PROFESSIONAL PAPERS, No. 32
CORPS OF ENGINEERS, U. S. ARMY

MILITARY RAILWAYS

BY

MAJ. W. D. CONNOR
CORPS OF ENGINEERS

▽

REVISED EDITION : 1917

Reviewed and Approved by the
Board on Engineer Troops

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

WAR DEPARTMENT

Document No 539

Office of the Chief of Engineers

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF STAFF,
Washington, May 5, 1916.

The following Manual of Military Railways, prepared by Maj. William D. Connor, Corps of Engineers, is approved and published for the information and government of the Regular Army and the Organized Militia of the United States. It is intended to supplement Part IV, Military Railways, of the Engineer Field Manual (Professional Papers No. 29, Corps of Engineers).

By order of the Secretary of War:

TASKER H. BLISS,
Major General, Acting Chief of Staff.

(this page is blank)

MILITARY RAILROADS.

COMBAT RAILWAYS.

1. The subject of military railroads as here treated will include the location, construction, operation, and maintenance of railroads in the theater of war under military auspices and for military purposes; that is, with a personnel consisting of officers, enlisted men, and civilian employees, and for the main purpose of facilitating the movements and supply of the Army.

The difference between war and peace conditions will cause a wide departure of military from civil railroad practice. Some of the conditions of military railroad service are:

(*a*) Quick results for a short period are of the first consideration.

(*b*) The mechanical possibilities of the property can not be fully developed by reason of an untrained personnel.

(*c*) Speed requirements are moderate and practically uniform for all traffic.

(*d*) The roadbed and equipment are subject to damage beyond that resulting from the operation of the road, or from the elements, or from decay. A civil road is operated on the presumption that the track is safe; a military road must be operated on the presumption that the track is unsafe.

(*e*) The property will usually be in fair but unequal condition, often hastily restored after partial demolition. The operation of the whole will depend on the condition of the worst parts.

(*f*) A military road is best operated with an ample supply of motive power and rolling stock, and a moderate speed; whereas on a civil road the tendency is to increase speed to economize rolling stock, and to increase train loads to economize motive power. The known ratios of equipment and mileage on civil roads can not be taken as sufficient for military roads.

2. Railways constructed and operated for military purposes vary from a rough, narrow-gage road on which the motive power is man or mule, to a fully equipped, modern, standard-gage road. The first would probably be used in the approaches of siegeworks or to supply an army in a winter camp or a fortified position of great extent, and the latter when an existing commercial line was taken over for military uses. Between these two extremes are many grades of railways, but each grade shades imperceptibly into the next above and below, and any considerable classification must be artificial and of little use in discussing the general subject. The only classification that seems logical is to divide them into those that are built and operated within the field of the enemy's observation and fire, and those built and operated beyond his field of observation and fire. The former are called **combat railways** and the latter **supply railways.**

3. **Combat railways** differ from permanent railways only in the degree of care taken in their construction, maintenance, and operation. The same general rules govern both, and the engineer officer must apply those rules to suit the requirements of his particular case. They will practically always be narrow gage lines, and in most cases will be made of portable track similar to that used in mines and industrial works. Rolling stock and track, while not kept on hand in large quantities, can be obtained in small amounts, and orders placed can be quickly filled.

Requirements.—Combat railways must be capable of transporting guns, ammunition, and other supplies, especially those of the heavier kinds, to the various siege batteries, magazines, and bombproofs, and, possibly, to the various parallels that are constructed in carrying on a siege. From the nature of the line, it must be one that can be rapidly laid and as rapidly taken up and relaid elsewhere; it must not occupy too much space in the approaches and parallels; it must be of light weight, and it must permit of very sharp curves. These various requirements demand a light, narrow gage railway.

4. **Motive power.**—The loads will be hauled either by men, animals, or gasoline motors, as a steam locomotive would indicate too clearly its position by its smoke. If the requirements of the service are great enough, **gasoline motors** of the type shown in fig. 1 can be used with advantage. These motors are made from 2 ft. to 4 ft. 8½ in. in gage, and one weighing 2 tons will haul 10 tons on a level track. Details of heavier types are shown in Table I.

TABLE I.—General dimensions and capacities of vulcan gasoline locomotives.

Weight.	Horsepower of engine.	Diameter of drivers.	Optional speeds (miles per hour).	Rated drawbar pull.	Frictional resistance per ton.	Hauling capacity (tons of 2,000 pounds) in addition to weight of locomotive.						Wheel base.	Outside dimensions.		
						On a level.	On a grade per mile of—						Length.	Width.	Height.
							52'.8 1%.	105'.6 2%.	158'.4 3%.	211'.2 4%.	264'.0 5%.				
Tons.				*Pounds.*	*Pounds.*										
4	25	16″	3 and 6....	1,600	10	156	49	28	19	14	10	3′ 0″	10′ 0″	4′ 0″	3′ 4″
			4 and 8....		20	76	36	22	16	12	9				
			5 and 10...		30	49	28	19	14	11	8				
					40	36	22	16	12	9	7				
6	35	18″	3 and 6....	2,400	10	234	74	42	29	21	15	3′ 9″	11′ 0″	4′ 0″	3′ 10″
			4 and 8....		20	114	54	34	24	18	14				
			5 and 10...		30	74	42	29	21	16	12				
					40	54	34	24	18	14	11				
8	45	22″	3 and 6....	3,200	10	312	100	56	38	28	21	4′ 0″	12′ 0″	4′ 2″	4′ 0″
			4 and 8....		20	152	72	45	32	24	19				
			5 and 10...		30	100	56	38	28	22	17				
					40	72	45	32	24	19	15				
10	55	22″	4 and 8....	4,000	10	390	123	70	47	34	26	4′ 0″	12′ 6″	4′ 8″	4′ 2″
			5 and 10...		20	190	90	57	40	30	23				
			6 and 12...		30	123	70	47	34	26	20				
					40	90	57	40	30	23	18				
12	75	24″	4 and 8....	4,800	10	468	148	84	57	41	31	4′ 3″	13′ 0″	4′.8″	4′ 4″
			5 and 10...		20	228	108	68	48	36	28				
			6 and 12...		30	148	84	57	41	31	25				
					40	108	68	48	36	28	22				
15	90	25″	4 and 8....	6,000	10	585	185	105	71	51	39	4′ 6″	14′ 3″	5′ 0″	4′ 6″
			5 and 10...		20	285	135	85	60	45	35				
			6 and 12...		30	185	105	71	51	39	31				
					40	135	85	60	45	35	28				

All of the above locomotives can be furnished with either one of the two-speed transmissions as listed in tables under "Optional speeds."

The **hauling capacity** is the heaviest train of cars and their loads which a locomotive can start on a straight track in addition to itself and pull at speeds specified.

Mine cars will usually have a frictional resistance of from 20 to 30 pounds per ton on comparatively straight track, and with sharp curves will often run as high as 40 pounds and over. To determine the maximum hauling capacity of a locomotive from the table, use the frictional resistance, together with the proper percentage of grades.

Use 10 pounds per ton frictional resistance with good cars, good track, and no curves.

Use 20 pounds per ton frictional resistance with fair cars and track and easy curves.

Use 30 pounds per ton frictional resistance with hard-running cars and track with fair curves.

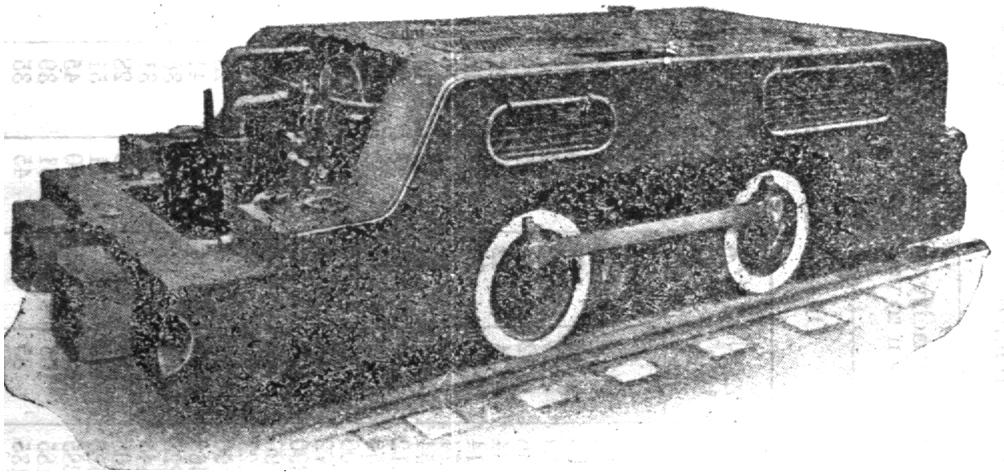

FIG. 1.—FOUR-WHEEL GASOLINE LOCOMOTIVE.

This motor (fig. 1) is designed for hauling in mine, quarry, elevator, and industrial works.

SPECIFICATIONS.—Motor; Vertical type, ample power for service conditions. Gage; 24 to 56½ in. Material, metal throughout, heavy railroad construction giving ample tractive power. Control: Two speeds forward and same in reverse. Height of drawbars to suit requirements. Exhaust screened. Brakes: Standard type, applied to all four wheels.

5. **The usual motive power** will be either men or animals, and since the roadbed will ordinarily be very rough, the form of construction used should permit them **to travel outside of the track** and the cars should be supplied with corner rings for attaching the drag lines or harness. Derailments will be frequent and the rolling stock should be such that replacing loaded cars will not be a very difficult operation.

6. **Capacity.**—The portable railway used by the Japanese in Manchuria was 23.6-in. gage; that by the Russians was 30-in. gage. Both used short sections, 6.5 ft. and 5 ft. long, respectively. The Russian rails weighed 25 lbs. per yard. The Russian line had passing tracks, or sidings, at intervals of about 7 miles. They used cars weighing about 1,920 lbs., which carried a load of about 4,400 lbs. The cars were hauled by two animals, one on each side of the track. The capacity of the line was about 600 tons each way daily, equal to about the capacity of 400 escort wagons. This capacity could have been increased considerably by decreasing the interval between sidings and enormously by double tracking. Portable railway is particularly useful for laying diversion or "shoo-fly" tracks around short breaks in the line during permanent repairs.