



Pedestrian/Bicycle Crash Analysis



Instructors: Tony Becker & Mike Reade

Date: 08-Sep-11

Place: Kingston, Jamaica

Vehicle: 1996 Honda Civic
VIN: ??

OL:	445	cm
OW:	171	cm
WB:	262	cm
FOH:	86	cm
ROH:	97	cm
Weight:	1,200.00	kg
Hood H:	63.5	cm

Searle (Angle):

$$V = \frac{\sqrt{2 \times \mu \times g \times d}}{[\cos \theta + (\mu \times \sin \theta)]}$$

Searle (Mass & Carry):

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

Searle Maximim:

$$V_{\max} = \sqrt{2 \times \mu \times g \times d}$$

Searle Minimum:

$$V_{\min} = \sqrt{\frac{2 \times \mu \times g \times d}{1 + \mu^2}}$$

Crash Data:	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8	Test 9	Test 10
Ped Ht (m):	1.6	1.6	1.6	1.6	1.6	1.6	N/A	N/A	N/A	N/A
Ped C/M Ht (m):	1.11	1	1.03	1	0.98	0.95	N/A	N/A	N/A	N/A
Ped Slide D (m):	1.86	2.15	10.5	15.5	8	3.9	N/A	N/A	N/A	N/A
Airborne D (m):	7.29	6.9	17.3	19.8	0	0	N/A	N/A	N/A	N/A
Ped f-Value:	0.66	0.66	0.66	0.66	0.66	0.66	N/A	N/A	N/A	N/A
Throw D (m):	9.15	9.05	27.8	35.3	8	3.9	N/A	N/A	N/A	N/A
Takeoff (Min):	10	10	10	10	10	10	N/A	N/A	N/A	N/A
Takeoff (Max.):	20	20	20	20	20	20	N/A	N/A	N/A	N/A
1st Evid. (m):	2.33	2.7	0	0.48	0	0	N/A	N/A	N/A	N/A
Ped Weight (kg):	20.45	20.45	20.45	20.45	20.45	20.45	N/A	N/A	N/A	N/A
Vehicle Data:										
Hood Height (m):	0.635	0.635	0.635	0.635	0.635	0.635	N/A	N/A	N/A	N/A
C/M - Hood Change (m):	0.48	0.37	0.40	0.37	-1.52	-1.55	N/A	N/A	N/A	N/A
Braking (Yes=Y/No=N):	Y	Y	Y	N	Y	N	N/A	N/A	N/A	N/A
Skid Total (m):	11.05	12.6	41.5	N/A	23.1	62.9	N/A	N/A	N/A	N/A
Skid to Impact (m):	3.9	6.03	19.04	N/A	15.5	N/A	N/A	N/A	N/A	N/A
Road f-Value:	0.72	0.72	0.72	N/A	0.46	0.46	N/A	N/A	N/A	N/A
Impact Spd (km/h):	36.22	34.66	63.93	N/A	29.88	85.00	N/A	N/A	N/A	N/A
Radar (Start Braking):	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Radar (Impact):	45	48	68	59	N/A	N/A	N/A	N/A	N/A	N/A

Disclaimer: Documentaion is provided to supplement IPTM Crash Testing.
Additional training required to fully understand the technical analysis.



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Test 1



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	35.62 km/h
Searle (20 Degree) Takeoff:	33.61 km/h
Searle Minimum Formula:	32.69 km/h
Searle Maximum Formula:	39.17 km/h

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	1,300.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	1.11 meters

Vehicle Speed Analysis:

Vehicle Speed - Start of Braking:	45.00 km/h
Vehicle Speed - Impact:	36.22 km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	45.00 km/h
IMPACT SPEED To Be Used:	36.22 km/h

Searle Minimum Analysis: (1993, 2009)

$$V_{\min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 31.35 \text{ km/h}$$

Other Calculations:

Speed (With Adjusted Data):	35.41 km/h
Throw Minus Carry Distance:	7.65 meters
Location of First Evidence:	2.3 meters
% of Speed Attained (Ped):	90%
Difference (C/M vs. Hood H):	0.5 meters
Takeoff From Video (Degrees):	1 Degrees
Carry Distance:	1.50 meters

Searle Minimum Analysis: (2009)

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 30.36 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)

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Test 2



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	35.43 km/h
Searle (20 Degree) Takeoff:	33.42 km/h
Searle Minimum Formula:	32.51 km/h
Searle Maximum Formula:	38.95 km/h

Vehicle Speed Analysis:

Vehicle Speed - Start of Braking:	48.00 km/h
Vehicle Speed - Impact:	34.66 km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	48.00 km/h
IMPACT SPEED To Be Used:	34.66 km/h

Other Calculations:

Speed (With Adjusted Data):	33.99 km/h
Throw Minus Carry Distance:	7.05 meters
Location of First Evidence:	2.7 meters
% of Speed Attained (Ped):	94%
Difference (C/M vs. Hood H):	0.4 meters
Takeoff From Video (Degrees):	1 Degrees
Carry Distance:	2.00 meters

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	1,300.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	1.00 meters

Searle Minimum Analysis: (1993, 2009)

$$V_{\min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 31.30 \text{ km/h}$$

Searle Minimum Analysis: (2009)

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 29.14 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)

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Test 3



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	62.09 km/h
Searle (20 Degree) Takeoff:	58.58 km/h
Searle Minimum Formula:	56.98 km/h
Searle Maximum Formula:	68.27 km/h

Vehicle Speed Analysis:

Vehicle Speed - Start of Braking:	87.00 km/h
Vehicle Speed - Impact:	63.93 km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	68.00 km/h
IMPACT SPEED To Be Used:	63.93 km/h

Other Calculations:

Speed (With Adjusted Data):	65.03 km/h
Throw Minus Carry Distance:	25.80 meters
Location of First Evidence:	0.0 meters
% of Speed Attained (Ped):	89%
Difference (C/M vs. Hood H):	0.4 meters
Takeoff From Video (Degrees):	1 Degrees
Carry Distance:	2.00 meters

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	1,300.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	1.03 meters

Searle Minimum Analysis: (1993, 2009)

$$V_{\min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 56.28 \text{ km/h}$$

Searle Minimum Analysis: (2009)

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 55.75 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)

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Test 4



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	69.97 km/h
Searle (20 Degree) Takeoff:	66.01 km/h
Searle Minimum Formula:	64.20 km/h
Searle Maximum Formula:	76.93 km/h
Searle Contact (80% of Searle Min):	51.36 km/h

Vehicle Speed Analysis:

VC Speed - Start of Braking:	N/A km/h
VC Speed - Impact:	N/A km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	59.00 km/h
IMPACT SPEED To Be Used:	59.00 km/h

Other Calculations:

Speed (With Adjusted Data):	72.86 km/h
Throw Minus Carry Distance:	33.80 meters
Location of First Evidence:	0.5 meters
% of Speed Attained (Ped):	109% 87%
Difference (C/M vs. Hood H):	0.4 meters
Takeoff From Video (Degrees):	3 Degrees
Carry Distance:	1.50 meters

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	1,300.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	1.00 meters

Searle Minimum Analysis: (1993, 2009)

$$V_{min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 63.60 \text{ km/h}$$

Searle Minimum Analysis: (2009)

$$V_{min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 63.81 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)
(Suspected secondary contact - Searle (2009) vehicle could be as low as 80% of Searle Minimum)



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Test 5



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	33.31 km/h
Searle (20 Degree) Takeoff:	31.42 km/h
Searle Minimum Formula:	30.56 km/h
Searle Maximum Formula:	36.62 km/h

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	7,475.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	0.98 meters

Vehicle Speed Analysis:

Vehicle Speed - Start of Braking:	52.00 km/h
Vehicle Speed - Impact:	29.88 km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	N/A km/h
IMPACT SPEED To Be Used:	29.88 km/h

Searle Minimum Analysis: (1993, 2009)

$$V_{\min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 29.30 \text{ km/h}$$

Other Calculations:

Speed (With Adjusted Data):	35.93 km/h
Throw Minus Carry Distance:	7.70 meters
Location of First Evidence:	0.0 meters
% of Speed Attained (Ped):	102%
Difference (C/M vs. Hood H):	0.3 meters
Takeoff From Video (Degrees):	0 Degrees
Carry Distance:	0.00 meters

Searle Minimum Analysis: (2009)

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 30.65 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)

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Test 6



Searle Analysis: (1983)

Searle (10 Degree) Takeoff:	23.26 km/h
Searle (20 Degree) Takeoff:	21.94 km/h
Searle Minimum Formula:	21.34 km/h
Searle Maximum Formula:	25.57 km/h

Vehicle Speed Analysis:

VC Speed - Start of Braking:	85.00 km/h
VC Speed - Impact:	85.00 km/h
Radar Speed - Start of Braking:	N/A km/h
Radar Speed - Impact:	N/A km/h
IMPACT SPEED To Be Used:	85.00 km/h

Other Calculations:

Speed (With Adjusted Data):	25.57 km/h
Throw Minus Carry Distance:	3.90 meters
Location of First Evidence:	0.0 meters
% of Speed Attained (Ped):	25%
Difference (C/M vs. Hood H):	0.3 meters
Takeoff From Video (Degrees):	0 Degrees
Carry Distance:	0.00 meters

NEW Searle Formulae Analysis:

Vehicle Weight: (M)	7,475.00 kg
Pedestrian Weight: (m)	20.45 kg
Ped C/M Height: (H)	0.95 meters

Searle Minimum Analysis: (1993, 2009)

$$V_{\min} = \sqrt{\frac{2\mu g(d - \mu H)}{1 + \mu^2}}$$

$$= 19.55 \text{ km/h}$$

Searle Minimum Analysis: (2009)

$$V_{\min} = \frac{M + m}{M} \sqrt{\frac{2\mu g(d - \text{Carry})}{1 + \mu^2}}$$

$$= 21.40 \text{ km/h}$$

(Percentage is determined by dividing Searle Minimum result by Vehicle Impact Speed)

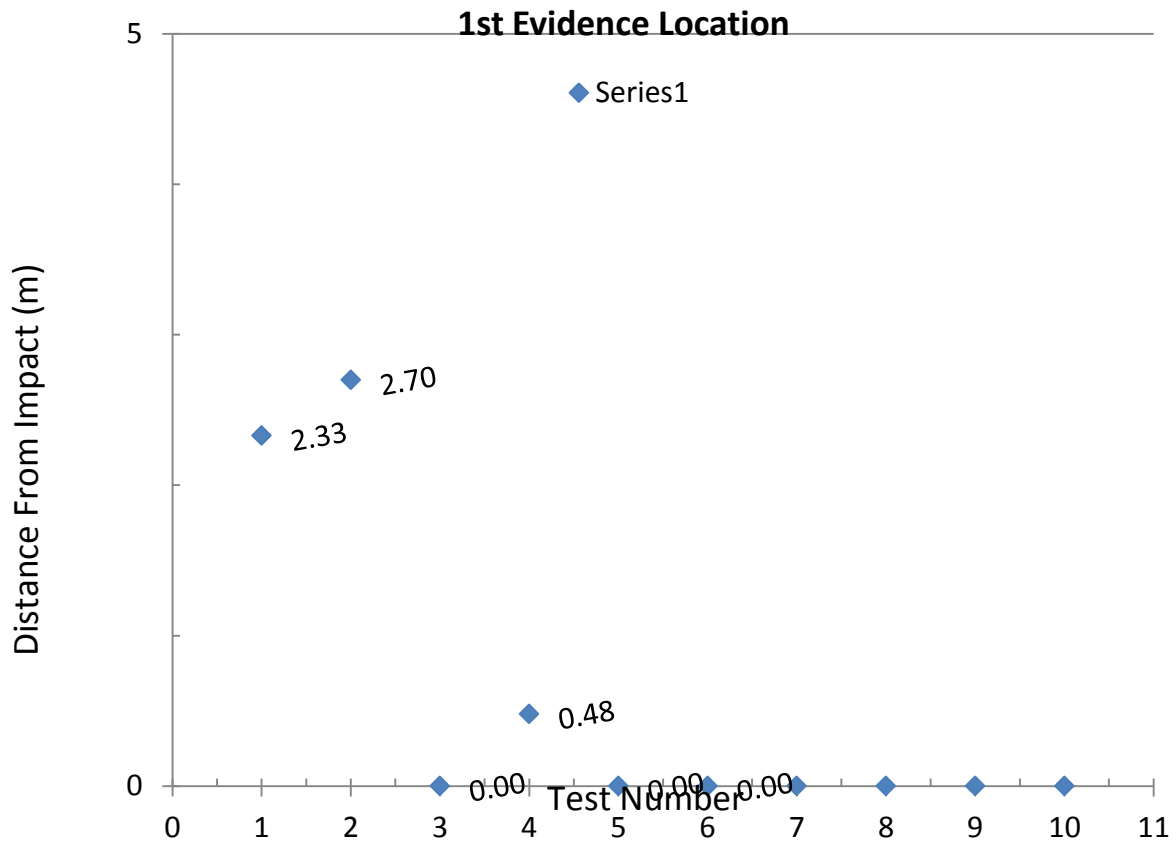
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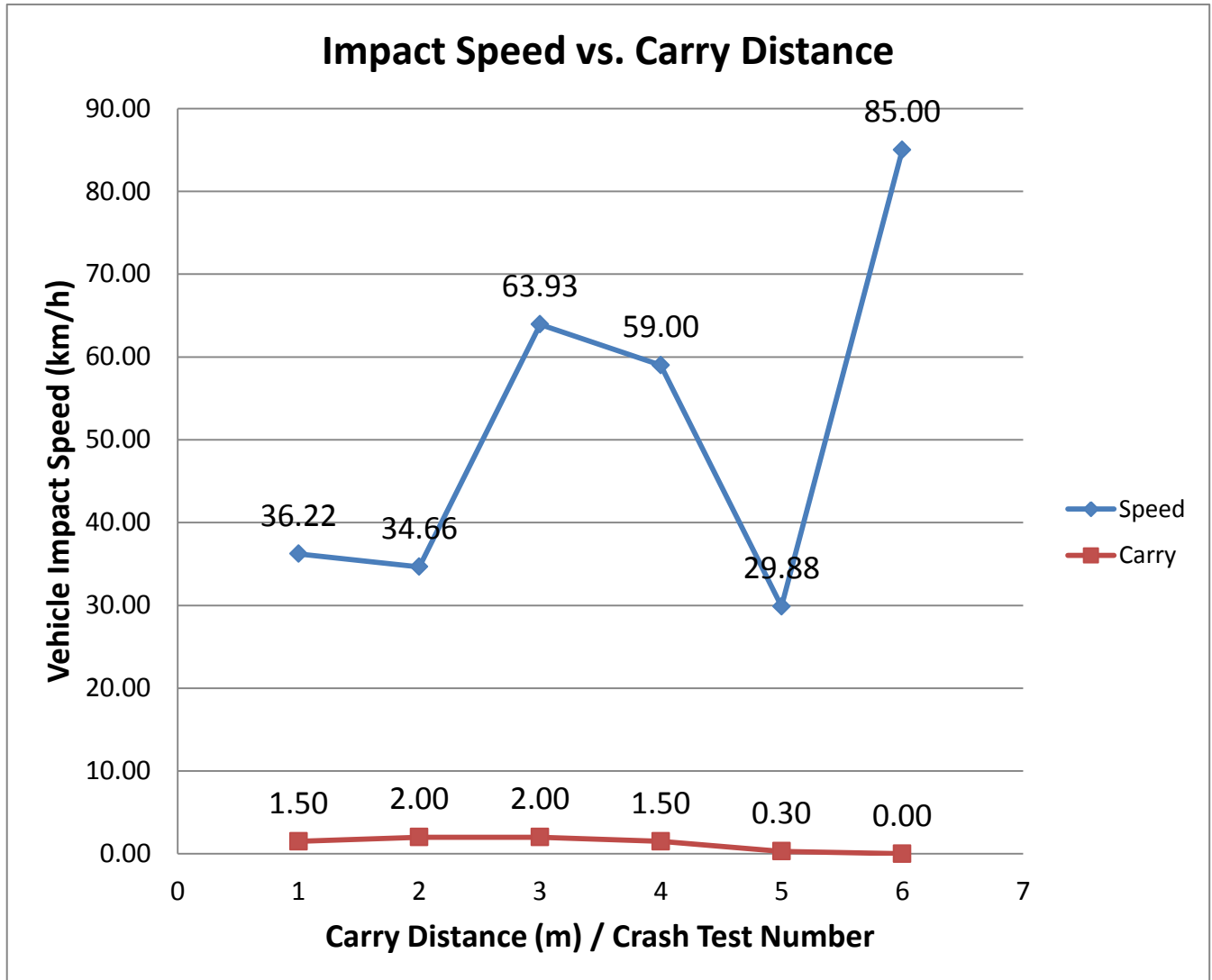
The above graph represents the location of the "1st" Evidence after impact. The longitudinal distance was measured from the impact location either forward or backward. In cases where the 1st Evidence lands before impact, the value is shown as a "RED" negative number.



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Data	Speed	Carry
Test 1:	36.22	1.50
Test 2:	34.66	2.00
Test 3:	63.93	2.00
Test 4:	59.00	1.50
Test 5:	29.88	0.30
Test 6:	85.00	0.00
Test 7:		
Test 8:		
Test 9:		
Test 10:		
Average:		1.22

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