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DARCOM Mobility Model	Vehicle, tracked
Mobility	Vehicle, wheeled
Obstacles	Wall climbing
Ramp-climbing ability	Wave course

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Provides a method for evaluation of obstacle-negotiating capability. Describes procedures for bridging, wall climbing, trench crossing, frame twisting, and aircraft/landing-craft loading-ramp tests. Discusses obstacle courses to include a profile sketch of each. Excludes slope, fording, washboard, and other standard obstacle tests covered in other TOP's. Applicable to all military vehicles. Addresses obstacles in DARCOM Mobility Model.

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US ARMY TEST AND EVALUATION COMMAND
TEST OPERATIONS PROCEDURE

DRSTE-RP-702-101
*Test Operations Procedure 2-2-611 25 June 1980
AD No.

STANDARD OBSTACLES

Page

1. SCOPE. This TOP describes the standard obstacles used to simulate various conditions that vehicles may encounter. Procedures are specified for evaluating bridging, wall climbing, trench crossing, vehicle-twisting capabilities, and the ability to negotiate standard aircraft and landing-craft ramps. Some of the data obtained can be used with the DARCOM Mobility Model.

Slopes and fording obstacles are described in TOP 2-2-610 and TOP 2-2-612, respectively. Various other standard courses, such as "washboards," are described in TOP 1-1-011.

2. FACILITIES AND INSTRUMENTATION.

2.1 Facilities.

a. Bridging device.

b. Vertical walls.

c. Trench-crossing facility.

d. Frame-twister course, with 8.54-meter (28-foot) long waves.

e. Simulated loading ramp.

*This TOP supersedes TOP 2-2-611, 16 September 1975.

2.2 Instrumentation.

ITEM	MAXIMUM ERROR OF MEASUREMENT*
Tape measure	±2 mm (±1/16 in.)

*Values may be assumed to represent ±2 standard deviations; thus the stated tolerances should not be exceeded in more than 1 measurement out of 20.

3. PREPARATION FOR TEST. Plan the testing to meet the needs of the requirements document and the directive. Also, where stipulated, plan the testing to satisfy the needs of the DARCOM Mobility Model (Appendix A).

Load vehicles with an actual or simulated combat load. The simulated loads should duplicate the rigidity as well as the weight and center of gravity of the actual load.

Provide maintenance and servicing of the vehicle to insure that the vehicle is in condition for optimum performance, with particular attention being given to the engine, transmission, brakes, and running gear.

4. TEST CONTROLS. Prepare data sheets and checklists to assure that all steps in testing are covered and operations are conducted efficiently. Use referee grade fuel.

5. PERFORMANCE TESTS.

5.1 Bridging (Tracked Vehicles Only). The bridging limit is defined as the maximum free space that a slowly moving vehicle can cross, starting from a level platform with a straight lateral edge and crossing to a like surface on the same level.

5.1.1 Method.

a. Set the bridging test device (Figures 1 and 2) to produce an initial gap that is well within the bridging ability of the vehicle, as deduced from the length and center of gravity of the vehicle.

b. Increase the gap by suitable increments until the bridging limit is reached to the nearest 7.9 cm, making each crossing at minimal speed.

5.1.2 Data Required.

a. The bridging limit in the forward direction, and reverse if required.

b. All vehicle parts, other than tracks, that make contact with the edge of the platform.

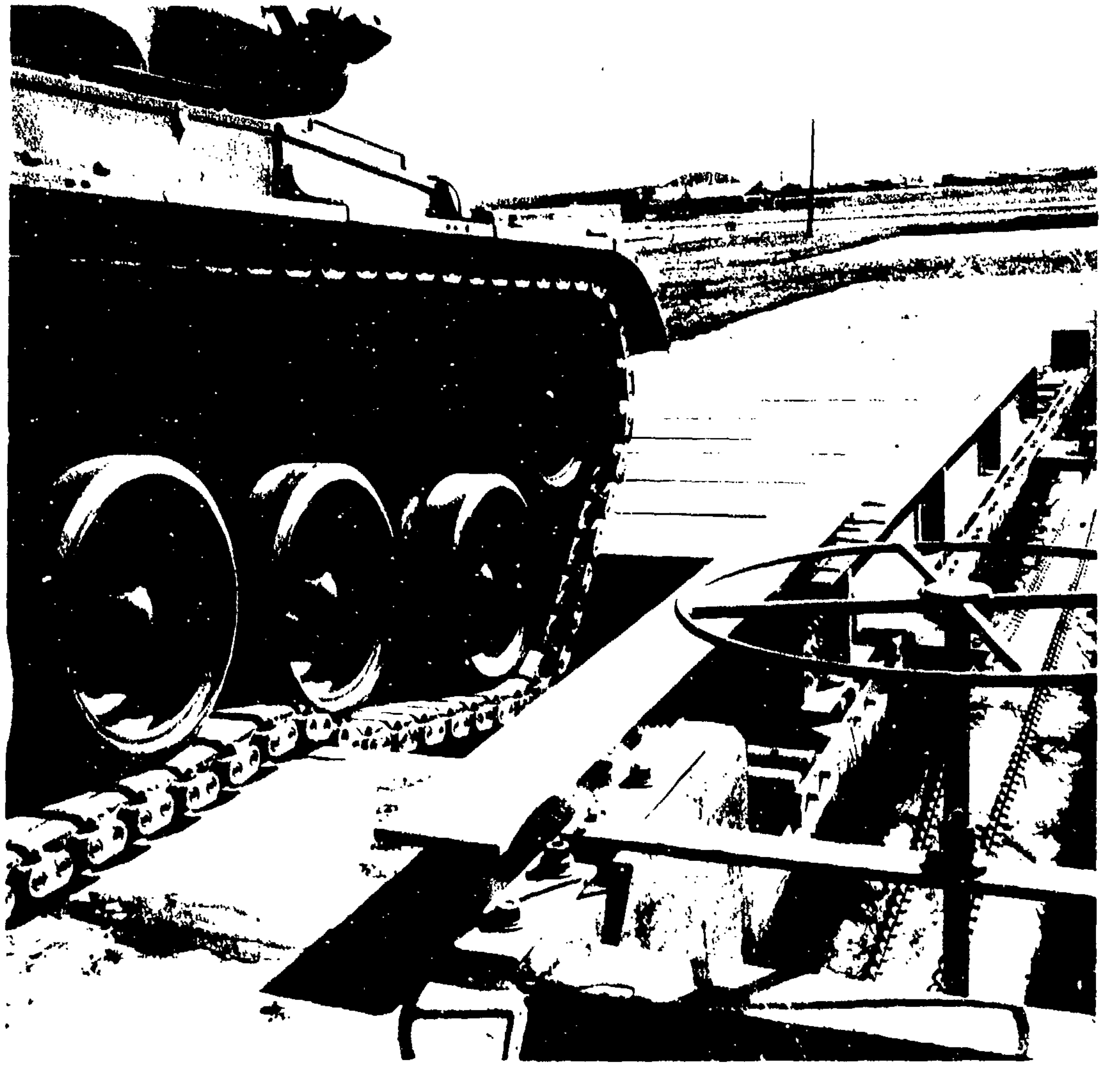

Figure 1. Bridging Device.

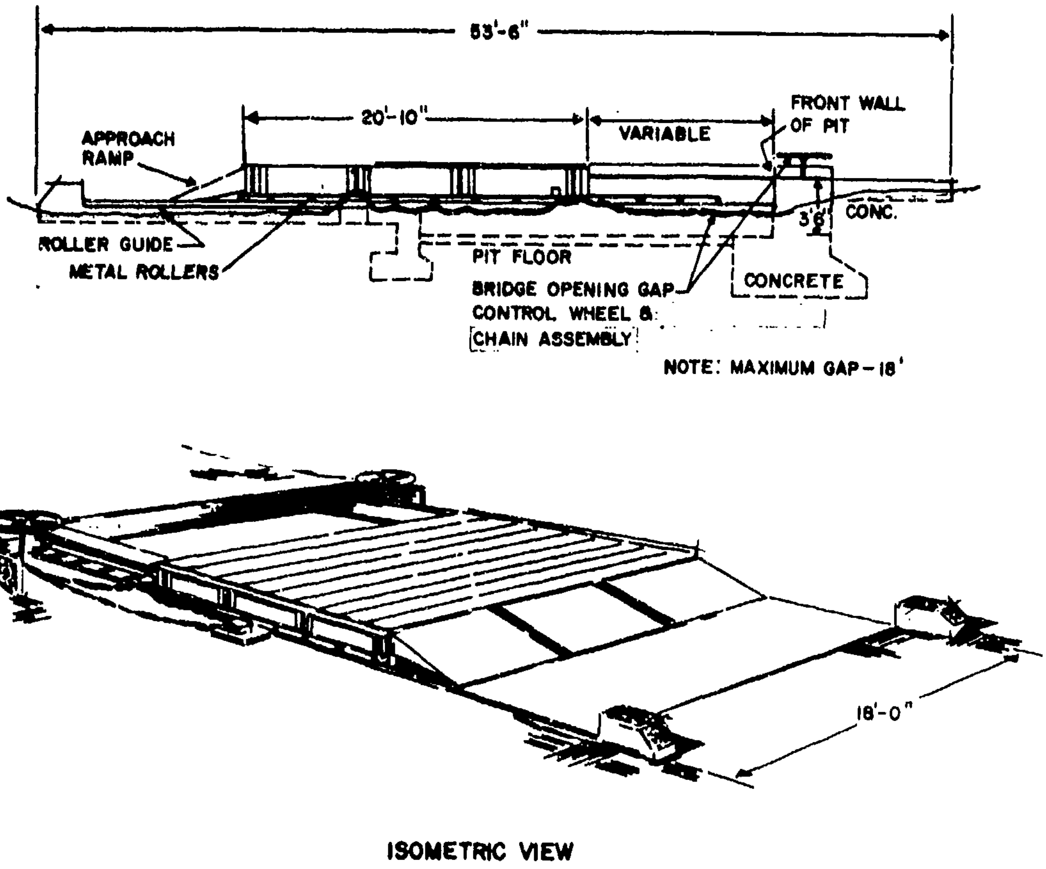

Figure 2. Plan and Isometric View of Bridging Device.

5.2 Wall Climbing. The ability of vehicles to climb vertical obstacles is evaluated using a wall constructed to the specified obstacle height. The Aberdeen Proving Ground facility includes permanent walls 46, 61, 92, and 107 cm (18, 24, 36, and 42 inches) high. However, a wall of any desired height can be readily improvised. Replaceable timbers are used for the top edge of the walls so that a squared edge at the required height can be maintained. Vehicles are in a combat-ready condition; e.g., guns of tanks are at 12 o'clock position. The vehicle is on a concrete surface when approaching the wall.

5.2.1 Method. Place both tracks or front wheels in contact with the wall, and apply sufficient power to climb the obstacles. The wall will be successfully negotiated only when the vehicle passes completely over it. Two attempts are made in forward direction, and reverse direction when specifically required. Any contact made by the vehicle (other than tracks or wheels) with the wall or the ground is noted. When required, vehicles should be tested in the descending mode at heights equal to the maximum ascending mode.

NOTE: The application of steering during climbing attempts, except to keep the axis of the vehicle perpendicular to the wall, invalidates the results. If a vehicle fails the wall-climbing test as prescribed, an attempt will be made from an angle of less then 90° so that only one wheel or track at a time makes initial contact. Successful climbing in this manner is a qualified success and is not considered as fully meeting the requirement. These conditions, as well as any application of steering during climbing, must be fully described in the test results.

5.2.2 Data Required.

a. Maximum height of wall traversed in ascending mode, and descending mode when required.

b. Angle required if unsuccessful at 90°.

c. Contacts made by vehicle with the ground and obstacle.

5.3 Trench Crossing. Trench-crossing tests are conducted to determine whether a vehicle has angles of approach and departure that are adequate to clear an obstacle that has become an accepted standard of comparison within the Army, and whether there are vehicle projections that interfere with the negotiation of the obstacle. A concrete trench should be used (Figure 3), but whenever a steel-tracked vehicle on concrete has insufficient traction to negotiate the obstacle, an earthen ditch of the same configuration may be used.

5.3.1 Method. Attempt vehicle crossings, forward only, across the trench of Figure 3 at a 90° angle. If unsuccessful, make attempts at other angles.

5.3.2 Data Required.

a. Dimensions of trench.

b. Angles tried and success at each.

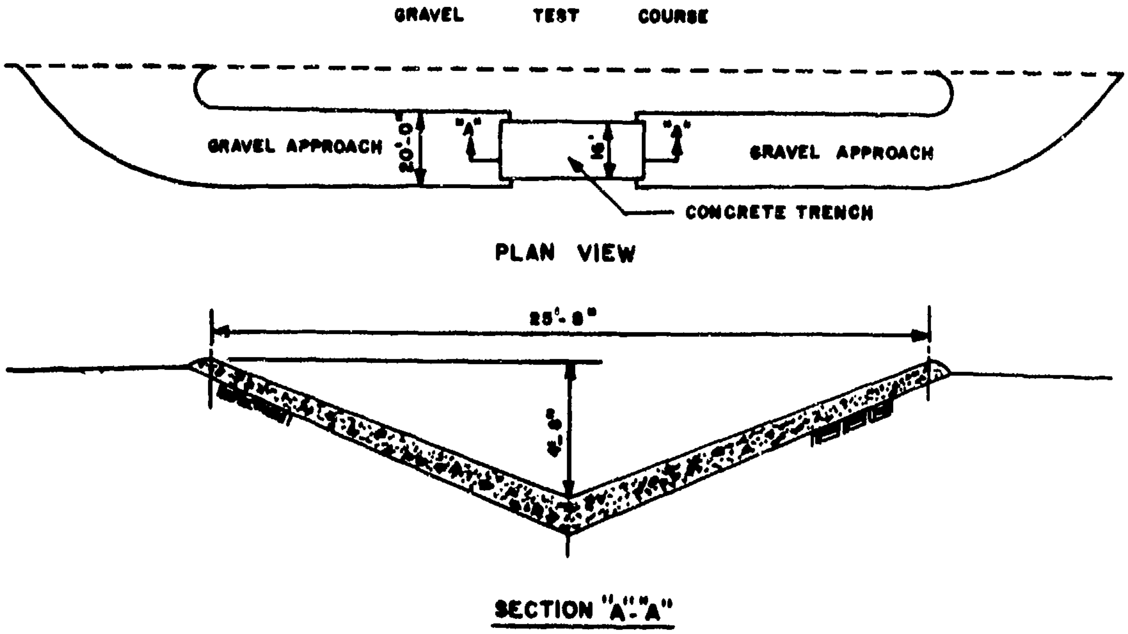

Figure 3. Plan and Profile of Trench-Crossing Facility

5.4 Frame-Twister Course (Wave Course) - (Wheeled Vehicles Only). Wheeled vehicles are operated over the frame-twister course to determine whether:

a. The design provides sufficient strength and clearance for extreme articulation, horizontally and vertically, of wheels, shock absorbers, springs, engine, power train, support arms, stops, and limits.

b. The frame, body, and components have adequate stiffness or flexibility.

c. Any part of the body, hood and compartment latches, controls, engine, power train, or suspension operates improperly or becomes misaligned.

d. There is a tendency for an automatic transmission to "hunt" between speed or gear ratios.

5.4.1 Method. Operate the vehicle over the wave course shown in Figures 4 and 5. (This shows the wave course at Aberdeen Proving Ground.) Cover a reasonable range of gears and speeds, starting at a very slow speed. Stop the vehicle at a point producing the maximum tendency to twist, so that operation of the doors and controls can be checked under the most severe conditions.

Figure 4. Truck, 2-1/2 Ton, Traversing the Wave Course ("Frame Twister").

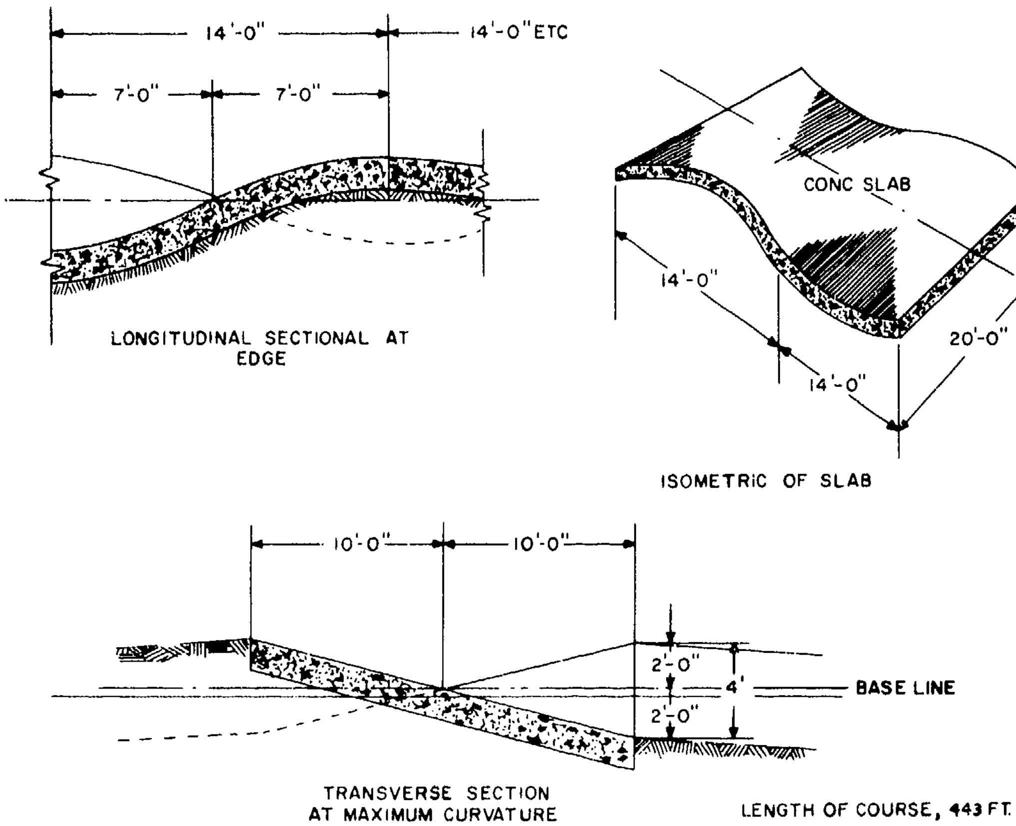

Figure 5. Sections of Wave Course.

5.4.2 Data Required.

a. Observations of contacts made by body, and ability of components to function at maximum twist angle.

b. Description of course.

c. Speed and gears used, and observations.

5.5 Simulated Loading Ramp. All vehicles intended for transport by air or landing craft are required to negotiate a 20° ramp without inhibiting interferences when entering or leaving the ramp.

5.5.1 Method. Using the 20° ramp shown in Figure 6, make two attempts to negotiate the ramp in both directions.

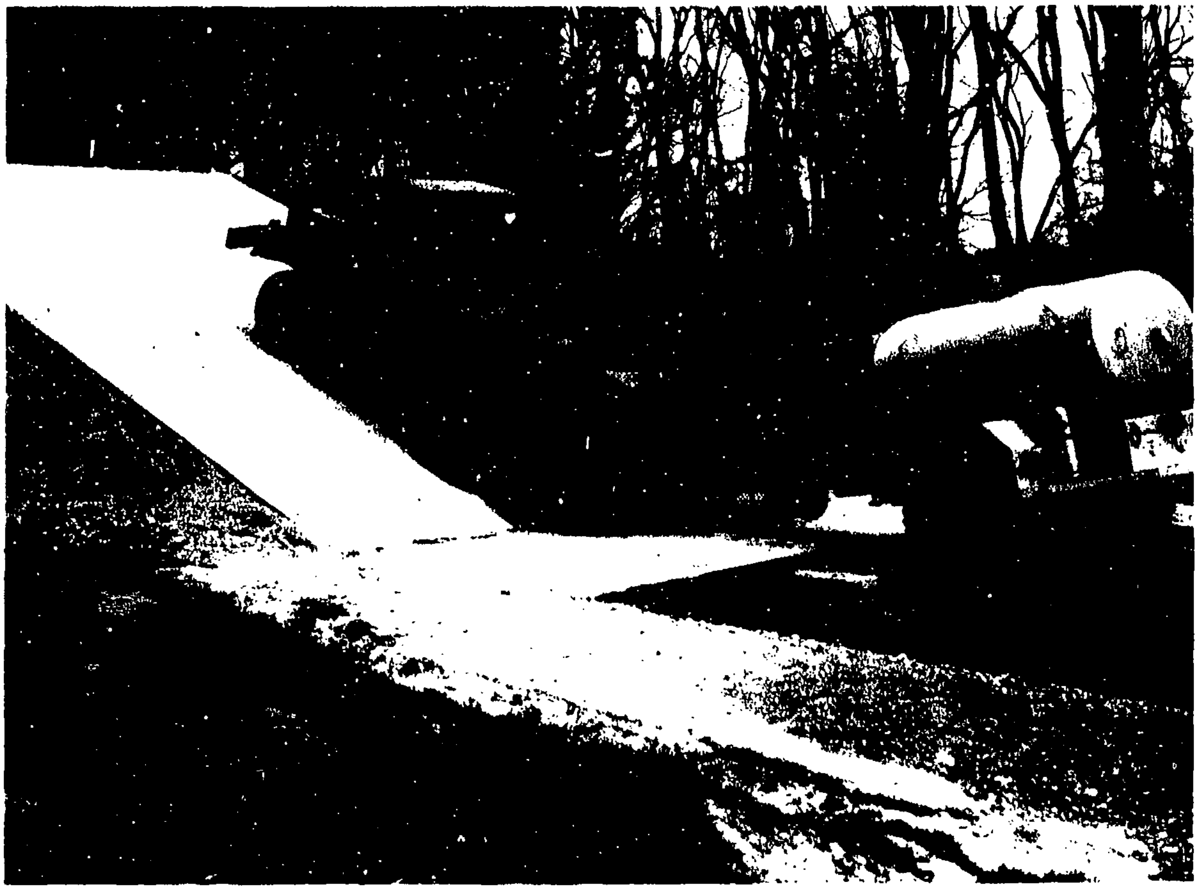

Figure 6. Simulated Loading Ramp.

5.5.2 Data Required.

a. Successes and failures.

b. Points of contact with the ramp, and damage, if any.

5.6 DARCOM Mobility Model Obstacles.

5.6.1 Method. Based upon requirements, determine which obstacles in the DARCOM Mobility Model (Appendix A) the vehicle is expected to negotiate. Set up the necessary obstacles and attempt to negotiate them.

5.6.2 Data Required.

a. Characteristics of each obstacle attempted and results of each effort with speed and gear.

b. Observations.

c. Damage to vehicle.

6. DATA REDUCTION AND PRESENTATION. Results of the attempts to negotiate obstacles are tabulated, and compared to the requirements, and to a baseline vehicle when specified. Photographs are taken of significant happenings.

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APPENDIX A
AREA TERRAIN FACTORS FOR THE DARCOM MOBILITY MODEL

TERRAIN FACTORS	Class Numbers 1	2	3	4	5	6	7	8	9	10	11	12	13	14
SURFACE TYPE	Fine Grained Soils	Coarse Grained Soils	Muskeg	New Permanent Snow	Permanent Snow							Snows		
**SURFACE STRENGTH (CI or RCI) CLASS RANGE	> 280	221-280	161-220	101-160	61-100	41-60	33-40	26-32	17-25	11-16	0-10	13-25	7-12	0-6
VALUE SELECTED FOR PREDICTION	> 300	250	190	130	80	50	36	29	20	14	5	19	10	3
SLOPE (%) CLASS RANGE	> 0-2	2.1-5	5.1-10	10.1-20	20.1-40	40.1-60	60.1-70	> 70						
VALUE SELECTED FOR PREDICTION	> 1	3.5	7.5	15.0	30.0	50.0	65.0	72.0						
OBSTACLE APPROACH ANGLE (Deg.) CLASS RANGE	178.6-180	180-181.5	175.6-178.5	181.5-184.5	170.1-175.5	184.5-190	158.1-170	190.1-202	149.1-158	202.1-211	135.1-149	211.1-225	90.0-135	226-270
VALUE SELECTED FOR PREDICTION	179	181	177	183	173	187	164	196	154	206	142	218	112	248
OBSTACLE VERTICAL MAGNITUDE (cm) CLASS RANGE	0-15	16-25	26-35	36-45	46-60	60-85	> 85							
VALUE SELECTED FOR PREDICTION	8	20	30	40	52	72	85							
OBSTACLE BASE WIDTH (cm) CLASS RANGE	> 120	91-120	61-90	31-60	0-30									
VALUE SELECTED FOR PREDICTION	360	105	75	45	15									
OBSTACLE LENGTH (m) CLASS RANGE	0-.3	0.4-1.0	1.1-2.0	2.1-3.0	3.1-6.0	6.1-150	> 150							
VALUE SELECTED FOR PREDICTION	0.2	0.6	1.5	2.5	4.5	78	150							
OBSTACLE SPACING (m) CLASS RANGE	Bare	20.1-50	11.1-20	8.1-11	5.6-8	4.1-5.5	2.6-4.0	0-2.5						
VALUE SELECTED FOR PREDICTION	60	40	15.5	9.5	6.8	4.8	3.3	1.2						
OBSTACLE SPACING TYPE	Random	Linear												
SURFACE ROUGHNESS (rms elev., in.) CLASS RANGE	0-.4	0.5-1.5	1.6-2.5	2.6-3.5	3.6-4.5	4.6-5.5	5.6-6.5	6.6-7.5	> 7.6					
VALUE SELECTED FOR PREDICTION	0.2	1	2	3	4	5	6	7	8					
STEM DIAMETER (cm)	0	> 2.5	> 6.0	> 10	> 14	> 18	> 22	> 25						
FACTOR VALUE	0	3	6	10	14	18	22	25						
STEM SPACING (m) CLASS RANGE	Bare	> 20	11.1-20	8.1-11	5.6-8	4.1-5.5	2.6-4	0-2.5						
VALUE SELECTED FOR PREDICTION	100	20	15.5	9.5	6.8	4.8	3.3	1.2						
VISIBILITY (m) CLASS RANGE	> 50	24.1-50	12.1-24	9.1-12	6.1-9	4.6-6	3.1-4.5	1.6-3.0	0-1.5					
VALUE SELECTED FOR PREDICTION	50	37	18	10.6	7.5	5.3	3.8	2.3	0.8					
SNOW DEPTH (cm) CLASS RANGE	2.5-30.5	30.6-45.7	45.8-61.0	61.1-76.2	76.3-91.4	91.5-121.9	122.0-152.5	152.6-182.9	> 182.9					
VALUE SELECTED FOR PREDICTION	16.5	38.2	53.4	68.6	83.8	106.7	137.2	167.8	182.9					
SNOW MOISTURE CONDITION	Dry	Wet												

*The AMC '71 Mobility Model, US Army Tank-Automotive Command, Warren, Michigan, TACOM Technical Report 11789 (LL 143).

**Surface strength for dry, average, and wet seasons.