloons and airplanes had been purchased before World War I, the first training facilities were not constructed until 1917. A timber-frame hangar, as a temporary building type for American camps, was designed by Albert Kahn, the well known and respected Detroit architect responsible for large-scale industrial plants required for automobile manufacturers—the Ford and Dodge plants in particular. These structures were introduced to airfields in 1917, but were replaced by permanent steel hangars of similar design the following year. The wooden hangars, with a gambrel-type roof, measured 66 x 122 ft, and could accommodate between six and eight aircraft (Figure 3.7). Because of the need for clear spans, a modified Pratt truss with a lower chord made of 2 x 12s and the remaining web members (including diagonal and vertical bracing) of 2 x 8s, were framed in pairs and inserted into reveals in the top of 18 ft wall columns. The columns divided the hangar into 15 ft bays, and each column was built up of four 2 x 12s. The two outer boards were separated from the inner two by 2 in. blocks, thus forming a cross-section of 12 x 12 with slots at the top to receive the truss. The columns were braced outside the wall by pairs of 2 x 8s inserted into the spaces between the inner and outer laminates of the columns, and anchored by U-bolts embedded in a 4 in. concrete slab that extended 3 ft beyond the walls of the hangar. Purlins of 2 x 8s placed 24 in. on center between the paired trusses tied the trusses together and carried the roof decking. The purlins were blocked solid in between on the lower pitch of the gambrel roof. The decking and exterior wall cladding was 7/8 in. shiplap siding, the roof portion covered with paper with a crushed-slate red aggregate finish. Six-part composite sash windows were employed one to a bay (or sixteen to a hangar). The doors were 18 ft high and attached to rails by grooved "Hyatt" rollers. So that the doors could open fully, 8 x 8 in. braced frames extended to carry the doors 16 ft beyond the side walls at the end of the hangar. Despite the temporary nature of the buildings, they were painted. The yellow pine used throughout in the hangars at Kelly Field near San Antonio, Texas, for example, was painted white with gray trim.[3.10]

The Quonset Hut was also developed for the Army Air Signal Corps during World War I on plans furnished by the British. Originally known as the Nissen Bow Hut, it was a prefabricated structure intended for use on the airfields of France, and was used for squadron offices, guardhouses, field stores, and hospitals (Figure 3.8). With a width of only 16 ft, Nissens were not large enough to use as hangars, and appear not to have been used as barracks. During World War II, a larger version of the Nissens came to be called Quonsets because of the large numbers of them used by the Navy and Marines at posts like the Naval Air Station at Quonset Point, Rhode Island. The early Nissens combined both wood and metal components. They are identified by their unique form, a semi-cylindrical roof of galvanized corrugated sheet metal attached to timber purlins and supported by steel ribs. Hook bolts with nuts and washers connected the purlins to the ribs. The semicircular ends of the building were of board-and-batten construction, with a door at center and two windows with two over two lites each. Lumber was also used in the foundation and floor of the building. Bearers carried joists placed 18 in. on center, and these in turn were decked with 4 x 9 ft panels of plywood. The Quonsets of World War II were of metal construction throughout, except for the windows and flooring.[3.11]



PLAN



SECTION

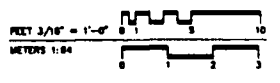
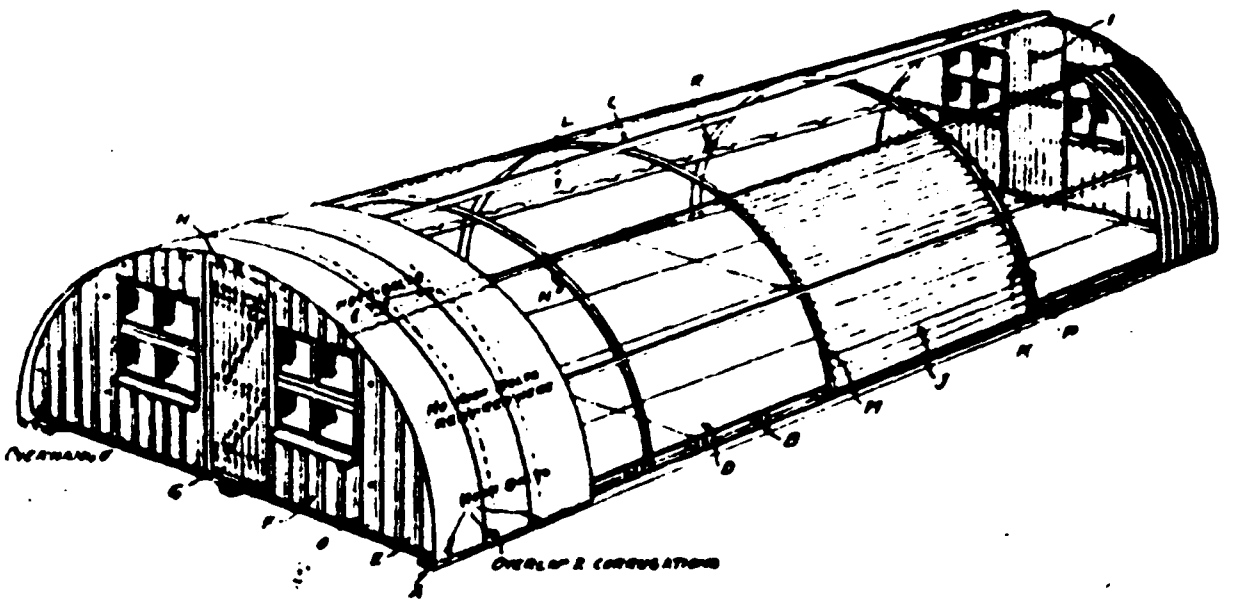


Figure 3.7. Timber Frame Hangar, 1917: Travis Field.



	WOODWORK			IRONWORK	
A	BOTTOM BEARERS (IN HALVES)	3	M	RIBS (IN 3 SECTIONS)	5
B	FLOOR JOISTS	13	N	NUTS & BOLTS FOR RIBS	10
C	PURLINS FOR BOWS	5	O	HOOK BOLTS, NUTS & WASHERS FOR PURLINS	
D	FLOOR PANELS 8'0"×6'0"	12		ENDS	10
E	END PANELS RIGHT & LEFT	4		CORRUGATED IRON	2
F	WINDOW PANELS	4		BUTT JOINTS	5
G	DOOR	1		FOOT OF RIBS	10
H	END PANEL OVER DOOR	1		SPARE	7
I	END PANEL WITH HOLE FOR PIPE	1		WIRE NAILS 3"	
J	MATCHBOARDED LINING APPARITES			WASHER PLATES	
	SUPPLIED IN 6-100 BUNDLES		P	SHEET IRON CLIPS FOR LINING STRIPS	
K	LINING STRIPS			SPARE	5
L	SHELF & RIFLE-RACK (IN HALVES)	2	Q	CORRUGATED IRON SHEETS 8'0"×2'6"	
				WIRE NAILS 3"	
			R	BRACKETS FOR SHELVES	6

Figure 3.8. Nissen Hut, 1917: Isometric Cutaway Drawing.
(Source: Loring 1919.)

The Navy also used temporary construction during World War I, but to a lesser extent than the Army. Moreover, there was not the same carryover of design in Naval buildings between the two world wars (except in barracks) that was exhibited in Army buildings. During peacetime, the Navy trained sailors at one of four receiving stations before assigning them to ships. Naval stations did not provide extensive quarters for enlisted men, since all but those assigned to specialized branches were remanded to sea when not on furlough. Mobilization, however, produced more sailors than the existing receiving stations and ships could hold. At Charleston, South Carolina, for example, barracks and latrines were provided for training regiments of 1,000 men each. Four sections of 75 men each composed a ship's company, and each section was provided three separate barracks. Cantonment barracks, administrative quarters, mess hall, and latrines were frame construction of a type specified by the Naval Civil Engineering Corps and supervised on site by the commandant of the local Naval yard and his assistants. The barracks structures were small compared to those of the Army, and not unlike those used in logging camps. One story in height and just 16 x 30 ft in plan, Naval barracks could accommodate only 25 sailors (Figure 3.9). The structure's close quarters—250 cu ft of space per sailor—were intended to simulate the confined conditions aboard a ship, such as the slinging of hammocks that were stowed during the day. A foundation of brick piers of 12 x 12 in. cross-section, and extending 18 in. above ground, carried 6 x 6 in. sills supporting 2 x 6 in. joists with 1 in. tongue-and-groove flooring. The roof and walls were supported by three rows of six columns extending from one end of the barracks to the other, and dividing the plan into 10 bays of 8 x 6 ft. From floor to wall plate was 10 feet, to allow space for ventilation overhead. The center row of columns was taller than the outer rows to support the apex of the roof that had a one-to-four pitch. Each column bears directly on the sill below, positioned over a pier for added reinforcement. The columns supported crosstrees of 6 x 6 in. dressed timber placed about 7 ft above the floor from which the hammocks were suspended. Girts of 2 x 4 in. span along the walls between the columns provided stiffness as well as bearers for the plank siding. Neither inside wall sheathing nor ceilings were provided. The siding stopped two ft short of the top of the wall to allow a continuous screened window from one end of the building to the other. Additional ventilation was provided by 2 x 6 ft windows midway up the wall, which had awning shutters hinged at the top and adjusted by cords attached to clews in the ends of rafters. The roof was carried by 4 x 6 in. plates positioned above the columns and supporting 2 x 4 rafters, decking, and roofing paper. One end wall contained the entry and a louvered window; the other wall was blocked with pigeon holes to contain the sailors' duffel bags. Designed for southern or even tropical climates, these lightweight structures were neither provided with stoves nor glazed windows, and they would not have been suitable for use elsewhere.[3.12]

World War II Mobilization Buildings: Army and Army Air Corps

The Series 700 or mobilization-type construction that accounts for the majority of Army buildings erected in 1940 and 1941, originated with drawings prepared in 1917 and modified during the 1920s and 1930s. The Advisory Architect of the Construction Division, Maj. Elsmere J. Walters, completed a final set of drawings between 1937 and 1940. The occasionally used designation "Theater of Operations" (T.O.) to describe these buildings is incorrect. T.O. buildings, although also of temporary construction, were intended for use outside the continental U.S. for advance bases, and they varied in modular proportion and detail from the Series 700 and later Series 800 structures. In overall appearance, differences between the buildings of the two world wars had less to do with type or style than with proportion and construction. To the eye, the most immediate difference lay in the fact that the buildings of World War II were painted instead of being left to weather. An ivory-colored enamel coated the exterior of all frame buildings, whether they be a major general's quarters or an enlisted men's barracks. Doors and aprons around the foundation were painted light gray. Another difference was that doors were moved to the front (or gable) end of the later buildings, depending on their use. Company buildings that emptied out onto drill fields

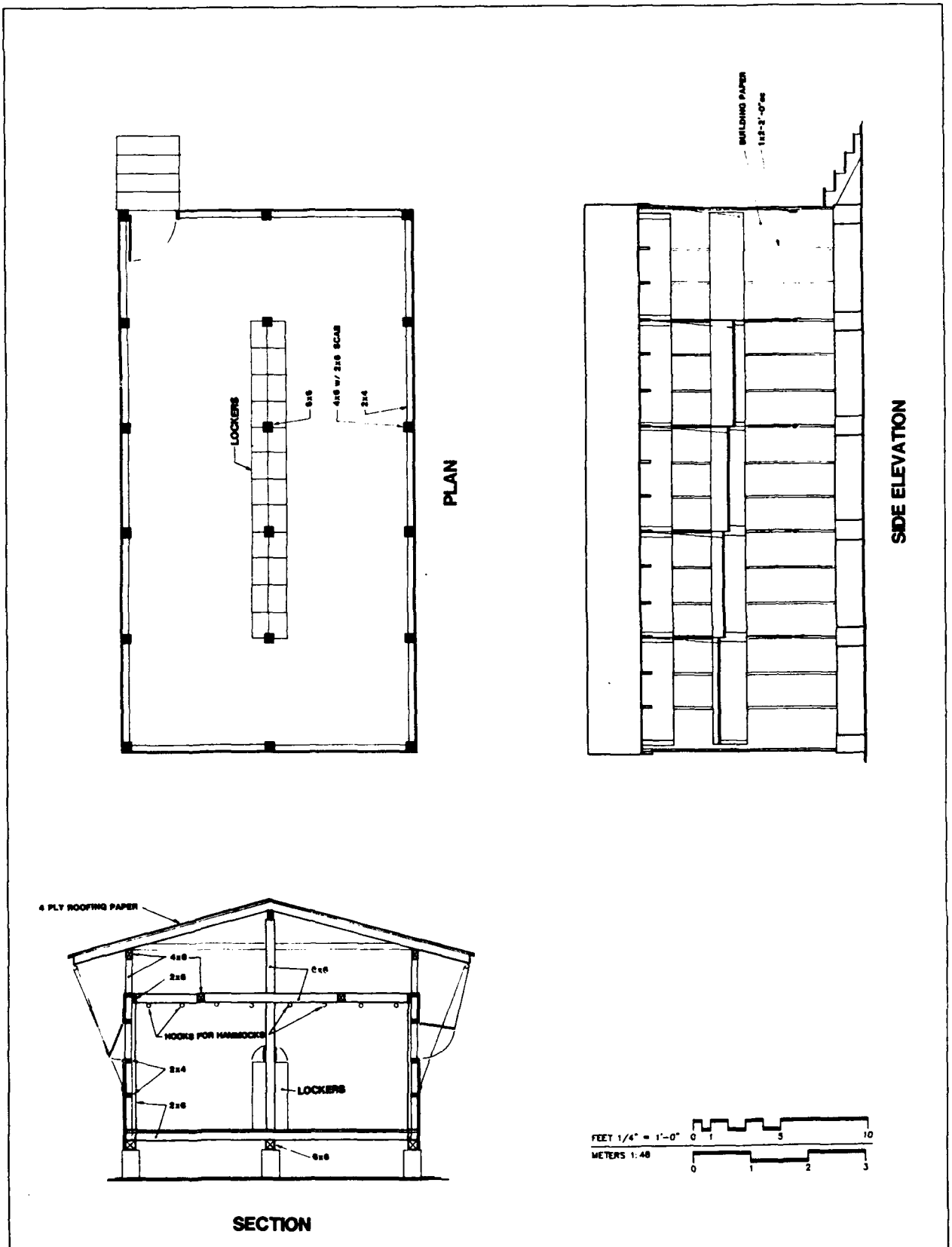


Figure 3.9. Twenty-Five-Man Barracks, 1917: Naval Training Camp, Charleston, S.C.

benefited from this logical modification. As a safety measure, fire escapes (wooden ladder and landing) made it necessary to put an additional exterior door on two-story barracks. Another small improvement was the location of a wood-framed ventilator in the gable end wall of any building with a ceiling. This detail, although recommended as early as 1917, had been omitted in the Series 600 buildings. Obviously, there were differences in use, but the needs of the new Army could usually be accommodated with slightly modified existing building types. For example, there were no radio station buildings among the types prepared in 1917, but a World War I signal company storehouse could be converted into a World War II radio station. A remount station could be converted to a motor pool building. The Series 700-100 administrative building occupied by battalion commanders and above changed little between the wars (Figure 3.10). The meager proportions of the offices and clerical bays were not enlarged, and although the building exteriors were painted, the interiors remained unpainted (throughout the war), and, in most locations, uninsulated and unsheathed.[3.13]

Tables of organization, beginning with company strength, changed between the wars. Following demobilization, company size was reduced from 200—in late 1917 it had been increased to 250 to conform to British and French strengths—to 126 by 1941, which could be increased to 192 as made necessary by war. The typical barracks—a Series 700-1165, for example—accommodated half a company, or 63 men. The Surgeon General determined occupancy by establishing minimum space requirements for quartering in order to ensure health and sanitation. From 400 cu ft of space for those living in tents and barracks in 1916, requirements increased to 500 cu ft in 1917, and to 700 cu ft by 1940. These changes affected the plans of barracks and hospital buildings, as well as the layout of bunks. In addition to barracks, each company area contained a mess hall to seat 170 men, a recreation building (day rooms), and storehouse (to include the company office).[3.14]

Architectural standards were upgraded considerably in Series 700 buildings. Stud construction (rather than plank frame) was used in one- and two-story structures (Figures 3.11 and 3.12). Concrete piers and footings replaced treated-timber posts, and that, together with the painting of exterior walls, ultimately extended the life of remaining World War II temporary buildings. Designed for a building life of 5 to 7 years, many have now stood up to five *decades* of use. Exterior sheathing (with damp-proof courses beneath plywood or shiplap cladding) and the laying of subfloors did much to tighten up these later buildings and to prevent the drafty conditions experienced in their World War I predecessors. Composition board (a pressed-wood fiber board) and sheetrock (gypsum-lath wallboard) were also used—although to a limited extent—even in the northern cantonment areas. Composition board and plywood had been introduced early in the century, but weak glues limited their usefulness until the development of stronger resins in the 1940s. Gypsum board, although developed before the war, met with resistance among plasterers, and would not be adopted commercially until the postwar housing boom. Wallboard was most often used for ceilings and partitions, but not for sheathing the interior face of exterior walls. Perhaps the most welcome improvements to the later Series 700 buildings were the installation of plumbing and electrical conduit, and an improved heating system.[3.15]

Outdoor showers and latrines had been a standard fixture of military posts. Soldiers from farms and small towns had grown accustomed to the inconvenience of traveling between house and outhouse. But city dwellers, even by the time of World War I, considered outdoor toilet facilities to be among the great disadvantages of cantonment life. Although sewers had been provided in the larger World War I camps, the showers and latrines remained detached as small outbuildings located between barracks and elsewhere. Either it was considered a health measure to have them separated, or an expedience in the event that the barracks would be replaced by National Guard tents after the war. In the new barracks, concrete slabs were poured for showers, latrines, and mechanical rooms, with vitreous ceramic fixtures used in sinks, urinals, and toilets. Shower walls were lined with galvanized sheet metal. Electrical service had been provided in many World War I buildings, including enlisted

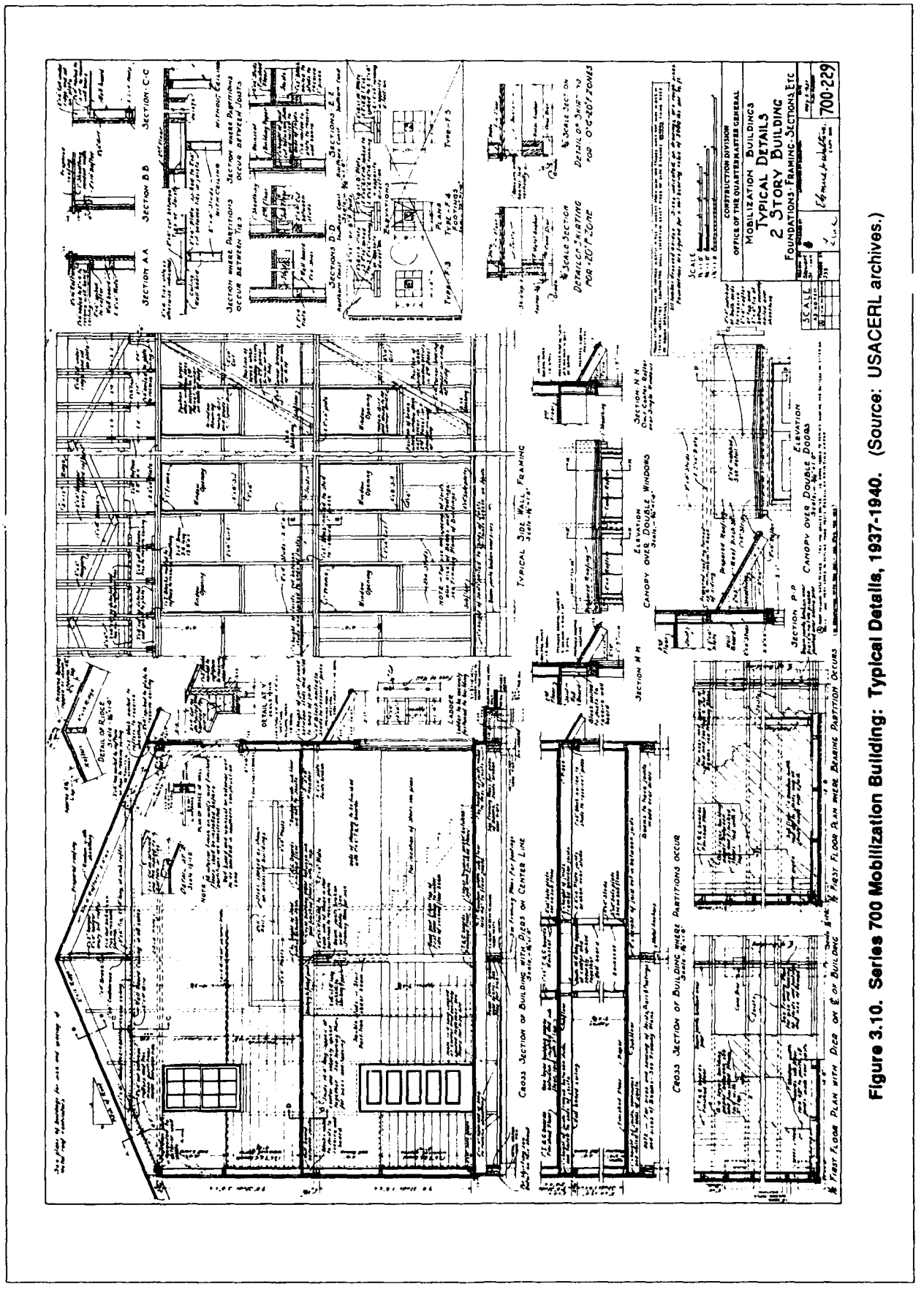
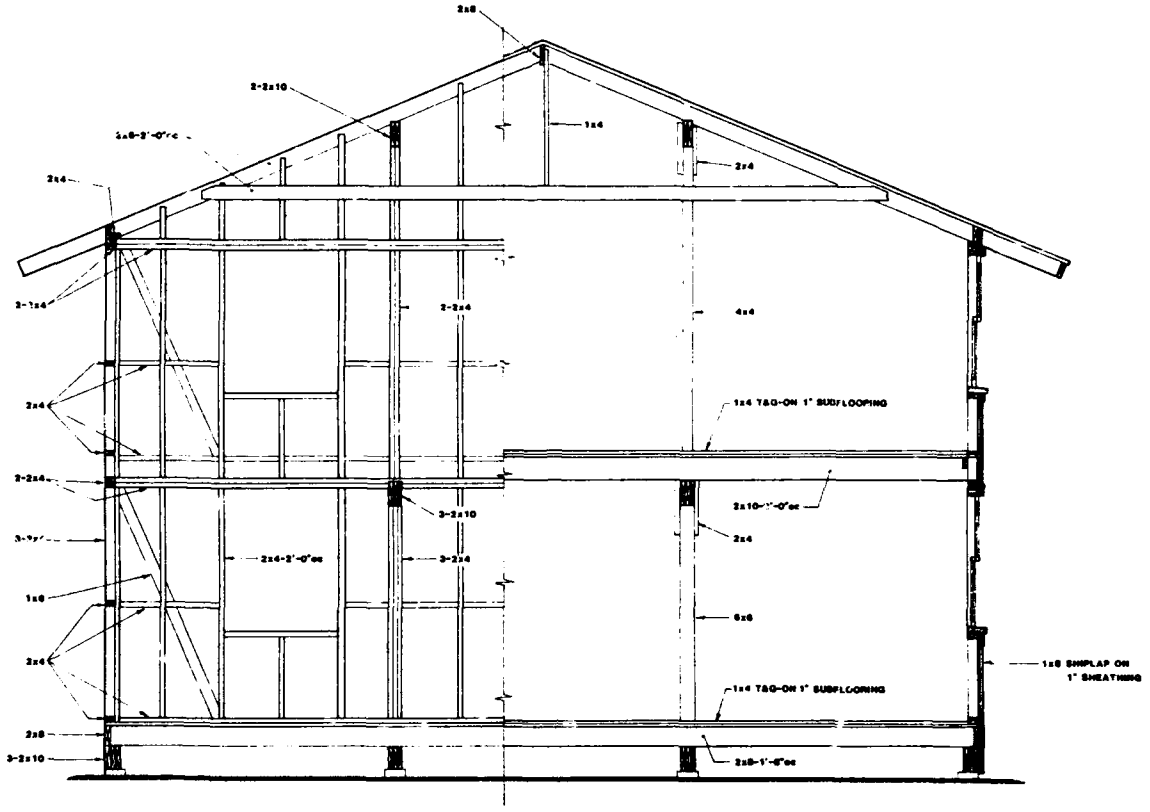
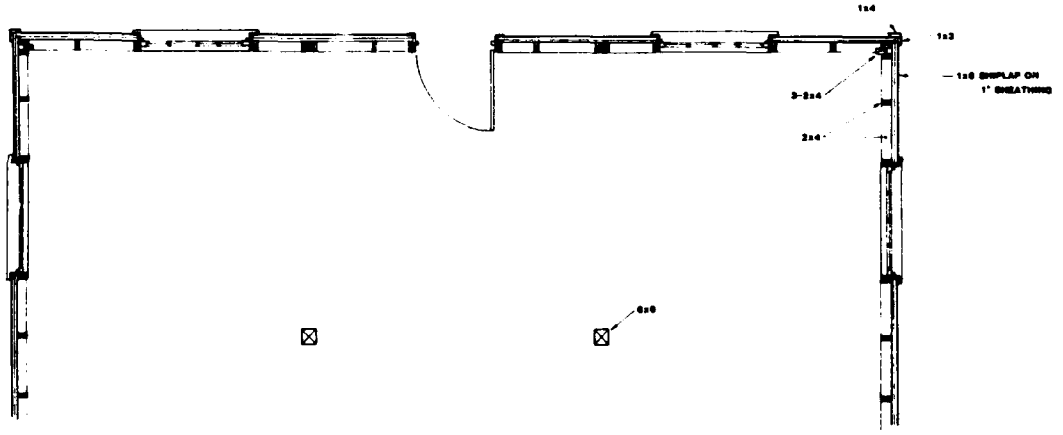


Figure 3.10. Series 700 Mobilization Building: Typical Details, 1937-1940. (Source: USACERL archives.)



PARTIAL SECTION & END WALL ELEVATION: 700 SERIES

29'-6" WIDE BUILDING



PARTIAL PLAN: 700 SERIES

29'-6" WIDE BUILDING

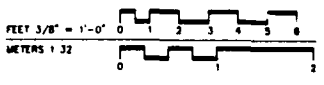
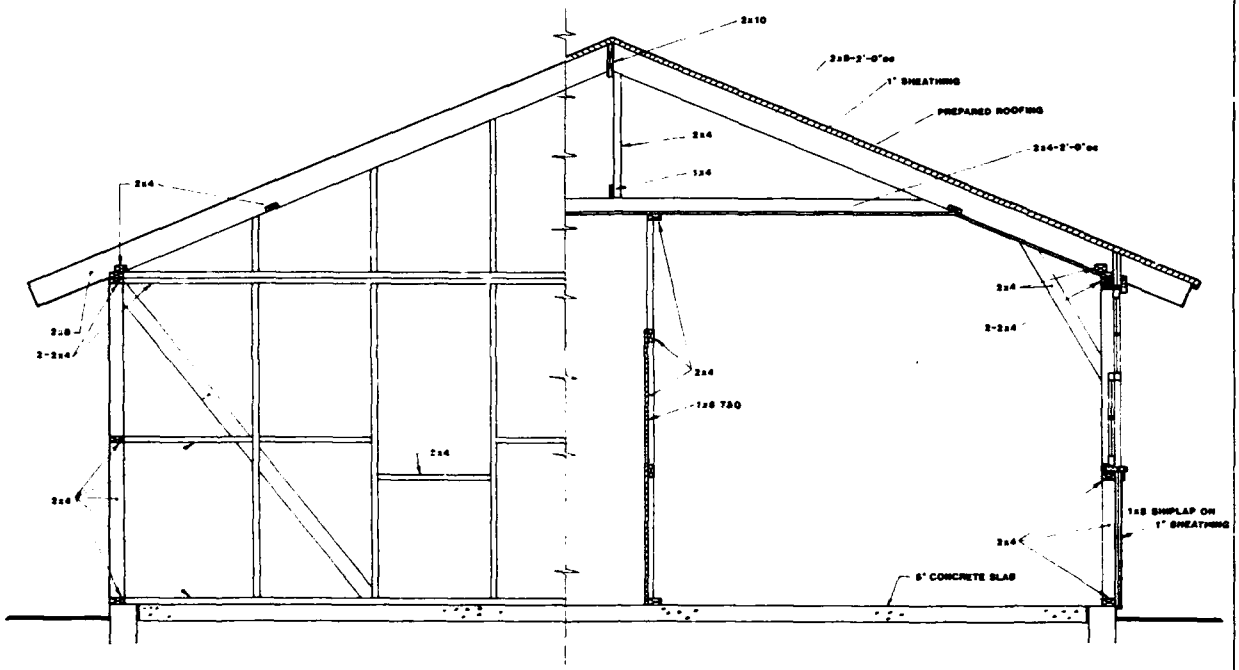
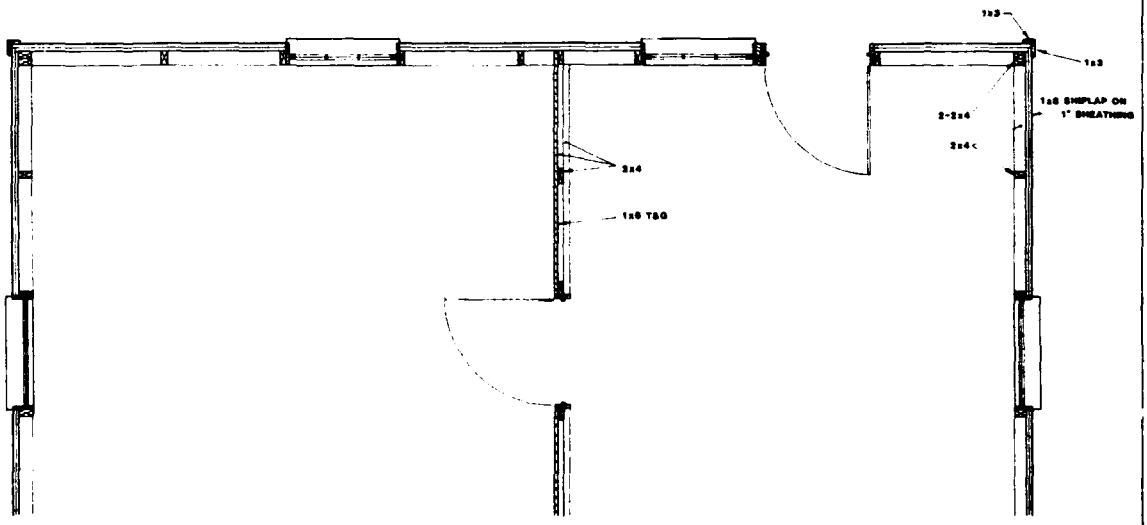


Figure 3.11. Series 700 Two-Story Barracks, 1940: Section Drawings.



PARTIAL SECTION & END WALL ELEVATION: 700 SERIES

25'-4" WIDE BUILDING



PARTIAL PLAN: 700 SERIES

25'-4" WIDE BUILDING

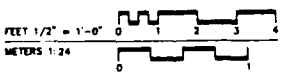


Figure 3.12. Series 700 One-Story Combination Company HQ and Supply Room, 1937-1940.

barracks, but overhead lighting, connected in series by flexible conduit, would now be provided to all occupied buildings. Also, wall outlets were furnished to single rooms. A porcelain base and naked 40 W bulb illuminated each structural bay of a dormitory space. Electrical appliances now could be used in senior enlisted and officer barracks and housing.

The greatest improvement, however, was the heating and ventilating of buildings (Figure 3.13). Gone from barracks were the space heaters and cannon stoves. These old-fashioned heaters usually occupied the center of a bay. They "cooked" the soldiers bunking nearest to them, while leaving those sleeping farther away and near a wall or window to freeze. Furnaces would now be installed in separate mechanical rooms. Flues, instead of penetrating floors and roofs, were set 4 ft outside the exterior wall of the mechanical room. Electric fans and thermostats controlled the flow of heated air through sheet-metal (or, sometimes during the war, fiber board) ducts. Dampers within the registers or duct outlets regulated the distribution of heat. The forced-air system was not as efficient as the convective stoves, and in large dormitories it rarely provided sufficient heat; but occupants no longer had to compete with the stove for oxygen. Moreover, the risk of fire was substantially reduced by the separation of the furnace from occupied rooms and the relocation of flues outside the building envelope. One design flaw, however, affected coal-fired (but not oil-fueled) units: the coal bins used to store fuel for the furnaces were installed inside the mechanical rooms next to the furnace. Consequently, the intake air that was heated and distributed throughout the buildings contained coal dust. Sash-type windows, pivoted in one-story buildings and double-hung in two-story structures, provided natural ventilation. Doors at the fronts of barracks, both above (for fire escape) and below, and a side door at the rear, offered better air circulation than the side entries of the 1917 barracks. With opened windows placed one to a bay, there was not a problem with ventilation when the doors were not shut.[3.16]

Ease and speed of construction were key design criteria. Framing remained simple. Anticipated manpower shortages made it necessary to use unskilled labor. Only a portion of those employed on building crews would be experienced carpenters, so framing techniques were intentionally designed to be uncomplicated. Platform framing, in which floors are framed separately (as opposed to balloon framing), had been in practice since the turn of the century. Second-story floors obtained greater stability and load-bearing capacity. Dimensioned lumber and stock items such as doors and windows were used throughout. The concrete foundation piers of most company buildings were 8 x 8 in. posts of 5 ft height, set on 16 in. square concrete footings installed 3 ft below grade. Anchor bolts set in the middle of each pier fastened a composite sill made up of three 2 x 8s spiked together. The sills carried 2 x 8 joists that spanned either 10 or 13 ft, depending on the building.

One-story company buildings were 25 ft, 4 in. (two bays) wide, whereas the two-story barracks were 29 ft, 6 in. (three bays) wide. Spacing between joists was 20 in. for the ground floor of barracks and day rooms, and 16 in. for mess halls. Second-story floor framing of barracks placed joists 24 in. on center, but substituted 2 x 10s with bridging. Subfloors were 1 x 8 in. tongue-and-groove stock, separated by a damp course of rolled felt from a finish floor of 1 x 4s. Many of these wooden floors would later be covered by linoleum for ease of maintenance. Studs, girts, and plates were 2 x 4s. Wall framing was enclosed on the exterior face by 1 x 8 sheathing nailed on a 45 degree diagonal to the studs, covered by a damp course, and finished with 1 x 8 shiplap siding (sometimes referred to as "drop" or "novelty" siding, wherein one edge is rabbeted to cover the board below). Interior partitions used to separate NCO rooms from dormitory areas, and to sheath stair and latrine walls, were mostly made of horizontally nailed 1 x 6 tongue-and-groove flush boarding on 2 x 4 stud framing. The shower room was lined with galvanized sheet metal, and the mechanical room with sheetrock or fiber board. Two rows of 6 x 6 freestanding columns helped support the barracks' upper floor and roof, and these were placed 10 ft apart and located over the foundation piers to define a 10 x 10 ft module. The ground-story columns carried built-up beams of three 2 x 8s braced by pairs of 2 x 4s, which extended along the axis of the barracks from front to rear. Second-

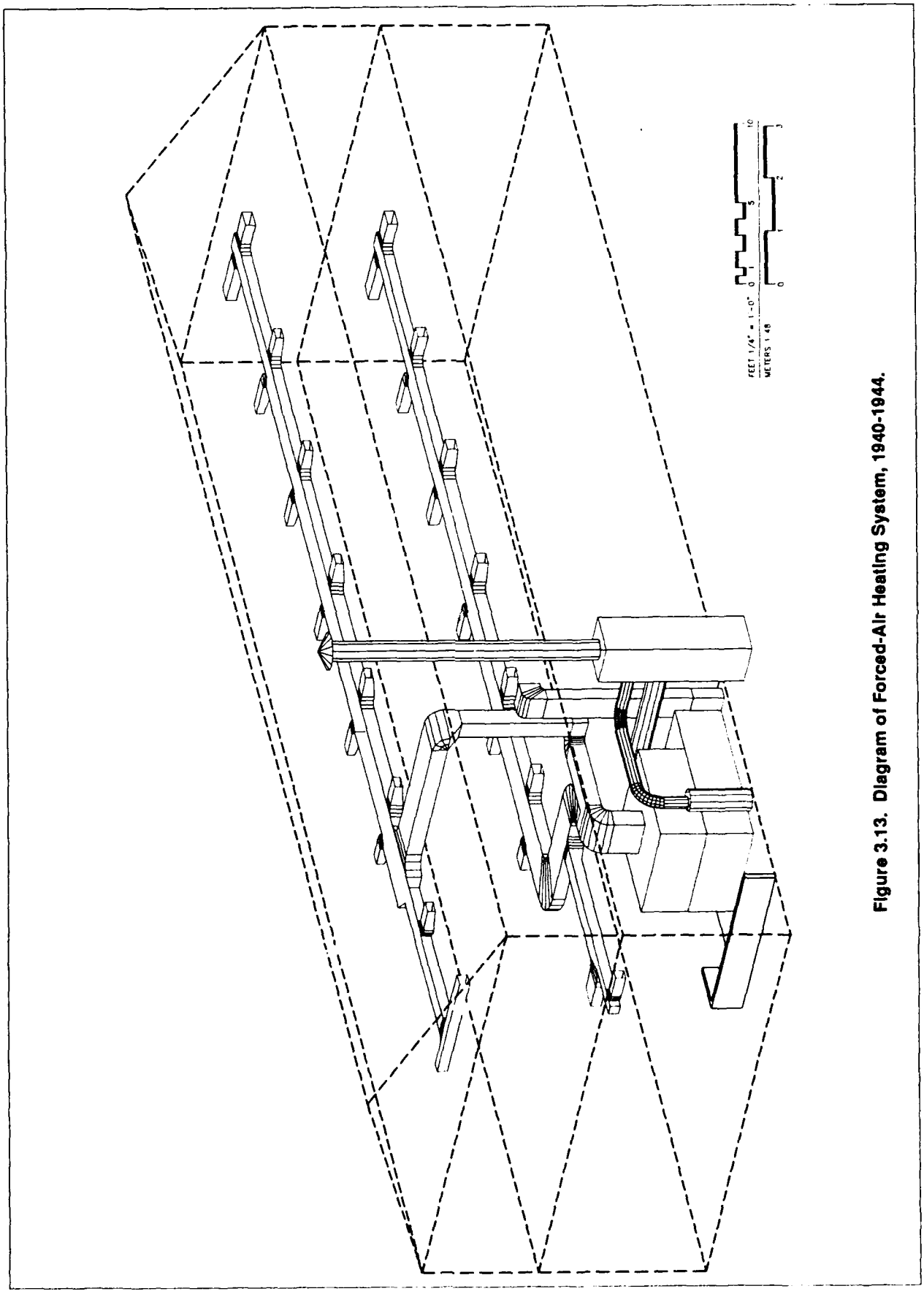


Figure 3.13. Diagram of Forced-Air Heating System, 1940-1944.

story columns, placed directly above, penetrated the upstairs ceiling to support a beam of two 2 x 8s. That beam served as a bearer for the roof. Rafters of 2 x 6 in. placed 24 in. on center were decked with 1 x 8s and covered with a roofing paper rolled in continuous sheets from front to back, with the first course beginning at the eave and successive courses extending to the ridge (with 4 in. overlapped joints between each). This roofing felt was a heavy green bituminous paper of a type superior to that used in earlier roofing.[3.17]

A distinctive feature peculiar to Series 700 buildings was a skirt-roof that projected from the spandrel wall above the ground-story windows on two-story buildings, and continued around all four sides (Figure 3.14). On both the single-story and two-story buildings, it also extended the eave line beneath the front and rear gables to span the width of the building. Other terms used to describe this skirt-roof were "canopies" and "eyebrows." The official term used by the Army to designate this feature is "aquamedia," and its origin is as uncertain as its Latin derivation. Whatever its ontology, aquamedia was of questionable value. A pent roof had been used above windows on barracks designed in 1917, for the purpose of shedding rain while permitting the window sash to remain open for ventilation. Rather than frame separate pents for each window, however, a continuous skirt was devised in 1940, extending 3 ft from the face of the wall and braced by 2 x 4s. The feature was dropped from the Series 800 buildings because it could not shield against blowing rain, and leaks could occur where the stub rafters were framed into the wall.[3.18]

Other differences in the Series 800 buildings, introduced in 1941 and further modified by the Corps of Engineers in 1942, were the proportions of two-story barracks (Figure 3.15). When Col. Somervell took charge of the Construction Division, he reorganized each of the departments, including personnel changes. In the Engineering Department, George E. Bergstrom, a prominent architect and president of the American Institute of Architects, was made Chief of the Architecture Unit. Bergstrom continued in this capacity after the construction mission was transferred to the Corps of Engineers. Already, he had begun to respond to criticism of the Series 700 buildings. In the larger of the two standard widths that carried over to the Series 800s, bays 10 ft square continued to define the dormitories and NCO rooms. However, the ceiling heights were increased. Instead of cots or single bunks, double-bunk sleeping arrangements were determined. Laterally, the double bunks were not placed as close together as singles, but the overall effect was a reduction in terms of cubic feet of air space per occupant. Since 1870, the Surgeon General had frowned on use of double bunks. However, wartime conditions, together with improved medical service and personal hygiene, permitted the return of the double bunk. Hence in the new Series 800-1129 74-man barracks (as opposed to the Series 700-1165 63-man barracks it replaced), floor-to-ceiling heights increased 5 in. on the first story and 1 ft, 6 in. on the second. Overall height from the bottom of the apron to the apex of the roof increased from 24 ft, 6 in. to 26 ft, 5 in., which meant more head height for sleeping arrangements in the dormitory bays. The barracks length gained an additional 10 ft bay, allowing companies to accommodate one-and-a-half platoons per barracks at full strength. The one floor left over in the three barracks assigned per company was used for quartering the cooks, steward, clerk, supply sergeant, and first sergeant (assuming they were confined to the company area when placed on alert).[3.19]

In an effort to avoid waste, the 8-, 10-, and 16-penny nailing schedules were revised to use fewer nails per connection. The generous 3 ft overhangs of the roof eaves were cut back to 9 in., although boxed in with a facia and soffit. During the latter part of 1942, cement-asbestos shingles began to be substituted for the standard shiplap wood siding used previously. Timber depletions resulting from the previous 2 years of construction meant that nonstructural applications of lumber would be avoided whenever possible. The natural gray shingles, which came in 11 x 24 in. pieces, required no painting but were susceptible to checking. Shortages may also have figured into the use of trusses in the 25 ft wide buildings, such as the mess halls and the combination company headquarters-supply-day room. The truss design employed in these Series 800 structures (Figure 3.16) was similar to those

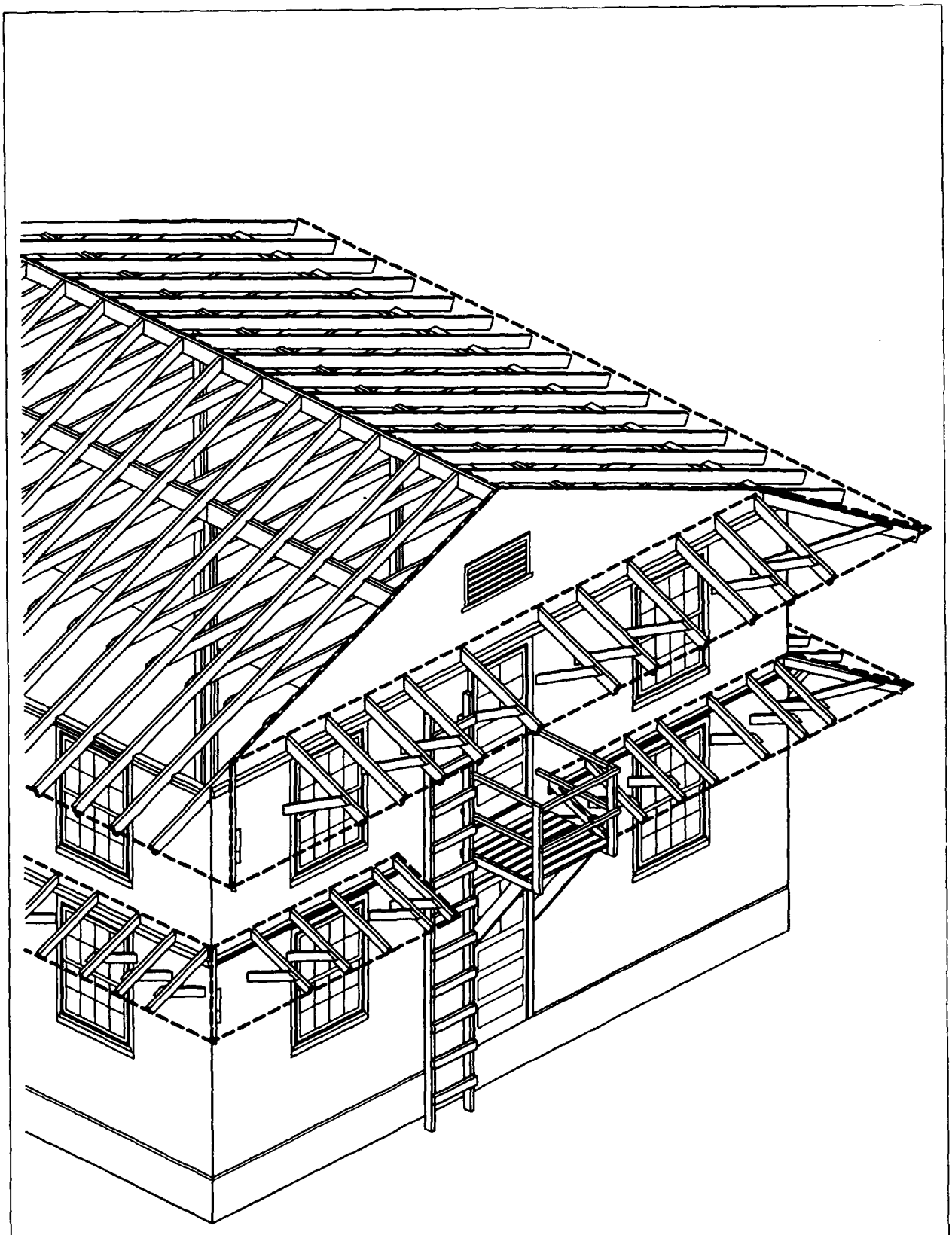
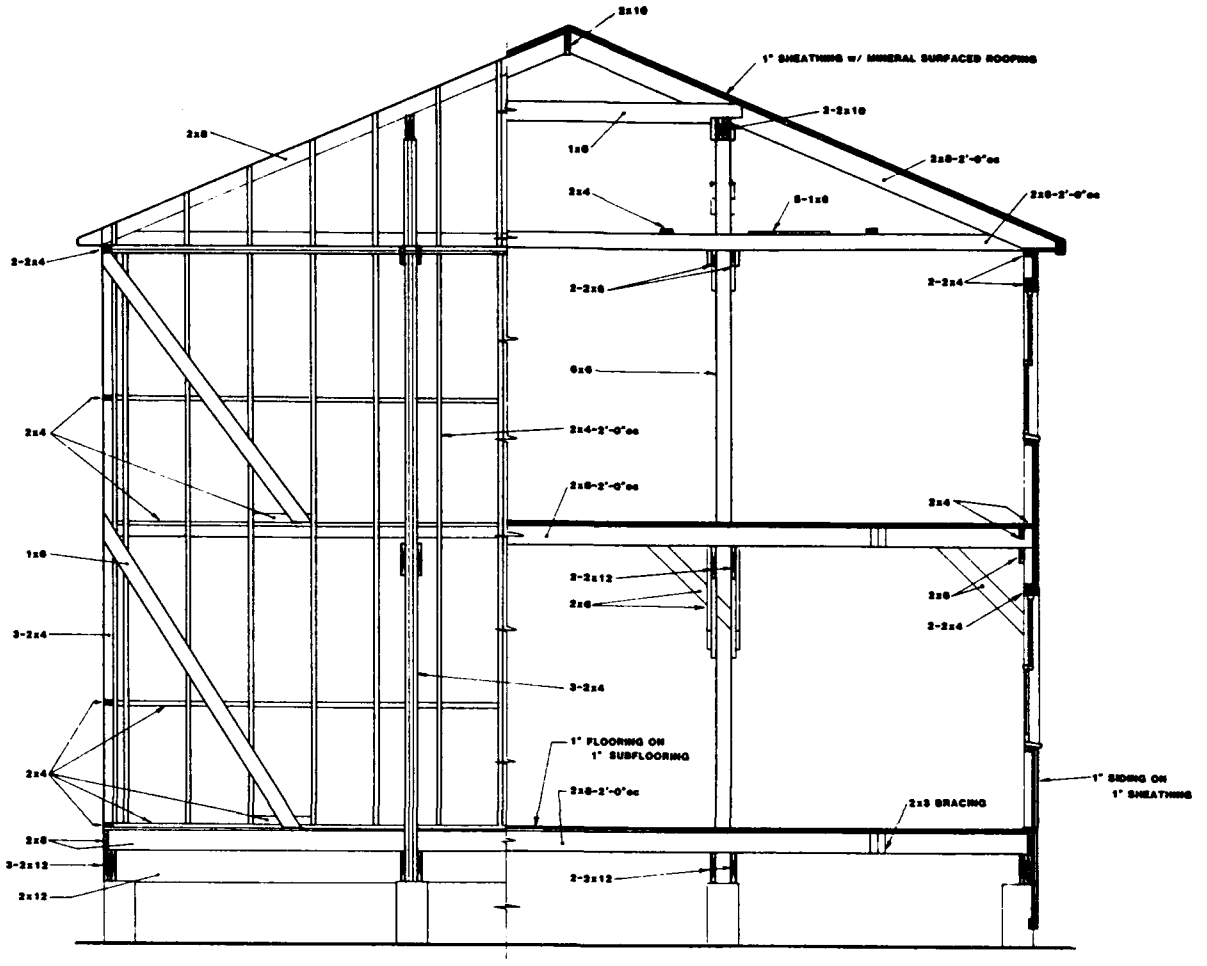
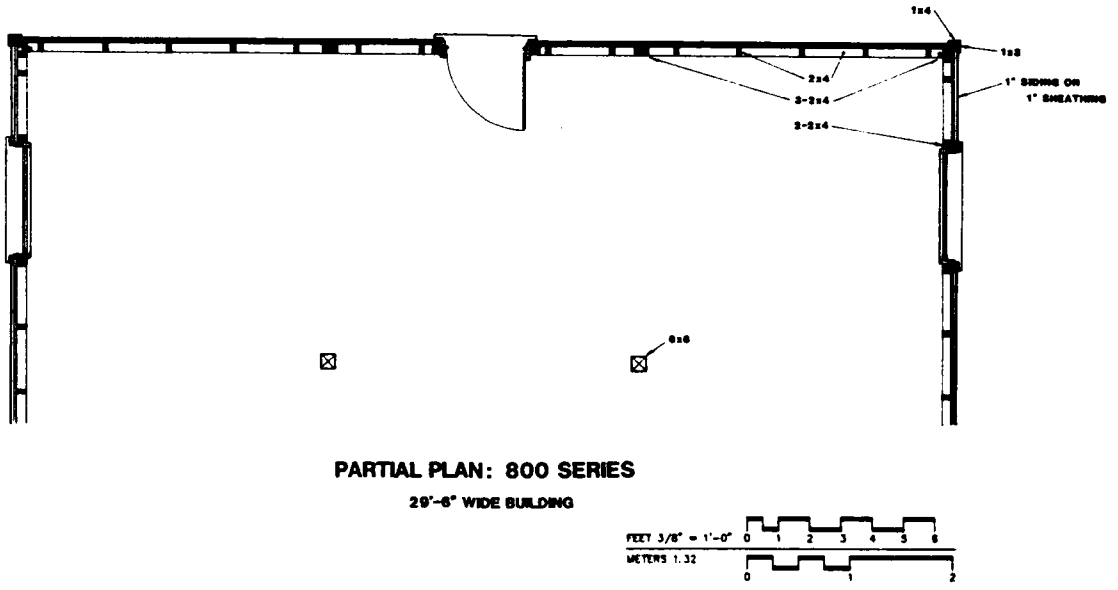


Figure 3.14. Detail of Series 700 Skirt-Roof (Aquamedia), 1940.



PARTIAL SECTION & END WALL FRAMING: 800 SERIES

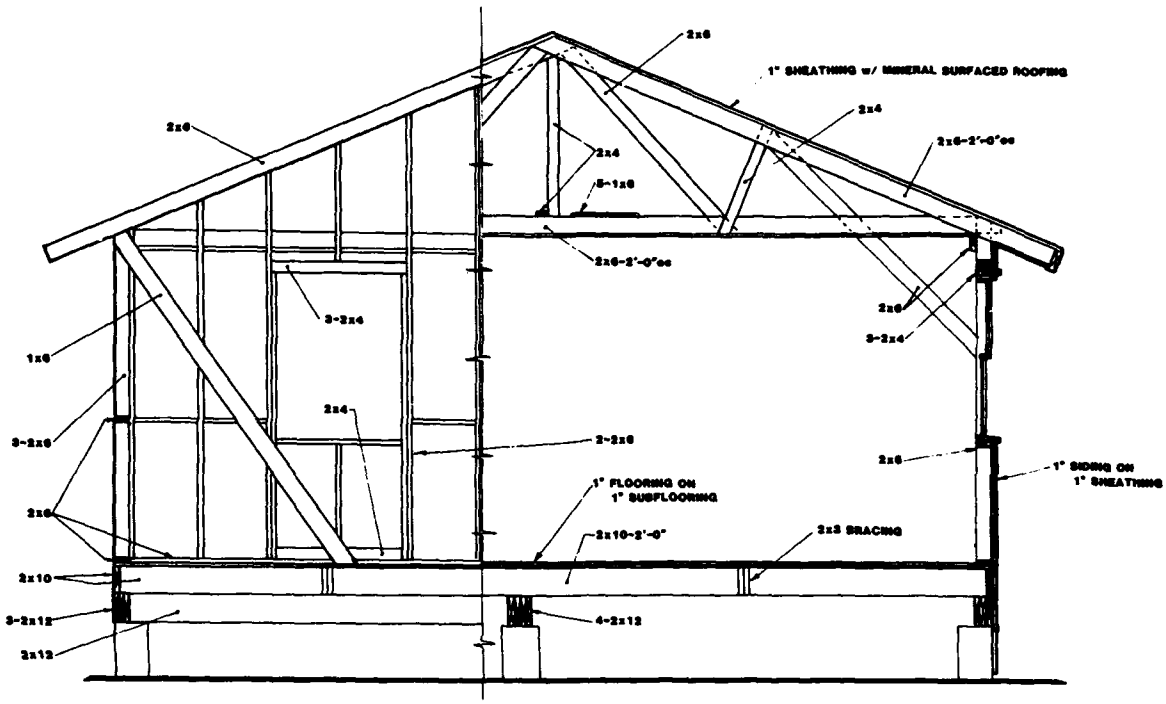
29'-6" WIDE BUILDING



PARTIAL PLAN: 800 SERIES

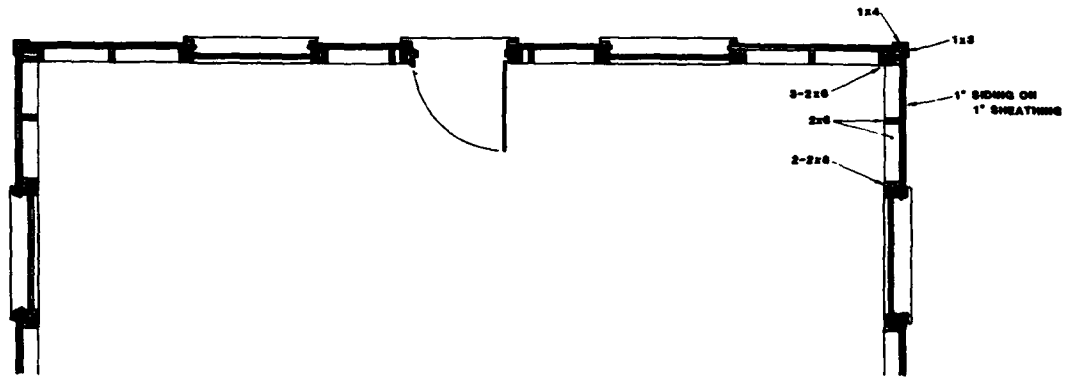
29'-6" WIDE BUILDING

Figure 3.15. Series 800 Mobilization Building: Two-Story Barracks, 1941-1944.



PARTIAL SECTION & END WALL FRAMING: 800 SERIES

25'-0" WIDE BUILDING



PARTIAL PLAN: 800 SERIES

25'-0" WIDE BUILDING

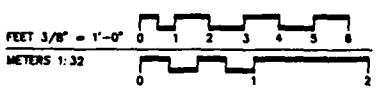


Figure 3.16. Series 800 One-Story Combination Company HQ, Supply, and Day Room, 1941-1944.

specified for the 36 ft Series 600 spans of World War I. The upper chord or rafter was tied to the bottom chord or ceiling joist by struts and knee braces. The knee braces, which attached to the wall studs, provided transverse bracing for the open diaphragm left by the clear span. The advantage, of course, was that no intermediate supports were needed. Less lumber went into framing a truss than a load-bearing partition wall.[3.20]

Among the more imposing of the Series 800 structures were the field houses. Until the development of the Type FH-A Field House in late 1941 (replaced by the FH-1 in 1942), large assemblies for sports activities took place in modified theater buildings designated as sports arenas (Figure 3.17). Organized team sports were considered important to the recreational needs of soldiers, and the new structures provided clear spans and overhead clearances for indoor volleyball and basketball. Steel segmental arches set 20 ft apart and anchored at each end to a concrete deadman offered a span between stabilizing columns of 104 ft. From finish floor to the bottom flange of the arch at center span was approximately 32.5 ft. The arches were the only steel members; the columns, beams, and purlins were timber. The columns were composed of four 2 x 12s. The end walls were framed in 2 x 12s spaced 2 ft on center; side walls were 2 x 4s spaced 16 in. on center. On either side of the playing courts were rows of offices and lockers. Above these a clear story of fixed sash windows lighted the interior space. Built-up roofing covered timber decking supported by 2 x 10 purlins that spanned between the arches. Because field houses were considered division-echelon buildings, no more than one such structure per division was constructed.

Chapels were also special structures. Although intended for use by all congregations, with rabbis serving among the chaplains, the chapels in outward appearance were Christian landmarks, and easily recognized as such. Their form was based on the New England Protestant meetinghouse, but a lightning rod, rather than a cross, was affixed to the finial above the roof of the steeple. Instead of being painted white, as were the Colonial Revival style prototypes, chapels were painted the ubiquitous ivory and appeared in both the Series 700 and 800 chapels (ChAP A-M and Ch-1). There were also T.O. chapels for construction overseas. Approximately 37 x 83 ft in plan, these one-and-a-half-story buildings were divided into seven bays: the first bay was occupied by the entry and overhead choir loft, the end bay contained the altar, and the central bays (nave) were open to the roof to expose the chapel's most attractive feature—a braced hammer beam truss. The truss' lower chord ran parallel to the incline of the roof, which exceeded in steepness the typical 5/12 pitch. A window in the choir loft on the chapel front, and windows along the aisles, provided natural light. No stained glass was used. Ventilators on front and back of the tower that projected above the roof provided a draft through the sanctuary from above the choir loft. A double-leaf, five-panel door with overhead transom, framed by a pavilion front and approached by wooden steps, provided a very traditional entry motif. Chapels were regimental-echelon buildings.

Emphasized by press releases during 1940 and 1941 were the methods employed by construction crews in erecting buildings. Deadlines required accelerated schedules for site preparation, materials layout, and assembly. Crews of masons, carpenters, plumbers, and electricians went from building to building performing specialized functions. Among carpenters, different crews performed framing, roofing, and finishing work (millwork, setting doors and windows, etc.). Such an assembly-line approach would be used by developers in postwar housing developments, where entire tracts would be laid out, constructed, and marketed by a single enterprise. Marshaling yards were established at new camp sites, with lumber and other materials arriving by rail. Once building foundation piers and slabs were poured, the requisite amount of lumber was driven by truck to each building site. The larger framing members had already been cut to length at the marshaling yard by table saws. Hand-held power saws were operated by gasoline-powered electric generators to trim the lumber on site. As specified, all four sides of the lumber was surfaced at the mill before shipping. No. 2 yellow pine was used for framing, sheathing, and cladding. Finish floors were straight-grain fir. After the first floor was framed and its subfloor laid, the

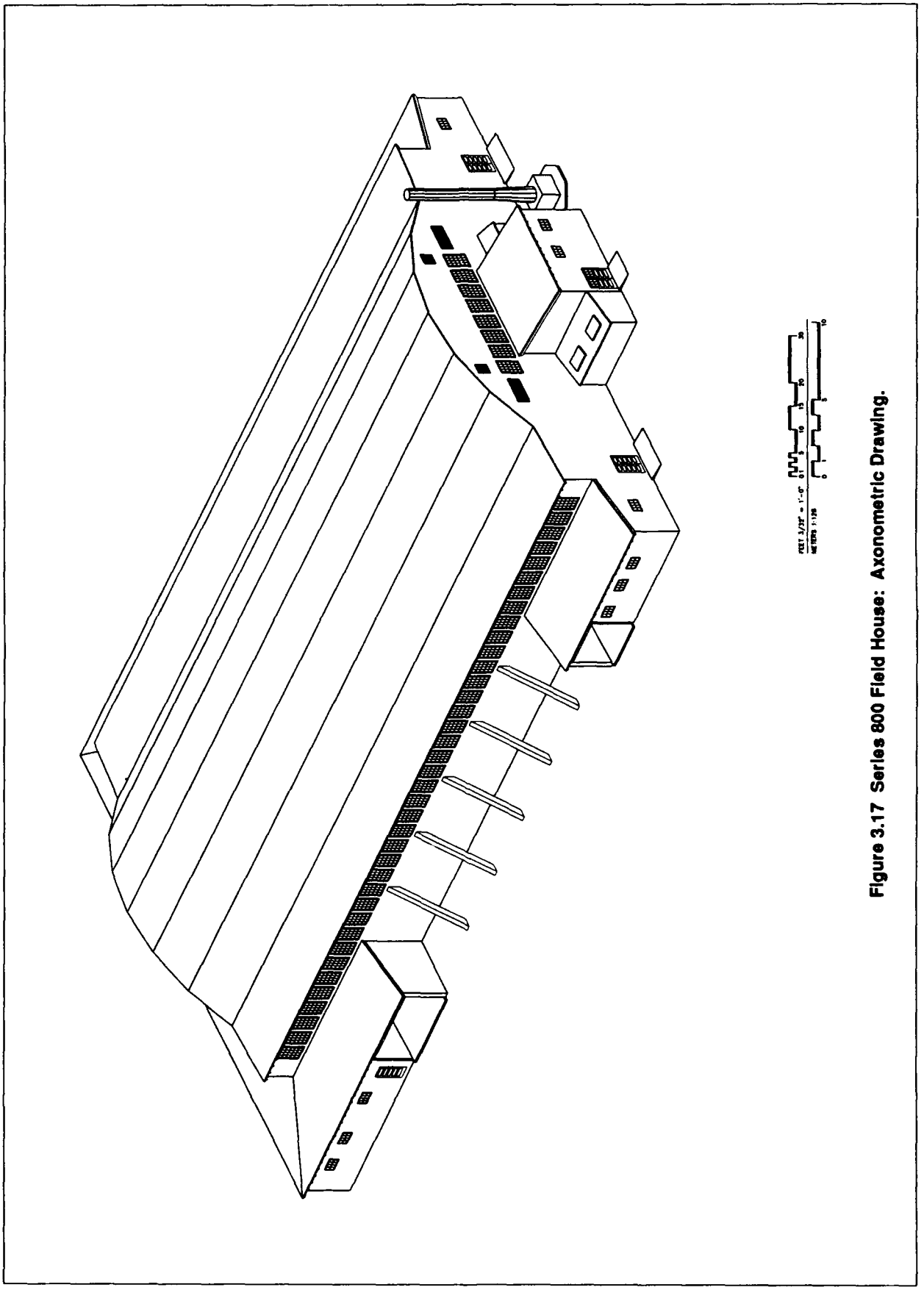


Figure 3.17 Series 800 Field House: Axonometric Drawing.

remaining materials would be stacked on the floor or sorted into spaces between the foundation piers, to avoid obstructing work on adjacent structures. First-story walls were then framed, clad, and raised into position from the inside. Next, the second floor was framed and decked to serve as a stage for the second-story walls, which were then framed, clad, and assembled with skirt-roof while on the horizontal before being lifted into place. The brackets for the skirt-roof rotated down into place beneath the first-story wall plate for attachment. Falsework or scaffolding was thereby unnecessary as construction proceeded. However, the roofing gang would need ladders (for decking and felting), as would the trim-out crew (for setting the window trim on the building's exterior). Roof slopes inclined only 5 in. over a run of 12 in., enabling roofers to work without risk of sliding off. At Fort Ord, contracts with the Ford J. Twaits and Morrison-Knudsen companies specified 1,200 buildings constructed at the rate of one building per hour. Using the techniques described above, the contractors cut the time on the first 820 units to 'a building every 54 minutes.' This rate far exceeded records set for the erection of World War I barracks, which required 3 hours to construct at Camp Pike, Arkansas. However, at Camp Pike, wooden foundations were also set. The greatest difference between the building campaigns for each world war was in the numbers of workers involved on the site. At Camp Pike during World War I, 200 were required.[3.21]

Comparing Camp Edwards, Massachusetts, Fort Ord, California, Fort Dix, New Jersey, Fort Leonard Wood, Missouri, and Indiantown Gap, Pennsylvania, similar construction techniques among installations sped up the jobs. These techniques included the breakdown of labor into specialized units, the staging of materials, and rapid assembly methods. At Camp Edwards, for example, construction began in September 1940 and was completed in March 1941, providing facilities for 30,000 soldiers. Although construction costs would first be estimated to total about $8 million, the actual cost rose to $28.5 million. To erect 1,400 buildings, some 33 million board-feet of lumber was purchased before construction, and to that amount, an additional 30 million had to be acquired. In addition, 5 million sq ft of fiber board, 85,000 rolls of roofing and sheathing paper, 26,000 kegs of nails, and 64,000 cu yd of concrete were consumed. Foundations were dug by power-post augers mounted on trucks. Because the post holes were round, cylindrical section footings and piers were substituted for square ones; 8 in. stovepipe was used for forms. Concrete was mixed *en route*. From the Boston and Providence region, 20,000 men were assembled, about half of whom were carpenters. These were divided into crews averaging 15 men each. All work was supervised by the constructing quartermasters (Maj. H. Algeo, Capt K. M. Pattee, and Capt. F. E. Robbins). The general contractor (Walsh Construction Co.) provided field superintendents and foremen, and the consulting engineer (Frank Gunby) from Charles T. Main, Inc., of Boston, was the former chief of the Engineering Department of the Cantonment Division during World War I. According to D. G. Aronberg, who managed construction for Walsh:

> Time was the essence of this contract. Ours was one of the largest camp contracts let on a cost-plus-fixed-fee basis—and one of the first. When the Army terminated the contract on March 8, 1941, all of the buildings were 100 percent complete and accepted.[3.22]

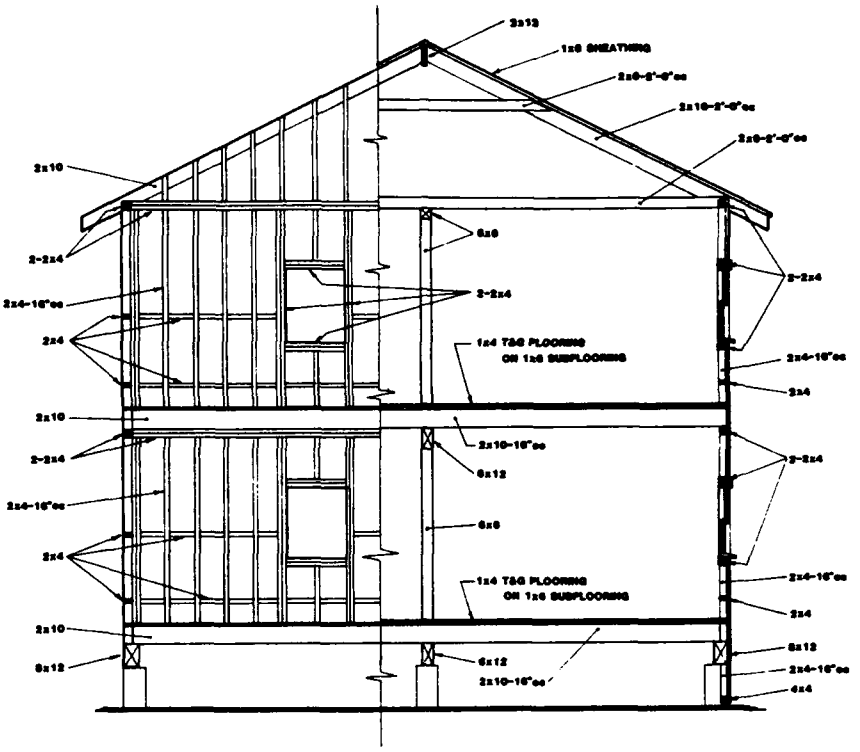
World War II Mobilization Buildings: Navy and Marines

Just as the Army's World War I mobilization construction had set a precedent for its World War II temporary buildings, the Navy also employed variations of its earlier buildings in the World War II mobilization effort. The Bureau of Yards and Docks had adopted a B-1 type barracks towards the end of the earlier war. The B-1 was a frame building with an H-shape

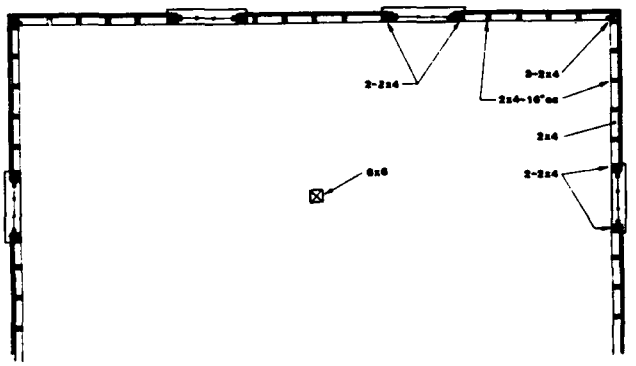
plan—two legs connected at the center by a service element. The B-1 was introduced first at Camp Lawrence, the last and best designed of the temporary camps at the Great Lakes Naval Station in 1918. This building was a two-story structure with dormitory space for a company of 300 men. The connecting leg contained the latrine and laundry, located inside the building. The B-1 was reintroduced in 1940 and employed until 1942 (Figure 3.18). In construction it was much like its Army counterpart, with stud walls of 2 x 4s, sheathed with diagonal boarding and clad in shiplap siding or cement-asbestos shingles. There were structural differences between the Navy and Army versions, however. Each outer leg measured 28 x 100 ft and the connecting leg measured 28 x 112 ft (Figure 3.19). Foundations were continuous along the peripheral walls. The outer legs of the plan had center rows of piers spaced 10 ft apart, while the connecting wing had two intermediate rows of piers to carry the additional weight of the shower, latrine, and laundry floors. Foundation walls and piers were concrete, extending 3 ft above and 3 ft below grade in the northern construction zone. Atop the foundations were laid 4 x 6 sills. Center beams, or "sleepers," spanned from pier to pier, and were made of 6 x 12s. These in turn carried the floor joists, 2 x 10s spaced 16 in. on center. The dormitory floors consisted of a subfloor of 1 x 6s and finish floor of 1 x 4 tongue-and-groove stock with vapor barrier between plies. The ground floor of the connecting service wing received a 4 in. slab of concrete above the subfloor. Each floor of the two dormitory wings contained a squad bay sleeping 75 men in hammocks. A center row of 6 x 6 in. columns with knee braces separates the space into 14 ft cross-sectional bays, and the sailors' hammocks were hung from cross-trees that stretched between the columns and outside walls. A 4 x 4 in. shoring scabbed to the outer wall helped support the cross-trees. Floor-to-ceiling heights of 9 ft, 2 in. took into account double-tiered sleeping arrangements. Each 10 x 14 ft structural bay was lit by a double-hung window similar to those used by the Army. Rafters were 2 x 10s spaced at 2 ft on center, decked with 1 x 6 tongue-and-groove boarding with asphalt roofing paper.[3.23]

Material shortages that had already become apparent by 1942 dictated revisions in building design. Albert Kahn, who had been a consultant to the military services since World War I, produced many of the designs for Naval installations—especially those for air hangars—and the Bureau of Yards and Docks honored him with a special commendation "for outstanding services rendered in designing buildings and facilities." In all, Albert Kahn, Associated Architects and Engineers, Inc., produced some 1,650 drawings, complete with specifications, for Naval installations prior to April 1943.[3.24]

However, it was another architectural firm that successfully took on the challenge of designing a new barracks that would be more efficient in its use of structural timber. Eggers and Higgins of New York produced a modern style barracks with a flat-roof profile, banded windows, and new substitute materials used for siding and interior finishes. Created in 1942, the new barracks design—called the B-2—was introduced in the construction of the Bainbridge, Sampson, and Farragut training stations of 1943 (Figure 3.20). Eventually, the new design was employed in other Naval facilities before the war's end. In contrast to the old "H" style, the new barracks adopted a rectangular plan with dimensions of 42 x 150 ft, and capable of quartering 250 sailors (232 seamen and 18 petty officers). The structures were two stories with dormitory bays above and below. The ground floor also contained at one end a single entry and stairwell, showers, laundry, latrine, boiler room, and chief petty officer quarters. Either concrete piers or continuous concrete or brick foundation walls supported the framing. When piers were used, they sat on 2.5 ft square footings of 18 in. thickness, placed 3 ft below grade. The 5 ft piers were placed in four rows 15 ft apart across the length of the building. In cross-section, there were three bays of 14.5 ft on the sides and 13 ft in the center, defined by the foundation. The sills that spanned the piers along the axis of the building were composite timber 4 x 16s on the exterior, and 8 x 16s on the interior. Columns—4 x 10 in. on the exterior walls and 8 x 10 in. for the freestanding two interior rows—were located above each pier. The columns, in turn, carried lateral beams to support the second floor of the same dimension as the sills. The outer beams at the walls were bolted through



PARTIAL SECTION AND END WALL ELEVATION: B-1 H-TYPE NAVY BARRACKS



PARTIAL PLAN: B-1 H-TYPE NAVY BARRACKS

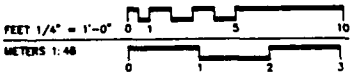


Figure 3.18. B-1 H-Type Navy Barracks, 1939-1941: Section Drawings.

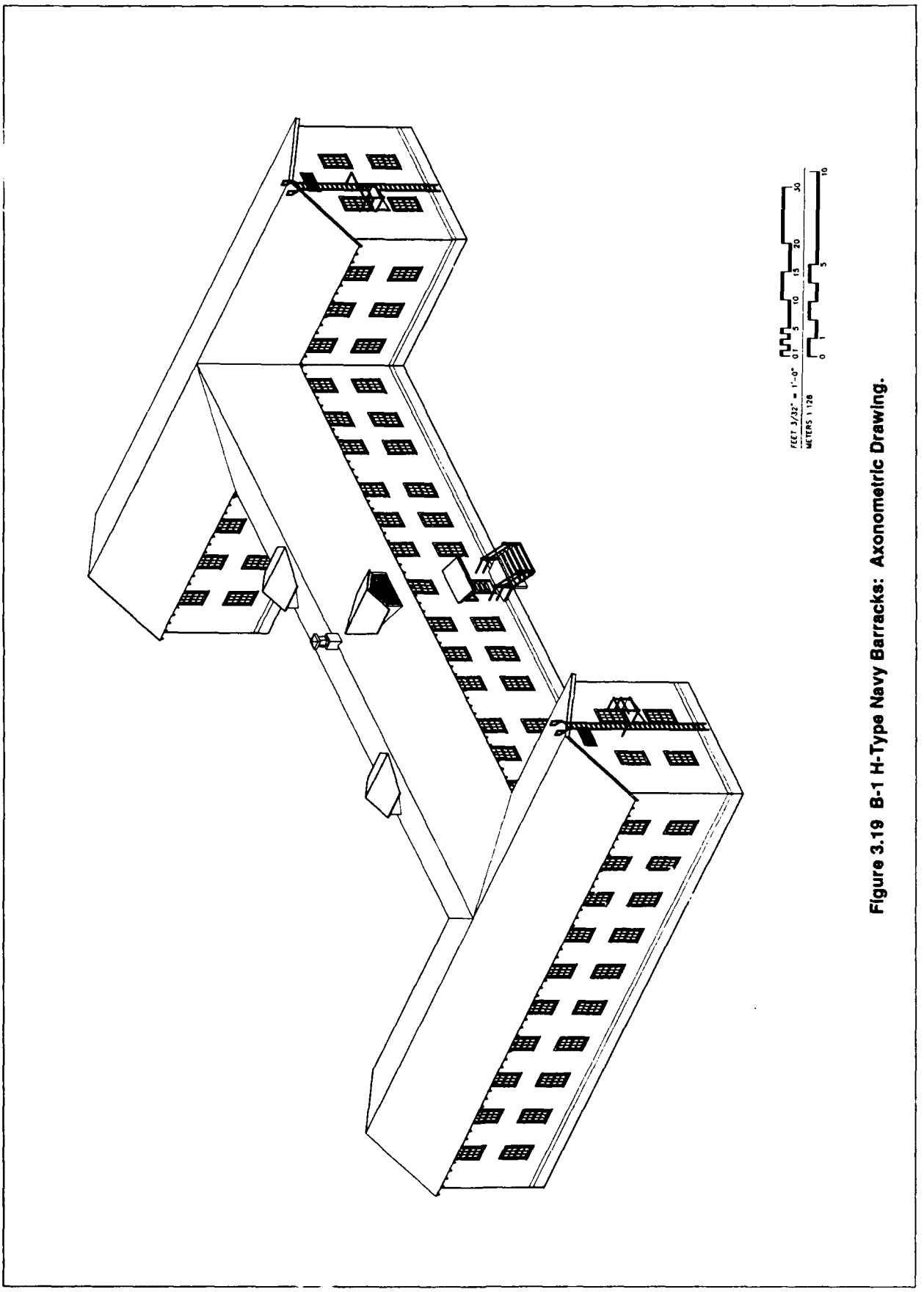
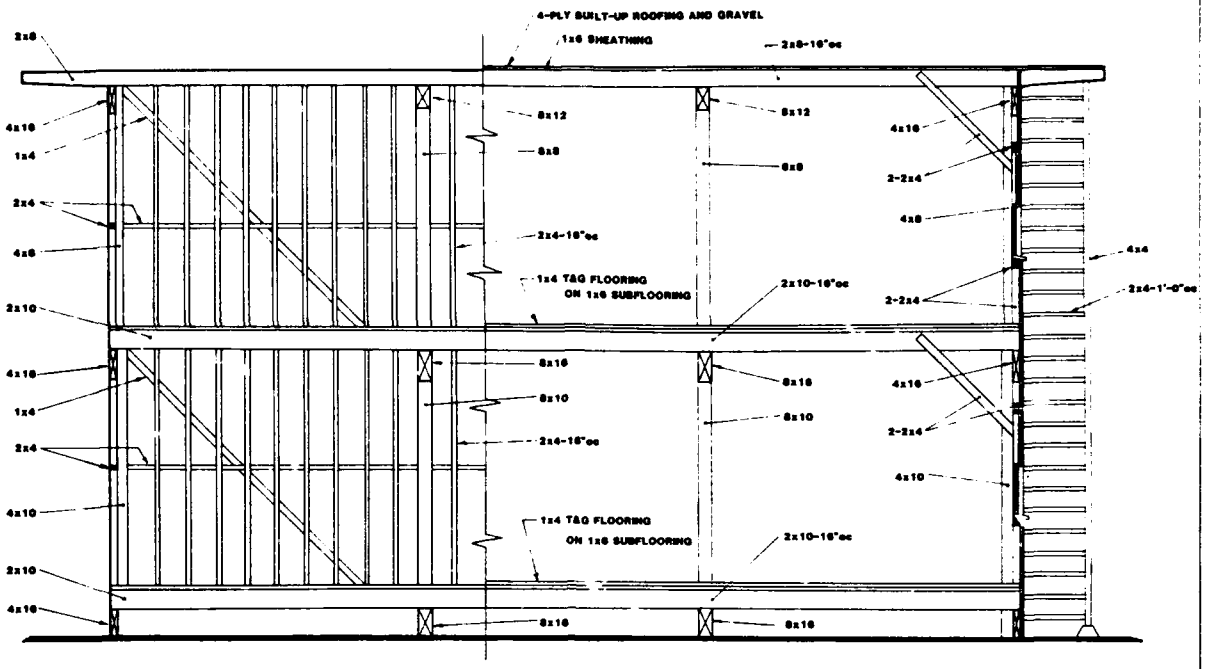
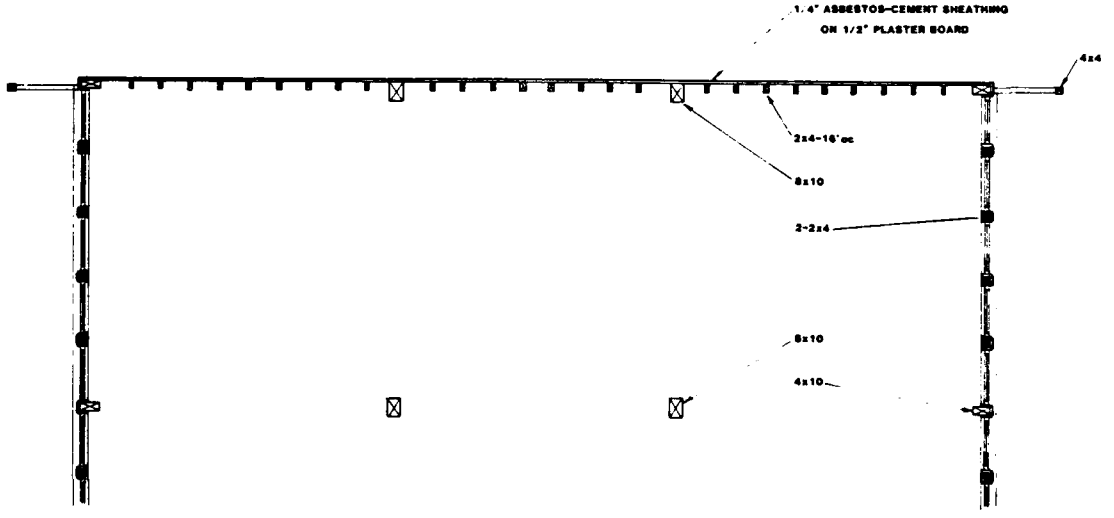


Figure 3.19 B-1 H-Type Navy Barracks: Axonometric Drawing.



PARTIAL SECTION AND END WALL ELEVATION: B-2 NAVY BARRACKS



PARTIAL PLAN: B-2 NAVY BARRACKS

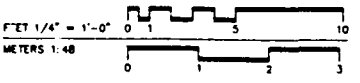


Figure 3.20. B-2 Navy Barracks, 1942-1943: Section Drawings.

the columns and formed a header for the window walls below. Floor joists at both levels were 2 x 10s placed 16 in. on center. Above the floor joists was a plywood subfloor covered by half-inch rock wool mat insulation, and topped with a hardwood finish floor. A flat roof supported by 2 x 8 rafters spaced 16 in. on center received the weight of treated 1 x 6 decking and a four-ply built-up felt covering with gravel finish.[3.25]

Exterior walls substituted gypsum board and asbestos-cement for wood. Plywood, which easily delaminated because of inferior glues, would nevertheless prove to be an alternative to 1 x 8 in. boarding. But, because wood was in high demand, plywood cost about $0.10 per square foot in 1943, compared to only $0.05 or $0.06 for asbestos-cement. Hence, the Navy ordered 6.5 million sq ft of asbestos-cement. Scabbed onto the exterior columns were 2 x 4s on either side to provide framing for the window units and cripples for the lower wall spandrels. To these, half-inch gypsum board was nailed on the outside as sheathing. It was then covered with felt paper and clad with 4 x 8 ft sheets of quarter-inch light gray asbestos cement. Interior wall and ceiling surfaces, where finished, employed other substitute materials such as Masonite, a hardboard produced by the Celotex Corp. of Chicago. Ribbon windows divided the spandrels into horizontal strips that extended from one end of the building to the other. The windows were wood double-hung, but unlike the Federal-style pattern of earlier barracks windows, these had one single pane above and below, instead of the traditional six over six. The flat roofline, smooth wall finish, and *fenetre-de-longueur* placed the barracks within the character of the International style, at least when seen from a distance. And like much of the experimental European housing of the 1920s, the new barracks materials did not hold up well. The roofs leaked, the windows rattled, the gypsum board warped, and siding was easily checked or broken. The new buildings were intended to be temporary and many of them were razed rather than repaired. At Farragut, however, because of its proximity to nearby lumber mills and its rustic setting, wood siding was used in place of the asbestos-cement (Figure 3.21). After the war, contractors would learn to use the gypsum board or sheetrock for interior walls and ceilings, the hardboard for exterior siding, and the rock wool insulation in the wall cavities.[3.26]

Perhaps the most important contribution to building design by the Navy during the war years was in the use of laminated trusses for drill halls. Also introduced in 1943, these large clear-span drill halls were designed by the New York architecture firm of Shreve, Lamb, and Harmon, the same firm that designed the Empire State Building. Again, because of material shortages, the use of steel in construction was limited by the War Production Board. Long-span wood trusses of the Pratt and Vierendeel type, with deep webbing between upper and lower chords, had been used by both the Army and Navy since World War I in theaters, hangars, drill halls, and other buildings requiring long spans. But the arch in comparison to deep trusses required less timber. Moreover, as seen in the Army field houses that used steel segmental arches, they offered greater floor-to-ceiling heights and more usable interior space. The drawback to using wood in an arch, however, was the problem of scarfing (splicing) together the laminations of dimensioned lumber. Nailing or bolting was impractical when many laminations were required. Compounding the problem was a shortage of high-grade structural timber. Much of what was delivered to construction sites was green—and poor quality at that. The design called for a 120 ft wood laminated arch, each arch spaced 16 ft apart for the length of the drill hall, or 625 ft total (Figures 3.22 and 3.23). Original specifications stipulated the use of 1 x 8s glued together and offset by scarf joints, to provide a cross-section 7.5 in. wide and 30 in. deep, made up of 37 laminations. Natural resin casein glues bonded the 1 x 8s, which were held in place under pressure and then heat-dried. The first applications erected at Sampson Naval Training Station were factory produced and shipped in two halves for final assembly. At other locations, the arches were sometimes fabricated on site within a sheltered space. Jack frames were used to shape the arches while laid out on the ground, and occasionally 2 x 8s were substituted for the lamination timbers. Green lumber with a moisture content above 15 percent and poor quality glue produced distortions and delamination in many of the field constructed trusses. Nevertheless, they were remarkable structures.[3.27]

Figure 3.21. Barracks at Farragut Naval Training Station, 1943. (Source: Moreel 1943.)

Figure 3.22. Laminated Arch Naval Drill Hall by Shreve, Lamb, and Harmon, 1943. (Source: Great Lakes Public Works Department.)

Figure 3.23. Interior, Laminated Arch Naval Drill Hall. (Source: USACERL archives.)

The arches, which acted in compression, carried the loads directly to the foundation. The end timbers were anchored to a concrete deadman that measured 3 ft, 3 in. by 6 ft, 6 in., with the long dimension on axis with the arch. Foundations were joined together under the floor of the hall by five three-quarter-inch reinforcing rods encased in concrete. The arches were stiffened laterally by four straight timber trusses set between each arch. The arches then carried 2 x 10 purlins spaced 16 in. on center, which received 1 x 6 sheathing boards and an outer covering of asbestos-cement panels. The floors were hardwood installed on a 6 in. concrete slab. At one end of the floor was a training pool, the sides of which were flush with the floor. From a center height of 39 ft above the floor, the curvature of the roof stopped about 12 ft above grade. Straight walls of 2 x 6 stud construction between the exposed ends of the arches continued perpendicularly to the foundation. Within the end bays of the drill hall were located lockers, showers, latrines, and offices. Composite windows made up of six-over-six and twelve-over-six lite configurations provided natural lighting in the end bays and every other 16 ft bay along the sides. Gangs of windows were separated by mullions, and a row of 24 in. steel sash pivoting windows formed a monitor at the top of the building for additional light and ventilation. A number of these remarkable drill halls still survive at Great Lakes and other locations, although they have been extensively altered.[3.28]

The Quonset Huts used extensively by the Navy and Marines may be considered a miniature version of the Navy drill hall. As noted earlier, the Quonset was patterned on the Nissens of World War I, and later named for their place of manufacture—the Davisville Construction Battalion Center at Quonset Point Naval Air Station, North Kingston, Rhode Island. The Bureau of Yards and Docks contracted with George A. Fuller and Co. to design a prefabricated portable building for use at advance bases. Within a month after receiving a directive from Adm. Moreell in March 1941, Fuller's architects produced designs for Quonsets of two sizes: one 20 ft span (Figure 3.24) and one 40 ft span. Under the Lend-Lease Act of 1941, land was made available to contractors for the production of war materiel. In 1942, space was provided at Quonset Point for production operations. The Anderson Sheet Metal Company of Providence developed a process for forming the curved corrugated sheet metal panels, and became a leading supplier of components. Stran Steel, a division of Great Lakes Steel Corp., Detroit, also manufactured Quonsets based on the Fuller's specifications (Figure 3.25), as did other manufacturers. The Davisville facility, alone, fabricated some 32,253 Quonsets, most of which were shipped overseas.[3.29]

The smaller of the two units was 20 x 48 ft, and could be erected by an eight-man crew of Seabees in 1 day. Its components weighed about 6 tons. When assembled, the unit could be bodily lifted and repositioned by a detail of men. Precut sheets of corrugated galvanized iron were attached to segmental arched steel ribs spaced 4 ft apart and stiffened by metal purlins and wooden headers. The only nonmetal components were the wooden headers, sills, and sash of the hinged windows that extended the length of the hut, the framing of the bulkheads (ends of the huts), and the floor decking (which comprised 4 x 8 ft sheets of plywood). Each smaller hut could accommodate one squad, whereas the "jumbos" (40 ft huts) could accommodate two squads and a latrine. Once the materials were assembled on site, the construction sequence began with the foundation. Five I-section sills were spaced 5 ft apart and extended the length of the structure from front to rear. Joists, also of I-section and spanning between the sills, were bolted to the top flange of the sills and set 2 ft apart from front to rear. Channels were set along the two long sides of the floor. These were bolted to the tops of the joists parallel with the outer sills. Each channel formed a floor plate with its C-section facing upwards to receive the ends of the arched ribs of the superstructure. The ribs came in two sections that connected at the top of the structure by bolts and splice plates. Three purlins centered at the top of the ribs and bolted to purlin spacers extended from front to rear. The wooden headers and sills spanned between the ribs along the lower wall, and with them in place the structure was framed. Thirty sheets of plywood butted side to side, five across, and nailed through the top flange of the joists provided the floor decking. Corrugated galvanized-iron sheeting covered the outer surface, while hardboard (Masonite)

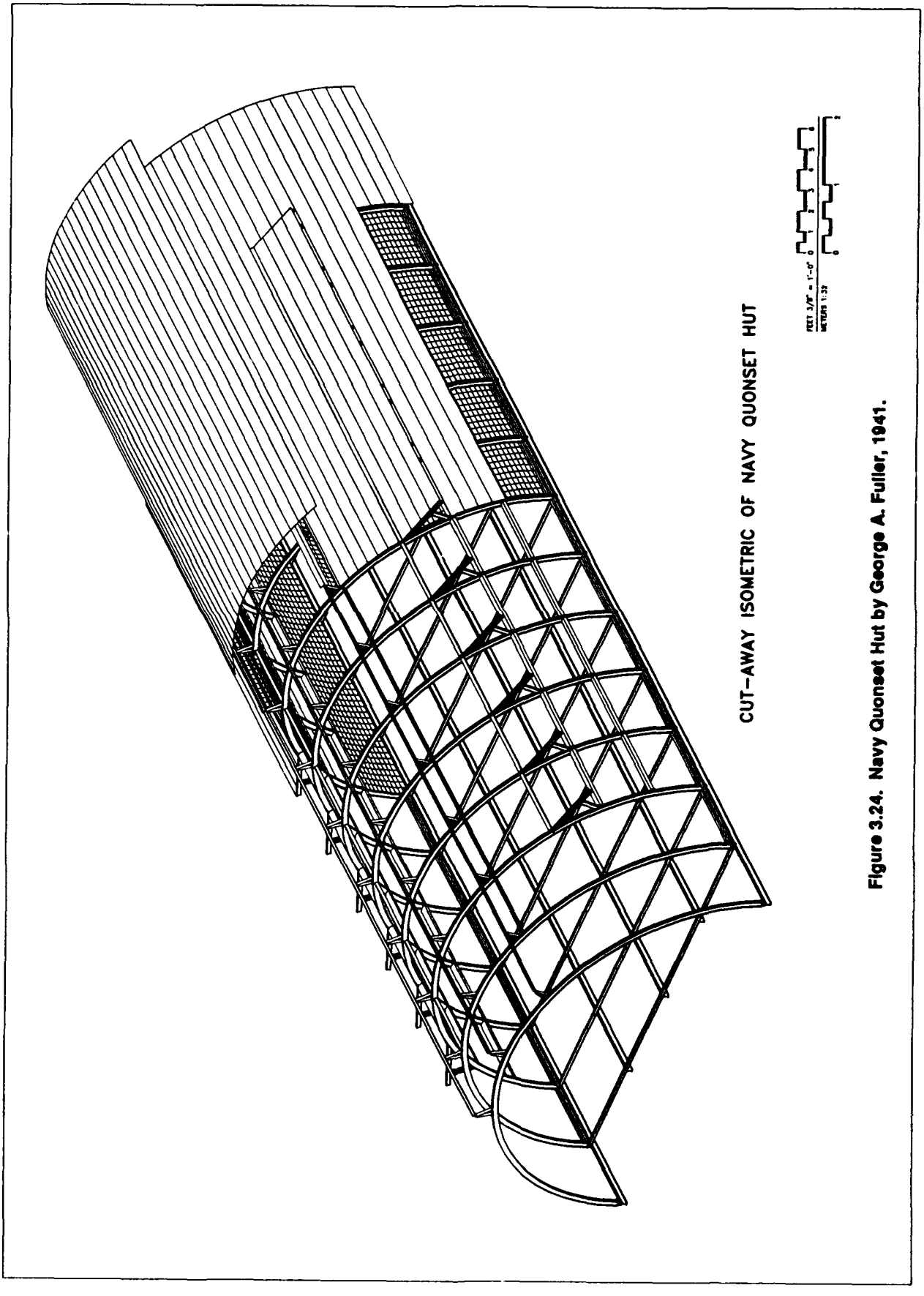


Figure 3.24. Navy Quonset Hut by George A. Fuller, 1941.

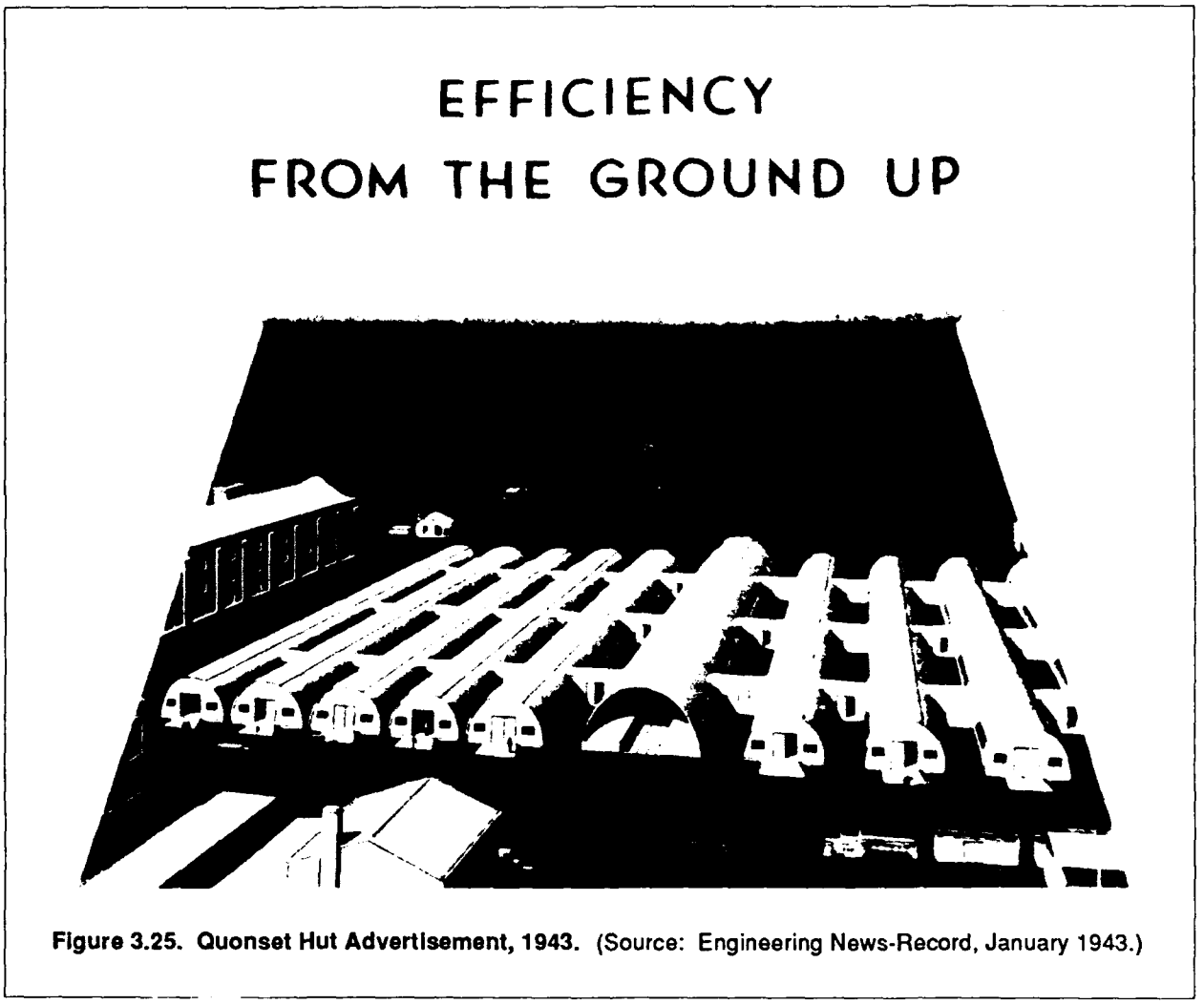


Figure 3.25. Quonset Hut Advertisement, 1943. (Source: Engineering News-Record, January 1943.)

formed the inside surface. Because of the rapid expansion of Navy and Marine training stations after 1942, Quonset Huts were used in place of tents for emergency construction. But because of their durability and adaptability, they continued to be used in place of frame-constructed barracks and other temporary buildings, and are still in use today.[3.30]

4 Cantonments and Training Stations

A cantonment is a temporary garrison. Cantonments during World War II were designated as camps and forts. Their primary purpose was to provide training facilities for land, air, and naval operations, although some received special designation as munitions and testing sites. Later in the war, some cantonments were expanded to accommodate prisoners of war (POWs), and thus served as compounds or internment camps. By definition, a fort is a defendable site. However, strictly speaking, forts have not been constructed within the continental United States since the late 1860s (although appropriations for coastal defenses continued through World War II).

The cantonments of World War II were not defensive bastions, and their fortifications rarely amounted to more than a chain-link fence. Post gates merely provided checkpoints to monitor arrivals and departures. Security against armed attack was not a consideration in the layout of cantonments. Isolation and patrolled surveillance were the only protections against the threat of espionage and theft. The rows of barracks and the open space of the parade field, together with the command post at the termination of the main drive, are the principal architectural and landscape features. The expanse and repetition of these features and the institutional character of the cantonments leave no doubt about their purpose. Matters of terrain, drainage, fields of fire for artillery and rifle ranges, and access to existing roads and highways governed the plans of these installations.

The following sections present historical background on U.S. military cantonments and describe a variety of representative cantonments from all services and regions of the nation.

Early Camps

A precedent for the layout of World War II cantonments can be found in those built for World War I. Even earlier, there were camps established for temporary uses. The western frontier posts of the latter 19th century might be considered a precedent. Because of the westward extension of the "moving frontier" during the second half of the 19th century, and the continual relocation of various Indian tribes and nations, these outposts were temporary in nature. This is reflected in their construction. And despite Hollywood depictions of Indian attacks against Fort Defiance (Arizona) and Fort Laramie (Wyoming), those cantonments were seldom attacked. Skirmishes took place outside of camp. Indeed, there was little need for fortification. Hence, there was no need to arrange the barracks to form a palisade and enclose a parade, which had characterized the plans of most military posts built before 1870. Surgeon C.H. Alden, who was posted to Fort D.A. Russell (Wyoming), established in 1867, found to his surprise that "barracks do not directly face the parade, but are arranged *en echelon*, by which means light and air have free access to all sides of the buildings..." (Figure 4.1)[4.1]

By the Spanish-American War in 1898, military and naval cantonments had begun to adjust to the expansion of war materiel. Depots for the marshaling of troop supplies and field equipment were necessary to prepare for foreign campaigns of indefinite length in support of U.S. expansionism. Bases of operation became specialized, and cantonments were required to accommodate specialized operations such as training and war games. Regular Army enlistees, for example, would receive training before assignment to a regiment or unit, and bases were needed to handle the unprecedented numbers of volunteers during periods of heightened nationalism, such as after the sinking of the Battleship Maine. No longer would troops train with their units in the field, which had been the tradition. The numbers, alone, required new types of facilities. In the period between the Civil War and the Spanish-American War, and despite the expansion of the settled frontier to the West Coast, the number of Americans in uniform averaged as few as 25,000 during the 1880s and 1890s. Only

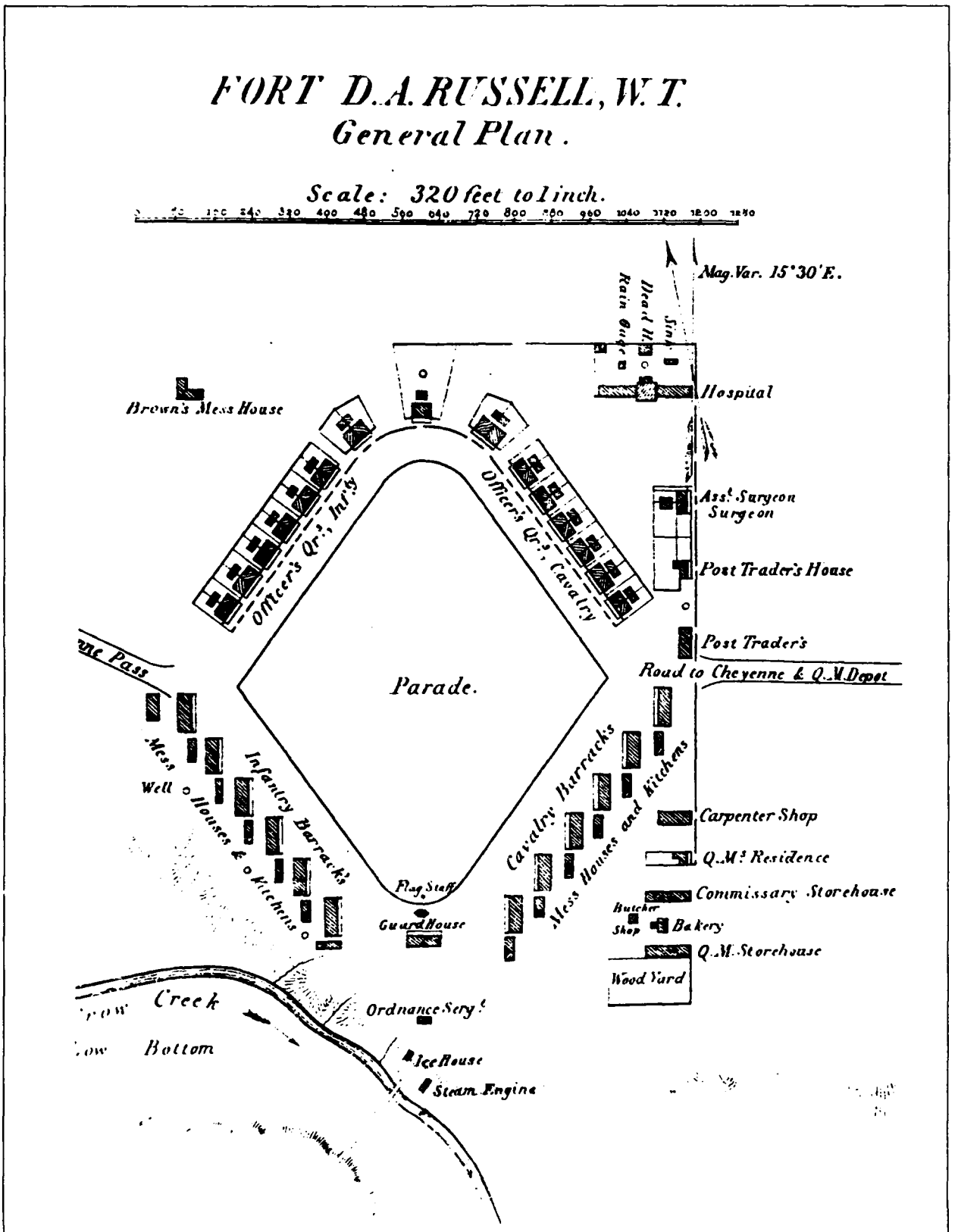


Figure 4.1. Plan of Fort D.A. Russell, Wyoming Territory, 1867.
(Source: Billings 1870.)

the Navy increased in size following its modernization after 1883. The Newport (Rhode Island) Training Station at Coaster's Harbor, commissioned in 1881, was the first installation of its type, departing from the tradition of training recruits aboard training ships. At the Charleston Naval Station, discussed earlier, a cantonment for a regiment of 1,000 sailors was laid out in a rectangular clearing of 40 barracks, divided into four rows of five barracks each, with one long continuous latrine building separating the rows in the middle. A similar layout was provided at Hampton Roads (Norfolk), Virginia, but the Navy abandoned this arrangement before the end of World War I. Only a handful of Army forts obtained a troop strength or garrison greater than several hundred—the size of a cavalry battalion. By contrast, cantonments during times of national emergency would need to accommodate between 25,000 and 35,000 regulars and National Guardsmen, as the Selective Service Acts of 1917 and 1940 drove enlistments to record numbers. The layout and organization of such large-scale installations required considerable planning.[4.2]

Temporary facilities were also needed to accommodate state militias during annual training exercises. Colonial and state militias had provided the backbone of the armies raised during the American Revolution and Civil War. These militias, formed into regiments and divisions, were seen as a mechanism to ensure against future insurrections in the aftermath of the general demobilization of 1865. They could also be called upon by governors to protect state property, quell riots, and settle industrial disputes. They provided an organizational structure within each state that could be placed under federal control during times of national emergency. After 1879, most state militias received designation as National Guard units and became America's reserve behind Army regulars. Camps—at least one per state—were needed for assembling National Guard units and conducting maneuvers.[4.3]

The problem with National Guard camps, such as Camps Blanding (Florida), Huachuca (Arizona), San Luis Obispo (California), and Hulen (Texas), to name a few of the early ones, was their size and relative isolation. Most were small reservations used during the summers only, and thus never were intended for year-around training. Water supplies were needed to serve only a few thousand soldiers at any one time. Few of these cantonments had been graded, since their grounds were covered by tents and paulins rather than buildings.[4.4]

The camps and cantonments for World War I called for as many as 30,000 soldiers to be billeted in National Guard Camps, and 45,000 or more in national Army cantonments. The delivery of building materials and transport of personnel required that installations be located near railroads and highways. Good supplies of water were a necessity, and for larger installations, sewerage was also a factor. Cantonments during the Spanish-American War—especially at the three large installations at Chickamauga, Tampa, and Jacksonville, and in the 1916 camps of the Mexican Border Uprising—did not provide sewerage. As a result, typhoid fever disabled 10 percent of those encamped in 1898. Hence, sanitation would become a factor in the planning of future installations. This meant adequate water supplies would become a location requirement and that gradients had to be considered in the siting of buildings. In matters of planning, the Engineering Department of the Cantonment Division provided a suggested plan for camp layouts. Col. Frank Gunby was assisted by Maj. George Gibbs, "expert on camp planning." It should be noted, however, that the suggested plans had to be approved by the War College because Army tables of organization were constantly changing during 1917. The War College approved two schemes of layout: one linear and one in a U-shape. Sixteen of the larger cantonments and 16 National Guard camps were constructed anew. Among the largest of these was Camp Lewis, Washington.[4.5]

Camp Lewis: A World War I Army Cantonment

Established in July 1917, Camp Lewis (now Fort Lewis) became a cantonment for 44,685 soldiers, the first of whom arrived in September, a scant 2 months after the awarding of contracts. Named for Meriwether Lewis of the Lewis and Clark Expedition, the camp was

located near where that expedition ended—at American Lake, south of Tacoma, at the lower end of Puget Sound. Apparently the Washington National Guard had used the site for summer training, but only bivouacked. Construction covered approximately 6,000 acres of the more than 140,000 acres acquired for the fort. The method of acquisition and construction at Camp Lewis was much the same elsewhere. But in this instance, the government was assisted in its choice of site by the people of Pierce County, who dedicated half the acreage. The rest of the land was condemned under federal law with settlements negotiated among owners. Access to Camp Lewis was provided by the Pacific Highway and the Northern Pacific Railroad.

At Camp Lewis and the other World War I cantonments, planning was placed in the hands of an architect/landscape architect/planner, a civil engineer for water and sewerage, and a construction supervisor. The supervisor was an officer from the Quartermaster Corps, usually of field grade. The other two were civilian professionals chosen from a list provided by the Committee on Emergency Construction of the Council of National Defense. Contractors were also chosen from a list. Apparently, the suggestion of a three-member design team originated with Frederick Law Olmsted Jr., chairman of the Council of National Defense. The planner, who was responsible for overall design, usually came from the ranks of architects and landscape architects, since the profession of planning was still in its infancy at that time. Carl F. Pilat was the team member in charge of planning and layout. Some of the better-known planners and landscape architects chosen to lay out cantonments included George E. Kessler, Edward H. Bennett, and Warren Henry Manning. Pilat was a Seattle architect who had previous experience in the layout and design of industrial housing projects. W. J. Roberts served as engineer and Maj. David L. Stone was assigned Constructing Quartermaster.[4.6]

Because of the tight construction schedule, the laying of mains and sewers, paving of roads with gravel, and the erection of buildings were undertaken simultaneously. More than 30 miles of paving, 41 miles of water pipe (both wood stave and iron), and 31 miles of tile and concrete sewer pipe were laid, and a record 1,148 buildings went up in a period of just 8 weeks. Some 55 million board-feet of lumber was consumed, 84,500 window sashes, more than 13,000 doors, 15,586 rolls of building paper, and nearly 7,500 kegs of nails. Labor was recruited from Tacoma, Seattle, Spokane, Portland, and San Francisco, with as many as 5,000 employed at a time. The general contractor operating the crews was Hurley & Mason Company. Overall construction costs amounted to between $6.8 million and $7 million, based on cost plus a fixed fee. The team was assisted by the availability of an existing site survey and topographical map, and what must have been very good weather. Equally unique was the fact that not a single labor dispute or injury occurred during construction, whether a matter of luck or because of a heightened sense of patriotism by those involved. The chief criterion for the camp's layout was the organizational structure of an infrantry division. A plan was devised from cantonment groupings provided by the Cantonment Division (Figure 4.2). These groupings were based on a regiment of three battalions of four companies, plus a machine gun company, administrative buildings, supply, post exchange, and remount station (corral, stables, and sheds). The planner was then free to organize the regimental units to best fit the site, with utmost attention paid to the gradients required by the water and sewage conduit as well as surface drainage.[4.7]

Pilat chose to cluster the buildings around brigades of two regiments each, in quadrangular blocks defined by streets of 50 ft width (Figure 4.3). Open spaces (or fire breaks) large enough to serve as brigade parades separated one brigade from another, although streets to either side connected the infantry and artillery brigades. A railroad spur provided service to the supply houses and corrals of each unit. Partly in response to the War College's recommendations, partly as a result of the terrain, and partly as a matter of aesthetics, the streets curved to form a U-shape in plan, composed of the various brigade segments. These came together at one end of the site where the brigade headquarters, store houses, bakeries,

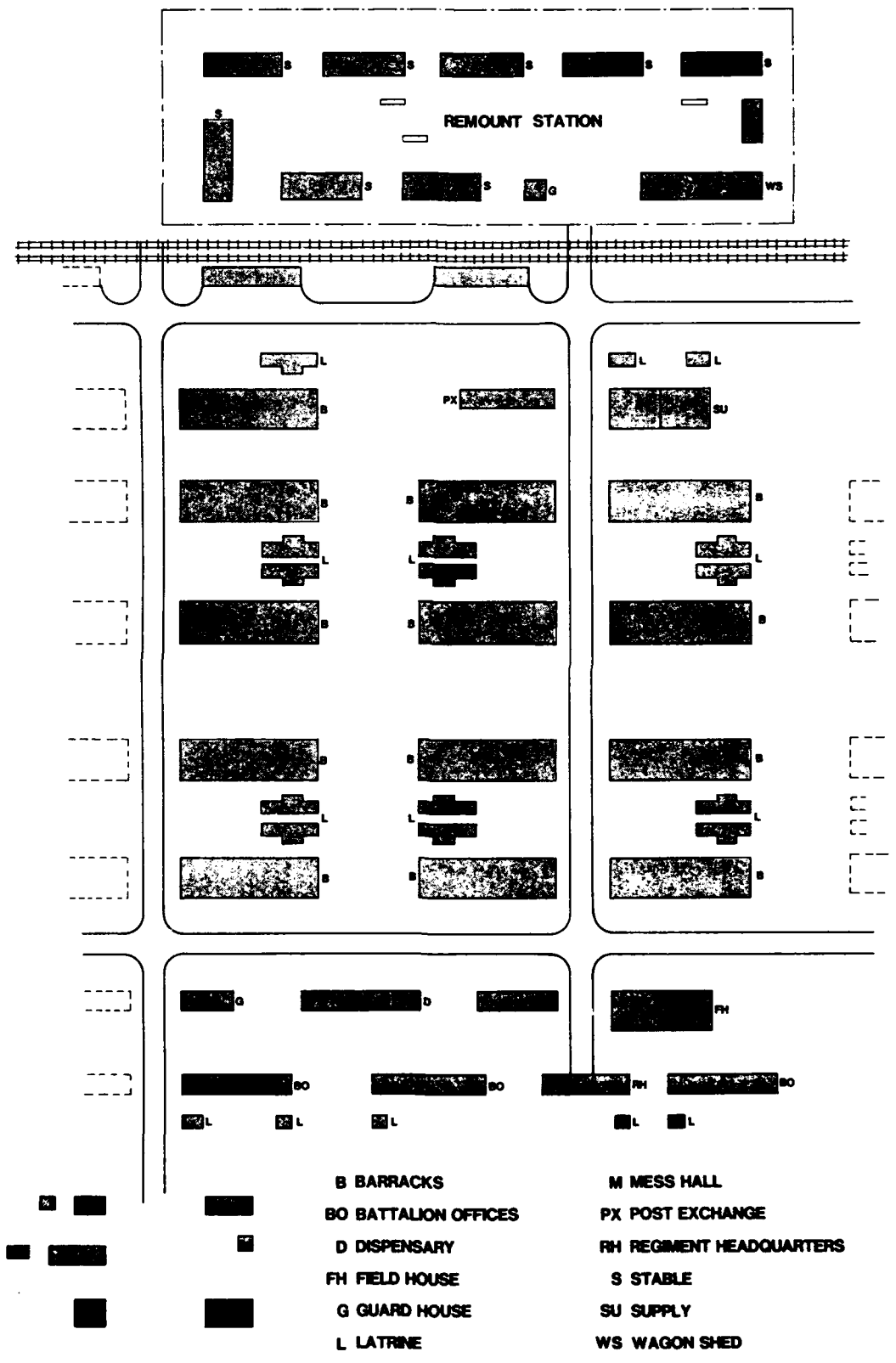


Figure 4.2. Plan of Cantonment Regimental Grouping, 1917.

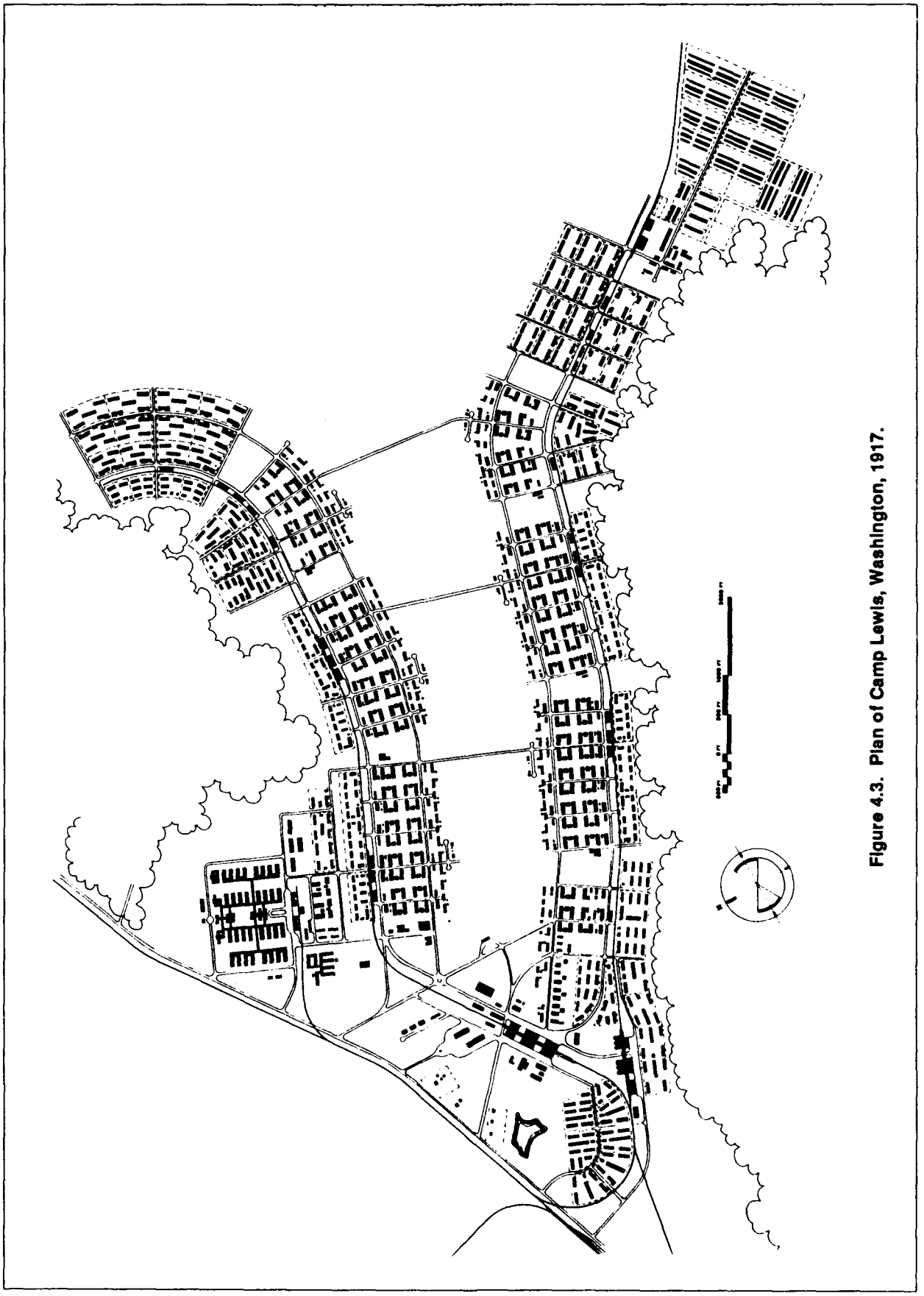


Figure 4.3. Plan of Camp Lewis, Washington, 1917.

hospital, and ammunition dump were located. At the upper ends of the U were the stables and ordnance sheds for light and heavy artillery. Barracks were placed in pairs separated by a street. They were of the new type of two-story construction, each designed to billet and board a company of 200 men. Construction documents were furnished by the Construction Department of the Cantonment Division and provided directly to the contractor, whose work was supervised on site by the constructing quartermaster, Maj. Stone.[4.8]

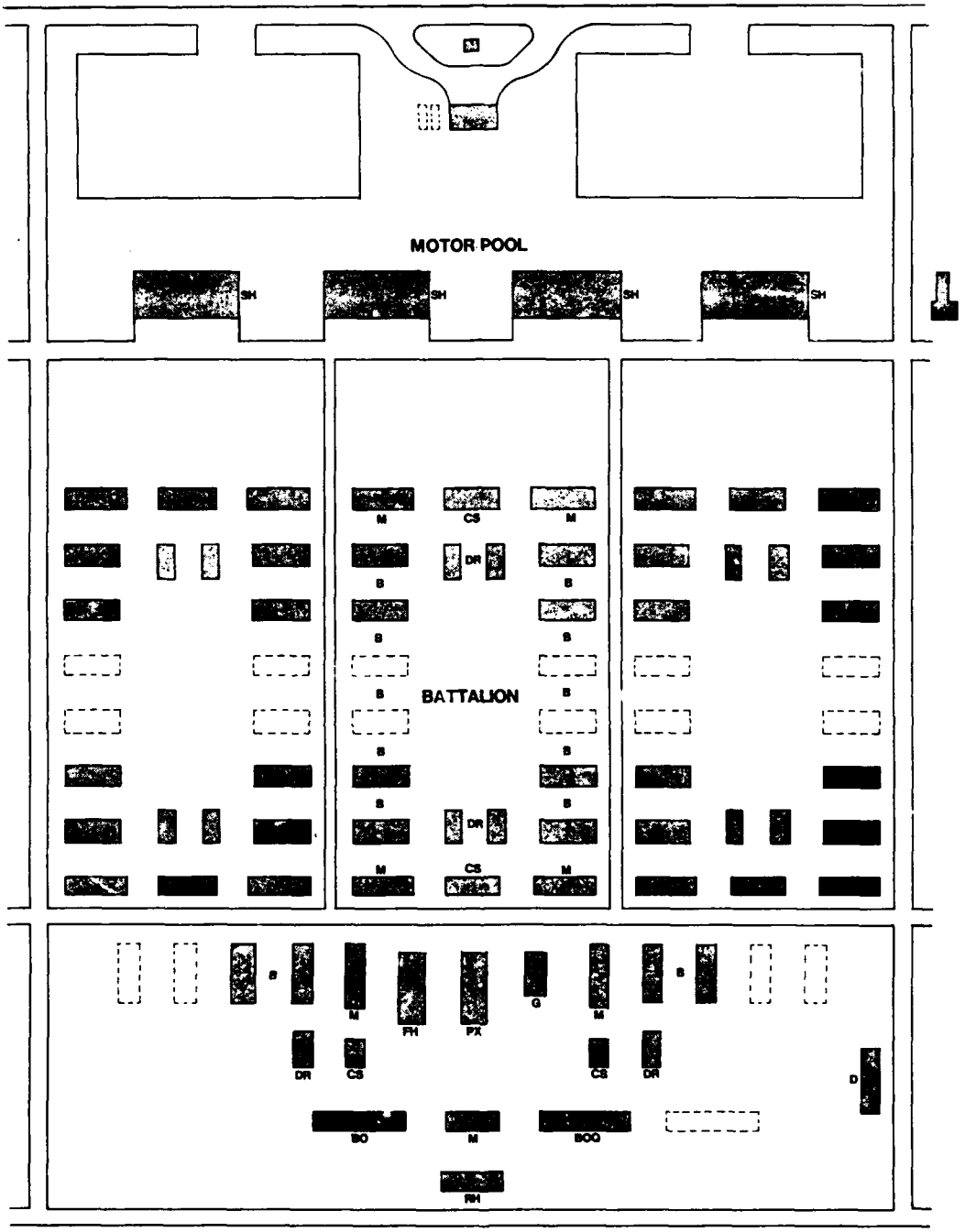
At Camp Lewis and elsewhere, cantonment life was thoroughly regulated. Trainees arose at reveille, received breakfast, visited the latrines, policed their barracks, and then moved into the field. Morning and afternoon maneuvers and drills were separated by noon mess, served in the barracks or in the field, followed by the cleaning of weapons, stowing of equipment, consuming of evening mess, and bedding down by taps. The authors of *The Cantonment Manual* offered simple rules for trainees, including "Ten 'be's' that will beat the Kaiser." These included: "Be clean," "Be sure to sleep with lots of fresh air," and "Be sure to defecate daily." Contagion endemic to camp life was a justified concern to camp planners and sanitary officers, especially in large-scale installations. Typhoid, influenza, meningitis, and measles could become life-threatening. Venereal disease, contracted during off-duty periods of liberty, affected nearly 10 percent of U.S. Army troops during World War I. The "Ten 'be's" ended with the maxim: "A dead soldier is of less burden than a sick soldier," presumably to emphasize the idea that soldiers should actively participate in maintaining their own health.[4.9]

Detention centers were points of arrival for new recruits. They remained at the detention center for a period of 1 to 3 weeks to receive medical exams, inoculations, clothing, and testing for unit assignment after basic training. The Navy was the most stringent in terms of confinement, requiring 21 days detention both before training and then afterwards, before ship assignment. The purpose was to quarantine against the risk of infectious diseases. By World War II the name of these facilities had been changed to "reception" centers, and periods of detention had been shortened. Medical advancements, especially with the discovery of penicillin and the regular dispensing of antibiotics, had reduced the toll taken by common serious diseases such as pneumonia.

World War II Army Camps

Cantonment layouts for World War II differed from those of the earlier war. Triangular and quadrangular layouts, with each leg serving a brigade, were chosen over the linear and U-shaped configurations. Centralized plans offered better administrative oversight (Figure 4.4). Leon H. Zach, formerly with Olmsted Associates, landscape architects and planners, joined the Engineering Department of the Construction Division in 1941 and devised the various plans for divisional layouts. Training ranges adjacent to each brigade would permit movement into the field without crossing into other brigade areas. Division size determined whether an arrangement of three or four sides was to be employed. As in the previous war, artillery units would be attached to brigades, but what had been a novelty in 1917 became a major feature of the new Army—the use of tanks for armored units. By 1942, however, armored units formed separate divisions of an army. The Army Air Corps, now separated from the Signal Corps and given its own command in 1926, figured far more prominently in base development than in the previous war. Numbers alone indicate the magnitude of World War II: before the end, 10.4 million had served in the Army, the majority of whom were trained in the 25 new cantonments and nearly 25 camps upgraded between 1940 and 1942.[4.10]

Training camp routines were not much different from those of the earlier war. However, no other war has been more thoroughly documented or depicted in fiction and film. Mort Walker's comic strip *Beetle Bailey* continues to entertain, embellished with brown boots, fatigues, and wooden barracks right out of World War II. *G.I. Joe* (1944), the irreverent and



B BARRACKS
BO BATTALION OFFICES
BOQ OFFICERS BARRACKS
CS COMPANY OFFICE & SUPPLY
D DISPENSARY
DR DAY ROOM
FH FIELD H HOUSE
G GUARD HOUSE
M MESS HALL
PX POST EXCHANGE
RH REGIMENT HEADQUARTERS
SH STORE HOUSE

Figure 4.4. Plan of Cantonment Regimental Grouping, 1940.

fatalistic creation of Ernie Pyle, injected both humor and pathos into everyday wartime situations. Pyle's writings and cartoons personalized the soldier's involvement, and put a face on the average G.I. (government issue) "joe." James Jones's *From Here to Eternity* (1951) is perhaps the best-known fictional account of Army camp life in the months leading up to the bombing of Pearl Harbor. Despite the hardships of Private Pruitt, the living conditions at Hickam Field were superior to the temporary construction of stateside training cantonments. The Schofield barracks were relatively new, permanent construction, offering vastly improved accommodations for enlisted personnel. Hickam was not a training facility, and soldiers considered stationing to Hawaii the next best thing to paradise. A more recent account of World War II training camp conditions has been rendered in Neil Simon's screenplay *Biloxi Blues* (1986). In this partially autobiographical account, Simon caricatures his training near the war's end at Camp Keesler: its oppressive heat, salmonella, and schizoid sergeants. But the truth about cantonment life lies somewhere between Keesler and paradise. During the war years, circumstances made it necessary for officers treat soldiers better. Efforts were made to ensure a modicum of social freedom and informality to maintain high morale, more so than in peacetime. Public relations officers were assigned to each installation, and the military services courted a good press image. There was a certain excitement and camaraderie attached to camp life. Journalists were invited to report on the training and treatment of young men and, later, women (in the auxiliary corps after 1942) in service. Alvah Bessie, whose political sympathies had led her to report on the Spanish Civil War, visited Fort Bragg, North Carolina, in 1942, to write about camp conditions. She was impressed by the friendliness of those in command, and the special efforts made to relieve tension and provide recreation for those soon to be assigned overseas. Nevertheless, there was still the routine:

> At Fort Bragg the sunrise gun goes off these days at six-thirty, and the soldier rises automatically from sleep to hear reveille already sounding. The tune is familiar to us all, but it has a special meaning for anyone who's ever been in the army.... [T]he men roll out of bed, scramble into their clothes and rush for the washrooms, their faces still crinkled with sleep, their hair mussed. First call sounds within ten minutes after reveille, and assembly follows it by another five minutes. There's not much time to dawdle.
>
> In the next half hour the soldier gets a chance to clean up his barracks, make his bed, and head for the mess-hall. In twenty minutes he's lined up again, having washed his mess-kit in the meantime, and the 'sick, lame, and lazy' have fallen out to report to the doctor. By eight o'clock the hard school of the soldier has begun for the day, with what is euphemistically termed 'drill' on the schedule of service calls.[4.11]

What struck the journalist most, however, was the use of leisure time at service clubs, beer gardens, movies, and dances scheduled in the field houses. Training films and lectures on subjects ranging from sexual hygiene to military history were a new dimension in training. The G.I. learned about principles of democracy in addition to the concept of 'fighting for his country.' The cleanliness and orderliness of the cantonment were pervasive, and wartime rations were generous:

> There were 300 men in the mess hall, and it was so clean you could literally have eaten off the floor. We had beef stew in gravy, mixed salad, boiled potatoes, creamed carrots, rolls and butter. Some men were kicking because there was no ice cream. 'We only get it three times a week,' the soldier sitting next to me said with a grin.[4.12]

Hearty meals—if rather starchy ones—were part of the routine. So was KP, where men KP were said to have fallen into a "frenzy of ecstasy" over an electric potato peeler. Drills and field maneuvers were taxing, but the soldiers were fed well as a reward. One aspect of camp life that could not escape notice was the segregation between blacks and whites. Much had been made of the fact that at Bragg and elsewhere, "soldiers [came] from every state in the Union... an army of men of every national origin." Although the training facilities were identical in every respect, there was virtually complete separation of the two races, a situation that would endure throughout the war. The single exception was Negro officer training, which at Fort Benning, Georgia, was integrated. The journalist Bessie returned from her visit convinced the Army was taking steps to eliminate discrimination, and was doing all in its capacity to provide the best prepared fighting men at any time in our nation's history.[4.13]

Camp Edwards: A World War II Rectangular Cantonment

Camp Edwards, Massachusetts (now part of Otis Air Force Base), was one the very first World War II Army cantonments (Figure 4.5). Located on a level plain near Falmouth on Cape Cod, 19 sq mi of land within the western portion of the peninsula was procured by the Army in early 1940. Much of this land was leased from the Commonwealth of Massachusetts. Construction began in September 1940 on a square division to accommodate 30,000 men. Charles T. Main, Inc., an architect-engineer firm in Boston, and the Walsh Construction Company of Davenport, Iowa, carried out the design and construction. Three regimental groups formed each side of the rectangle, and a parade ground 1 mile square formed the centerpiece of the layout. Before construction above grade, the site was cleared of scrub pines and excavated for about 74 mi of water and sewer lines. In addition to arterial highways that already existed, nearly 30 miles of paved roads were constructed, together with the laying of 11 miles of a rail spur from the Old Colony Railroad. As cited earlier in this study, the Camp Edwards project proved to be a tremendous challenge, and by the end of construction more than 63 million board-feet of lumber had been consumed. However, the tremendous quantities of materials required and the effort to get them to the site created unexpected bottlenecks. At one point, more than 250 freight cars were backed up waiting to unload their cargo; at other times, delays in getting supplies slowed construction. Not only were there snags in the process getting materials, but also in getting labor. Eventually, the men from nearby cities gathered for the work force, but many of them drove to the site, creating additional problems in traffic congestion. The contractor eventually set up a bus transit system to carry workers to and from the job. Looking back on the challenge, Aronberg, the construction manager for Walsh, stated that criticisms of labor and supplies were understandable given the scale of the project. More perplexing, however, were the drawings provided by the Quartermaster Corps:

> The drawings given Walsh by the Quartermaster General included the T.O. series and Series 700, and in order to find the details to complete any one building, innumerable drawings had to be studied. Walsh employed a group of senior draftsmen who assembled and coordinated on a single sheet the information scattered throughout these hundred of drawings, so that only a single sheet was given to the superintendents in the field for the erection of any building. General Groves (Major at that time) was so pleased with these Walsh working drawings that he personally asked the writer for 50 sets... [to send] to all other camp builders.[4.14]

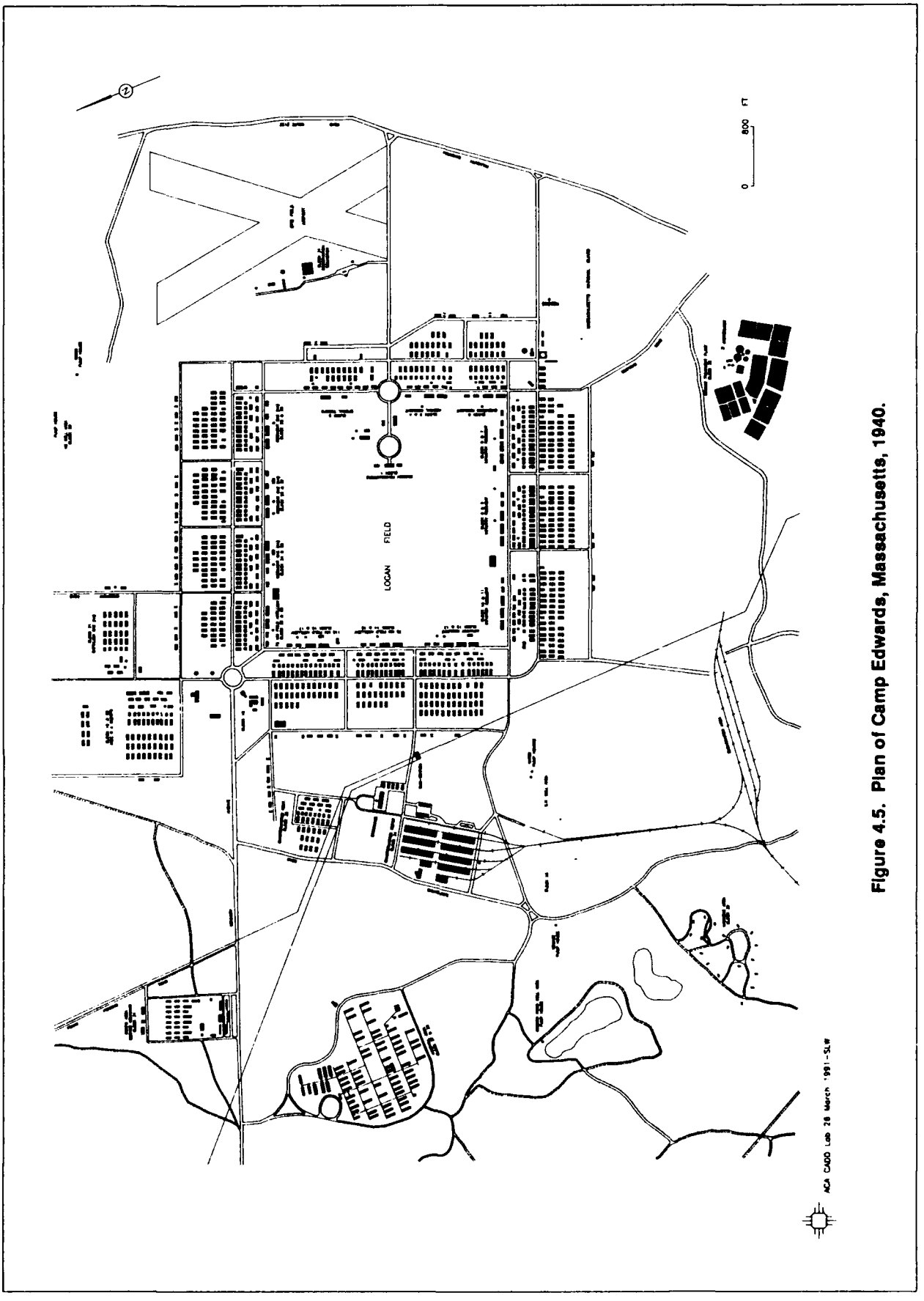


Figure 4.5. Plan of Camp Edwards, Massachusetts, 1940.

The architect-engineers, on the other hand, provided detailed drawings of the overall layout based on the Construction Division's guidelines for cantonment planning. They also completed the surveying of the site and staked each and every building plot. More than 62,000 acres were available for training, so range design was also a part of the architect's responsibilities. Within the main quadrangle and at the border of the parade were located the regimental headquarters, three to a side. Between the inner and outer roads were located the store houses, infirmaries, post exchanges, guard houses, officers' quarters, and mess halls. Along the outer flank, defined by the blocks of the outermost streets, were the company barracks and company administration and supply buildings. Beyond the quadrangle, a hospital complex with 1,500 beds was located to the west and Otis Field, a landing strip, to the east. By December 1940, construction was sufficiently completed to accommodate the arrival of the first trainees. All construction was completed by March 1941 at an estimated cost of $28.5 million.[4.15]

Camp McCoy: A World War II Triangular Cantonment

Camp McCoy, Wisconsin (now Fort McCoy), provides a useful case study of a National Guard camp that was expanded to handle the large numbers of a training cantonment during World War II. Largely constructed during 1942, it represents planning for a triangular division of infantry. The site of Camp McCoy had earlier been used for training exercises, beginning in 1909 when units of the Wisconsin National Guard acquired use of 14,000 acres in central Wisconsin for artillery practice near the small town of Sparta. The War Department purchased the land from Robert Bruce McCoy, later a World War I general, for whom the site was formally named in 1926. However, it was first known as Camp Robinson, the site of a National Guard camp in 1917 and 1918. Because it lay in the zone of northern construction (see Figure 2.1), wooden barracks were constructed (instead of tents). But these buildings were dismantled after the war. The site continued to be used for summer maneuvers however, and in 1933, it was selected as a regional base of operations for the Civilian Conservation Corps (CCC). Although several CCC buildings—together with two temporary bath houses completed in 1940—occupied the grounds, the site was largely clear in 1941 when Gen. Somervell authorized his Zone Constructing Quartermaster (Lt. Col. Everett C. Hayden) to prepare topographical surveys.[4.16]

During the second half of 1941 an additional 55,000 acres were acquired by the Real Estate Department of the Construction Division. The architecture-engineering firm of Mead, Ward, and Hunt of Madison signed a cost-plus-a-fixed-fee contract with the War Department to prepare drawings. Construction, however, awaited the beginning of 1942 until after Pearl Harbor and congressional approval for financing the construction of a second group of six proposed cantonments, including Camp McCoy. In the meantime, the transfer of construction from Quartermaster Corps to Corps of Engineers had occurred, and although Gen. Somervell had been reassigned to Assistant Chief of Staff for Construction (G-4), he nonetheless received approval for these six additional cantonments. Lt. Col. Hayden was assigned Area Engineer (the replacement title for Constructing Quartermaster) and put in charge of construction.[4.17]

Mead, Ward, and Hunt located the new cantonment at the juncture of two service roads just north of the old camp. Each leg of the triangular plan (Figure 4.6) contained a segment of a division. Tables of organization for 1942 assigned at least 19,000 men to a division, but when special units were attached, the numbers of a training cantonment would escalate accordingly. Three infantry regiments of 3,000 men each occupied one leg of the plan; an artillery regiment, special, and nondivisional units occupied the other two. Three parallel roads traced each leg of the layout. Smaller connecting roads cut across these to subdivide the leg into the three regimental units with a 250 ft wide firebreak between each, much like those of the World War I cantonment plans. These connecting roads created large blocks, each one

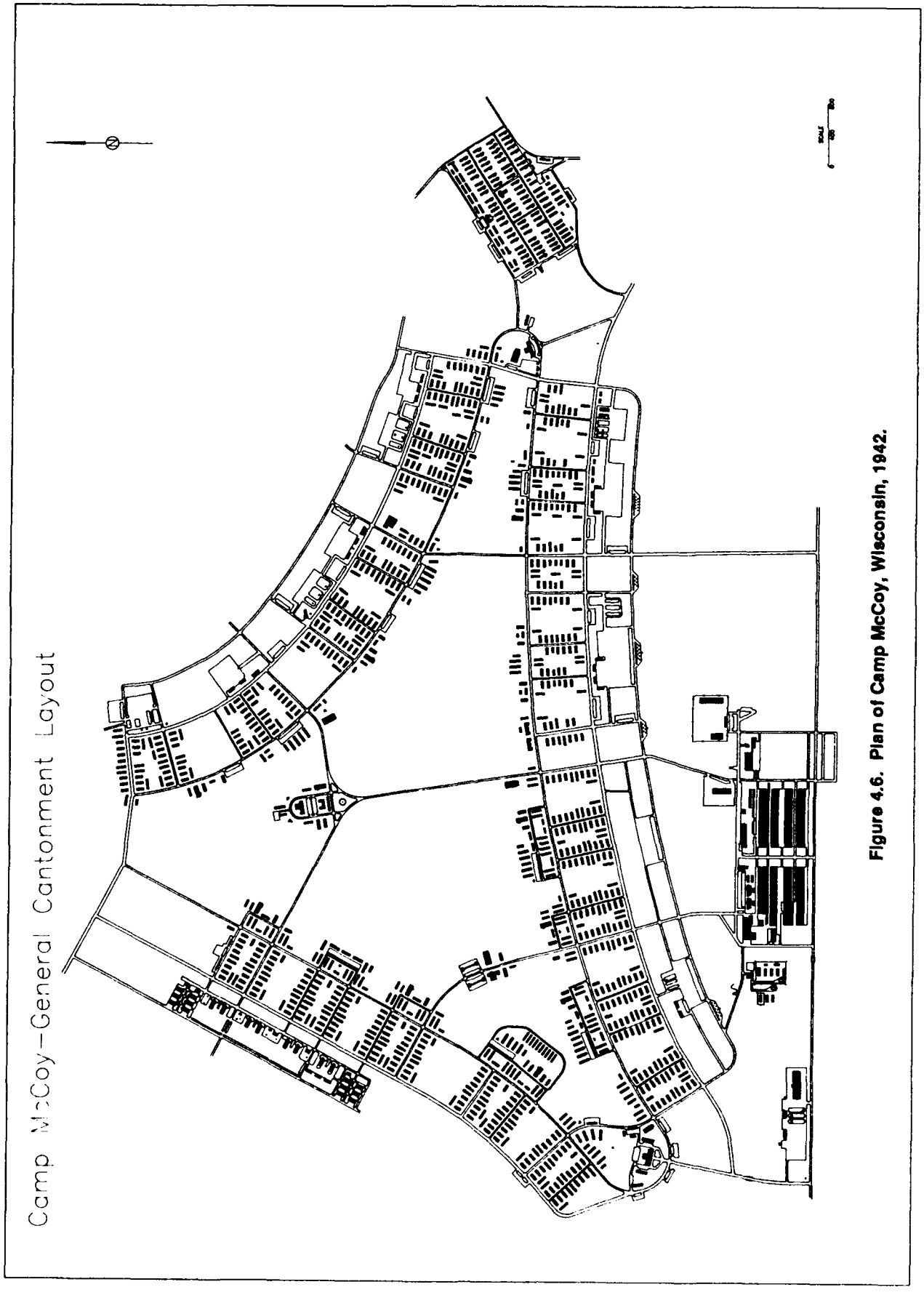


Figure 4.6. Plan of Camp McCoy, Wisconsin, 1942.

serving a battalion of approximately 1,000 men, comprising four companies of the line, cooks, clerks, etc. Hence, each road was lined with at least two companies, with barracks and mess halls all in a row. A combination company headquarters and supply building completed the blocks at each end. These blocks differed somewhat with the standard regimental plans of 1940. The mess halls were placed toward the center instead of at the end of the blocks. Across from these battalion blocks and within the large triangular parade were the regimental buildings, including officers barracks, post exchange, dispensary, chapel, field house, and other structures. Opposite this flank and at the other end of the battalion blocks, lay the motor pool buildings. These buildings and their accompanying parking lots form the outer line of parallel streets at the far edge of the triangle. Beyond these streets were the various training courses located in such a way to correspond to the infantry or artillery regiments, and enabling soldiers to move directly from their quarters into the field.

A distinctive feature of Camp McCoy, as seen in plan, is the concave curve of each leg. The architect/planners injected this design element for aesthetic purposes. By bending the lines of sight, the curve abated the monotony imposed by the rigid rows of similar buildings. Curved or contour planning had achieved popularity among planners between the two world wars, and had been employed in numerous industrial housing estates as well as more exclusive developments. In contrast to these curved streets were the hospital area and storage depot to the east and south, respectively. These formed rectangular blocks. Because of its period of construction, Camp McCoy primarily contains Series 800 buildings. Among these were 469 enlisted barracks, 42 officers' barracks, 172 mess halls, and 184 combined administrative, supply, and recreation buildings. An estimated 20,000 construction workers were employed on the project, and the total cost was $32.3 million. When completed, the cantonment provided a training capacity for 36,836 officers and enlisted men. Some 1,325 World War II temporary buildings still remain on the installation.[4.18]

Chanute: An Army Air Corps Training Field

Chanute Field (now Chanute Air Force Base) is located in east-central Illinois adjacent to Rantoul. Named for aviation pioneer Octave Chanute, the field was one of five flight-training schools commissioned by the War Department in the spring of 1917. The others included Wright Field (now Wright-Patterson Air Force Base), Ohio; Mineola, New York; Mt. Clemens, north of Detroit; and Kelly Field, near San Antonio. Shortly after the commissioning of these bases, additional air fields would be located in the southern states to avoid winter conditions that inhibited all-year flight training. The Rantoul site was chosen because of the land's attractive lease conditions and the relative flatness of the prairie. Some 2,600 acres were acquired by local businessmen, who rented the land to the Army with an option to purchase. The Signal Corps hired Albert Kahn to design the hangars and other aeronautical buildings, and one of these early hangars survives today. The barracks, mess hall, and headquarters buildings were single-story frame structures patterned on those of the Cantonment Division. A grass field bordered by a row of hangars, behind which were two parallel streets with temporary quarters and service buildings in between, represented the extent of the installation.[4.19]

After World War I, Chanute Field was nearly abandoned, and the original buildings declined for lack of maintenance. Forlorn and isolated, Chanute was considered an assignment to be avoided. When referring to the posting of unwanted servicemen, a popular phrase of the day went, "Don't boot 'em, Chanute 'em." However, with Army reorganization in 1920 and the establishment of the Army Air Corps as a combat branch of the service, the Chanute training facility took on renewed importance. (The Air Corps would not achieve independence until 1926, and did not become a separate branch of service—the U.S. Air Force—until after World War II, in 1947.) However, between the two world wars, Chanute developed a reputation for its training schools in mechanics, aerial photography, and communications. These missions

continued to dominate the development of the base until 1988, when Chanute was included among the Secretary of Defense's recommended list of bases to be closed.[4.20]

Between 1940 and 1945, more than 200,000 servicemen were trained at Chanute. In 1937, the War Department began investing in the air field's facilities, and in 1938 three large permanent hangars reconfigured the site layout (Figure 4.7). The new hangars and runways were located to the south of the original field. To the west of the hangars was the cantonment of temporary buildings, largely Series 700 and 800 buildings. In 1943, combat flight training commenced with the famous B-17 Flying Fortress, then later with the B-25 Mitchell Bomber. After World War II, many of Chanute's temporary buildings were relocated. A number of barracks were moved to the University of Illinois at Urbana-Champaign and converted to student housing. Today, only 143 World War II temporary buildings remain on the base.[4.21]

World War I and II Naval Training Stations

During World War I, the Navy expanded its receiving stations to accommodate the press of new enlistments that had swamped the prewar capacities of Newport, Norfolk, San Francisco, and Great Lakes. The Great Lakes Naval Station, founded in 1911 and located 30 miles north of Chicago on Lake Michigan, was the largest. This installation started with the capacity to train 3,000 sailors, but expanded to handle 17,000 by the end of 1917. But this was far from adequate. Because of the emergency, small camps to train 1,000 sailors were constructed within 2 to 3 months in makeshift barracks at or near naval yards in Boston, Hingham, Portsmouth, New York, Philadelphia, Gulfport, New Orleans, Detroit, San Diego, San Pedro, and Seattle (such as the one described earlier at Charleston, South Carolina). The barracks design at Charleston, however, was abandoned when the Naval Bureau of Medicine and Surgery found the cubic air space within sleeping quarters to be insufficient. These smaller camps were built, for the most part, on land leased by the Navy. After the war ended, the buildings were removed. At Great Lakes and the other permanent training stations, temporary camps were developed as separately planned units of two or more regiments (approximately 1,728 men per regiment), each with its own mess halls, barracks, store house, drill hall, and headquarters. From 167 acres, the station expanded to include more than 1,200 acres. By 1918, more than 50,000 sailors occupied the encampments at Great Lakes.[4.22]

In a departure from the way the Army contracted cantonments, the camps at Great Lakes (Figure 4.8) were awarded to separate contractors: Paschen Bros. laid out three regiments, John D. Griffith & Son Co., three regiments, and J. C. Heyworth, three regiments and a hospital. Roads, walks, water supply, and sewerage contracts went to the firm of Leyden & Ortseifen. Overall, the contractors employed some 6,000 laborers. Cmdr. George A. McKay from the Bureau, who had overseen construction of the original station, was the Constructing Engineer. The architect on the site was Lt. E. H. Clark, who had practiced in Chicago before joining the Navy. It was Clark's job to approve the materials and standard details used by the contractors on drawings prepared by the Bureau. Between August and October 1917, some 450 buildings were erected, consuming 23.8 million board-feet of lumber and costing about $5.5 million. Work continued in 1918 at the same feverish pace as during the previous fall. Among the various camps at Great Lakes, Camp Lawrence was considered a model. Located west of the original station and following a linear plan dictated by Sheridan Road and the Chicago and Northwestern Railroad, its barracks were laid out in groupings of eight (two rows of four), forming a regiment. Separating the groupings were drill halls, and at the end of each of the two rows were mess halls. The new H-type barracks and drill halls would become a fixture of the early World War II training stations.[4.23]

At the beginning of World War II, the Navy once again undertook a massive buildup of its four permanent training stations. Because of the specialized nature of naval training and the

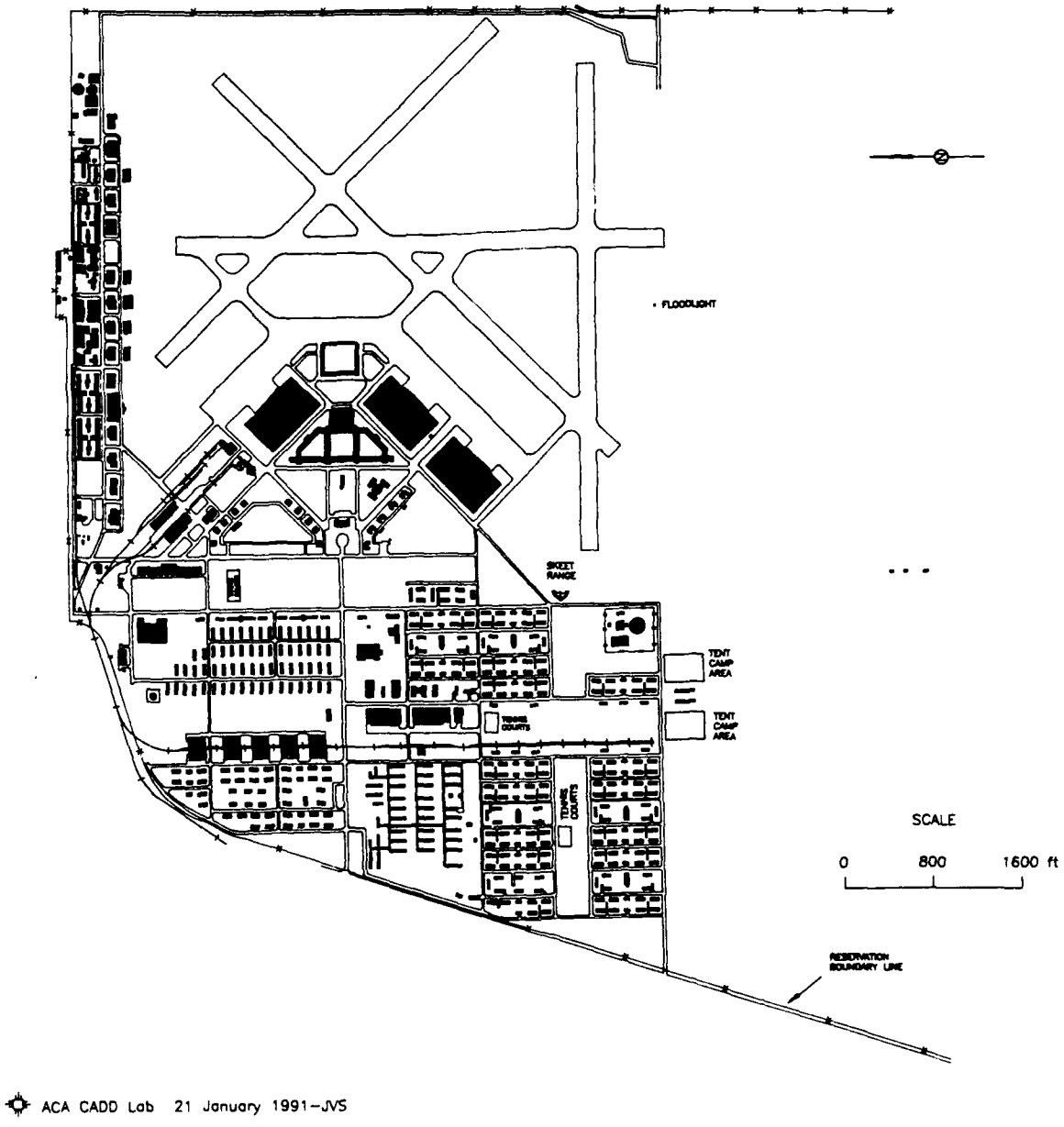


Figure 4.7. Plan of Chanute Field, Illinois, 1945.

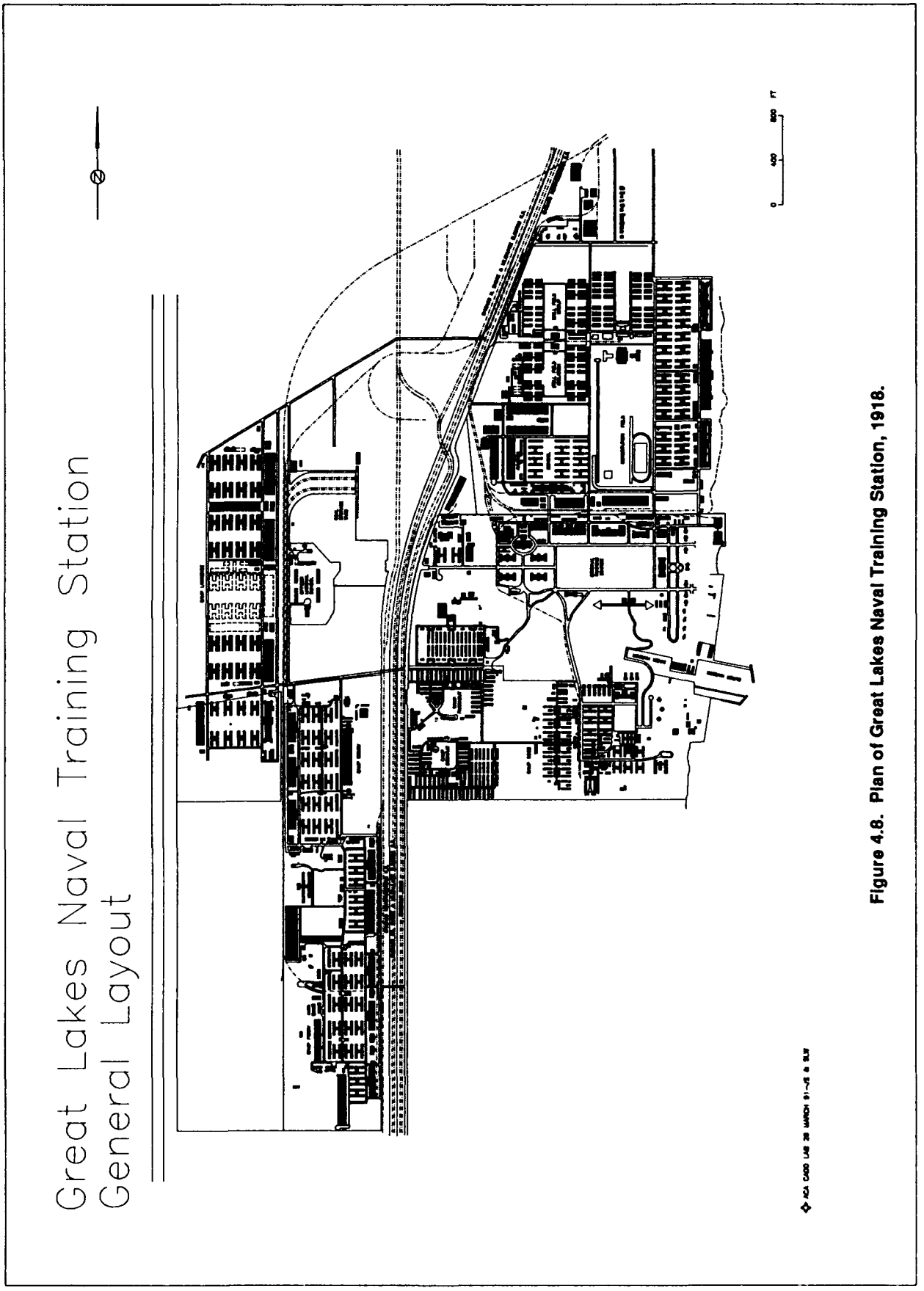


Figure 4.8. Plan of Great Lakes Naval Training Station, 1918.

added dimension of a fleet of aircraft carriers, special emphasis was given to the development of naval air training stations. Both the Army and the Navy built airdromes in France during World War I, and the Navy completed nine training stations in coastal states by the end of that war. The first permanent naval air training station was built at Pensacola, Florida in 1914. The development of seaplanes and lighter-than-air ships—dirigibles lofted by helium—were undertaken as a means of safeguarding American ports from submarine attack. Early submarines operated near the surface and could be spotted from the air. Hence, the Naval Air Service would become the nation's first line of defense during World War II. Interestingly enough, however, most of the naval air training stations built during the war—12 of 18—were located in the Midwest. Only advanced training was conducted at Pensacola, Corpus Christi, and San Diego. The centerpiece among these was the Naval Air Primary Training Command at Kansas City (1943). Apart from distributing defense contracts, the midwestern sites took advantage of their flat terrain and good drainage, which minimized the need for runway excavation and tarmac foundations:

> "Far from the sea and the airplane carrier decks that will be their eventual home, thousands of pilots are being trained for the Navy's fleet air arm... operating from runways and land mats that only a few months ago sprouted corn or wheat, cotton or buffalo grass..."[4.24]

Naval pilots conducted their practice takeoffs and landings. Concrete was used for heavy runways, and asphalt for lightweight landing mats. At Kansas City the excavation for runways required 500,000 cu yd of grading. However, at Corpus Christi—a 2,000 acre site built on sand dunes and clay covered by mesquite and scrub oak—more than 3 million cu yd were graded. Apart from the hangars, repair shops, and control towers, the buildings at these stations were similar to those at other Naval training facilities. The Corpus Christi Naval Air Station, which retains a number of its World War II temporary and permanent buildings, was completed in 1941 at a cost of $28 million. Brown and Root of Houston was the principal contractor; Robert & Co. of Atlanta was the architect/engineer. Cmdr. L. N. Moeller was the Constructing Engineer in charge of the site.[4.25]

Farragut: A World War II Naval Training Station

No more unusual than planting Naval air bases in Midwest cornfields was the decision to locate a training facility for sailors at Lake Pend Oreille, Idaho. Although the Great Lakes facility was on Lake Michigan, Lake Pend Oreille was landlocked among the upper Rocky Mountains near the Canadian border. No corvettes or cruisers (let alone battleships) would come steaming from between snow-capped mountain fjords. Nevertheless, the Naval Appropriations Bill of 1942 included $31 million in funding for Farragut Naval Training Station, constructed in 1943 in this remote wilderness 485 miles east of Seattle and more than 2,000 ft above sea level (Figure 4.9). When news headlines about the station first surfaced, both the Associated Press and United Press received queries from Idahoans about whether references to "Navy" instead of "Army" in the stories were typographical errors. The state had been unsuccessful in securing an Army cantonment. A forest supervisor, used to the solitude of the Cabinet, Selkirk, and Bitteroot mountain ranges that converge on the pine-covered site south of the lake, noted:

> This is the biggest thing that ever happened in this part of the U.S.A...., but I've got to pinch myself to make sure I'm not seeing things when I run into Navy uniforms way up in these mountains.[4.26]

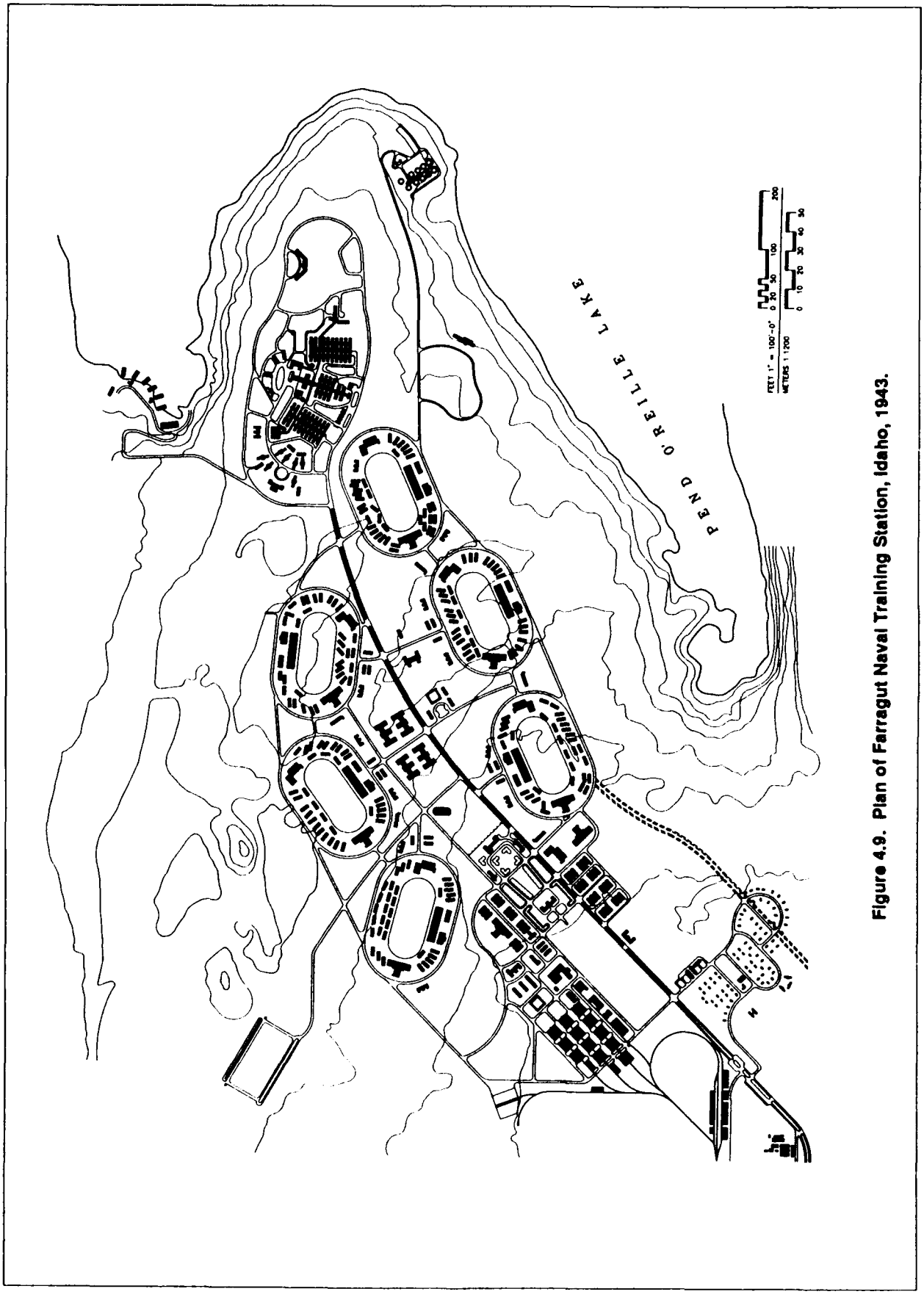


Figure 4.9. Plan of Farragut Naval Training Station, Idaho, 1943.

Named for Adm. David G. Farragut, commander of the Union fleet and the hero of Mobile Bay, the isolated site had its advantages. It would avoid the congestion experienced at Naval bases in metropolitan areas. The land could be obtained quickly. The lake was large, clear, and deep enough for diving and small-craft maneuvers. And it was located near a plentiful supply of lumber.

Farragut, and its sister stations Bainbridge and Sampson, included structural groupings for (1) recruit training, (2) schooling, (3) recreation, (4) administration, (5) officers' facilities, (6) station personnel, (7) a hospital, (8) service, (9) utilities, (10) storage, (11) a marina, and (12) outgoing assignees. Following the concept at Great Lakes and the older stations, Farragut was divided into six camps for training. Each camp hosted 5,000 apprentice sailors, or 30,000 overall. Partially separated from one another and occupying a clearing of about 12 acres, the training camps were screened by stands of pine intentionally left intact during site preparation (Figure 4.10). Each camp was laid out in the form of an oval, inscribed by a service road. A drill field of approximately 800 x 1000 ft occupied the center of the camp and was bordered by one or two rows of the new flat-roofed, two-story barracks. The barracks were not aligned but set enfilade for good ventilation and natural lighting. Across the shorter ends of the drill field were the mess hall and ship's service buildings. Facing center on the long side of the drill field was the drill hall, the installation's largest structure. Immediately behind it sat the indoor rifle range and storage building. Outside the oval, a dispensary, officers' barracks, administration building, and chapel completed the ensemble. The contours of the peninsula on which the training station was located suggested the informal arrangement of the camps in the overall plan.[4.27]

Water for the installation was drawn from deep wells, not the lake, and a sewage treatment plant was constructed. In all, 26 miles of water mains and 34 miles of sewer pipe were laid. Nearly 46 miles of macadam roads were paved, and 7 miles of 6 ft chain-link fence stretched around the base. One reporter suggested that the place would be a veritable resort, with boating in the summer, Alpine skiing in the winter, fishing in a lake "chock-full of Kootenai rainbows, cut throats, steelheads, and landlocked blue-back salmon." He also noted that "[t]he woods and uplands are full of elk, deer and all kinds of game birds. Sharpshooters can test their marksmanship on pheasants, mallards and blue grouse..." Obviously, a resort was not what the Navy had in mind with Farragut. The residents of this minimum-security training facility rarely made it past the fence. "Recreation" was indeed part of the trainees' routine, but it was *Navy* recreation. The 75 x 75 ft training pool beneath the floor at one end of the drill hall was a place where sailors learned to swim or drown, not relax. Mess halls ("subsistence" buildings) lacked the atmosphere of a resort: sailors stood in line, ate, and digested on the way out. Despite the installation's beautiful setting, the modern architecture, tall green pines, white snow-capped mountains, and blue lake, the camps at Farragut were for work, not play.[4.28]

Farragut was capable of preparing 150,000 sailors a year. Despite the huge expenditure—$46,000,000 by the date of completion—Farragut was reduced in status to a Naval Reserve facility after 1946. Because of its high maintenance costs, the installation was decommissioned and permitted to fall into disrepair. Within 30 years of its founding, Farragut was completely razed. Cleared of remaining buildings, the site was dedicated to the National Forest Service, and new stands of pine have reclaimed the once-busy clearings.[4.29]

Camp Pendleton: A World War II Marine Corps Training Station

With President Roosevelt presiding over the ceremonies, Camp Pendleton, California—named for Maj. Gen. Joseph H. Pendleton—was commissioned in September 1942. By the beginning of October, the first Marine recruits began arriving. The Marines, a small, elite

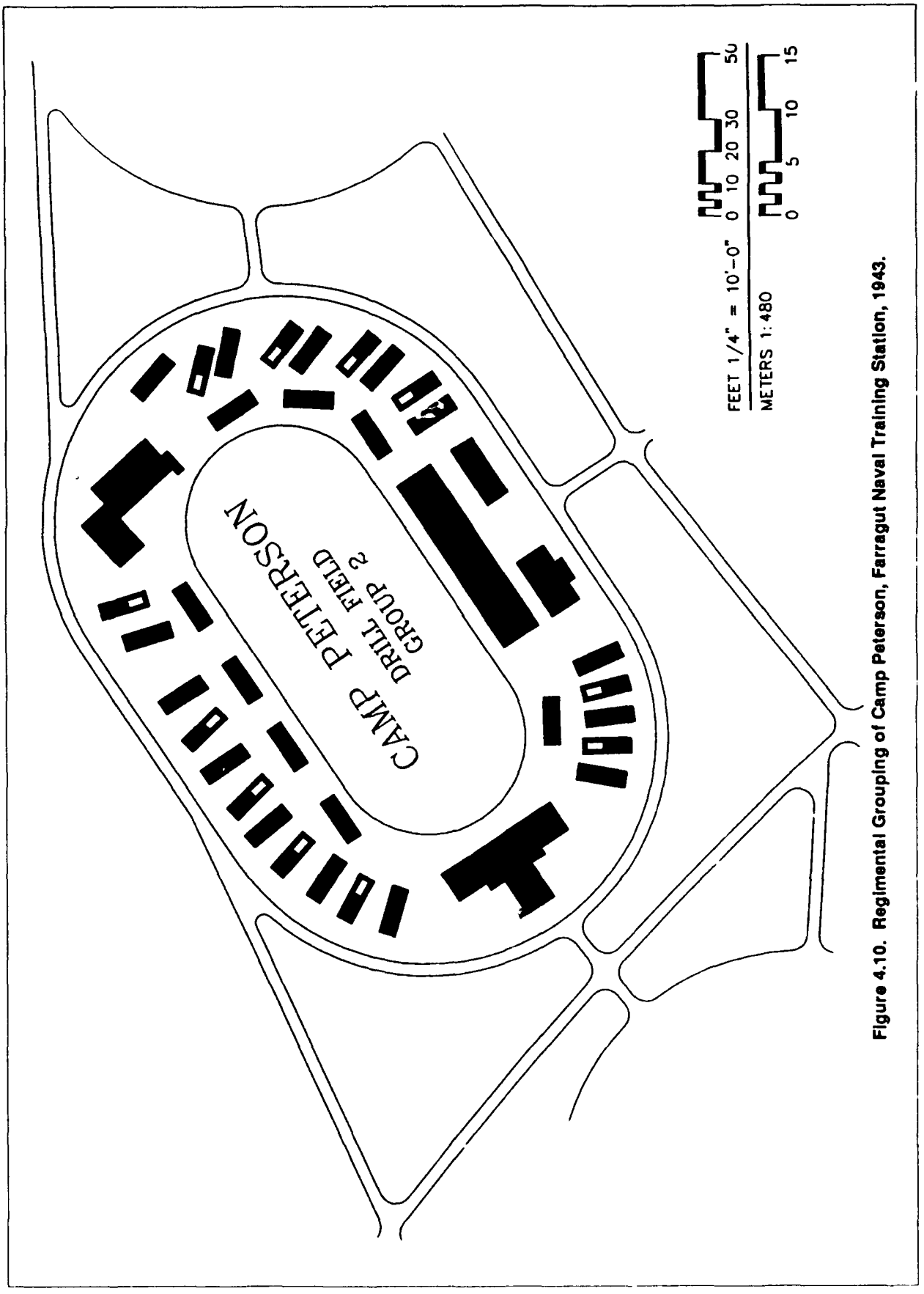


Figure 4.10. Regimental Grouping of Camp Peterson, Farragut Naval Training Station, 1943.

Corps at the beginning of the war, were trained primarily for guarding American diplomatic missions and protecting American interests overseas. Posted from Port-au-Prince to Peking, their presence was more visible overseas than at home. Were it not for the men in dress uniform at Marine Barracks in Washington and the popularity of Band Master John Philip Sousa, the pre-World War II Marines could easily be overlooked. They had been used in the Philippines (although to a lesser extent than the Army), but had only a limited role in World War I. They played a part in the nation's "hands-on" foreign policy in Latin America between the wars, in countries such as Nicaragua and Panama. However, their real test as the "Navy's army" would be in the South Pacific at Guadalcanal, Tarawa, Iwo Jima, and other Japanese strongholds during World War II. Camp Pendleton was located in California for staging to the Pacific Theater, and was the single largest Marine Corps training station.

Most marine training stations had been located on the East Coast at Quantico, Virginia, and Paris Island, South Carolina. Both were founded during World War I. A Marine expeditionary force was also stationed at the San Diego Naval Training Station during that war, and nearby land was acquired for a dedicated Marine facility. But construction on a $5 million permanent station did not begin until the 1920s. When in 1940 the Marine Corps doubled in size to more than 36,000, the Quantico, Paris Island, and San Diego facilities expanded to handle the influx of volunteers. With the bombing of Pearl Harbor and the "two-ocean war," however, it became apparent that the West Coast facilities would have to be enlarged, and new sites obtained. The Marine base at San Diego did not have enough area to accommodate more than 5,000 men. Just north of San Diego, an additional 9,000 acres was acquired for building a temporary camp, eventually named Camp Elliott. By 1942, this camp had reached its capacity. That summer, another site 40 miles north of San Diego—midway between San Diego and Los Angeles—was obtained. This site was much larger than the others, encompassing a 197 mi tract—the former Rancho Santa Margarita. Its rugged coastal terrain and 17 miles of beach offered training ranges unavailable at Camp Elliott. Planned for 20,000 Marines—a full division plus an extra regiment—Camp Pendleton would soon become the principal training facility on the West Coast and point of departure for the leathernecks of the Pacific islands campaigns.[4.30]

Unlike Camp Lejuene, its East Coast counterpart, Camp Pendleton's construction was temporary. In regimental layout, however, the two camps were similar. Despite its frame barracks and tents, the station did not skimp on providing water lines, sewers, and paved roads. In the first phase of construction, 68 barracks, 19 mess halls, 39 storehouses, 5 dispensaries, and 5 theaters (field houses) were built for a grouping of five regiments. In addition to the frame buildings, three 5,000-man tent-camps were completed. By the end of 1942, an airfield had been built and a 600-bed, single-story frame hospital completed. Amphibious training operations began at Camp Pendleton in the fall of 1943, and Quonset Huts for 9,000 more men and 600 officers were located near the boat basin.[4.31] During the postwar period, Quonsets would replace the remaining tent structures. Today, this Marine training station is the largest repository of the prefabricated Quonsets, and they are still very much in use. Within Camp Pendleton, the regimental training camp—Camp Vado del Rio—is typical of the original tent-camp layouts (Figure 4.11). A regimental headquarters occupied space within a semicircular drive at one end of the parade. On either side of the parade were two rows of tents, with latrines placed in between. In 1944, small Quonsets—the 20 x 48 ft version—began to replace the tents. Four battalions, each containing 12 to 14 Quonsets and framed by gravel drives, created the two flanks. Mess and officers' quarters lay outside the regimental configuration. Because of its size and variety of training ranges, Camp Pendleton was not abandoned after the war as intended. The installation's temporary buildings represent the nature of its origin, and its amphibious facilities and strategic West Coast location continue to offer a base for rapid deployment to the Pacific islands and Asian rim.[4.32]

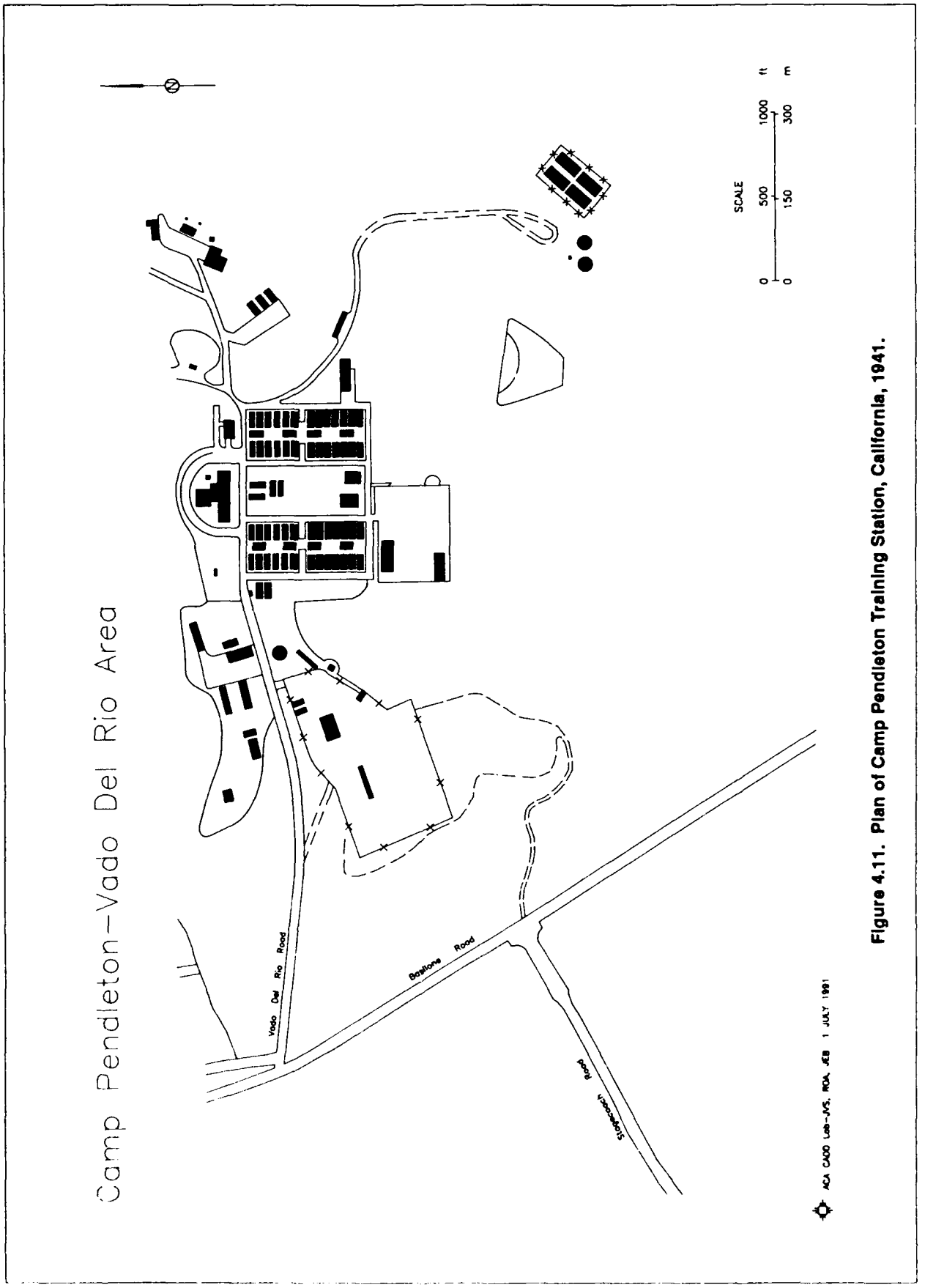


Figure 4.11. Plan of Camp Pendleton Training Station, California, 1941.

5 Overview of Historical Significance

Despite their designation as "temporary," many World War II temporary buildings have endured well beyond their life expectancy. According to the most recent survey, 26,798 temporary structures survive, and many are still in use.[5.1] The magnitude of what this construction effort produced—and the rapid manner in which the construction was carried out—defies comparison. Whatever the shortcomings in architecture and planning, just the size of this undertaking makes the effort worthy of consideration, indicative of what the United States can accomplish in an emergency. In surveying the cantonments and training stations of World War II, one cannot help being impressed by the overall effort: administrative coordination, procurement, and labor worked together for a common good despite tremendous obstacles. The very fact that so many temporary buildings from that era survive probably says less about their construction than about their raw numbers.

It would be unwise to assume that large-scale mobilizations will never again occur. But even if such a massive mobilization were necessary, it should not involve the level of manpower and construction required for the World War II effort. In an era of nuclear weaponry, such a conventional approach to mobilization would not be applicable. However, the continuing improvement of relations among the global military powers, from the 1970s into the present, makes it conceivable that future world wars may be averted. With the signing cooperative agreements and weapons-reduction treaties, downsizing of the military services is inevitable. More base closings will be necessary, and many buildings will be razed. Some, however, may be retained and readapted to new uses. There should be a place for these temporary buildings that represent the nation's World War II experience. Readaptation on a large scale would be a challenge to the military services and those who wish to preserve the architectural heritage described in this report.

Of some importance is the fact that many temporary structures of World War II have been upgraded for less than it would have cost to replace them. Furthermore, these structures have remained resilient to various powerful forces of nature. For example, temporary World War II structures located in areas affected by the Loma Prieta earthquake of 1989 (San Francisco and vicinity) withstood the tremors far better than their masonry-constructed counterparts. Because temporary structures were set on pier supports instead of continuous, rigid foundations, and because they provided for structural flexibility in their materials and design, these buildings shook but did not crack or collapse.[5.2] Furthermore, the Theater of Operations buildings used overseas in more recent actions, such as the Vietnam War, incorporated many features of earlier temporary buildings. The old adage "if it ain't broke, don't fix it" applies to the Army Series 700 and 800 temporary buildings and the Navy Quonsets. Essentially, designers could not improve upon the expedience and utility of the World War II prototypes.

For all their utility, these temporary frame buildings have practical drawbacks. They are not as comfortable as permanent buildings and they require considerable maintenance. Because of the cellulose materials used in their construction, chemicals must be applied regularly to prevent them from being consumed by fungi or insects. Unless clad with asbestos-cement during the war or aluminum siding after the war, temporary buildings require periodic repainting (Figure 5.1). Their asphaltic roofing must be replaced at regular intervals. Because they are set on independent pier foundations, differential settlement will eventually stress the underpinning timbers.

Unless insulated, World War II temporary buildings cannot be made airtight for conventional heating and cooling technologies. And even if insulated, their single-pane wooden sash windows undermine the insulation's thermal benefits. The buildings were meant to be naturally ventilated whenever possible, but by today's comfort standards, these buildings would be considered drafty—unfit for dormitory use.

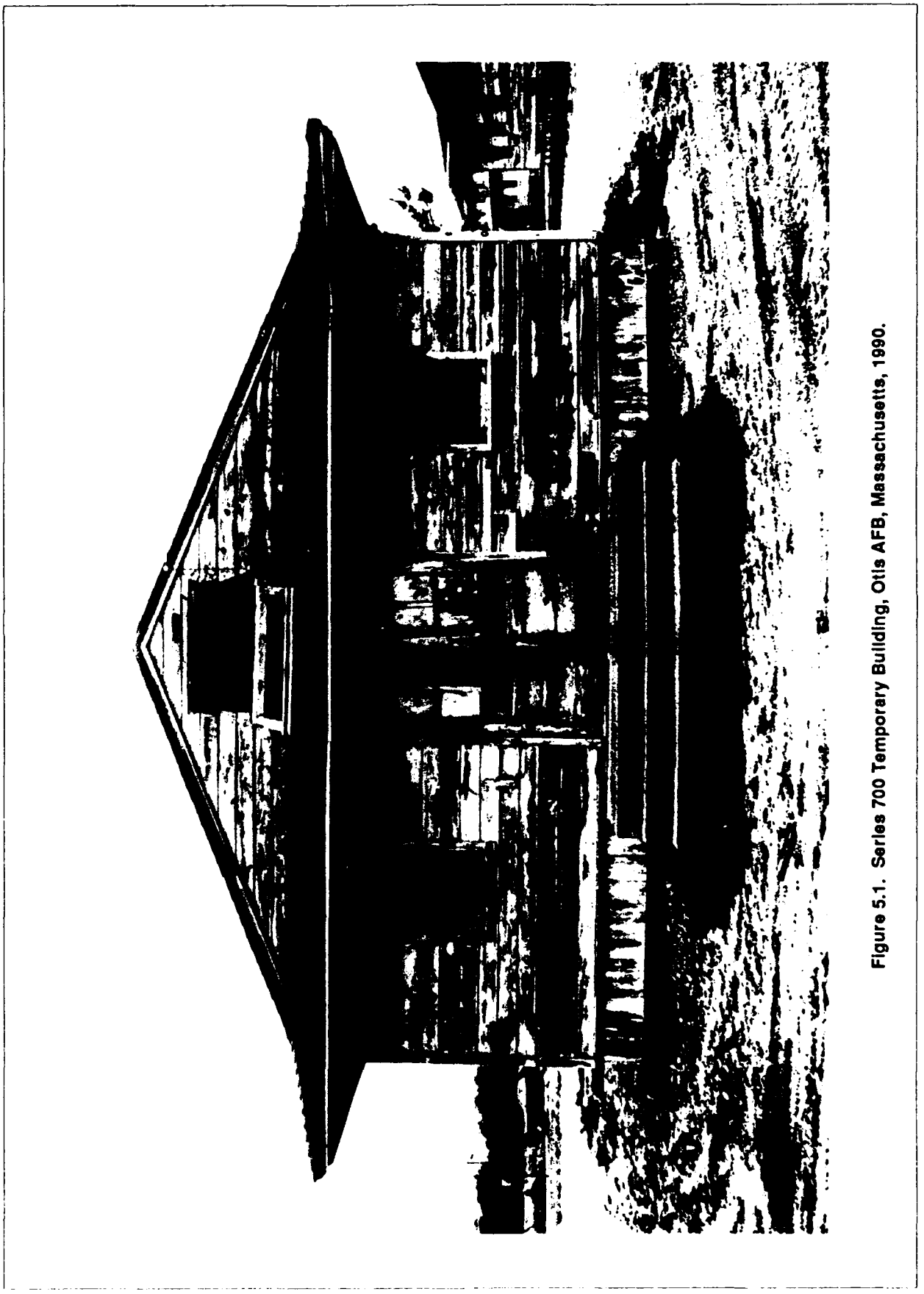


Figure 5.1. Series 700 Temporary Building, Otis AFB, Massachusetts, 1990.

Another drawback is the fire hazard inherent in many such buildings. The author recalls his own experience as an occupant of a Series 700 barracks in the early 1960s (Figure 5.2). The threat of fire was a constant concern. No standpipe system existed. "Butt cans" attached to the interior columns of each floor were installed to extinguish cigarettes, but their real value was as a tool for a bucket brigade trying to douse a fire. With buildings fire-rated at less than 10 minutes, it would have taken an extraordinary effort by an alert and disciplined crew to save a burning barracks and its occupants. Throughout the southern construction zone, and at many installations in the north, none of the barracks, supply rooms, or mess halls had interior sheathing, leaving the structures, occupants, and contents even more vulnerable. Because of the type of construction and consequent low fire-rating, these temporary buildings have long been marked for replacement. However, fire-retardant insulation, interior wall and ceiling sheathing, smoke alarms, and sprinklers have in many instances have reduced the fire hazard in such buildings. These refurbishment techniques may considerably enhance the usefulness of surviving World War II temporary buildings.

In terms of the history of cantonment planning, it should be remembered that temporary buildings arrayed in training and tactical formations have long been the standard of military cantonments. A number of World War II temporary buildings should be maintained as part of the nation's military heritage. Preferably, groupings of such buildings should be preserved to reflect their former use in a company or battalion layout. Today's soldiers and sailors are trained and billeted differently. Barracks are no longer so spartan, and the company mess hall has now disappeared. Enlistees in an all-volunteer military are given more freedom, and many of the more onerous and punitive duties such as KP no longer exist.[5.3]

For many, of course, World War II cantonments do not rekindle fond memories. But never was a time or an experience more indelible in the minds of those who lived through it than service to the United States during the mobilization of World War II. It is unlikely that a mobilization of such scale will ever happen again, so a fitting record—a living record—of that unique achievement should be maintained.

Beyond the cantonments, temporary buildings were constructed or relocated to university campuses for training schools and postwar housing for returning students. The author can look out the window of his office in the Architecture Building at the University of Illinois to a frame-constructed Theater of Operations building that is still used today as a classroom. Isolated as it is, and long scheduled for demolition, the destruction of the building seems inevitable. But the destruction of entire complexes of such structures would be difficult to justify, not only because of their place in U.S. military history, but also because resources for the military services are becoming more scarce. Inactive cantonments, such as Fort Chafee, Arkansas, which contains one of the Army's larger collections of temporary buildings, provide needed training sites for regional National Guard units. Maneuvers cannot be conducted at local armories, so some facilities must be maintained for this purpose. Another use for these cantonments and their buildings might be as the "boot camps" for first-time offenders that state departments of correction are presently funding with federal assistance. Whatever their specific fate, in the end, it simply makes good sense to put to better use the nation's remaining temporary structures produced in the historic mobilization effort of World War II.[5.4]

Figure 5.2. Author and Series 700 Barracks at Fort Polk, 1963.

6 Summary

The massive mobilization effort required for World War II stands as a unique achievement in U.S. history. This effort produced untold thousands of temporary structures on U.S. soil to support the training and deployment of millions of soldiers and sailors. Today, more than 26,000 of these temporary structures survive. Many have been cost-effectively modified or refurbished to continue in service long beyond their original intended life cycle.

The longevity and abundance of World War II temporary structures on DOD installations is living proof of their utility and fundamental ingenuity of design. While it is true that many temporary buildings had inherent design problems that would not be acceptable in permanent structures—energy inefficiency, low fire rating, and susceptibility to biological pests, for example—these problems frequently can be mitigated or eliminated through conventional refurbishment and maintenance techniques. In fact, the need for costly new construction of facilities has often been postponed or avoided by upgrading temporary buildings with techniques as simple as insulation, internal sheathing, and periodic painting.

DOD's need to make optimal use of its existing resources and may overlap with the desirability of preserving temporary facilities built for the World War II mobilization. Preserving usable clusters of buildings in their original cantonment layout would, where feasible, be a desirable approach to designating a "living monument" to the U.S. World War II effort.

METRIC CONVERSION FACTORS

1 cu yd	=	0.7646 m^3
1 in.	=	2.54 cm
1 ft	=	0.305 m
1 sq ft	=	0.093 m^2
1 mi	=	1.61 km
1 sq mi	=	2.59 km^2

Endnotes

1.1 *Military Construction Authorization Bill of 1983*, Public Law (PL) 97-321.

1.2 *National Historic Preservation Act*, sec 106, PL 89-665 (15 October 1966).

1.3 *Programmatic Memorandum of Agreement Among The United States Department of Defense, The Advisory Council on Historic Preservation, and The National Conference of State Historic Preservation Officers*, letter of 2 July 1986.

2.1 The figure $20.2 billion represents the combined totals of expenditures in the continental U.S. by the Army ($15.3 billion) and Navy ($8.9 billion). Lenore Fine and Jesse A. Remington, *The Corps of Engineers: Construction in the United States, vol 6, part 6, vol 3, in U.S. Army in World War II* (Washington: Government Printing Office [GPO], 1972), p 703. John J. Manning, *Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946* (Washington: GPO, 1947).

2.2 Erna Risch, *Quartermaster Support of the Army: A History of the Corps, 1775-1939* (Washington: GPO, 1962), p 580; Fine and Remington, *The Corps of Engineers*, pp 8-11; Richard Severo and Lewis Milford, *The Wages of War: When American Soldiers Came Home* (New York: Simon and Schuster, 1989), pp 189-210.

2.3 The Construction and Repair Division of Army Army Quartermaster Corps was renamed the Cantonment Division in 1917 and placed in charge of Col. Isaac W. Littell. To streamline its chain of command and expedite construction, it was detached from the Corps and placed directly under the Office of the Quartermaster General. By War's end, its name had been changed back to Construction Division, and Littell had been replaced by Brig. Gen. Richard C. Marshall. R. E. Wood, "Report of the Quartermaster General," *War Department Annual Reports, 1918, vol 1* (Washington: GPO, 1919), p 268.

2.4 R. C. Marshall, Jr., "Report of the Construction Division," *War Department Annual Reports, 1918, vol 1* (Washington: GPO, 1919), p 1278.

2.5 *Activities of the Bureau of Yards and Docks, Navy Department, World War, 1917-1918* (Washington: Government Printing office, 1921), pp 41-42.

2.6. Richard Hofstadter, et al., *The United States: The History of A Republic* (Englewood Cliffs, N.J.: Prentice-Hall, 1961), chap 29; *Annual Report of the Chief of Engineers, 1939: Commercial Statistics Water-borne Commerce of the U.S.* (Washington: GPO, 1939); Howard P. Chudacoff, *The Evolution of American Urban Society* (Englewood Cliffs, N.J.: Prentice-Hall, 1981), chaps 7-8; Harold W. Thatcher, "Planning for Industrial Mobilization, 1920-1940," *Q.M.C. Historical Studies* (no. 4, August 1943), pp 1-15, 295-304.

2.7 Alan Gowans, *The Comfortable House* (Cambridge: MIT, 1986), pp 43-50.

2.8 Carl Condit, *American Building* (Chicago: University of Chicago Press, 1968), chap 3; Paul E. Sprague, "The Origin of Balloon Framing," *Journal of the Society of Architectural Historians*, XL (December, 1981), pp 311-19; George E. Woodward, *Woodward's Country Homes* (New York: Geo. E. Woodward, 1866), pp 151-66. When asked about prefab construction, William A. Starrett stated: "'As a practical matter the thing would be a disappointment, if not a disaster.' He pointed out that prefabs would necessitate longer roads and utility lines than the larger two-story cantonment types. Productive capacity was small, and a prefab order... would 'swamp the mills of the country.'" Leonore Fine and Jesse A. Remington, *The Corps of Engineers*, p 68.

2.9 *Report of the Board of Review of Construction to the Assistant Secretary of War* (Washington: GPO, 1920), pp 121, 70; Fine and Remington, *U.S. Army in World War II,* pp 171-72; "Construction Trends," *Engineering News-Record,* 127 (July 1941), front matter; "Experimental Barracks at Camp Grant," *Engineering News-Record,* 126 (May 1941), pp 50-52.

2.10 For an overview of cost-plus-fixed-fee contracting, see Fine and Remington, *U.S. Army in World War II,* pp 23, 102-06, passim. See also: Harry B. Yoshpe, "The Small Business Man and Quartermaster Contracts, 1940-1942," *Q.M.C. Historical Studies,* no. 2 (April 1943), pp 1-3.

2.11 Maurice Matloff, *American Military History* (Washington: GPO, 1969), pp 418-19, 435, 463, 465.

2.12 Samuel Eliot Morison, *History of United States Naval Operations in World War II,* vol 3 (Boston: Little, Brown, and Co., 1947-62), p 59; Manning, *Building the Navy's Bases in World War II,* pp 261-62, 268-276.

2.13 *Ibid.,* pp 61-76; Ben Moreell, "The Bureau of Yards and Docks," *The Military Engineer,* 35 (July 1943), p 345; for an historical sketch of the Bureau of Yards and Docks, see: Eugene J. Peltier, *The Bureau of Yards and Docks of the Navy and the Civil Engineer Corps* (Princeton: The Newcomen Society, 1939); for a study of its counterpart see: William P. Robert, *History of the Construction Corps of the United States Navy* (Washington: GPO, 1937). Moreell, father of the Seabees, received approval in October 1941, but the first units were not assembled until 1942, see: Morison, *History of United States Naval Operations in World War II,* vol 5, p 75; Waldo G. Bowman, "The Seabees Are Coming," *Engineering News-Record,* 129 (September 1942), pp 65-72.

2.14 Brehon B. Somervell, Brig. Gen., "The Army and National Defense," *United States Investor,* 52 (November 1941), pp 2047-48.

2.15 Fine and Remington, *The Corps of Engineers,* pp 158-59, 217, 242-43; Eugene Reybold, "The Construction Program for Our Army," *The Military Engineer,* 35 (July 1943), pp 329-33.

3.1 Willard B. Robinson, *American Forts: Architectural Form and Function* (Urbana: University of Illinois Press, 1977), pp 63, 65-67.

3.2 *Ibid.,* pp 95-103.

3.3 James McPherson, *Battle Cry of Freedom: A History of the Civil War* (New York: Oxford University Press, 1988); *The Rock Island Arsenal*; John S. Billings, *A Report on Barracks and Hospitals, with Descriptions of Military Posts* (Washington: GPO, 1870), pp xi, 25-26.

3.4 Robert A. Murray, *Military Posts in the Powder River Country of Wyoming, 1865-1894* (Lincoln: University of Nebraska Press, 1968), chap 3; For dates of occupation of frontier forts see: Robert W. Frazer, *Forts of the West. Military Forts and Presidios and Posts Commonly Called Forts West of the Mississippi River to 1898* (Norman: University of Oklahoma Press, 1965). Robinson, *American Forts,* pp 163, 165.

3.5 Billings, *A Report on Barracks and Hospitals,* pp xxxii-xxxiii.

3.6 Risch, *Quartermaster Support of the Army,* p 581; *Report of the Board of Review of Construction to the Assistant Secretary of War* (Washington: GPO, 1920), p 121; *Handbook for Quartermasters* (Washington: GPO, 1930), pp 817-67.

3.7 *Manual for the Quartermaster Corps: United States Army* (New York: Military Publishing Co., 1916), app 16, pp 337-369; two essays that explain the differences in board and batten and plankwall construction as opposed to balloon frame are: Robert Jensen, "Board and Batten Siding and the Balloon Frame: Their Incompatibility in the Nineteenth Century," *Journal of the Society of Architectural Historians*, 30 (March 1971), pp 40-50; T. Ritchie, "Plankwall Framing, a Modern Wall Construction with an Ancient History," *Journal of the Society of Architectural Historians*, 30 (March 1971), pp 66-70.

3.8 "Plans for Army's Big Training Camps Made Public," *Engineering News-Record*, LXXIX (July 1917), pp 8-10; *Handbook for Quartermasters*, pp 831-33; Carl F. Pilat, "Camp Lewis, American Lake, Wash.," *Architectural Record*, XLIII (January 1918), pp 52-64.

3.9 *Manual of the Quartermaster Corps*, pp 356-57.

3.10 Daniel B. Niederlander, "United States Aeronautical Schools: Kelly Field No. 2, South San Antonio, Texas," *Architectural Record*, XLV (May 1919), pp 441-49. See also: Howard Dwight Smith, "Barracks Group and Hospital for the U.S. Army School of Military Aeronautics at Ohio State University, Columbus, Ohio," *Architectural Record*, XLIV (November 1918), pp 387-405.

3.11 Charles C. Loring, "American Combat Airdromes," *Architectural Record*, XLV (April 1919), pp 311-24.

3.12 "Housing the Navy Ashore," *Engineering News-Record*, 79 (July 1917), pp 4-7.

3.13 For details of Theater of Operations buildings in World War II, see *War Department Technical Manual, TM 5-280* (Washington: GPO, 1944).

3.14 "Housing the New Army," *Engineering News-Record*, 125 (October 1940), pp 43-47.

3.15 *Ibid.*, p 44.

3.16 *Ibid.*

3.17 *TM 5-226, War Department Manual, Carpentry* (Washington: GPO, 1943), p 144.

3.18 *Ibid.*; see also Diane Wasch and Perry Busch, "World War II Temporary Structures: The U.S. Army" (unpublished report by HABS/HAER, National Park Service, 1988), pp 44-46; E. F. Porter, Jr., "Barracks," *St. Louis Post-Dispatch Magazine*, 28 May 1989, pp 6-10.

3.19 Fine and Remington, *The Corps of Engineers*, p 266; James A. Glass, "Historic American Buildings Survey: Fort McCoy, Building T-1129 (Barracks)" (HABS: unpublished report, 1988), pp 2-11.

3.20 Glass, "HABS: Fort McCoy, Building T-1129 (Barracks)," p 7; *Manual of the Construction Division of the Army... 1918*, sec C, plate 60, "Details of Standard Roof Trusses."

3.21 "A Thousand Buildings in Five Months," *Engineering News-Record*, 126 (March 1941), pp 72-75; "A Building Every 54 Min. at Fort Ord," *Engineering News-Record*, 126 (March 1941), pp 75-76; "Erect Company Barracks in Three Hours," *Engineering News-Record*, 79 (September 1917), p 614.

3.22 "Handling a 20,000-Man Crew on a Camp Job," *Engineering News-Record*, 126 (June 1941), pp 66-68.

3.23 *Activities of the Bureau of Yards and Docks... 1917-18,* p 91; "Navy Goes into Action on Housing," *Engineering News-Record,* 125 (October 1940), pp 40-42.

3.24 "Honor Albert Kahn, Inc.," *Engineering News-Record,* 130 (April 1943), p 2.

3.25 "Naval Training Station: East Coast," *Architectural Forum,* 79 (September 1943), pp 47, 50-51; "Navy Camp Built from Non-Critical Materials," *Engineering News-Record,* 130 (January 1943), pp 46-48; "Construction documents," Navy Public Works Center, Great Lakes, IL.

3.26 "Navy Camp Built from Non-Critical Materials," p 48.

3.27 *Ibid.*, pp 48-49; "Plan to Hold 1943 Building to Two-Thirds of 1942 Rate," *Engineering News-Record,* 129 (October 1942), p 597; "Special Expedients Speed Construction of Naval Air Training Station, *Engineering News-Record,* 130 (June 1943), pp 99-100.

3.28 "Construction documents," Navy Public Works Center, Great Lakes, IL.

3.29 Charles F. O'Connell, Jr., "Historic American Engineering Record: Quonset Point Naval Air Station" (HAER: unpublished report, 1979), pp 106-108.

3.30 David W. Chase, "Camp Endicott: Davisville Construction Battalion Cetner," National Register of Historic Places Inventory - Nomination Form, 1977, pp 1-2.

4.1 Robinson, *American Forts,* p 165.

4.2 Maurice Matloff, *American Military History* (Washington: GPO, 1969), p 322; "Housing the Navy Ashore," pp 4-7; Navy Camp Contracts Let," *Engineering News-Record,* 79 (July 1917), p 93.

4.3 *Ibid.*, p 287.

4.4 Fine and Remington, *The Corps of Engineers,* pp 139-42.

4.5 *Ibid.*, p 16; "Report of the Construction Division," *War Department Annual Reports, 1918,* pp 1291-92, 1277, 1287.

4.6 Pilat, "Camp Lewis," 52-64; "Report of the Construction Division," *War Department Annual Reports, 1918,* p 1331.

4.7 *Ibid.*, p 46; "The Making of Camp Lewis," *American Architect,* CXII (November 1917), p 359.

4.8 "The Making of Camp Lewis," pp 352-53.

4.9 W. G. Kilner and A. J. MacElroy, *The Cantonment Manual* (New York: D. Appleton and Co., 1918), pp 8, 190; "Report of the Construction Division," *War Department Annual Reports, 1918,* p 1291.

4.10 "Housing the New Army," *Engineering News-Record,* 125 (October 1940) 43-47; Matloff, *American Military History,* pp 461-62, 465.

4.11 Alvah Bessie, "From Reveille to Rest," *New Masses,* 44 (August 1942), p 9.

4.12 Alvah Bessie, "Meet the Army," *New Masses,* 44 (August 1942), p 11.

4.13 Bessie, "From Reveille to Rest," p 11.

4.14 Letter from D.G. Aronberg, Walsh Construction Company, to August G. Sperl, 13 August 1956, p 2.

4.15 Architect-Engineer's Report on Camp Edwards, 4 June 1941, pp 8, 17-22, 35-36; "Handling a 20,000-Man Crew on a Camp Job," pp 66-68.

4.16 James A. Glass, "Historic American Buildings Survey: History of the Planning and Construction of Camp McCoy, Wisconsin, 1940-46" (unpublished report, 1988), pp 1-5. Thomas Doherty, "Blitzkrieg for Beginners: The Maneuvers of 1940 in Central Wisconsin," *Wisconsin Magazine of History,* 68 (Winter 1985), pp 83-107.

4.17 Fine and Remington, *The Corps of Engineers,* pp 342-54; Glass, "HABS: History of the Planning and Construction of Camp McCoy," pp 9-16.

4.18 See: Mel Scot, *American City Planning Since 1890* (Berkeley: University of California Press, 1969); Glass, "HABS: History of the Planning and Construction of Camp McCoy," p 25.

4.19 Robert David Kreger, "The Making of an Institutional Landscape: Case Studies of Air Force Bases, World War I to the Present" (Urbana: University of Illinois Ph.D. dissertation, 1988), pp 122-47.

4.20 *Ibid.*

4.21 Chanute Air Force Base, "History of Chanute Technical Training Center," vol 1 (Chanute: unpublished history, 1985); USACERL tabulations: World War II Temporary Buildings.

4.22 *Activities of the Bureau of Yards and Docks... 1917-18,* pp 46-76, 83-91.

4.23 *Ibid.,* pp 83-91.

4.24 "Special Expedients Speed Construction of Naval Air Training Station," *Engineering News-Record,* 130 (June 1943), pp 96-101.

4.25 "Building the Corpus Christi Naval Air Base," *Engineering News-Record,* 127 (July 1941), pp 54-59.

4.26 *U.S. House Reports, 5630, 77th Congress, 1st. Session* (Washington: GPO, 1942); Richard L. Neuberger, "Mountain Air for the Navy," *Collier's,* 110 (December 1942), pp 60-63.

4.27 Manning, *Building the Navy's Bases in World War II,* pp 268-73.

4.28 *Ibid.;* Neuberger, "Mountain Air for the Navy," 61; "Navy Life," *The New Yorker Magazine,* 19 (September 1943), pp 44-45.

4.29 Manning, *Building the Navy's Bases in World War II,* p 271.

4.30 *Activities of the Bureau of Yards and Docks... 1917-18,* pp 93-94; Manning, *Building the Navy's Bases in World War II,* pp 279-90.

4.31 *Ibid.*

4.32 "Marine Corps Base, Camp Pendleton: Basewide Maps" (Public Works Office, Camp Pendleton, 1988), p 37.

5.1 U.S. Army, U.S. Air Force, U.S. Navy, and U.S. Marine Corps real property databases, September 1991.

5.2 Carl Nelson, *Protecting the Past From Natural Disasters* (Washington: Preservation Press, 1990), pp 45-47.

5.3 To offer insight into just how different today's Army life is than that of World War II, see: Larry H. Ingraham and Frederick J. Manning, *The Boys in the Barracks: Observations on American Military Life* (Philadelphia: Institute for the Study of Human Issues, 1984), chap 6.

5.4 An amusing reminiscence of life in the old-style barracks at Fort Leonard Wood, Missouri, and one the author also recalls during his internment there, was recently written by John M. McGuire and entitled "Not So Fond Recollections of 'Fort Lost in the Woods'," *St. Louis Post-Dispatch Magazine,* Sunday, 28 May 1989, p 11. See also: E. F. Porter, "Barracks: Once Home to Millions, the World War II Design Classic is About to Become a Memory, and Museum" in the same issue, pp 6-10.

Appendix A: Remaining World War II Temporary Buildings by Service and Installation (as of 10 July 1990)

ARMY Installations with 100 or more units	*(No. of units)*
Aberdeen Proving Ground	251
Fort Chaffee	1202
Fort Benning	616
Fort Bliss	385
Fort Bragg	1216
Fort Campbell	738
Fort Carson	242
Fort Devons	366
Fort Dix	105
Fort Drum	890
Fort Eustis	109
Fort Meade	547
Fort Gillem	112
Fort Gordon	494
Fort Hood	688
Fort Indiantown Gap	988
Fort Jackson	471
Fort Knox	907
Fort Lee	313
Fort Leonard Wood	651
Fort Lewis	1415
Fort McCoy	1325
Fort Monmouth HQ ECOM	139
Fort Ord	981
Fort Pickett	436
Fort Polk	1028
Fort Riley	379
Fort Sam Houston	168
Fort Sill	715
Fort Stewart	434
Fort Huachuca	288
Hunter Army Airfield	101
Joliet AAP Elwood	109
McClellan	273
NG Camp Atterbury	141
NG Camp Roberts	728
NTC & Fort Irwin	116
Rucker	348
Schofield BKS	100
USA Engr. Cntr. Fort Belvoir	238

AIR FORCE Installations with 100 or more units ***(No. of units)***

Boise Air TRML 127
Chanute AFB 143
Hill AFB 133
Lackland AFB 330
Vandenberg AFB 107

NAVY Installations with 20 or more units ***(No. of units)***

CBC Davisville RI 51
CBC Port Hueneme CA 28
NAS Barbers Point HI 20
NAVIRTESTCEN Patuxent Rivr MD 61
NAVORDSTA Indian Head MD 37
NAVPHIBASE Coronado SD 28
NAVPHIBASE Little Creek VA 45
NAVSTA Treasure Island CA 48
WPNSTA Seal Beach CA 21
WPNSTA Yorktown VA 22

MARINE CORPS Installations with 20 or more units ***(No. of units)***

MCAS El Toro CA 97
MCB Camp Pendleton CA 115

Appendix B: Bibliography

Bound Volumes: Government Reports and Histories

Activities of the Bureau of Yards and Docks, Navy Department, World War, 1917-1918. Washington: GPO, 1921.

Annual Report of the Chief of Engineers, 1939: Commercial Statistics Water-borne Commerce of the U.S. Washington: GPO, 1939.

Billings, John S. *A Report on Barracks and Hospitals, with Descriptions of Military Posts.* Washington: GPO, 1870.

Chudacoff, Howard P. *The Evolution of American Urban Society.* Englewood Cliffs, N.J.: Prentice-Hall, 1981.

Citadels of Democracy: Camps & Plants for Men and Munitions. Washington: GPO, 1941.

Condit, Carl. *American Building.* Chicago: University of Chicago Press, 1968.

Fine, Lenore and Jesse A. Remington. *The Corps of Engineers: Construction in the United States, vol 6, part 6, vol 3, in U.S. Army in World War II.* Washington: GPO, 1972.

Frazer, Robert W. *Forts of the West: Military Forts and Presidios and Posts Commonly Called Forts West of the Mississippi River to 1898.* Norman: University of Oklahoma Press, 1965.

Gowans, Alan. *The Comfortable House.* Cambridge: MIT Press, 1986.

Handbook for Quartermasters. Washington: GPO, 1930.

Hofstadter, Richard, et al. *The United States: The History of A Republic.* Englewood Cliffs, N.J.: Prentice-Hall, 1961.

Ingraham, Larry H. and Frederick J. Manning. *The Boys in the Barracks: Observations on American Military Life.* Philadelphia: Institute for the Study of Human Issues, 1984.

Kilner, W. G. and A. J. MacElroy. *The Cantonment Manual.* New York: D. Appleton and Co., 1918.

Manning, John J. *Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946.* Washington: GPO, 1947.

Manual for the Quartermaster Corps: United States Army. New York: Military Publishing Co., 1916.

Manual of the Construction Division of the Army . . . 1918. Washington: GPO, 1918.

Matloff, Maurice. *American Military History.* Washington: GPO, 1969.

McPherson, James. *Battle Cry of Freedom: A History of the Civil War.* New York: Oxford University Press, 1988.

Morison, Samuel Eliot. *History of United States Naval Operations in World War II,* vol 3. Boston: Little, Brown, and Co., 1947-62.

Murray, Robert A. *Military Posts in the Powder River Country of Wyoming, 1865-1894.* Lincoln: University of Nebraska Press, 1968.

Peltier, Eugene J. *The Bureau of Yards and Docks of the Navy and the Civil Engineer Corps.* Princeton: The Newcomen Society, 1939.

Report of the Board of Review of Construction to the Assistant Secretary of War. Washington: GPO, 1920.

Risch, Erna. *Quartermaster Support of the Army: A History of the Corps, 1775-1939.* Washington: GPO, 1962.

Robert, William P. *History of the Construction Corps of the United States Navy.* Washington: GPO, 1937.

Robinson, Willard B. *American Forts: Architectural Form and Function.* Urbana: University of Illinois Press, 1977.

Scot, Mel. *American City Planning Since 1890.* Berkeley: University of California Press, 1969.

Severo, Richard and Lewis Milford. *The Wages of War: When American Soldiers Came Home.* New York: Simon and Schuster, 1989.

TM 5-226, War Department Manual, Carpentry. Washington: GPO, 1943.

U.S. House Reports, 5630, 77th Congress, 1st. Session. Washington: GPO, 1942.

War Department Annual Reports, 1918, vol 1. Washington: GPO, 1921.

War Department Technical Manual, TM 5-280. Washington: GPO, 1944.

Woodward, George E. *Woodward's Country Houses.* New York: Geo E. Woodward, 1866.

Serials

"A Building Every 54 Min. at Fort Ord." *Engineering News-Record,* 126 (March 1941), pp 75-76.

"A Thousand Buildings in Five Months." *Engineering News-Record,* 126 (March 1941), pp 72-75.

Bessie, Alvah. "From Reveille to Rest." *New Masses,* 44 (11 August 1942), pp 9-11.

_____. "Meet the Army." *New Masses,* 44 (4 August 1942), pp 10-13.

Bowers, N. A. "New Barrack[s] Design Saves Lumber." *Engineering News-Record,* 133 (November 1944), pp 68-69.

Bowman, Waldo G. "The Seabees Are Coming." *Engineering News-Record,* 129 (September 1942), pp 65-72.

"Building a Camp in the Wilderness [Fort Leonard Wood]." *Engineering News-Record,* 126 (May 1941), pp 86-89.

"Building for Defense." *Architectural Forum,* 74 (April 1941), pp 16, 94.

"Building the Corpus Christi Naval Air Base." *Engineering News-Record,* 127 (July 1941), pp 54-59.

"Construction Trends." *Engineering News-Record,* 127 (July 1941): frontmatter.

DeBerard, W. W. "Commndeer Organizations for Illinois Cantonment Construction." *Engineering News-Record,* 79 (August 1917), pp 388-93.

Doherty, Thomas. "Blitzkrieg for Beginners: The Maneuvers of 1940 in Central Wisconsin." *Wisconsin Magazine of History,* 68 (Winter 1985), pp 83-107.

"Emergency Cantonment Construction." *The Military Engineer,* 33 (January-February 1941), pp 6-9.

"Emergency Hospitals for the U.S. Navy." *Architectural Record,* 92 (August 1942), pp 59-60.

"Erect Company Barracks in Three Hours." *Engineering News-Record,* 79 (September 1917), p 614.

"Experimental Barracks at Camp Grant." *Engineering News-Record,* 126 (May 1941), pp 50-52.

"Fighting Mud at Camp Wallace." *Engineering News-Record,* 126 (April 1941), pp 58-60.

"5,000 Houses in 5 Months." *Engineering News-Record,* 129 (August 1942), pp 80-85.

"Glued, Laminated Wood Arches for Defense Projects." *Engineering News-Record,* 130 (April 1943), p 513.

"Handling a 20,000-Man Crew on a Camp Job." *Engineering News-Record,* 126 (June 1941), pp 66-68.

"Headway and Headaches." *Architectural Forum,* 74 (February 1941), p 82.

"Housing the Navy Ashore." *Engineering News-Record,* 79 (July 1917), pp 4-7.

"Housing the New Army." *Engineering News-Record,* 125 (October 1940), pp 43-47.

Jensen, Robert. "Board and Batten Siding and the Balloon Frame: Their Incompatibility in the Nineteenth Century." *Journal of the Society of Architectural Historians,* 30 (March 1971): 40-50.

Loring, Charles C. "American Combat Airdromes." *Architectural Record,* 45 (April 1919), pp 311-24.

McGuire, John M. "Not So Fond Recollections of 'Fort Lost in the Woods'." *St. Louis Post-Dispatch Magazine* (Sunday, 28 May 1989), p 11.

"Military and Naval Buildings." *Architectural Forum,* 70 (November 1940), pp 342-71.

Moreell, Ben. "The Bureau of Yards and Docks." *The Military Engineer,* 35 (July 1943), p 345.

"Naval Training Station: East Coast." *Architectural Forum,* 79 (September 1943), pp 47-53.

"Navy Camp Built from Non-Critical Materials." *Engineering News-Record,* 130 (January 1943), pp 46-49.

"Navy Camp Contracts Let." *Engineering News-Record,* 79 (July 1917), p 93.

"Navy Goes Into Action on Housing." *Engineering News-Record,* (October 1940), pp 40-42.

"Navy Life." *The New Yorker Magazine,* 19 (September 1943), pp 44-45.

Neuberger, Richard L. "Mountain Air for the Navy." *Collier's,* 110 (December 1942), pp 60-63.

Niederlander, Daniel B. "United States Aeronautical Schools: Kelly Field No. 2, South San Antonio, Texas." *Architectural Record,* 45 (May 1919), pp 441-49.

Pilat, Carl F. "Camp Lewis, American Lake, Wash." *Architectural Record,* 43 (January 1918), pp 52-64.

"Plan to Hold 1943 Building to Two-Thirds of 1942 Rate." *Engineering News-Record,* 129 (October 1942), pp 1-2.

"Plans for Army's Big Training Camps Made Public." *Engineering News-Record,* 79 (July 1917), pp 8-10.

Porter, E. F. "Barracks." *St. Louis Post-Dispatch Magazine (*Sunday, 28 May 1989), pp 6-10.

_____. "Saluting the GI Garden Apartment." *Chicago Tribune,* Monday, 19 June 1989.

"Prefabricated Housing for Marines at Quantico." *Engineering News-Record,* 126 (January 1941), pp 4-5.

"Prefabrication: Modulok—a Wartime System." *Architectural Forum,* 79 (September 1943), pp 65-67.

"Pride of the Cantonment Program [Camp Robinson]." *Architectural Forum,* 74 (March 1941), pp 179-80.

Reybold, Eugene. "The Construction Program for Our Army." *The Military Engineer,* 35 (July 1943), pp 329-33.

Ritchie, T. "Plankwall Framing, a Modern Wall Construction with an Ancient History." *Journal of the Society of Architectural Historians,* 30 (March 1971), pp 66-70.

Smith, Howard Dwight. "Barracks Group and Hospital for the U.S. Army School of Military Aeronautics at Ohio State University, Columbus, Ohio." *Architectural Record,* 44 (November 1918), pp 387-405.

Somervell, Brehon B., Brig. Gen. "The Army and National Defense." *United States Investor,* 52 (November 1941), pp 2047-48.

"Special Expedients Speed Construction of Naval Air Training Station." *Engineering News-Record,* 130 (June 1943), pp 96-101.

Sprague, Paul E. "The Origin of Balloon Framing." *Journal of the Society of Architectural Historians,* 40 (December 1981), pp 311-19.

Thatcher, Harold W. "Planning for Industrial Mobilization, 1920-1940." *Q.M.C. Historical Studies,* no. 4 (August 1943).

"The Making of Camp Lewis." *American Architect,* 112 (November 1917), pp 352-59.

Tomlin, Robert K. "Engineering Team-Work Aids Rush Army Job at Camp Upton, N.Y." *Engineering News-Record,* 79 (August 1917), pp 340-46.

"War-Front Type Barracks Built in Record Time." *Engineering News-Record,* 129 (July 1942), pp 68-69.

Yoshpe, Harry B. "The Small Business Man and Quartermaster Contracts, 1940-1942." *Q.M.C. Historical Studies,* no. 2 (April 1943).

Unpublished Documents

Chanute Air Force Base. *History of Chanute Technical Training Center,* vol 1, Chanute: unpublished history (1985).

Glass, James A. *Historic American Buildings Survey: Fort McCoy, Building T-1129 (Barracks),* HABS: unpublished report (1988).

_____. *Historic American Buildings Survey: History of the Planning and Construction of Camp McCoy, Wisconsin, 1940-46,* HABS: unpublished report (1988).

Kreger, David Robert. *The Making of an Institutional Landscape: Case Studies of Air Force Bases, World War I to the Present,* Urbana: University of Illinois Ph.D. dissertation (1988).

Moots, R., et al. Map Illustrating U.S. Military Bases with WWII Temporary Structures, USACERL: ACA laboratory (1990).

O'Connell, Charles F. *Historic American Engineering Record: Quonset Point Naval Air Station,* HAER: unpublished report (1979).

Snyder, Alan K. *A Guide to Archival Sources for the Study of World War II Temporary Buildings,* U.S. Army: Corps of Engineers (1988).

Swanberg, Arnold Frederick. *The Development of the Army Planning Process: A Case Study of Fort Lewis,* Seattle: University of Washington M.U.P. thesis (1982).

Wasch, Diane and Perry Busch. *World War II Temporary Structures: The U.S. Army,* HABS/HAER: unpublished report (1988).

Wood, Richard G. *Preliminary Inventory of the Records of the Bureau of Yards and Docks,* Washington: The National Archives Preliminary Inventory no. 10 (1948).

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