ACTAR - Prep Practical Reconstruction Project

"Controlled Crash Test"
St. Petes Beach, Florida

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Disclaimer

The information provided in this practical reconstruction project is to the best of my knowledge consistent with the current standards of practice in traffic crash research, testing, investigation and reconstruction. However, neither The University of Tulsa Crash Reconstruction Research Consortium, nor the author assumes any liability in connection with the use of this material. Every acceptable precaution has been taken for accuracy and that every procedure may not have been presented and some circumstances may require additional or substitute procedures.

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Preface

This project has been prepared to assist those considering to take, or those practicing to retake Part II of the ACTAR practical reconstruction project. This project is not connected to, sponsored by, or affiliated with ACTAR or its groups in any way.

The ACTAR Rounding Guide allows a 5% tolerance for all numeric answers in both the Theory and Practical tests, with the exception of answers expressed in degrees; those answers have an absolute tolerance of ± 4 degrees. The tolerances have been provided in the answers section of these instructions.

The intent of this project is to provide users with a practical experience similar to what they might be expected do to as part of completing Part II - the ACTAR practical project.

With that in mind and to make this experience as realistic as possible, allow yourself **FOUR HOURS** maximum to complete this project.

Before starting, collect all of the materials that you intend to use during the actual ACTAR test. Keep in mind that you are **NOT** allowed to use computers for any reason, and your calculator cannot have the ability to program or store mathematical forumlas.

Bring:

- Scientific Calculator (Non-programmable)
- Mechanical Pencils, color markers, eraser
- Scissors
- Clear plastic (For use when creating scaled vehicles for placement on diagrams.)
- Straight-Edge Rulers for (Imperial) 1" = 10', 1" = 20' or (Metric) 1:100, 1:200
- A flex curve for measuring any curved tire marks, and post-impact distances
- Two right-angle triangles (For plotting coordinate points on diagram.)
- Masking tape (For securing vehicle cutouts on diagrams.)
- 360-Degree Protractor

NOTE:

Some formulas have been provided in these materials. But you can use any printed materials keeping in mind you cannot share materials during the test.

List of Symbols

α = Approach Angle of V_1 (Alpha)

ψ = Approach Angle of V_2 (Psi)

θ = Departure Angle of V_1, or V_3 (Theta)

ϕ = Departure Angle of V_2, or V_4 (Phi)

β = Difference of Approach Angle of V_2 and Departure Angle of V_2

V_1 = Vehicle One Pre Impact, Bullet Vehicle

V_2 = Vehicle Two Pre Impact, Target Vehicle

V_3 = Vehicle One Post Impact, Bullet Vehicle

V_4 = Vehicle Two Post Impact, Target Vehicle

PDOF = Principle Direction of Force (Assists with occupant movement.

1 Formulas

1.1 Post-Impact Speed

$(Imperial)$	$(Metric)$	
$S = \sqrt{30 \times d \times f}$	$S = \sqrt{254 \times d \times f}$	(1.1)
$V = \sqrt{2 \times f \times 32.2 \times d}$	$V = \sqrt{2 \times f \times 9.81 \times d}$	(1.2)
$S = \frac{V}{1.466}$	$S = \frac{V}{0.2777}$	(1.3)

1.2 Impact Speed (V2)

(Imperial/Metric)

$$v_2 = \frac{w_1 \times v_3 \times sin\theta}{w_2 \times sin\psi} + \frac{v_4 \times sin\phi}{sin\psi} \tag{1.4}$$

1.3 Impact Speed (V1)

(Imperial/Metric)

$$v_1 = v_3 \times cos\theta + \frac{w_2 \times v_4 \times cos\phi}{w_1} - \frac{w_2 \times v_2 \times sin\psi}{w_1} \tag{1.5}$$

2 Introduction / Information

This project has been prepared from an actual controlled crash test performed as part of the 2013 IPTM Special Problems Conference. The University of Tulsa Crash Reconstruction Research Consortium under the direction of Dr. Jeremy Daily, Ph.D and his team were responsible for conducting this crash event. Both vehicles were instrumented with accelerometers, gyroscopes, vericoms, GPS, video equipment and other electronic devices in order to record the impact speeds for both vehicles and to determine the post-impact coefficient of friction value.

NOTE:

For this collision, use μ =0.40 as the post-impact coefficient of friction for both vehicles.

To complete this practical reconstruction project you will need to perform the following tasks:

1. Determine the drawing scale of the diagram based upon the provided information. The roadway travel lane width is 12 feet (3.65 meters).
2. Locate the Original Point (0,0), then draw the coordinate points to locate each of the two vehicles at final rest.
3. Draw the two collision vehicles to scale (complete with center of mass location) based upon the vehicles' description and damage measurements that has been provided in this project.
4. Prepare 3 scaled cutouts for each of the two vehicles so you can place each vehicle at their respective final rest, impact and at separation/departure.
5. Measure the length of tire mark A & B.
6. Determine which vehicle and tire made tire marks A & B.
7. Mathematically determine the Impact Speed, Delta-V, and PDOF Angle for each vehicle.
8. Using a protractor, draw each vehicle's PDOF to scale.

You will need to answer the questions provided in Chapter 8 - Questions. The corresponding answers are provided in Chapter 9 & 10 - Answers.

3 Crash Test Vehicles

3.1 2006 Chevrolet Impala

Figure 3.1: 2006 Chevrolet Impala Post-Impact

Description

- Total Weight 3764 lb (1719.91 kg)
- Total Length 200 inches (508 cm)
- Total Width 73 inches (185 cm)
- Front Bumper to Front Axle 42 inches (107 cm)
- Rear Bumper to Rear Axle 47 inches (119 cm)
- Center of Mass Location From Front Bumper 84.18 inches (213.81 cm)

Damage Measurements

- C1 (L = 1.65 inches / 4.19 cm, D = 17.72 inches / 45.00 cm)
- C2 (L = 6.85 inches / 17.39 cm, D = 18.04 inches / 45.82 cm)
- C3 (L = 33.85 inches / 85.97 cm, D = 17.04 inches / 43.28 cm)
- C4 (L = 54.85 inches / 139.31 cm, D = 12.04 inches / 30.58 cm)
- C5 (L = 61.85 inches / 157.09 cm, D = 8.04 inches / 20.42 cm)
- C6 (L = 68.43 inches / 173.81 cm, D = 8.61 inches / 21.86 cm)

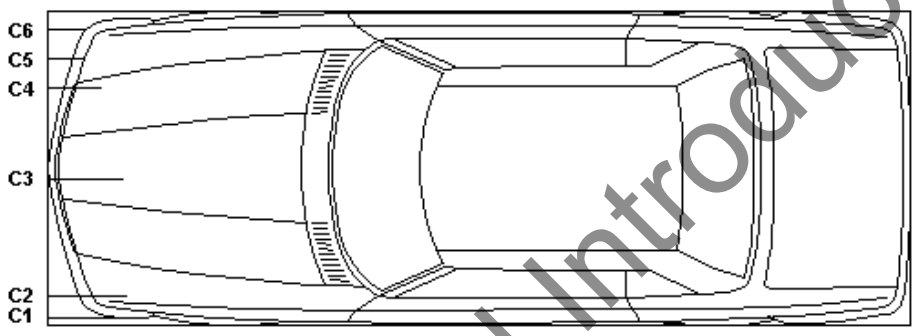

Figure 3.2: 2006 Chevrolet Impala Damage Measurements

4 Scale Diagram Information

You need to plot the following coordinate points once you have established the Origin Point location. Be mindful that you must first also determine the scale of the diagram.

4.1 Origin Point Location

The location of the Origin Point is 26.24 feet (8.0 meters) east of the SouthEast (bottom right) corner vertex. First locate this point, then plot the vehicle final rest coordinates.

4.2 Final Rest Coordinate Measurements

Description	North	South	East	West
V1 - Front Left Corner	43.59 ft (13.38 m)			8.22 ft (2.50 m)
V1 - Rear Left Corner	29.45 ft (8.97 m)			17.05 ft (5.19 m)
V1 - Rear Right Corner	26.23 ft (7.99 m)			11.89 ft (3.62 m)
V2 - Front Left Corner	46.00 ft (14.02 m)			11.34 ft (3.54 m)
V2 - Front Right Corner	50.70 ft (15.45 m)			7.11 ft (2.16 m)
V2 - Rear Left Corner	34.74 ft (10.58 m)		1.15 ft (0.35 m)	
V2 - Rear Right Corner	39.44 ft (12.02 m)		5.39 ft (1.64 m)	

6 Roadway Evidence Photos

Figure 6.1: Roadway Evidence Photos

Figure 6.2: Roadway Evidence Photos

7 Diagrams

This project includes two diagrams; one prepared in Imperial Units and the other in Metric Units. You also need to know that both of these diagrams have been setup to be printed on 11" by 17" paper. If you have a printer capable of this, simply print the respective Imperial/Metric diagram on 11" by 17" paper.

Otherwise, you will need to take the included PDF diagram file to another source for printing.

NOTE:

It is necessary that you print the diagram you need on 11" by 17" paper in order to successfully complete this project.