FKSM.5-100-3

FORT KNOX SUPPLEMENTAL MATERIAL

BRIDGE-VEHICLE CLASSIFICATION SYSTEM AND ROUTE RECONNAISSANCE

PROGRAMED TEXT

SEPTEMBER 1989

COMMAND AND STAFF DEPARTMENT
U.S. ARMY ARMOR SCHOOL
FORT KNOX, KENTUCKY

INTRODUCTION

1. Purpose. This programmed text is designed as a preclass self-paced instructional text concerning the fundamentals of the vehicle and bridge classification system and route reconnaissance.

2. Scope. At the completion of this programmed text, you will be able to

a. identify and know the meaning of bridge classification signs.

b. hastily classify vehicles and bridges.

c. identify the types of bridge crossings.

d. identify symbols used on a route reconnaissance.

e. classify a route by a formula based on the route reconnaissance overlay.

3. Instructions.

a. You will complete this programmed text before coming to the Pioneering for Armor/Cavalry class given by the Command and Staff Department. Bring the text to class. Annotate in the text where you have problems so that you can get the point in question clarified in class.

b. This is a linear programmed text, starting with FRAME 1 and ending with FRAME 101. Proceed from one frame to the next, there is no need to skip around.

c. When you have finished the text, take the exam at the end which covers vehicle and bridge classifiction and bridge crossing.

d. Retain this booklet as it will be of use in future assignments.

e. The average completion time for the text is from 2 to 3 hours.

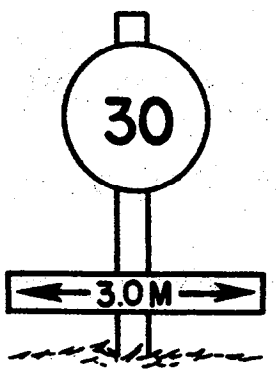
This publication supercedes FKSM 5-100-3, undated.

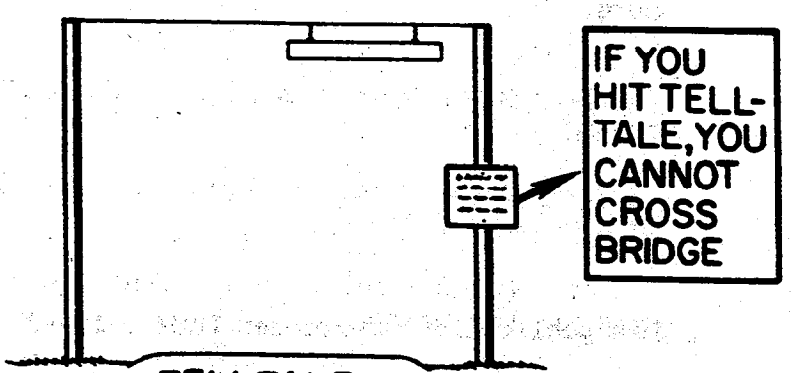
FRAME 1

VEHICLE CLASSIFICATION SYSTEM

FRAME 50

Not only must a bridge conform to weight and structure requirements, it must also meet height and width requirements for its rated class. If a bridge does not meet the established height or width requirements for its classification, then a sign with the width of the bridge is posted below the classification sign as shown below. If the height restrictions cannot be met, the clearance restriction is posted before encountering the bridge and often a warning device such as a telltale is also used to indicate the restrictive overhead clearance. The restrictive width and height requirements are given on pages 4-6 and 4-7 of FM 5-36. One way bridge classifications are not downgraded because of height and width restrictions. Remember, however, the restrictions are posted before the bridge is encountered.



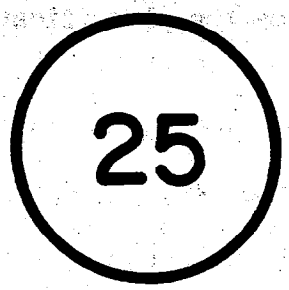


FRAME 2

A military vehicle is any item of equipment that is mounted on wheels, tracks, or a combination of the two. For purposes of classification, vehicles are grouped into two categories, SINGLE and COMBINATION.

FRAME 51

The bridge classification sign below indicates



a. Rated wheel vehicles weighing 25 tons or less may cross this bridge.

b. Rated wheel or track vehicles of class 25 and below may use this two-way bridge.

c. Rated wheel or track vehicles of class 25 and below may use this one-way bridge.

FRAME 3

A SINGLE vehicle is any vehicle which has only one frame or chassis, such as a truck, tank or trailer.

A STANDARD COMBINATION vehicle is a military vehicle consisting of two or more single vehicles designed to be connected and to move as a unit, such as a towed artillery piece and its prime mover.

FRAME 52

ANSWER. c.

If this single lane bridge did not meet the minimum roadway width for class 25 wheeled or tracked vehicles, then the actual bridge lane width would be posted below the classification.

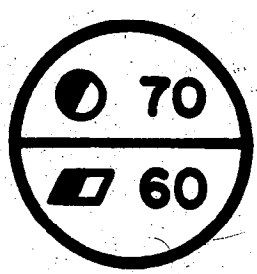
FRAME 4

A 2 1/2 ton cargo truck pulling a water trailer is classified as a _____ _____ vehicle.

FRAME 53

Wheeled and tracked vehicles have sufficiently different loading effects on bridges once their rated class exceeds 30. Due to this, bridges that have classifications of over 30, normally have two different classifications posted, one for wheels and one for tracks. The classification of the bridge for wheeled vehicles is generally higher than that for tracked vehicles due to the load distribution of the wheeled vehicles.

The bridge classification sign below indicates that at a maximum, a class 70 wheeled vehicle may cross this bridge or a class 60 tracked vehicle may cross the bridge. The wheeled vehicle class is always posted above the tracked vehicle class. If the bridge does not meet the width or height restrictions, then this is also posted.



FRAME 5

ANSWER. STANDARD COMBINATION

A standard combination is any military vehicle consisting of two or more single vehicles designed to be connected and move as a unit.

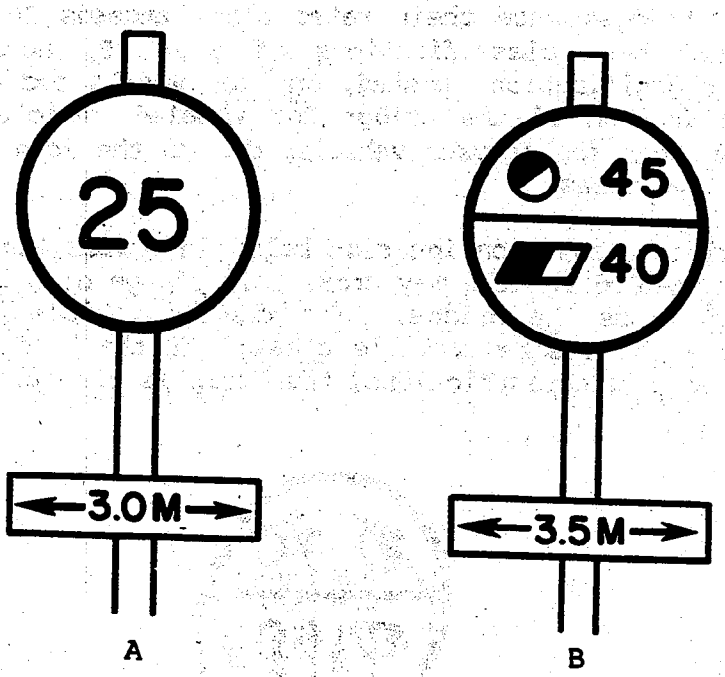
FRAME 54

Which bridge can a 5 ton wrecker (class 17, width 3.2m) use?

a. Bridge A

b. Bridge B

c. Neither



FRAME 6

Each single and standard combination vehicle is assigned a load classification number which is a whole number and represents the effects of the vehicle on a bridge while crossing it.

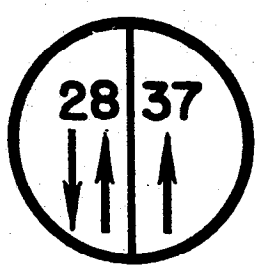
The vehicle classification number is a whole number which represents the gross weight of the vehicle (True or False).

FRAME 55

ANSWER. B.

On bridge B, the width and class are sufficient to handle the load. Bridge A is too narrow for the wrecker.

The sign below indicates a two-way bridge. It has classes for both one-way and two-way traffic. The sign indicates that at one time on the bridge, there can be two wheel or track vehicles of class 28 or below, each in their own lane. It also indicates that one wheel or track vehicle between class 37 and 29 must be on the bridge by itself. If a class 37 vehicle is on the bridge, traffic from the opposite direction must temporarily halt and the class 37 vehicle must travel down the center line of the bridge. The two-way class is always on the left side of the sign.



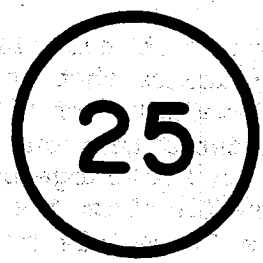
FRAME 7

ANSWER. False.

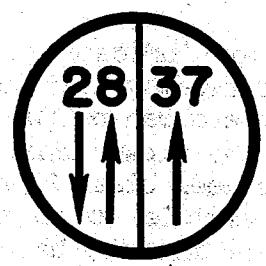
The vehicle classification number represents the effects of the vehicle on a bridge while crossing it. This effect is a combination of gross weight, weight distribution of the vehicle, speed at which the vehicle crosses the bridge, and the impact loading of the vehicle on the bridge.

FRAME 56

A self-propelled howitzer M107 (class 29) encounters two bridges as indicated below. Which bridge can be crossed and do any special precautions have to be taken?



A



B

FRAME 8

Most standard Army vehicles are classified. The exceptions are trailers with a rated payload of 1 1/2 tons or less and other types of vehicles with a gross weight of 3 tons or less. Classification numbers are listed in Appendix C, FM 5-36, (Military Load Classification for Standard Vehicles).

FRAME 57

ANSWER. B.

One-way traffic only. Bridge A has too low of a classification. When bridge B is used, two-way traffic must be halted and the vehicle must move down the centerline of the bridge.

The multilane bridges must conform to the minimum lane widths and unlike a single lane bridge, the two-way classification is downgraded to a class within the limits of the bridge width. Because the two-way classification is downgraded to within the limits of the actual width, the actual lane widths need not be posted.

FRAME 9

All military vehicles are classified (True or False).

FRAME 58

Table of minimum lane widths for bridges.

Bridge Class	4-12	13-30	31-60	61-100
One Lane	9'-0"(2.75m)	11'-0"(3.35m)	13'-2"(4.0m)	14'-9"(4.5m)
Two Lane	18'-0"(5.5m)	18'-0"(5.5m)	24'-0"(7.3m)	27'-0"(8.2m)

A two-way bridge capable of supporting two-way class 60 wheeled and tracked vehicle traffic and one-way class 70 wheeled and tracked traffic has a minimum width between curb of 8.00 meters. What is the bridge classification? (Draw the bridge sign.)

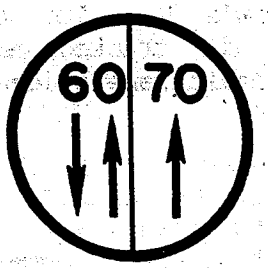
FRAME 10

ANSWER. False.

The exceptions are trailers with a rated payload of 1 1/2 tons or less and other types of vehicles with a gross weight of 3 tons or less.

FRAME 59

ANSWER.



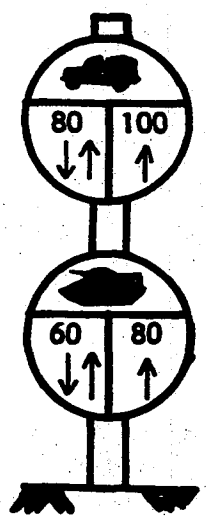
Using the table, we see that a width of 8.0 meters is not sufficient for a two-way crossing of class 65 vehicles. We must then downgrade the two-way classification to 60 as the necessary width for two-way traffic is only 7.3 meters. The roadway width for the one lane classification is not restrictive (8.00m vs 4.5m required for one-way traffic).

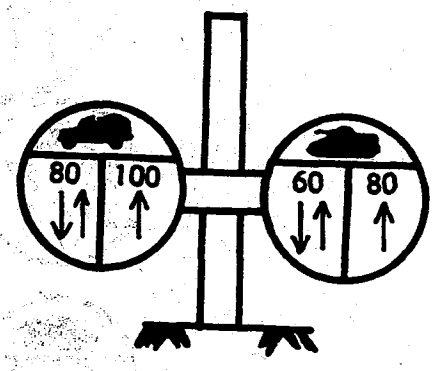
FRAME 11

The vehicle class number for a single vehicle can be found on the front of the vehicle. The sign is 9 inches in diameter, painted either yellow or a subdued color and has the vehicle's classification number in black.

FRAME 60

Multilane bridges are normally given dual classifications when the class of the bridge exceeds 30. The wheel vehicle sign is either above or to the left of the tracked vehicle sign. Types of dual classification signs of a multilane bridge is shown below.



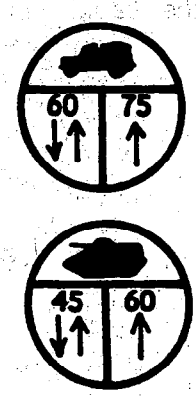


FRAME 12

Standard combination vehicles are marked with a front sign which shows the vehicle class number of the combination with a red letter C above the class number. Side signs are also posted on each part of the combination to show the class number of each part as a single vehicle.

FRAME 61

Your company is convoying to its assembly area. The largest wheeled vehicle is a dump truck (class 21) and the largest tracked vehicle is a M60 tank (class 50). Can you cross the bridge which is as posted below? What special precautions, if any, must you take?



FRAME 13

If a vehicle is unclassified, there are several ways to get an expedient classifiction:

1. Compare the unclassified vehicle to a similar classified vehicle.

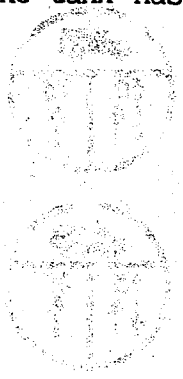
2. Refer to Appendix C, FM 5-36.

3. Determine the gross weight of the vehicle in tons (can be found on the data plate of the veicle or in the -10 manual for that particular vehicle). If you are classifying a tracked vehicle, you will use the gross weight in tons as the classification. If you are classifying wheel vehicle, use 85% of the gross weight in tons for the expedient classification.

FRAME 62

ANSWER. Yes, one-way traffic for tank.

In a mixed convoy you must consider wheeled vehicles and tracked vehicles separately. Once you've determined the highest rated vehicle by type then compare them to the appropriate bridge classification sign. In your case, the wheeled vehicle is no problem but two-way traffic must be stopped and the tank has to cross by itself by proceeding down the centerline.



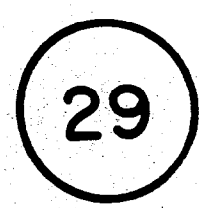
FRAME 14

What would the expedient classification be for a cargo truck that weighed 20,000 pounds combat loaded?

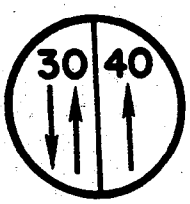
What would be the expedient classification for an M728 (Combat Engineer Vehicle) that weighs 115,000 pounds combat loaded?

FRAME 63

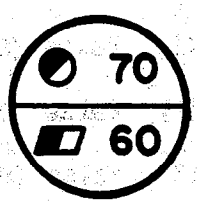
By way of summarization of the bridge classification system, answer TRUE or FALSE to each of the following statements.



A



B



C

(1) Sign A posted in front of a bridge indicates the maximum speed limit.

(2) Sign C permits wheeled vehicles with a class of 70 and tracked vehicles with a class of 60 on this multilane bridge.

(3) Sign B permits only wheeled vehicle on this bridge.

(4) Wheeled and tracked vehicles with a class of 29 or less may use a bridge posted with sign A.

(5) Sign C is wrong! The two-way classification is omitted.

FRAME 15

ANSWER. 9, 58

For the wheeled vehicle, divide the 20,000 pounds by 2000 pounds/ton to obtain the weight in tons which is 10 tons. Multiply this by 0.85 to get 85% of the gross weight. The expedient classification is 8.5, rounded up to 9.

For the tracked vehicle, divide the 115,000 pounds by 2000 pounds/ton to obtain 57.5 tons. Round this up to the next higher whole number for a class 58.

FRAME 64

ANSWER.

(1) False (See Frame 48)

(2) False (See Frame 52)

(3) False (See Frame 54)

(4) True (See Frame 48)

(5) False (See Frame 54)

FRAME 16

A NONSTANDARD COMBINATION VEHICLE is a single vehicle towing another vehicle at a distance less than 30.5 meters or 100 feet. It can also be two vehicles separated by less than 30.5 meters, both moving under their own power.

FRAME 65

Types of Bridge Crossings

There are two types of bridge crossings: NORMAL and SPECIAL.

Normal crossings are made when the vehicle classification is less than or equal to the bridge classification number. Only normal convoy discipline is imposed; vehicles must have a minimum spacing of 30.5 meters (100 feet) and a maximum speed of 40 km/hour (25 mph).

There are both one-way and two-way normal crossings. If a one-way crossing is made on a multilane bridge, the two-way traffic must be temporarily halted and only the vehicle conducting the crossing may be on the bridge.

In the Special crossing category there are two types: Caution and Risk. Any type of special crossing is made only due to exceptional circumstances. Whenever a vehicle exceeds the classification of a bridge, the highest tactical commander using the bridge (usually brigade or division commander) may authorize a caution or risk crossing.

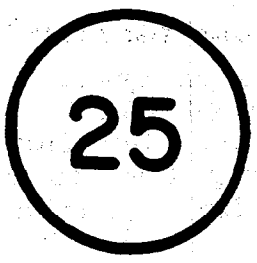
FRAME 17

The classification number for a nonstandard combination vehicle must be computed as it is not listed in any table. To obtain the class number, add the classification of both vehicles of the nonstandard combination. If the sum of the two class numbers is greater than 60, that will be the classification. If the sum is 60 or less, multiply the sum by 0.9 to obtain the nonstandard combination classification.

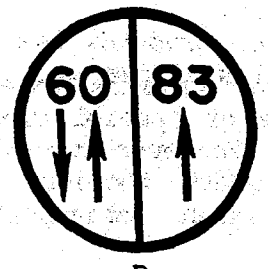
FRAME 66

To determine the highest classed vehicle that may make a caution crossing on a specified civilian type bridge, the classification of that bridge must be temporarily recomputed. For military standard prefabricated fixed or floating bridges, the caution classification is found in the appropriate technical manual. For civilian type bridges, the existing classification is increased by 25% by multiplying the existing classification by 1.25 and rounding down to the next whole number to obtain the caution classification.

What are the caution classifications of the two bridges below?



A



B

FRAME 18

A M88 recovery vehicle (class 55) is towing an M60A1 tank (class 50) at a distance less than 30.5 meters. What is the class for this nonstandard combination?

A 5 ton dump truck (class 16) is being towed by a 10 ton wrecker (class 15) at a distance less than 30.5 meters. What is the classification of this nonstandard combination?

FRAME 67

ANSWER. 31, 103

Bridge A	Bridge B
25 x 1.25 = 31.25 round down to 31	83 x 1.25 = 103.75 round down to 103

When a vehicle makes a caution crossing, it must travel down the centerline of the bridge, not stop, turn, accelerate or shift gears, it must not exceed a speed of 12 km/hours (8 mph), and vehicles must remain 50 meters apart.

After a caution crossing has been accomplished the bridge reverts to its original classification.

FRAME 19

ANSWERS. Class 105, Class 28

Add the class numbers of the vehicles in the two problems. In the first, the sum is 105, this is greater than 60 so this is the class for that nonstandard combination. In the second problem, the sum is 60 or less so we multiply the sum by 0.9 and round up to the class number.

Remember, this method is used for nonstandard combinations. The class for standard combinations is found in Appendix C of FM 5-36.

An M113, (class 11) is towing another M113 at a distance of 3 meters. What is the classification for this nonstandard classification?

FRAME 68

The second type of special crossing, the RISK crossing may be made only on military prefabricated fixed or floating bridges. The risk crossing classification is obtained from the appropriate TM on the bridge. An engineer officer must be present to inspect the bridge after each risk crossing. If any damage is discovered, traffic is halted until repairs have been affected.

RISK CROSSINGS ARE MADE ONLY IN THE GRAVEST EMERGENCIES.

FRAME 20

ANSWER. Class 20.

Adding the two classifications together we get 22. Since the sum is 60 or less, we multiply the sum by 0.9 to obtain the nonstandard combination classification which in this case is 19.8 or 20 when rounded up to the next higher whole number.

FRAME 69

When conducting a caution crossing the vehicle must remain on the _____ of the bridge, maintain a spacing of _____ meters between vehicles, do not exceed a speed of _____ kph, do not stop, _____, or shift gears when crossing.

FRAME 21

HASTY BRIDGE CLASSIFICATION

FRAME 70

ANSWER. Centerline, 50 meters, 12 kph, ACCELERATE.

After the caution crossing is made, the bridge immediately reverts to its original classification.

FRAME 22

The Engineer Bridge Classification Wheel (EBCW) was developed to give soldiers the capability to quickly classify a bridge when the need for haste overrides the need for accuracy which can be obtained from more analytical methods.

FRAME 71

In summary, answer the following questions either TRUE or FALSE.

a. Normal crossings can only be authorized by the local tactical commander.

b. Multilane bridges can withstand normal crossings of both one-way and two-way traffic of appropriately rated vehicles.

c. Caution crossings are computed by multiplying the one-way classification by 1.25 and rounding up.

d. In combat, a driver of a military vehicle can conduct normal, caution, or risk crossings without higher authorization.

e. Risk crossings can be made on both civilian and military bridges, but caution crossings can only be made on military bridges.

FRAME 23

There are several assumptions that must be made concerning the wheel.

1. The bridge is a simply supported steel or timber stringer bridge. If it is of any other type, the wheel cannot be used.

2. The bridge is in good condition with no structural or combat damage.

3. Vehicle speed will be limited to 25 miles per hour.

4. Only one vehicle will be on the bridge at one time.

5. A wheeled vehicle may cross the bridge only if the decking is adequate. (See page 2 EBCW).

6. For multispan bridges the lowest individual span classification will be the classification of the bridge.

FRAME 72

ANSWERS.

a. False (FRAME 65)

b. True (FRAME 65)

c. False (FRAME 66)

d. False (FRAME 65)

e. False (FRAME 65, 66)

FRAME 24

The Engineer Bridge Classification Wheel can be used on a concrete stringer bridge (True or False).

FRAME 73

ROUTE CLASSIFICATION & RECONNAISSANCE

The route classification system provides you a valuable planning tool that will allow you to avoid or plan for delays and to get the most efficient use of a route. The basis of route classification is the route classification formula. The parts of this formula are given and explained in Chapter 2, Route Reconnaissance Procedures, FM 5-36.

FRAME 25

ANSWER. False

The bridge classification wheel can only be used on steel or timber stringer simply supported bridges.

FRAME 74

There are five pieces of information in a route classification formula.

1. Width of road.
2. Type of road.
3. Load carrying capacity.
4. Lowest overhead clearance on route.
5. Presence of obstructions.

FRAME 26

Various dimensions are necessary to compute the classification of the bridge using the bridge classification wheel.

The first piece of information needed is the height or depth and the breadth or width of the steel or timber stingers. Steel stringers are measured in 1/8 inch increments whereas wood is measured in one inch increments. If the measurement doesn't come out to the increment desired, round down to the desired interval.

FRAME 75

The width of road given in the route classification formula is the width of the narrowest part of the road expressed in feet or meters. This measurement is the first number in the route classification formula.

FRAME 27

Once the measurements have been taken from the stringers, you must change these dimensions into a code number for that particular stringer. This is done by using the charts on Page 4 of the EBCW (illustrated at left). Refer to the appropriate chart for the type of stringer (timber or steel). Find the "d" (depth or height) of the stringer and the "b" (breadth or width of the stringer). Read the number to the right of these two dimensions. That is the code number for that particular stringer.

STEEL	d	b	CODE
39WF211	39¼	11¾	78.7
37WF206	37¼	11¾	73.6
36WF300	36¼	16⅝	110.5
36WF194	36¼	12¼	66.3
36WF182	36¼	12¼	62.1
36WF170	36¼	12	57.9
36WF160	36	12	54.1
36WF230	35⅞	16½	83.5
36WF150	35⅞	12	50.3
36WF201	35⅝	11¾	68.7
33WF196	33⅝	11¾	63.7
33WF220	33¼	15¾	73.8
33WF141	33¼	11½	44.7
33WF130	33¼	11½	40.5
33WF200	33	15¾	66.9
31WF180	31½	11¾	59.0
30WF124	30¼	10½	35.1
30WF116	30	10½	32.8
30WF108	29¾	10½	29.9
30WF175	29½	11¾	51.4
27WF171	27¼	11¾	47.1
27WF102	27¼	10	25.6
27WF94	26⅞	10	24.2
26WF157	25½	11¾	40.7
24WF94	24¼	9	22.1
24WF84	24¼	9	19.6
24WF100	24	12	24.9
24I120	24	8	25.1
24I106	24	7⅞	23.4
24I80	24	7	17.4
24WF76	23¾	9	17.5
24WF153	23¾	11¾	36.8
24I134	23¾	8½	28.2
22I75	22	7	13.7
21WF139	21¼	11¾	31.1
21I112	21¼	7⅞	22.0
21WF73	21¼	8¼	15.0
21WF68	21¼	8¼	14.0
21WF62	21	8¼	12.6
20I85	20	7¼	15.0
20I65	20	6¼	10.9
20WF134	19¾	11¾	27.6
18WF80	18¼	7½	10.8
18I86	18¼	7	14.5
18WF56	18¼	7¼	9.78
18I80	18	8	13.0
18WF50	18	7½	8.89
18I55	18	6	8.84
18WF122	17⅞	11¾	28.8
18I62	17¾	6¼	10.6
18I77	17¾	6¾	12.5
16WF112	16¾	11¾	20.0
16I70	16¾	6¼	10.6

STEEL	d	b	CODE
16WF50	16¼	7⅛	8.04
16WF45	16¼	7	7.24
16WF64	16	8⅛	10.4
16WF40	16	7	6.44
16I50	16	6	6.89
16WF36	15⅞	7	5.64
16WF110	15¾	11¾	15.3
16I62	15¾	6¼	8.89
16I45	15¾	5⅛	6.67
15WF103	15	11¾	16.4
15I56	15	5⅛	7.69
15I43	15	5¼	5.67
14WF101	14¼	11¾	15.3
14I40	14¼	5⅛	5.29
14I51	14¼	5¼	6.67
14I70	14	8	9.07
14I57	14	6	6.80
14I40	14	5¼	5.38
14WF34	14	6¾	4.84
14WF30	13⅞	6¾	4.18
14WF92	13⅞	11¾	13.2
14I46	13⅞	5⅛	5.80
13I35	13	5	3.78
13I41	12⅞	5¼	4.80
12WF36	12¼	6⅝	4.58
12I65	12	8	8.09
12WF27	12	6½	3.36
12I50	12	5¼	5.02
12I32	12	5	3.60
12I34	11¾	4¾	3.60
11WF76	11	11	8.98
10I29	10¼	4¼	2.98
10WF25	10¼	5¾	2.62
10I40	10	6	4.09
10I35	10	5	2.89
10I25	10	4⅛	2.44
10WF21	9⅞	5¾	2.13
10WF59	9¼	9¼	5.67
9I25	9¼	4⅛	2.27
9I50	9	7	4.56
8I35	8	6	2.89
8I28	8	5	2.18
8WF31	8	8	2.71
8WF44	7⅞	7⅞	3.60
7WF35	7⅛	7⅛	2.58
6WF31	6¼	6¼	2.00

TIMBER		
b×d	CODES	
6 × 12	12.0	1.47
6 × 14	14.0	2.00
6 × 16	15.0	2.62
6 × 18	16.0	3.31
8 × 12	18.0	1.96
8 × 14	18.7	2.67
8 × 16	21.3	3.49
8 × 18	24.0	4.42
8 × 20	26.7	5.45
8 × 22	29.3	6.60
8 × 24	32.0	7.85
10 × 10	15.7	1.70
10 × 12	20.0	2.45
10 × 14	23.3	3.34
10 × 16	26.7	4.35
10 × 18	30.0	5.52
10 × 20	33.3	6.81
10 × 22	36.7	8.25
10 × 24	40.0	9.81
12 × 12	24.0	2.94
12 × 14	28.0	4.01
12 × 16	32.0	5.23
12 × 18	35.0	5.62
12 × 20	40.0	8.18
12 × 22	44.0	9.90
12 × 24	48.0	11.8
14 × 14	32.7	4.67
14 × 16	37.3	6.11
14 × 18	42.0	7.73
14 × 20	46.7	9.54
14 × 22	51.3	11.06
14 × 24	56.0	13.7
16 × 16	42.7	6.98
16 × 18	48.0	8.83
16 × 20	53.3	10.9
16 × 22	58.7	13.2
16 × 24	58.1	15.7
18 × 18	54.0	9.94
18 × 20	59.0	12.3
18 × 22	59.5	14.3
18 × 24	59.9	17.7
⌀= DIAMETER IN INCHES		
⌀=12"	21.2	1.74
⌀=13"	25.0	2.20
⌀=14"	29.0	2.75
⌀=16"	37.7	4.11
⌀=18"	47.7	5.86
⌀=20"	59.0	8.03
⌀=22"	59.5	10.7
⌀=24"	59.9	13.8

FRAME 76

The next piece of information found in the formula is the worst type of road surface found along the route and is indicated by a letter "X", "Y", or "Z".

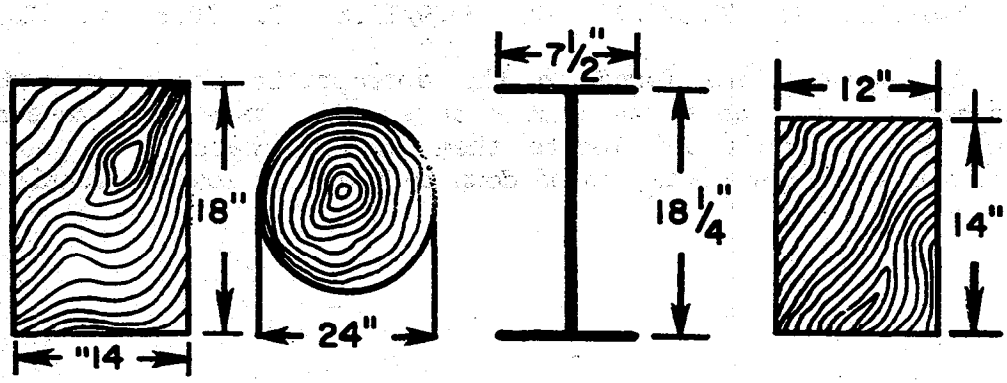
An "X" type road surface is an all weather road. It has a permanent surface such as asphalt or concrete.

A "Y" type road is a limited all weather route. The surface of this road is usually crushed rock or gravel. This type of road can be used in most weather, however, it may require considerable maintenance to keep it open during periods of heavy rain and snow.

A "Z" type road is a fair weather road. This is a road that is passable only during periods of good weather. This type of road would be impassable during periods of inclement weather.

FRAME 28

Determine the stringer code numbers for the stringers shown below



FRAME 77

The third piece of information in the formula is the load carrying capacity of the route. This is found to the right of the type of road in the formula. This load carrying capacity indicates the highest class vehicle that may use the route. It is generally determined by the lowest classified bridge on the route, but if there are no bridges on the route it will indicate the load bearing capacity of the road itself.

The fourth piece of information in the formula is the lowest overhead clearance on the route.

Following the load bearing capacity of the route there may be the symbol (OB), (W), or (T) indicating obstructions, seasonal flooding, or impassable amounts of snow respectively. If these conditions do not exist, these symbols are not used.

FRAME 29

ANSWERS. 1. 42.0/7.73 2. 59.9/13.8 3. 10.8 4. 28.0/4.01

The answers are found in the appropriate chart, depending on whether the stringers are timber or steel. Take your measurements from the stringers and locate them in the chart. If your exact dimensions are not given, round down to the next lower dimension.

FRAME 78

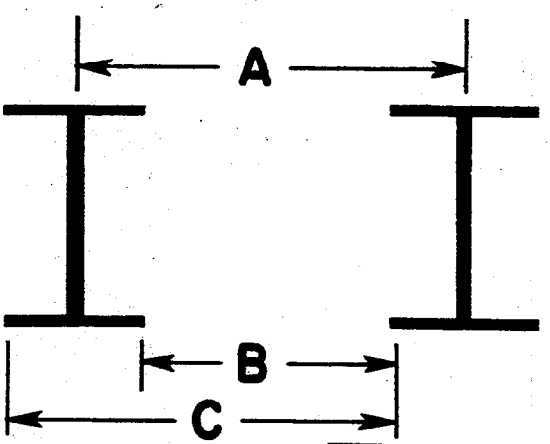
Indicate what the following route reconnaissance formulas mean:

4m/x/4.1/70	22 ft/Z/5/35/(OB)	6m/Y/8/50
A	B	C

FRAME 30

The next measurement we need to obtain is the stringer spacing. The stringer spacing is the center-to-center distance of the stringers or the distance from the side of one stringer to the same side of the next adjacent stringer.

Which of the following stringer spacing measurements is taken incorrectly?



FRAME 79

ANSWER.

A. 4 meters wide at the narrowest part, an all weather road surface, a class 70 wheeled or tracked vehicle can travel the length of the route. Overhead clearance 4.1 meters.

B. The route is 22 feet wide at its narrowest point, it is a fair weather road surface, a class 35 wheeled or tracked vehicle can travel over the entire length of the route, and there are obstructions. Overhead clearance 5 meters.

C. The route is 6 meters wide at its narrowest point, it has a limited all weather road surface, and a class 50 wheel or track can travel the entire length of the route. Overhead clearance 8 meters.

FRAME 31

ANSWER. b.

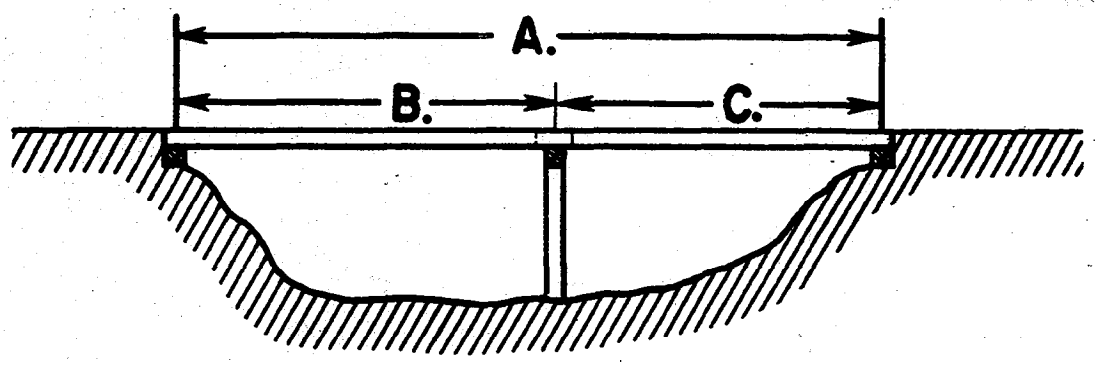
Using the measurement of "b" would greatly raise the classification of the bridge and give it an erroneous rating.

FRAME 76

The symbol (OB) in a route classification formula alerts the user of that route that there is some type of obstruction on the route that he will have to plan for or possibly avoid. Obstructions include things such as steep grades, sharp curves, and road width restrictions, to name a few. FM 5-36, Chapter 3, discusses obstructions along with the dimensions that make curves, slopes, overhead clearance and widths obstructions.

FRAME 32

The last measurement needed is the length of the span measured from the center of one support to the center of the next adjacent support whether that support be an end or intermediate support. The length of span is the length of the unsupported portion of the bridge.



In the bridge above, what is the incorrectly measured span length?

FRAME 81

The information from which a route classification is obtained is usually the route reconnaissance overlay. The overlay is a graphic method to show the route itself and any information concerning it that would be of use to anyone traveling on that route.

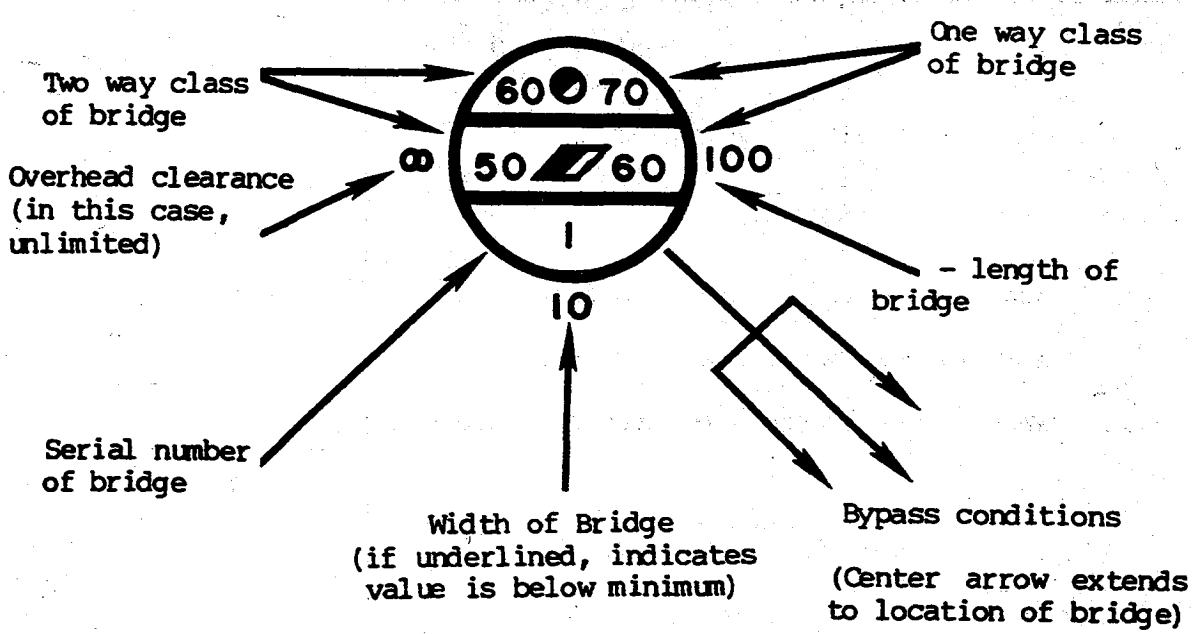
FRAME 33

ANSWER. a.

The span length must only be the unsupported portion of the bridge, measured from one support to the next support, whether the supports are end or intermediate.

FRAME 82

One of the symbols that will be on a route reconnaissance overlay is the symbol showing the characteristics of a bridge. All measurements are expressed in meters, therefore no length abbreviation is used after the numbers.



FRAME 34

Which of the following pieces of information are not necessary for classifying a bridge with ABCW?

a. Span length.

b. Stringer width and depth.

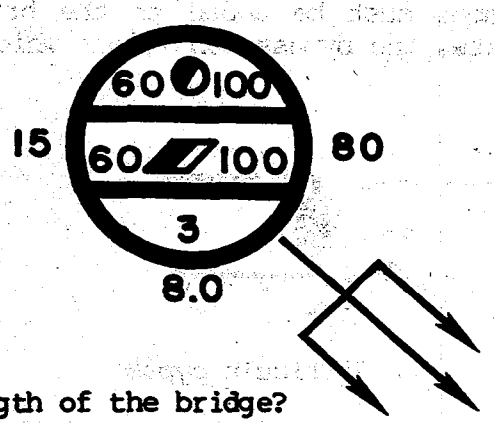
c. Number of stringers.

d. Bridge width.

e. Stringer spacing.

FRAME 83

Answer the following questions about the bridge symbol below.



a. What is the length of the bridge?

b. What is the width of the bridge?

c. What is the overhead clearance of the bridge?

FRAME 35

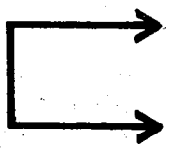
ANSWER. c, d

Items a, b, e, are necessary for classifying a bridge with the EBCW. Item c. and d. are not necessary.

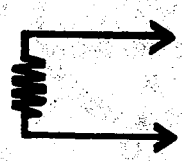
FRAME 84

ANSWER. a. 80 meters b. 8.0 meters c. 15 meters

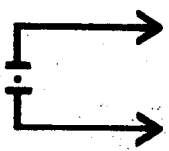
One more symbol must be added to the bridge sign before it is considered complete, the bypass conditions which are listed below.



easy bypass



difficult bypass



impossible bypass

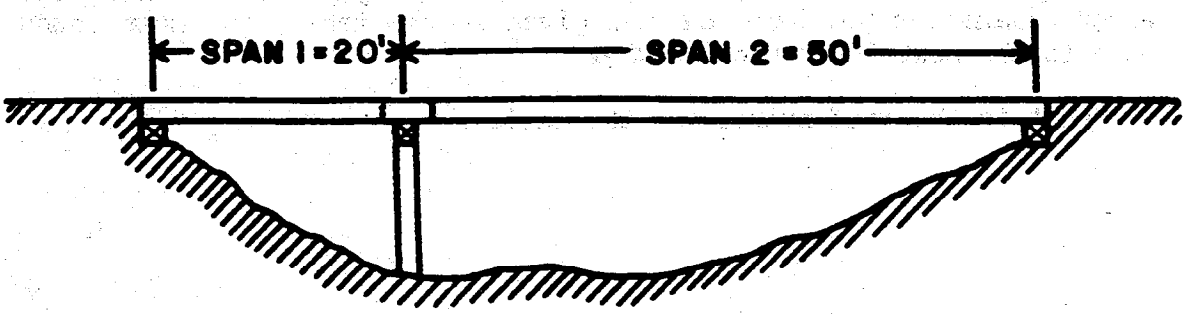
An easy bypass is one which can be utilized by a 2 1/2 ton (6x6) truck without work to improve the bypass.

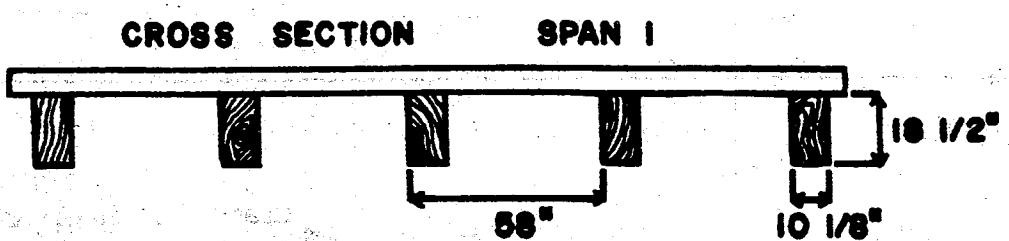
A difficult bypass symbol signifies that the bridge can be bypassed in the immediate vicinity but some work will be necessary.

An impossible bypass is one that indicates that the obstacle can be bypassed only by: (1) reconstructing the bridge; (2) new construction; (3) use of an alternate route which crosses the obstacle some distance away.

FRAME 36

To classify a bridge using the EBCW, we will use an example problem to help you understand the system. You will need to refer to the diagram below for the necessary information.





FRAME 85

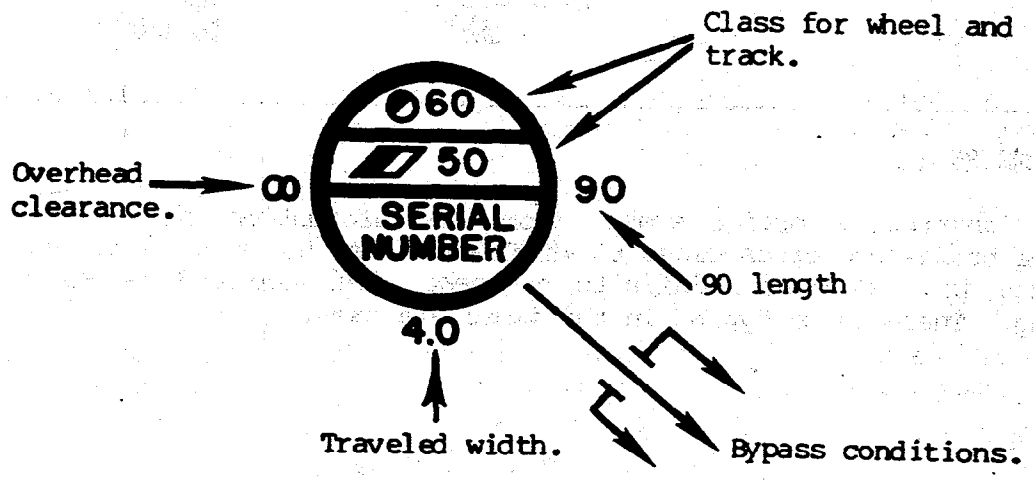
Construct a bridge symbol from the information given. The one lane bridge can cross class 60 wheel and class 50 track vehicles. The width is 4.0 meters, infinite overhead clearance and is 90 meters long. There is no bypass in the immediate area.

FRAME 37

The first step is to classify the stringers. Refer to the diagram in frame 36. We see that the stringers in span 1 are wood and b = 10 1/8" and d = 18 1/2" . Refer to page 4 of the EBCW and locate the timber column. Using the timber column, locate the stringer corresponding to your dimensions and read the number immediately to the right of these dimensions (the first stringer code). Since the exact dimensions you have are not given in the table, you must round down to the next lower whole number.

What is the code number for the stringer?

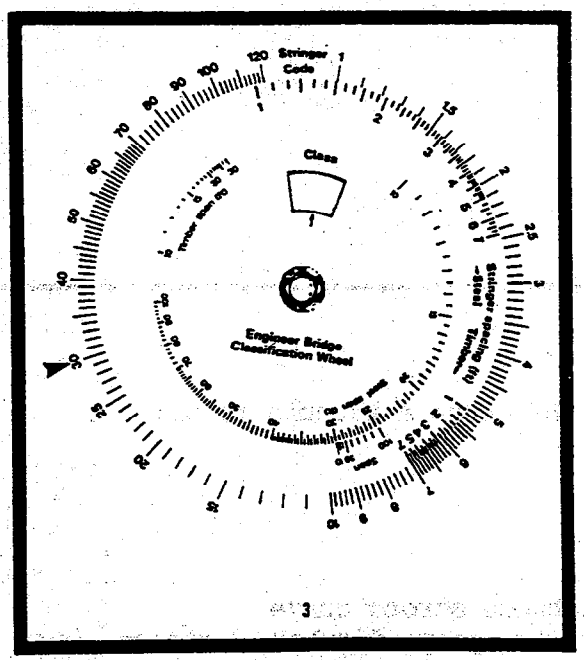
FRAME 86



FRAME 38

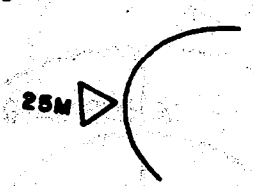
ANSWER. 30.0

Now that you have found the stringer code, we must enter it on the wheel. The figure at left shows page 3 of the EBCW. The stringer code portion is the very outside portion and consists of numbers running from 1 to 120. The heavy black arrow in the figure at the left points to the location of 30.0 on the stringer code portion of the wheel.

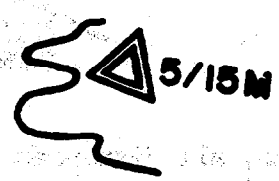


FRAME 87

Another symbol used on a map overlay is the symbol for a sharp curve. The symbol is a triangle with the radius of curvature at the base of it, as shown below.



If there is a series of sharp curves, a double triangle is entered with the number of curves and radius of the sharpest curve as shown below.



Curves 45 meters or less in radius are reportable and curves 25 meters or less in radius are considered as obstructions and would be indicated as (OB) in the route classification formula.

FRAME 39

Now that you have located the stringer code on the wheel, we must get the next piece of information we go into the wheel with, the stringer spacing. Refer to the cross section of the bridge on FRAME 36 and determine the stringer spacing. What is the stringer spacing?

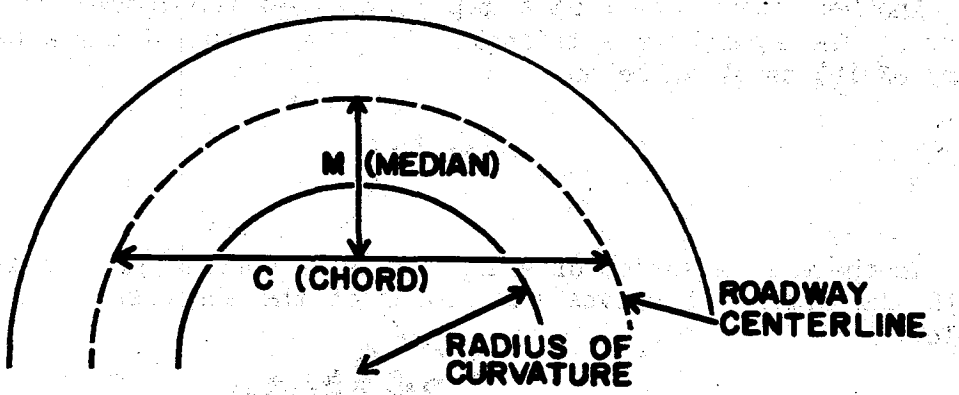
FRAME 88

To determine the radius of the curve a formula is used

$$R = \frac{C^2}{8m} + \frac{M}{2}$$

where R = radius of curvature
C = chord distance, or distance across curve
M = median distance, or the perpendicular distance from the center of the chord to the center of the road.

The diagram below will give you an idea of where the measurements are taken from on the road itself.



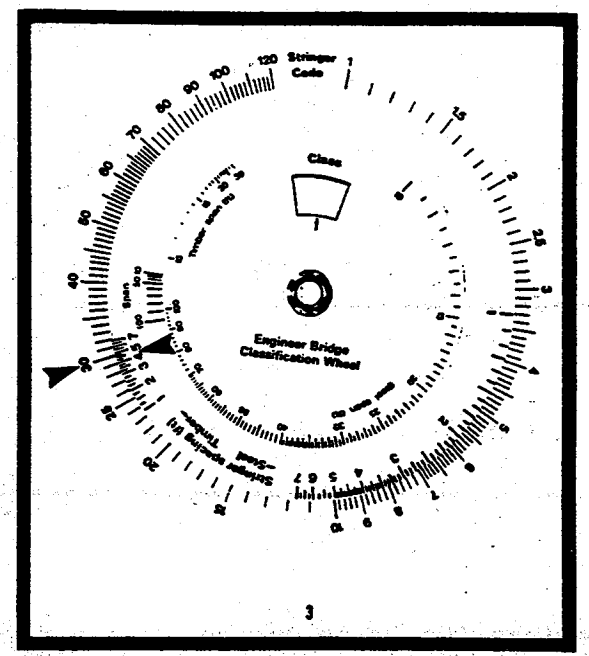
When making calculations, all distances must be in the same units i.e. feet or meters, do not mix units.

Calculate the radius of curvature from the following information: chord distance is 100 ft, median distance is 10 feet.

FRAME 40

ANSWER. 4' 10"

Stringer spacing from FRAME 36 was 58" or 4' 10". Locate the 4' 10" mark on the outer edge of the larger wheel, and align the 4' 10" timber stringer spacing mark with the 30.0 stringer code mark as shown by the heavy black arrows in the figure at the left. Secure the large wheel and the backing and do not allow them to move in relation to one another.



FRAME 89

ANSWER. 39 meters Given m = 10' find R
c = 100'

$$R = \frac{C^2}{8m} + \frac{m}{2}$$

$$R = \frac{(100)^2}{8(10)} + \frac{10}{2}$$

$$R = \frac{10000}{80} + 5$$

$$R = 125' + 5'$$

R = 130' (multiply feet by 0.3 to obtain meters).

R = 39 meters

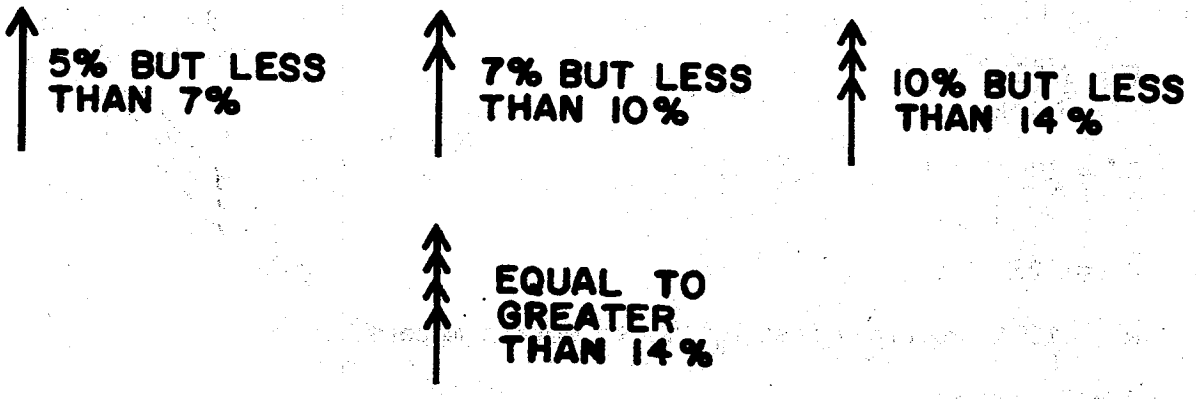
This curve is reportable but it is not an obstruction.

FRAME 41

The last piece of information needed is the span length for the span we are classifying. Refer to FRAME 36 and determine the span length. What is the span length?

FRAME 90

Another symbol that is used on the route reconnaissance overlay expresses the slope. The arrow indicating slope always points up hill and where possible should be as long as the slope. Slopes 5% and greater are reportable, however any slope 7% or greater is an obstruction.

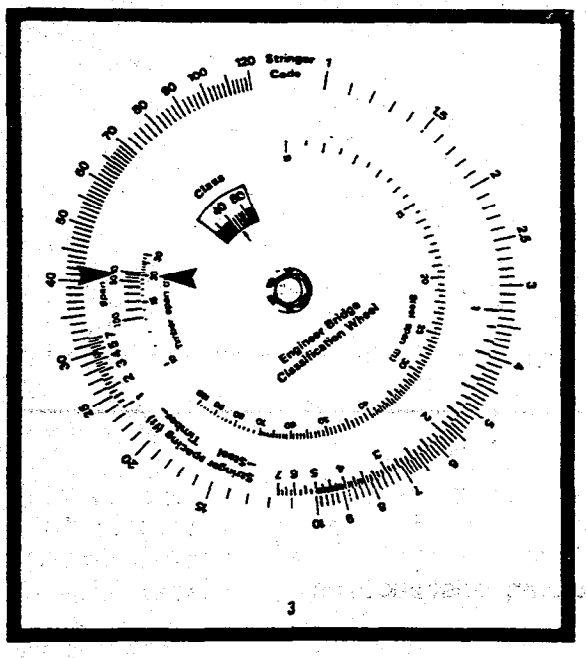


FRAME 42

ANSWER. 20'

The span length is determined by referring to the figure on FRAME 36. The length of span 1 is 20'.

Once you have the span length, you must rotate the inner wheel until the 20 foot mark on the inner wheel lines up with the 20 foot mark on the inside of the outer wheel as shown by the heavy black arrows in the figure at the left.



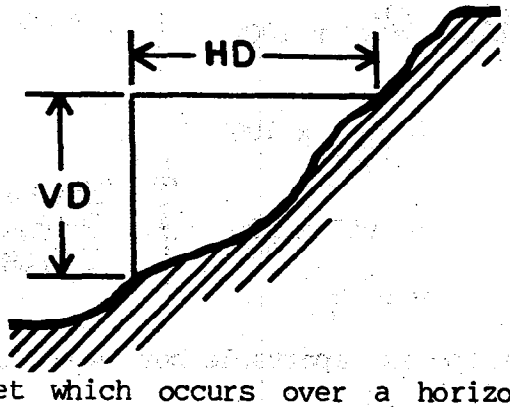
The initial classification of span 1 is indicated in the window of the inner circle of the EBCW. What is the initial classification of span 1 in this bridge example?

FRAME 91

Slope is computed by dividing the vertical rise in the slope by the horizontal distance in which the rise took place. The formula is

$$\text{slope} = \frac{VD}{HD} \times 100\%$$

where VD = vertical distance
HD = horizontal distance.



Given a vertical rise of 10 feet which occurs over a horizontal distance of 175 ft, what is the slope?

FRAME 43

ANSWER. Class 42.

Depending on how accurately you used the EBCW, the window arrow should have indicated between class 42 and 44. In cases where the arrow fails between classes, you should round down.

FRAME 92

ANSWER. 5.7%

This slope is reportable but not an obstruction.

Give VD = 10'

HD = 175'

Find the slope

$$\text{Slope} = \frac{VD}{HD} \times 100\%$$

$$= \frac{10'}{175'} \times 100\%$$

$$= .057 \times 100\%$$

$$= 5.7\%$$

The slope is reportable but is not considered an obstruction.

FRAME 43a

Now that you have found the initial classification of span 1 using the first timber stringer code, you must reclassify span 1 using the second timber stringer code as if it were steel (use steel stringer spacing and steel span length).

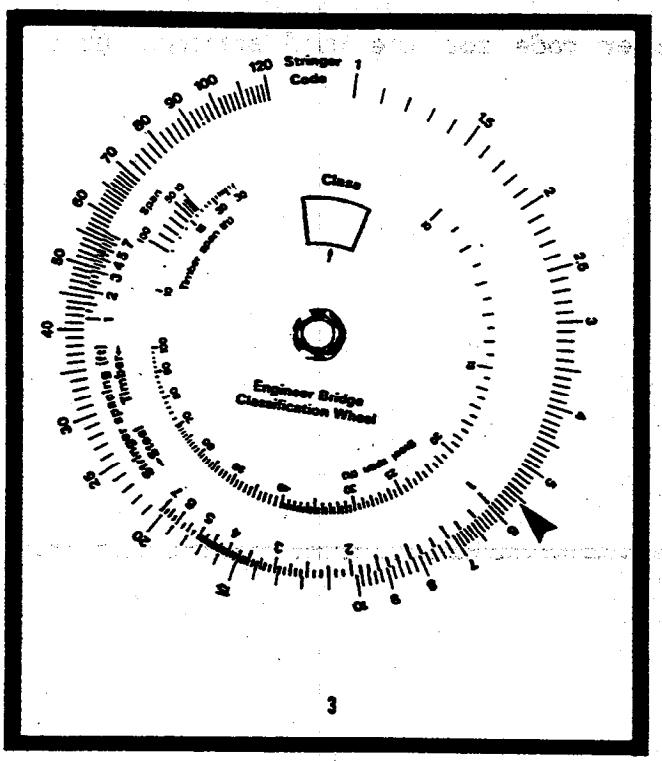
What is the second stringer code for the wood stringer used in this bridge example?

Proceed to FRAME 93.

FRAME 43b

ANSWER. 5.52

Now that you have found the second timber stringer code, you must enter it on the wheel. The figure at left shows page 3 of the EBCW. The stringer code portion is the very outside portion and consists of numbers running from 1 to 120. The heavy black arrow in the figure at the left points to the location of 5.52 on the stringer code portion of the wheel.



Proceed to FRAME 93.

FRAME 43c

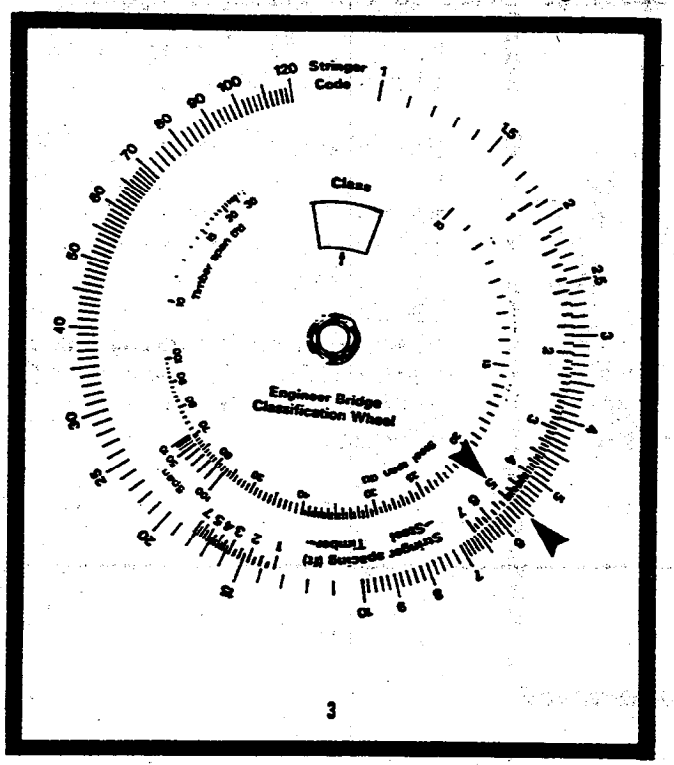
Now that you have located the stringer code on the wheel, we must get the next piece of information. We go into the wheel with the stringer spacing. Refer to the cross section of the bridge of FRAME 36 and determine the stringer spacing. What is the stringer spacing?

Proceed to FRAME 93.

FRAME 43d

ANSWER. 4'10"

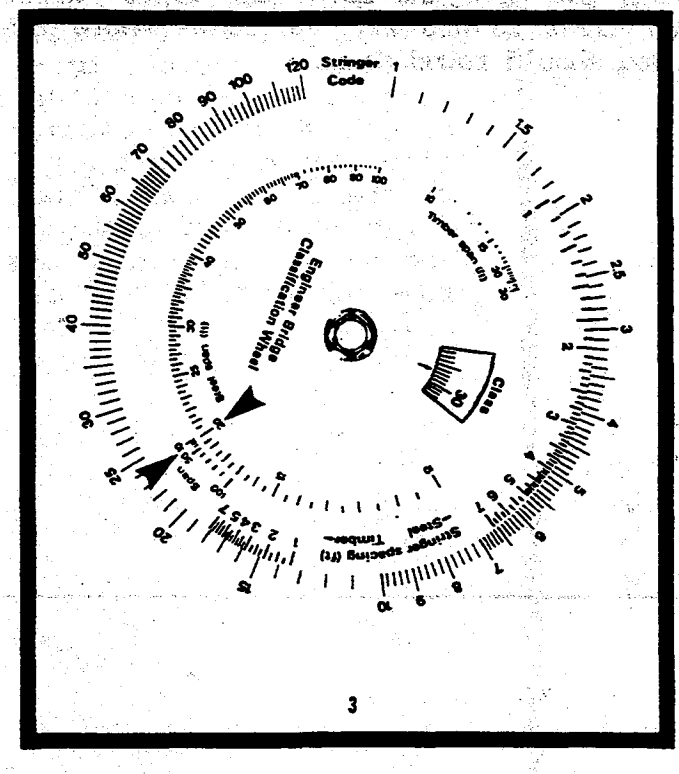
Stringer spacing from FRAME 36 was 58" or 4'10". Locate the 4'10" mark on the outer edge of the larger wheel, and align the 4'10" steel stringer spacing mark with 5.52 stringer code mark as shown by the heavy black arrows in the figure at the left. Secure the large wheel and backing and do not allow them to move in relation to one another.



Proceed to FRAME 93.

FRAME 43e

The span length for span 1 is 20' you must rotate the inner wheel until the 20 foot mark for steel span on the inner wheel lines up with the 20 foot mark on the inside of the outer wheel as shown by the heavy black arrows in the figure at the left.



The classification (using the reclassification method) of span 1 is indicated in the window of the inner circle of the EBCW. What is the classification using the reclassification method of span 1 in this bridge example?

Proceed to FRAME 93.

FRAME 43f

ANSWER. Class 26.

Depending on how accurately you used the EBCW, the window arrow should have indicated between class 26 and 27. In cases where the arrow falls between classes, you should round down.

Proceed to FRAME 93.

FRAME 43g

Now you must compare the two weight classes (42 and 26). The lower of the two classification is the final classification of span 1 for tracked vehicles. What is the final classification of span 1 for tracked vehicles?

Proceed to FRAME 93.

FRAME 43h

ANSWER. Class 26.

Proceed to FRAME 93.

FRAME 43i

Bridges with timber decks must have the deck classified prior to wheeled vehicle crossings. Concrete decks are assumed adequate for both wheeled and tracked vehicles. The EBCW should be used to classify timber decks.

You have the requirement for wheeled vehicles to cross span 1 of this bridge example. The decking is multilayer plank seven (7) inches thick. Refer to page 2 of the EBCW and determine the effective thickness ("t") of the decking of span 1.

Proceed to FRAME 93.

FRAME 43j

ANSWER: "t" effective = 7 inches - 2 inches
"t" effective = 5 inches

Recall that the stringer spacing was 58". Now refer to the graph chart on page 2 of the EBCW and determine the classification of span 1 for wheeled vehicle crossings.

Proceed to FRAME 93.

FRAME 43k

ANSWER. Class 16 (interpolation was required).

Refer to the figure below, the arrows show where to enter the figures and interpolate the answer.

Proceed to FRAME 93.

FRAME 431

The final classification of span 1 for wheeled vehicles is the lower of those determined using all methods.

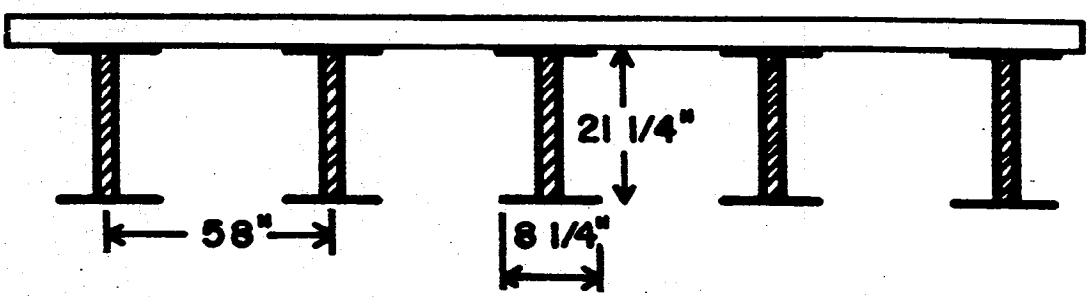
What is the final classification of span 1 for wheeled vehicles?

Proceed to FRAME 93.

FRAME 44

ANSWER. Class 16.

Continuing with the original bridge diagram on page 37, FRAME 36, classify the 50 foot span (span 2) using the bridge cross section provided below. Span 2 has concrete decking and does not require decking classification.



What is the largest tracked vehicle weight class that can cross this bridge example?

What is the largest wheeled vehicle weight class that can cross this bridge example?

FRAME 93

In order to determine slopes, the vertical and horizontal distances must be found. There are several methods by which this can be done.

1. An average man's height is approximately 1.75 meters and his stride is 0.75 meters. To determine the slope, sight on a portion of the slope with eyes level. This gives a vertical distance of 1.75 meters to that spot. Then pace the distance to that spot to find the horizontal distance. This may be repeated as often as necessary on a particular slope depending on the length of the slope.

2. From a map, locate the top and bottom of the slope. Measure the horizontal distance between these two points. The vertical distance is obtained by subtracting the elevation at the base of the slope from the elevation at the top of slope as determined from the contour lines. Then plug the horizontal and vertical distances into the formula for slope. The answer will be the percentage of slope.

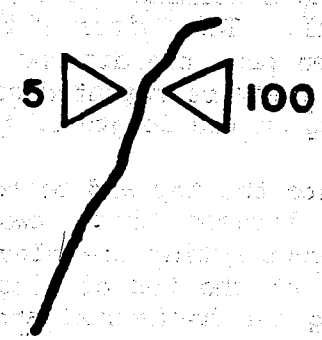
FRAME 45

ANSWERS. 1. Class 22 for span 2.
2. Class 22 for bridge (tracked vehicles).
3. Class 16 for bridge (wheeled vehicles).

If you did not obtain these answers, re-read and re-work the material starting on FRAME 22 through FRAME 45.

FRAME 94

Another item that is found on the route recon overlay is the symbol for a constriction along the route. The sumbol is two triangles, one on each side of the road with the width of the road in meters by the left triangle and the length of the constriction in meters by the right triangle. The triangles point to the area on the road where the constriction is first encountered. See illustration below.



FRAME 46

BRIDGES AND BRIDGE SIGNS

FRAME 95

A portion of the route is considered to be an obstruction if the width of the road does not meet the requirements placed on the route by the commander. Recommended roadway widths are listed below:

	Wheel	Track
One-way	5.5 - 7m	6-8m
Two-way	Over 7m	Over 8m

If the route does not meet this requirement, the constriction symbol is used to show the actual width and length of the constructions.

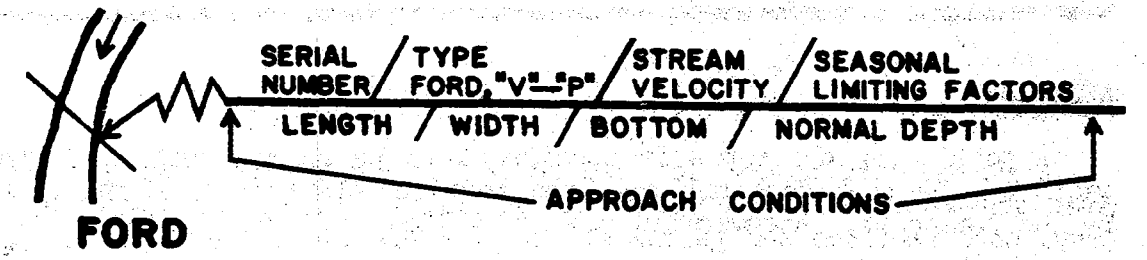
FRAME 47

A system of bridge classification has been adopted by NATO. This system of classification permits an unlimited number of crossings by rated vehicles and ensures the bridge can withstand these crossings.

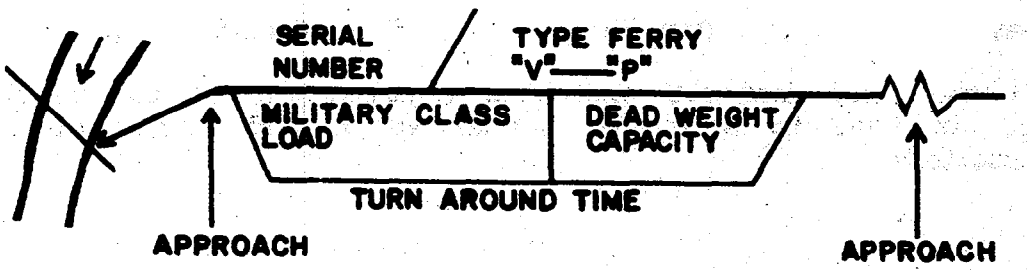
According to the adopted NATO system of bridge classification, bridges are classified according to their capability to safely withstand a limited number of crossings by a rated class vehicle because of the nature of combat operations (True or False).

FRAME 96

Ferries and fords are also considered as obstructions. When a ferry or ford is encountered an appropriate symbol is used to indicate the conditions of the ferry or ford as shown below.



FORD



FERRY

Symbols are explained on pages 3-20 and 3-27 of FM 5-36.

FRAME 48

ANSWER. False

If you did not get the correct answer, re-read the first paragraph in FRAME 46.

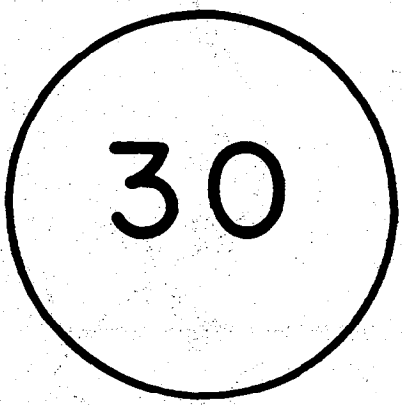
The bridge classification number is the complement of the vehicle classification number. Any classified vehicle with a number equal to or less than the classification number for a bridge can safely cross that bridge.

FRAME 97

Draw the ford symbol for the following conditions. As you look down stream, the left approach is difficult, the right approach is easy, both vehicles and personnel can use the ford, the depth is 0.7 meters and velocity is 2 meters/sec. the bottom is rock, the stream is 20 meters long and the difficult approach is 4 meters wide. There are no seasonal limiting factors.

FRAME 49

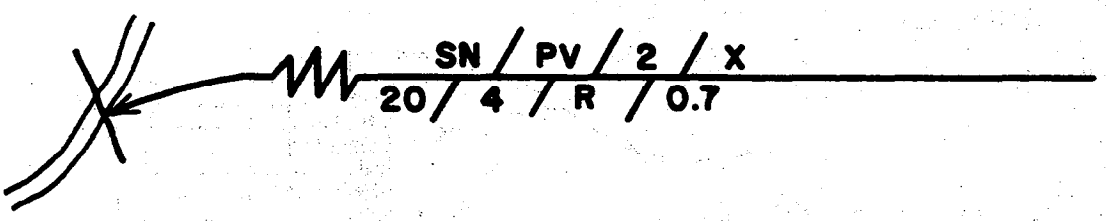
The bridge classification sign for a single lane bridge is shown below. All bridge classification signs are posted at each end of the bridge in a conspicuous place so that they can be seen by all approaching vehicles. The bridge sign below indicates a one lane bridge that any vehicle, track or wheel, of class 30 or below can safely cross.



GO TO FRAME 50 ON PAGE 2

FRAME 98

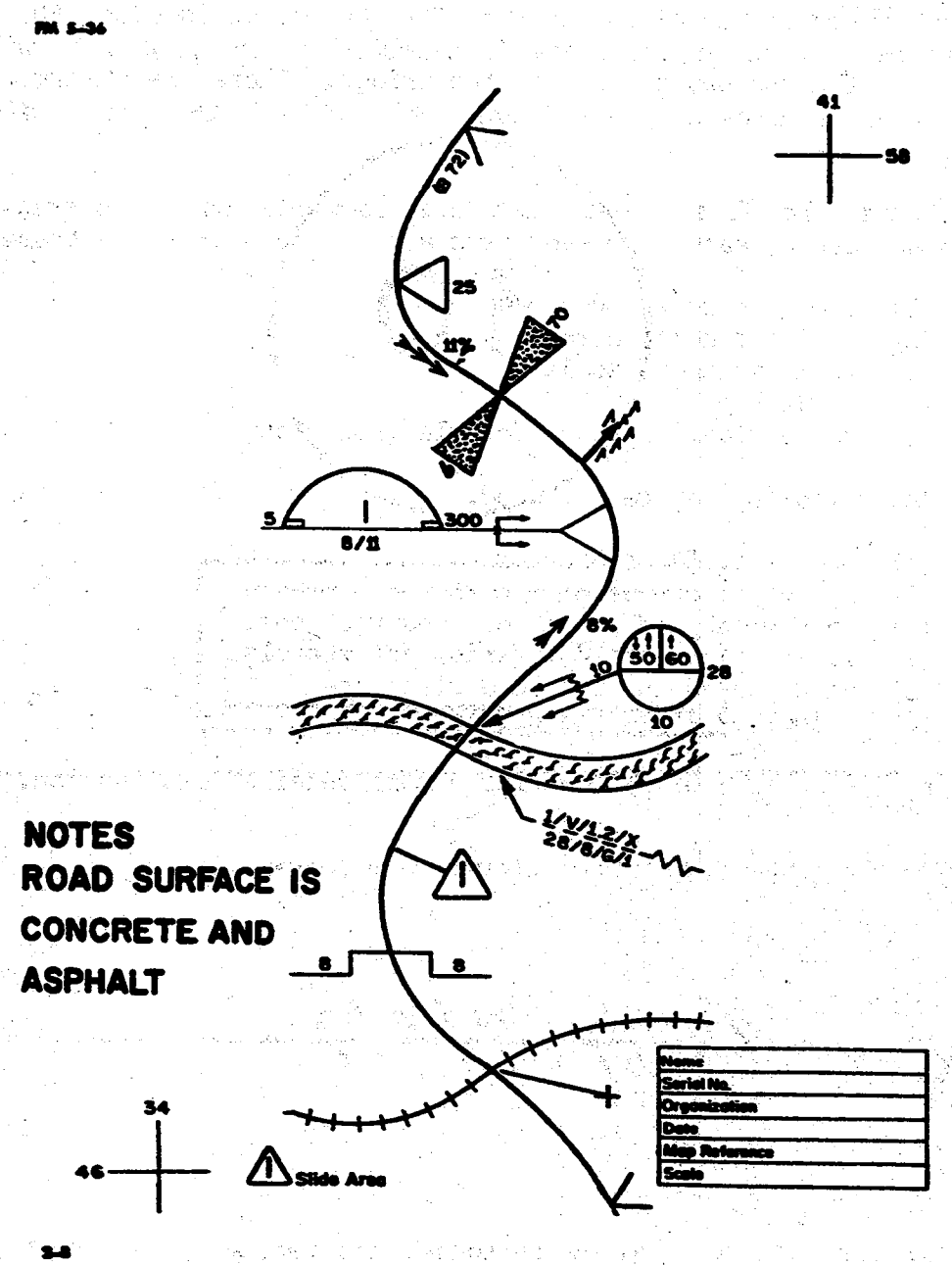
ANSWER. Your ford symbol should have looked like this.



The ford can be used by personnel and vehicles, it is .7 meters deep and has no seasonal limitations, the ford is 20 meters long and 4 meters wide, it has a rock bottom and the stream flows at 2 meters/ sec.

FRAME 99

A complete route reconnaissance overlay is shown below with symbols indicating slopes, curves, fords, and bridges. What is the formula for the route shown below?



FRAME 100

ANSWER. 6m/x/50/8/OB

The width restriction is located at the 70 meter long constriction that is 6 meters wide. The route is all weather (X) as found in the notes. The two-way classification for the bridge is class 50. If the commander wishes to use class 60 vehicles on the route, he will have to block the two-way traffic on the bridge. There are obstructions on the route such as slopes - 8 and 11%, curves - 25 meter radius, and fords.

There are five items that are required on an overlay of a reconnaissance, each of these items are on the overlay in frame 99.

(1) two grid references
(2) magnetic north arrow
(3) route drawn to scale
(4) title block
(5) route classification formula (not shown)

The following may be included:

(1) slopes of 5% or greater.
(2) radius of curves 45 meters.
(3) road width and length of constrictions.
(4) location of ferries, fords, and tunnels.
(5) underpasses and overhead clearance.
(6) bridge bypasses and bridges.

Refer to Chapter 3 of FM 5-36 for a more detailed explanation.

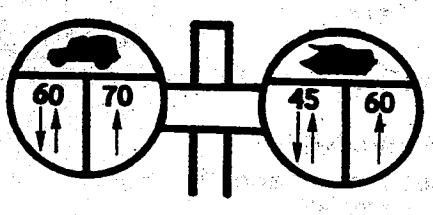
FRAME 101 (cont)

This test is designed to test your knowledge on the vehicle-bridge classification system.

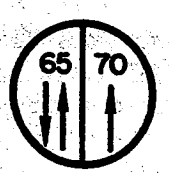
a. The vehicle class number is a whole number which represents the _____ of the vehicle on a bridge while crossing it.

b. What is the nonstandard combination classification of a class 15 vehicle towing another class 15 vehicle at a distance of 10 feet?

c. Your company is convoying to its assembly area. The largest wheeled vehicle is class 51 and the largest tracked vehicle is class 50. Can you cross the bridge whose sign is posted below? What special precautions, if any, must you take?



d. What is the largest tracked vehicle that can cross a bridge whose sign is posted below? (Normal crossing)



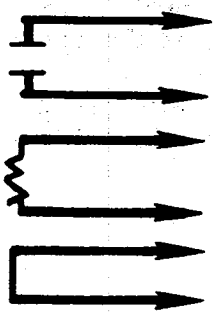
e. Normal crossings may be made when the vehicle class number is _____ to or _____ than the bridge classification number.

f. Who may authorize a caution or risk crossing?

g. What is the caution crossing classification of the bridge whose sign is posted below?

FRAME 101

h. Match the bypass symbol with it meaning.

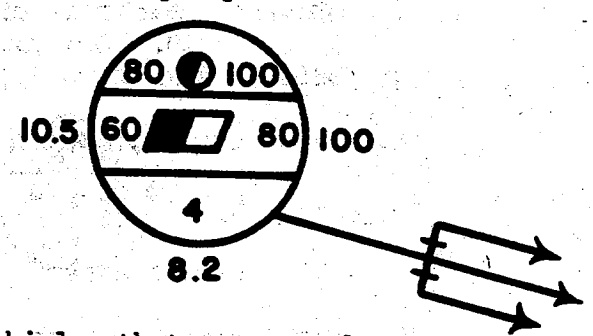


(1) bypass easy

(2) bypass impossible

(3) bypass difficult

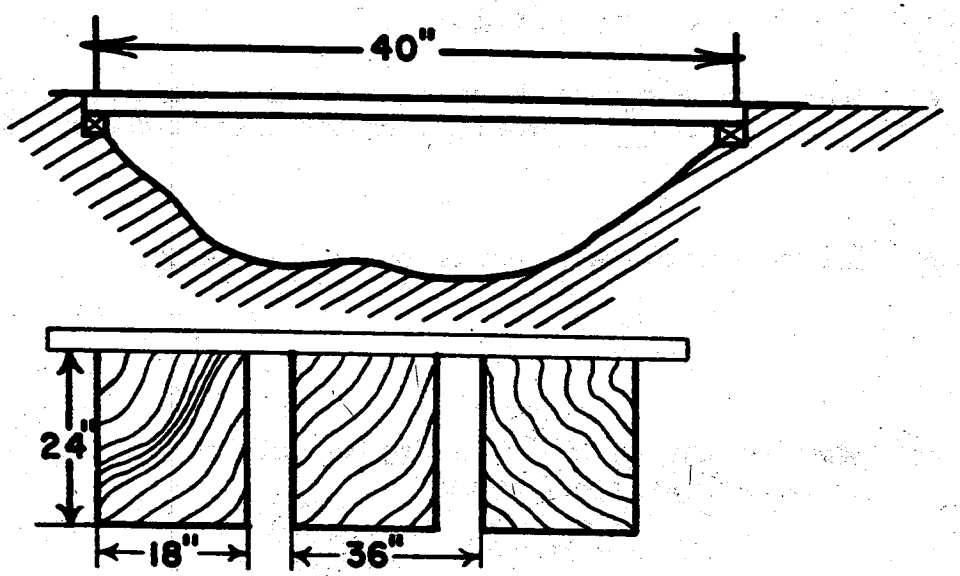
Answer questions "i" and "j" with regard to the bridge symbol below.



i. What is the overhead clearance?

j. What is the largest tracked vehicle that can conduct a caution crossing over this bridge?

k. You have encountered an unclassified bridge of the specifications below. Can your M1 tank cross it. What is the largest vehicle weight class that can cross it?



FRAME 102

ANSWERS.

a. effects

b. 27

c. yes, one way traffic for tank

d. 70

e. equal, less

f. highest tactical commander using the bridge

g. 100

h. (1) bypass impossible

(2) bypass difficult

(3) bypass easy

i. 10.5 meters

j. 100

k. No, class 11

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