SHORT PAPER PCB 4-2006

IN-LINE COLLISIONS

ENGINEERING EQUATIONS, INPUT DATA AND MARC 1 APPLICATIONS

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PURPOSE OF PCB SHORT PAPERS

To provide the accident reconstruction practitioner with a concise discussion of the engineering equations and limiting factors involved, evaluation of critical input data, and the analysis of actual cases by use of the MARC 1 computer software.

Short Papers are available free of charge and can be obtained by visiting our website at

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We hope that our Short Papers will assist the practitioner in better understanding the limitations inherent in any derivation of engineering equations, to properly use critical input data, to more accurately and effectively formulate his or her case under consideration, to become a better prepared expert in the field of accident reconstruction, and to more effectively utilize the full potential of the MARC 1 computer program.

Comments and suggestions are always invited by visiting our Discussion Forum and/or by writing to:

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Throughout the Short Papers we will extensively reference the 5th Edition of "Motor Vehicle Accident Reconstructions and Cause Analysis" by Rudolf Limpert, the "Accident Reconstruction Catalog" (ARC) CD, as well as the MARC 1 software.

IN-LINE COLLISIONS

Part Four

Rear Two-Vehicle Side Swipe Collision

1. DEFINITION OF SIDE SWIPE IN-LINE COLLISION

In a side swipe collision the approach and departure velocity vectors are approximately parallel. The velocity vectors of vehicles do change magnitude, however the direction remains unchanged. In a rear side-swipe collision both vehicles travel in the same direction before and after impact with the vehicle in the rear traveling faster than the vehicle in front. The center-of-gravities do not attain a common velocity. In two-vehicle rear side swipe the contact area may the sides, corners, tops or bottoms of vehicles. For example, if a car under-rides the right rear corner and right under side of a high pickup truck with both vehicles continuing in their original directions, the side swipe analysis applies. In general, crush energies are minor (to moderate).

2. WHAT ENGINEERING PRINCIPLES APPLY

Details are discussed in Section 33-4(c) of the Text. Equations 33-27 and 33-28 were derived from the general oblique impact linear momentum analysis, energy balance (crush energy), and after impact run-out analysis. The approach and departure angles for each vehicle are then set equal to each other, that is, the oblique collision diagram is "collapsed" to two vehicles traveling on parallel lines in opposite directions.

After-impact decelerations and distances for each vehicle, crush energies and weights are required to calculate impact velocities.

2.1. REAR SIDE-SWIPE

Consider the following accident where the left side of a 1985 Mazda 616 side-swiped a stationary 1985 Ford Escort on its right side. The Ford was parked on the left shoulder of a highway when the Mazda veered left of the yellow lane marking line. The Mazda was braking before and after impact. MARC 1 X – 4, RUN 1 shows the reconstruction. The results indicate that the Mazda impacted the Escort at approximately 28 mph while the Escort was stationary.

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MOTOR VEHICLE ACCIDENT RECONSTRUCTION AND CAUSE ANALYSIS
******** PROGRAM 'X-4' RUN FOR PCB 4 - 2006, RUN 1 ********
REAR SIDE-SWIPE COLLISION

Information For Vehicles		1985 MAZDA 616	1985 FORD ESCORT
Vehicle Weight, LBS:	===>	2051.00	2844.00
Surface #1			
Pre-Impact Braking Distance, FT:	===>	39.00	0.00
Pre-Impact Deceleration, g-UNITS:	===>	0.80	0.00
Surface #1			
Distance Traveled After Impact, FT:	===>	26.00	3.00
After-Impact Deceleration, g-UNITS:	===>	0.80	0.05
Max. Force Not Causing Damage, LBS/IN:	===>	185.00	190.00
Stiffness/Inch of Width, PSI:	===>	66.00	52.00
Force Angle Offset from Perpendicular, DEG:	===>	0.00	0.00
Width of Crush Region, IN:	===>	58.00	34.00
Number of Crush Measurements:	===>	4	4
Crush Measurement #1, IN:	===>	6.00	7.00
Crush Measurement #2, IN:	===>	4.00	6.00
Crush Measurement #3, IN:	===>	2.00	3.00
Crush Measurement #4, IN:	===>	2.00	1.00
Energy from Secondary Impacts, FT·LBS:	===>	0.00	0.00
Pre-Impact Speed, MPH:	===>	41.57	0.20
Speed at Impact, MPH:	===>	28.17	-0.20
After-Impact Speed, MPH:	===>	24.95	2.12
Crush Energy, FT·LBS:	===>	6289.52	4977.86
EES Speed, MPH:	===>	9.58	7.24