Simulation of a Side Impact and Vehicle Rollover Using EDVSM and EDSMAC4 within HVE

James E. Flynn, Stephen Harper, Howard Underwood,
Robert Buckert and Phillip Parks
J2 Engineering, Inc.

ABSTRACT:

EDVSM and EDSMAC4 were used to determine impact speeds, vehicle changes in velocity and vehicle rollover mechanics during the analysis of a side impact collision. On the date of the incident, a 1997 Ford "Crown Victoria" was parked facing westerly on the northerly shoulder of the No. 2 westbound lane of a four lane, east-west directed roadway. The driver of the Crown Victoria initiated a U-turning maneuver from the shoulder with the reported intent of crossing the center earthen median and proceeding easterly within the eastbound lanes of the roadway. As the Crown Victoria crossed into the No. 1 westbound lane, it was collided with at the left front fender and left front wheel by a westbound 1991 Chevrolet "S-10 Blazer." Subsequent to the collision, the Crown Victoria was propelled in a westerly direction while rotating clockwise to its point of rest. The Crown Victoria came to rest facing southerly on the line striping separating the No. 1 and No. 2 westbound lanes. The collision deflected the Blazer in a southwesterly direction after which it exited the No. 1 lane and traveled onto the earthen median where it rolled over and came to rest on its top while facing northerly. The right front occupant of the Blazer was ejected and sustained a severe brain injury during the rollover process.

The use of EDVSM and EDSMAC4 allowed for successful modeling of both pre and post impact vehicle dynamics. Tire marks produced by the model were found to match those imported from the post-collision scene survey. Vehicle crush, including that resulting from secondary vehicle to vehicle contact, matched damages documented during the inspections of the vehicles. The rollover simulation was found to correlate well with the vehicle rollover damages and the Blazer's documented final orientation and point of rest.

INTRODUCTION:

This two vehicle accident occurred on Panama Lane in Bakersfield, CA. The accident occurred during daylight hours in early Spring. The 1997 Ford Crown Victoria was an "on duty" police vehicle. The driver of the vehicle stated that she was responding to a call and, at the time of the collision, was accelerating from a stop and was attempting to make a U-turn. The driver further stated that she had no memory of the collision.

The driver of the Blazer stated that immediately prior to the accident, he was traveling westerly at a speed of approximately 80 miles per hour. (The posted speed limit was 55 miles per hour.) The driver stated that when he observed the Crown Victoria begin to turn into the

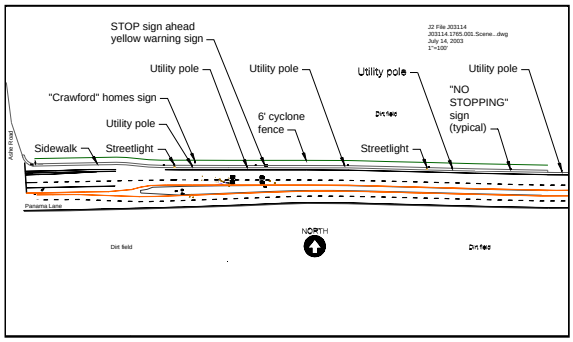
roadway, he applied the brakes of his vehicle but was unable to avoid the collision. The Blazer left approximately 109 feet of pre-impact skid marks. The driver of the Blazer subsequently stated that he had been misquoted and that his actual pre-braking speed was closer to 60 miles per hour.

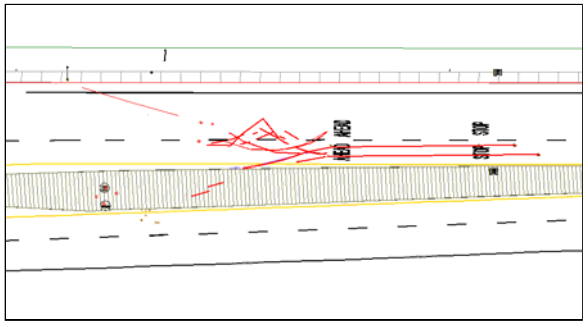
The Blazer was occupied by the driver, a right front occupant and two rear seated occupants. Only the driver was utilizing his restraint.

Approximately one year after the date of the collision, J2 Engineering was retained by the attorneys representing the right front occupant. J2 Engineering was asked to determine the pre braking speed of the Blazer, the Blazer's speed at impact and the change in velocity (ΔV) of the Blazer resulting from the impact.

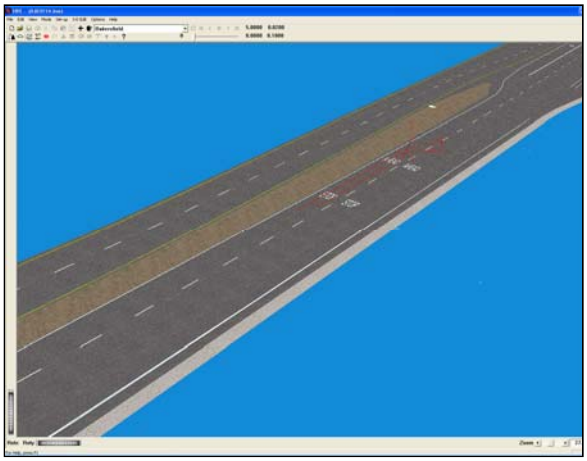
ENVIRONMENT:

As the collision involved a vehicle owned by the City of Bakersfield, both the scene and the vehicles were well documented. Post collision police photographs were obtained and taken to the scene. The scene inspection revealed the presence of skid marks, gouges and paint marks which were consistent in location with those apparent in the police photographs and which were located as set forth in the scene diagram of the Traffic Collision Report. The scene was photographed and subsequently surveyed with a Trimble 5600 series Total Station. A scaled scene diagram was generated with AutoCAD.





The Surfaces were created with the AutoCAD Ruled Surface tool and were exported as a 3D Studio file. The surface was then converted to VRML with 3D Explorer and imported to HVE. 3D Editor was used to create a high friction zone in the median to cause the Blazer to trip.



VEHICLES:

Both the Blazer and the Crown Victoria were available for inspection. The Blazer was found to have sustained an impact to the front end, the direction of which primarily was from front to rear. The PDOF was approximately 20 degrees. Maximum engagement and maximum residual crush of approximately 31 inches was located at the right front corner of the vehicle.

Evidence of rollover was also apparent, with damages located on the roof panel, the right 'A' pillar and the right 'C' pillar.

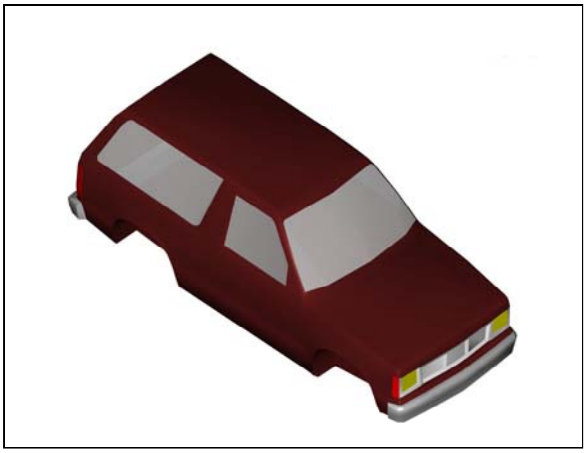
The inspection of the Crown Victoria revealed that it had sustained an impact to the left side, the direction of which primarily was from left to right. The PDOF was -70 degrees. Maximum engagement and maximum residual crush of approximately 18 inches were located at the left front wheel.

Evidence of secondary contact was apparent at the left rear quarter panel of the Crown Victoria. The location of the damage indicated that, as the rear quarter panels of the vehicles came together, the right rear tire of the Blazer was not in contact with the roadway surface.

At the time of the vehicle inspections, the Blazer and the Crown Victoria were photographed and dimensioned. Photomodeler was utilized in diagramming the vehicle crush.

A three dimensional model of the Blazer was purchased from 3D Cad Browser.

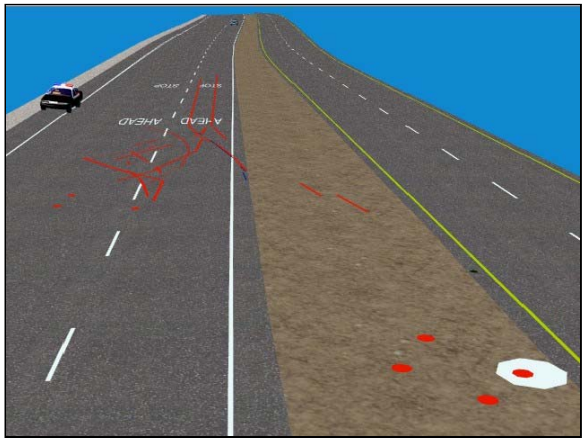
A 3D model of the Crown Victoria was

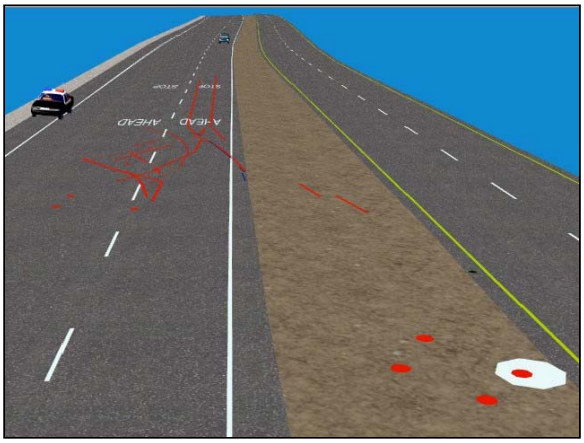


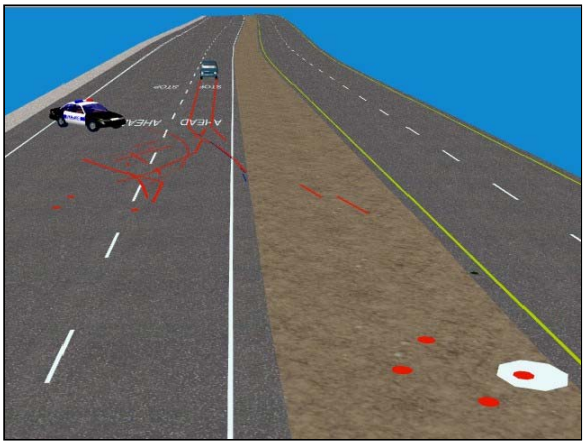
modified from the EDVDB geometry File. Cinema 4D was used to create the police vehicle markings.

SIMULATION:

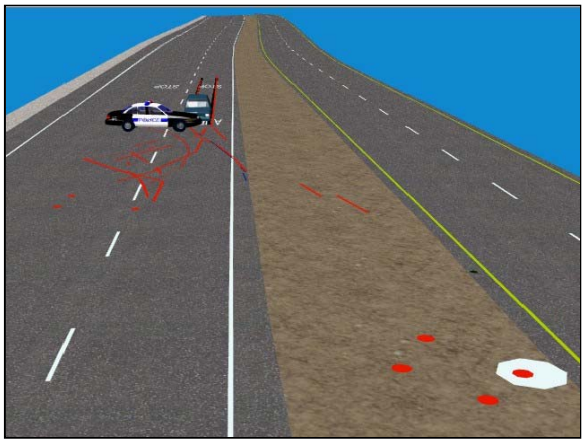
The simulation of the collision involved the use of EDSMAC4 and EDVSM. Two separate EDSMAC4 events were utilized to model the pre-collision movements of the vehicles. In one event, the Crown Victoria , which was stopped facing westerly along the northerly edge of the roadway, was accelerated during a U-turning maneuver to a point located approximately 5 feet northerly of the point of impact. In the other pre-collision event, the westbound travel of the Blazer was modeled as it approached the point of impact. Separate modeling of the pre-collision phase allowed repeated runs of the impact phase without first having to wait for the pre-collision phase to run.

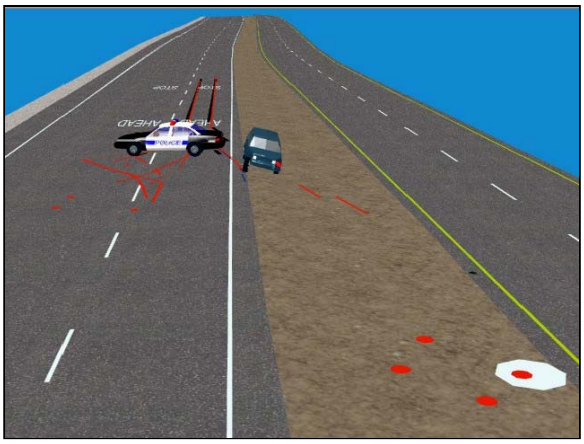


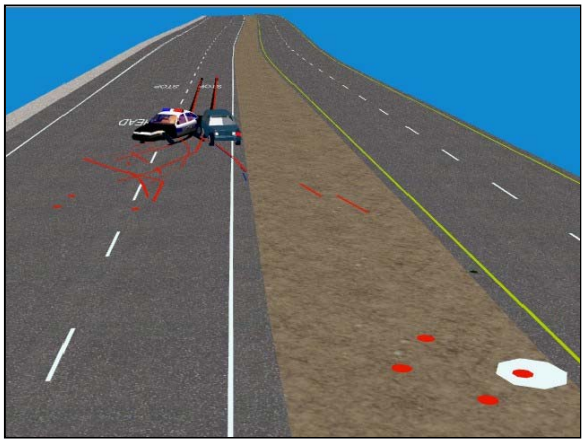


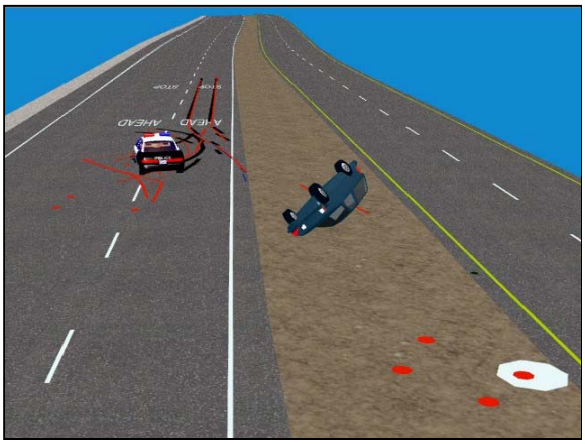


The collision phase lasts from initial contact between the vehicles through secondary contact. This phase was also modeled with EDSMAC4.

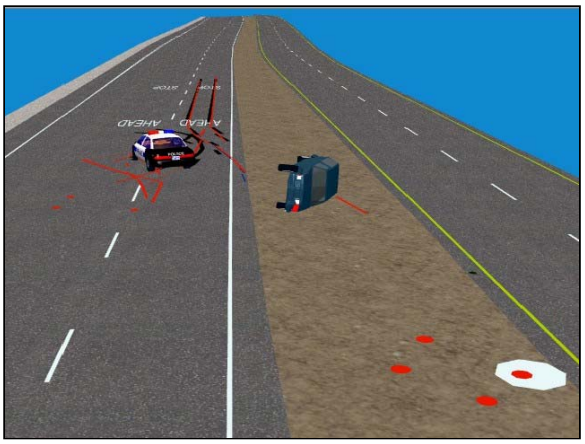


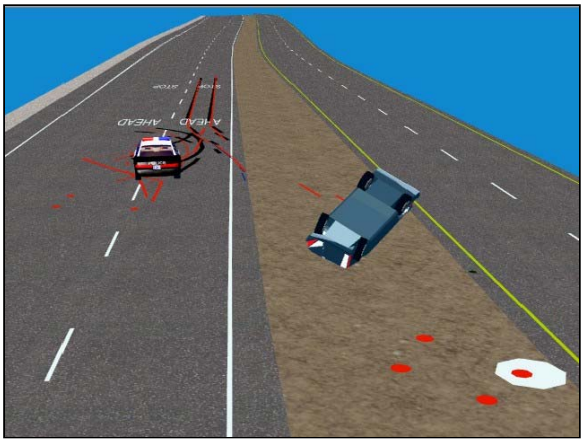


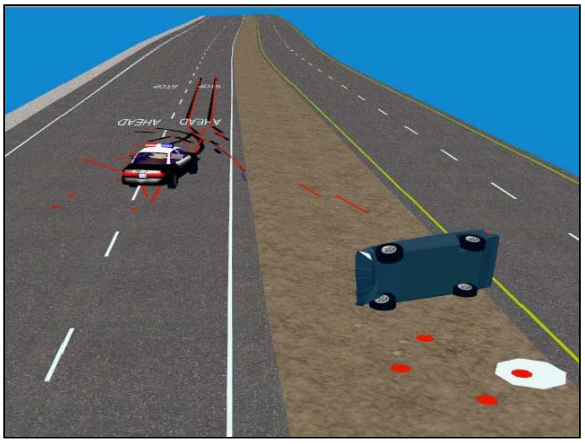


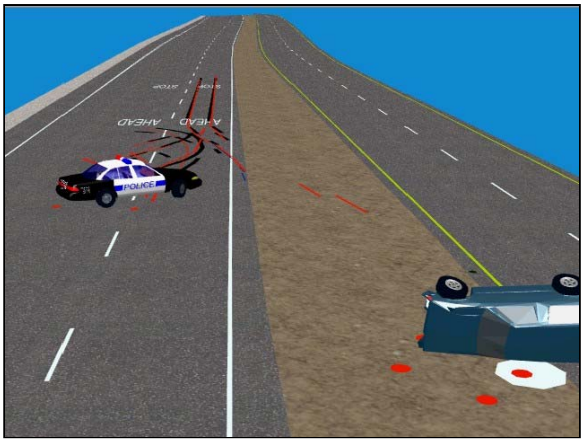


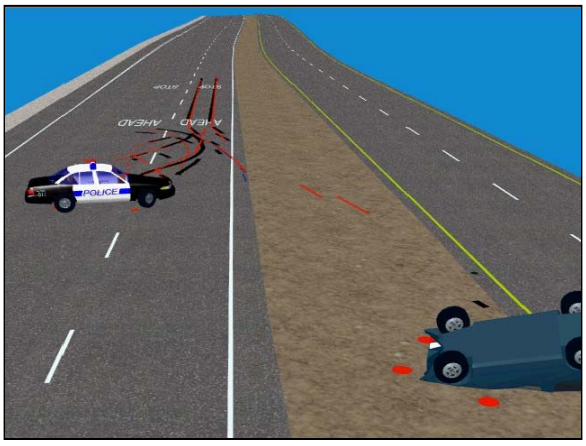
Subsequent to the collision phase, EDSMC4 was used to model the post-impact movement of the Crown Victoria as it traveled to its point of rest. EDVSM was utilized to model the rollover of the Blazer during its post-impact travel.











Multiple runs were necessary to complete the simulation. The simulation was considered complete when the pre and post-impact travel of both vehicles was found to be consistent with the physical evidence as set forth in the post-collision police photographs and the data collected by the investigating agency.

RESULTS:

The HVE simulation of the collision revealed that, at the onset of braking, the Blazer was traveling 82 miles per hour. The Blazer was traveling 70 miles per hour at the time of impact and experienced a ΔV of 38 miles per hour.

CONCLUSION:

The use of HVE allowed the simulation of the collision based upon physical evidence only. The HVE data was presented and admitted as evidence in the Superior Court of California:

Tanguay vs. City of Bakersfield, et al
Kern County Superior Court
No. CV248973-AEW
Trial Date: March 8, 2004

REFERENCES:

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3. NHTSA New Car Assessment Program, General Motors Corporation 1990 Chevrolet S-10 Blazer, NHTSA Test No. ML0105, U.S. Department of Transportation, 1990.