Road Construction on New Georgia

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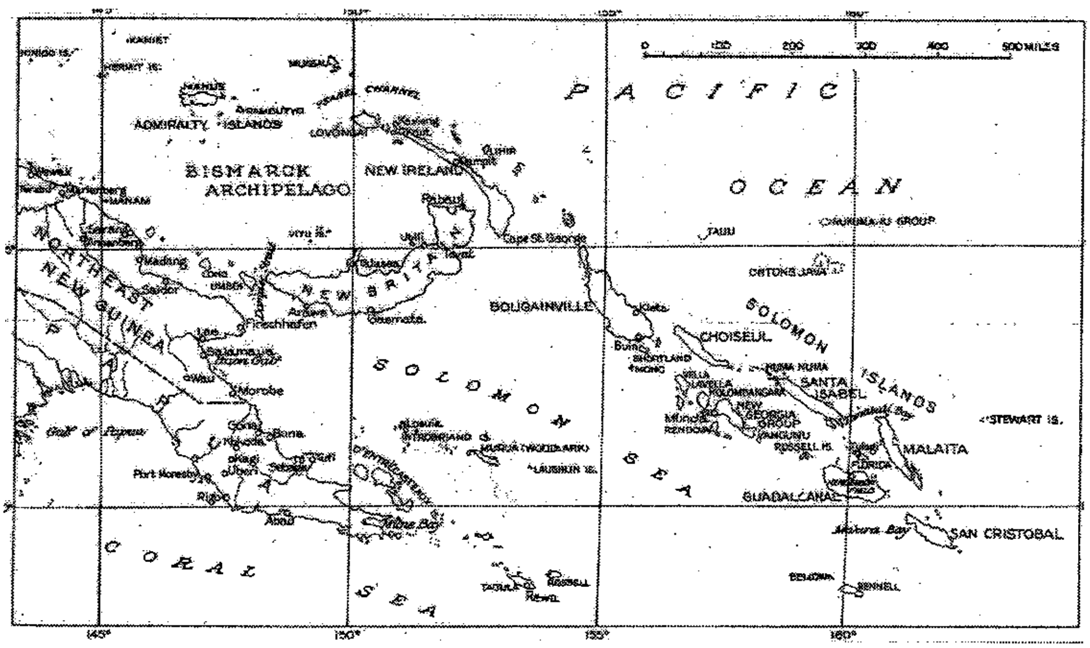
The Combat Engineer Battalion has as one of its general missions in the operations of an Infantry Division that of furthering the advance of our own troops. The fulfillment of this mission ordinarily consists of constructing low-order roads and bridges, assisting the artillery into position, and similar duties. Although it does not carry the heavier bridging equipment the Battalion is able to erect heavy bridges when the equipment is available from higher engineer echelons. The Battalion is not normally equipped or organized to engage in heavy road construction, a job usually relegated to higher echelon engineers. However, in the South Pacific theater, the combined circumstances of a complete lack of existing roads on the islands occupied, and the absence of higher engineer units, and the nature of organization of the ground component of the Task Forces have made it necessary for this Combat Battalion (118th Engineer Combat Battalion, 43rd Infantry Division) to obtain equipment in excess of its "book" allowances, and to construct higher-order main supply roads. This is, of course, in addition to the type of road construction that is the usual task of the Battalion. The words "normally," "ordinarily," and "usually," are used with some misgivings because, in the situations encountered, there has been little that could be regarded as normal, ordinary, or usual.



The Southwest Pacific Theater of Operations

General Problems

Because of the characteristics peculiar to the South Pacific theater of operations a variety of problems was encountered. Perhaps the most important of these resulted from the complete lack of existing roads both in the Russell Islands and in the New Georgia Group, the two island groups in which this Battalion has operated. The unit was part of the original landing forces on both of these groups.

Upon landing on the Russells the only thing found resembling a road was a one-way coral treadway path built in the coconut plantation areas by the plantation owners. The treadway had been constructed by simply cutting two ditches approximately 18 inches wide and 18 inches deep, spaced at the proper distance apart and filling them with coral. The inadequacy of this road for military use is obvious.

In the Southwest Pacific, engineers had to overcome these conditions to support their divisions.

When the first landing was made on Rendova Island in the preliminary phases of the Munda campaign not even this much was found. The landing was accomplished in the middle of a wet period, under combat, and on a part of the island where there was no coral base as had been found in the Russells, but only a deep clay-loam sub-soil. Even though the supply distances were very short on the island the task of moving supplies, because of the absence of a firm sub-base, was tremendous. The passage of a bulldozer over what was supposedly the roadway rendered it practically impassable to wheeled vehicles. The placement of large artillery pieces was particularly difficult.

After the operations on the New Georgia mainland had begun, the difficulty of the road problem was somewhat diminished by better terrain and the absence of heavy axle-load traffic. (The artillery supporting the offensive was emplaced on outlying islands.) The clearing and location problems, however, were increased because the landing was made on a jungle portion of the island. Generally speaking, the lines of existing communication stopped at the beach and from there on it was necessary to start from scratch. Only when our forces reached the Japanese-occupied portion of the island where the enemy had built a road of sorts was this not the case. Even here our previous artillery shelling and aerial bombardment had rendered the road practically useless.

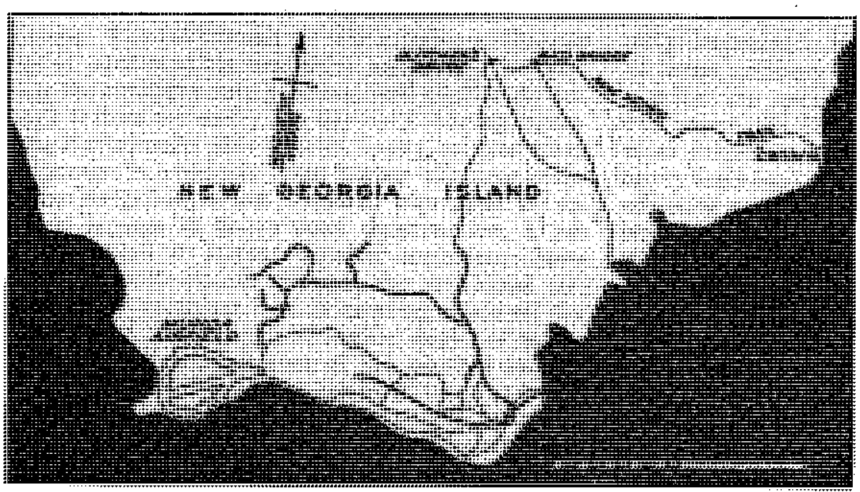
The terrain and topographic features of the two island groups gave rise to certain problems. Geologically the islands are of volcanic origin, with the medium and lower-lying portions predominantly of coral. From the shore progressing inland, there is first a fairly flat coastal plane of varying width, but rarely in excess of a few hundred yards. Mangrove swamps are often found in portions of the coastal plain. Beyond this there is a characteristic escarpment that is sometimes vertical and may reach a height of 30 feet or more. At the top of the escarpment begins the undulating section, which is sometimes packed with sinkholes and is characterized by many knolls, seldom exceeding a half mile in width. The coconut plantations are found on these portions of the island that are underlaid with coral covered by an overburden of from 0 to 20 feet of soil. On the knolls themselves coral is found right at, or close to, the surface, but the sub-soil is deep in the draws between these knolls. The rolling section then gives way to the rugged, jungle-covered, central part of the islands. There are found numerous steep, sharp hills; sheer cliffs; and heights up to 2,000 or 3,000 feet.

No more than jeep trails, and very few of these, were constructed in these portions of the islands. Whenever possible, advantage was taken of the coral knolls in order to reduce the road sub-grade work; otherwise coral base courses 2 to 3 feet in thickness had to be put down. The coral is tough and dense and similar to slag in its properties except for its white color. It has very good compacting and self-cementing qualities and is generally an excellent road material.

In the location of a military road both the tactical and technical aspects must be considered. In combat the tactical situation determines the location of the road to a major extent. In most of the combat situations encountered by the Battalion the necessary life of the line of communication was not more than three weeks and since the road consisted only of a bulldozer-cleared right of way, the location was dependent almost entirely on the tactical situation. On the Russell Islands and following combat on New Georgia Island the development of the islands into bases allowed criterions of location more similar to those found in civil practice.

MacKenzie Trail

The element of time plays a most important role in all the phases of military road construction. In combat it is probably the most vital factor to be considered and, together with the tactical situation, determines the type of road, its location, and general construction procedure. There is, however, a certain amount of inter-dependence of all factors involved. This may be well illustrated by a brief description of the Battalion's operations on the MacKenzie Trail (named in honor of one of the Battalion officers who was killed during its construction), in the initial phases of the offensive on the mainland of New Georgia.



Roads on New Georgia

The initial landing was at Zanana where the jungle grew right down to the beach. The movement was generally in a westerly direction and culminated in the capture of Munda Airfield. A supply and evacuation route for the division from the Zanana Beach to the front line units was constructed, the western end of the road advancing with the front line troops. Because of the time element and the technical obstacle of swampy ground it was necessary to locate the trail on the north or right flank of the division and to have it swing south following the latter landing at Laiana.

Two timber trestle bridges were built on the trail and a few corduroy sections had to be laid down. During the entire construction period there was enemy action in the vicinity of the trail so that local security for the Engineer work parties was necessary at all times. The trail being on the flank, made it especially susceptible to enemy action. As a result of one ambush of a work party and a night attack on a bivouac area, the Engineer casualties were one officer and three men killed. No casualties were caused by Japanese sniper fire. The trail was approximately 5 miles long and was built in the period from July 4 to July 15. Its importance in the operation is something that could not be exaggerated.

Types of Roads

The type of road constructed was entirely dependent on the tactical requirements. While in combat, bulldozer trails just sufficient to take the necessary traffic were made. In some cases this also required construction of stretches of corduroy road but in all cases the engineering was purely of a combat nature. Passability was the only requirement.

As the operation progressed, the rearward portions of the bulldozer trails were maintained by corduroying or by spreading coral. In some instances the corduroy was used as the road base and a surface course of coral was placed on it. All of the corduroy

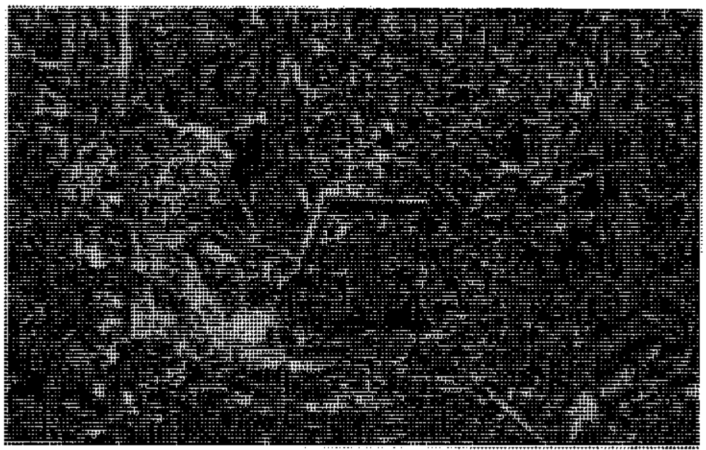
Engineer works on corduroy road over swampy ground on New Georgia.

road put down was one way. The corduroy varied from 3 to 6 inches in diameter and was placed perpendicular to the road centerline. On Rendova, coconut logs were used.

On Banika Island, in the Russell Group, a plank road was constructed over a swampy portion of the ground. All of the planks used were sawed from native timber and were for the most part heavy, dense mahogany. Plank stringers, 3 by 12 inches, were placed parallel to the centerline of the road on approximately 2-foot centers. The deck, or road surface was of 3-inch plank placed perpendicular to the road centerline. The width of the road was 12 feet between curbs, and the length of the road was 200 yards. Because of the timber used this stretch of road was known as "Mahogany Boulevard."

On the Russells and beginning with the landing at Laiana, the so-called main supply roads were constructed. This type of road was very similar to the good gravel roads found in the United States. The road generally has a 50-foot right-of-way, allowing 30 feet for the roadway, 5 feet for the shoulders and 5 feet for the ditches. Coral is used for the base and surface courses. Very little use was made of the Marston, Sommerfield, or other types of metal mat in the construction of roads.

Construction Procedures



Bulldozer blazes a trail through the jungles of New Georgia.

In combat, construction procedure is necessarily simple. The road location reconnaissance is carried out with the tactical requirements and time element foremost in mind, and the road location is determined. A compass survey is all that is made for this purpose. Grade requirements are of minor importance. All of the rest of the construction is embodied in the clearing of the road. The traffic follows the bulldozer.

The construction of the main supply roads follows the same general procedure as in civil practice. The reconnaissance for the general road location is made and the final centerline is surveyed in. Detailed balancing of cuts and fills is not attempted; the centerline is located so that a general balance exists. Here also grade and slight distance are of secondary importance and are checked only at crucial points. The maximum grade on the roads constructed on New Georgia is 30 per cent over a distance of 600 feet.

The bulldozers doing the clearing are followed up by carry-alls doing the cutting and filling and the road patrols preparing the sub-grade. Where coral is found at or near the ground surface very little sub-grade preparation other than shaping is necessary. In other cases where the main supply roads are located on the sites of previously built and used combat roads coral fill up to 2 or 3 feet in depth has been necessary for a sub-base. Sheepsfoot and smooth rollers are used for compaction.

Because of the excessive rainfall, proper drainage is of particular importance. It has been found that an 8-inch crown is advisable. Fifty-five-gallon oil and gasoline drums with their ends cut out, are the standard culvert and are very satisfactory. Improper drainage has been the most important contributing factor to road failure. It has often been necessary to allow traffic on the road during construction; in these instances the road with the proper drainage was completed up to the stopping point for the day. This eliminated any sub-grade destruction that might have been caused by traffic or heavy rains.

The surface course is of coral and is 8 inches in thickness. When graded and rolled it is comparable to a macadam surface, except for the dust problem, and is probably superior to a gravel-surfaced road. The material for the road is spread as it comes from the coral pit, no screening being done.

The average rate of construction of these main supply roads has been approximately 200 yards per day. Considering the density of the jungle that has to be cleared and the toughness of the coral cuts, it is believed that this is very satisfactory. Maintenance problems are the same as are always found on this type of road and present no special problems.

Equipment

On embarking for overseas duty, the Battalion's road-building equipment consisted of 4 R-4 Caterpillar bulldozers. It soon became evident that more heavy equipment would be needed in order to accomplish the road-building missions with which the Battalion would be charged. At present the equipment in the unit consist of 5 R-4 bulldozers, 3 D-7 bulldozers, 2 Motorized Road Patrols (graders), 1 half-cubic-yard shovel with dragline, clamshell, and pile-driving attachments, and two captured Japanese rollers. It is likely that this equipment will be increased for future operations. In addition, other borrowed equipment including carryalls, sheepsfoot rollers, leaning-wheel grader, and a trenching machine were used at various times. There are thirty 1 ½-ton dump trucks in the Battalion, and it has been authorized that twenty-seven be replaced by trucks of 2 ½-ton capacity. It should be noted that the maintenance of this equipment was an ever-present problem and the excellent work of the Battalion's Maintenance and Repair Section was highly instrumental in accomplishing the road-building missions assigned to the Battalion.

Grader levels surface course of coral on a main supply road.

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Roads—Transport—Firepower, in Korea

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Lieutenant Colonel, Infantry

Shackled to the highways! Too many tanks and trucks, too much artillery! You cannot fight a war with heavy equipment in Korea. Such were the accusations of many critics during the grim days of last December when hordes of Chinese swarmed over the hills to hack at American motorized columns. Some even proposed that our Army revert to the standards of the enemy, and do away with their big guns and high-powered equipment, for it appeared that the Chinese, with only a rifle and a sack of rice strapped on their backs, were handing us a licking.

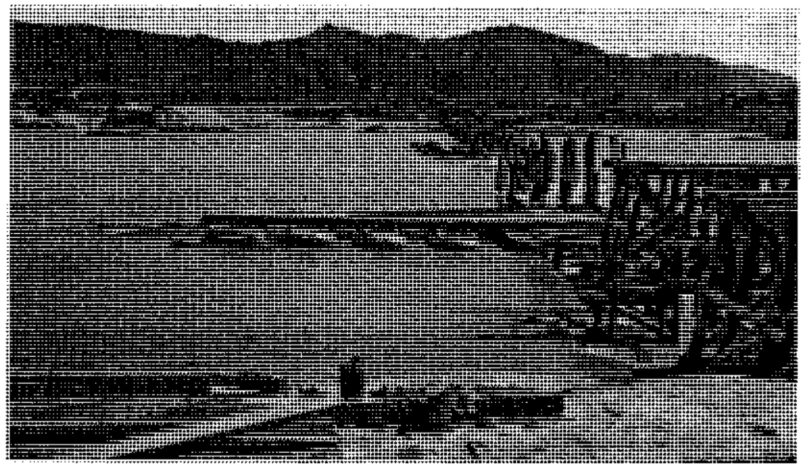
And at the time it did sound fairly logical. After all, mountainous Korea, with its primitive road net, was scarcely the ideal maneuvering ground for American armor. Korea's oxcart paths winding over mountains and bridgeless rivers just could not carry the truckloads and truckloads of ammunition needed to feed American big guns.

Tanyang Pass, Korea. Typical Korean terrain that required extensive Engineer roadwork.

However, those who would have revised tactics and organization so drastically to combat the methods of the enemy overlooked two very important factors: First, they had forgotten that the axiom of the American Army is firepower. Firepower, stemming from the superior industrial plant of the United States, had defeated Hitler's crack legions in Europe not so long ago. Only firepower could defeat the suicidal human-wave tactics of the Chinese Communist. Second, they had not taken into account the Army engineers. If

Korea did not have the roads needed for fighting our kind of war, then the engineers could build them, as they had done no more than eight years earlier in Burma, in Okinawa, and in the jungles of New Guinea.

To provide such roads was the challenge faced in late February as the Eighth Army stiffened in its southward withdrawal and began to recoil in counterattacks against the victory-flushed Chinese. It was one of the greatest challenges in the history of the Corps of Engineers, and one that gave little cause for optimism.



Korean floods destroyed both float and fixed bridges.

Pre-seasonal thaws were already turning the few existing roads into bottomless quagmires and flood-swollen streams were severing vital supply arteries. During the dry season of late fall and early winter, blown bridges and poor roadbeds had presented no particular problem. Practically any stream could be forded or crossed on improvised structures. Now torrents of water pouring down Korean hillsides converted winter-dry streambeds into impassable barriers. Rice paddies, frozen solid in winter, now became treacherous traps of sticky mud.

The problem was two-fold: to overcome the effects of spring thaws and floods and, at the same time, to develop a road network that would sustain the spring military offensive in the ranges of mountains ahead. The problem, similar in aspect along the entire Eighth Army front, was probably more acute in the X Corps zone, commonly referred to as the East Central front. The zone extended squarely across a large segment of the mountainous spine of Korea, a region in which American troops had never operated.

In the Battle of the Soyang River, three months later, the double-barreled challenge was answered. In fifteen days UN forces met and hurled back in decisive defeat the most massive Red offensive of the Korean War. Spearheaded by the 2nd Infantry Division, the X Corps bore the brunt of that attack in some of the most mountainous country in Korea.

Thirty-seven thousand tons of supplies were consumed in the twenty-nine days during and immediately preceding the battle—an average of 1,200 tons a day. Fifteen thousand 2 ½-ton truckloads of ammunition, food, and equipment were transported from railhead to front lines, over a supply route which, before the war, in many places had been a single lane road, passable only in dry weather and then suitable only for light vehicles. At the height of the battle, when massed Chinese infantry were hurled at UN lines in successive waves to be slaughtered by artillery barrages, eight hundred truckloads of ammunition were rushed to this sector of the front in a single day.

These same engineer-built roads played an equally important part in that battle by increasing the tactical mobility of UN forces. Army leaders, as well as the Chinese, knew that UN troops could not prevent a penetration of their defense line, stretched thinly as it was across the peninsula from Kansong on the east coast to Imjin River. What the Chinese did not know was that the Eighth Army Commander had a defensive strategy to meet that eventuality. After an enormous build-up and numerous light probings, the Reds stuck in force on the night of May 16. It soon became apparent that the enemy was making an all-out effort on the East Central front. One spearhead plunged southward toward Soksa Ri, expecting to take with ease their objective, Chechon, after overpowering units in their path. Surprised and dismayed they ran head-on into tanks and infantry of a fresh division at Soksa Ri. Their advancing column was cut to ribbons with American Army firepower and was soon in hasty and disorderly retreat.

Capitalizing on engineer-build roads that could carry an infantry division's tanks, the Commander had quickly shifted the 3rd Infantry Division to the East Central front. Thirty-eight hours after the order was issued, elements of the division were moving into battle, after their rapid 130-mile move across the battlefront. The Chinese were dumbfounded. Their intelligence had plotted accurately the location of every UN division, and there was the 3rd Infantry 130 miles from where they thought it should be. Here, once more, as in World War II, our forces had been able to throw in their superior firepower at the crucial place and time using engineer-built roads.

The Road Problem

Three months earlier, a study was made of the approximately 35-mile-wide belt which made up the East Central sector of operations. It was a logistical nightmare. Depicted on a terrain map, the area looked like a giant nutmeg grater, with its highest projections representing hills 6,500 feet high and its depressions the valley floors, most of which were scarcely 300 feet above sea level. Over this mountainous mass threaded only a few arteries worthy of the name roads; mostly they were oxcart trails, shelved precariously on the steep hillsides ready to be washed away by the first spring rains. The only north-south road which even remotely approached the requirements of a main supply road was, for the most part, on the extreme west flank of the sector and branched completely out of the sector at Hongchon.

The immediate need was a network of all-weather roads 22 feet wide, well crowned and well ditched for drainage, which would stand up in wet weather under the constant pounding of heavy military traffic. Bridges would have to carry 50-ton vehicles, and the heaviest tanks. Also the bridges would have to be high enough to stand above the flood crest of rivers, such as the Soyang, known to rise 15 feet above its low water level during the monsoon season.

In some cases this meant improving existing structures; in other cases new roads had practically to be built. All told, in answer to this requirement, there have been developed over 600 miles of roadway in the X Corps sector alone since last January.

Korean laborers level road.

Korean Labor Assistance

Short on equipment and engineer troops, the engineers have gratefully accepted and used to advantage the services of Korean workers. Some of the workers are recruited locally by the American Army, others are organized by the ROK government into units called the Korean Service Corps. In the X Corps alone as many as five thousand Koreans have been employed in engineer work, under the supervision of regular engineer troops.

Powerful earthmoving machines, common to any American construction scene, have proved their worth in the Korean war zone. The bulldozer, workhorse of the engineers in World War II, though severely challenged on the steep and rocky Korean hillsides, has come through as the favorite piece of equipment in the engineer's eye. Occasionally, one of these 16-ton machines slides off a precarious ledge or tumbles over a steep embankment. But dozer operators have learned to ride their machines down the grades, dropping the blade to gouge out enough earth to halt the descent. In this manner few operators are injured and the machines can be rescued.

Soil Problems and Landslides

Like every new engineering venture, Korea has presented some baffling problems in the solution of which new techniques have been devised and applied. Ironically, in that country whose river bottoms are lined with rock and sand, road-surfacing material has been a hard-to-get item. Engineers explain that the smooth surfaces of river bottom rock do not provide good bond, so it has been necessary to crush thousands of tons of rock to provide the satisfactory surfacing material. However, many wind and water-eroded rock deposits were discovered which have yielded material suitable for road surfacing and thus alleviated the demands on overworked crushers.

In Korea, where loose, exposed earth fairly dissolves during the monsoon downpours, landslides have plagued the engineers over every hilly mile. These slides may occur from above, wherever a steep cut has been made on a mountainside, and during extremely heavy rainfalls tons of rock and earth come plunging down to block the roadway. Traffic then has to be held up while bulldozers and men with picks and shovels go in and clear the road. Alert to this threat, the engineers have work teams stationed 24 hours a day at critical points, ready to act the instant a slide occurs. To minimize the danger of slides, roadways are constantly being widened inward and as time permits retaining walls of stone masonry are erected.

Engineers repair damage caused by a landslide.

An even more dangerous landslide occurs when the roadbed itself gives way. Many such slides have occurred in old Korean roadways, which do not have retaining walls sufficiently strong to support American tanks and heavy trucks. Many a tank or bulldozer has plunged hundreds of feet down a steep cliff as a result of roadbed landslides.

Major Vernon L. Watkins, Engineer officer of the 8224th Engineer Group (who served for six years with the Denver District of the United States Forestry Service) has met this threat by using a type of cribbing successfully employed on Colorado mountain roads. Whereas most retaining walls are build of cribbing composed of vertical and horizontal log lacing, the Forestry specification calls for additional lateral binders, which literally anchor the retaining wall to the center of the roadway. In effect, the weight of passing vehicles serves to reinforce their own support. This method of cribbing has now become standard across the entire X Corps.

Improvisation and Salvage

Dangling on the end of a 5,000 to 8,000-mile supply line, scarcity of materials has put the pinch on engineer operations throughout the war, but American ingenuity, substitution, and improvisation have provided the needed supplies with remarkable success.

Captain Robert Milosovic of the 630th Light Equipment Company is credited with devising a unique form for the construction of concrete culvert sections, which are used in vast quantities here. The form, made of heavy rubber belting, is easily removed from the finished culvert section and its use speeds the production of concrete culverts immensely.

Wide use has been made of prefabricated Bailey bridges, but often salvaged steel has been used with great success. Scrap steel has been used in short-span permanent steel I-beam bridges. Some of the salvaged materials was highly stylized and much of it was twisted and broken from Allied bombings. All diaphragm bracing to reinforce and give rigidity to structures, has been cut from the wreckage of bombed bridges or abandoned structures. Much reinforcing steel has been obtained from abandoned gold mines in the area.

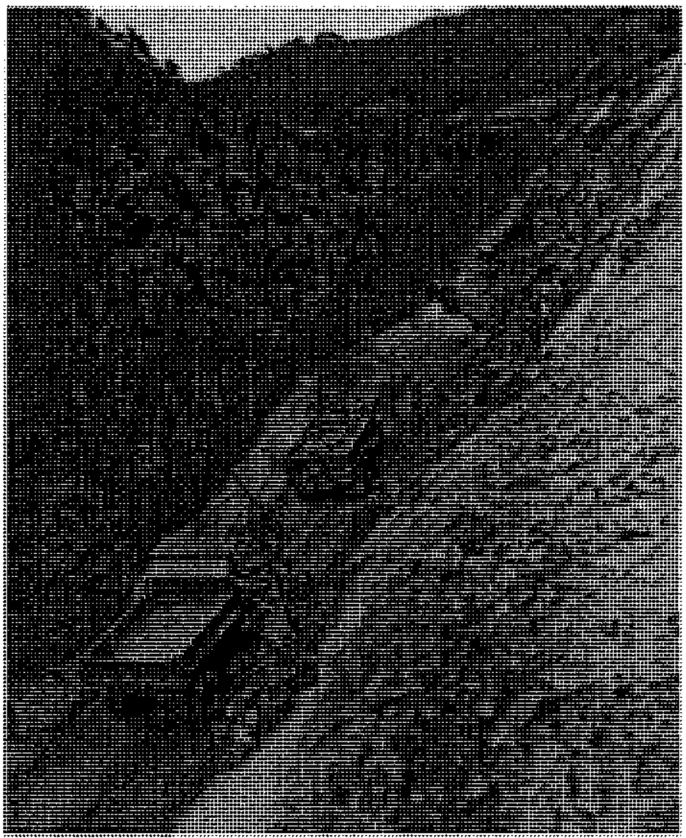
In the use of damaged oil drums the engineers have shown themselves masters improvisers. Oil drums have been used for road culverts, for a novel type of bridge, as scour protection for bridge pilings and other purposes. In the earlier days of the war, before corrugated steel culvert material was available (and even yet in the forward areas) several oil drums with the ends cut out made acceptable culverts to prevent roadbed washouts when laid end-to-end and covered with earth. Though not as strong as the standard corrugated steel culvert, they have carried even heavy tank traffic with at least 2 feet of rock and earth.

Engineers halt work to allow passage of truck convoy.

These oil drums also make effective protective jackets for bridge pilings driven into riverbeds. The swift Korean streams, heavily charged with sand and stone washed from the hillsides, chew into wood pilings and quickly destroy them unless they are given some protection. Oil drums with the ends knocked out and filled with stone and cement serve that purpose admirably.

While faced with the necessity of improvising methods and scrounging materials, Army Engineers always operate under requirements more restricting than civilian contractors. The civilian roadbuilder can reroute or detour the traffic but the military road must be kept open at all times.

Each project has its own story and its particular problems. One example is the Inje Pass road and bridge line extending from the Soyang River crossing at the 38th Parallel northward to Inje. The engineers have dubbed it the "Inje Parkway." Recurring slides on the steep embankments of the original roadway, generally paralleling the river on the west bank, had to be overcome by revetting the bank both below and above the road. Each time a slide occurred traffic was blocked while the engineers worked feverishly to repair the damage. To reduce traffic congestion, to provide an alternate route for safety, and to divert the heavy tanks from the perils of this route until it could be improved, a by-pass route was constructed on the opposite side of the river. The route followed level just above the river bed and crossing the river over 500-foot floating bridges at two points. Now southbound traffic follows "East Riverside Drive" and northbound takes "West Riverside Drive," just like a divided-lane highway in the United States. Altogether, the engineers have constructed six bridges in this 6-mile route.


Inje Road widened by X Corps Engineers

Victory in the Battle of Roads

No 8-hour day has won the battle of the roads in Korea. Work round-the-clock is not unusual. Engineering work begins at the front line infantry regiment and is closely integrated right on though the Army. Infantry regiment pioneer platoons may hack out a footpath or a jeep trail over which they can carry rations and ammunition for the infantry battalions, fording streams or building light log bridges. Then troops of the division's engineer battalion come in, widening and improving the roads as much as possible with emergency types of construction. Corps Engineer troops then take over and convert the road into a two-way all-weather highway that can carry any military vehicle. Finally, Eighth Army Engineers give it the finishing touches, widening and strengthening the bridges, straightening curves, and improving the surface.

As the battle of roads was won, so was won the battle of machines and firepower against massed manpower. In that victory was vindication of fighting the American way. General Bradley summed up the situation in an interview for the *Buffalo Evening News:*

"What does it matter if a thousand Chinese soldiers can carry 200 pounds each on their backs all night and bring up 200,000 pounds of supplies? Are they going to fight as well week after week as our boys who ride to war on top of their supplies—the kind of supplies, heavy guns and powerful shells that Chinese soldiers, no matter how sturdy they are, can't carry on their backs? The mechanical genius and productive capacity of our country can produce destructive weapons and lifesaving transport faster than mere masses of soldiers can be mobilized and trained. And in modern warfare this must eventually win."

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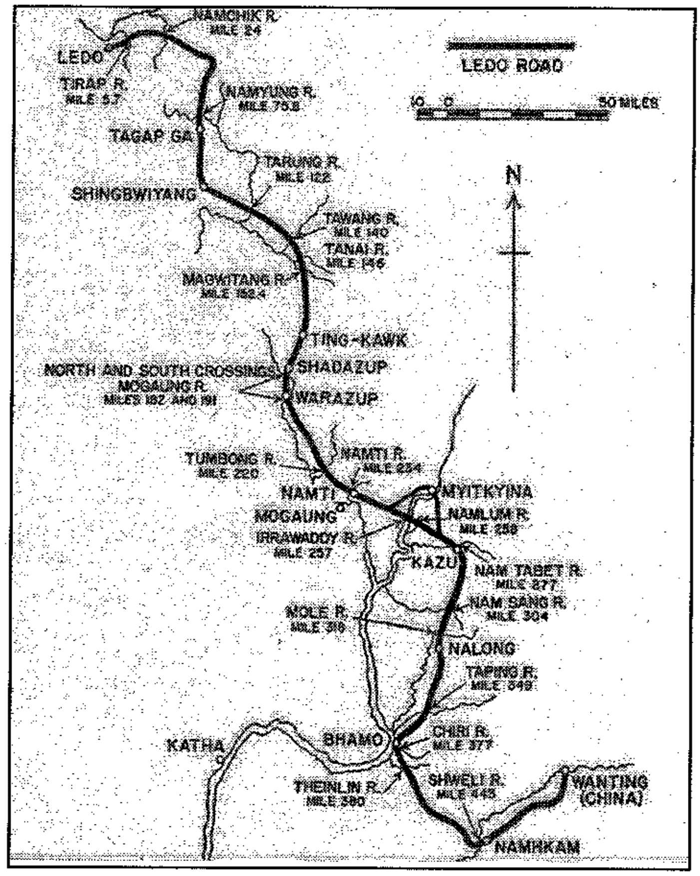
Bridges on the Ledo Road

Leslie Anders



Many aspects of the Ledo Road project will continue to excite the interest of engineers and arouse the wonder of non-engineers. Not the least among the problems connected with the construction of the road was that of bridging. The 483-mile route from Ledo, India to Wanting, China, ran through terrain drenched with torrential rains during the May-to-October monsoon. Hundreds of gullies and ravines lay across the route, to say nothing of such large rivers as the Tarung, Tanai, Tawang, Shweli, and Irrawaddy. When completed, the Ledo Road possessed 5.5 miles of bridging and an average of seven culverts to the mile in mountainous areas.

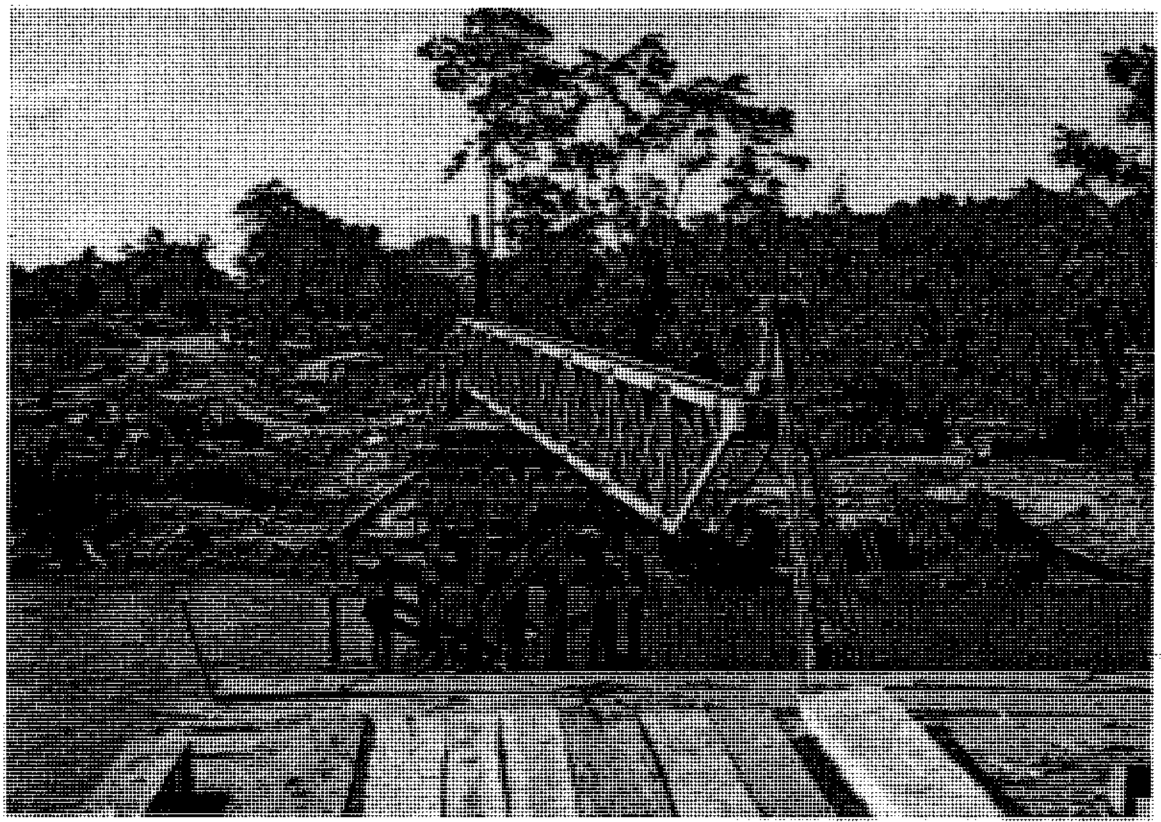
Planning Problems

During the first two years of the road project, the engineers in the China-Burma-India Theater were assisted in procuring bridges suitable for the road by the Chief of Engineers in Washington. The Engineer Board was assigned the responsibility for the design of bridges for the Tarung, Tanai, Mogaung, Irrawaddy, and Shweli rivers, the lesser crossings to be spanned with standard military bridging. The Board was not far along with these special projects before it became apparent that the scarcity of available information on the stream crossings rendered their task hopeless. The fundamental trouble was that little was actually known of the behavior of the rivers hidden in the jungle-covered mountains of Upper Burma. At that time the Japanese still occupied the future route of the Ledo Road almost in its entirety.

Two bridge experts were sent to India in January 1944, to study the situation at first hand. In New Delhi they conferred with the SOS (Services of Supply) Engineer and careful consideration was given to several plans. The conferees first rejected a plan for 60-foot prefabricated, all-welded deck-girder spans with foundation piers of wooden or steel piles because the construction of too many piers would be required in the deep swift water. Next, they decided against the proposal of the Engineer Board to use portable steel, deck-girder pile trestles of H-32 loading. The girders were too long (45 feet) and too heavy (4 tons) for hauling over the creaky Indian railways, and it was doubtful if the required specially trained Engineer units would be available to erect the bridges when they were needed. Apart from logistical considerations, it was agreed that the Board plan represented "an entirely adequate solution" to the problem of spanning Burmese rivers.

Bridge Types

It was finally decided to make the H-20 steel deck girder the basic bridge for the Ledo Road. The girder sections of this bridge were 12.5 feet long; the rectangular span sections weighing 1,237 pounds. A 100-foot H-20 bridge, consisting of two parallel

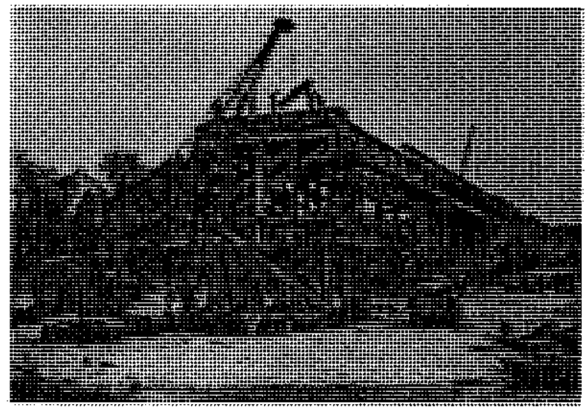


Engineers on the Ledo Road use cranes to move a H-20 box girder panel into position on a bridge.

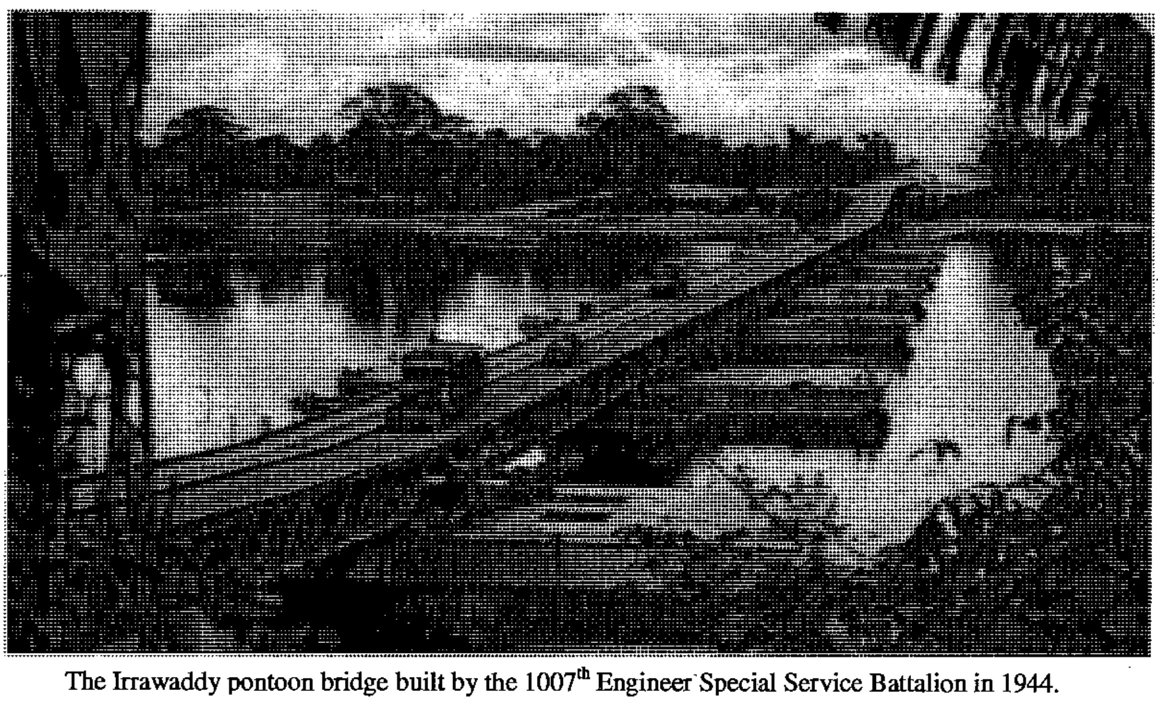
girders, each made up of six span and two end sections, had a load capacity of 20 tons (without supplementary supports). This bridge was especially suited for spanning deep gorges that would ordinarily necessitate high and complicated intermediate supports, wide depressions that would otherwise require numerous pilings, and crossings where satisfactory footings for piles were scarce or non-existent. Lateral clearance was unlimited on a deck girder of this type, and its assembly was simpler than that of most other comparable bridges. Few piers and no cofferdams were needed, and the ordinary 2 ½-ton truck could easily haul its components.

The H-20 was used at most important crossings in the 180 miles between the Namyung and Irrawaddy Rivers. The largest of these bridges were built in the Hukawng Valley southeast of Shingbwinyang. Company A, 209th Engineer Combat Battalion, erected the 960-foot Tarung bridge in less than a month, completing it in early April 1944. The same unit shared with Company F, 330th Engineer General Service Regiment, the three-month task of spanning the Tawang with a 1,205-foot H-20, which was opened to traffic early in June 1944. Company F, incidentally, built the Tanai H-20 bridge, 607 feet long, in less than two months, having started work on it in mid-March 1944.

Actually, the 1,625-foot Irrawaddy pontoon bridge was an H-20 type. The intermediate portion, consisting of 850 feet of deck girders laid on steel barges, was connected with each bank by means of extensive timber-trestle approaches. The 1007th Engineer Special Service Battalion built this monumental structure in 75 days, completing it on March 31, 1945. The basic design, modified in some details at the site, was worked out by the Engineer Board in the spring of 1944.



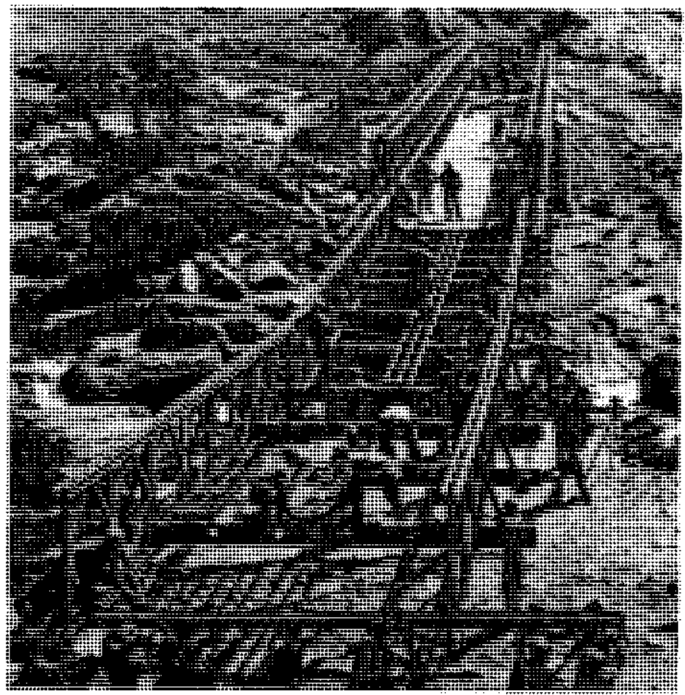
Timber trestle piers support H-20 girders on the bridge over the Irrawaddy River



The Irrawaddy pontoon bridge built by the 1007th Engineer Special Service Battalion in 1944.

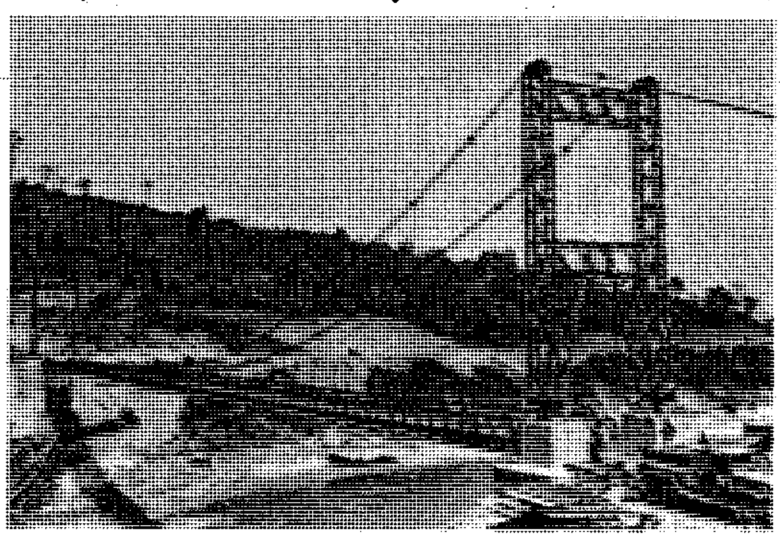
The second most important bridge type, the Bailey, was used more widely than the H-20 between the Irrawaddy and the Chinese border. Adopted by the Corps of Engineers in the winter of 1942-1943 as an alternative to the H-20, the Bailey was in great demand in the European Theater by 1944; by the last winter of the war, however, the British were able to provide the Americans in the CBI theater with a considerable amount of Bailey components from their stocks in India.

Company B, 236th Engineer Combat Battalion, on October 20, 1944, was the first unit to complete a Bailey bridge on the Ledo Road; on this date it opened to traffic the 248-foot Namlum bridge after only five days' work. The 1875th Engineer Aviation Battalion, it should be pointed out, had completed the concrete abutments just before the 236th took over the project. The 1304th Engineer Construction Battalion began the 560-foot bridge over the south crossing of the Mogaung River near Warazup on October 10, 1944. Companies B and C of the 1304th completed work there on October 28.



Engineers work on a Bailey bridge over the Taho River.

The fact that the War Department decided in August 1944, to reduce specifications for the Ledo Road east of the Irrawaddy from two lanes to one made it practicable to substitute the Bailey bridge for the H-20. The 236th Engineers built most of the major Baileys between the Irrawaddy and the Shweli. The most noteworthy were: the 270-foot Nam Sang bridge, completed on December 15, 1944, in less than eleven days; the 270-foot Mole bridge, completed in mid-January 1945, in less than a month; and the 280-foot Theinlin bridge, finished in twelve days, January 17, 1945. More spectacular were the Bailey suspensions erected over the Taping River, at Bhamo, and the Shweli River at Namhka, by



Suspension Bailey bridge over the Shweli River in Burma the 209th Engineers. Company A built the 380-foot Taping bridge in less than two months, finishing the work on February 28, 1945; the 450-foot Bailey at Namhkam built by Company B took about the same length of time, and traffic began using it on March 11, 1945. In each case the bridge was suspended on cables from towers made of Bailey panels and resting on concrete abutments.

At crossings where adaptations of the Bailey or the H-20 were not employed, a variety of types were used. In the original sector of the road, west of the Indian border, several Hamilton truss (steel) bridges were built, over such streams as the Tirap and Namchik Rivers. These were of one-lane design, just as the Bailey, and to afford traffic a two-way crossing at each stream, it was necessary either to build a second Hamilton truss or a separate bridge of another design. In the latter category were the field –fabricated timber-trestles, the steel I-beam bridges, and varying combinations of these and other types.

Engineers build a low-level timber pile bridge on the Ledo Road.

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Bridges Over the Imjin

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There is little about the Imjin River, when seen under normal conditions, to suggest the excesses of which it is capable at flood time. Through the greater part of the year it bubbles over its rocky course, seldom exceeding 200 feet in width and easily fordable at several points. Its waters are blue and transparent and the sight of this stream threading its way between steep cliffs and over broad flood plains presents a very attractive picture. Yet this apparently gentle watercourse annually floods to an incredible extent. In late July, August, and September, 1952, it seriously threatened the supply lines to our Western Front in Korea.

From its beginning in North Korea behind the enemy lines, the Imjin crosses into South Korea territory about 55 miles north and east of the point at which it empties into the Yellow Sea. Its path lays immediately behind and roughly parallel to the front line for a distance of nearly 44 miles; therefore, all of the Allied supply lines in the western third of Korea had to pass over this obstacle.

In the summer of 1952 there were nine bridges of various types spanning this section of the Imjin. Beginning where the river first entered our lines there were, in downstream

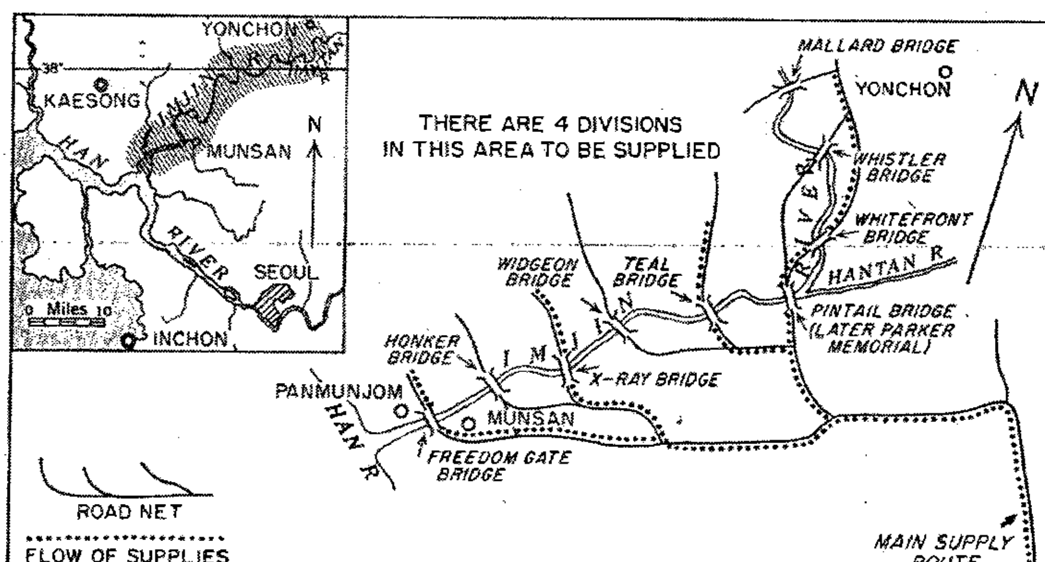


Diagram of Supply Routes over the Imjin River, 1952

order, the following bridges: Mallard, Whistler, Whitefront, Pintail, Teal, Widgeon, X-ray, Honker, and Freedom Gate, the last one forming a link between Musan, site of the Allied Base Camp, and Panmunjom, site of the truce talks. Some were standard low-level floating bridges of the Corps of Engineers, while others were of a semi-permanent fixed type, including bridges supported on steel piles, timber piles, and combinations of these two types of trestles. Only one, Freedom Gate, was built prior to the Korean War. This was a concrete pier railroad bridge decked over for highway traffic. The others had been constructed since late 1951 by Army Engineer Units

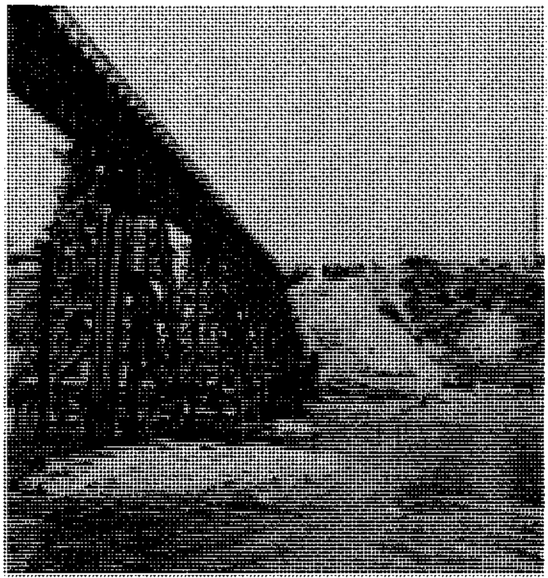
The engineers were not unprepared for the flood season of 1952. Flood records of previous years and other data were available. The yearly transition from lamb to lion was fully anticipated and the probably high water mark could even be forecast with some degree of accuracy.

During the late sprint, two 16-ton landing craft (LCMs) were brought to Inchon from Japan and moved by truck to key locations along the river to serve as ferries, if necessary, and for other emergency uses. A master plan was drawn up to co-ordinate efforts and give adequate warning of rising water. Debris booms were stretched across the river at two points, and plans were made for the removal of temporary bridges which were not expected to withstand the high water and swift current.

By late July preparations were almost complete. Mallard Bridge, a temporary structure of steel treadway supported on steel trestles, was to be left in service until the last possible moment because of its strategic location. A detachment was stationed near it with orders to remove the bridge at the first sign of rising water. About 4 miles downstream at the Whistler site, the temporary floating bridge had been removed. A ferry was in operation to keep the route open while work was speeded to a 24-hour schedule on the erection of a new semi-permanent bridge at the same site. This structure was to be a low-level Bailey bridge supported on rock cribs.


Whitefront Bridge

Whitefront was a two-way, high-level, timber trestle span which had been in use only a few months. The bridge itself was considered safe, but steel piling was being driven upstream of it to arrest debris. Farther downstream, Pintail, a floating bridge, had been removed and replaced by a high-level structure christened Parker Memorial Bridge. Formally opened in July, it was recognized as the aristocrat of the Imjin crossings. One of the most vital arteries of supply was dependent on Parker Bridge, which was designed to carry a very heavy load of traffic. Spanning a rock gorge of almost vertical walls, it was higher and shorter then the other Imjin bridges. Very high water and swift currents were expected there due to the constricting effect of the gorge. Between the Whitefront and the Parker Memorial Bridges the Hantan River joined the Imjin. Underestimating the capabilities of this river was to add to the engineer troubles later.



Teal Bridge

Next in line, the Teal Bridge, was a one-way, high-level span supported on timber-pile trestles. A utility power boat was stationed here to clear debris from its supports. Although this was a comparatively new bridge, the scouring action of the current had reduced the penetration of the piles to the danger point. Widgeon Bridge, 4 ½ miles downstream from Teal, was a low-level bridge consisting of steel treadways supported on rock cribs. The hollow cribs were 18 feet high, constructed of 12-inch timbers joined with bolts. They rested on the river bed and were filled with rock.

X-ray, another two-way, high-level bridge, was designed to remain open through even the highest water. It was of a type similar to the Whitefront and Parker Memorial Bridges. All three were at least 25 feet above the normal water level and seemed, to the uninitiated, far higher than necessary.

About halfway between X-ray and Freedom Gate was another floating bridge, Honker. This prefabricated type of bridge, the most common in use in Korea, consists of steel treadways supported on 18-ton rubber pneumatic pontoons. It provides a suitable crossing in most instances, but in swift currents becomes unstable and may overturn. It is also limited in use to fairly static water levels, as the approaches may be destroyed when the water rises and lifts the bridge. Knowing the limitations of this type of bridge, the engineers made plans to remove it when the water began to rise.

Steel treadway float bridge over the Imjin River

Overall then, in late July, there were eight bridges and one ferry carrying traffic over the Imjin. Four were high-level bridges; two were of a standard Engineer portable type, quickly installed and easily removed; one was a semi-permanent low-level type designed to hold fast even though inundated by the flood and to be quickly returned to service after the water dropped, and the eighth was the completely reliable Freedom Gate Bridge, the only one which had proved its ability to withstand the fury of the river. It was believed that the minimum number of crossings required for the supply load was four, one for each division in the line. The four considered to be reliable were Whitefront, Parker Memorial, Teal, and X-ray Bridges. Of course Freedom Gate Bridge made a fifth, but its location was so far west as to make its use inconvenient.

The Flood

About 5 o'clock on the morning of July 27, 1952, work on the new bridge at the Whistler site was progressing steadily. The officer in charge had reported that the job would be completed in 18 hours. There had been light rains all night but not enough to cause any noticeable change in the river. Both abutments, timber end dams, were virtually complete, and two of the three cribs were in place although not yet filled with rock. The third crib was being assembled at the river edge. A clamshell shovel was in the river going about this work when suddenly, with no warning, the river began rising rapidly. The workers had to turn their attention to moving equipment to higher ground away from the swiftly rising water.

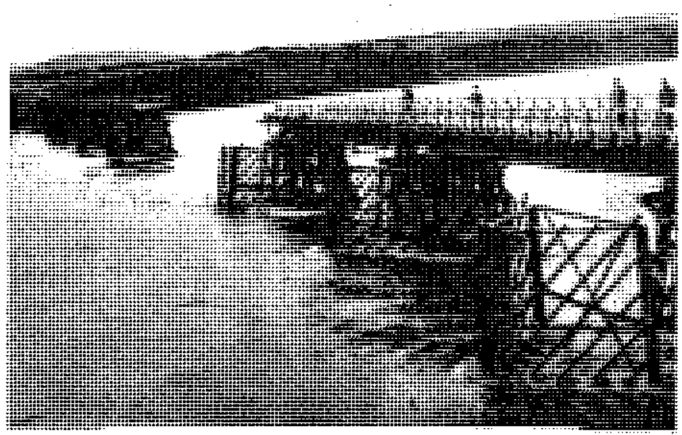
The river, which had been very shallow at this point, crept steadily upward on the unfilled crib. The timber framework, rapidly becoming more buoyant as the water rose, suddenly floated and then went end over end down the river. The shovel had been forced to the bank by the rising water, leaving the first crib only half filled with rock. Despite this partial anchorage, within an hour it too was gone. Still the water rose, washing behind the finished abutments and carrying away the earth which had been piled there by bulldozers. By noon the end dams were gone and not a trace was left of the Whistler project; all was covered by smoothly flowing deep brown water.

Upstream at Mallard Bridge, the sudden flood caught everyone by surprise just as at Whistler. The water level stood at 2.2 feet at 5 o'clock and within five hours reached 15.3 feet. The debris boom broke in the first hour. As the water rose about the bridge, the LCM stationed there made an attempt to clear the debris which was massed against the steel trestles. The overpowering current drove the boat against the bridge, where it was swamped and two members of the crew were drowned despite the fact that they were wearing life jackets. A bulldozer and truck-mounted shovel were trapped by the rising flood and lost to view beneath the water. By midmorning nothing was left of Mallard.

At Whitefront, drift wood collected rapidly against the trestles. The steel pile fenders which were to have prevented this were quickly inundated. The bridge was closed to traffic and cranes were kept working constantly to free the groaning trestles from the clogged masses of drift. Tanks were stationed upstream to break up concentrations of debris with shellfire. The ferry which had been in use at Whistler was torm from its moorings and washed downstream. It was partially sunk by shells and machine-gun fire and pulled ashore before it could damage the bridge. Whole sections of crude log bridges were borne along by the flood, proof that the enemy upstream was suffering as well. By this time the river was rising along its entire length.

It was 11 o'clock before orders were received to remove Honker. By Herculean efforts more than half of the bridge was saved before the current became so swift that further work was impossible. Widgeon, the low-level bridge, disappeared completely beneath the river by 3 p.m. There was nothing further to be done but to wait and hope that the bridge would still be usable when the water receded.

The river crested about noon and showed a slight fall throughout the afternoon of July 27, although the rain continued into the night, pouring thousands of gallons of water into the flood basin. Rain fell intermittently for two days but the river show little change. Debris clearing crews worked day and night to keep the bridges open to traffic. Early on July 30 the river started building toward a new crest, and the Hantan then began to reach serious flood stage for the first time. The high water mark of the 27th was exceeded as the flow from the swollen tributary was added. Higher and higher the water climbed, reaching almost to the decks of the high-level bridges. The Whitefront and Parker Memorial Bridges were kept open but Teal was closed to traffic about midmorning. There was a perceptible quivering toward the center of the bridge, and at noon two of the middle spans collapsed and were carried away.


Flood damage to the Teal Bridge

X-ray had held firm all morning and the men on duty there were beginning to feel that it would survive. However the lost spans of the Teal Bridge, massive debris, made the 12-mile journey in an hour and a half, and about 1:30 p.m. reached the barrier formed by X-ray. The already overtaxed bridge was torn from its foundations and almost the entire structure was carried toward the sea.

The struggle continued to save the bridges which were still remaining. At Whitefront, cranes on the deck of the bridge were accomplishing wonders in clearing debris. Riflemen stationed along the bridge fired at floating objects which might have held mines released upstream by the enemy. When one of the cranes engaged in the debris clearing work had its hook in a mass of driftwood, the current seized the driftwood and carried it downstream. The entangled cable bent the boom of the crane into a horseshoe shape, pulling its end under the bridge. For a moment it appeared that the craft would be dragged through the railing and into the river, but fortunately the cable snapped and the crane was released.

The substructure of Parker Bridge had originally been painted bright orange. When orange timber were seen in the river downstream, it was assumed that Parker Bridge also had been swept away. It was found, however, that the bridge still stood although the current had ripped off some of its timbers.

The crest of the new food was expected at midnight and as the hour drew near, Parker Bridge was closed. The structure was vibrating visibly. Had the bridge failed, it would have been virtually impossible to supply the divisions at the front, a scant 3 miles to the north. Fortunately, some time after midnight, the river showed a slight fall; the river had crested and the bridge remained undamaged.

As the first 1952 flood of the Imjin receded, only three bridges of the original six remained—Whitefront, Parker Memorial, and Freedom Gate. Sixty per cent of the material in Mallard was lost. Whistler, Team, and W-ray were completely lost. Widgeon was still in place, but the approaches were gone and the bridge itself was far out of line. Much of the material in Honker remained.

The Imjin flooded twice more in the following thirty days, but neither of the floods compared with that of July, the highest on record. Although the damage was great, it was still possible to supply the fighting divisions with needed materials by dint of long hours of hard work. The engineers profited by the mistakes made in 1952 and learned not only about the preparations to be made and precautions to be taken, but also to respect the capabilities of the capricious Imjin.

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