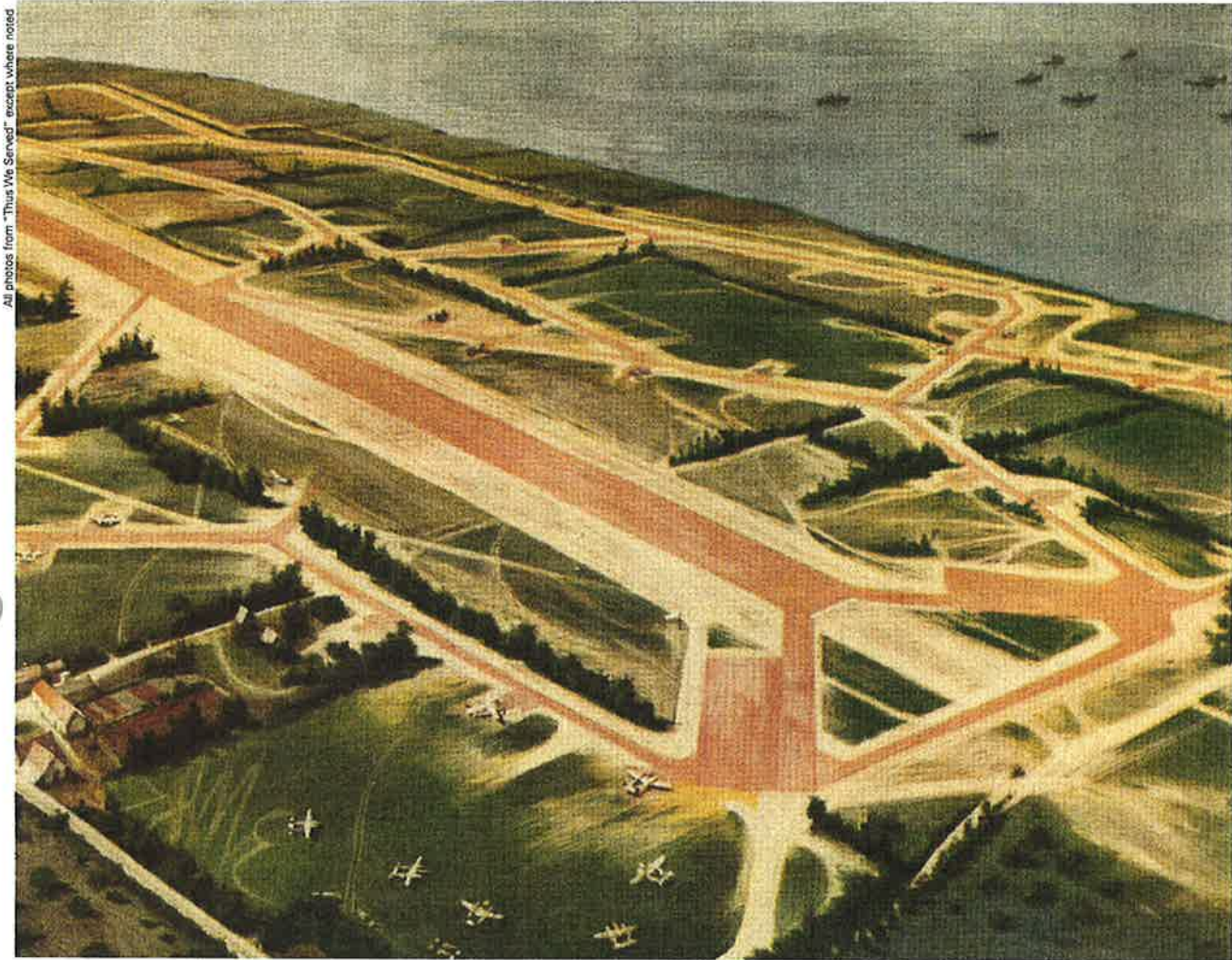


Lost in history: "Geo-Airdromes"

From World War II engineer battalions to today's geosynthetics

By Gregory Richardson



All photos from "Thus We Served" except where noted

| An artist's schematic rendering of the airfield built atop the bluffs of Omaha Beach following the Allied D-day invasion of Normandy in June 1944.

Having been born immediately following the only global war in the history of the world, tales of military adventure often filled our family gatherings. One particular set of stories always touched the budding engineer in me and provided the root of my interest in geosynthetics. These stories followed my uncle as he moved across the European theater of war mounted, not on a tank, but on a bulldozer. This article provides a glimpse of the role of an unheralded aspect of military

engineering and the life of individuals who implemented it. It also begs the question of the 30-plus-year interval between the military use of war-inspired construction devices and their later introduction to civil engineering.

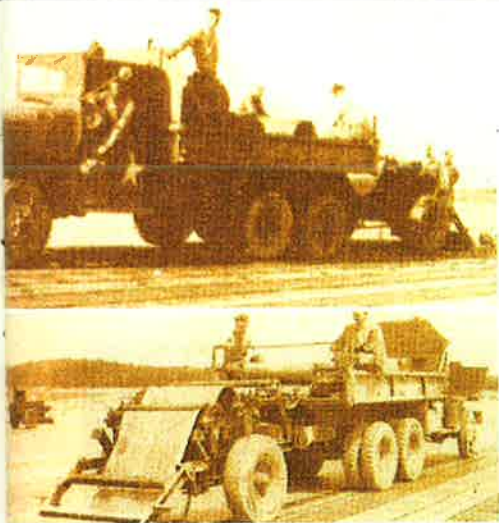
Engineer Aviation Battalions (EABs)

At the beginning of World War II, 12 EABs existed to support the construction and maintenance of avia-

tion fields for the Army Air Force. The 804th repaired Hickman Airfield in Hawaii after the attack on Pearl Harbor in 1941 and later built Kua-loa Airdrome (airfield) that played an instrumental role in the battle of Midway. The 803rd maintained airfields in Bataan and Corregidor before they fell to Japanese troops. Few of the 803rd survived the war.

In the European theater, 16 aviation battalions were shipped to England in 1942 to construct airdromes in

| The Designer's Forum column is refereed by Greg Richardson, Ph.D., P.E., of G.N. Richardson & Associates, www.gnra.com



| Rolling out the "Hessian."

England to support bombers and to prepare for operations in North Africa and eventually Europe. By December 1942, the number of EABs had grown to 51 worldwide. EABs were staffed with soldiers who had prior engineering or construction experience.

In the battle for North Africa, four EABs were sent to support the air war. Their job was to rapidly repair cap-

Their job was to rapidly repair captured airfields [and] construct new strips where needed.

tured airfields, construct new strips where needed, and remove mines from those areas. These new fields commonly began life as Emergency Landing Strips (ELs) to support spotter planes and provide emergency landing for damaged planes. Such fields were then upgraded to Refueling and Re-arming Strips (RRSs) to support fighter planes providing cover to ground troops. Such planes then (and today) have limited airtime and must be fueled close to battle if they are to provide adequate cover. Thus, as the fighting front moved, so did the RRS. A few of these fields were then upgraded to Advanced Landing Ground (ALG) to support long-range bombers and stationing of fighters. The engineering requirements, of course, varied for each type of airfield. The EABs experienced notable successes in North Africa, such as the Biskra Airdrome in the Sahara receiving B-17 bombers within 24 hours of the

battalion arriving on site. Problems were experienced in both shipping of equipment and the utility of miniature equipment (compactors, pans, etc.) that had been developed to be flown into remote sites.

By the end of the North African campaign there were 10 EABs and 129 airdromes in action. This campaign provided valuable experience both in









the field and the command structure. Air power was playing an increasingly critical role, yet the integration of the Army Air Force and the EABs into the command and supply structure of the conventional Army was evolving as combat raged. In 1943, EABs participated in landings in Sicily, quickly establishing the airdromes required to support air cover for an advancing Al-

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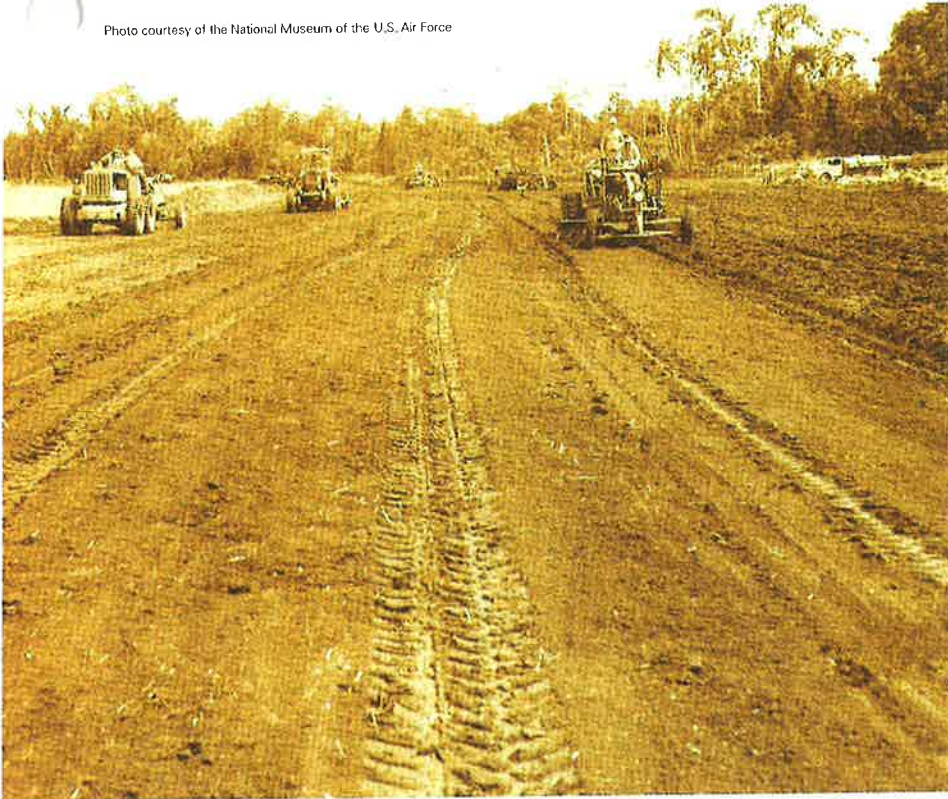
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Photo courtesy of the National Museum of the U.S. Air Force



| The engineer battalion's graders and dozers paved the way for airstrip construction.

lied front. In January 1944, EABs hit the beach at Anzio and foreshadowed an even greater day that would occur in June of that year.

Airdrome technology development

Even before American entry into the war, research had been proceeding in France, England, and the U.S. on the technical means of quickly restoring or constructing a serviceable airstrip. While these strips were simple compared to today's standards, an airdrome servicing fighter planes required a 3,500-ft. runway. Those servicing bombers required a 5,000-ft. runway. And they had to be serviceable in days, or preferably, within 24 hours. Site conditions ranged from blowing sand to mud that only partially supported the weight of a man.

During this period, extensive work was being carried out at the U.S. Army Waterways Experiment Station (WES) near Vicksburg, Miss., to develop better landing mats and airfield waterproofing systems. All the components

had to be light and readily transported in the smaller cargo planes of that day. These components were commonly referred to as "expedient surfaces."

Before the war, France and England had experimented with flexible mesh mats to form runway surfaces. The French envisioned conversion of agricultural fields into airdromes and used a very rigid mat formed of T-shaped longitudinal beams interconnected by zigzag-shaped bars to form panels. Referred to as a "chevron grid," the panels were bolted together and had a herringbone appearance when assembled.

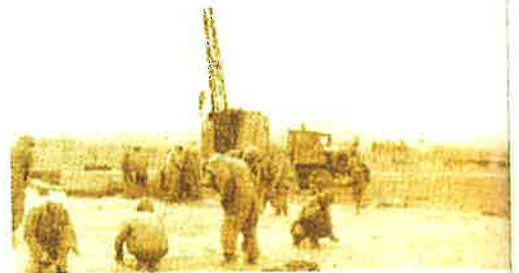
Conversely, the British envisioned conversion of grassy fields into airdromes and focused on a flexible mesh mat called Square Mesh Track (SMT) that resembled heavy wire mesh used even today to reinforce concrete slabs. Fabricated into large rolls, the mat sections could be installed at such a rapid rate that the British constructed a 3,000-ft. runway in only 15 hours. The British mat also provided a natural camouflage since the runway retained the appearance of a pasture

with grass simply growing through the mesh.

In 1939, the U.S. Army Air Force asked WES to study the European mats and to select or modify one for American planes. Much of this research was conducted at WES using heavy vehicle loadings over trial subgrades built within a large Quonset hut at WES. This same location would be used some 30 years later for nearly identical research using geocells.

WES observed that both types of mesh disintegrated under service and that neither could support large bombers. At a joint industry and government meeting, Gerald Greulich of Carnegie-Illinois Steel Corporation sketched out what would become the "pierced steel plank" (PSP) landing mat now familiar to all. After many alterations, the final steel mat was 10 ft. long, 15 in. wide, and ¼-in. thick, weighing 70 lbs. The planks were held together by spring clips and could support a 60,000-lb. bomber.

Since these mats would be deployed worldwide, there was concern about the performance under varying soil conditions. In 1943 and 1944, the WES Flexible Paving Laboratory investigated the performance of the PSP mats in fat clays at a site near Mound, La.,



| Working the PSP liner.

and silt-loam at a site just south of WES. These tests used wheel loads from heavy earth-moving equipment to mimic the loads of bombers and established a test procedure that would later be used to evaluate geosynthetic applications to roadways. The recently developed California Bearing Ratio (CBR) was used to quantify the bearing capacity of each potential soil. The success of the program led to the production of a staggering 800 million ft.² of PSP during the war.

WES also helped develop prefabricated bituminous surfacing (PBS) that became a critical component used in the rapid construction of temporary airdromes. This technique was developed in Canada, modified by the British, and improved in the United States. PBS placed a waterproof surfacing over graded and compacted soil to keep the soil dry to maintain its bearing capacity.

PSP could be used to protect both the landing strip and areas used to park aircraft. Known as "Hessian Mat," this PSP consisted of burlap fabric impregnated and coated with asphalt. While having the appearance of roofing material, the 1/4-in.-thick PSP could be placed at the rate of 2.5 to 4 miles per hour. PSP also mimics pre-impregnated paving products still sold to repair and waterproof asphalt paving systems today.

The PSP rolls were placed and then a "stamplicker" machine was used to moisten one side of the mat with solvent to soften the asphalt and produce a sticky surface. A staggered second layer could then be applied to produce a thin, waterproof and dust-proof surface. A fine layer of sand placed on the surface enhanced friction and reduced skidding. Damaged PSP was easily repaired using a mop, bucket of solvent, and a scrap piece of PSP. Repairing larger problems caused by bombing or water under the PSP required removal of the PSP, replacing the subgrade, and putting down a fresh section of PSP. PSP was used in more than 100 airstrips in Europe between D-day (June 6, 1944) and the crossing of the Rhine River in March 1945.

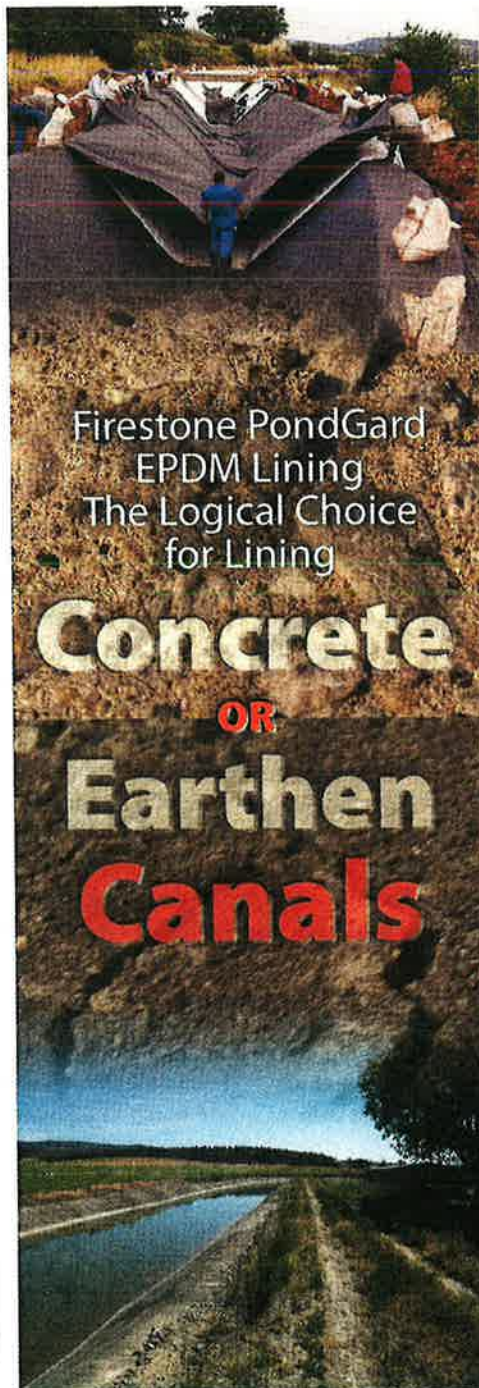
The EABs quickly developed methods to remove and reassemble PSP landing strips as the fighting front moved. Additionally, it was observed that the performance of PSP in that portion of the landing strip where the wheels of planes touched down was marginal. The impact force required to begin the rotation of the airplane wheels would damage the PSP. It became common for these sections to be reinforced with either PSP or SMT wire mat reinforcement. Once the wheels of

the aircraft were rolling, little damage was done to the PSP.

The Philadelphia connection

My awareness of the existence of EABs began in childhood through stories told by my uncle, Dan Ogborn. Philadelphia-born, he escaped home at

age 14 and soon learned he was skilled in operating heavy construction equipment. As many from "The Greatest Generation," he volunteered for service in the EABs early in World War II and found himself south of Reykjavik, Iceland, aiding in the construction of Keflavik Air Base. This facility served as a refueling point for the aircraft being delivered to England. Conven-



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| The 834th Engineer Aviation Battalion built a series of airfields in the final year of World War II, from the beaches of Normandy across Europe and into Germany.

tional in construction, with concrete runways, this base was placed in service in March of 1943 and remains in service today.

Later that year, he was transferred to the 834th EAB stationed in Matching Green outside of Essex, England. The 834th was constructing a full-size heavy bomber base that included concrete runways, and an experienced dozer operator was in demand. Home was a tent but the wet weather of England

was better than the cold of Iceland. For Uncle Dan, ice was swapped for mud.

In addition to construction of the airfield, the 834th was being prepared for service on the continent. Courses in clearing minefields and training in concealment, chemical warfare, and other tactics were attended with interest because on Dec. 23, 1943, the men of the 834th were told that they would participate in a "strategic mission." Most of the battalion was moved to

Chiseldon Camp, Wiltshire, for training in construction of emergency landing strips and ALGs.

Battalion members also began experimenting with waterproofing equipment so that they could operate fully submerged—a hint of what was to come. As fate would have it, my uncle remained in Matching Green completing work on that airstrip. Being new to the battalion, but more-experienced in field construction, he was selected to stay and finish "a few minor details." In the latter phase of training, the battalion was moved to Torquay, Devonshire, and participated in amphibious landing practice. Uncle Dan remained at Matching Green doing the finishing work.

The 834th returned briefly to Matching Green but by April 1, 1944, had moved to Great Barrington, Gloucestershire, and on April 3 was alerted for a "short sea voyage." Operation Overlord had begun and D-day was fast approaching. For the next two months the battalion prepared equipment, practiced loadings, and made ready. The 834th was divided into seven "serials" that would depart from different locations at different times. At this time they were effectively cut off from the outside world. Uncle Dan remained at Matching Green doing finish work.

A short sea voyage

Early in June 1944, Uncle Dan became a replacement bulldozer operator for an echelon of the 834th designated A-1. Along with echelons A-2 and A-3, they were headed for a landing on

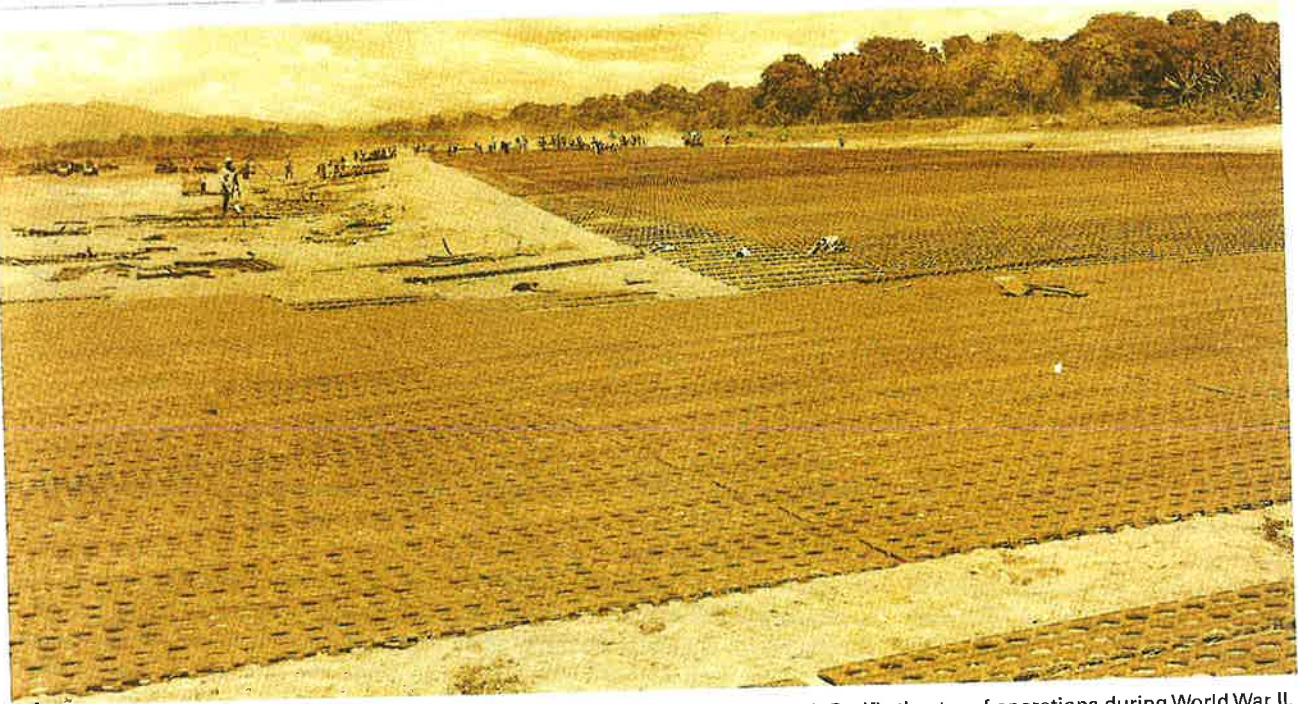
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| EABs built airfields in North Africa, Europe and, as seen in this photo, in the South Pacific theater of operations during World War II.

tended ELS site still in enemy hands. Lt. Col. John Livingston of the 834th requested permission to seek an alternate site and one was located between the villages of St.Pierre-du-Mont and St.Laurent-sur-Mer. The site was on the bluffs overlooking Omaha Beach (see artistic rendering on page 14).

By June 8 (D+2), the strip was operational as an ELS for small planes. In 24 hours it had been upgraded to handle C-47 transport planes. As an ELS it consisted simply of a graded and unsurfaced runway. By June 14 (D+8) it had been upgraded to Advanced Landing Ground (ALG), with a PSP/mat-surfaced runway. An average of 100 C-47s landed there daily during the next six weeks. In addition, P-30 and P-47 fighter planes operated from the field as early as June 11, 1944.

With the air superiority of the Allies quickly established, the landing strip at St.Pierre-du-Mont/St.Laurent-sur-Mer was again upgraded for bomber support. This required extension of the runway to 5,000 ft., plus the construction of support facilities and bomber parking areas. This site quickly returned to agricultural fields after the war.

Beyond D-day

As the war advanced in Europe, the capture of enemy airfields that were readily repaired reduced the need for ELS strips and more attention was paid to the repair of damaged conventional runways. Uncle Dan shipped home before the May 8, 1945 capitulation of Germany. Assigned to the Ordinance Arsenal in eastern Oregon, he met my aunt and became a part of my life.



| Victory in Europe: "Here we were on V-E Day!"

The facility at WES that had served so well in evaluating landing mats for airplanes would return to service in the later 1970s and early '80s to evaluate geosynthetic alternatives for roadways and runways. Fabric impregnated with asphalt would provide a poor landing surface for today's jet fighters but continues to serve a role in paving overlay applications.

On the worst days of my career, I have always thought of Uncle Dan driving a submerged bulldozer onto Omaha Beach.

Compared to that, mine has been an easy job. E

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