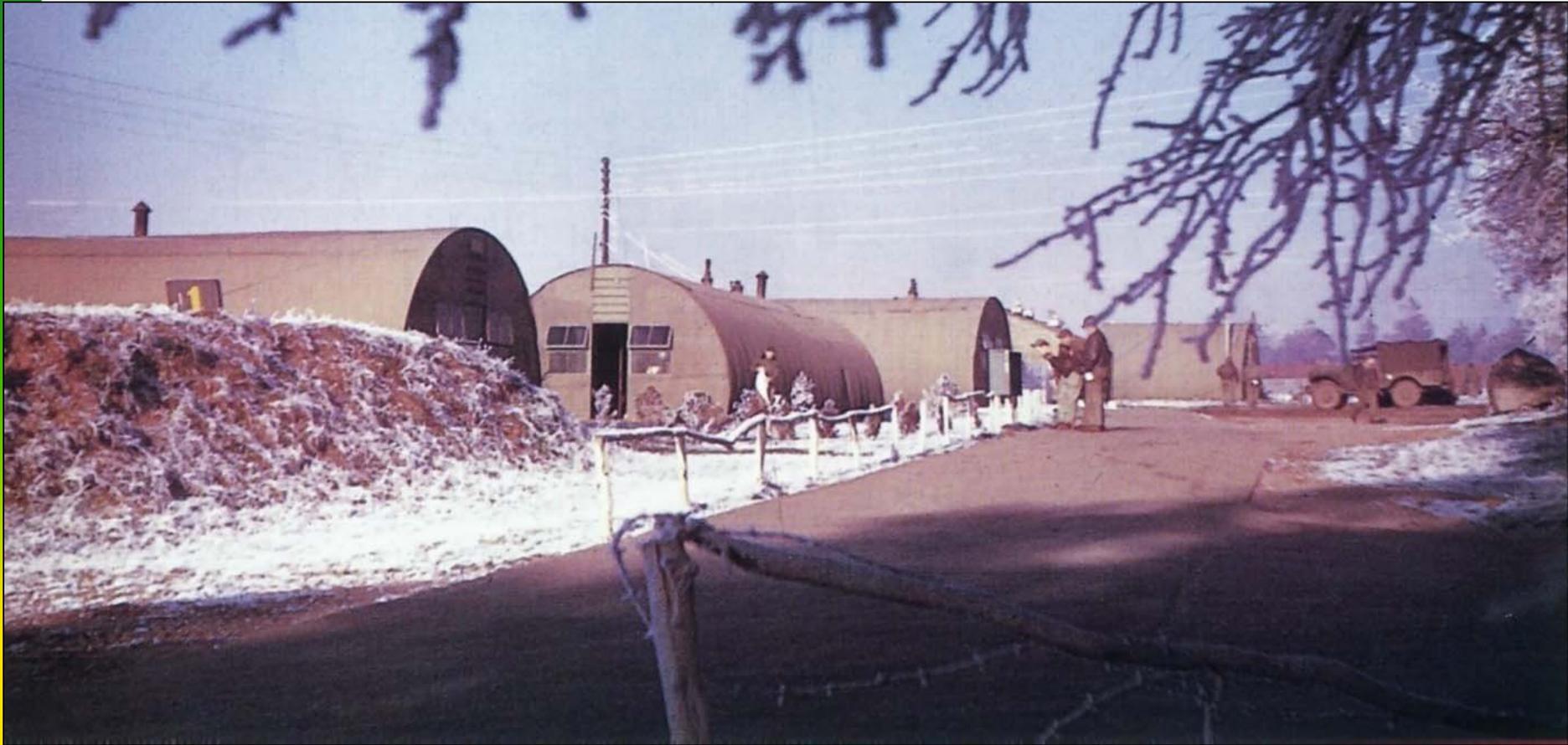
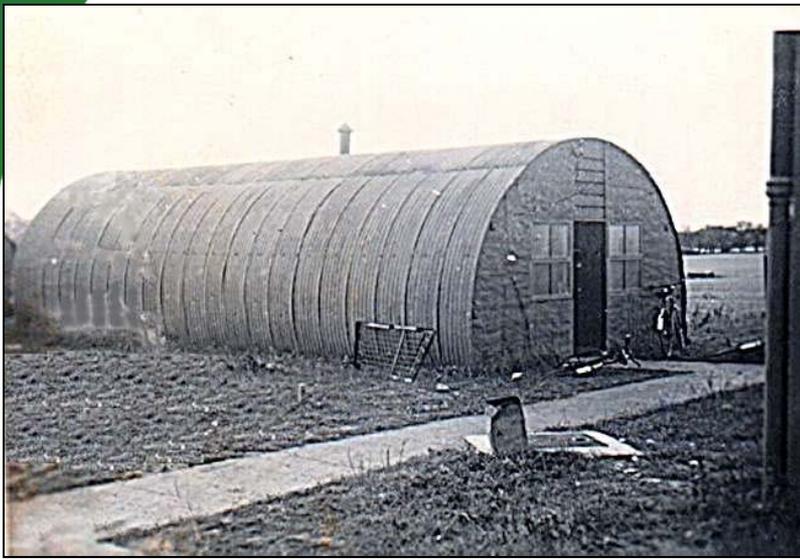


NISSEN and QUONSET HUTS



J. David Rogers, Ph.D., P.E.

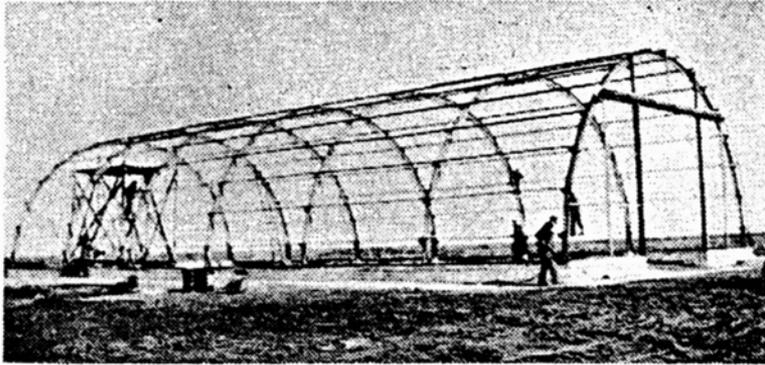
Missouri University of Science & Technology



- Image at right shows Lt Colonel Peter Nissen, a Canadian officer in the Royal Engineers during the First World War. He developed the Nissen Hut in mid 1916 to house troops in the build-up for the Battle of the Somme. The early huts had dirt or concrete floors and were devoid of insulation. Nissen Huts were usually equipped with a single coke and coal-fired potbelly stove for heating. **100,000 examples** were produced after its introduction in August 1916.

Field Construction Simplified in All-Steel Building

A new type of steel building, built without interior supporting posts, has been developed by the Columbian Steel Tank Co., Kansas City, Mo., to meet a demand for large storage space with a minimum of steel used. The building is made up of a series of steel trusses of welded construction, with angle iron

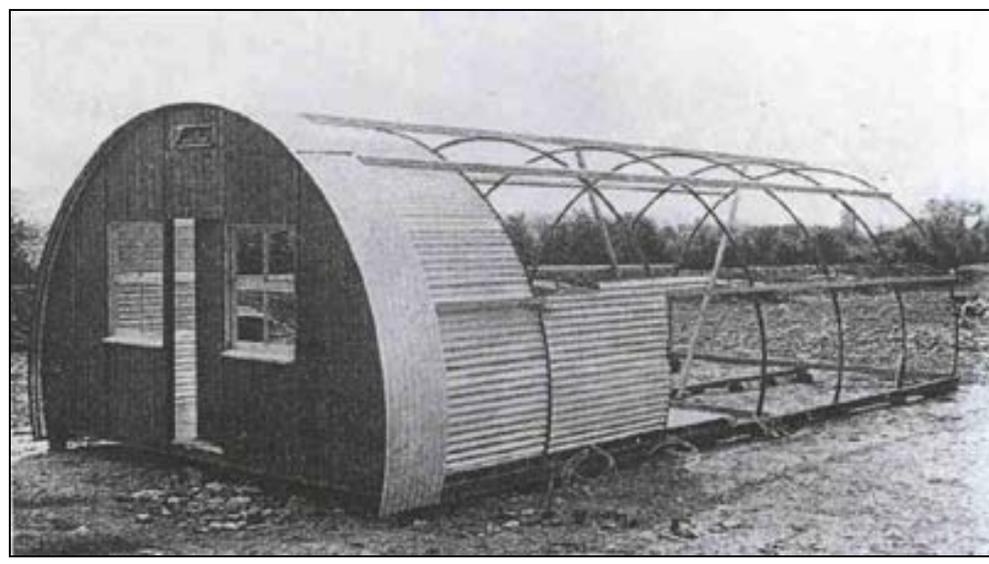


FRAME OF ALL-STEEL BUILDING

purlins running from end to end about 4 ft. apart, the whole covered by galvanized steel sheets. It is fabricated at the Columbian plant and may be set up by unskilled labor. The building pictured here is 40x90 ft. and is used to store combines and other large pieces of machinery on a Kansas wheat farm.

Steel Frame Hemispherical Structures in the United States

- In 1930 the Columbian Steel Tank Co. based in Kansas City began marketing a 40 x 90 ft steel frame storage structure, using a hemispherical structure with arch ribs and purlins, strikingly similar to the Navy's 'Elephant Quonset 40' Hut that appeared 13 years later, during the Second World War.

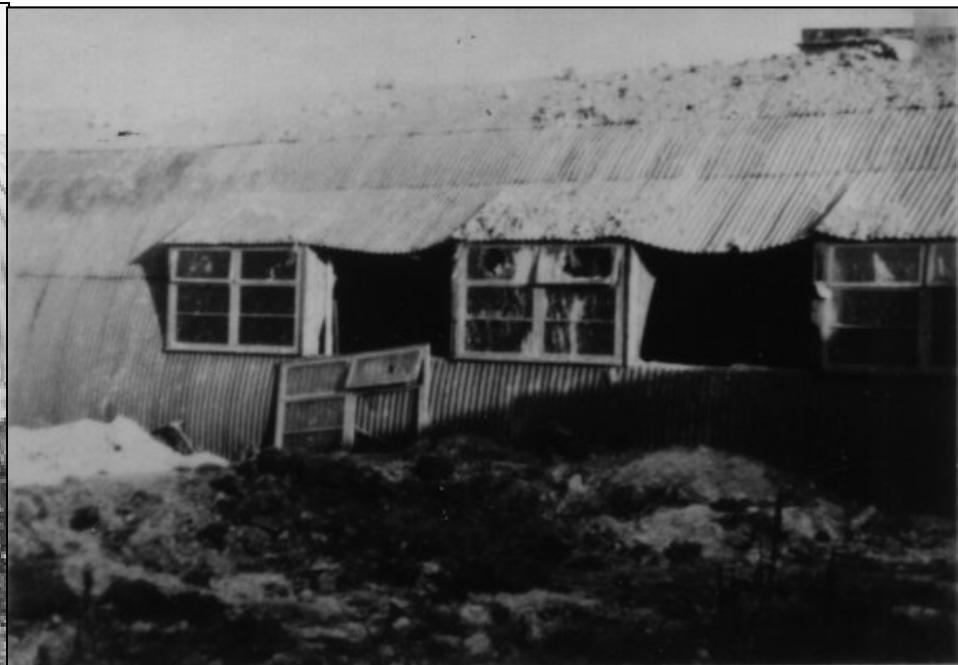


- Production of **Nissen Huts** waned between the wars but was revived in 1939, when the Second World War erupted. **Nissen Buildings Ltd** waived their patent rights for war-time production. The small Nissen Hut kits only weighed 3 tons and employed eight T-shaped ribs ($1\frac{3}{4} \times 1\frac{3}{4} \times 0.2$ inches) set 6 ft apart. Three pieces were bolted together to form each rib, with 24 rib sections comprising each kit. Nissen Huts could be constructed in any of **three widths: 16, 24, or 30 feet wide**, and any length, in multiples of 6 ft, shown to good effect at above left.

- Nissen Huts were used extensively at the former English air bases occupied by American forces in England, Scotland, Northern Ireland, and Iceland, as well as lend-lease bases in Newfoundland and the Caribbean during the Second World War.



Right - American Marines assembling English Nissen Huts in Iceland, where they were garrisoned in 1941-42 to relieve British forces. The Nissen Hut was smaller than American Quonset Huts, and it employed two layers of corrugated steel sheets on the lower sides and a single sheet over the above the roof. Those assembled in Iceland were unusual in that they included insulation, shown at right. The kit included assembly tools and a team of six could erect a Nissen Hut in a couple of hours. The huts were equipped with canvas cots and could accommodate 24 men.



- Left - In order to provide additional weatherproofing and insulation for their older style Nissen Huts in Iceland in 1941, American Marines **stacked sod** around the foundations and tied down the tin roofs with barbed wire. Note the wood frame **wind-baffle vestibules**, tacked onto the end of the Hut.
- Right - **Resilient Huts**: Bomb damage to Nissen Hut from nighttime German air attack on the American airfield at Rattlesden in England (708th BS/447th BG)



- View down "main street" of Nissen Huts at one of the camps built by the 1st Provisional Marine Brigade in Iceland during the summer of 1941, as seen in wintertime. Sandbags and peat piled against the huts were intended to provide greater warmth as well as protection from shrapnel. This view was taken after occupation by Army troops (Jan'42) and electrification of the huts.



- **16 ft and 36 ft wide Quonset Huts** begun by the George A Fuller Co. and completed by Navy Seabees at NAS Argentia, Newfoundland for the British Ferry Command in 1941-42. Note the covered corridor connecting the ends of the windowless Huts, seen at left. These huts were 16 ft wide and 72 ft long. Note the larger, 36 ft wide warehouse huts, in the center background. Argentia was an enormous lend-lease base with 10,000 inhabitants, constructed between January 1941 and the summer of 1943. US Navy patrol aircraft began operating from here in September 1941.



The American Army Air Force occupied 126 air bases in England in 1942-45. Image at right shows former RAF Nissen Huts with brick end walls at Deenethorpe (401st BG), constructed by the British in 1943 (note olive drab paint); while that at left shows standard Quonset Huts at Molesworth (303rd BG), constructed by American Army Engineers in May-June 1942. The American Quonset Huts employed corrugated steel end walls and provided about 224 sq feet of additional floor space. Note the contrast in curvature between the two types.

Life in a Nissen Hut

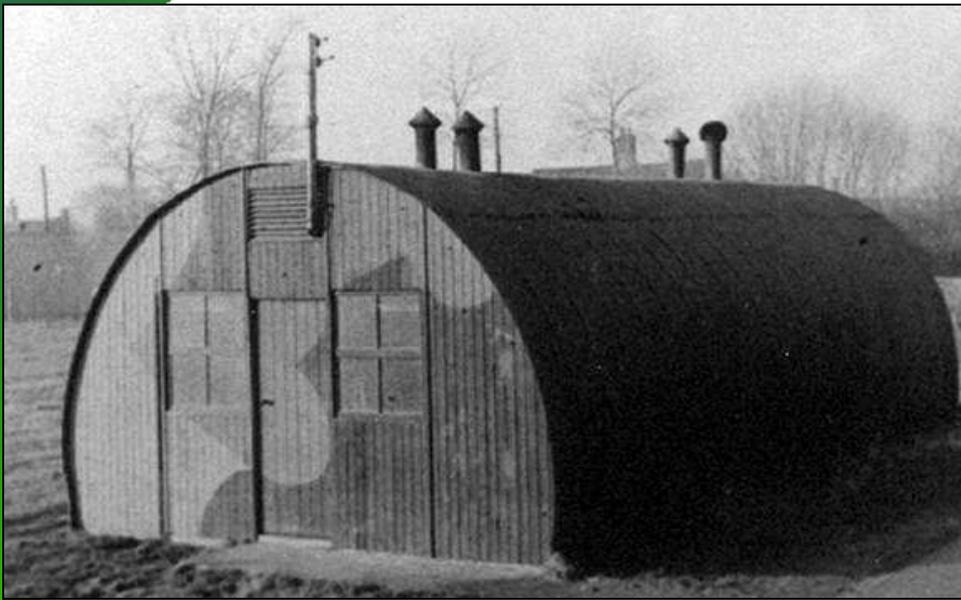


English Nissen Huts were usually constructed without interior insulation or paneling, as shown here (612th BS BOQ at Deenethorpe). The lower portion of the sidewalls were painted olive drab, heated by a coal fired pot belly stove, and usually filled with cigarette smoke and perpetual card games between missions.



- Interior of a 36 ft wide Nissen Hut serving as the officer's mess for the 401st Bombardment Group (H) at Deenethorpe Air Base in Northamptonshire, about 100 miles north of London. Note concrete slab floor, window dormers and layout of circular frames (3 ft on center) and connecting purlins. The 401st took this base over from the RAF in November 1943 and remained until June 1945.

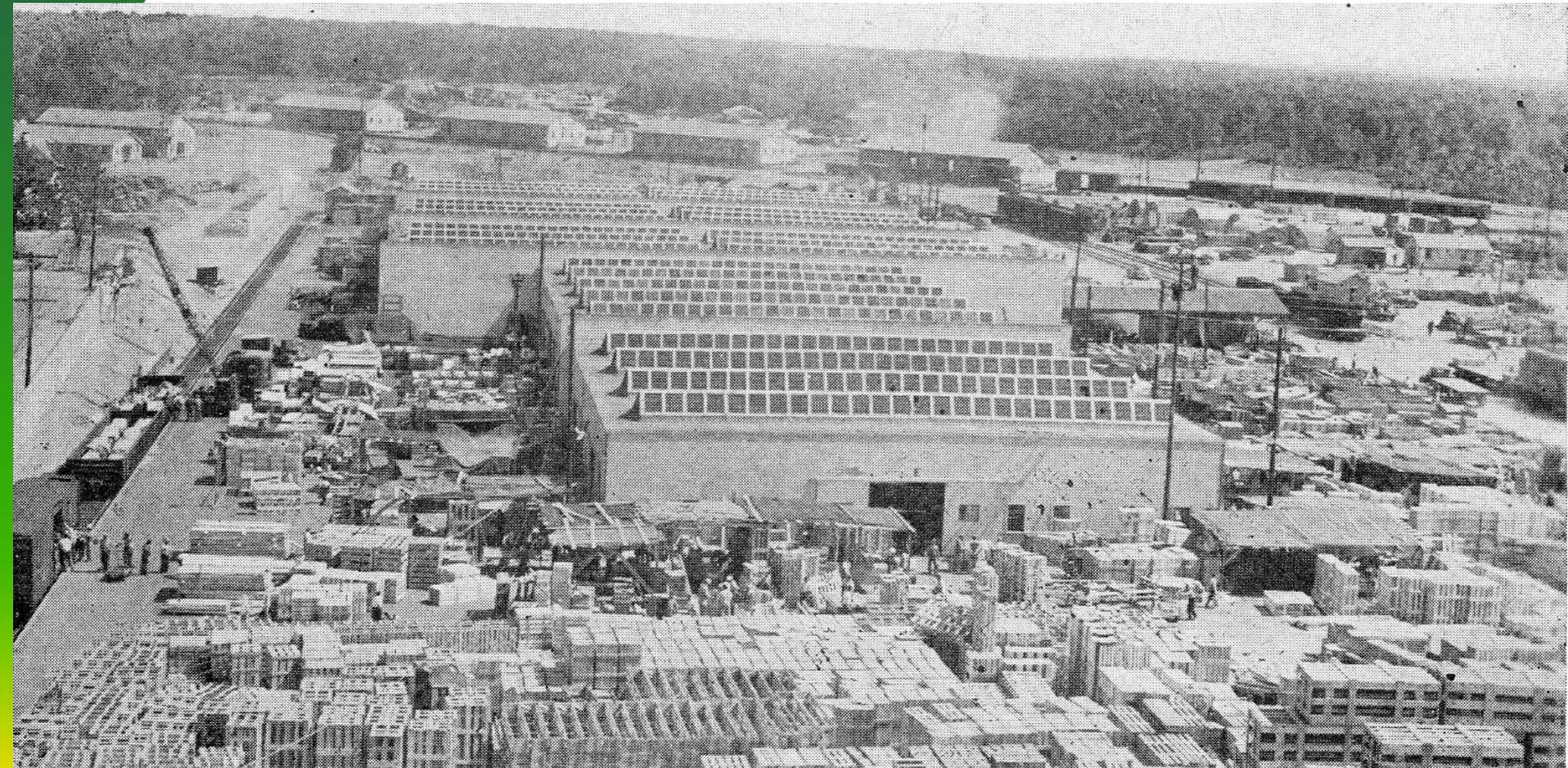
Nissen versus Quonset Huts



English Nissen Hut (above) and American Quonset Hut (below)



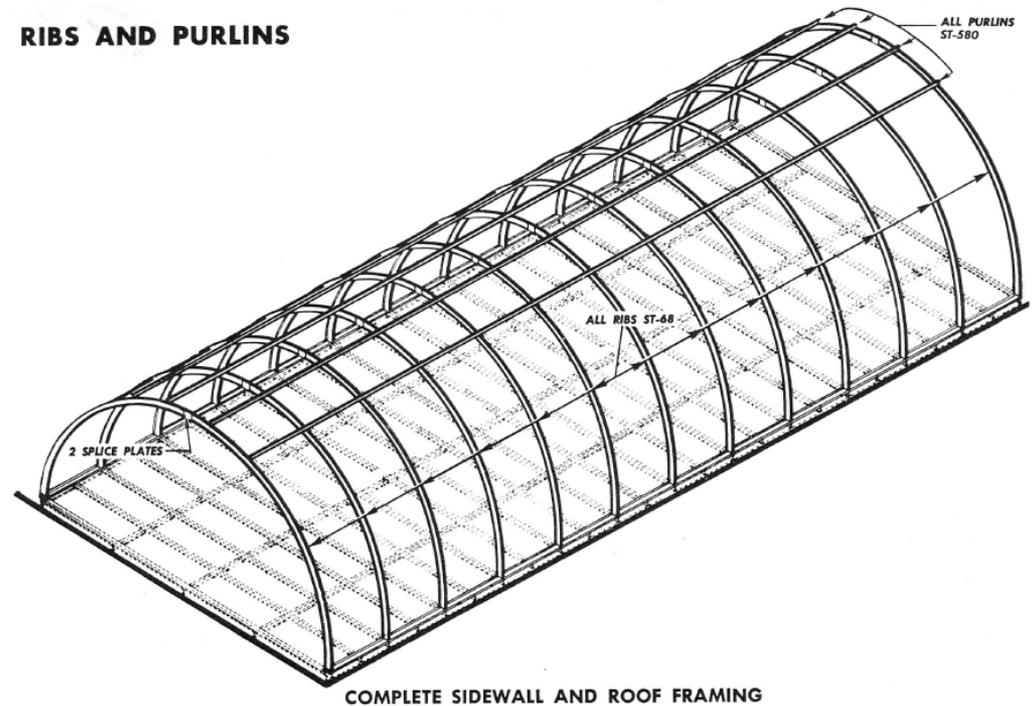
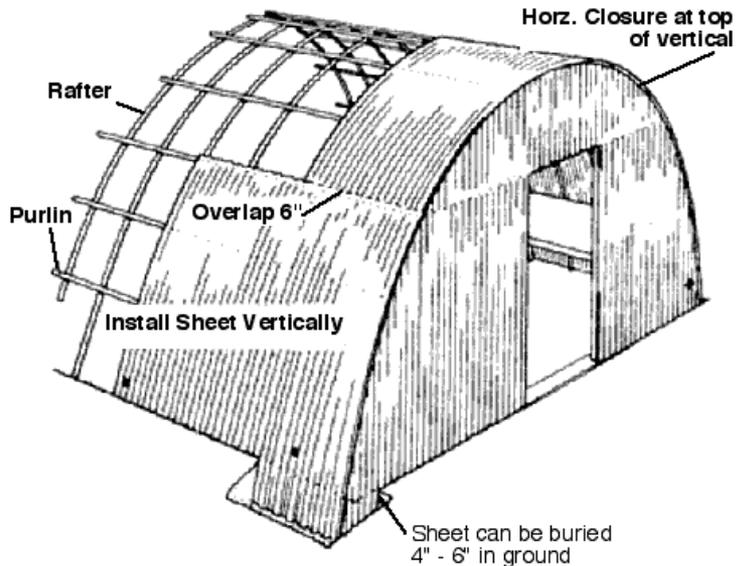
- The 8 ft radius of an English Nissen Hut was smaller than a Quonset 20 and encompassed 210 degrees of curvature; while the curvature of a 10 ft radius American Quonset Hut never exceeded 180 degrees, as seen here.
- The British felt their version allowed greater utilization of floor space, which was true.



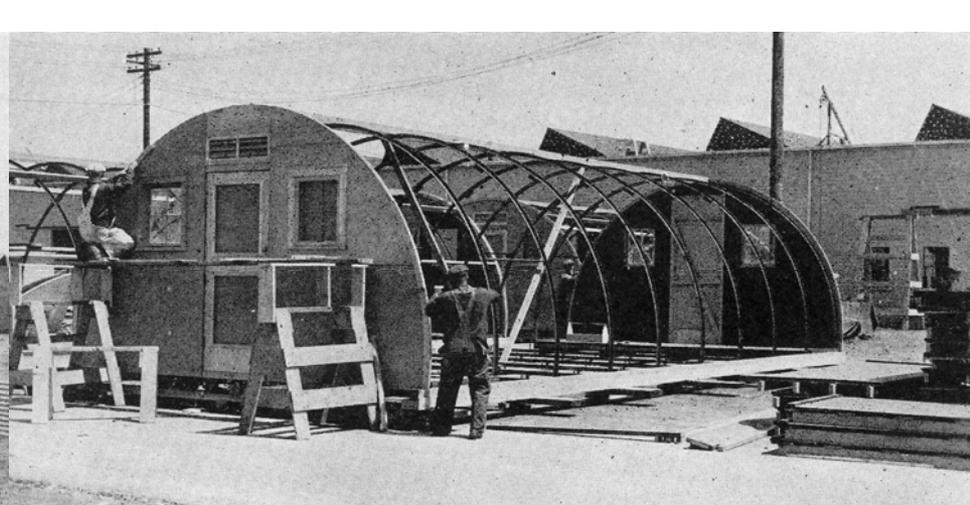
- In the spring of 1941 the Navy established a Temporary Advance Facilities compound at West Davisville, Rhode Island. It was here that the design and manufacturing concepts for prefabricated Quonset Huts was developed by a team from the George A. Fuller Co of New York, led by engineer Peter Dejongh and architect Otto Brandenberger.

Hallmark was its easy assembly

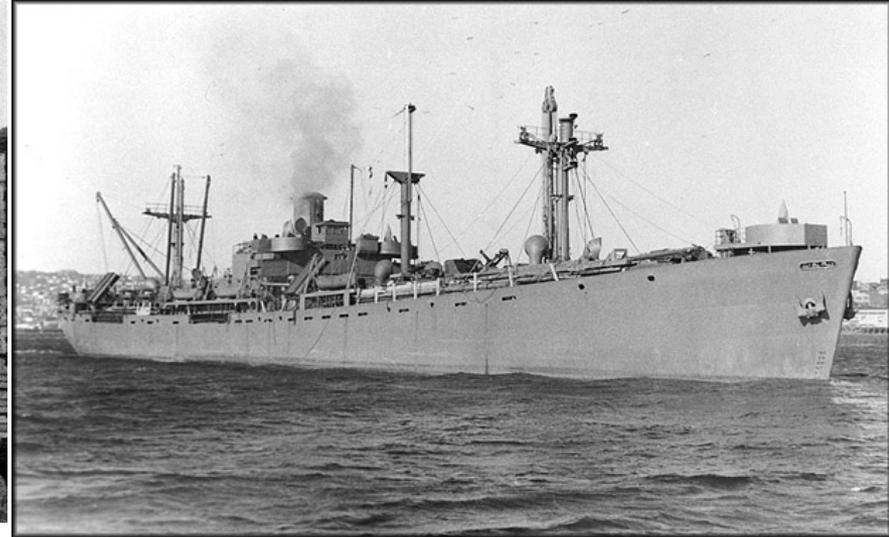
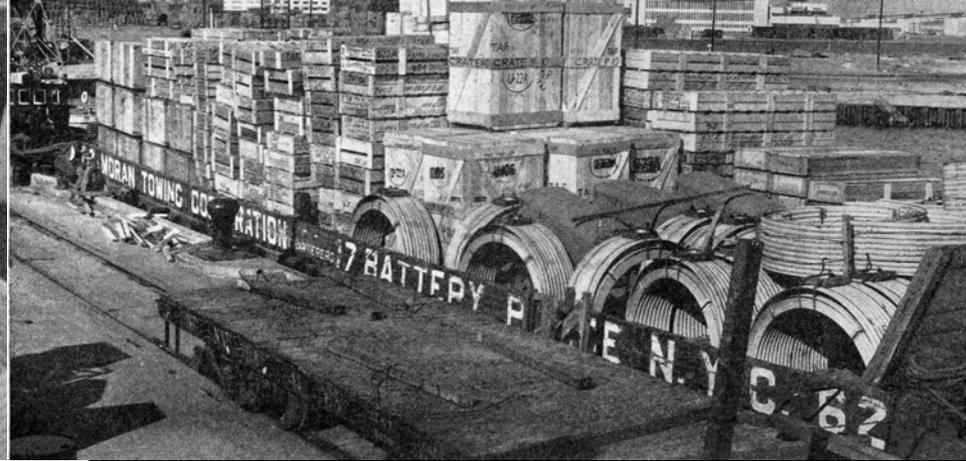
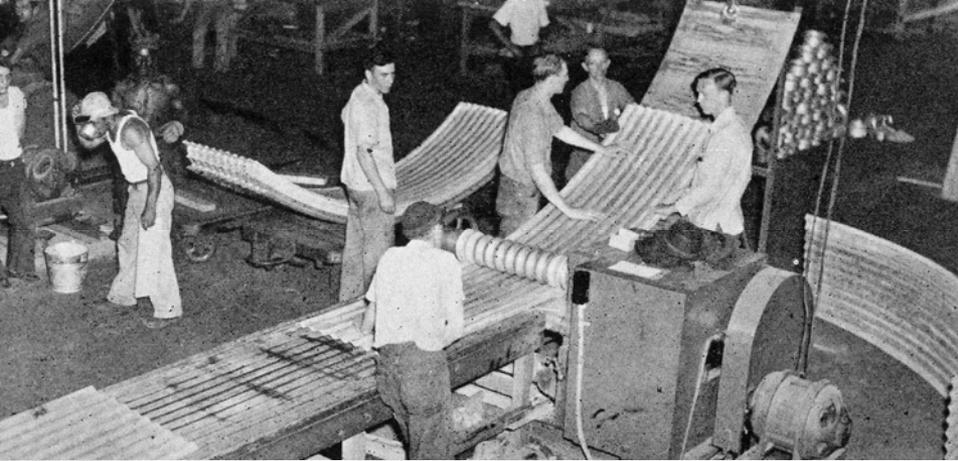
RIBS AND PURLINS



The original Quonset Huts utilized arched ribs using steel T-sections, 2 x 2 x $\frac{1}{4}$ inches, and the hut was only 16 by 36 ft. These were replaced by Stran-Steel's novel ribs, which were 2 x 3-5/8 inches, formed by sandwiching two lightweight channels welded back-to-back (see detail in following slide)



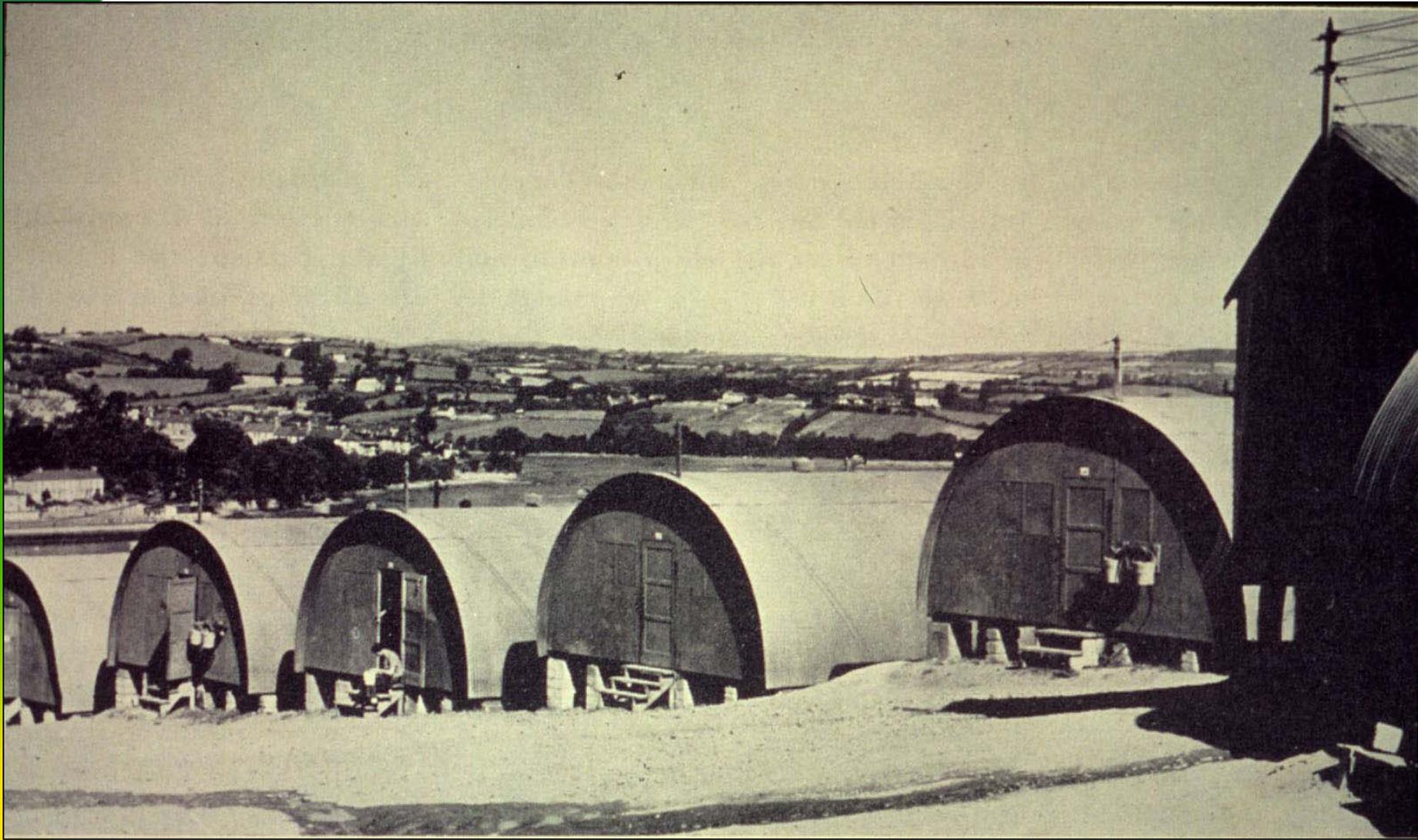
- Details of the original Fuller-built 16' x 36' Quonset Huts, assembled at West Davisville in the summer of 1941. The American hut employed masonite interior walls with a galvanized steel shell, and the gap filled with insulation.



- The corrugated steel shapes were bent at Fuller's factory in West Davisville (upper left), and shipped in 12 crate sets, shown at upper right and lower left. Various packing schemes evolved during the war, to make more efficient use of cargo hold space aboard transport ships (lower right.)

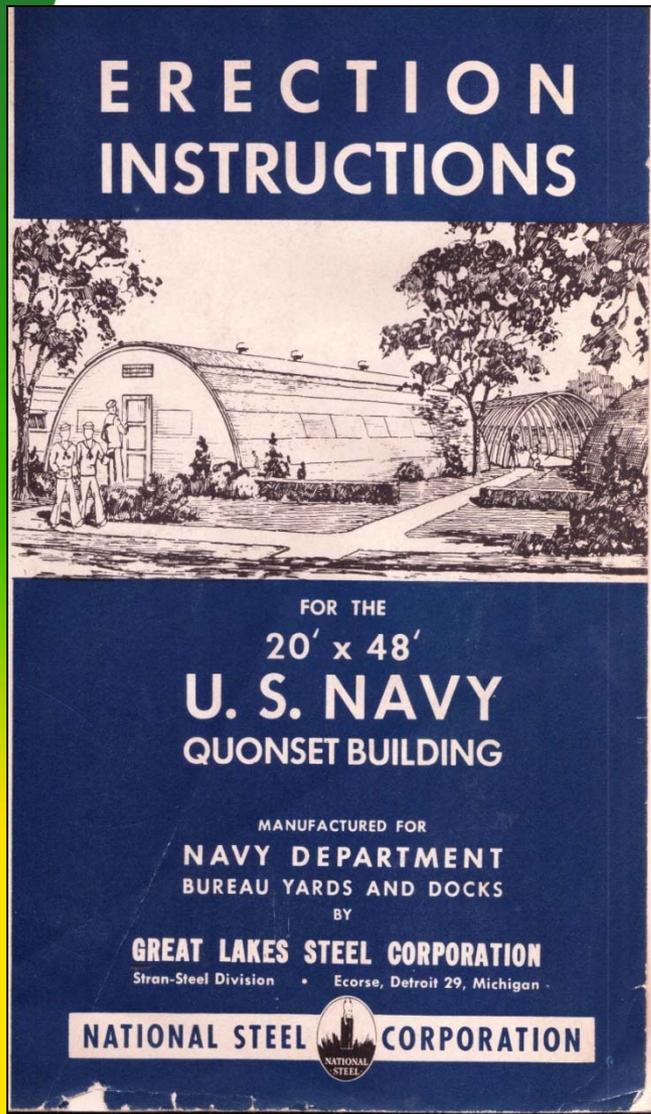


- Early model 16 x 36 ft Fuller Quonset Hut, fabricated in West Davisville, RI sometime between June 1941 and Dec 1942. Note absence of windows on the sides, which was the most basic 'warehouse configuration.' These early models were painted olive drab. Any number of windows could be added to the sides by inserting prefab window dormers between adjacent ribs, which were 4 ft apart.
- Several thousand surplus huts were sold off after World War II. In 1946 a standard Quonset 20 sold for \$1048 and a Elephant Warehouse 40 for \$3436, plus shipping. This hut is preserved at the Castle Air Museum in Atwater, CA.

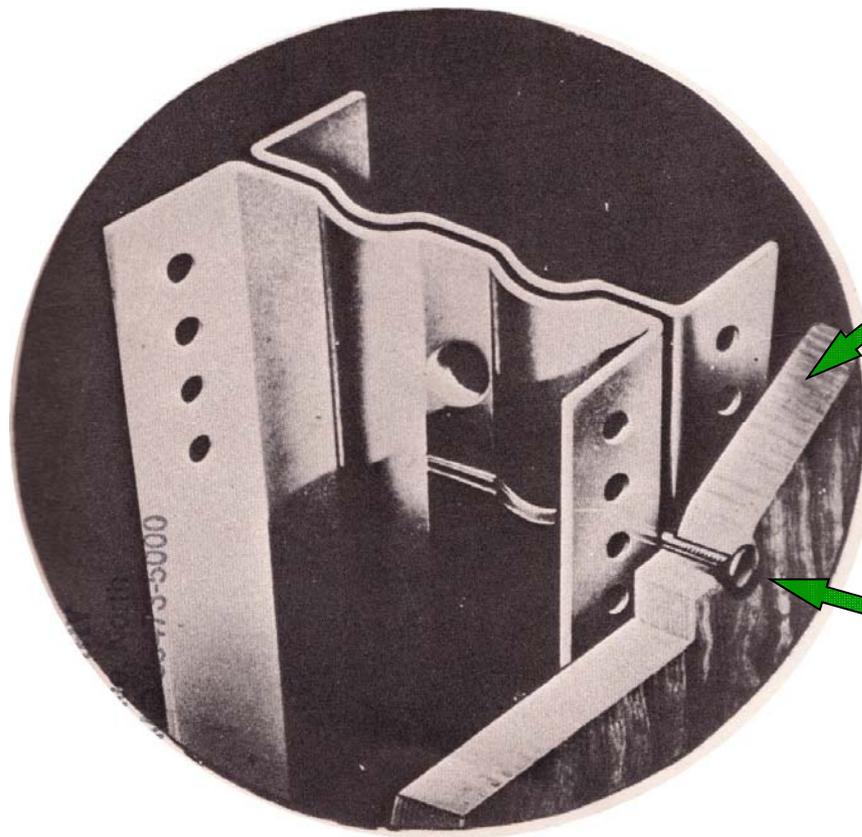


- Early **16 x 36 ft Quonset Huts** fabricated by the George A. Fuller Co. in Rhode Island employed wood end walls, with optional widow cut-outs. This views shows Fuller Huts at the Vicarage Base on the English coast near Plymouth, in the summer of 1943. These Huts were used for billeting American naval forces operating in the English Channel.

Navy 20 by 48 ft Quonset Huts



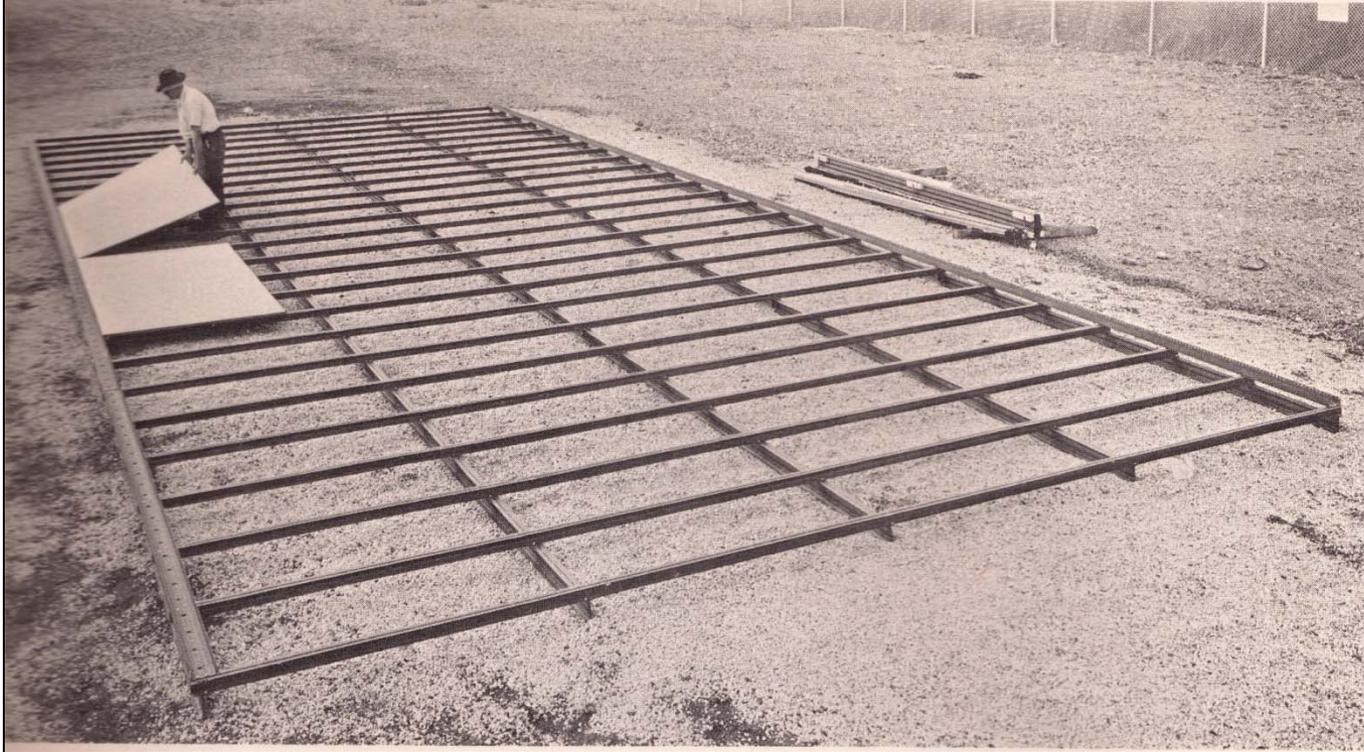
- Developed at Navy Seabee Base Quonset Point, Rhode Island, the original Fuller version was 16 by 36 ft
- This was succeeded by the Stran-Steel **20-by-48 model**, which became the most produced version
- The 20x48 kit weighed 7000 pounds; requiring 270 to 325 ft³ of shipping space
- 10 Seabees could assemble a Quonset 20 in less than one day
- Intended to house 25 men
- Northern, southern and tropical styles
- Final design required less shipping space than tents with wood floors and frames for the same occupancy
- A total of **153,200 units** produced or procured by the U.S. Navy during World War II



Galvanized
steel sheathing

Nail head

The **George A. Fuller Co** couldn't produce a sufficient quantity of the new huts, so **Stran-Steel**, a subsidiary of the **Great Lakes Steel Corporation** in Detroit, was retained to fabricate the thousands of Quonset Huts that were needed. Stran-Steel came up with a novel grooved rib by spot welding **two W-shape (grooved) channels** together to form the arched rib sections (shown above). This allowed simple nailing of the corrugated steel skins and interior Masonite liner sheets to the arched frames, which further reduced the erection time, by eliminating most of the nuts and bolts used in the early model huts fabricated by Fuller. These new pressed ribs were also lighter than the old steel T ribs.



The basic 20-by-48 kit included a **floor frame** (upper left) which allowed placement of a one inch thick tongue-and-groove plywood floor, using 4 x 8 ft sheets (later, using 5/8-inch thick plywood floors on steel floor joists, 24 inches apart). This system was intended to maintain a 2 to 4 inch air space between the gravel leveling subbase and the floor. Practice found this gap created favorable habitat for rats and other vermin in the tropics, so slabs-on-grade were constructed for more permanent installations, whenever possible. The original design requirement was for a team of **10 Seabees to erect a Quonset 20 in one day.**



Quonset Huts were known for quick erection of arched **frame ribs** and connecting **purlins**. This shows a hut being assembled on a jig, or erection platform by 33rd Naval Construction Battalion in the Russell Islands in Nov. 1943. The exterior sheathing was nailed to the frames and the purlins. After assembly of the frame and exterior sheathing, the unit was moved to its pad (note completed shells in background).

Insulation was only supplied for American Quonset Huts



INSULATION APPLIED OVER MASONITE



FASTENING INTO CHANNEL

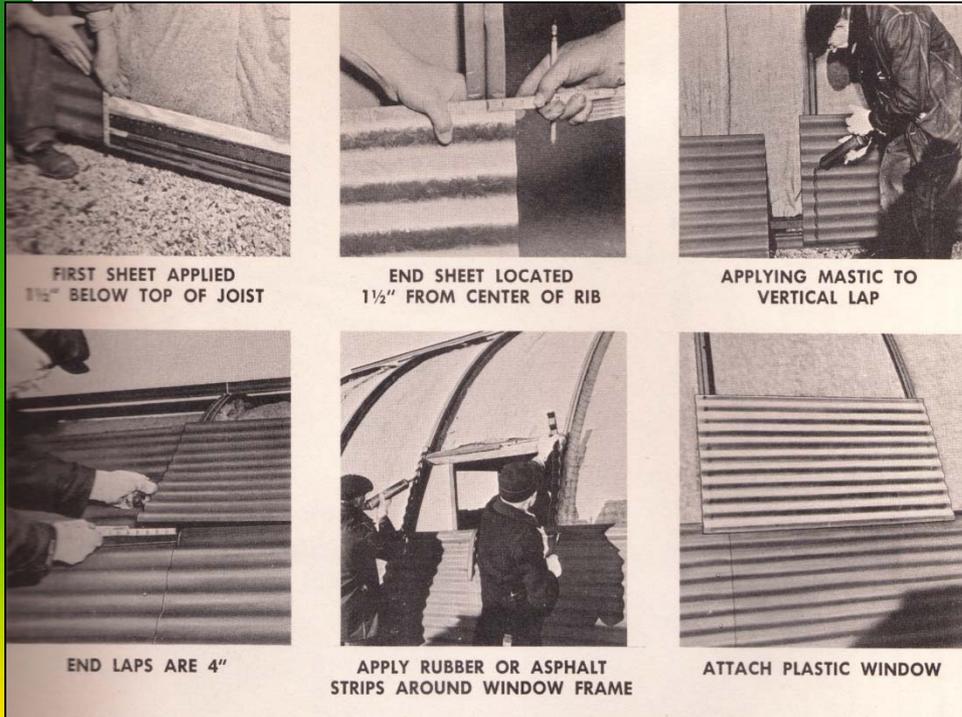


NAILING TO WINDOW SILL

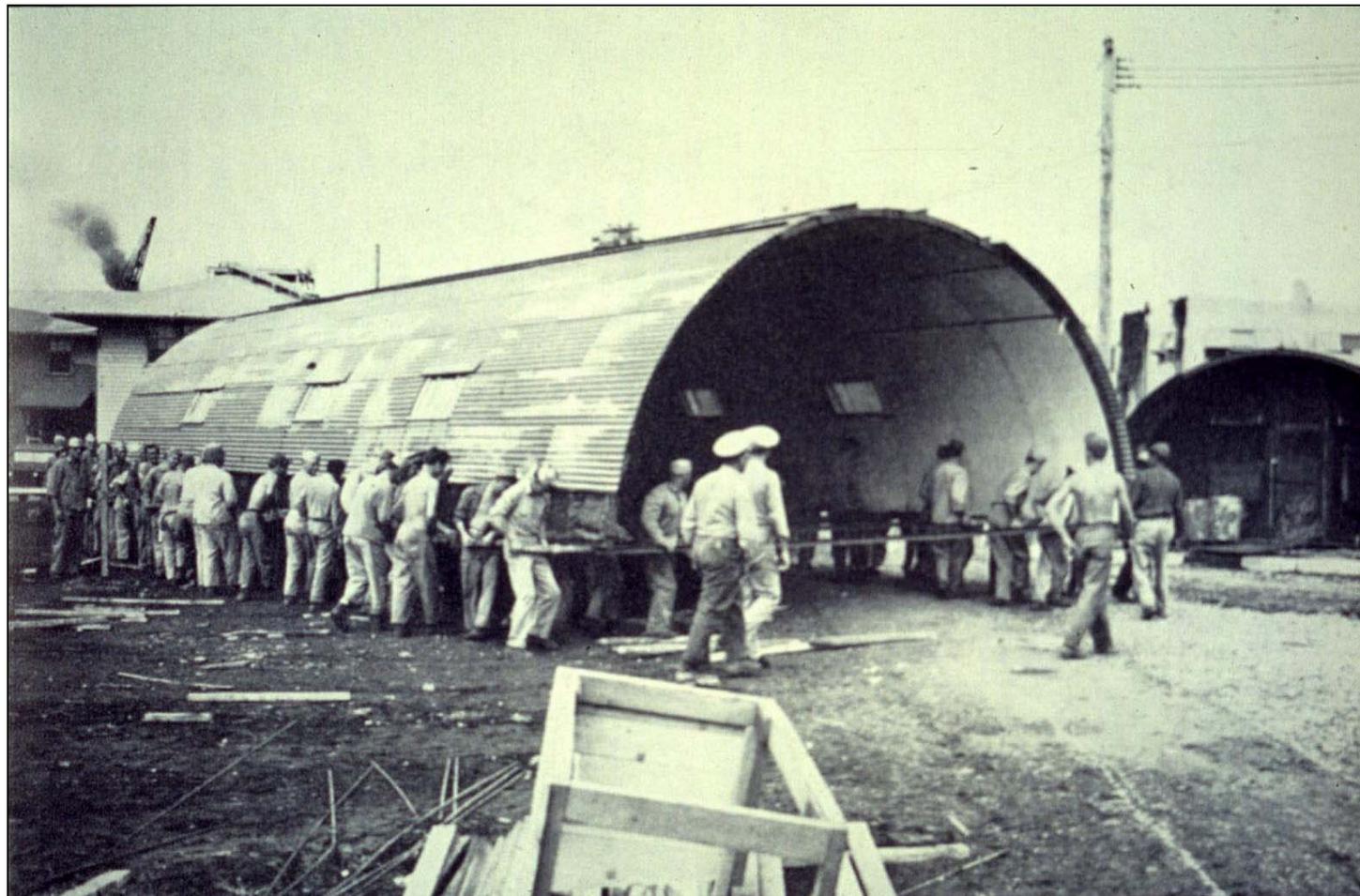


The assembly instructions directed that the Masonite lining be installed first, followed by the wood fiber insulation, then by the exterior corrugated steel sheathing. Image at right shows window and door frames/dormers on a standard 20-by-48 ft Quonset Hut, produced by Stran-Steel.

Details of External Shells, Windows and Vents



Typical assembly details from the Navy's erection manual. As Seabees gained experience with the assembly procedures, they were able to construct them more quickly. By war's end a 6-man team could assemble a Quonset 20 in less than 6 hours.



- Several dozen Seabees of NCB 90 man-handle a 20 by 48 Quonset Hut on Iwo Jima using steel stretchers with pipe handles, moving it to a new location. An empty hut weighed about 7000 lbs

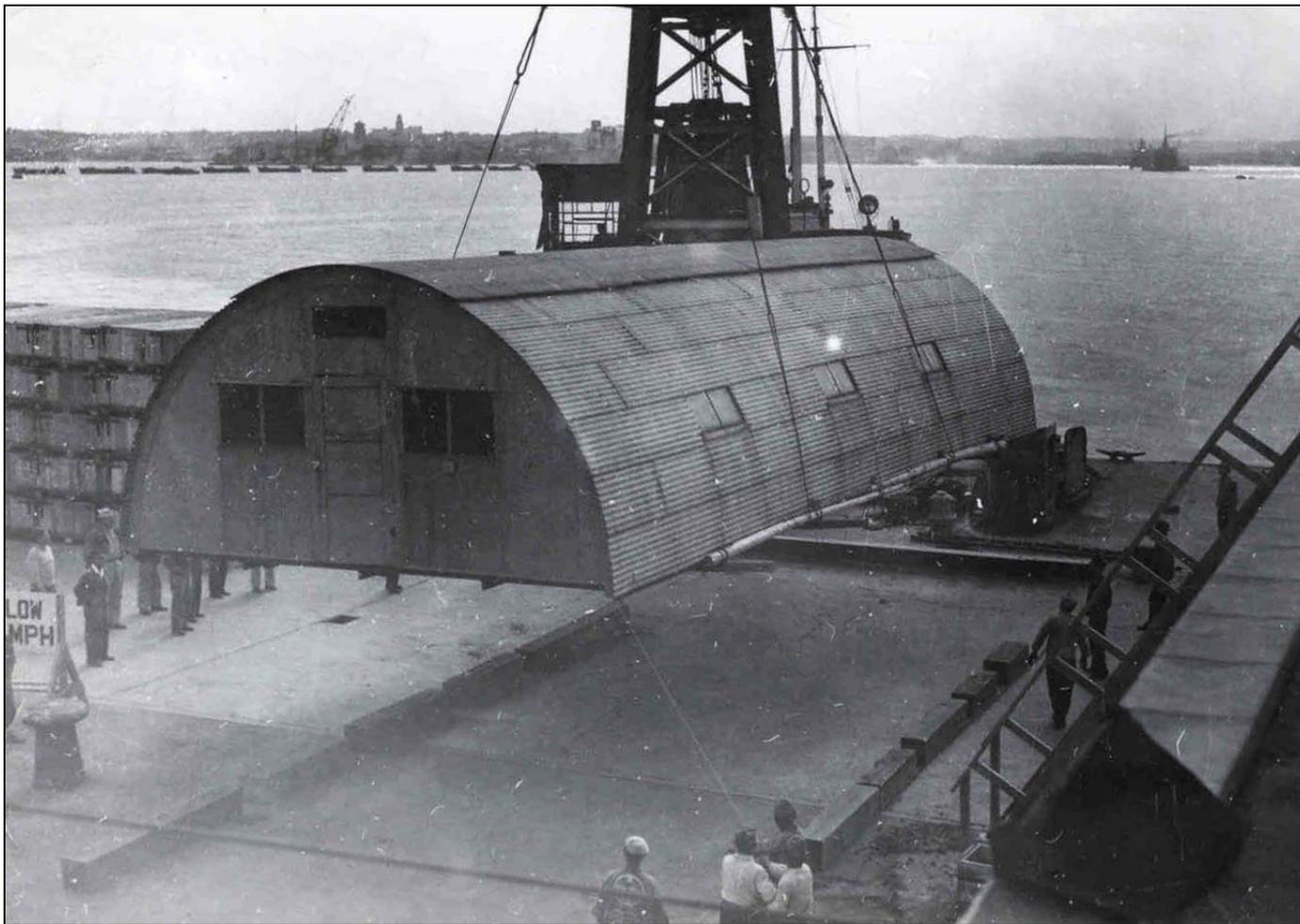


Monsoon Season

- Seasonal flooding during the summer monsoon season was a major design issue in laying out any of the large military bases in the South Pacific.
- These views show dry season (upper left) and same are during the wet season (below left), on Guadalcanal.



- Prefabrication of Quonset frames was a necessity in those islands subject to severe flooding during the summer monsoon season. This shows completed huts on elevated frames, to keep their contents dry during seasonal inundation of the local flood plain. This shows Naval Hospital No. 3 at Espiritu Santo.



- Mobile crane lifting an assembled Quonset 20 to a newly poured foundation, while constructing a base in occupied Japan in early 1946.



- Interior **Masonite panels** were nailed to the inside of the steel frame ribs, as shown here, somewhere in the South Pacific. **Metal splines** were then installed between the sheets. Note plywood floor, already in-place.



- Quonset 20 configured as a **24 bed temporary hospital ward** (St. Michael's Hospital in Falmouth). Note 6 sets of bunk beds at far end and hinged window covers, lying vertical. Late war huts employed vertical walls on lower 4 ft of both sides, because of the wasted space in this zone.



- These Quonset 20s were joined together to construct the **Creevagh Hospital Base** in Londonderry, Northern Ireland by the Navy's 97th Seabee Battalion in 1943. These huts were purposefully sunk into the earth to provide for better insulation and protection from bomb damage. Note submerged stairwell in left foreground.



- From late fall of 1943 through the fall of 1944 the standard 20-by-48 Quonset was produced with **4 ft long overhangs** at each end wall, to protect the bulkheads from driving rain and sun. This model was often referred to as a **"20-by-56."** The example above soldiers on at the former site of Camp Hastings, near Mt. Gretna, PA



- This shows the first adaptation of Quonset 20s with open, upturned sides to make them more bearable in tropical climates. These open side Quonsets were built as living quarters at Carter City on Florida Island in the Solomon Islands. Frame structures in foreground are the base laundry and one of the power plants.



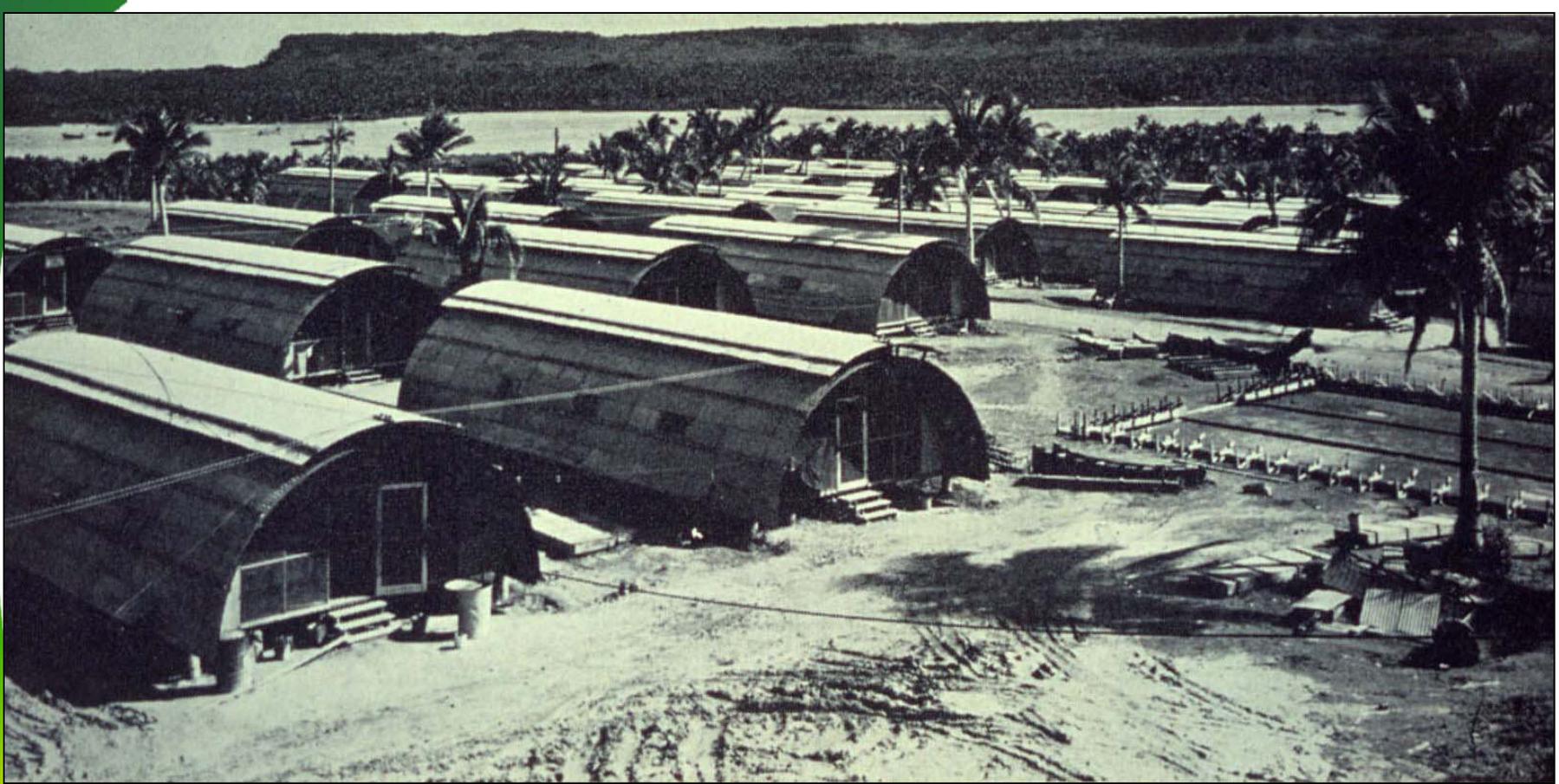
■ Quonset 20s with 4 ft overhangs, screened ends, and umbrella vet hoods were designated as “tropical design” huts. The tropical models shown here in the Marianna Islands employed a 12 ft wide ‘umbrella hood,’ which sat 1.5 ft above the arched frame ribs, and the inside ceilings were unsheathed for a width of 8 ft. This allowed warm air to rise and vent off during the cooler evening hours. This gap had to be screened to preclude entry by mosquitoes.



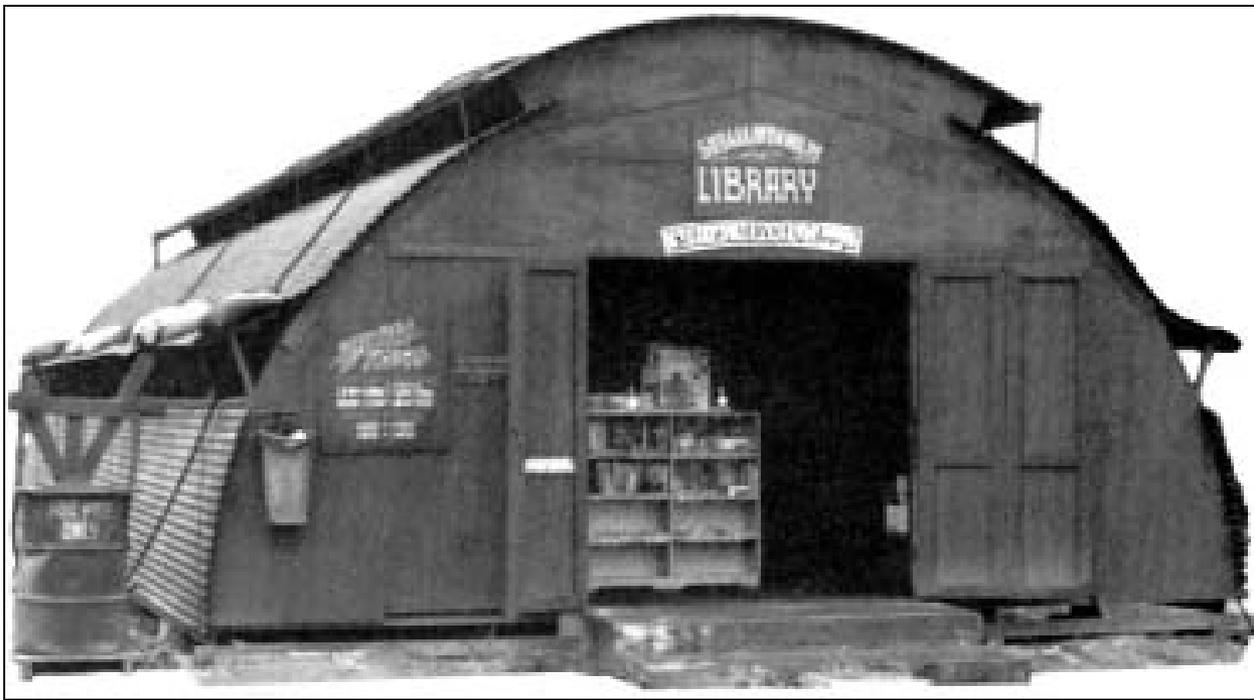
- **Tropical Quonset 20** with its noticeable 'umbrella hood,' occupied by elements of the 509th Composite Group on Tinian in 1945. Tropical Quonsets employed screened end walls, raised roofs, and additional vent flaps along their sides to promote better air circulation. Note elevation of floor in this example, well above the ground. This enhanced better cooling as well.



- Interior view of a **tropical Quonset 20** with screened end walls, on Tinian Atoll in the Marianna Islands, in the summer of 1945. Note the absence of interior Masonite panels in the ceiling, to allow warm air to vent off beneath the umbrella hood. Make-shift curtains over windows were used to darken the room for briefings. This shows a pre-mission briefing of the 393rd Bomb Squadron of the 509th Composite Group, which flew the atomic bomb missions against Japan from North Field in August 1945.



- **Late model Tropical Quonset 20s** at the forward receiving station at Tubabao on Samar, in the Philippine Islands. These huts employed 'double umbrella hoods,' with additional laps that helped prevent blowing rain from entering the open top of the huts during the monsoon season, between mid-May and mid-October. Note open screened end walls and two ft high crawl space beneath the huts, which aided cooling and prevented flooding.



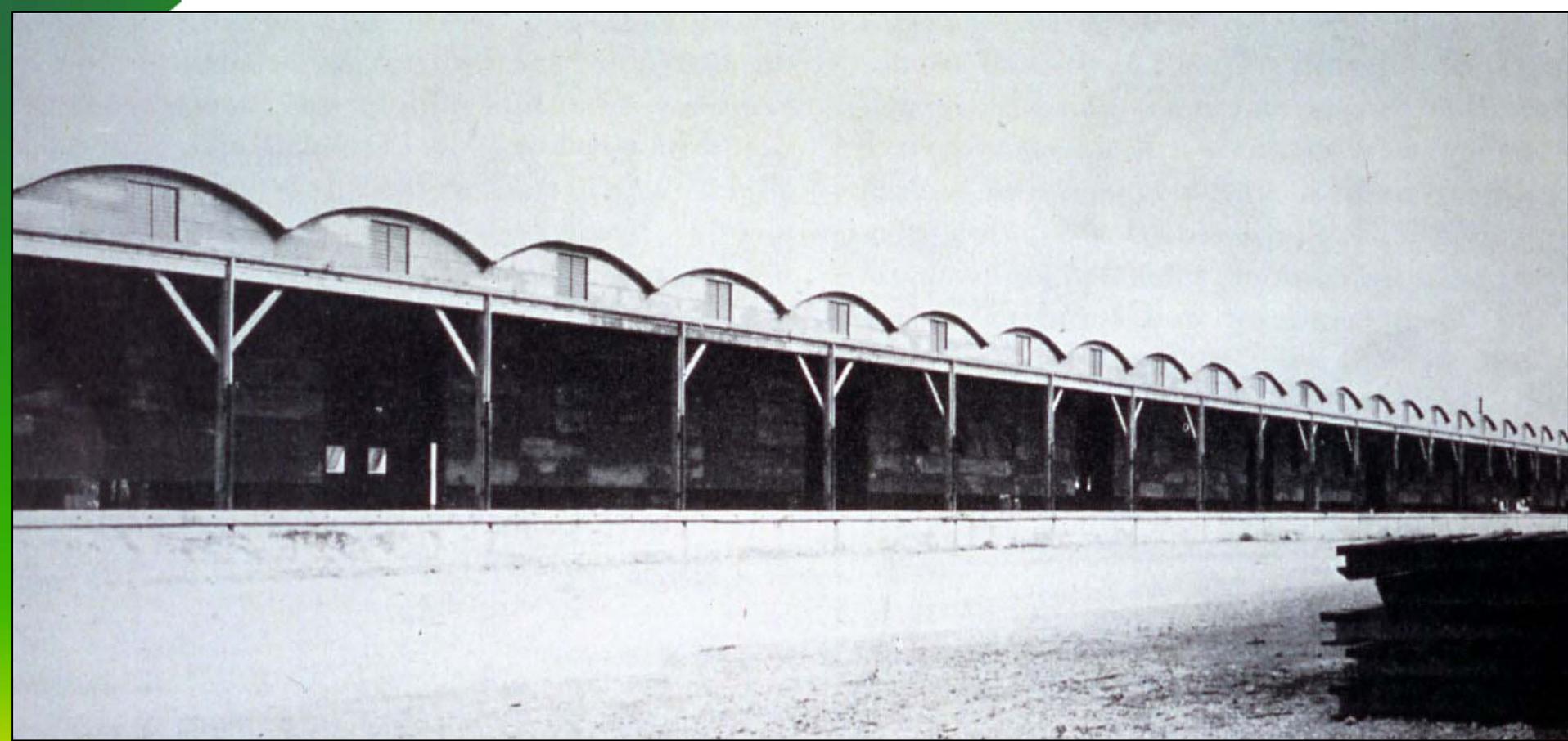
■ Modified Quonset 20 seen on Okinawa in 1948, after conversion to a post library. This was originally configured as a 'Jeep Warehouse' or machine shop structure, with the larger swinging doors (to allow vehicles or equipment access) and the upturned sides typical of shop buildings (to enhance cross ventilation). Many modifications were hastened by the severity of the summer monsoons, which precluded routine maintenance beneath tarps. This standard hut was likely retrofitted with the umbrella hood and continuous 'vent flaps' to enhance air circulation, giving it the appearance of a tropical design. The end walls of this hut were extended up into the umbrella hood, to prevent blowing rain from entering the structure.



- Seabees were famous for their 'cumshaw' work. 'Cumshaw' is a nautical term for the procurement of needed material outside the supply chain, usually by swapping, barter, mutual back-scratching, or 'midnight requisition.' This shows a covered porch the Seabees tacked onto a standard tropical 20-by-56 hut on Tinian, taken over by the 504th BG.

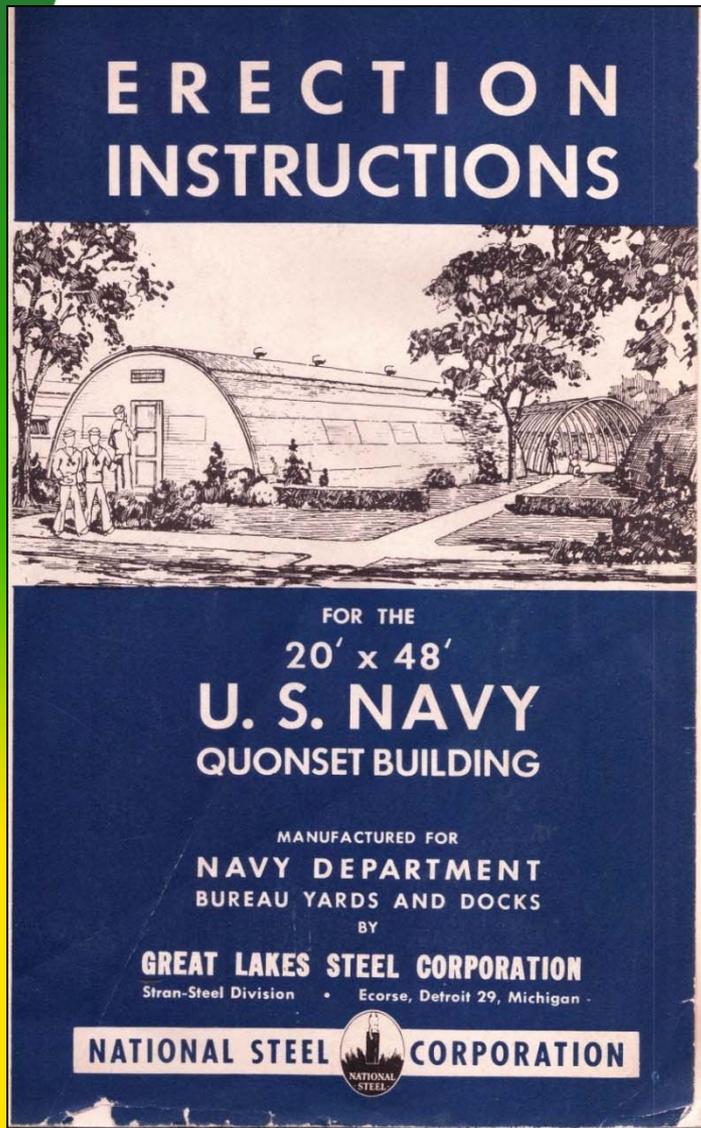


- Late model tropical Quonset 20 huts with upturned side walls at the Philippine Sea Frontier headquarters at Tolosa on Leyte, constructed by the 61st Seabees in January 1945. The entire hut was fitted with screens to promote cross ventilation. These modifications came about as a matter of necessity and comfort, operating in extreme heat and humidity.

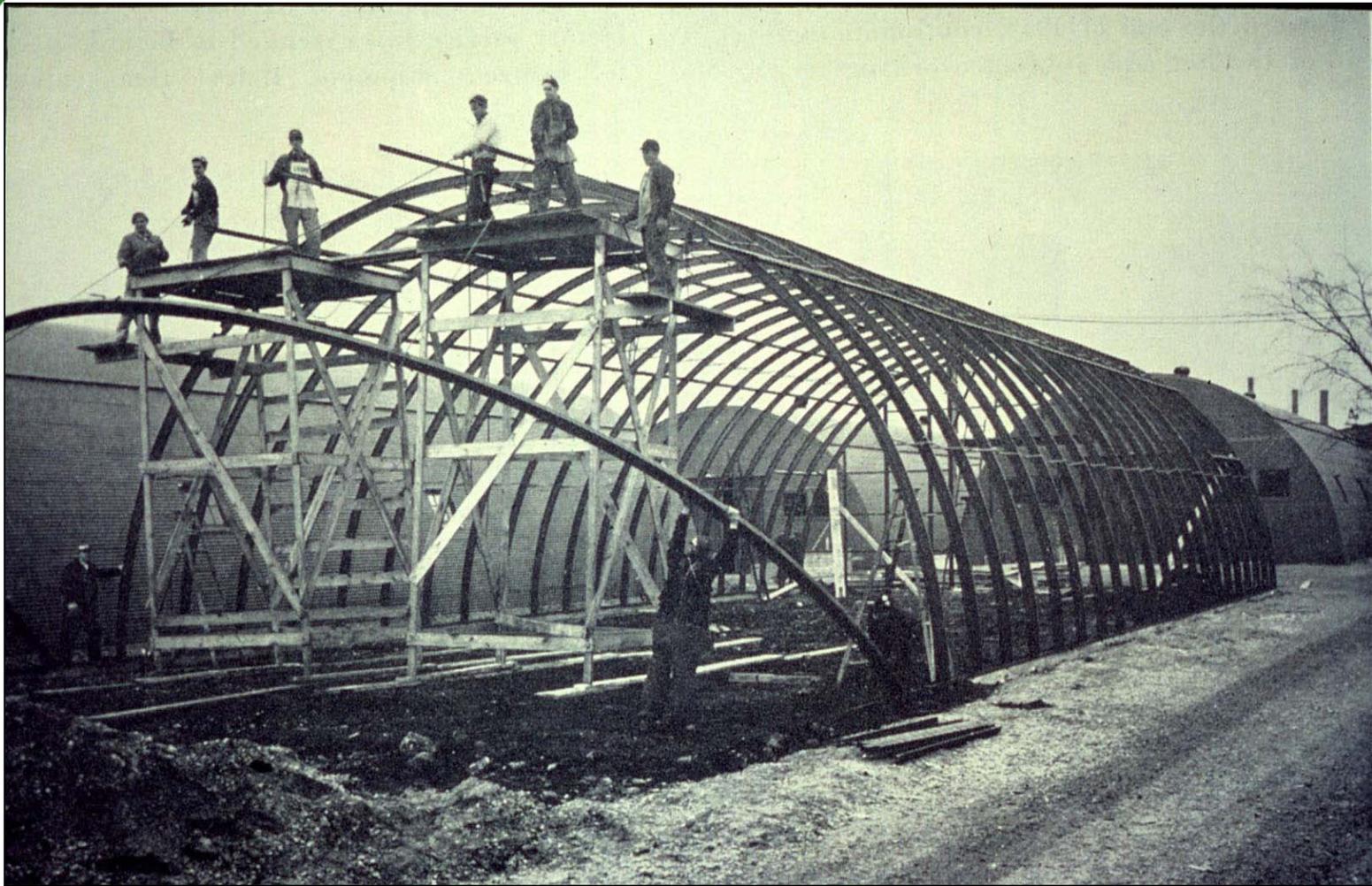


- The largest Quonset structure assembled during World War II was this '**Multiple Mae West**' facility on Guam, a massive warehouse with 54,000 square feet of floor space. It was fashioned from a series of Elephant Warehouse Huts.

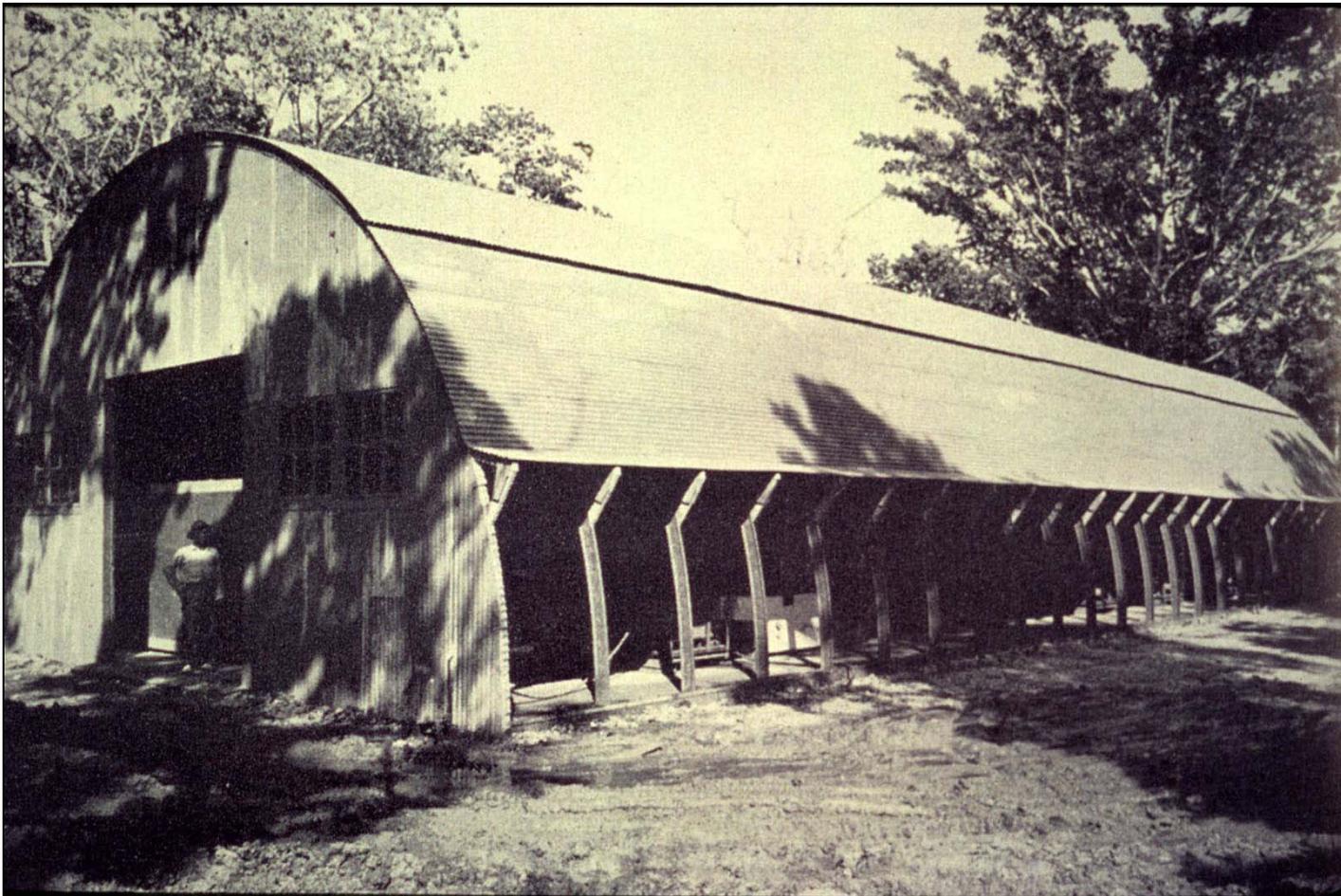
40 x 100 ft 'Elephant Huts'



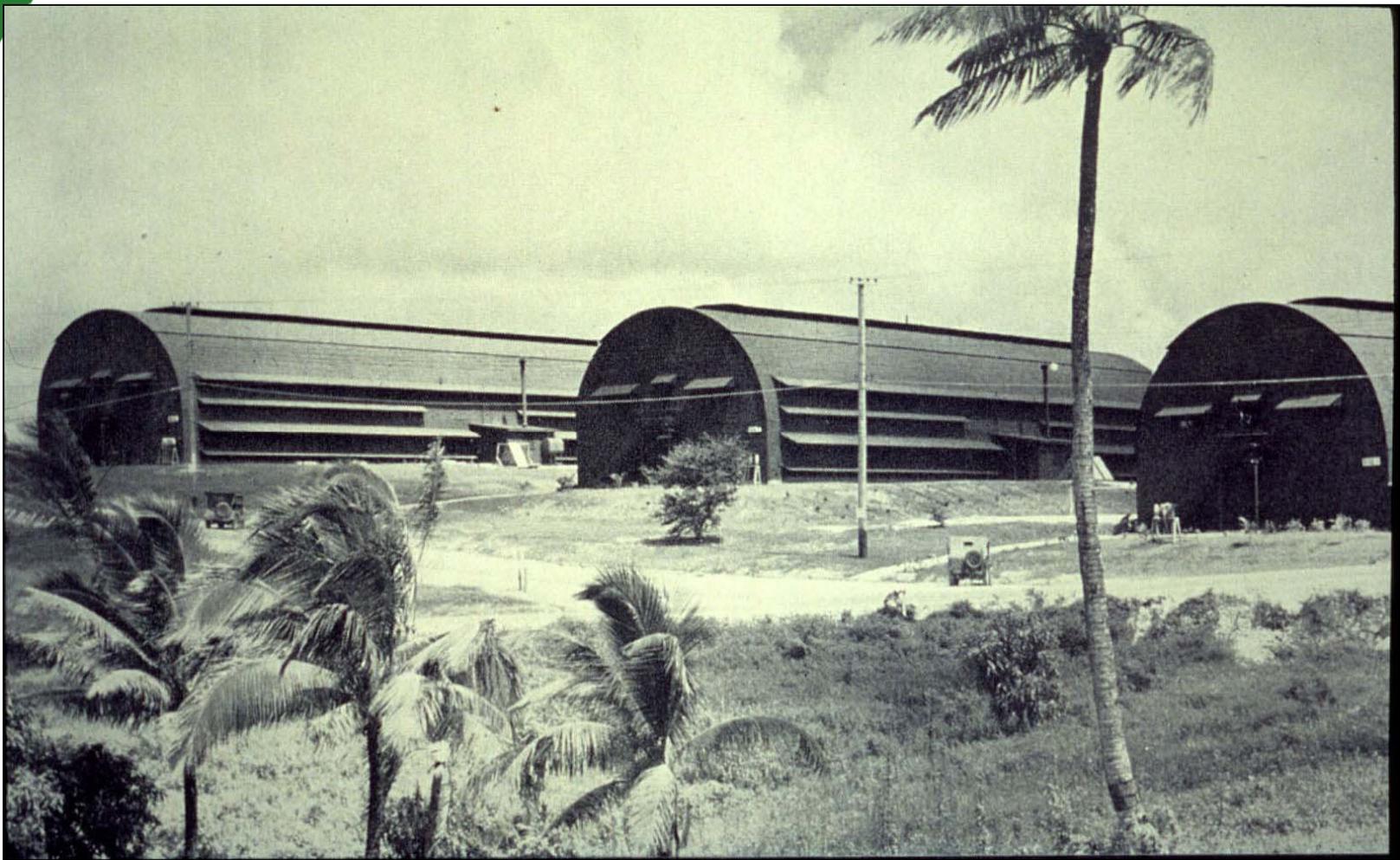
- The “**Quonset 40-by-100**” **Arched Rib Warehouse** version was developed for use at ‘advance bases’ (supply)
- Referred to as ‘**Elephant Huts**’
- Used **20 tons** of steel and required **650 cubic feet** of shipping space in cargo holds
- **11,800 produced** during World War II
- Olive drab camouflage paint was added to exposed panels at the factory to retard reflectance. Later the color was changed to flat light grey.



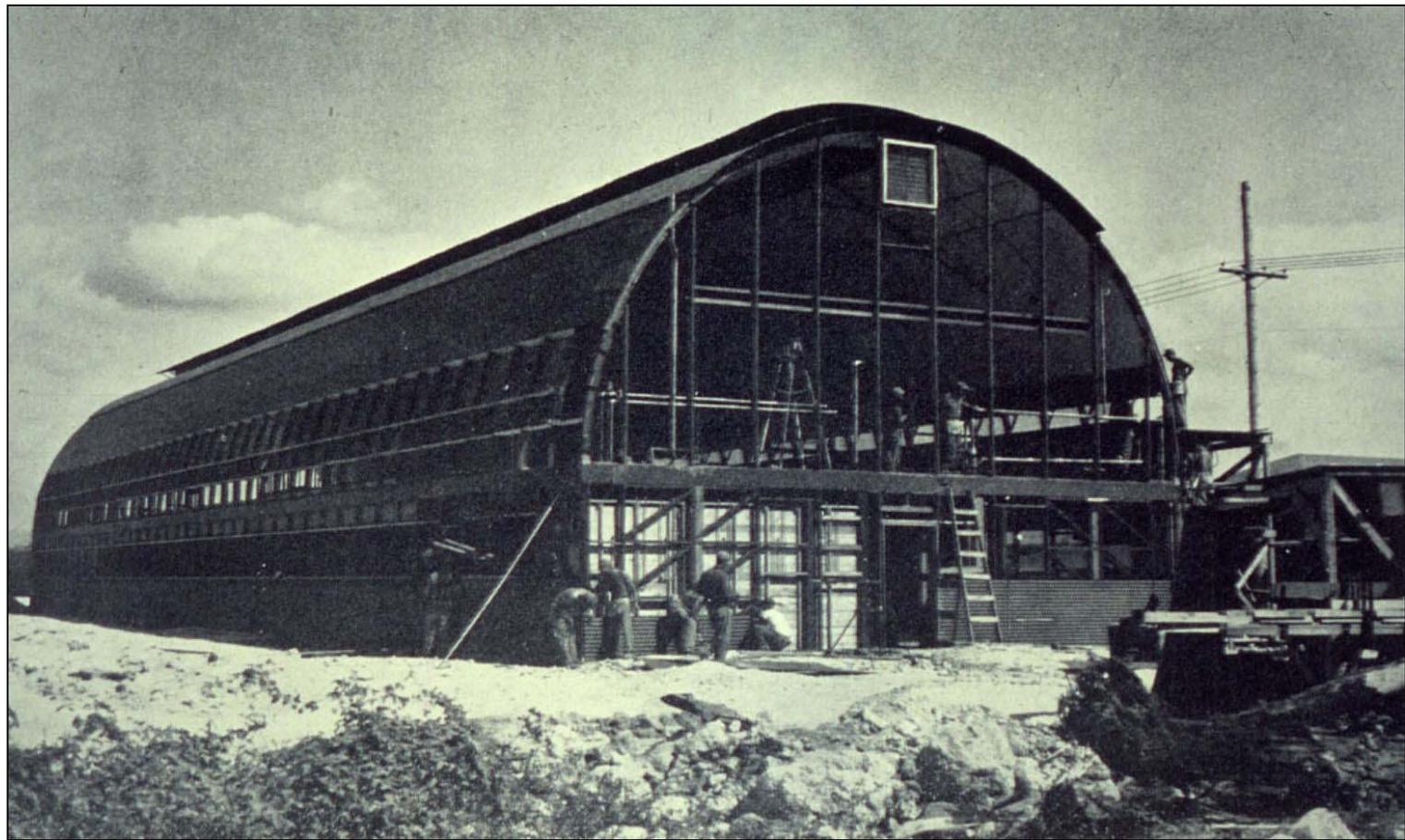
- The larger Elephant Huts were usually assembled directly upon on gravel pads and/or concrete floors of their building pads, as shown here. Note temporary scaffolding.



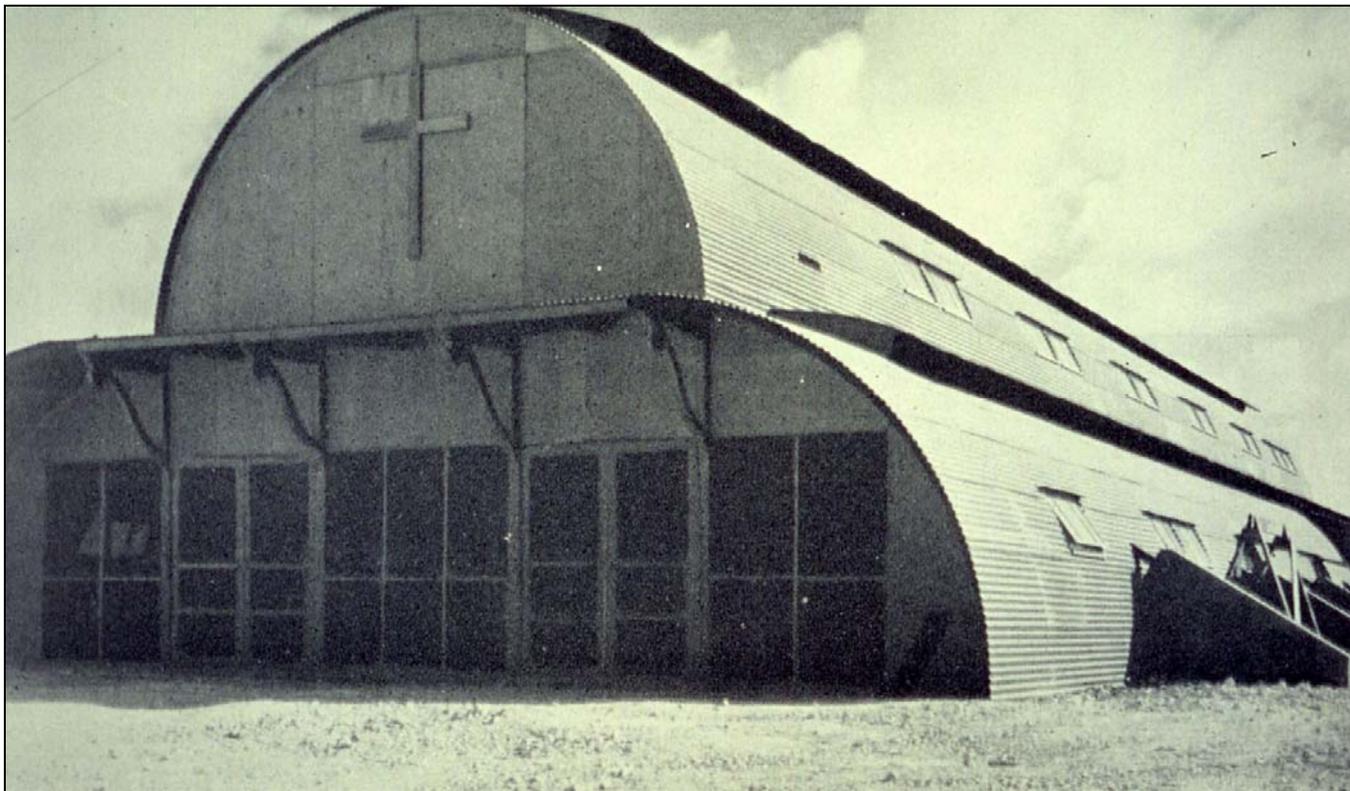
- **Quonset 40-by-100s** were used as warehouses, machine shops, power and pump plant enclosures, etc. Note the large doorway in the end wall. The suffocating heat of the tropics soon led to on-site adaptations, such as that shown here. This allowed better ventilation while keeping most of the rain off of equipment. This shows a refrigerator warehouse at Havannah Harbor on Efate in the New Hebrides.



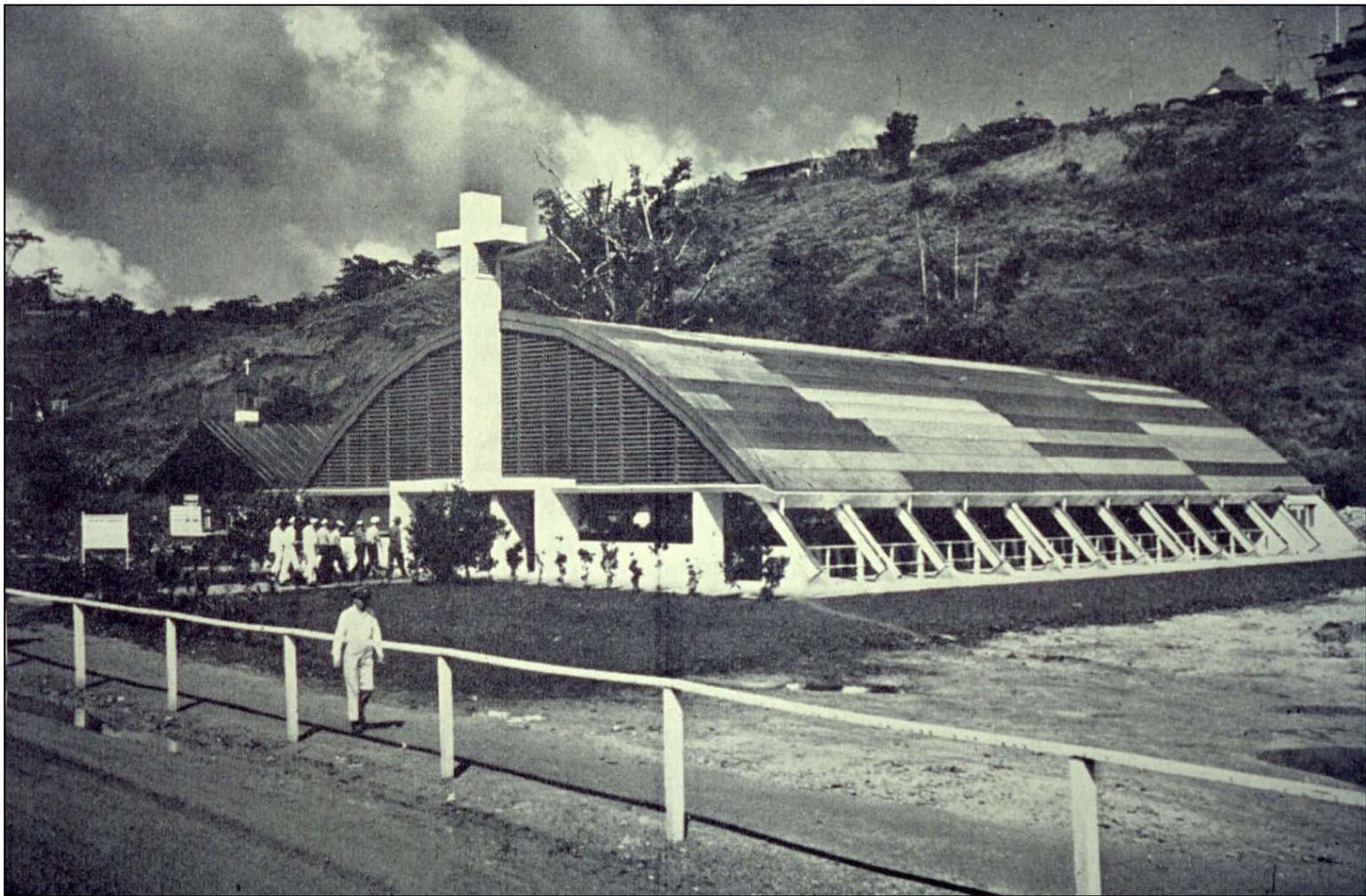
- Elephant Quonsets converted to double-deck Bachelor's Officer's Quarters on Guam. Note extensive use of awnings over screened window openings and diminutive umbrella hoods along the crest.



- Seabees erecting **double-deck B-1B Elephant Quonset Barracks** to serve as female WAVE's Quarters on Oahu in the Hawaiian Islands. Note extensive use of screens to promote cross ventilation and fan portal at crest of arched end wall. The umbrella hoods on B-1B Elephant Quonsets were 28 ft wide, as shown here.



- Seabees were famous for improvising and scratch building variations of the Quonset Hut. This shows a non-standard base chapel constructed from four standard Q20 Quonsets, constructed by the 117th Seabees on Saipan. Note concrete thrust blocks along the right side, to accommodate the loads of the upper hemisphere shell.



- Variation on a theme: Arched base chapel built by Seabees on the Navy's Advance (Supply) Base at Manus Island in the Admiralties, seen on Easter morning, April 1, 1945. Note open sides and use of very large arched rib members.



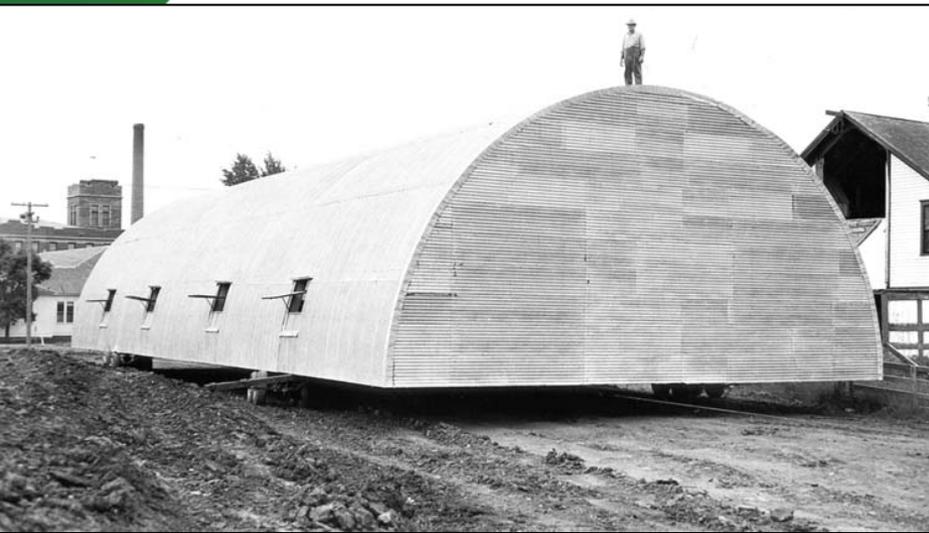
- English Nissen Huts assembled in Hamburg, Germany as temporary housing because so many structures had been destroyed by Allied bombing, as seen in 1946. The exterior of these huts were painted with coal tar to enhance solar heat absorption during the cold winter months and better resist corrosion.



- There was an unprecedented housing shortage following the Second World War. The federal Public Housing Authority sought to ease the shortage by encouraging the rapid erection of Quonset Hut subdivisions on the outskirts of major metro areas, like New York City. Standard Huts were converted to 720 sq ft or 960 sq ft homes. The 720 ft model sold for just \$2,700 (\$1000 for the hut and \$1700 for the conversion expenses).
- This shows a happy couple moving into their new Stran-Steel home in Grand Rapids, Michigan in March 1946. The stop-gap measure was short-lived and most surplus huts were utilized for student housing at universities and light commercial applications; e.g. Michigan State University set up 75 Quonset Huts as housing for married veterans.



- Colleges were the biggest beneficiaries of surplus Quonset Huts, as government agencies were given priority to bid any surplus government property, before it was auctioned off to the public.
- The colossal increase in post-war enrollments was triggered by returning servicemen, whose tuition was paid by the GI Bill
- This shows a old 40-by-100 Elephant Hut acquired by the State of Louisiana in 1947 and re-assembled at the Louisiana State University in Baton Rouge, where it is still used for storage.
- Note symmetrical layout of side windows and door, which were standard options in kits produced after Jan 1945.



Surplus 40-by-100 Elephant Huts were used primarily for commercial, industrial, and agricultural buildings, across the USA. This shows but a few examples that still soldier on, from California to New Jersey.



Northern 20-by-48 Quonset Huts used by the 36th Fighter-Bomber Squadron at Suwon Air Base (K-13) during the Korean War (1950-53) and thereafter. Note flat light grey color.



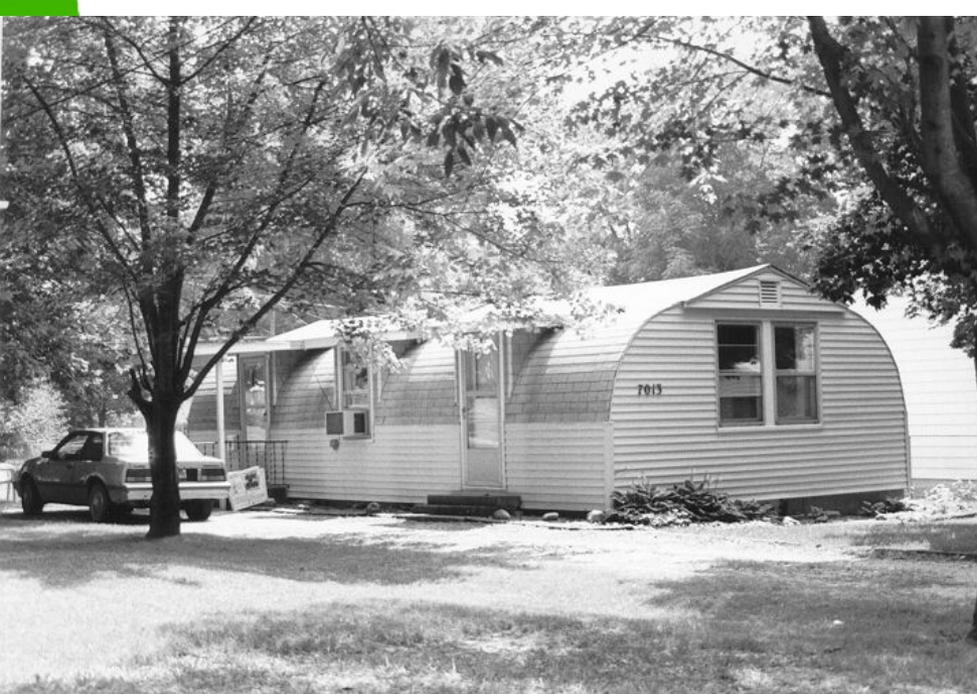
■ The Korean Armistice in June 1953 necessitated the construction of more permanent military bases south of the Demilitarized Zone (DMZ) for American and Korean security forces guarding the border. This shows a standard 20-by-48 hut being erected by Combat Engineers of the US 8th Army.



- As the US presence in South Korea continued after the 1953 armistice, more permanent facilities were constructed each year. This shows Army Engineers erecting the frames of a post-war straight-side Hut in Korea, sometime after their introduction, in 1957. This modification made more efficient use of the interior floor space.



- Surplus Elephant Quonsets were used in a variety of applications. This shows an 40 by 100 Quonset converted to a supermarket in the 1950s
- Most state transportation departments use hemispherical wrapped-frame structures (seen at left) to provide all-weather protection for stockpiles of road salt used in the winter for de-icing applications.

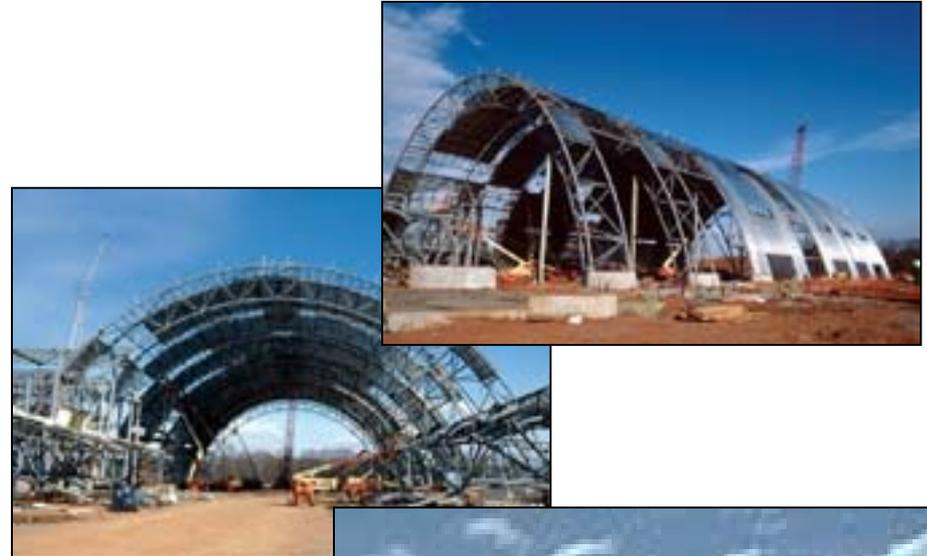


Numerous examples of prefabricated structures emerged during the postwar period; and these continue to evolve to the present day. Most utilize much lighter weight materials, as shown here.

Present Day Applications of the Quonset Design



Personal Carport



Milwaukee Hummer Dealership



National Air and Space Museum, Udvar-Hazy

Most Cited References

- ***Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946. Vol.1. Washington: Government Printing Office, 1947.***
- **Donovan, James A., *Outpost in the North Atlantic: Marines in the Defense of Iceland.*
<http://www.ibiblio.org/hyperwar/USMC/USMC-C-Iceland.html>.**
- **Great Lakes Steel Corporation. *Erection Instructions: U. S. Navy Quonset Building.* Northern Design, 1951.**
- **<http://www.uh.edu/engines/epi1278.htm>**
- **http://www.dailyreporter.com/news/2_210/construction/6272-1.html**

Cited References - Continued

- Lamm, Michael. “The Instant Building.” *Invention and Technology*. Winter 1998, Vol. 13 No. 3. Pg 68-70.
- http://www.alsdiscount.com/quanset_quonset.htm
- http://www.nasm.edu/nasm/ext/constr_photos/02-28-02_5.htm
- <http://www.jimmylescalle.com/>
- <http://adak.orneveien.org/allstock/quon5755.htm>
- <http://www.nuwc.navy.mil/hq/history/quonsetpoint.html>