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METHODS OF PASSING  
VEHICLES OVER AREAS  
SIMILAR TO RICE PADDY  
FIELDS

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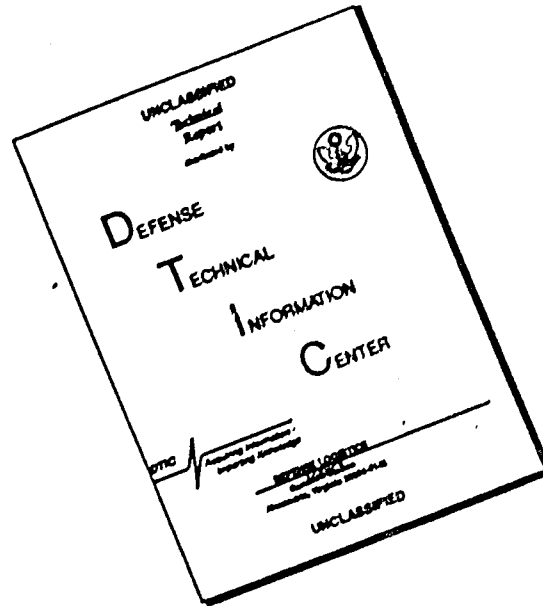
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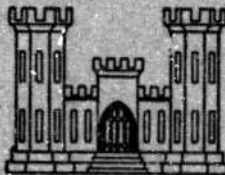
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WAR DEPARTMENT

Report 900  
METHODS OF PASSING VEHICLES OVER AREAS  
SIMILAR IN CHARACTER TO RICE PADDY FIELDS

2 January 1945

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THE ENGINEER BOARD  
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Fort Belvoir, Virginia

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ARMY SERVICE FORCES  
THE ENGINEER BOARD  
FORT BELVOIR, VIRGINIA

FILE NO. 400.1 (MRS 261)

Subject: Transmittal of Engineer Board Report 900, Methods of Passing Vehicles Over Areas Similar in Character to Rice Paddy Fields

To: Chief of Engineers, U. S. Army  
Attention: Equipment Development Branch  
Engineering and Development Division

1. Transmitted herewith is Engineer Board "Report 900, Methods of Passing Vehicles Over Areas Similar in Character to Rice Paddy Fields," dated 2 January 1945, which has been considered by the members of the Board.

2. This report covers an investigation of methods of passing both track-laying and pneumatic-tired vehicles over terrain similar in character to rice paddies. Tests with and without road expedients were made at the Yuma Test Branch in specially prepared mud areas, some of which had been planted with rice and hemp.

3. From these and previous tests it is concluded in the report that expedient roadways across areas simulating rice paddies are not required for track-laying vehicles unless traffic is confined to repeated passages in the same track; but that they are required for pneumatic-tired vehicles except in specially favorable conditions, under which low-pressure-tired vehicles may negotiate the paddies without expedients. Pierced plank landing mat placed on a two-plank longitudinal trackway, with a 6 x 6-inch curb, is the most satisfactory expedient for use under the conditions tested. Pierced plank landing mat with 6-inch curb placed on prefabricated bituminous surfacing with sealed joints, or on two or more layers of untreated burlap, can be used only on mud of stiff consistency.

4. The tests covered by this report have been limited to the use of standard types of material that might be expected to be reasonably available in the theaters, and also to soil conditions prevalent in only one locality. A complete solution to the problem would involve a comprehensive investigation in various localities with different soil conditions, similar to different conditions that might occur in rice paddy terrain in the theaters, and with additional materials and equipment. Such an extensive investigation, which would require considerable time, probably a minimum of six months, has not been understood to be included in the scope of the present directive, and, in the absence of further directions, no further work on this investigation is contemplated.

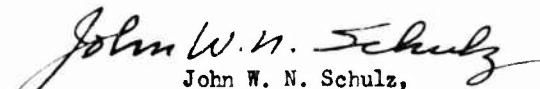
5. The Engineer Board concurs in the conclusions contained in the subject report, and in the recommendations that:

a. The information contained in the report be transmitted to the theaters concerned.


Ltr. EB to OCE  
File: 400.1 (MRS 261)  
Par: 5<sub>b</sub> cont.

b. It be determined whether a military requirement exists for a further, more-comprehensive investigation of this problem.

For the Board:

  
John W. N. Schulz,  
Brigadier General, U. S. Army  
President

1 Incl. (in dup)  
Report as above

  
Report 900

METHODS OF PASSING VEHICLES OVER AREAS  
SIMILAR IN CHARACTER TO RICE PADDY FIELDS

Project MRS 261

2 January 1945

Submitted to

THE ENGINEER BOARD

Fort Belvoir, Virginia

and/or

The Chief of Engineers

U. S. Army

Washington, D. C.

FOR OFFICIAL ACTION

by

Elmer M. Ward  
Senior Engineer (Civil)  
Military Roads Branch

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METHODS OF PASSING VEHICLES OVER AREAS  
SIMILAR IN CHARACTER TO RICE PADDY FIELDS.

I. SCOPE

1. Scope. This report covers the investigation of methods of passing vehicles and track-laying vehicles (including tanks) over terrain similar in character to that encountered in rice paddy fields.

II. AUTHORITY

2. Authority. The authority for this investigation is contained in a 1st Indorsement from the Chief of Engineers to the Engineer Board, dated 19 September 1944, file CE (400.112 Jungle Warfare 14 Sept 1944) SPENE CM106098, Subject: Investigation of the Means of Passing Transport Across Terrain of Character Similar to that of the Rice Paddy Field, (Work Order No. DGN 3913). A copy of this correspondence is included in Appendix A.

III. PREVIOUS INVESTIGATION

3. Previous Investigation. There has been no previous investigation of this nature as related to rice paddy areas; however, the Engineer Board has conducted tests with regard to the passage of pneumatic tired vehicles over areas of low lead bearing saturated soils and with regard to the passage of track-laying prime movers over swamp terrain. The results of these tests are contained in Engineer Board Report 825, Summary Report on Road Expedients, dated 7 June 1944, and in Report 895, Low Speed Tractors as Prime Movers for Field Artillery in Jungle Terrain, dated 11 December 1944.

IV. PRESENT INVESTIGATION

4. Status Report. A letter report covering the status of tests to date, in accordance with the directive mentioned in Paragraph 2, was forwarded to the Chief of Engineers on 14 October 1944. This information is included in the present report.

5. Plan of Tests. The tests covered by this report were conducted by the Engineer Board Yuma Test Branch at Yuma, Arizona.



The plan called for the conduct of tests in flooded areas with varying depths of water and in flooded areas immediately subsequent to draining by the breaching of boundary dikes. Four test areas were constructed adjacent to and parallel with an existing irrigation canal (see Fig. 1 for a general view of the areas). Each area contained dikes varying in height from less than one foot to three feet, with a water depth from three to nine inches, to simulate rice paddies. The mud caused by flooding the areas ranged in depth from 12 to 36 inches. The soil on the test sections is of the silty type, and a mechanical analysis showed 70 percent passing a no. 200 sieve, and 26 percent to be of particle size less than five microns (0.005m). The Liquid Limit was 21; Plastic Limit, 15; Plasticity Index, 6. The test areas are listed as follows:

a. One area 100 by 300 feet prepared for immediate use for "go - no go" tests.

b. Two areas 90 by 210 feet each, one planted with rice and the other planted with hemp, for later use.

c. One area 100 by 300 feet, with four plots separated by dikes two feet high by three feet wide, for use in testing roadway expedients.

6. Tests Without the Aid of Expedients. Preliminary "go - no go" tests were conducted in the unplanted area, which was flooded to a depth of three or four inches. The mud was of such consistency that a man would sink from six to eight inches. The depth of the mud increased as traffic progressed. The vehicles tested and the results are as follows:

a. 1/4-Ton Truck (Empty). This truck, equipped with special 9.00-13 tires for added flotation, could not negotiate the area even at emergency inflation.

b. Four-Ton, 6x6 Truck (Loaded). This truck, equipped with special 14.00-20, 12-ply single tires for added flotation at emergency inflations, made six trips through the area. It was unable to pass over the dikes, however, because of the lack of axle housing clearance. The same truck with chains was able to negotiate the area and raise the front wheels over the three-foot dike. Lack of clearance rather than mobility prevented further forward action. (See Fig. 2.)

c. Light Tank (16-Ton). This tank made 13 trips through the area before becoming immobilized because of lack of clearance and insufficient traction. The tank rested in 36 inches of mud and water, and was unable to climb the dike due to loss of traction. (See Fig. 3.)

d. Medium Tank (35-Ton). (Fig. 4.) This tank operated in two feet of mud and water on the first trip and in 38 inches after



FIG. 1. GENERAL VIEW OF THE TEST AREA CONSTRUCTED TO SIMULATE RICE PADDY FIELDS.

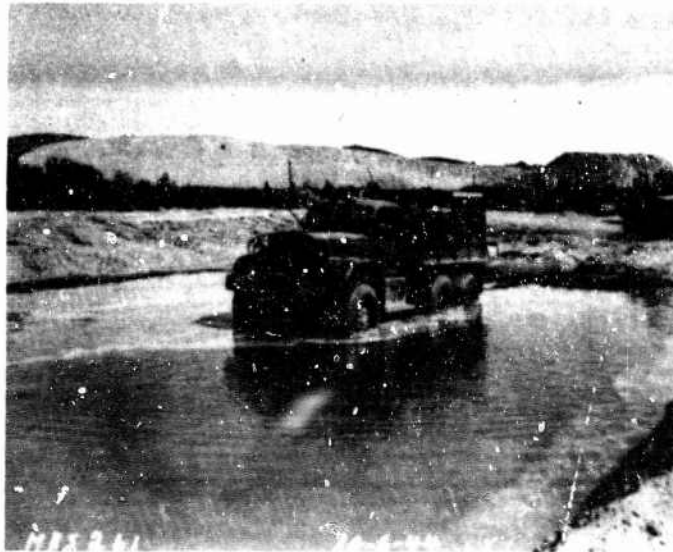


FIG. 2. "GO - NO GO" TEST. A 4-ton 6 x 6 truck equipped with special 14.00-20 tires at emergency inflation pressures on initial trip.



FIG. 3. LIGHT TANK TRAVELING THROUGH THE TEST AREA ON INITIAL TRIP.



FIG. 4. REAR VIEW OF MEDIUM TANK PASSING THROUGH THE TEST AREA ON THE TWENTIETH TRIP. It became immobilized after the thirty-fifth trip.

the eighth trip. It became immobilized in 60 inches of mud and water on the thirty-fifth trip, due to loss of traction. The tank passed over the dike on the second attempt. (See Fig. 4.)

#### 7. Deck Balk.

a. Treadways from Deck Balk. Deck balk treadways from components of the Floating Bridge, M4, were constructed over the flooded unplanted area. Two tracks, each 6 balk in width, were laid on removable gunwales resting in the mud. Not all the balk were pinned to the gunwales because of the difficulty encountered in inserting the pins, owing to the mud. Curbs were improvised with 6 x 6-inch timbers held in place by side rail clamps. The clamps for the inside rails were inverted to provide clearance for 1/4-ton trucks. Traffic forced the gunwales into the mud, and the unpinned balk floated out of position after 6 vehicle trips. This installation was considered unsatisfactory. Figs. 5 and 6 show the deck balk before and after test.

b. Full Track Roadway from Deck Balk. A solid deck of 15 balk was constructed in a flooded area with the outside balk and the sixth balk from each side pinned to the gunwales. The gunwales were placed on 6 x 12-inch timbers to reduce bending. It was found extremely difficult to make the pin connection in the mud, since it was necessary to work under the balk where a hammer could not be used to drive the pin when resistance was encountered. Fig. 7 shows the solid deck, 15 balk wide. The continued movement of the balk, as traffic progressed, caused the pins to work free, causing subsequent additional roadway failure. Traffic was discontinued after 879 trips, due to the roadway conditions. The vehicle trips are recorded as follows:

<u>Vehicle</u>	<u>No. of Trips</u>
1/4-ton truck	35
1/2-ton truck	63
1 1/2-ton truck	147
2 1/2-ton truck	71
2 1/2-ton truck and bolster trailer	72
4-ton truck	128
6-ton truck	122
7 1/2-ton truck	5
Light tank	108
Gun motor carriage, M18	151
Medium tank	7
Total trips	879

• Tank not available during most of test.

8. Pierced Plank Landing Mat Without Collateral Material. A section of pierced plank landing mat 120 feet long was laid in a flooded area without any collateral material below. The

following wheeled vehicle traffic was passed over this roadway.

<u>Vehicle</u>	<u>No. of Trips</u>
1/4-ton 4x4 truck	10
1/2-ton 4x4 truck	22
1 1/2-ton 4x4 truck	172
2 1/2-ton 6x6 truck	445
4-ton 6x6 truck	116
5-ton 6x6 truck	55
Total Number of Trips	760

At the conclusion of the traffic tests, the roadway had subsided in the mud to such an extent that the 1/4-ton truck could not pass over it without flooding the engine.

9. Pierced Plank Landing Mat on Prefabricated Bituminous Surfacing (PBS).

a. Lapped Joints of PBS Unsealed.

(1) In the unplanted area, a section of pierced plank landing mat one plank wide without curbs was constructed on one layer of prefabricated bituminous surfacing (PBS) in 3 to 6 inches of water. The strips of PBS were lapped approximately 6 inches, with the joints unsealed. A total of 271 vehicle passages were made over the section before the plank became entangled in the tank tracks. Failure was caused by the bayonet hooks straightening out, allowing a section of plank to become disconnected and eventually to become entangled in the tank track. The plank had not become deformed sufficiently to impede traffic at this stage; however, they were considered unfit for reuse. It was noted that outer strips of PBS tended to float from under the planks as traffic progressed. Approximately 30 percent of the PBS was still suitable for further use.

(2) In the area planted with hemp, a section consisting of pierced plank landing mat (one plank wide) with 6 x 6-inch timber curb was constructed on two layers of PBS. The unsealed joints were lapped in such a manner that the mud was not forced through. Traffic was started immediately following the draining off of the water, and was discontinued after 151 trips because the truck differentials were becoming entangled in the plank. The sparse growth of hemp offered no noticeable resistance to the settlement of the roadway in the mud.

b. Lapped Joints of PBS Sealed.

(1) In the area planted with rice, a section was constructed with pierced plank landing mat (one plank wide)

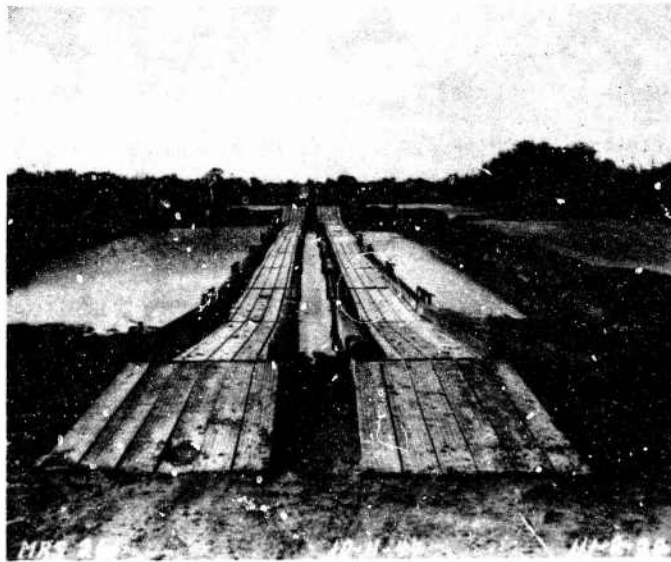


FIG. 5. DECK BALK FROM FLOATING BRIDGE, M4, (UNPINNED TO GUNWALES). With 6 x 6-inch curb clamped in position, prior to testing.



FIG. 6. DECK BALK FROM FLOATING BRIDGE, M4, (UNPINNED TO GUNWALES). AFTER 6 TRIPS OF THE CONVOY. The balk in the foreground are floating.



FIG. 7. ROADWAY OF DECK BALK FROM FLOATING BRIDGE, M4, AFTER 271 TRIPS. The outside row and the sixth row from each edge are pinned to the gunwales.

placed on one layer PBS with joints lapped 13 inches, and sealed before placing. A 6 x 6-inch timber curb was wired in place on the extreme ends of the plank. Traffic was begun subsequent to draining and was discontinued after 1178 passages of pneumatic-tired vehicles, although the roadway was in good condition. The sparse growth of rice afforded no discernible aid to flotation of the plank.

(2) In the unplanted area, a section of pierced plank landing mat (1/2-plank wide) without curb was placed on one layer of PBS with sealed joints. The 5-foot sections of plank were alternated to avoid having all short sections on one side of the roadway. Traffic was begun subsequent to draining and was discontinued over this section after 879 trips because the 5-foot sections of plank began to work loose and impede traffic. See Fig. 8 for a general view of the test section after 100 vehicle trips. Fig. 9 shows the same section after 877 trips.

(3) In the area planted with hemp, a section was constructed using pierced plank (one plank wide) with curb placed on two layers of PBS with sealed joints. This section was placed as an extension to the roadway described in paragraph 9a(2), above. Traffic was begun subsequent to draining and was discontinued after 131 trips because the truck differentials were becoming entangled in the plank.

(4) In the area planted with hemp, a section using pierced plank landing mat placed longitudinally two plank wide in the trackway was constructed on one layer of PBS with sealed joints. Plank were then laid crosswise over the longitudinal plank to form the roadway. A 6 x 6-inch curb was wired into place at the extreme edges of the trackway. This section was placed as an extension to the roadway described in paragraph 9b(2), above. Traffic was discontinued after 131 vehicle trips because the truck differentials were becoming entangled in the plank. Fig. 10 shows the condition of the plank at the conclusion of the test.

10. Pierced Plank Landing Mat on Burlap (Untreated). Sections of pierced plank were laid over the flooded unplanted area on burlap (Hessian) of one, two, and four layers (Figs. 11 and 12). It was found that the single layer was of little value, and tended to float from under the plank as well as to shred into small pieces under the pumping action of the plank. The two and four layers of burlap, respectively, gave good results, although the tendency of the burlap to float from beneath the plank was still prevalent. It was noted that the plank on the four layers of burlap was less deformed at the end of 760 vehicle passages (no tanks were used) than with two layers, and also that the subsidence was less in the mud. The sections were in good condition at the end of the 760 trips.



11. Pierced Plank on Longitudinal Plank Trackway. A section was constructed by placing longitudinally in each trackway pierced plank landing mat (two planks wide) on top of which plank was placed crosswise. (Fig. 13.) A 6 x 6-inch curb was wired in place at the extreme edge of the roadway. This combination performed as well as any section tested using pierced plank. This section was drained immediately before traffic was started and reflooded and drained at the end of 877 vehicle trips in order to produce more severe conditions. A total of 1178 vehicle trips were made over this section before traffic was discontinued. The roadway was still in good condition and would have accommodated considerably more traffic. Fig. 14 shows the condition of this section after 800 vehicle trips.

12. Steel Treadways. Steel treadways were used in a flooded test section. Pinned singly, they formed a solid trackway over the mud, which settled only slightly under traffic. The treadways had to be laid by mechanical means due to their weight. In this instance the regular 6-ton 6x6 bridge erecting truck equipped with hydraulic hoist was used, laying the sections and backing over them as the construction progressed.

13. Track Laying Vehicles. The "go - no go" tests of the track laying vehicles conducted in undrained areas (a 16-ton light tank, a 35-ton medium tank, a motor gun carriage, M-18, and a D-7 tractor were used) indicated that these vehicles were capable of negotiating the mud without the aid of roadway expedients. Tests conducted by the Engineer Board with crawler tractor prime movers in swamp areas reveal that track extensions made from oak wood are satisfactory for effecting passage over such areas. These comprehensive tests are the subject of Engineer Board Report 895, Low Speed Tractors as Prime Movers for Field Artillery in Jungle Terrain, dated 11 December 1944, which is now on file in the Office of the Chief of Engineers.

14. Summary of Results. The results of tests conducted to date are summarized as follows:

a. Deck balk from the Floating Bridge, M4, constructed in a solid roadway 15 balk wide with the outside balk and the sixth balk from each side pinned to the gunwales, performed the best of the expedients tested. With all balk pinned to the gunwales, this type of roadway would accommodate extended traffic. This type of roadway, however, is considered impracticable because of the difficulty of pinning the balk to the gunwales, because of the cubage of the material involved, and because of the need of using all available balk in floating bridges.

b. Pierced plank landing mat without collateral material or curb accommodated 760 vehicle trips before traffic was discontinued.

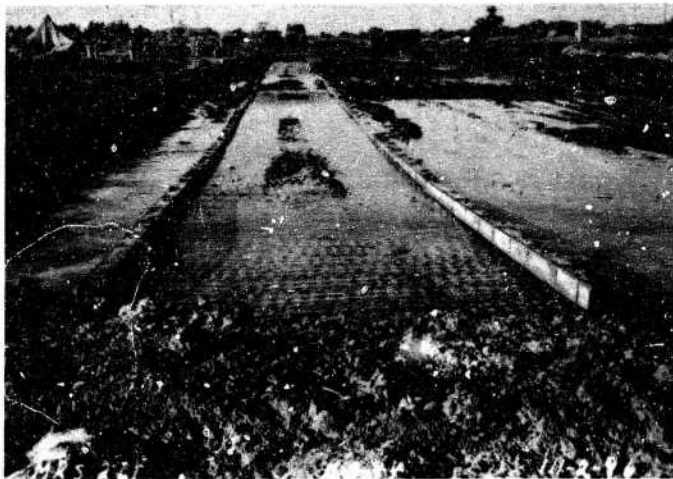


FIG. 8. ROADWAY OF PIERCED PLANK LANDING MAT AFTER 100 TRIPS. Foreground: Section on longitudinal; plank in trackway; Center: 10-foot width roadway on PBS; Background: 15-foot width roadway on PBS.



FIG. 9. ROADWAY OF PIERCED PLANK LANDING MAT ON PBS AFTER 877 TRIPS. Note position of the 5-foot lengths of plank. Foreground: 15-foot width section; Center: The 10-foot width on PBS; Background: Longitudinal plank in trackway.

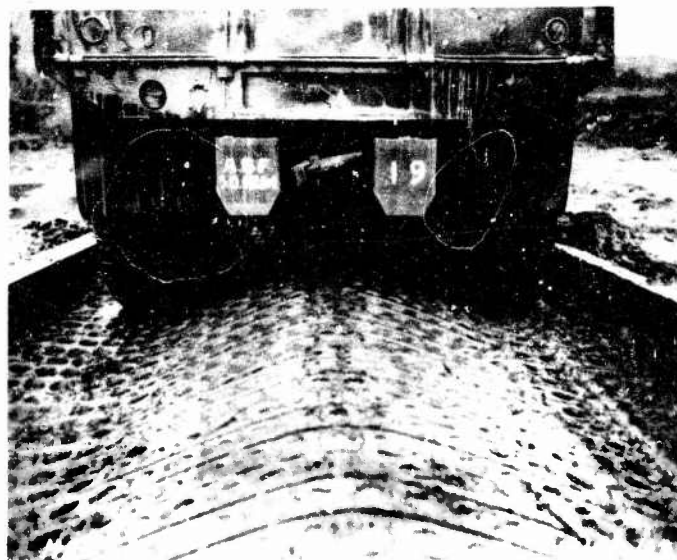


FIG. 10. EFFECTS OF UNEQUAL SETTLEMENT OF THE ROADWAY. Settlement is caused by confining the mud under the center. The truck differential housing is dragging on the pierced plank.



FIG. 11. LAYING PIERCED PLANK LANDING MAT ON UN-TREATED BURLAP.

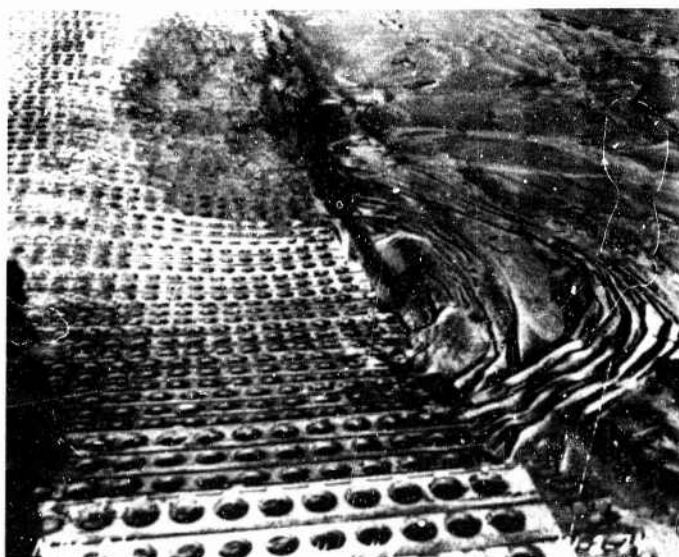


FIG. 12. PIERCED PLANK LANDING MAT ON BURLAP. Showing outside strip washed from under the plank by traffic action.



FIG. 13. PIERCED PLANK LANDING MAT PLACED ON LONGITUDINAL PLANK (2 PLANK WIDE) IN THE TRACKWAY.

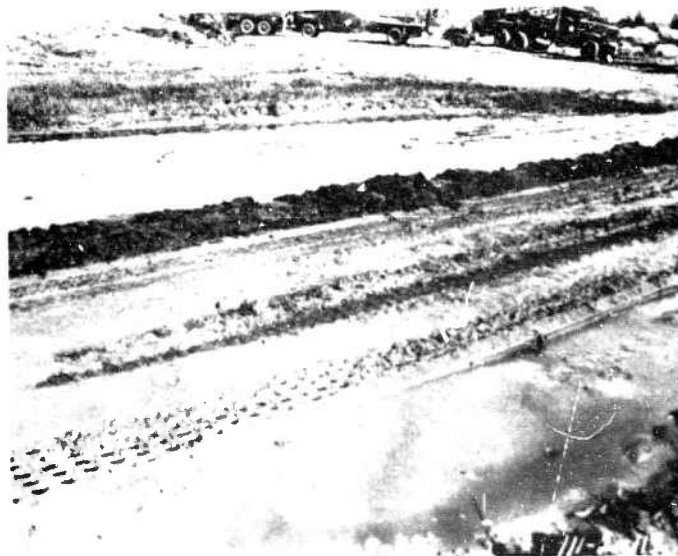


FIG. 14. PIERCED PLANK LANDING MAT PLACED ON LONGITUDINAL PLANK (2 PLANK WIDE) IN THE TRACKWAY. Condition after 800 vehicle-trips.

c. Pierced plank landing mat on PBS with the joints unsealed accommodated 271 vehicle trips before traffic was discontinued. A considerable amount of mud was forced up through the joints of the PBS.

d. Pierced plank landing mat on PBS with sealed joints accommodated 1178 vehicle trips before traffic was discontinued.

e. Pierced plank landing mat on one layer of burlap (untreated) gave unsatisfactory results because of the inability of the burlap to restrain the mud and its inability to withstand the pumping action of the plank.

f. Pierced plank landing mat with two or more layers of burlap (untreated) without curb accommodated 760 vehicle trips before traffic was discontinued.

g. Pierced plank landing mat over longitudinal plank (two planks wide) in each trackway, with curb, accommodated the largest number of vehicle trips of the plank roadways tested. At the end of 1178 vehicle trips the roadway was in good condition. However, in the test area planted with hemp the same combination plus a layer of PBS accommodated only 131 vehicle trips.

h. Steel treadways pinned singly formed a solid trackway over the mud, which settled only slightly. This type of expedient is too heavy to be handled by hand.

i. The track-laying vehicles, consisting of a 16-ton light tank, a 35-ton medium tank, a motor gun carriage, M-18, and a D-7 tractor, made repeated trips through the test area without the aid of roadway expedients.

j. Pneumatic-tired vehicles, even though equipped with special tires for added flotation, were capable of making only a limited number of trips through the areas.

k. Expedient roadways gave more satisfactory performance when the dikes were breached, allowing the water to drain off. The drivers of the vehicles were able to follow the roadway more easily, and the expedients became stable more rapidly because of the surface drying and compaction which took place under the action of traffic.

## V. DISCUSSION

16. Soil Conditions. The test sections were prepared near Yuma, Arizona, in an area where soil conditions were considered similar in character to those found in some rice paddy regions. Information on rice paddy soils, obtained from published literature and from personnel with experience in such localities, indicated

a wide variance of soil characteristics. In some localities a layer of impervious soil or "hardpan" is prevalent immediately below the tilled zone; in other regions the unstable soil may extend for several feet below the surface. Obviously, with such varying conditions, an expedient roadway which would be adequate in one area might be unsatisfactory in another. A thorough reconnaissance of the terrain involved to establish the soil characteristics and depth to "hardpan", if present, should precede the selection of the type of construction to be used with the roadway expedients that are readily available.

16. Surface Drainage. Too much emphasis cannot be placed on the need for surface drainage. In rice paddy terrain, it would largely consist of breaching dikes to permit the drainage of excess water. This could be accomplished by hand methods, by demolitions, or mechanically by means of a bulldozer-equipped crawler tractor without wooden track extensions. Breaching of the dikes should be performed as far in advance of actual operations as conditions will permit, in order to allow the water to drain. Should favorable weather conditions prevail, the need for expedient roadways would be reduced, and their construction, where required, would be greatly facilitated.

17. "Go - no go" Tests. These tests were conducted to ascertain relative mobility of the various vehicles (including tanks) of a Division train through an area similar to that found in rice paddy fields. It was found that the pneumatic-tired vehicles, even though equipped with special tires at emergency inflation pressures for greater flotation, could not negotiate the area in many instances. It was definitely established that such vehicles would require roadway expedients over such areas to assure positive passage. The track-laying vehicles, including light and medium tanks, were capable of making repeated trips through the area until the trackway became too deep for body clearances. It is likely the movement of this type traffic would not have to be concentrated in any single roadway, and, therefore, could be expected to successfully pass over most rice paddy areas encountered.

18. Rigid Type Roadway Expedients.

a. Deck Balk. A roadway composed of the deck balk used in the Floating Bridge, M-4, is capable of accommodating extended traffic when properly constructed. The balk should extend over the entire roadway, at least 15 balk wide, and all balk should be pinned to the gunwales. Additional bearing support should be provided for the gunwales to prevent bending. While such a roadway is adequate, it is considered impracticable because of the cubage of material necessary to accommodate the lengths of roadways involved and because of the excessive difficulty of pinning the balk to the gunwales, and especially because this type expedient is not available in the theaters at the present time.

b. Steel Treadway. This type of roadway is capable of accommodating extensive traffic, and might be considered for very

short lengths of road over impassible areas. The treadways should be transported and placed into position by use of the regular 6-ton, 6x6 bridge erecting trucks. The truck should back over the roadway as the unloading and laying progresses. This type of roadway expedient is considered impracticable because of the weight and cubage involved, and because of the fact that it cannot be laid by hand methods.

19. Pierced Plank Landing Mat.

a. Pierced Plank Landing Mat on Longitudinal Plank Trackway. It is believed that pierced plank laid over longitudinal plank (two plank wide) in each trackway affords for all the conditions to be encountered as good a roadway expedient as is readily available in the theater. A wooden curb approximately 6 inches by 6 inches should be wired in place at the extreme ends of the plank. The curb serves as a guide to traffic in keeping it on the roadway, and at the same time prevents mud which has been forced laterally from below from coming back on the roadway. Although the mud is forced up through the tubulation in the plank, causing a slippery condition, the roadway settles uniformly under traffic, and thus eliminates excessive deformity to the center of the mat. The tests showed that for mud of thin consistency better results were obtained in this manner than by entrapping the mud by an impervious layer of collateral material below the plank. All surface water and mud of this type should be removed by normal drainage procedure.

b. Pierced Plank Landing Mat Laid on Prefabricated Bituminous Surfacing (PBS) or Untreated Burlap.

(1) Prefabricated Bituminous Surfacing.

(a) Mud of Stiff Consistency. Pierced plank landing mat on PBS performed satisfactorily on stiff consistency mud that did not tend to flow laterally from below the roadway. The PBS provided added flatation to the plank and kept the mud from being forced through the tubulations. For this application the joints of the PBS should be sealed to prevent the mud from being forced through. Sealing the joints should be accomplished prior to use by laying the material on firm ground, applying solvent to the adjacent layers, and rolling after the asphalt has become softened. Rolls of PBS of the required width and of such length that they can be handled conveniently can thus be stockpiled ready for use.

(b) Mud of Thin Consistency. The use of PBS under plank in mud of thin consistency was not satisfactory for extended traffic. The mud was trapped under the center of the roadway and forced from under the trackway at both ends of the plank. As a result, the center of the roadway did not subside as rapidly as the trackway, causing a ridge



to develop in the center to such an extent that traffic was impeded. It was definitely proven that mud of thin consistency should not be confined under the center of the roadway.

(2) Untreated Burlap. Two or more layers of untreated burlap under pierced plank are necessary in order to achieve beneficial results on mud of stiff consistency. Its use in mud of thin consistency is of little value, since the mud is readily forced up through the material. The flexing and pumping action of the plank under traffic readily shreds the burlap to pieces, and also tends to force the outside strips from under the plank.

20. Test Limitations. The investigation and tests covered by this report have been limited mainly to items of material that might reasonably be available in the theaters. Cognizance must be taken also of the fact that tests were confined to only one vicinity, in which certain soil conditions prevailed. While it is believed that the test conditions were made sufficiently severe to secure results that would reasonably be expected in other localities, different terrain and different soil conditions might require a different solution to the problem. This answer could be obtained only by comprehensive investigation in various localities where widely different soil conditions similar to those occurring in rice paddy terrain prevail, and perhaps with the use of different materials and equipment. Such an extensive investigation would involve a considerable time, and is not understood to be included in the scope of the present directive.

## VI. CONCLUSIONS

21. Conclusions. On the basis of previous tests covered by Engineer Board Report 825, Summary Report on Road Expedients, and on recent tests conducted at Yuma, Arizona, it is concluded that:

a. Expedient roadways across areas simulating rice paddies are not required for track-laying vehicles where traffic is not necessarily confined to repeated passages in the same track.

b. In general, expedient roadways are required for pneumatic-tired vehicles for crossing areas simulating rice paddies, although in specially favorable conditions, low-pressure-tired vehicles may negotiate these paddies without expedients.

c. The following combination of expedient roadways, listed in order of preference, are most satisfactory for use in crossing such areas:

(1) For use in all types of mud: Pierced plank landing mat placed on a longitudinal trackway of plank (two

planks wide) with a 6 x 6-inch curb.

(2) For use only on mud of a stiff consistency: Pierced plank landing mat with 6-inch curb placed on PFS with sealed joints, or on two or more layers of untreated burlap.

d. If a more comprehensive solution to the problem involved is desired, a full development study covering a minimum time of six months would be required.

## VII. RECOMMENDATIONS

22. Recommendations. It is recommended that:

a. The information contained in this report be transmitted to the theaters concerned.

b. It be determined whether a military requirement exists for a further, more-comprehensive investigation of this problem.

Submitted By:

*Elmer M. Ward*  
Elmer M. Ward  
Senior Engineer (Civil)  
Military Roads Branch.

*Vernon G. Gould*  
Vernon G. Gould  
Major, Corps of Engineers  
Chief, Military Roads Branch

Forwarded by:

*Carl A. Meyer*  
Carl A. Meyer,  
Colonel, Corps of Engineers,  
Director, Technical Division IV.

APPENDIX A

AUTHORITY

<u>Item</u>	<u>Page</u>
First Indorsement from the Chief of Engineers to the Engineer Board, Dated 19 September 1944, Subject: Investigation of the Means of Passing Transport Across Terrain of Character Similar to that of the Rice Paddy Field. (Work Order No. DGN 3913)	32

ARMY GROUND FORCES  
Army War College  
Washington, D. C.

451.94/141.(S) - (14 Sep 1944) -  
GNRQT-4/98208

14 September 1944

400.1 (MRS 261).

Subject: Investigation of the Means of Passing Transport Across  
Terrain of Character Similar to that of the Rice Paddy  
Field

To: Commanding General, Army Service Forces (Attention:  
Chief of Engineers, New War Department Building,  
Washington, D. C.)

1. It is requested that a testing area be set up at the  
Bridge Branch, Engineer Board, Imperial Dam, Arizona, for the  
purpose of investigating methods of passing wheeled and track  
laying vehicles (including tanks) over comparatively long distances  
of terrain similar in character to the terrain normally encountered  
in rice paddy fields.

2. It is requested that tests be conducted both upon flooded  
fields and upon fields immediately subsequent to draining by the  
breaching of boundary dikes.

3. It is further requested that material and equipment used  
to effect the passage be held to an absolute minimum.

4. It is requested that a high priority be assigned the tests  
and report made in part by 15 October 1944.

For the COMMANDING GENERAL:

/s/

R. A. MEREDITH  
Lt. Col., A. G. D.  
Asst. Ground Adj. Gen.

CE(400.112)Jungle Warfare  
14 Sept 44) SPENE  
CM 106098

Subject: Investigation of the  
Means of Passing Trans-  
port Across Terrain of  
Character Similar to that  
of the Rice Paddy Field.  
(Work Order No. DGN 3913.)

1st Ind.

ASF, Office, Chief of Engineers, WASHINGTON 25, D. C., 19 September 1944.

To: The President, The Engineer Board, FORT BELVOIR, VIRGINIA

1. Reference is made to basic communication; inclosed copies of messages, dated 6 and 7 September 1944 from Lt. Col. Hill of this office to Chief of Engineers; copy of message, dated 8 September 1944, from this office to Engineer Board, Imperial Dam; copy of memorandum from this office to Military Supply, dated 9 September 1944; and to telephone conversation between Colonel Sykes of this office and Colonel Matteson of the Engineer Board on 7 September 1944, in which the Engineer Board was directed to prepare a test site at Imperial Dam, California.

2. In confirmation of the above telephone conversation, and in accordance with the desires of Headquarters, Army Ground Forces, the Engineer Board is requested to proceed with tests as outlined in basic communication, special attention being given to the deadline of 15 October 1944.

By order of the Chief of Engineers:

/s/  
WILLIAM J. NEW,  
Lt. Col., Corps of Engineers,  
Chief, Equipment Development Branch,  
Engineering and Development Division

4 Incls:

- Incl. 1 - Copy of message fm Col. Hill, dtd 6 Sept 44.
- Incl. 2 - Copy of message fm Col. Hill, dtd 7 Sept 44.
- Incl. 3 - Copy of message to Engr. Bd. Imperial Dam, dtd 8 Sept 44.
- Incl. 4 - Copy of memo to Military Supply, dtd 9 Sept 44.

OCE WA 500 GA

ENGR BD IMP DAM CALIF 6 SEPT 44 2215Z

TO CHIEF OF ENGRS ENGR DEVELOPMENT DIV WA DC

AGF HOLMER DESIRES EXPEDITE TESTS OF EXPEDIENTS TO CROSS INUNDATED AREAS. DESIRES TO TEST PIERCED PLANK OVER HESSIAN AND TO TEST USE OF S&S DECK BALK. ALSO DESIRES TO TEST PERFORMANCE OF TRACTORS AND TANKS WITH AND WITHOUT EXPEDIENTS AND WITHXX WITH NORMAL TRACKS. HOWARD CAN READILY PREPARE SILT CLAY AREA FOR SUCH TESTS AND PERFORM TESTS WITHOUT INTERFERENCE WITH BRIDGE TESTS. REQUEST HOWARD BE AUTHORIZED TO PROCEED WITH PREPARATION TEST SITE PENDING REQUEST FROM AGXXX AGF WHICH HOLMER WILL ISSUE ON 11 SEPT. SUGGEST OUR PEOPLE TALK TO CXXX DOCTOR LI AND HIS ASSOCIATES AND CONSIDER WHAT WORK IN ADDITION TO ABOVE CAN BE DONE AT SLOW SPEED TRACTOR TEST ARE. COL WITTERS HAS MADE ARRANGEMENTS FOR HESSIAN AND PLANK AND IS WAITING SHIPPING INSTRUCTIONS.

COL HILL

END PLS ACK DMP

END WLH

ENGR BD IMP DAM CALIF 7 SEPT 44 2235Z

TO - CHIEF OF ENGRS ENGR CXX DEVELOPMENT DIV WA DC

REQUIRE SUFFICIENT PIERCED PLANK FOR ROADWAY 400 FT. BY 20 FT.  
PLUS TEN PERCENT SPARES. REQUIRE TWELVE THOUSAND SQ. FT. OF  
ASPHALT IMPREGNATED HESSIAN AND TWELVE THOUSAND SQ. FT. OF  
UNTREATED HESSIAN. ABOVE FOR TESTS ON PASSAGE OF INUNDATED  
AREAS.

COL. HILL

END PLS ACK ES

END MJ

8 September 1944.

CE (8 Sept 44) SPENE

OCE, ENGINEERING & DEVELOPMENT EQUIP. DEV. CON. EQUIP. SPENE  
21ST & VIRGINIA AVENUE, N. W., WASHINGTON 25, D. C.

ENGINEER BOARD IMPERIAL DAM  
ENGINEER STATION  
YUMA, ARIZONA  
ATTN: COL. HILL

WILLIAM J. NEW,  
LT. COL., CORPS OF ENGINEERS  
CHIEF, EQUIPMENT DEVELOPMENT BRANCH  
ENGINEERING AND DEVELOPMENT DIVISION.

ENGINEER BOARD AUTHORIZED TO PROCEED WITH PREPARATION OF TEST  
SITE STOP COLONEL MATTESON REQUESTS HE BE FURNISHED INFORMATION  
ON QUANTITIES OF HESSIAN COMMA PIERCED PLANK AND OTHER MATERIALS  
REQUIRED END 665 SPENE

REYBOLD



(UNPUBLISHED CARD)

RESTRICTED

ATI 121 177

(U.S. MILITARY ORGANIZATIONS  
REQUEST COPIES FROM CADO. OTHERS  
ROUTE REQUESTS TO CADO THRU OFFICE,  
CHIEF OF ENGINEERS)

CORPS OF ENGINEERS, ENGINEER BOARD, FORT BELVOIR, VA.  
(REPORT 900)

METHODS OF PASSING VEHICLES OVER AREAS SIMILAR IN  
CHARACTER TO RICE PADDY FIELDS - AND APPENDIX A

WARD, ELMER M. 2 JAN<sup>0</sup>45. 35PP PHOTOS

ROADS - CONSTRUCTION

CIVIL ENGINEERING (53)

VEHICLES - TRACTION DEVICES

TRANSPORTATION ENGINEERING (3)

RESTRICTED

