

Contents

Index of Tables	vii
List of Figures.....	viii

Introduction & General Topics 3

Introduction	3
Terminology	4
Closing speed	4
Impact Speed Change (ΔV)	4
Barrier Equivalent Velocity (BEV)	5
Coefficient of Restitution	6
Cornering Stiffness And Static Margin.....	7
Cornering Stiffness.....	7
Static Margin	9
Sample Application	10
Limitations on the Ability of a Vehicle to Change its Direction of Motion	11
Collinear Central Collisions.....	18
Collinear Central Collisions (cont.).....	19
Error Analysis.....	19

Vehicle Control Factors 21

Introduction	21
Wet Pavement.....	21
Hydroplaning	21
Shoulder Excursions, Pavement Edges.....	25

Trajectory Analysis 27

Introduction	27
Linear Motions Without Yawing.....	27
Spinouts on Flat, Uniform Surfaces	29
Combined Rotation and Translation Subsequent to Collision	33
Yaw Inertia	35
Sample Applications.....	36
Further Reading.....	36
Conservation of Momentum	39
Sample Application 1	43
Sample Application 2 - Intersection Collision.....	46
Sample Application 3	49

Damage Analysis 50

Introduction	50
History and Analytical Basis	50
Impulse-Energy Relationship	59
Side Impacts:	59

NHTSA Research	62
Forced Intercepts	62
Custom-Fitted Coefficients.....	65
Abandonment of A, B and G	65
Comparison of Crush Property Definitions	67
Energy Correction Factor and Coefficient of Restitution	68
Energy Correction Factor	68
Coefficient of Restitution	71
2000 Update.....	71
OFFSET FRONTAL COLLISIONS	76
Refinement in the Simulation of Structural Interactions During Collisions	81
Snag Option.....	82
Crush Coefficients	85
Crush Coefficients Derived from Crash Test Data	85
Sample Application to Moving Barrier (Rigid) Test Data:.....	87
Prasad Coefficients, d_0 , d_1	90
Compatible Crush Definitions for the CRASH and SMAC Computer Programs.....	91
Sample Calculation.....	92
Occupant Trajectory	95
Distance Traveled by an Ejected Vehicle Occupant or Component	95
Simple Ballistic Trajectory	95
Ballistic Trajectory Followed by Sliding.....	97
Simple Horizontal Launch.....	98
Horizontal Launch Followed by Sliding.....	99
LAUNCH Routine.....	101
Pole/Tree Collisions	103
Introduction.....	103
Work-Energy Relationships.....	103
Conservation of Angular Momentum	105
Relationships for Pure Rotation about Tree/Pole.....	107
Sample Applications.....	107
Pole Impact Damage Analysis	110
Sample Application:	111
Crush Properties for <i>m-smac</i> Pole Impacts	117
Effects of Vehicle Pitch	119
Rollovers	121
Introduction.....	121
Resistance to Rollover	121
“Static Stability” Factor	121
Tripping Type Rollovers.....	122
Non-Tripping Type Rollovers.....	122
Literature Review	122
Minimum Lateral Speed for a Tripping-Type Rollover.....	124
Speed Required for a Lateral Rollover Beyond 90°.....	126
End-Over-End Rollover	128
Speed Change at Occupant Positions	129
Background.....	129

Full-Scale Test Results	130
Test Equivalent Speed Change	131
SMAC Equivalent Speed Change.....	131
Demonstration of Positional Differences in Speed-Change	132
CG-Transform Procedure	134
CRASH Damage Analysis	139
Introduction	139
CRASH Trajectory Solution Procedure	141
Introduction	141
Discussion.....	145
Tire-to-ground “External” Forces.....	147
Impact Duration.....	148
SMAC Computer Program	149
Introduction	149
Current Status of SMAC.....	150
HVOSM & 3D Reconstruction Analysis	153
Introduction	153
Research Rationale for Computer Simulation Models.....	153
HVOSM - Highway Vehicle Object Simulation Model	154
Analytical Approach of the HVOSM	154
The Astro-Spiral Jump	157
Research with HVOSM.....	158
CVS/ATB Occupant Simulation Model	171
Introduction	171
Background on ATB/CVS.....	171
Validation of ATB	172
Force-Deflection Stiffness, Coefficient of Restitution	174
ATB Inputs	175
Some Sample Applications/Areas of Investigation	175
Conclusions and Recommendations	176
Appendix 1	177
Forms of Restitution Behavior.....	177
Appendix 2	179
Conversion Factors	179
ERRATA	185
Changes made to document since Nov 2000	185
Index	186
REFERENCES	188

McHenry Training Seminar 2008

McHenry

Accident Reconstruction

2008

by
Raymond R. McHenry
Brian G. McHenry

© McHenry Software®
PO Box 1716
Cary, NC 27512 USA
(919)-468-9266
email: mchenry@mchenrysoftware.com
www: <http://www.mchenrysoftware.com>