U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – GROUND VEHICLE SYSTEMS CENTER

Military Load Classification

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OUTLINE

- What is Military Load Classification?
- International Documents
- Bridge MLC Testing Overview
- Vehicle MLC Calculation Procedure
- Summary

WHAT IS A MILITARY LOAD CLASSIFICATION (MLC)?

- **Definition: A number representative of the load carrying capacity of gap-crossing equipment (e.g. bridges, rafts) and the effect produced by a military vehicle crossing over a bridge**
  - MLC = f(vehicle weight, vehicle geometry (e.g. length, width))

- **Purpose: Used to assess the capability of a military vehicle to use gap-crossing equipment without damaging it**
  - Enables User to determine required gap-crossing equipment to support a particular mission
  - Helps to improve safe use of bridges and other gap-crossing equipment

- **MLC of military vehicle, bridge marked in accordance with NATO Standard AEP-3.12.1.5**

INTERNATIONAL DOCUMENTS

- **CCDC GVSC Bridging is involved in the working groups for the following documents:**
  - NATO STANAG 2021 (Standard AEP-3.12.1.5)
  - Trilateral Design and Test Code for Military Bridging and Gap Crossing Equipment (TDTC)

NATO STANDARD AEP-3.12.1.5

- **NATO Standard establishing method for calculating the Military Load Classification (MLC) for bridges, military ferries and rafts, and military vehicles.**
  - Mandates use of reference software, under the responsibility of national official authorities, as the only means to determine vehicle's official MLC
    - GVSC Bridging is national authority for the United States

- **Establishes hypothetical tracked and wheeled vehicles**
  - 16 standard tracked and 16 standard wheeled MLCs between MLC 4 and MLC 150 inclusive
  - Hypothetical vehicle characteristics for MLCs between these standard values may be calculated through linear interpolation

Official NATO Standard AEP-3.12.1.5 Statement on MLC/ Vehicle Weight Relationship

THE MILITARY LOAD CLASSIFICATION NUMBER IS ONLY A NUMBER, IT DOES NOT REPRESENT THE MASS OF THE VEHICLE

HYPOTHETICAL VEHICLES

- 32 total (16 tracked, 16 wheeled)
- Establishes standard tracked, wheeled classes for use in military bridge design, testing
- Also used for width correction for vehicle MLC calculation
- All hypothetical vehicle widths measured from outside to outside (e.g. outside tire to outside tire)

HYPOTHETICAL VEHICLES (FROM APPENDIX C, TDTC)

SI Units (note: tonnes = metric tons)

MLC	Tracked Vehicles	Wheeled Vehicles				
		Axle Load [Tonnes] and Spacing [m]	Maximum Single Axle Load	Tire Load and Nominal Ground Contact Width [m]	Axle Load and nominal Ground Contact Length [m]	Axle Wheel Spacing and nominal Ground Contact Width [m][1]
150	136.08 Tonnes; 7.32; 4.67; 1.27	154.22 Tonnes; 19.96, 38.10, 38.10, 29.03, 29.03; 3.66, 2.13, 6.71, 1.83	38.10 Tonnes	9.52 Tonnes; 0.50	38.10 Tonnes; 0.40	1.00; 3.48

US Customary Units

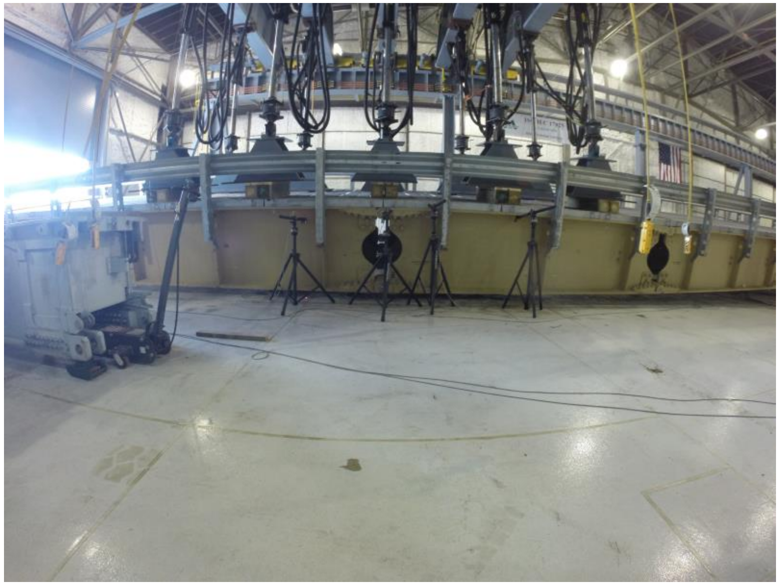
MLC	Tracked Vehicles	Wheeled Vehicles				
		Axle Load [short tons] and Spacing [ft]	Maximum Single Axle Load	Tire Load and nominal Ground Contact Width [in]	Axle Load and nominal Ground Contact Length [in]	Axle Wheel Spacing and nominal Ground Contact Width [in][1]
150	150.00 Tons; 24′; 184″; 50″	170.00 Tons; 22.00, 42.00, 42.00, 32.00, 32.00; 12′, 7′, 22′, 6′	42.00 Tonnes	10.50 Tons; 20″	42.00 Tons; 16″	39″; 137″

TRILATERAL DESIGN AND TEST CODE FOR MILITARY BRIDGING AND GAP CROSSING EQUIPMENT (TDTC)

- Primary design and test guide for military bridging
- Managed in cooperation with the United Kingdom and Germany
- Provides loading conditions (e.g. mud load, vehicle crossing speeds, bank bearing pressures) which must be considered when designing for a particular MLC
- Provides methodology followed by Army for testing of military bridges at a particular MLC

BRIDGE MLC TEST OVERVIEW

- TDTC provides general test procedure, parameters, evaluation criteria
- Requires at least two bridges to complete full test program
- Two Steps:
  - Step 1: Bridge Rating Qualification (Structural Strength)
    - Two required tests
      - Working Load (equal to bridge design load)
      - Overload (1.33 x Working Load)
    - Ultimate Load (1.5 x Working Load) performed if necessary
    - Hypothetical vehicle footprints used for load application



BRIDGE MLC TEST OVERVIEW

– Step 2: Bridge Rating Confirmation (Durability)
  - Consists of live, simulated crossings
  - 3 parts
    – Test to required number of crossings (n) per requirements document
    – Continue test to 1.5n
    – Continue test to achieve 95% confidence of 95% exceedance
      » n multiplied by factor based off of number of samples to determine # crossings
  - Test to fatigue failure may be performed after 95% confidence of 95% exceedance achieved

INFORMATION REQUIRED FOR MLC CALCULATION

Vehicle Weight (tons)	Length of Track in Contact with Ground (in)	Vehicle Width (in)	**Location of Vehicle Width Measurement** (fill out only if Vehicle Width was not measured from Outside Track to Outside Track)

Tracked Vehicle

Number of Axles				
Vehicle Width (in)				
Location of Vehicle Width Measurement (fill out only if Vehicle Width was not measured from Outside Tire to Outside Tire)				
Axle	**Axle Load (tons)**	**Distance from Axle 1 (in)**	**Axle Spacing (in)**	**Tire Footprint Length (in)***
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Wheeled Vehicle

MLC CALCULATION PROCEDURE PER NATO STANDARD AEP-3.12.1.5

1. Calculate maximum unit bending moment and shear force produced by vehicle at reference spans (1-100 m)
   – Unit Bending Moment = Max Moment/ span

2. Determine Rough MLC through Linear Interpolation between hypothetical vehicle bending moment, shear force curves at the point which gives the highest MLC

MLC CALCULATION PROCEDURE CONT.

Figure 5 : unit bending moments of tracked vehicles (spans 1 to 100 m)

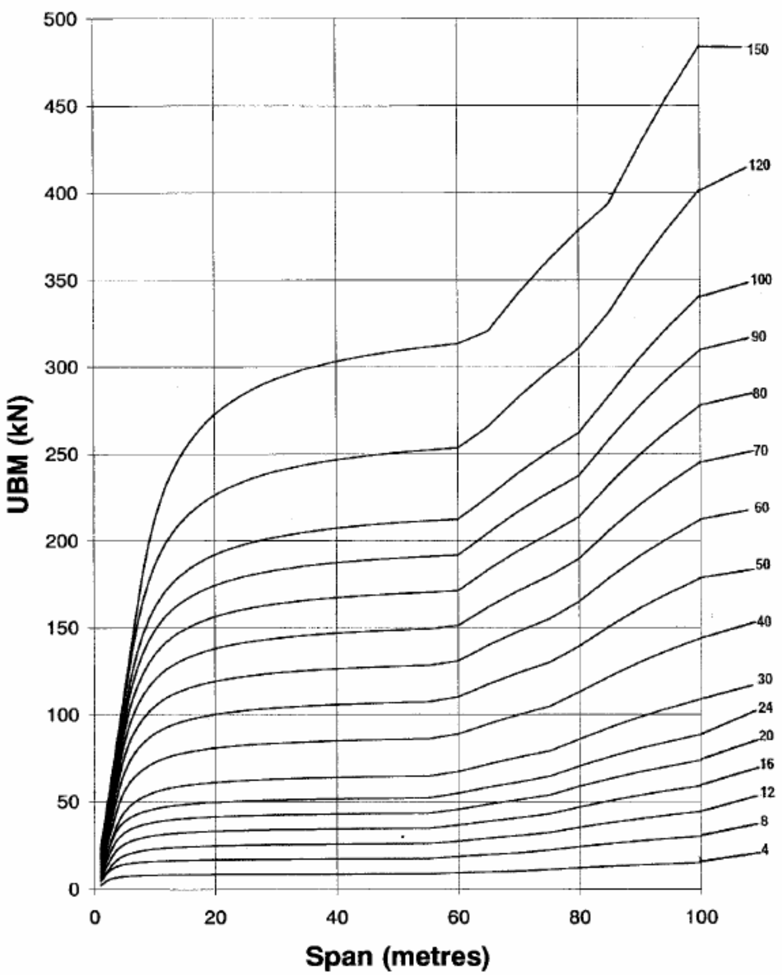
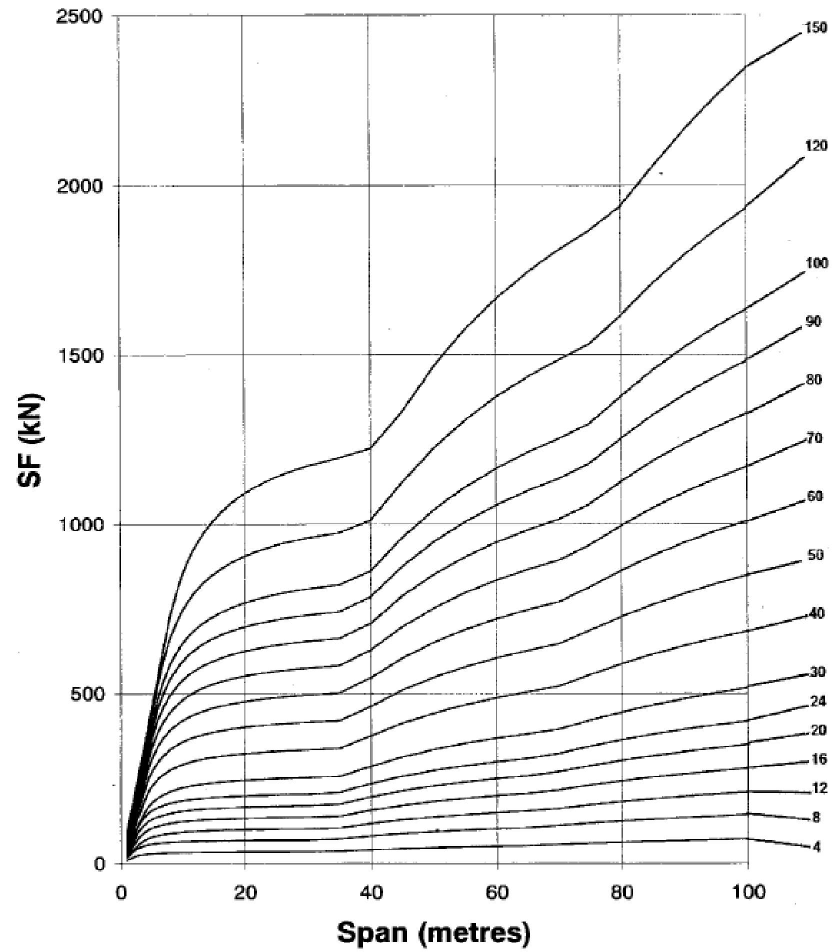


Figure 7 : shear forces of tracked vehicles (spans 1 to 100 m)



MLC CALCULATION PROCEDURE CONT.

Figure 1 : unit bending moments of wheeled vehicles (spans 1 to 100 m)

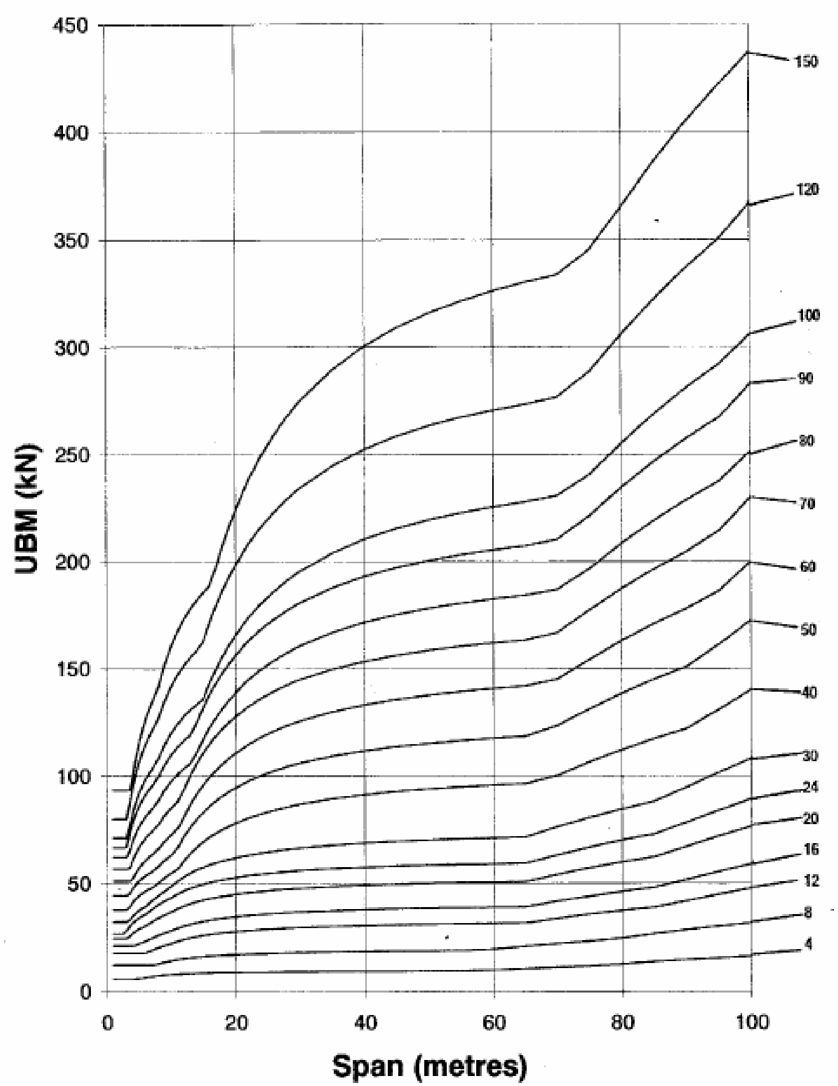
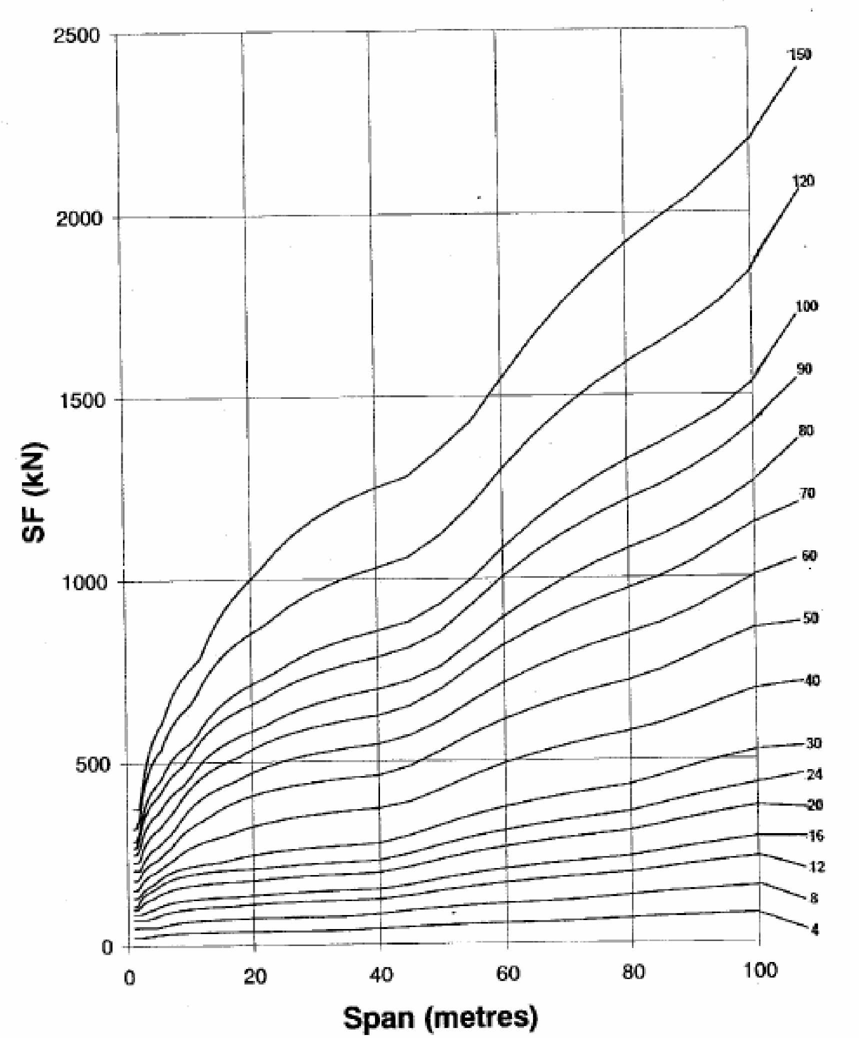


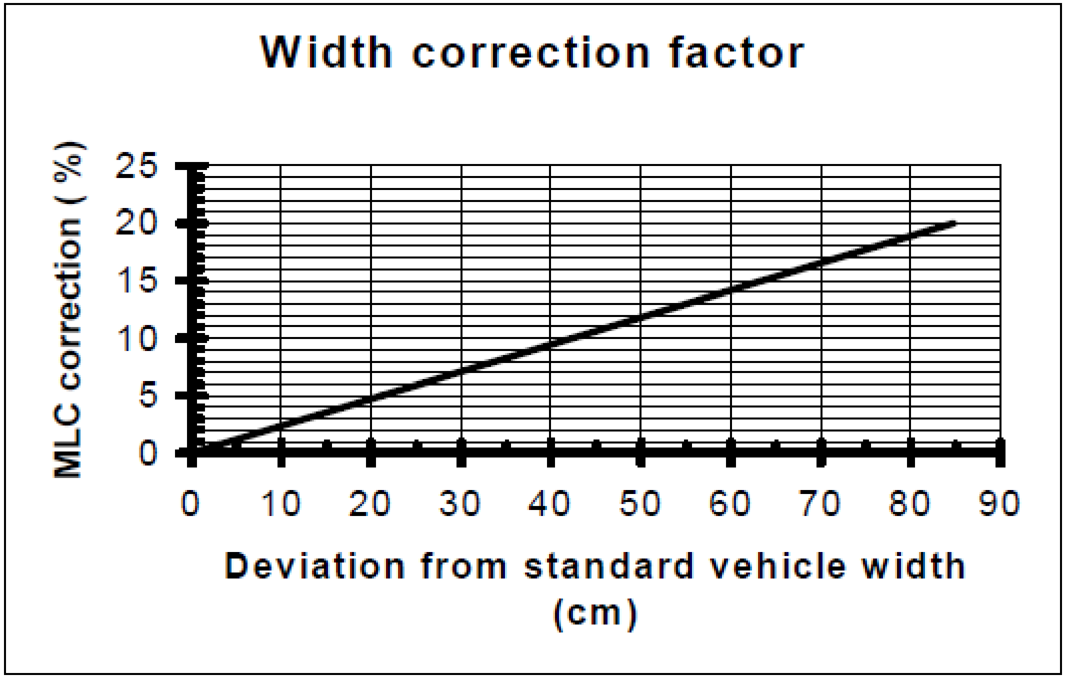
Figure 3 : shear forces of wheeled vehicles (spans 1 to 100 m)



MLC CALCULATION PROCEDURE CONT.

3. Compare the actual vehicle's width with the width of the hypothetical vehicle whose MLC is closest to the Rough MLC and apply a width correction factor, if necessary

– Width correction factor applied if Actual Vehicle is narrower than hypothetical vehicle



Slope of line = 6/25.4 (6% per 25.4 cm width)

4. Round calculated MLC from Step 3 to the nearest whole number to obtain final MLC

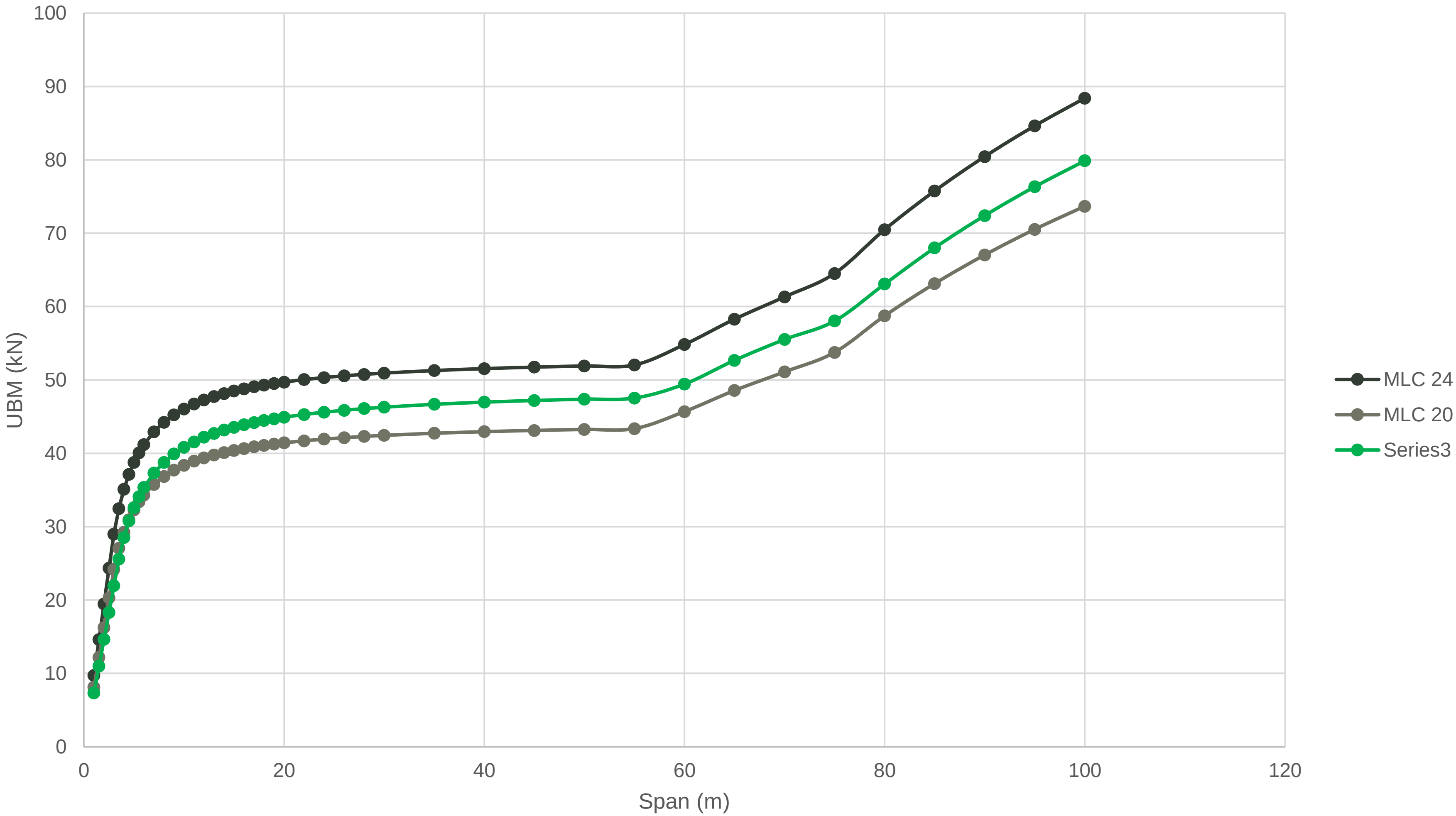
MLC CALCULATION PROCEDURE SUMMARY

1. **Calculate maximum unit bending moment and shear force produced by vehicle at reference spans (1-100m)**
2. **Determine Rough MLC through linear interpolation between hypothetical vehicle bending moment and shear force curves at the point which gives the highest MLC.**
3. **Perform width comparison between the actual vehicle and hypothetical vehicle with MLC closest to the rough MLC and apply a width correction factor, if necessary**
4. **Round calculated MLC from Step 3 to the nearest whole number to obtain the final MLC**

EXAMPLE

Calculate the final MLC for the vehicle whose bending moment curve is represented by the green line.

-Vehicle Weight = 20 tonnes, Width = 2.3 m, Contact Length = 3.35 m



EXAMPLE CONT.

1) Calculate the rough MLC at each span location through linear interpolation

EX:

<u>At 60 m</u>

UBM for MLC 20 Hypothetical Tracked Vehicle = 45.69 kN

UBM for MLC 24 Hypothetical Tracked Vehicle = 54.83 kN

UBM for Actual Vehicle = 49.45 kN

$$\frac{54.83-45.69}{24-20}=\frac{49.45-45.69}{MLC-20}$$

$$(54.83-45.69)(MLC-20)=(49.54-45.69)(24-20)$$

$$MLC\approx 21.6$$

For the vehicle in this example, maximum rough MLC = 21.92

EXAMPLE CONT.

2) Compare vehicle width with width of hypothetical vehicle representative of the rough MLC and calculate Width Correction Factor, if necessary

- **MLC 22 Tracked Vehicle Width = 2.49 m > 2.3m**

→ Width Correction Required

$$WidthCorrection = 1 + [\frac{6\%}{25.4cm} * (\frac{100cm}{1m} * (2.49m - 2.3m)) * \frac{1}{100\%}]$$

$$WidthCorrection = 1.0449$$

3) Calculate Final MLC

$$MLC = MaximumRoughMLC * WidthCorrection$$

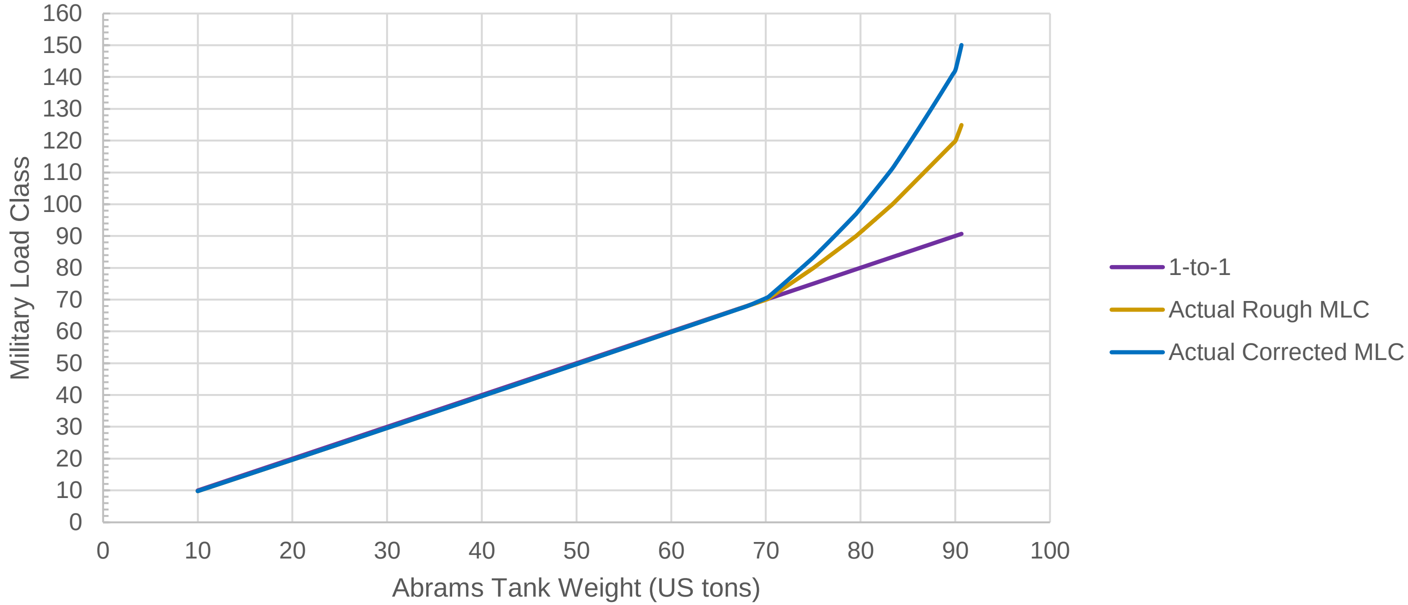
$$MLC = 21.92 * 1.0449$$

$$MLC = 22.9$$

$$MLC \approx 23$$

Vehicle's MLC = 23

EXAMPLE: ABRAMS MLC/ VEHICLE WEIGHT RELATIONSHIP

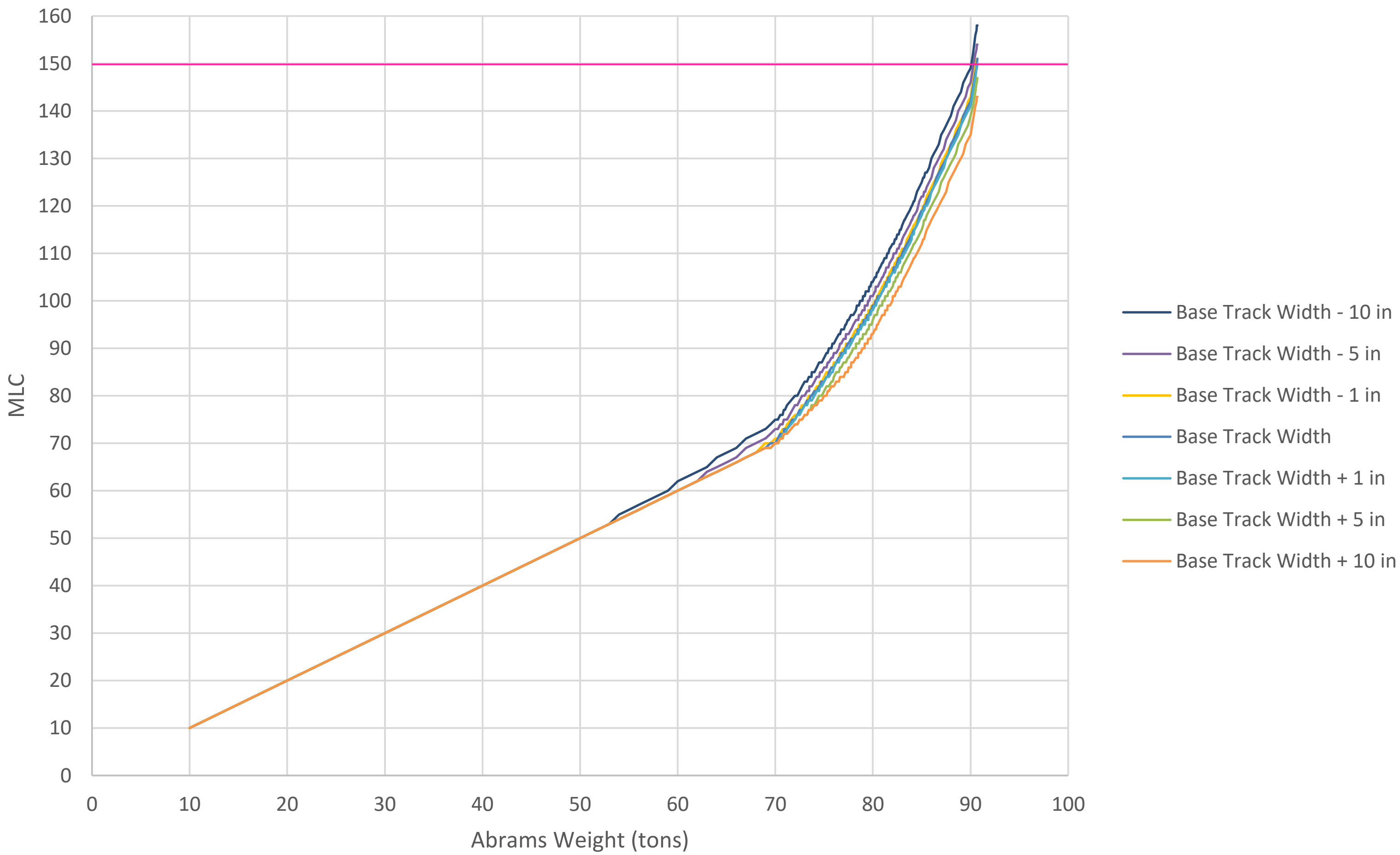


Up to 70 tons: Abrams MLC = Abrams Weight

Beyond 70 tons: Abrams MLC ≠ Abrams Weight -> Non-Linear Increase

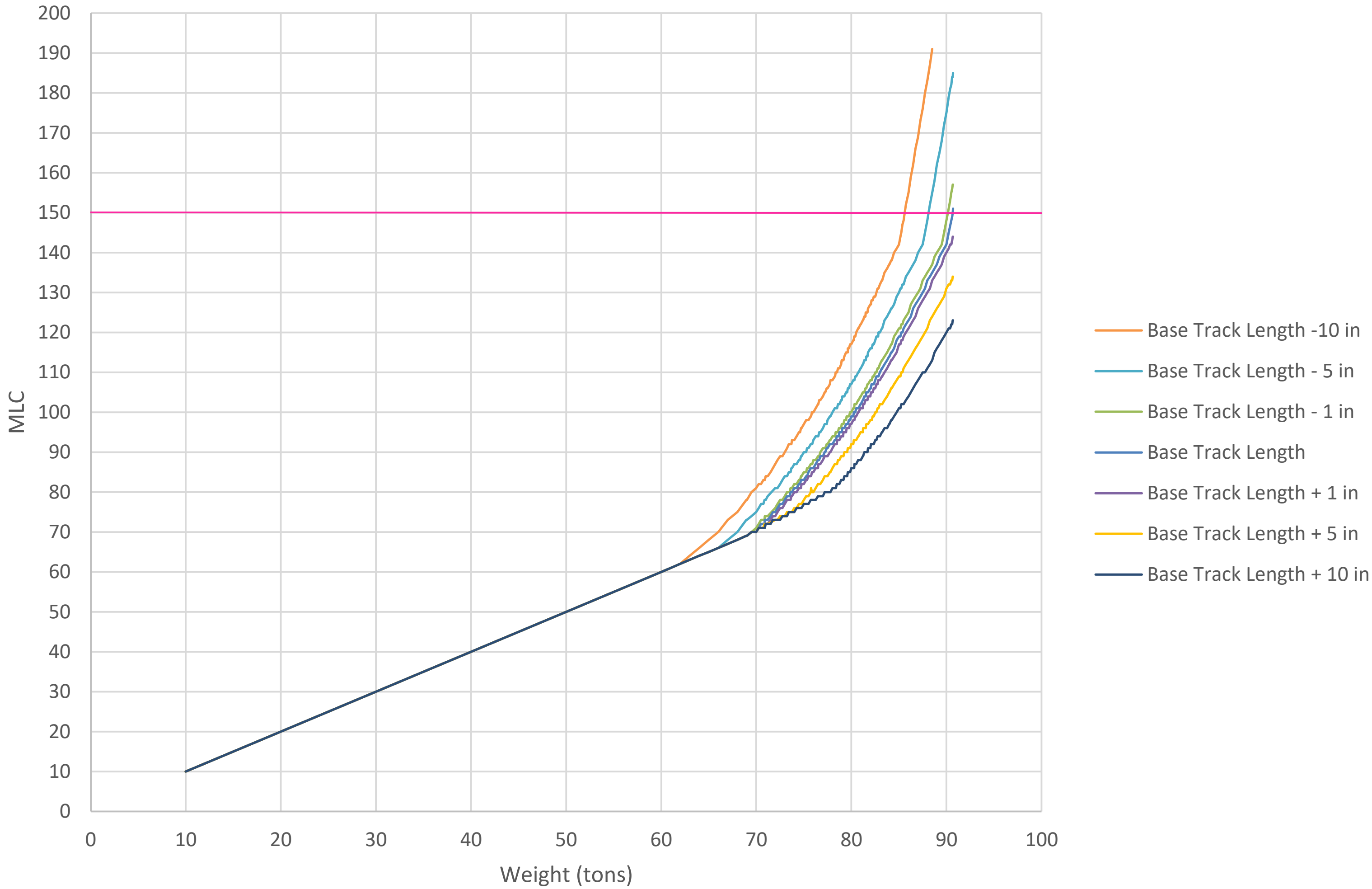
Abrams Weight (US tons)	Final Abrams MLC
70.25	71
71	73
75	83
80	99

EXAMPLE CONT.



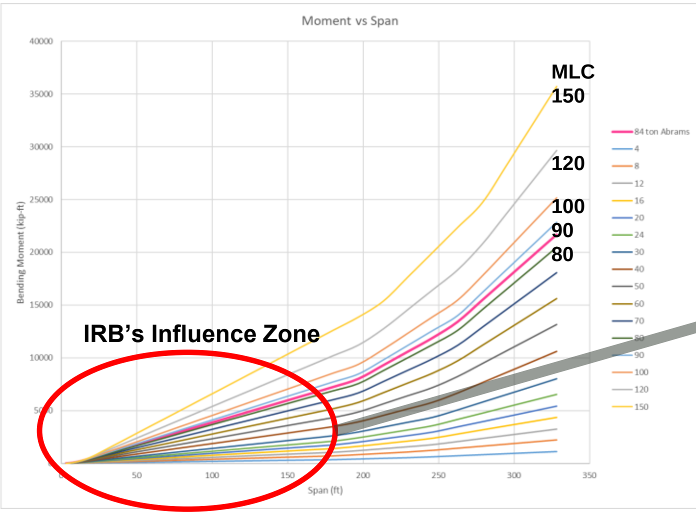
Changing vehicle width results in changes to vehicle's MLC

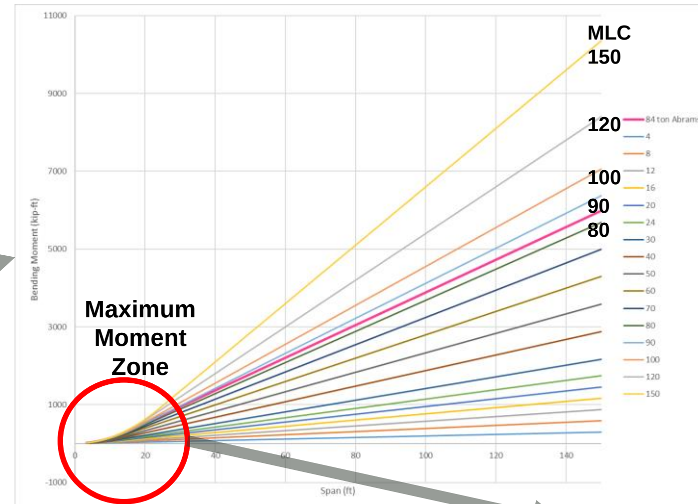
EXAMPLE CONT.

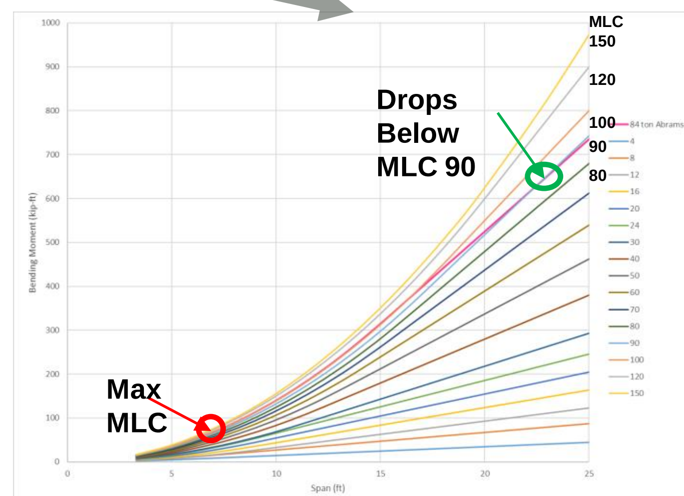


Vehicle length changes have more significant effect on vehicle MLC

EXAMPLE: M1A2 SEPv3 @ MLC 114 Bending Moment Plots







- 84 ton SEPv3 bending moment tracks between MLC 100, MLC 120 at spans up to 16 feet
  - Max MLC before width correction = 101
- 84 ton SEPv3 bending moment tracks between MLC 80, MLC 90 at spans greater than 23 feet
  - At 148 ft (45 m), MLC before width correction = 84
  - At 328 ft (100 m), MLC before width correction = 85

SUMMARY

- **MLC Calculation Method established by NATO Standard AEP-3.12.1.5**
- **MLC does NOT equal vehicle weight**
  - Vehicle geometry also factors into the calculation

Calculation of a vehicle's Military Load Classification is dependent not only on vehicle weight, but also on vehicle geometry.

Backup

WHEELED EXAMPLE 1 – SMALL WHEEL CALCULATION

- Maxx Pro Dash w/ Spark II Roller
  - Total Load = 29.5 tons
- No width correction applied – Vehicle is wider than hypothetical MLC 32 wheeled vehicle

Vehicle Type

Tracked Vehicle | Small Wheels (selected) | Large Wheels | Hybrid

Nationality	United States
National Code	
NATO Code	
Vehicle Name	Maxx Pro Dash w/ Spark II Roller
Vehicle Information	

Computing Versions associated to the vehicle

Version	Computing Version	Version Code
GVW	GVW	

New Version | New Computing Version

Characteristics

Axles Number	3
Width(inch)	117.992
Total Load(US Tons)	29.500

Axle	Load(US tons)	Inter-Axles Distance...
1	4.000	144.015
2	10.500	145.000
3	15.000	0.000

Version Information

Computing Version Information

MLC Computing | Save

MLC Computing Results

MLC : 32

Rough MLC : 32.017

The class is determined by the component UBM for a span of 1.000 m

Corrected MLC : 32.017

Complementary Values of MLC Computing

Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	33.373620	32.017	133.494480	32.017
1.500	33.373620	32.017	133.494480	32.017
2.000	33.373620	32.017	133.494480	28.746
2.500	33.373620	32.017	133.494480	23.794
3.000	33.373620	32.017	133.494480	22.442
3.500	33.373620	29.996	133.494480	21.559
4.000	33.373620	26.656	140.900086	22.246
4.500	33.373620	24.232	150.460145	23.039
5.000	33.373620	23.283	158.108192	23.249
5.500	33.373620	22.639	164.365685	23.407
6.000	33.373620	22.121	169.580262	23.529
7.000	34.815063	21.679	177.774599	23.706
8.000	37.263818	21.998	186.854559	24.496
9.000	39.225937	22.256	195.263958	25.681
10.000	40.831877	22.301	201.991476	26.576
11.000	42.169793	22.150	207.495810	27.277
12.000	43.301197	22.040	212.082754	27.840
13.000	44.412858	22.036	215.964015	28.302
14.000	45.791704	22.265	219.290810	28.688
15.000	47.003753	22.466	222.174032	28.904
16.000	48.077283	22.643	224.696851	28.558
17.000	49.034581	22.802	226.922869	28.318
18.000	49.893436	22.944	228.901551	28.142
19.000	50.668205	23.072	230.671950	28.008
20.000	51.370600	23.187	232.265310	27.902
22.000	52.595218	23.389	235.017477	27.688
24.000	53.626752	23.558	237.310949	27.455
26.000	54.507413	23.703	239.251579	27.268
28.000	55.267973	23.827	240.914977	27.113
30.000	55.931388	23.936	242.356588	26.983
35.000	57.270092	24.174	245.239810	26.735
40.000	58.284510	24.355	254.608926	27.239

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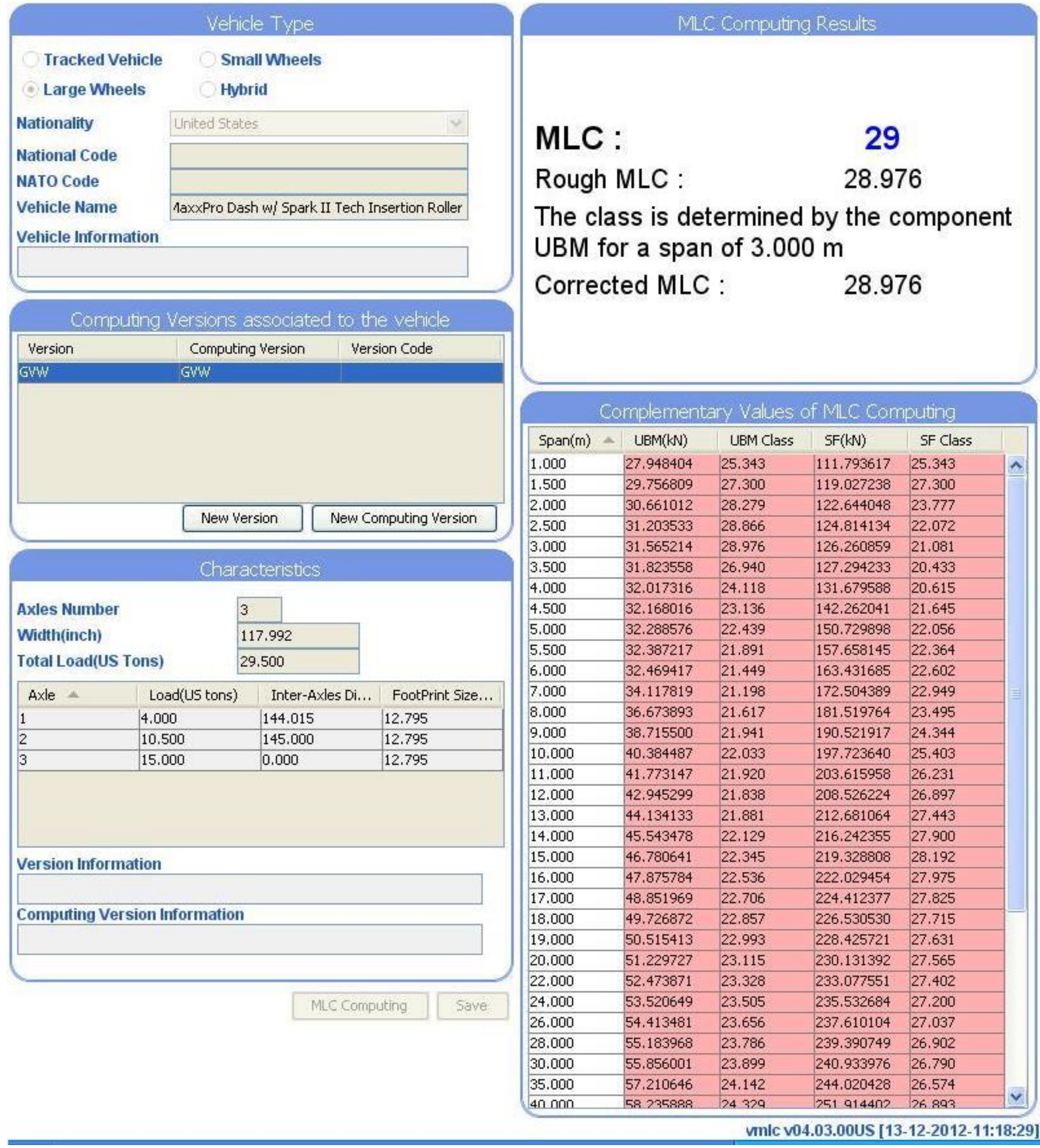
WHEELED EXAMPLE 2 – LARGE WHEEL CALCULATION

- Same vehicle as in Wheeled Example 1 – No changes to axle loads or spacing
- Additional Parameter added for calculation = Footprint Size (length of tire footprint)


Vehicle Type

Tracked Vehicle
Small Wheels
Large Wheels
Hybrid

Nationality: United States
National Code:
NATO Code:
Vehicle Name: MaxxPro Dash w/ Spark II Tech Insertion Roller
Vehicle Information:

Computing Versions associated to the vehicle

Version	Computing Version	Version Code
GVW	GVW	

New Version
New Computing Version

Characteristics

Axles Number: 3
Width(inch): 117.992
Total Load(US Tons): 29.500

Axle	Load(US tons)	Inter-Axles Di...	FootPrint Size...
1	4.000	144.015	12.795
2	10.500	145.000	12.795
3	15.000	0.000	12.795

Version Information:
Computing Version Information:

MLC Computing
Save

MLC Computing Results

MLC : 29
Rough MLC : 28.976
The class is determined by the component UBM for a span of 3.000 m
Corrected MLC : 28.976

Complementary Values of MLC Computing

Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	27.948404	25.343	111.793617	25.343
1.500	29.756809	27.300	119.027238	27.300
2.000	30.661012	28.279	122.644048	23.777
2.500	31.203533	28.866	124.814134	22.072
3.000	31.565214	28.976	126.260859	21.081
3.500	31.823558	26.940	127.294233	20.433
4.000	32.017316	24.118	131.679588	20.615
4.500	32.168016	23.136	142.262041	21.645
5.000	32.288576	22.439	150.729898	22.056
5.500	32.387217	21.891	157.658145	22.364
6.000	32.469417	21.449	163.431685	22.602
7.000	34.117819	21.198	172.504389	22.949
8.000	36.673893	21.617	181.519764	23.495
9.000	38.715500	21.941	190.521917	24.344
10.000	40.384487	22.033	197.723640	25.403
11.000	41.773147	21.920	203.615958	26.231
12.000	42.945299	21.838	208.526224	26.897
13.000	44.134133	21.881	212.681064	27.443
14.000	45.543478	22.129	216.242355	27.900
15.000	46.780641	22.345	219.328808	28.192
16.000	47.875784	22.536	222.029454	27.975
17.000	48.851969	22.706	224.412377	27.825
18.000	49.726872	22.857	226.530530	27.715
19.000	50.515413	22.993	228.425721	27.631
20.000	51.229727	23.115	230.131392	27.565
22.000	52.473871	23.328	233.077551	27.402
24.000	53.520649	23.505	235.532684	27.200
26.000	54.413481	23.656	237.610104	27.037
28.000	55.183968	23.786	239.390749	26.902
30.000	55.856001	23.899	240.933976	26.790
35.000	57.210646	24.142	244.020428	26.574
40.000	58.235888	24.329	251.914402	26.893

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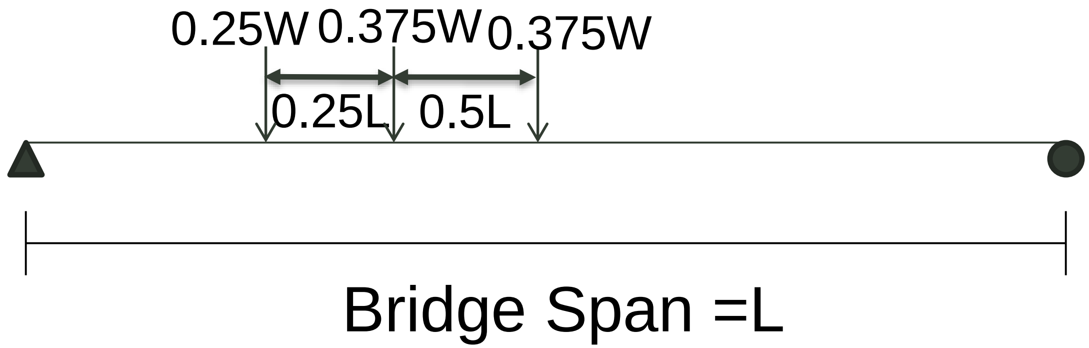
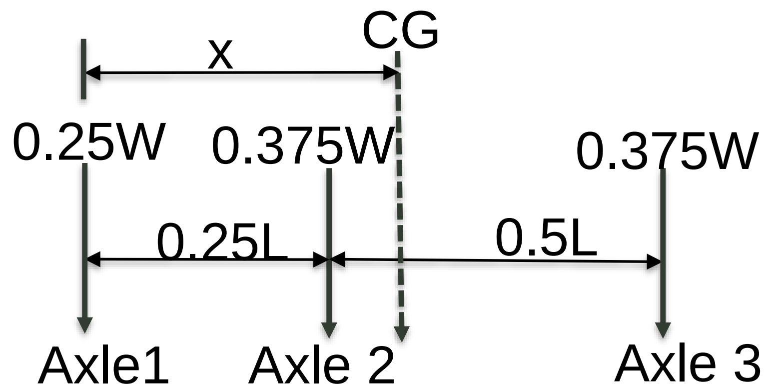
EXAMPLE: MAX MOMENT CALCULATION FOR WHEELED VEHICLE



Step 1: Determine Location of CG (CG = total weight of vehicle)



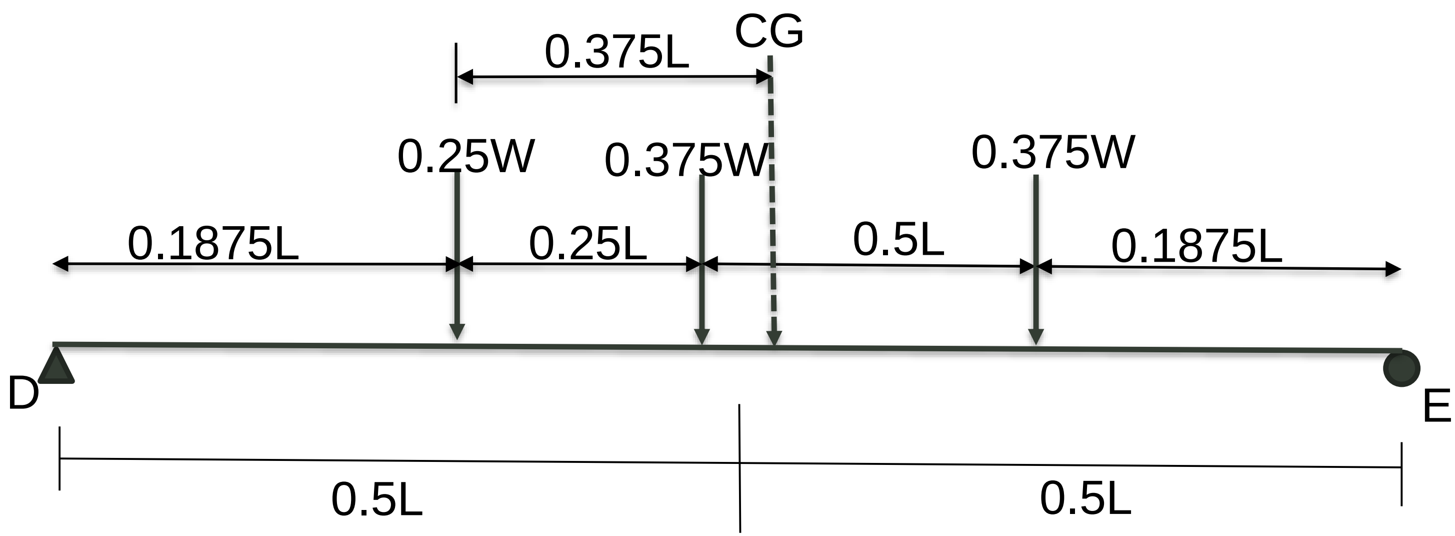
$$CGx = 0.375W * 0.25L + 0.375L * (0.25 + 0.5)L$$

$$x = \frac{1}{CG}(0.375W * 0.25L + 0.375L * (0.25 + 0.5)L)$$

$$x = 0.375L$$

EXAMPLE: MAX MOMENT CALCULATION FOR WHEELED VEHICLE

Step 2: Place vehicle on span so that CG and axle closest to it are equidistant from the center of the span



Step 3: Calculate Reaction at D and E

Moment Balance About D

$$EL = 0.25W * 0.1875L + 0.375W * 0.4375L + 0.375W * 0.9375L$$

$$E = 0.5625W$$

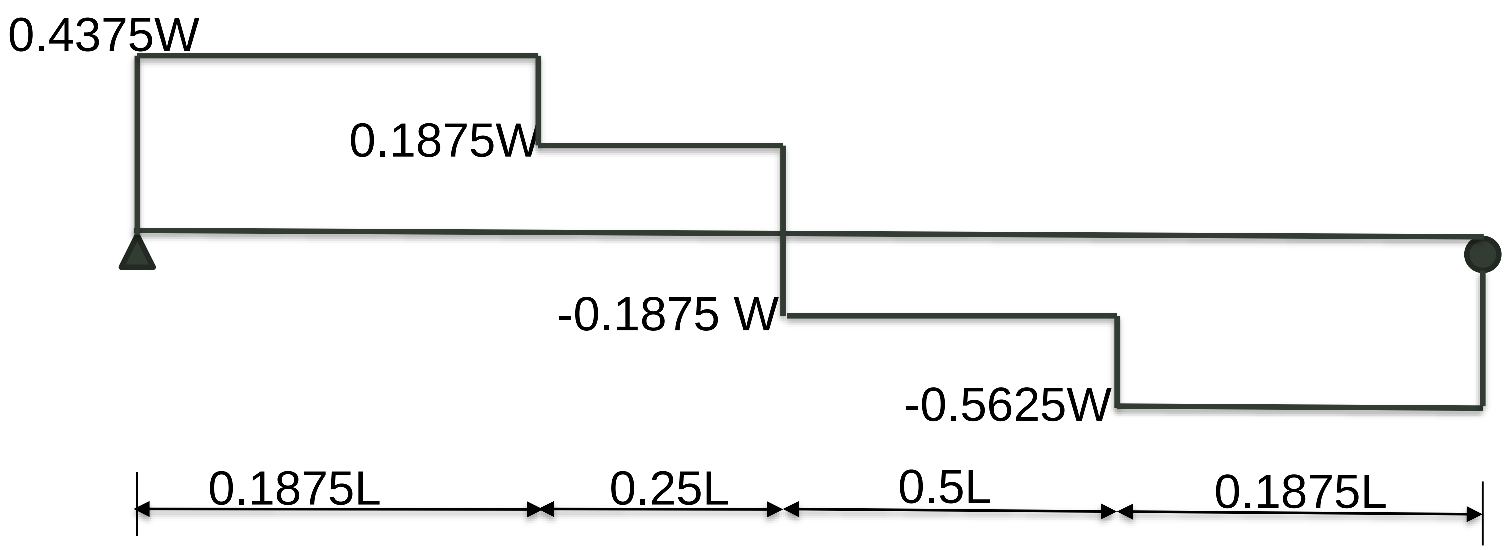
Vertical Force Balance →

$$D = 0.25W + 0.375W + 0.375W - E$$

$$D = 0.4375W$$

EXAMPLE: MAX MOMENT CALCULATION FOR WHEELED VEHICLE

Step 4: Construct Shear Force Diagram

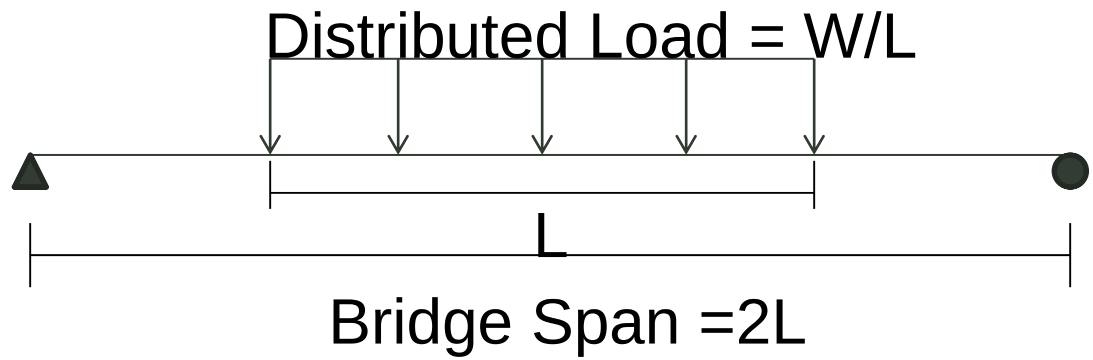


Step 5: Calculate Max Moment = Max Area Under the Shear Force Curve

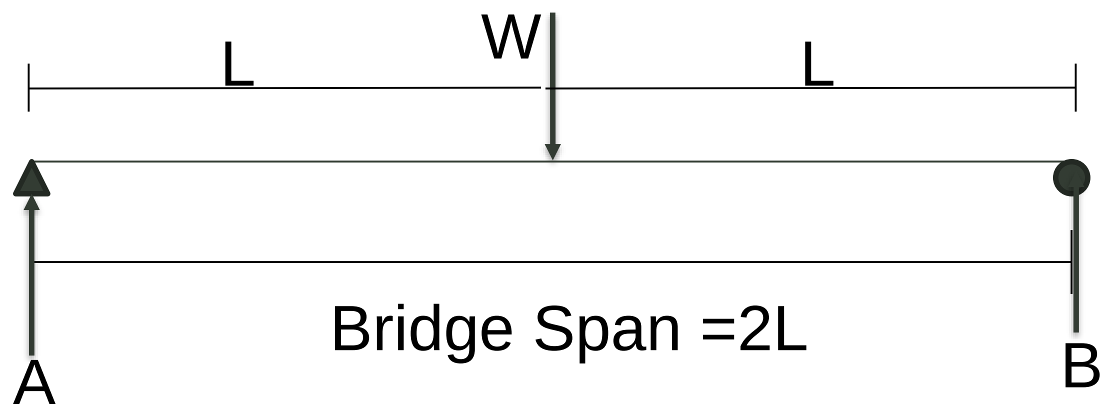
$$M_{\max} = 0.4375W(0.1875L) + 0.1875W(0.25L) = 0.1289WL$$

Max Moment ≈ 0.1289WL

EXAMPLE: LENGTH OF TRACK IN CONTACT WITH GROUND = L



Step 1: Calculate Reactions at the Supports

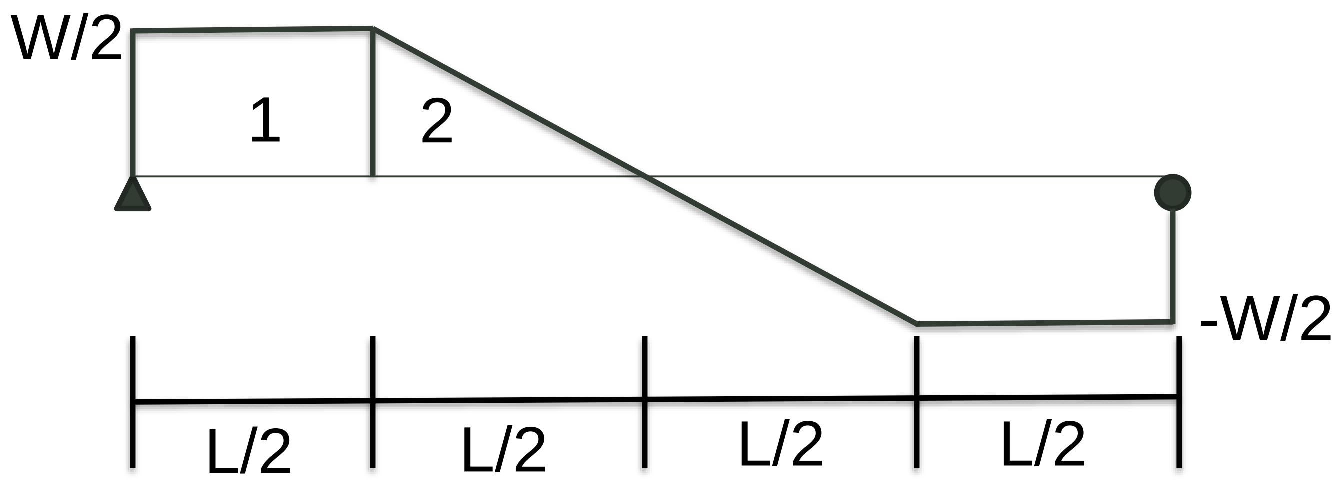


Moment Balance About B $\longrightarrow$ $A = \frac{WL}{2L} = \frac{W}{2}$

Vertical Force Balance $\longrightarrow$ $B = W - A = \frac{W}{2}$

EXAMPLE: LENGTH OF TRACK IN CONTACT WITH GROUND = L

Step 2: Generate Shear Force Curve

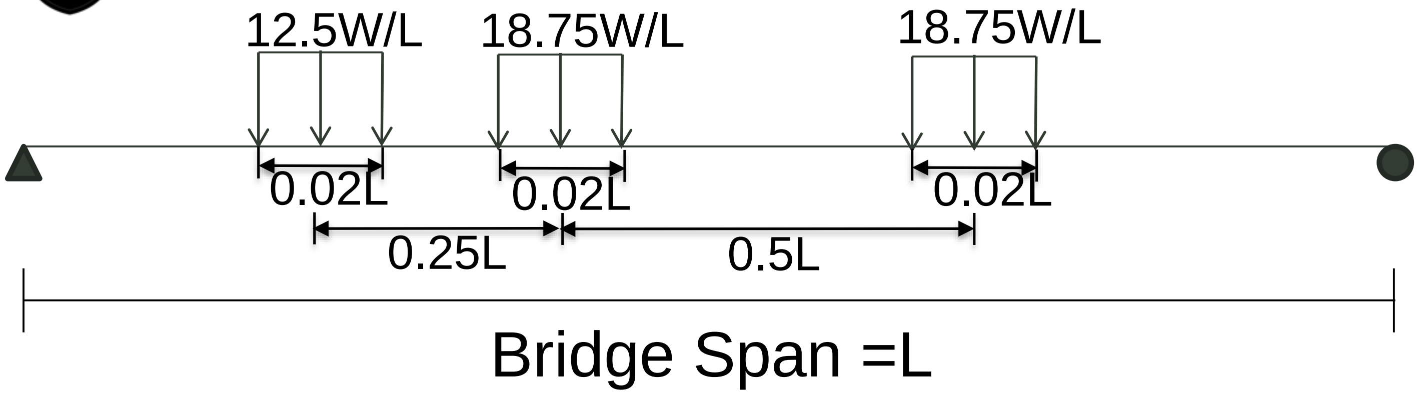


Step 3: Calculate Max Moment = Maximum Area Under Shear Force Curve

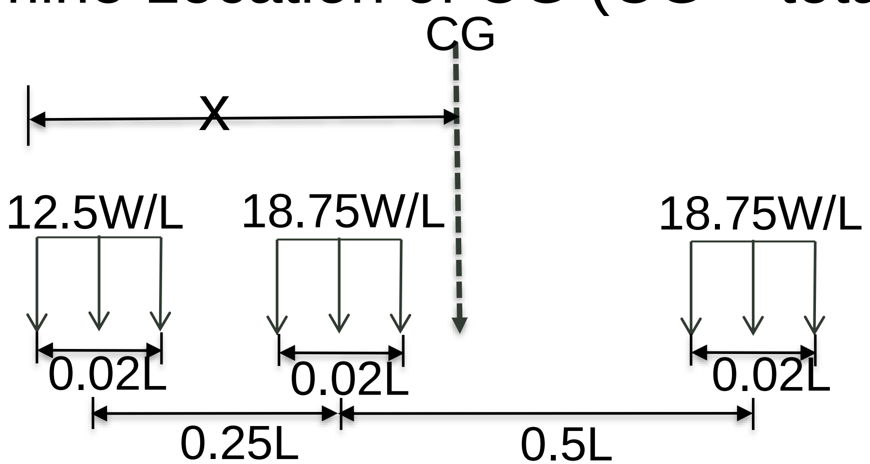
$$M_{max} = Area1 + Area2 = \frac{W}{2} * \frac{L}{2} + \frac{1}{2} * \frac{W}{2} * \frac{L}{2} = \frac{3WL}{8}$$

Max Moment = 0.375WL

EXAMPLE: LARGE WHEEL CALCULATION



Step 1: Determine Location of CG (CG = total weight of vehicle)



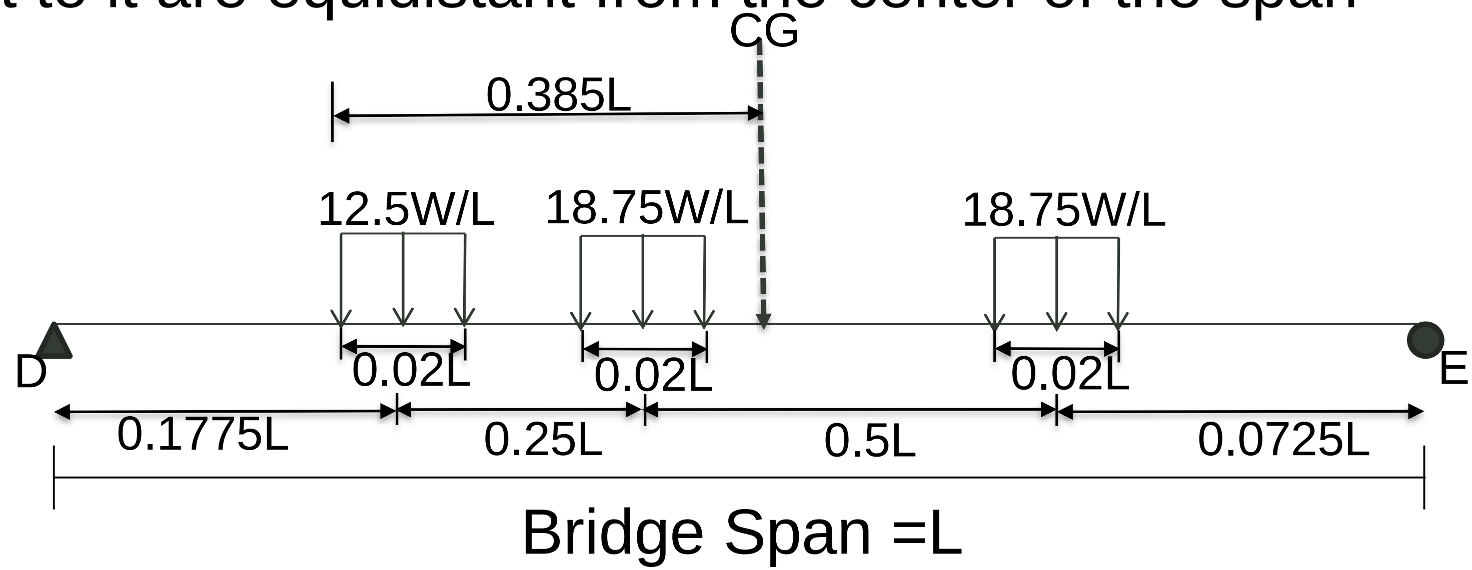
Moment Balance About Beginning of Convoy

$$CGx = \frac{12.5W}{L}(0.02L)(0.01L) + \frac{18.75W}{L}(0.02L)(0.25L + 0.01L) + \frac{18.75W}{L}(0.02L)(0.75L + 0.01L)$$

$$x = 0.385L$$

EXAMPLE: MAX MOMENT CALCULATION FOR WHEELED VEHICLE

Step 2: Place vehicle on span so that CG and end of axle closest to it are equidistant from the center of the span



Step 3: Calculate Reaction at D and E

Moment Balance About D

$$EL = \frac{12.5W}{L}(0.02L)(0.1775L) + \frac{18.75W}{L}(0.02L)(0.4275L) + \frac{18.75W}{L}(0.02L)(0.9275L)$$

$$E = 0.5525W$$

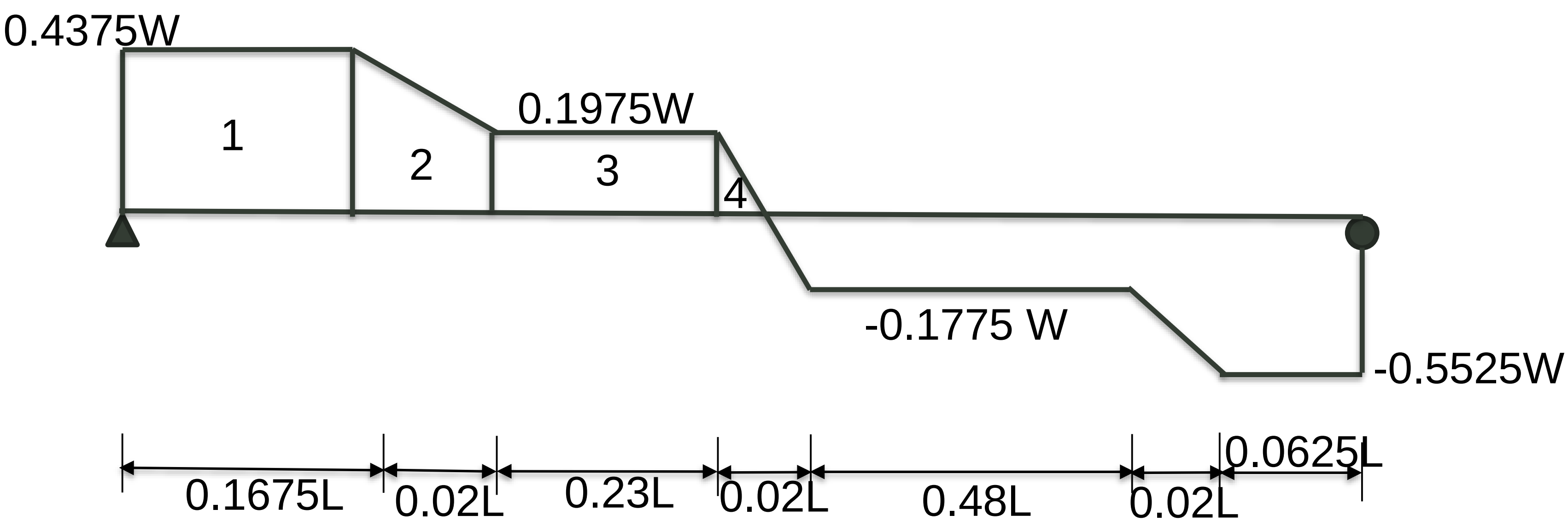
Vertical Force Balance →

$$D = \frac{12.5W}{L}(0.02L) + \frac{18.75W}{L}(0.02L) + \frac{18.75W}{L}(0.02L) - E$$

$$D = 0.4475W$$

EXAMPLE: MAX MOMENT CALCULATION FOR WHEELED VEHICLE

Step 4: Construct Shear Force Diagram



Step 5: Calculate Max Moment = Max Area Under the Shear Force Curve

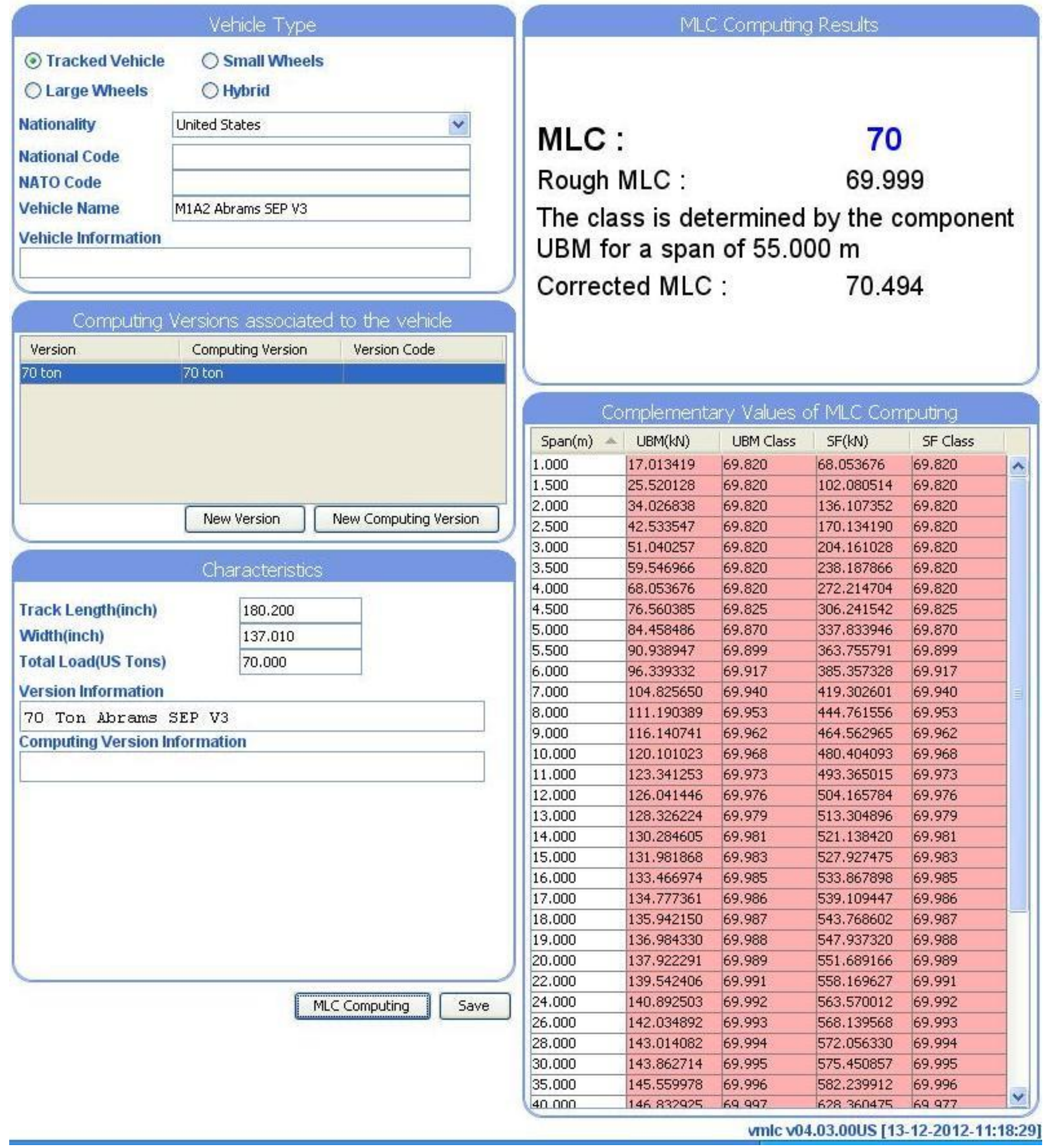
$$M_{max} = A_1 + A_2 + A_3 + A_4 \approx 0.1278WL$$

Max Moment ≈ 0.1278WL

ABRAMS CALCULATION EXAMPLE 1

- **70 ton M1A2**
  - Track Length = 180.2 in
  - Width = 137.01 in

- Width correction based on MLC 70 tracked hypothetical width
  - Width = 138.189 in (3.51 m)
  - Correction Factor ~ 1.0071



Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	17.013419	69.820	68.053676	69.820
1.500	25.520128	69.820	102.080514	69.820
2.000	34.026838	69.820	136.107352	69.820
2.500	42.533547	69.820	170.134190	69.820
3.000	51.040257	69.820	204.161028	69.820
3.500	59.546966	69.820	238.187866	69.820
4.000	68.053676	69.820	272.214704	69.820
4.500	76.560385	69.825	306.241542	69.825
5.000	84.458486	69.870	337.833946	69.870
5.500	90.938947	69.899	363.755791	69.899
6.000	96.339332	69.917	385.357328	69.917
7.000	104.825650	69.940	419.302601	69.940
8.000	111.190389	69.953	444.761556	69.953
9.000	116.140741	69.962	464.562965	69.962
10.000	120.101023	69.968	480.404093	69.968
11.000	123.341253	69.973	493.365015	69.973
12.000	126.041446	69.976	504.165784	69.976
13.000	128.326224	69.979	513.304896	69.979
14.000	130.284605	69.981	521.138420	69.981
15.000	131.981868	69.983	527.927475	69.983
16.000	133.466974	69.985	533.867898	69.985
17.000	134.777361	69.986	539.109447	69.986
18.000	135.942150	69.987	543.768602	69.987
19.000	136.984330	69.988	547.937320	69.988
20.000	137.922291	69.989	551.689166	69.989
22.000	139.542406	69.991	558.169627	69.991
24.000	140.892503	69.992	563.570012	69.992
26.000	142.034892	69.993	568.139568	69.993
28.000	143.014082	69.994	572.056330	69.994
30.000	143.862714	69.995	575.450857	69.995
35.000	145.559978	69.996	582.239912	69.996
40.000	146.832925	69.997	628.360475	69.977

ABRAMS CALCULATION EXAMPLE 2

- **Weight increased to 74 tons (combat weight)**
- Width correction now based on MLC 78 tracked hypothetical
  - Width = 142.913 in (3.63 m)
  - Correction Factor ~ 1.035

Vehicle Type

( ) Tracked Vehicle   ( ) Small Wheels
( ) Large Wheels   ( ) Hybrid

Nationality United States
National Code
NATO Code
Vehicle Name M1A2 Abrams SEP V3
Vehicle Information

Computing Versions associated to the vehicle

Version	Computing Version	Version Code
70 ton	70 ton	
Combat Weight	Combat Weight	

New Version | New Computing Version

Characteristics

Track Length(inch) 180.200
Width(inch) 137.010
Total Load(US Tons) 74.000
Version Information
Computing Version Information

MLC Computing | Save

MLC Computing Results

MLC : 81
Rough MLC : 77.895
The class is determined by the component SF for a span of 1.500 m
Corrected MLC : 80.623

Complementary Values of MLC Computing

Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	17.985614	77.895	71.942457	77.895
1.500	26.978421	77.895	107.913686	77.895
2.000	35.971228	77.895	143.884915	77.895
2.500	44.964036	77.895	179.856144	77.895
3.000	53.956843	77.895	215.827372	77.895
3.500	62.949650	77.895	251.798601	77.895
4.000	71.942457	77.895	287.769830	77.895
4.500	80.935264	77.895	323.741059	77.895
5.000	89.284685	77.181	357.138743	77.181
5.500	96.135459	76.377	384.541836	76.376
6.000	101.844436	75.897	407.377747	75.897
7.000	110.815687	75.351	443.262750	75.351
8.000	117.544125	75.049	470.176502	75.049
9.000	122.777355	74.858	491.109421	74.858
10.000	126.963938	74.725	507.855755	74.725
11.000	130.389325	74.628	521.557302	74.628
12.000	133.243814	74.554	532.975257	74.554
13.000	135.659151	74.496	542.636604	74.496
14.000	137.729439	74.449	550.917759	74.449
15.000	139.523689	74.410	558.094759	74.410
16.000	141.093658	74.377	564.374635	74.377
17.000	142.478925	74.349	569.915701	74.349
18.000	143.710273	74.325	574.841094	74.325
19.000	144.812006	74.304	579.248024	74.304
20.000	145.803565	74.285	583.214261	74.285
22.000	147.516258	74.254	590.065035	74.255
24.000	148.943503	74.230	595.774012	74.230
26.000	150.151171	74.209	600.604686	74.209
28.000	151.186315	74.192	604.745263	74.192
30.000	152.083440	74.178	608.333763	74.178
35.000	153.877691	74.150	615.510764	74.150
40.000	155.223378	74.129	664.266788	74.524

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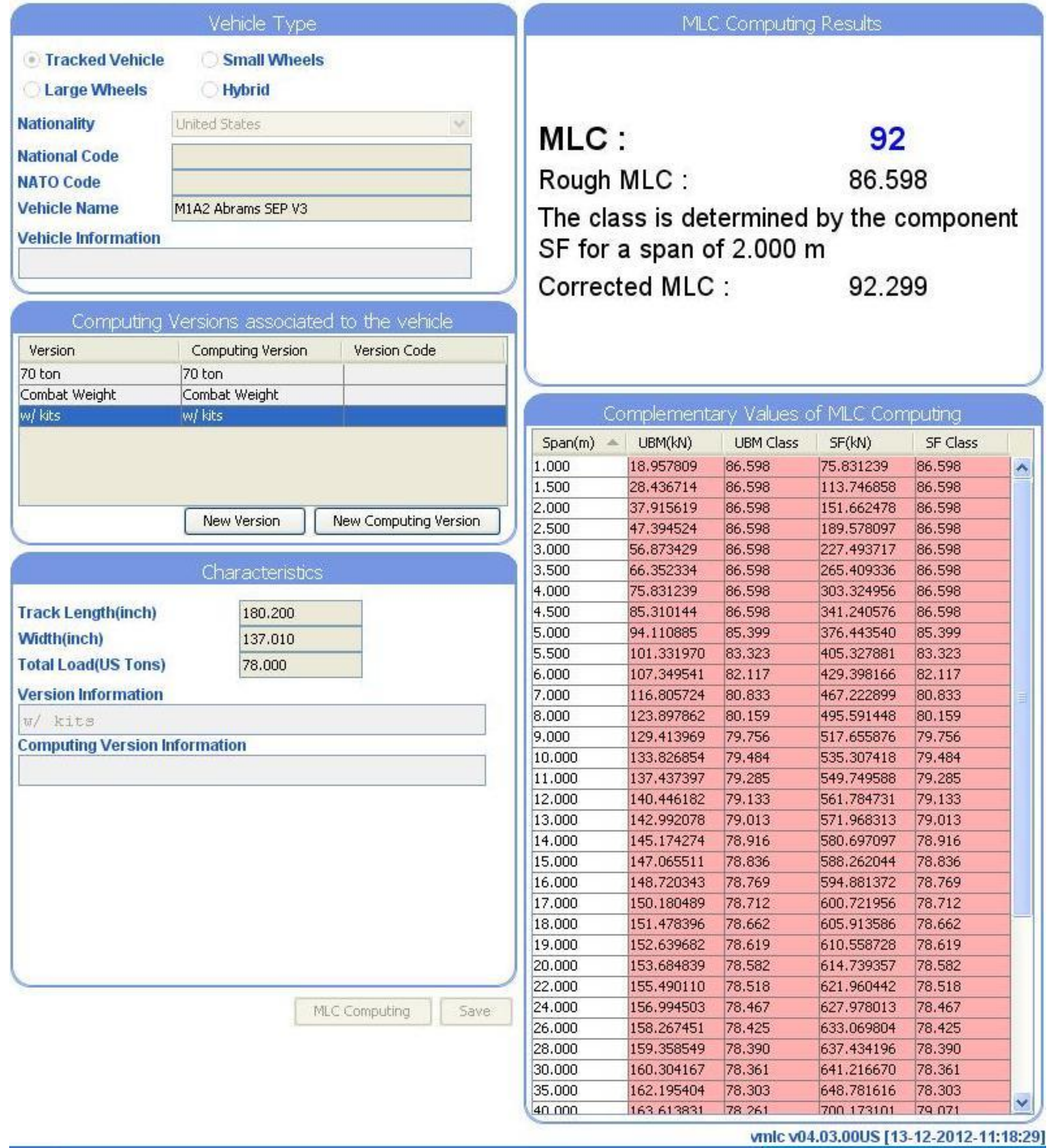
ABRAMS CALCULATION EXAMPLE 3

- **78 ton M1A2**
  - Track Length = 180.2 in
  - Width = 137.01 in

- Width correction now based on MLC 87 tracked hypothetical
  - Width = 148.228 in (3.765 m)
  - Correction Factor ~ 1.067

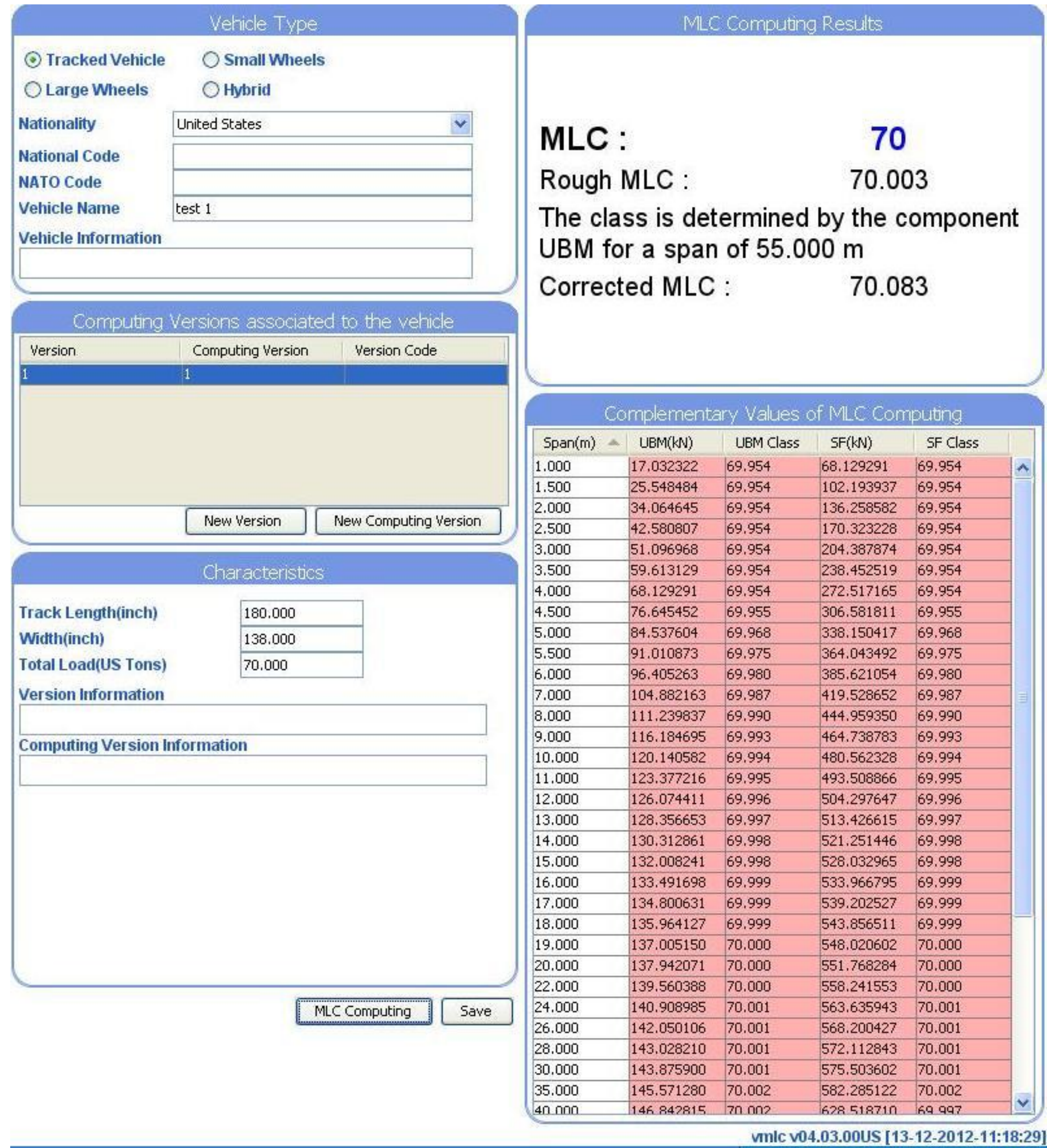


Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	18.957809	86.598	75.831239	86.598
1.500	28.436714	86.598	113.746858	86.598
2.000	37.915619	86.598	151.662478	86.598
2.500	47.394524	86.598	189.578097	86.598
3.000	56.873429	86.598	227.493717	86.598
3.500	66.352334	86.598	265.409336	86.598
4.000	75.831239	86.598	303.324956	86.598
4.500	85.310144	86.598	341.240576	86.598
5.000	94.110885	85.399	376.443540	85.399
5.500	101.331970	83.323	405.327881	83.323
6.000	107.349541	82.117	429.398166	82.117
7.000	116.805724	80.833	467.222899	80.833
8.000	123.897862	80.159	495.591448	80.159
9.000	129.413969	79.756	517.655876	79.756
10.000	133.826854	79.484	535.307418	79.484
11.000	137.437397	79.285	549.749588	79.285
12.000	140.446182	79.133	561.784731	79.133
13.000	142.992078	79.013	571.968313	79.013
14.000	145.174274	78.916	580.697097	78.916
15.000	147.065511	78.836	588.262044	78.836
16.000	148.720343	78.769	594.881372	78.769
17.000	150.180489	78.712	600.721956	78.712
18.000	151.478396	78.662	605.913586	78.662
19.000	152.639682	78.619	610.558728	78.619
20.000	153.684839	78.582	614.739357	78.582
22.000	155.490110	78.518	621.960442	78.518
24.000	156.994503	78.467	627.978013	78.467
26.000	158.267451	78.425	633.069804	78.425
28.000	159.358549	78.390	637.434196	78.390
30.000	160.304167	78.361	641.216670	78.361
35.000	162.195404	78.303	648.781616	78.303
40.000	163.613831	78.261	700.173101	79.071

GEOMETRY EFFECT EXAMPLE 1A

- **70 ton Tank**
  - Track Length = 180 in
  - Width = 138 in

- Width correction based on MLC 70T Hypothetical Vehicle Width
  - Width = 138.189 in (3.51 m)
  - Correction Factor ~ 1.00113



Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	17.032322	69.954	68.129291	69.954
1.500	25.548484	69.954	102.193937	69.954
2.000	34.064645	69.954	136.258582	69.954
2.500	42.580807	69.954	170.323228	69.954
3.000	51.096968	69.954	204.387874	69.954
3.500	59.613129	69.954	238.452519	69.954
4.000	68.129291	69.954	272.517165	69.954
4.500	76.645452	69.955	306.581811	69.955
5.000	84.537604	69.968	338.150417	69.968
5.500	91.010873	69.975	364.043492	69.975
6.000	96.405263	69.980	385.621054	69.980
7.000	104.882163	69.987	419.528652	69.987
8.000	111.239837	69.990	444.959350	69.990
9.000	116.184695	69.993	464.738783	69.993
10.000	120.140582	69.994	480.562328	69.994
11.000	123.377216	69.995	493.508866	69.995
12.000	126.074411	69.996	504.297647	69.996
13.000	128.356653	69.997	513.426615	69.997
14.000	130.312861	69.998	521.251446	69.998
15.000	132.008241	69.998	528.032965	69.998
16.000	133.491698	69.999	533.966795	69.999
17.000	134.800631	69.999	539.202527	69.999
18.000	135.964127	69.999	543.856511	69.999
19.000	137.005150	70.000	548.020602	70.000
20.000	137.942071	70.000	551.768284	70.000
22.000	139.560388	70.000	558.241553	70.000
24.000	140.908985	70.001	563.635943	70.001
26.000	142.050106	70.001	568.200427	70.001
28.000	143.028210	70.001	572.112843	70.001
30.000	143.875900	70.001	575.503602	70.001
35.000	145.571280	70.002	582.285122	70.002
40.000	146.842815	70.002	628.518710	69.997

GEOMETRY EFFECT EXAMPLE 1B

- **70 ton Tank**
  - Track Length = 179 in
  - Width = 138 in

- Slight increase in rough MLC compared to Example 1
- Width correction now based off of MLC 71T hypothetical vehicle width
  - Width = 138.78 in (3.525 m)
  - Correction Factor ~ 1.00468

Vehicle Type

- Tracked Vehicle
- Small Wheels
- Large Wheels
- Hybrid

Nationality: United States
National Code:
NATO Code:
Vehicle Name: test 1
Vehicle Information:

Computing Versions associated to the vehicle

Version	Computing Version	Version Code
1	1	

New Version | New Computing Version

Characteristics

Track Length(inch): 179.000
Width(inch): 138.000
Total Load(US Tons): 70.000
Version Information:
Computing Version Information:

MLC Computing | Save

MLC Computing Results

MLC : 71
Rough MLC : 70.740
The class is determined by the component SF for a span of 1.500 m
Corrected MLC : 71.005

Complementary Values of MLC Computing

Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	17.127475	70.740	68.509901	70.740
1.500	25.691213	70.740	102.764852	70.740
2.000	34.254950	70.740	137.019803	70.740
2.500	42.818688	70.740	171.274754	70.740
3.000	51.382426	70.740	205.529705	70.740
3.500	59.946164	70.740	239.784656	70.740
4.000	68.509901	70.740	274.039607	70.740
4.500	77.073639	70.740	308.294558	70.740
5.000	84.933193	70.562	339.732772	70.562
5.500	91.370499	70.421	365.481996	70.421
6.000	96.734920	70.337	386.939683	70.337
7.000	105.164726	70.241	420.658905	70.241
8.000	111.487080	70.188	445.948322	70.188
9.000	116.404467	70.154	465.617868	70.154
10.000	120.338376	70.131	481.353506	70.131
11.000	123.557029	70.114	494.228118	70.114
12.000	126.239240	70.101	504.956961	70.101
13.000	128.508803	70.091	514.035213	70.091
14.000	130.454143	70.083	521.816572	70.083
15.000	132.140104	70.076	528.560417	70.076
16.000	133.615320	70.070	534.461281	70.070
17.000	134.916981	70.065	539.667925	70.065
18.000	136.074013	70.061	544.296054	70.061
19.000	137.109252	70.057	548.437011	70.057
20.000	138.040968	70.054	552.163873	70.054
22.000	139.650294	70.048	558.601179	70.048
24.000	140.991400	70.044	563.965600	70.044
26.000	142.126181	70.041	568.504726	70.041
28.000	143.098851	70.038	572.395406	70.038
30.000	143.941832	70.035	575.767328	70.035
35.000	145.627793	70.030	582.511173	70.030
40.000	146.892264	70.026	629.309888	70.097

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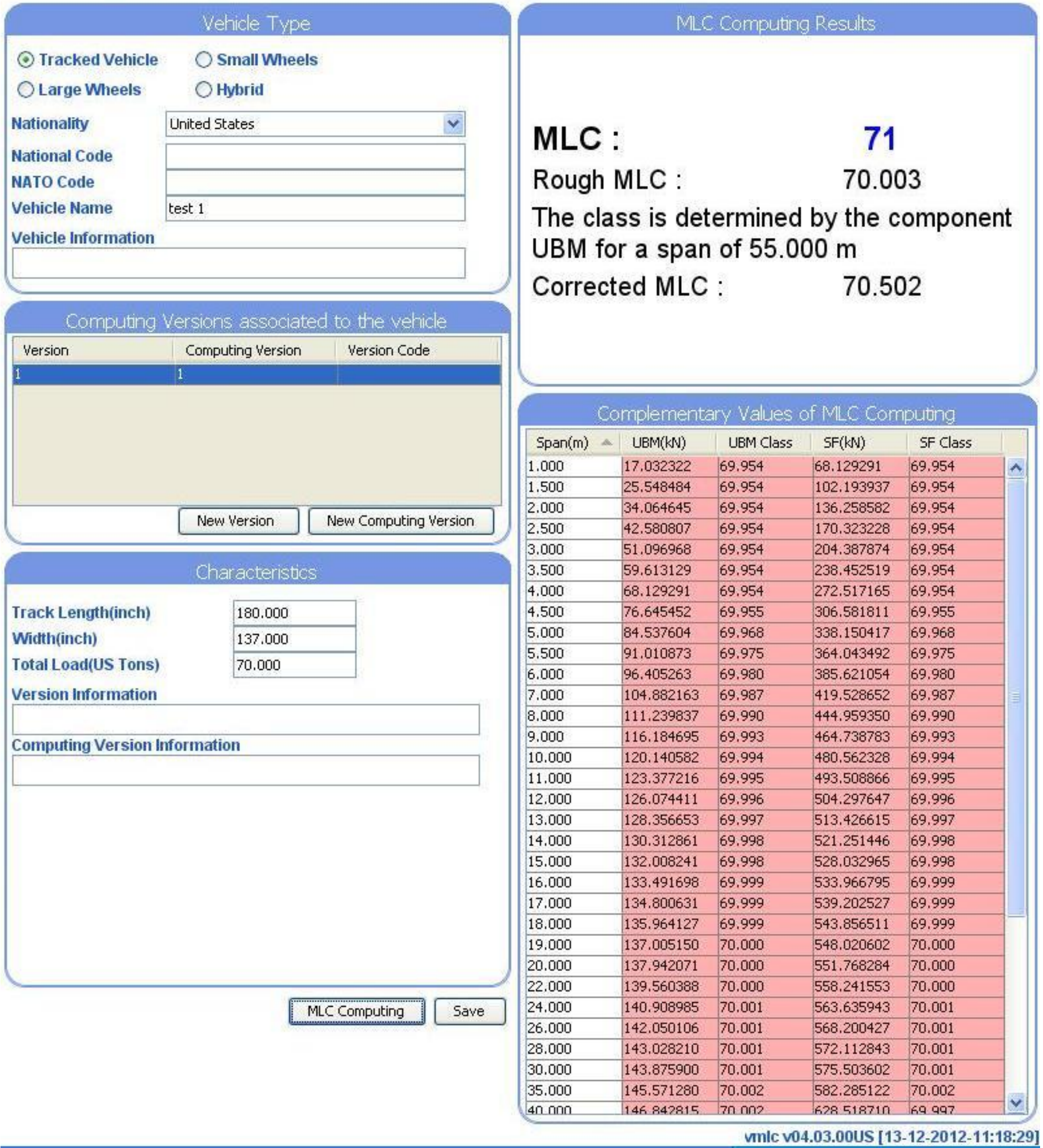
GEOMETRY EFFECT EXAMPLE 1C

- **70 ton Tank**
  - Track Length = 180 in
  - Width = 137 in

- 1 inch reduction in width from Example 1 results in greater width correction factor, higher MLC than that calculated in Example 1
  - Width Correction Factor ~ 1.00713 vs 1.00113 in Example 1



Span(m)	UBM(kN)	UBM Class	SF(kN)	SF Class
1.000	17.032322	69.954	68.129291	69.954
1.500	25.548484	69.954	102.193937	69.954
2.000	34.064645	69.954	136.258582	69.954
2.500	42.580807	69.954	170.323228	69.954
3.000	51.096968	69.954	204.387874	69.954
3.500	59.613129	69.954	238.452519	69.954
4.000	68.129291	69.954	272.517165	69.954
4.500	76.645452	69.955	306.581811	69.955
5.000	84.537604	69.968	338.150417	69.968
5.500	91.010873	69.975	364.043492	69.975
6.000	96.405263	69.980	385.621054	69.980
7.000	104.882163	69.987	419.528652	69.987
8.000	111.239837	69.990	444.959350	69.990
9.000	116.184695	69.993	464.738783	69.993
10.000	120.140582	69.994	480.562328	69.994
11.000	123.377216	69.995	493.508866	69.995
12.000	126.074411	69.996	504.297647	69.996
13.000	128.356653	69.997	513.426615	69.997
14.000	130.312861	69.998	521.251446	69.998
15.000	132.008241	69.998	528.032965	69.998
16.000	133.491698	69.999	533.966795	69.999
17.000	134.800631	69.999	539.202527	69.999
18.000	135.964127	69.999	543.856511	69.999
19.000	137.005150	70.000	548.020602	70.000
20.000	137.942071	70.000	551.768284	70.000
22.000	139.560388	70.000	558.241553	70.000
24.000	140.908985	70.001	563.635943	70.001
26.000	142.050106	70.001	568.200427	70.001
28.000	143.028210	70.001	572.112843	70.001
30.000	143.875900	70.001	575.503602	70.001
35.000	145.571280	70.002	582.285122	70.002
40.000	146.842815	70.002	628.518710	69.997